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Rogers, V.C. and K.K. Nielson 1991. “Correlations for Predicting Air Permeabilities and 222Rn Diffusion Coefficients of Soils,” Health Physics, Vol. 61, No. 2, August 1991.

SENES, 2011. “Radon Emissions from Tailings and Evaporative Ponds,” SENES Consultants Limited presented at the Nuclear Regulatory Commission Uranium Recovery Licensing Workshop, January 11-12, 2011. Denver, Colorado.

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SC&A (S. Cohen and Associates) 2011. “Risk Assessment Revision for 40 CFR Part 61Subpart W – Radon Emissions from Operating Mill Tailings, Task 4 – Detailed Risk Estimates,” Contract Number EP-D-10-042, Work Assignment No. 1-04, Task 4, SC&A, Inc., Vienna, Virginia, March 25, 2011

SC&A (S. Cohen and Associates) 2010. “Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings, Task 5 – Radon Emission from Evaporation Ponds,” Contract Number EP-D-10-042, Work Assignment No. 1-04, Task 5, SC&A, Inc., Vienna, Virginia, November 2010.

Schwarzenbach, Rene, P. Philip, M. Gschwend, and Dieter M. Imboden, 2003, Environmental Organic Chemistry 2nd edition, Chapter 19, Wiley-Interscience, Hoboken New Jersey, IBSN-0-471-35750-2.

Surbeck H., 1996, A Radon-in-Water Monitor Based on Fast Gas Transfer Membranes, International Conference on Technologically Enhanced Natural Radioactivity (TENR) Cause by Non-Uranium Mining, October 16-19, Szczyrk, Poland.

Usman, S.S., H.Spitz, and J Weisman, 2004, Transport of Radon in Still Water under Steady State and Transient Conditions, 11th International Congress of the International Radiation Protection Association, Madrid, Spain, May.

WISE, 2002, WISE Uranium Project, Uranium Mill Tailings Radon Flux Calculator. Researched by Peter Diehl, Germany (2002) http://www.wise-uranium.org/ctb.html accessed September 2010.

Appendix A

GEI Laboratories LLC, Cell 1 Total Alpha Radium

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: September 13, 2013

Company :	Energy Fuels Resources (USA), Inc.
Address :	225 Union Boulevard Suite 600 Lakewood, Colorado 80228
Contact:	Ms. Kathy Weinel
Project:	White Mesa Mill GW
Client Sample ID:	Cell 1
Sample ID:	331704001
Matrix:	Ground Water
Collect Date:	13-AUG-13 07:40
Receive Date:	16-AUG-13
Collector:	Client
Project:	DNMI00100
Client ID:	DNMI001

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gas Flow Proportional Counting												
GFPC, Total Alpha Radium, Liquid "As Received"												
Gross Radium Alpha		32700	+/-386	24.9	1.00	pCi/L		KDF1	09/11/13	1852	1326329	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
	EPA 900.1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Barium Carrier	GFPC, Total Alpha Radium, Liquid "As Received"			98.2	(25%-125%)

Notes:

Counting Uncertainty is calculated at the 68% confidence level (1-sigma).

SRL = Sample Reporting Limit. For metals analysis only. When the sample is U qualified and ND, the SRL column reports the value which is the greater of either the adjusted MDL or the CRDL.

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:30 PM
To: Thornton, Marisa
Subject: FW: Responses to Ute Mountain Ute Consultation Questions

---

From: Laumann, Sara
Sent: Tuesday, July 08, 2014 4:26 PM
To: Diaz, Angelique; Rosnick, Reid; Edwards, Jonathan; Perrin, Alan; Peake, Tom; Schultheisz, Daniel; Harrison, Jed; Cherepy, Andrea; Childers, Pat
Cc: Jackson, Scott; Palomares, Art; Patefield, Scott; Logan, Paul
Subject: RE: Responses to Ute Mountain Ute Consultation Questions

Thanks all for including me in these messages.

I am copying Paul Logan with this message, as he has kindly offered to cover this call for OGC/ORC, as I have competing priorities this week.

From: Diaz, Angelique
Sent: Tuesday, July 08, 2014 9:54 AM
To: Rosnick, Reid; Edwards, Jonathan; Perrin, Alan; Peake, Tom; Schultheisz, Daniel; Harrison, Jed; Cherepy, Andrea; Childers, Pat; Laumann, Sara
Cc: Jackson, Scott; Palomares, Art; Patefield, Scott
Subject: RE: Responses to Ute Mountain Ute Consultation Questions

Attached are my comments/edits. Not sure if everyone wanted to see them so I replied all just in case.

Sara, please look specifically at my comments on 6, 10 and 27. Those may require you to weigh in.

Thank you,
Angelique

Angelique D. Diaz, Ph.D.
Environmental Engineer
Air Program, USEPA/Region 8
1595 Wynkoop Street (8P-AR)
Denver, CO 80202-1129
Office: 303.312.6344
Fax: 303.312.6064
diaz.angelique@epa.gov

From: Rosnick, Reid
Sent: Monday, July 07, 2014 4:18 PM
To: Edwards, Jonathan; Perrin, Alan; Peake, Tom; Schultheisz, Daniel; Harrison, Jed; Cherepy, Andrea; Childers, Pat; Diaz, Angelique; Laumann, Sara

Subject: Responses to Ute Mountain Ute Consultation Questions
Importance: High

All,

Attached are the responses (in red) to the questions generated by the Ute Mountain Ute Tribe in preparation for our consultation this Thursday. Please take a look and provide any comments you have by COB Tuesday July 8. Thanks

Reid

_____

Reid J. Rosnick
US Environmental Protection Agency
Radiation Protection Division
202.343.9563
rosnick.reid@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:20 PM
To: Thornton, Marisa
Subject: FW: Conference Call Number Information

From: Scott Clow [mailto:sclow@utemountain.org]
Sent: Tuesday, July 08, 2014 6:45 PM
To: Rosnick, Reid
Subject: RE: Conference Call Number Information

HI Reid,
Did you get my email last week from my alternative email address about the call-in number?
Scott

From: Rosnick, Reid [mailto:Rosnick.Reid@epa.gov]
Sent: Thursday, July 03, 2014 10:42 AM
To: Scott Clow
Subject: FW: Conference Call Number Information

From: administrator@utemountain.org [mailto:administrator@utemountain.org]
Sent: Thursday, July 03, 2014 11:19 AM
To: Rosnick, Reid
Subject: Delivery delayed:Conference Call Number Information

Delivery is delayed to these recipients or groups:

sclow@utemountain.org

Subject: Conference Call Number Information

This message hasn't been delivered yet. Delivery will continue to be attempted.

Diagnostic information for administrators:

Generating server: UTEMTN.LCL

sclow@utemountain.org
Remote Server returned '< #4.4.7 smtp;400 4.4.7 Message delayed>'

Original message headers:

Received: from p01c11m004.mxlogic.net (208.65.144.247) by mail.utemountain.org
 (10.10.255.244) with Microsoft SMTP Server (TLS) id 8.3.348.2; Thu, 3 Jul
 2014 05:18:32 -0600
Authentication-Results: p01c11m004.mxlogic.net; spf=none
Received: from unknown [207.46.163.208] (EHLO
 na01-bl2-obe.outbound.protection.outlook.com) by
 p01c11m004.mxlogic.net(mxl_mta-8.0.0-2) over TLS secured channel with ESMTP
 id 70c35b35.0.244434.00-2349.426064.p01c11m004.mxlogic.net (envelope-from
 <rosnick.reid@epa.gov>); Thu, 03 Jul 2014 05:18:32 -0600 (MDT)
Received: from BLUPR09MB120.namprd09.prod.outlook.com (10.255.213.28) by
 BLUPR09MB0182.namprd09.prod.outlook.com (10.255.216.24) with Microsoft SMTP
 Server (TLS) id 15.0.974.11; Thu, 3 Jul 2014 11:18:12 +0000
Received: from BLUPR09MB120.namprd09.prod.outlook.com ([10.255.213.28]) by
 BLUPR09MB120.namprd09.prod.outlook.com ([10.255.213.28]) with mapi id
 15.00.0980.000; Thu, 3 Jul 2014 11:18:12 +0000
From: "Rosnick, Reid" <Rosnick.Reid@epa.gov>
To: "sclow@utemountain.org" <sclow@utemountain.org>
CC: "Diaz, Angelique" <Diaz.Angelique@epa.gov>, "Peake, Tom"
  <Peake.Tom@epa.gov>
Subject: Conference Call Number Information
Thread-Topic: Conference Call Number Information
Thread-Index: Ac+WsDhfrQtdSUjPTN+pHP1fsuQY/A==
Date: Thu, 3 Jul 2014 11:18:11 +0000
Message-ID: <52e42ad0c6304c2ca79d5b599d067d5c@BLUPR09MB120.namprd09.prod.outlook.com>
Accept-Language: en-US
Content-Language: en-US
X-MS-Has-Attach:
X-MS-TNEF-Correlator:
x-originating-ip: [161.80.37.76]
x-microsoft-antispam: BCL:0;PCL:0;RULEID:
x-forefront-prvs: 0261CCEEDF
x-forefront-antispam-report:
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003)(81342001)(99286002)(80022001)(83072002)(95666004)(229853001)(66066001)(81542001)(108616002)(2473600
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oRecords;MX:1;LANG:en;
Content-Type: text/plain
MIME-Version: 1.0
X-OriginatorOrg: epa.gov
X-Processed-By: Rebuild v2.0-0
X-AnalysisOut: [v=2.1 cv=OISp3EqB c=1 sm=1 tr=0 a=0+WLDoK8KZV22ogeu4Sc7Q==]
X-AnalysisOut: [:117 a=MqPwG-jSozoA:10 a=I_Ssn4h0YG4A:10 a=BLceEmwcHowA:10]
X-AnalysisOut: [a=UqCG9HQmAAAA:8 a=YlVTAMxIAAAA:8 a=AUX4iqLePKuzZx9HOK4A:]
X-AnalysisOut: [9 a=kaQioJfUrTef-ZB1:21 a=tTFA2NGzKAvKbVcP:21 a=CjuIK1q_8u]
X-AnalysisOut: [gA:10 a=BiOBlUs1UsIA:10 a=sQMwBKIVwqcA:10 a=zZB3KUw_e9cA:1]
X-AnalysisOut: [0 a=6ZlKLq9Ro_AA:10 a=yMhMjlubAAAA:8 a=SSmOFEACAAAA:8 a=0U]
X-AnalysisOut: [B3MNOFR56zzlOqrmEA:9 a=gKO2Hq4RSVkA:10 a=UiCQ7L4-1S4A:10 a]
X-AnalysisOut: [=hTZeC7Yk6K0A:10 a=frz4AuCg-hUA:10]
Received-SPF: None

X-Spam: [F=0.3684210526; B=0.500(0); spf=0.500; STSI=0.500(0); STSM=0.700(34); CM=0.500; MH=0.500(2014070302); S=0.200(2014051901); SC=]
X-MAIL-FROM: <rosnick.reid@epa.gov>
X-SOURCE-IP: [207.46.163.208]
Return-Path: rosnick.reid@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:20 PM
To: Thornton, Marisa
Subject: FW: attendees list/agenda/process for tomorrows consultation?

From: Childers, Pat
Sent: Wednesday, July 09, 2014 10:00 AM
To: sclow@utemountain.org
Cc: Rosnick, Reid; Harrison, Jed
Subject: attendees list/agenda/process for tomorrows consultation?

Hey Scott,

Hope you are well.

EPA is pulling together our list of attendees via phone and in person for tomorrows consultation and we will provide it to you. I am hoping you will have a list as well. It will help with introductions and memorializing the event. Also I know that staff has been briefing Mike on this so he will be prepared. I am hoping you will take the initiative to walk through the questions or have an agenda prepared to walk through after introductions.

thanks for everything, let me know if you have any questions.

Are you coming up to DC for the NTOC meeting on July 24th?
Pat

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:20 PM
To: Thornton, Marisa
Subject: FW: Ute Mountain Ute Tribe consultation

From: Daly, Carl
Sent: Wednesday, July 09, 2014 11:01 AM
To: Diaz, Angelique; Jackson, Scott
Subject: FW: Ute Mountain Ute Tribe consultation

Anything we should call Mike about?

Carl Daly
303-312-6416

From: Flynn, Mike
Sent: Wednesday, July 09, 2014 8:58 AM
To: Thomas, Deb
Cc: Daly, Carl; Edwards, Jonathan
Subject: Ute Mountain Ute Tribe consultation

Deb,

I understand from my folks that you will be participating in the consultation tomorrow with the Ute Mountain Ute Tribe on the Subpart W proposal (Radon Emissions from Operating Mill Tailings). I'm told you will be making the long trip to the reservation – I'll be on the phone with my folks here. I know our staff have been coordinating, but just wanted to touch base with you to see if there's anything you need or want to discuss before the meeting. If so, certainly let me know. Thanks a lot for your help with this.

Mike

Mike Flynn, Director
Office of Radiation & Indoor Air
U.S. EPA
202-343-9356

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:20 PM
To: Thornton, Marisa
Subject: FW: Ute Mountain Ute Tribe consultation

From: Thomas, Deb
Sent: Wednesday, July 09, 2014 11:55 AM
To: Palomares, Art
Subject: RE: Ute Mountain Ute Tribe consultation

Thanks Art.

From: Palomares, Art
Sent: Wednesday, July 09, 2014 9:26 AM
To: Thomas, Deb
Subject: RE: Ute Mountain Ute Tribe consultation

Deb,

Thus far it looks like I will be the only person (besides Paul Logan) that will be on the phone. If it changes I will let you know. Thanks!

Art Palomares, Director
Water Technical Enforcement Program
Office of Enforcement, Compliance
And Environmental Justice

From: Thomas, Deb
Sent: Wednesday, July 09, 2014 9:20 AM
To: Flynn, Mike
Cc: Daly, Carl; Edwards, Jonathan; Palomares, Art
Subject: RE: Ute Mountain Ute Tribe consultation

Mike,
Thanks for touching base. Yes, I will be traveling to Cortez with Angelique Diaz, R8 Rad expert, and Alfreda Mitre, R8 Tribal Advisor to the RA, for the consultation. It my understanding that HQ will be leading the consultation. I am there to listen and to engage on other issues such as the off-site rule after the Subpart W rulemaking consultation. It is important to have a bright line separating the Subpart W rulemaking consultation from other issues the Tribe may want to discuss regarding the White Mesa Mill. I really appreciate the extensive effort HQ has put into preparing for the consultation and coordinating with R8 staff.

Debra H. Thomas
EPA Region 8 (8P)
Acting Assistant Regional Administrator

Office of Partnerships and Regulatory Assistance
303-312-6298
thomas.debrah@epa.gov

From: Flynn, Mike
Sent: Wednesday, July 09, 2014 8:58 AM
To: Thomas, Deb
Cc: Daly, Carl; Edwards, Jonathan
Subject: Ute Mountain Ute Tribe consultation

Deb,

I understand from my folks that you will be participating in the consultation tomorrow with the Ute Mountain Ute Tribe on the Subpart W proposal (Radon Emissions from Operating Mill Tailings). I'm told you will be making the long trip to the reservation – I'll be on the phone with my folks here. I know our staff have been coordinating, but just wanted to touch base with you to see if there's anything you need or want to discuss before the meeting. If so, certainly let me know. Thanks a lot for your help with this.

Mike

Mike Flynn, Director
Office of Radiation & Indoor Air
U.S. EPA
202-343-9356

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:20 PM
To: Thornton, Marisa
Subject: FW: Ute Mountain Ute Tribe consultation

From: Jackson, Scott
Sent: Wednesday, July 09, 2014 1:01 PM
To: Daly, Carl; Diaz, Angelique
Subject: RE: Ute Mountain Ute Tribe consultation

I don't think there is anything we need to talk to Mike about. Angelique has been closely coordinating with Reid Rosnick and they will both be participating in the consultation.

_____

Scott Jackson, Unit Chief
Indoor Air, Toxics and Transportation Unit
U.S. EPA Region 8
1595 Wynkoop Street (8P-AR)
Denver, CO 80202-1129
(303) 312-6107

From: Daly, Carl
Sent: Wednesday, July 09, 2014 9:01 AM
To: Diaz, Angelique; Jackson, Scott
Subject: FW: Ute Mountain Ute Tribe consultation

Anything we should call Mike about?

Carl Daly
303-312-6416

From: Flynn, Mike
Sent: Wednesday, July 09, 2014 8:58 AM
To: Thomas, Deb
Cc: Daly, Carl; Edwards, Jonathan
Subject: Ute Mountain Ute Tribe consultation

Deb,

I understand from my folks that you will be participating in the consultation tomorrow with the Ute Mountain Ute Tribe on the Subpart W proposal (Radon Emissions from Operating Mill Tailings). I'm told you will be making the long trip to the reservation – I'll be on the phone with my folks here. I know our staff have been coordinating, but just wanted to touch base with you to see if there's anything you need or want to discuss before the meeting. If so, certainly let me know. Thanks a lot for your help with this.

Mike

Mike Flynn, Director
Office of Radiation & Indoor Air
U.S. EPA
202-343-9356

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:30 PM
To: Thornton, Marisa
Subject: FW: First batch of corrected FIR notices--I hope.
Attachments: FR2858.pdf; FR7280.pdf; FR15385.pdf; FR34056.pdf; FR43906.pdf

---

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 5:08 PM
To: Thornton, Marisa
Subject: First batch of corrected FIR notices--I hope.

Dear Marisa:

Here is the first batch of corrected FR notices—I hope. Some of the scans are upside down, and when I rotated them properly and saved it, they are still upside down! Before you spend much time with this, can you see if your version of Adobe will allow you to change the orientation? If so, could you then rotate the files and add the metadata.

Sorry that this is proving to be such a saga.

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
- **FR2858.PDF**

  Metadata:

  Title: EPA established environmental protection standards

  Author: EPA/OAR/Office of Radiation and Indoor Air

  Subject: environmental protection standards for nuclear power operations;

  Keywords: “FR2858” “EPA” “environmental protection standards,” “Atomic Energy Act”

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
  - **FR43906.PDF**
- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn”

- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR43906” “EPA” “NESHAPS” “Phosphorous Plants”

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
    - **FR7280.PDF**
- Metadata:
- Title: Final Standards for Elemental Phosphorous Plants DOE-Facilities, and NRC-Licensed Facilities”
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR7280” “EPA” “standards” “Phosphorous Plants” “DOE-Facilities” “NRC-Licensed Facilities”

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
    - **FR34056.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radon-222 Emissions from Licensed Uranium Mill Tailings”
- Keywords: “FR**34056**” “EPA” “NESHAP “ “Radon-222” “Uranium” “ Tailings”

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR15385.PDF**
- Metadata:
- Title: Work practice standard for Underground Uranium Mines
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: “FR**15365**” “EPA” “work practice standards” “underground uranium mines”

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 61

[AD-FRL 2694-2]

National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides

AGENCY: Environmental Protection Agency (EPA).

ACTION: Withdrawal of proposed standards.

SUMMARY: On April 6, 1983, the Environmental Protection Agency, pursuant to section 112 of the Clean Air Act, proposed standards for sources of emissions of radionuclides in four categories: (1) Elemental phosphorus plants; (2) Department of Energy (DOE) facilities; (3) Nuclear Regulatory Commission (NRC)-licensed facilities and non-DOE Federal facilities; and (4) underground uranium mines. In addition, the Agency decided not to propose standards for the following source categories of radionuclide emissions: (1) Coal-fired boilers; (2) the phosphate industry; (3) other extraction industries; (4) uranium fuel cycle facilities, uranium mill tailings, and management of high-level radioactive waste; and (5) low energy accelerators. The Agency is announcing the withdrawal of its four proposed standards for radionuclide emissions under Section 112 of the Clear Air Act and affirms its original decision not to regulate emissions from the other five source categories considered. The U.S. District Court for the Northern District of California has ordered EPA to take final action on its proposed standards by October 23, 1984.

DATE: This withdrawal is effective October 31, 1984.

ADDRESS: The rulemaking record is contained in Docket No. A-79-11. This docket is available for public inspection between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA's Central Docket Section, West Tower Lobby, Gallery One, Waterside Mall, 401 M Street, SW., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: James M. Hardin, Environmental Standards Branch (ANR-460), Criteria and Standards Division, Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460, (703) 557-8977

SUPPLEMENTARY INFORMATION:

I. Supporting Documents

A final Background Information Document has been prepared and single copies may be obtained by writing the Program Management Office, Office of Radiation Programs (ANR-458), U.S. Environmental Protection Agency, Washington, D.C. 20460, or by calling (703) 557-9351. Please refer to "NESHAPS-Radionuclides: Background Information Document for Final Rules, Volumes 1 and 2 [EPA 520/1-84-022-1, EPA 520/1-84-022-2], October 1984. These documents comprise the integrated risk assessment performed to provide the scientific basis for this rulemaking. Volume 1 of the Background Information Document contains a complete description of the Agency's methodology used in its risk assessment of the hazards associated with airborne emissions of radionuclides. Volume 2 is devoted to a detailed description of how the Agency applied this methodology to each source category considered in this rulemaking. For each source category, this document describes the radionuclide emissions, estimated doses and risks to nearby individuals and to populations, description of current emission control technology, and descriptions and cost estimates of additional emission control technology.

The Agency's written responses to oral and written comments on the proposed standards have been placed in Docket No. A-79-11. Single copies of the Agency's responses may be obtained by writing the Program Management Office, Office of Radiation Programs (ANR-458), U.S. Environmental Protection Agency, Washington, D.C. 20460, or by calling (703) 557-9351. Please refer to "NESHAPS-Radionuclides: Response to Comments for Final Rules, Volumes 1 and 2" [EPA 520/1-84-023-1, EPA 520/1-84-023-2], October 1984.

II. History of Standards Development

In 1977, Congress amended the Clean Air Act (the Act) to adddress airborne emissions of radioactive materials. Before 1977, these emissions were either unregulated or were regulated under the Atomic Energy Act. Section 122 of the Act required the Administrator of EPA, after providing public notice and opportunity for public hearings (44 FR 21704, April 11, 1979), to determine whether emissions of radioactive pollutants "cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health." On December 27, 1979, EPA published a notice in the Federal Register listing radionuclides as a hazardous air pollutant under section 112 of the Act (44 FR 76738). This action was based on the Agency's finding that studies of the biological effects of ionizing radiation indicated that exposure to radionuclides increases the risk of human cancer and genetic damage. In addition, the Agency found that emissions data indicated that radionuclides are released into air from many different sources with the result that millions of people are exposed. To support these findings, EPA issued a report entitled "Radiological Impact Caused By Emissions oof Radionuclides into Air in the United States, Preliminary Report," [EPA 520/7-79-006], Office of Radiation Programs, U.S. EPA, Washington, D.C., August 1979.

Section 122(c)(2) of the Act directed that, after having listed radionuclides as a hazardous air pollutant, EPA enter into an interagency agreement with the Nuclear Regulatory Commission with respect to those facilities under NRC jurisdiction. Such a memorandum of understanding was effected on October 24, 1980, and was subsequently published in the Federal Register (45 FR 72980, November 3, 1980). When EPA began developing standards for Department of Energy facilities, a similar memorandum of understanding was negotiated with DOE and signed in October 1982. Copies of both these memoranda have been placed in the Docket for public review.

On April 6, 1983, EPA announced its proposed standards for sources of emissions of radionuclides from four categories: (1) Elemental phosphorus plants; (2) DOE facilities; (3) NRC-licensed facilities and non-DOE Federal facilities; and (4) underground uranium mines. Several additional source categories emitting radionuclides were identified in the notice. However, the Agency concluded that good reasons existed to propose not to regulate these categories, which included: (1) Coal-fired boilers; (2) the phosphate industry; (3) other extraction industries; (4) uranium fuel cycle facilities, uranium mill tailings, and management of high-level radioactive waste; and (5) low energy accelerators (48 FR 15076, April 6, 1983). At the time of proposal, it was thought that these nine source categories were all that potentially released radionuclides to air at levels that could warrant regulatory attention. In support of these proposed standards and determinations, EPA published a draft report entitled "Background Information Document, Proposed Standards for Radionuclides," [EPA 520/1-83-001], Office of Radiation Programs, U.S. EPA, Washington, D.C., March 1983.

Following publication of the proposed standards, EPA conducted an informal public hearing in Washington, D.C., on April 28 and 29, 1983. The comment period was held open an additional 30 days to receive written comments. Subsequently, EPA received a number of

requests to extend the time for submission of public comments and to conduct a public hearing outside of Washington, D.C., on the proposed standards to accommodate those were unable to attend the first hearing. In response to these requests, EPA extended the comment period by an additional 45 days and held another informal public hearing in Denver, Colorado, on June 14, 1983 (48 FR 23665, May 26, 1983).

EPA has considered and responded to all written and oral comments; a copy of the Agency's responses is in the Docket. The Background Information Document has been revised and published in final form. In addition, a final economic analysis of the impact of the proposed standards for elemental phosphorus plants has been completed and placed in the Docket (Refer to "Regulatory Impact Analysis of Emission Standards for Elemental Phosphorus Plants," October 1984). The final report on control technology for radionuclide emissions to air at Department of Energy facilities has been published and a copy is available int he Docket. (Refer to "Control Technology for Radioactive Emissions to the Atmosphere at U.S. Department of Energy Facilities," [PNL-4621], October 1984).

In response to requests for wider scientific review of the Agency's risk assessment, the Administrator in December 1983, formed a Subcommittee on Risk Assessment for Radionuclides within the Agency's Science Advisory Board (SAB) to review the scientific basis for the proposed standards. This review is discussed in more detail in Section IV of this notice. On the basis of the Subcommittee's review, the final Background Information Document has been rewritten to incorporate recommendations made by the Subcommittee. The revised Background Information Document presents an integrated risk assessment following the format and methodology suggested by the Subcommittee, to the extent possible.

On February 17, 1984, the Sierra Club filed suit to compel final action in the U.S District Court for the Northern District of California, pursuant to the citizens' suit provision of the Act (Sierra Club v. Ruckelshaus, No. 84-0656 WHO). In August 1984, the Court granted the Sierra Club's summary judgment motion and ordered EPA to take final action on its proposed standards by October 23, 1984. On September 14, 1984, the Administrator requested that the Court delay its deadline until January 1985 to him enable him to personally evaluate the merits of the criticisms and suggestions presented by the Subcommittee. This request was denied.

On August 24, 1984, EPA announced in the Federal Register the availability of new technical information (49 FR 33695). The public was encouraged to comment on this new information which included the Final Report of the SAB Subcommittee, transcripts of all public meetings of the Subcommittee, information presented to the Subcommittee, and technical information relevant to elemental phosphorus plants and underground uranium mines. This new information was available in the Docket on September 7, 1984. The Agency's responses to these comments are included in Volume 2 of "NESHAPS-Radionuclides: Response to Comments for Final Rules."

III. Summary of the Final Actions.

On April 6, 1983, the Agency proposed standards for sources of emissions of radionuclides in four categories: (1) Elemental phosphorus plants; (2) DOE facilities; (3) NRC-licensed facilities and non-DOE Federal facilities; and (4) underground uranium mines. For DOE facilities, the Agency proposed an emission limit not to exceed an amount that causes a dose equivalent rate of 10 mrem/y to the whole body and 30 mrem/y to any organ of any individual living nearby. For NRC-licensees and non-DOE Federal facilities, the Agency proposed an emission limit not to exceed an amount that causes a dose equivalent rate of 10 mrem/y to any organ of any member of the public. The emission limit proposed for elemental phosphorus plants was 1 Ci/y of polonium-210.

For all three of these source categories, the Administrator has determined that current practice provides an ample margin of safety in protecting the public health from the hazards associated with exposure to airborne radionuclides, and has therefore decided to withdraw the proposed standards.

In the case of underground uranium mines, the Agency proposed a standard to limit the annual average radon-222 concentration in air due to emissions from an underground mine to 0.2 pCi/1 above background in any unrestricted area. The Agency is also withdrawing this proposed standard beacause it has concluded, for the reasons discussed below, that it did not meet the legal requirements of Section 112. The Agency has received additional technical information that suggests the possibility of using bulkheading and other techniques to control radon emissions. However, pursuing this course of action was not advocated or even suggested in the proposal. Indeed, the information available to EPA at the time of proposal indicated that these techniques were costly and "not very effective" and the Agency dismissed these techniques as the basis for an emission standard (48 FR 15083, col. 3). Since that time, new information suggests that conclusion may be erroneous. Technical information on which the base of final regulation or a proposal is not yet available; further work is needed to demonstrate how to set such a regulation at some future time. Therefore, the Agency is publishing, simultaneously with this notice, an Advance Notice of Proposed Rulemaking for Radon-222 Emissions from Underground Uranium Mines to solicit additional information on control methods, such as bulkheading and other forms of operational controls for radon-222 emissions from these mines. Such an approach could avoid many of the technical and legal difficulties pose by EPA's proposed standards.

In addition to the four source categories for which EPA did propose standards, the Agency has made a final determination not to regulate the following five source categories: (1) Coal-fired boilers; (2) the phosphate industry; (3) other extraction facilities; (4) uranium fuel cycle facilities, uranium mill tailings, and management of high-level radioactive waste; and (5) low energy accelerators. The Agency did not receive any new information during the public comment period that convinced it of a need for regulation of any of these five categories. Therefore, the Administrator affirms the original decision not to regulate these sources, believing that adequate public health protection exists to satisfy the requirements of the Clean Air Act.

When the Agency promulgated its standards for active uranium mill tailings (40 CFR 192, Subparts D and E), it decided that the control of the radon-222 emissions from the active uranium mill tailings piles could more appropriately be considered under the Clean Air Act, rather than the Uranium Mill Tailings Radiation Control Act. The preamble to the final uranium mill tailings standards noted that work practice standards were probably the most practical way to control radon emissions at active uranium mills. Consequently, EPA is issuing, simultaneously with this notice, an Advance Notice of Proposed Rulemaking for Radon-222 Emissions from Licensed Uranium Mills.

The withdrawal of the proposed standards for elemental phosphorus plants, Department of Energy facilities, Nuclear Regulatory Commission-licensed facilities and non-DOE Federal facilities, and underground uranium mines are final actions. Also, the decision not to establish radionuclide emission standards for coal-fired boilers; the phosphate industry, other extraction industries; uranium fuel cycle facilities, uranium mill tailings, and management of high-level radioactive waste; and low energy accelerators are final actions. Judicial review is available only by filing a petition for review in the United States Court of Appeals for the District of Columbia Circuit within 60 days of today's publication date.

III. Major Issues Raised in Public Comments

Many commenters expressed considerable dissatisfaction with the proposed standards. Operators of facilities for which standards were proposed objected vigorously to the stringency of the proposed standards; other groups objected on the grounds that the proposed actions were not sufficiently protective of public health. Both groups criticized the proposed standards for not meeting the intent of the Clean Air Act.

A number of comments were made which apply to all of the source categories considered and which address the bases of the standards-setting process. The following is a summary of the most significant comments and the Agency's responses:

Comment: Radionuclides should not be considered a hazardous air pollutant under section 112 of the Clean Air Act because ambient levels do not pose a significant risk to human health. One commenter petitioned for reconsideration of EPA's listing of radionuclides as a section 112 pollutant, on the basis that the Agency had not justified its conclusion that radionuclides are hazardous air pollutants within the meaning of section 112.

Responses: EPA has concluded that existing radionuclide emissions from some stationary sources can represent a significant risk of fatal and nonfatal cancers to exposed populations. There is no scientific doubt that radionuclides are carcinogens. This conclusion is based on extensive scientific evidence derived from studies of populations of humans and animals exposed to radiation at various levels ranging from very high doses to doses only slightly greater than environmental levels.

Both this conclusion and EPA's specific risk esitmates are based on the widely used assumption that there is no threshold below which exposure to radiation does not pose some risk to human health. Based on this premise, EPA concludes that exposure to radionuclides at low levels in the ambient air presents a risk of fatal and nonfatal cancers, as well as genetic damage.

In addition, section 112 requres not only a finding that the pollutant at issue is hazardous in the abstract, but also that it poses a public health risk in its form as an air pollutant. EPA has evaluated the air pollution risk of radionuclide emissions based on the magnitude of such emissions from stationary sources to the ambient air, on observed and estimated ambient concentrations of radionuclides, on the proximity of large populations to emitting sources, on estimates of health risks to exposed populations, and on considerations of uncertainties associated with risk estimates.

Based on this analysis, EPA has concluded that the present record does not support regulation of any of the source categories for which regulation was proposed. This conclusion, however, does not support delisting of radionuclides, because, in the case of uranium mines, the risks appear sufficient to warrant future regulatory action under section 112. It is only because regulation of the appropriate type is impossible at this time, due to the need for further work on the technical issues and the need to provide an opportunity for notice and comment on any proposed action, that no rules for uranium mines are being included in this decision.[1]

Therefore, with respect to the petition for reconsideration of the listing of radionuclides as a hazardous air pollutant, EPA has considered this option and has rejected it, believing that the original decision to list under section 112 is still appropriate.

Comment: The EPA standards are unnecessary because current administrative or regulatory standards of 500 mrem/y to the whole body and 1500 mrem/y to any organ (Federal Radiation Council guidance and NRC regulatory values), coupled with directives to keep emissions as low as practicable, are adequately protective of the public health. Other commenters felt that the proposed standards were too lax and that the Agency should set an emission limit of zero, with exceptions allowed only after a case-by-case examination.

Response: EPA does not believe that current Federal Radiation Council guidance and NRC policy of limiting exposure to individuals to 500 mrem/y to the whole body and 1500 mrem/y to any organ protects public health with an ample margin of safety, as required by the Clean Air Act. EPA estimates that a person receiving 500 mrem/y to the whole body over a lifetime would have an added potential risk of developing a fatal cancer of about one in one hundred due to the radiation exposure. In addition, that same person would face an approximately equal level of risk of nonfatal cancer and of passing on nonfatal genetic effects to succeeding generations.

However, EPA recognizes that the "as low as reasonably achievable" (ALARA) emissions policy had led to generally low emissions of radionuclides from most facilities. The Agency expects that this current policy will continue in the future and does not anticipate an increase in the emission level or the associated risks. Therefore, the Agency believes that in cases in which a vigorous and well-implemented ALARA program has achieved low emissions, such practice can provide an ample margin of safety for public health protection.

The Agency does not agree with the approach of establishing an emission limit of zero. The implementation of such a standard for the source categories considered would be extremely burdensome, and would result in little improvement in public health. More important, however, is the Administrator's determination that public health is currently protected to a degree which satisfies the requirement of Section 112 of the Act.

Comment: EPA is required to promulgate standards under all of its applicable authorities in order to fulfill the intent of its Congressional mandates. For example, the Agency must regulate air emissions from uranium fuel cycle facilities under the Clean Air Act, as well as under the Atomic Energy Act.

Response: The Agency believes that its primary objective is to provide reasonable public health protection, but that it was not the intent of Congress that the Agency issue duplicative regulations to achieve this goal. In light of the limited resources in both the

[1] The Administrator believes, based on an analysis by EPA's Office of General Counsel, that today's actions are consistent with the statute and the court order governing today's decision. EPA acknowledges, however, that an argument exists that the only proper way to procedurally express the substantive conclusions set forth in today's rulemaking is by delisting the particular pollutant involved. Though EPA does not presently accept that position, it stands ready to amend this package promptly along these lines if the Court should so direct.

public and private sector, it would be inefficient and unnecessarily complicated to require sources to comply with a standard they already meet, or alternatively, to meet several comparable standards set by one Agency under different statutory authorities.

Comment: Some commenters stated that the standards should be based on cost analyses, and if not cost-effective, they should not be promulated. Others felt that costs should not be considered at all.

Response: The Agency believes that giving equal weight to costs and benefits is inappropriate in developing standards under Section 112 of the Clean Air Act. Congress clearly intended that public health protection considerations be primary and that cost be secondary.

The Agency did consider, in developing these rules, the availability and practicality of control equipment. While this was not a primary consideration, knowledge of the availability of control technology is necessary when making judgments on the need for and level of emission standards. EPA believes these considerations are within the Administrator's discretion in determining what level of protection is adequate. The Agency considered costs to a limited degree consistent with this overall perspective in reaching its decisions on coal-fired boilers and elemental phosphorus plants, but otherwise today's action does not rest on cost considerations.

Comment: Some commenters stated that the Clean Air Act requires standards for all source categories releasing significant amounts of radionuclides into the air. Determinations that standards are not needed are not allowed for any reason. Others supported EPA's determinations that standards for some categories are unnecessary.

Response: The comment that every stack emitting radionuclides to air must be subject to an emission limit established under the Clean Air Act must be considered in light of the fact that every stack in the United States discharges at least minute quantities of radionuclides. These radionuclides include certain kinds of carbon and potassium atoms and other naturally-occurring radionuclides. Because these emissions are so small, the risk to nearby individuals and the total population group is minimal. To regulate these sources would not significantly improve the public health.

Section 112 of the Act requires the Administrator to assure public health protection with an ample margin of safety. A negative determination of the need for standards is permissible within the context of the Act, so long as this criterion is met. With respect to eight of the source categories considered in this rulemaking, the Agency has concluded that the public health is adequately protected under current practice, and therefore has met the requirements of the Act. For the uranium mines category, the Agency concludes that risks are significant; however, there is presently no feasible way to establish an emission standard. The Agency will consider such a standard, together with alternative design, equipment, work practice and operational standards, for future proposal.

Comment: There has not been sufficient review outside the Agency of EPA's methods and procedures for risk assessment. Specifically, EPA's Science Advisory Board should review the scientific basis of the proposed standards for radionuclides.

Response: The Agency agrees with this comment (see section V below).

Comment: The proposed standards should not be promulgated because they cannot be implemented with reasonable procedures. Compliance with indirect emission standards (dose or concentration limits at site boundary) must be determined by environmental measurements at the site boundary. Because the proposed standards are so restrictive, this is either very expensive or altogether impractical.

Response: Questions concerning the implementations of standards for airborne radionuclide emissions are moot in light of the Administrator's decision to withdraw the proposed rules.

Comment: Standards should be consistent with established international and national policies and regulations governing radiation protection, as well as among each source category.

Response: The Agency agrees with this comment and has based its decision to withdraw the proposed standards, in part, on the fact that current practices in radiation protection do provide adequate public health protection.

Comment: Standards should allow for greater operational flexibility in selecting control technology.

Response: Questions concerning the amount of operational flexibility necessary to comply with standards for airborne radionuclide emissions are moot in light of the Administrator's decision to withdraw the proposed rules.

V Technical Review by the Science Advisory Board

In response to criticism that the Agency did not have sufficient outside review of its methods used to assess risk due to radionuclides, the Administrator formed a subcommittee of the Agency's Science Advisory Board to review the scientific basis of the proposed standards for radionuclides. The Subcommittee held three public meetings: the first on January 16, 1984, the second on February 21–22, 1984, and the third on March 22, 1984. At these meetings, the Subcommittee was briefed by Agency staff on the methods used in estimating risks caused by airborne radionuclides. The panel heard from members of the public on the Agency's risk assessments, as well. The Subcommittee also held executive sessions to consider the information presented by the Agency and the public.

Transcripts of the public meetings are available in the Docket. The Subcommittee's final report, entitled "Report on the Scientific Basis of EPA's Proposed National Emission Standards for Hazardous Air Pollutants for Radionuclides," was transmitted to the Administrator on August 17, 1984. A copy of this report and the Agency's response are available in the Docket.

In the Executive Summary of its report, the Subcommittee noted that its activities could be viewed as addressing two interrelated questions. First, did the Agency's staff collect the scientifically relevant data and use scientifically defensible approaches in modeling the transport of radionuclides through the environment from airborne releases, in calculating the doses received by persons inhaling or ingesting this radioactivity and in estimating the potential cancer and genetic risks of the calculated doses? Second, are the individual facts, calculational operations, scientific judgments, and estimates of uncertainty documented and integrated in a clear and logical manner to provide a risk assessment that can be used as a scientific basis for risk management purposes, i.e., standard-setting? With regard to the first question, the Subcommittee concluded that EPA had gathered the appropriate scientific information needed for a risk assessment in a technically proficient manner.

The Subcommittee made several technical suggestions on how EPA could improve its assumptions, models, and methods for estimating risks. Most of these technical suggestions have been incorporated into EPA's risk assessment procedures. The risk assessment for the final rule reflects these modifications. Some of these technical suggestions involve additonal research to improve future risk assessment methods. Those

suggestions will be used as EPA conducts new studies.

The Subcommittee's greatest criticism in its report was related to the second question. They concluded that EPA had not assembled and integrated the available scientific data in the format of a risk assessment that provides an adequate basis for regulatory decisions. The panel suggested the need for an intermediate step between the collection of the relevant technical information and the selection of regulatory options. Specifically, they encouraged the Agency to assemble an intergrated risk assessment document that would lead a decisionmaker step-by-step from the identification of emission sources, through the calculation of radiation doses and the associated degree of uncertainty, to a variety of regulatory options from which to choose. Only in this way did the Subcommittee feel that a policymaker could be presented with all the facts necessary to make a responsible regulatory decision. Further, this analysis would enable the scientific community and the public to understand the rationale and basis for the Agency's actions.

The Agency recognizes and is concerned about the adverse criticism of its processes by its own Science Advisory Board. EPA does believe that, on balance, its risk estimates for specific sources of radionuclide emissions are accurate within the limitations inherent in making such estimates. It acknowledges, however, that the criticism of the Board does cloud the rulemaking record, and that the Subcommittee's concerns, by their very nature, cannot be fully addressed within the time available for this decision. Nevertheless, the final Background Information Document has been greatly modified to encompass the format and suggestions of the Subcommittee to the extent possible. However, the Subcommittee has not reviewed this revised document.

The Science Advisory Board also made several procedural suggestions for improving the Agency's risk assessment methods. These recommedations will be incorporated into the Agency's procedures and processes. Detailed responses to the Science Advisory Board's recommendations can be found in Volume 2 of "NESHAPS-Radionuclides: Response to Comments for Fiscal Rule."

VI. Perspectives on Risk Assessment

Today's decision is based on a developing body of science and policy concerning the treatment of one particular class of hazardous substances, namely materials that cause, or are thought to cause, cancer. In some cases, scientific evidence indicates that a given substance is hazardous at high levels or exposure, but has no effect below a certain level. For most carcinogenic substances, however, scientists are unable to identify such a threshold below which no effects occur; moreover, to the extent scientists understand the process of carcinogenesis, there is some reason to believe such thresholds may not exist. For these kinds of substances, EPA and other Federal agencies have taken the position that any level of exposure may pose some risks of adverse effects, with the risks increasing as the exposure increases.

EPA's approach to risk assessment for suspected carcinogens may be divided into several steps. The first is qualitative evaluation of the evidence to determine whether a substance should be considered a human carcinogen for regulatory purposes. This was done for radionuclides before they were listed as a hazardous air pollutant in 1979. The second step is quantitative: how large is the risk of cancer at various levels of exposure? The result of this examination is a dose-response function which gives the lifetime risk per unit of exposure (or "potency"). The third step is to estimate how many people are exposed to the sources of radiation, and at what levels. These exposure estimates then are combined with the dose-response function to obtain estimates of the risk caused by emissions of the pollutant, in this case radionuclides, into the environment.

Exposure levels for each specific source category are derived using emissions estimates, dispersion modeling, and population data. For any given level of emissions, dispersion models predict concentrations at different distances from the emission source. By combining those estimated concentrations with census data on population densities, the number of people exposed at different levels can be estimated. Several factors suggest that actual exposure levels will be lower than those estimated. In estimating exposure, the most exposed individuals are hypothetically subjected to the maximum annual average concentration of the emissions for 24 hours every day for 70 years (roughly a lifetime). This does not take into account indoor vs. outdoor air, for instance, or the fact that most people in their daily routines move in and out of the specific areas where the emission concentration are the highest.

The final risk estimates are the product of the exposure levels and the estimated unit-risk factor. Two summary measures are of particular interest: "nearby individual risk" and "total population impact." The former refers to the estimated increased lifetime risk from a source that is faced by individuals who spent their entire life at the point where predicted concentrations of the pollutant are highest. Nearby individual risk is expressed as a probability; a risk of one in one thousand, for example, means that a person spending a lifetime at the point of maximum exposure faces an estimated increased risk of cancer of one in one thousand. (For comparison, the average lifetime risk of dying of cancer in the United States is about 165 in 1,000, so eliminating a risk of one in one thousand reduces the overall lifetime risk of contracting cancer by less than 0.6 percent.) Estimates of nearby individual risk must be interpreted cautiously, however, since generally few people reside at the points of maximum concentrations and spend their whole lives at such locations.

The second measure, "total population impact," considers people exposed at all concentrations, low as well as high. It is expressed in terms of annual number of cancer cases, and provides a measure of the overall impact on public health. A total population impact of 0.05 fatal cancer per year, for example, means that emissions of the specific pollutant from the source category are expected to cause one case of cancer every 20 years. Such figures should not be viewed as precise estimates of the likely effects. Together with the estimates of maximum individual risk, they are intended to give an indication of a reasonable upper-limit situation.

The two estimates together provide a better description of the magnitude and distribution of risk in a community than either number alone. "Nearby individual risk" tells us the highest risk, but not how many people bear that risk. "Total population impact" describes the overall health impact on the entire exposed population, but not how much risk the most exposed persons bear. Two sources of radionuclide or chemical emissions could have similar population impacts, but very different maximum individual risks, or vice versa. Any sensible "risk management" system cannot rely on either measure alone; both are important.

Much more is known about the risks from exposure to radiation than exposure to most chemicals. While there is uncertainty in risk estimates from assessments of chemical emissions and radionuclide emissions, there is likely to be much less uncertainty in estimates of

risk from radionuclide emissions because of the extensive data base on human exposure to radiation. Therefore, a risk estimate of one in one thousand resulting from radionuclide emissions is likely to be more accurate than the same estimate for chemical releases. The situation for estimating risk from radionuclides is much less likely to reflect hypothetical maximum potential estimates than are estimates made for chemical emissions.

To provide general perspective regarding radiation exposure, everyone is exposed to background radiation due to cosmic radiation, and radioactivity in minerals, soils, and even our own bodies. Background radiation levels vary across the U.S., but average about 100 mrem/y for each person. There is very little that people can do to control exposure to background radiation. Over a lifetime this exposure is estimated to contribute to a fatal cancer risk of about one or two cases for every one thousand people.

VII. Withdrawal of Proposed Standards

A. Alternatives

In determining the appropriate course of action for the proposed standards, EPA considered the following alternatives.

1. Withdraw the Proposed Standards

This alternative is based on the finding that current and future emissions at the facilities under consideration are anticipated to be at levels that would protect the public with an ample margin of safety, as required by section 112 of the Act. This alternative is also appropriate if implementation of the proposed standards is infeasible.

2. Promulgate the Proposed Standards

This alternative is based on the conclusion that the findings made in the proposed rule were correct and that the proposed standards are necessary to adequately protect the public health.

3. Promulgate a Standard for Each Category at a Level That Would Limit Dose to 25 mrem/y to the Whole Body and 75 mrem/y to Any Organ

This alternative is based on the conclusion that the need for standards for each category for which the Agency proposed rules was correct, but that EPA could establish the standards at these recommended levels and still provide an ample margin of safety. Establishing the standards at these levels would also respond to several comments regarding consistency among the categories and with the recommendations of recognized national and international radiation protection groups, and regarding the need for greater operator flexibility in selecting control technology and methods of demonstrating compliance.

B. Elemental Phosphorus Plants

One of the decisions presented by this rulemaking concerns emission for elemental phosphorus plants. Risks from these plants are higher than for any other source category in this rulemaking except uranium mines. Moreover, technology to reduce these risks is available. Nevertheless, after consideration of the proposed rule, the public comments, the Science Advisory Board report, the risk assessment, and other pertinent information, it is the Administrator's judgment that the present record does not support a conclusion that regulation of elemental phosphorus plants is necessary to protect the public health, within the meaning of the Clean Air Act. Therefore, the proposed rule is withdrawn. This decision presents difficult questions and the Agency is undertaking a number of nonregulatory actions, explained below, that may lead to reexamination of this decision at some future date.

EPA estimates the total risk to human populations posed by radionuclide emissions from elemental phosphorus plants to be 0.06 fatal cancer per year, or approximately one case every seventeen years. This risk is similar to other risks that EPA has considered insufficient to warrant Federal regulation in comparable Section 112 proceedings. About 80% of the total risk presented by the industry is accounted for by two plants, the FMC plant in Pocatello, Idaho, and the Monsanto plant in Soda Springs, Idaho.

In the case of one of the plants, EPA estimates the dose rate to individuals at the location of highest air concentrations to be about 600 mrem/y to the lung. The chance of getting cancer from a lifetime of exposure at this location is calculated to be about one in one thousand. If risk to the "most exposed individuals" were the only criterion for judgment, this relatively high risk might well have led to a decision to regulate.

However, this risk must be weighed against both the low aggregate risk described earlier and against other factors. Our studies indicate that present emission controls on these plants are not efficient in removing radionuclides and could be improved. However, adding such additional controls will be expensive measured against the limited public health benefits provided.

Finally, the SAB Subcommittee's report harshly criticized EPA's analysis in support of its proposed standards. That alone would not justify a decision not to regulate, but in the context of the limited aggregate risk and other factors described earlier it contributes to such a decision, particularly given the Science Advisory Board's statutory role as the Agency's science advisor.

Over the next several years, EPA will work with the Science Advisory Board to satisfy its concerns regarding the scientific basis of regulations such as this. Undertaking this effort will also allow the development of answers to the following two questions that may have a bearing on any future EPA action.

1. EPA is curently reconsidering its ambient air quality standard for particulates, and may shift its emphasis toward regulating the smaller-sized particles. Since the two elemental phosphorus plants being considered here emit large amounts of these smallar particles, they may require additional controls based on these new standards. Limiting emissions of these smaller particulates would also control some of the radionuclide emissions from the plants.

2. The area surrounding these two plants is characterized by high total levels of radiation from a variety of sources. The storage and widespread use of slag and possibly other waste products from these plants have significantly increased the natural background radiation levels in parts of the communities. In particular, phosphate slag from these plants has been widely used as aggregate in road and house construction in these areas. EPA and the State of Idaho intend to perform a total assessement of the various sources and will investigate ways to reduce or prevent risks from growing. This assessment may find more effective ways to control the overall risks than by controlling the emissions at issue here.

C. Department of Energy (DOE) Facilities

It is also the Administrator's judgment that the present record does not support a conclusion that regulation of DOE facilities for radio-nuclide emissions to air is necessary to protect the public health with an ample margin of safety, within the meaning of the Clean Air Act. Therefore, the proposed rule is withdrawn and the rulemaking is terminated.

EPA estimates the total risk to exposed human populations by all DOE facilities for which regulation was proposed as 0.08 potential fatal cancer

per year, or one case every 13 years. This risk is comparable to risks that EPA has considered insufficient to warrant regulation in similar Section 112 proceedings.

Dose rates from the four DOE facilities with the greatest radionuclide emissions range from 50 mrem/y to 88 mrem/y to the lung; one of these facilities delivers a dose rate of 34 mrem/y to the whole body. EPA estimates the chances of fatal cancer from a lifetime of exposure to these plants' most concentrated emissions are about one to eight in ten thousand, somewhat lower than the maximum risks elemental phosphorus plants. Once again, this risk to nearby individuals must be weighed both against the low aggregate risks and the Science Advisory Board report described earlier.

The DOE currently has a program to keep exposure to the public to levels that are as low as reasonably achievable. This program is operated by the Department in keeping with the longstanding recommendations of the National Council on Radiation Protection and Measurements, the International Commission on Radiological Protection, and the Federal Radiation Council to avoid radiation exposure where practical. While the Agency recognizes that DOE facilities maintain very large quantities of radionuclides in their inventories at many of their facilities, there has been a general trend at most facilities for radionuclide emissions to be reduced over the years. Emissions should not significantly increase in the future. EPA intends to continue its oversight of emissions from DOE facilities and should this change, the Agency will reexamine its decision not to regulate.

As previously noted, EPA currently has a Memorandum of Understanding (MOU) with DOE regarding the development and implementation of standards under section 112. EPA intends to coordinate with DOE to seek to modify the Memorandum of Understanding as appropriate.

D. Nuclear Regulatory Commission (NRC)-Licensed Facilities and Non-DOE Federal Facilities

It is also the Administrator's judgment that the present record does not support a conclusion that regulation of NRC-licensed facilities and Federal facilities other than DOE facilities is necessary to protect the public health with an ample margin of safety, within the meaning of section 112. Therefore, the proposed rule is withdrawn and the rulemaking is terminated.

EPA estimates the total risk to human populations posed by NRC-licensed facilities and non-DOE Federal facilities for which regulations were proposed to be no more than 0.02 fatal cancer per year, or less than one case every fifty years. This risk is comparable to other risks that EPA has considered insufficient to warrant regulation in similar Section 112 proceedings.

EPA calculates the changes of developing fatal cancer from a lifetime of exposure to the most concentrated emissions from the NCR facility with the greatest dose rate at no more than two in ten thousands. EPA believes that the Nuclear Regulatory Commission and other Federal facilities will continue to implement programs to keep exposure of the public to levels that are as low as reasonably achievable, and adequate to protect the public against significant adverse effects from radiation. Emissions should not significantly increase in the future. EPA will continue its oversight of emissions from these facilities, and should this change, the Agency will reexamine its decision not to regulate.

As previously noted EPA currently has a Memorandum of Understanding (MOU) with NRC regarding the development and implementation of standards under section 112. EPA intends to coordinate with NRC to seek to modify the Memorandum of Understanding as appropriate.

E. Underground Uranimum Mines

The Agency proposed a standard for underground uranimum mines that would limit the annual average radon-222 concentration in air due to emissions from an underground mine to 0.2 pCi/1 above background in any unrestricted area. The standard was expected to be met by one of the following procedures: (1) Reducing the precentage of time the mine operates, (2) increasing the effective height of the release, and (3) controlling additional land. EPA expected that mine operators would most likely try to control land within about 2 kilometers of the mine vents in order to comply with the standard. EPA did not issue a direct emission standard for radon from underground uranium mines because, as the proposal explained, available information suggested that radon could not be collected by available pollution control equipment before being released from the vents, reductions afforded by better bulkheading or sealants were highly uncertain, and reducing the volume of air flow was not feasible due to the effect on occupational exposure. Comments on the proposed rule indicated that controlling a sufficient amount of land might not be feasible because private owners of land surrounding the mine might be unwilling to make their land available to the mine owners.

Several comments were received starting that EPA had overestimated the risks from radon-222 emissions from underground uranium mines. It was suggested that the Agency had used overly conservative assumptions in the dispersion and risk calculations and that it used greater risk coefficients than recommended by other recognized radiation experts. EPA has considered these comments in establishing its parameters for emission rates, plume rise, and equilibrium ratios in the revised risk assessment. The most recent estimates of the lifetime risks to individuals living near these mine range from one in one thousand to one in one hundred. The potential exists for even higher risks in some situations, e.g., a person living very close to several horizontal mines vents or in areas influenced by multiple mine emissions. Lifetime risks in these situations could be as high as one in ten. EPA estimates the fatal cancer risk to the total population to be about five fatal cancers per year. The Agency considers these risks to be significant and believes action is needed to protect populations and individuals living near underground uranium mines.

Analysis of the likely reduction in health risks afforded by the proposed standards showed that while risks to nearly individuals were reduced by a factor of about ten, the risks to the total population were only negligibly reduced. The lack of population risk reduction is due to the fact that radon releases would not be reduced by the proposed rule, they would only be more widely dispersed.

EPA has concluded that its proposed standard was legally flawed in two ways. First, because it would not have limited radionuclide emissions on a continuous basis, but was primarily based on the use of dispersion technology to reduce risks to nearby people, it did not qualify an "emission standard" within the meaning of section 112 (See Clean Air Act, section 302(k)). EPA also believes such dispersion techniques cannot qualify in this context as a "design, equipment, work practice or operational standard" within the meaning of section 112(e). EPA believes that for such standards to be valid, they must also have an emission limiting effect. (See Clear Air Act, sections 112(e)(3) and (e)(4).) Second, because this standard would not reduce the aggregate population risk appreciably, when such risk was high, if failed to

meet the public health protection purposes of the Act.

Because radon-222 is a noble gas and the volume of air discharged through mine vents is very large, there is no practical method to remove radon-222 from the mine exhaust air. Adsorption onto activated charcoal is the most widely used method for removing noble gases from a low volume air stream. However, application of this method to the removal of radon-222 from mine ventilation air at the volumes of air which must be treated would require large, complex, unproven systems which would be extremely costly (i.e., at least $18–44/lb of U_3O_8 produced).

Since proposal, EPA has received additional technical information in a report prepared for the U.S. Bureau of Mines, indicating that work practices, such as bulkheading abandoned sections of mines to trap the radon before it is vented, may be more feasible and cost-effective than previously thought. This information, which is of a preliminary nature, suggests that bulkheading, even without the use of charcoal filters, could reduce emissions of radon-222 by 10–60% from typical mines at a cost ranging from $4–$60 per curie reduced or about $0.01–0.05/lb of U_3O_8 produced.

Uranium mines are widely diverse in their characteristics. They differ in configuration; for example, some mines have very few side tunnels and cross cuts whereas others may have many side areas. Consequently, they have a wide variety of surface areas where radon can be generated. In addition, mines differ in the geologic strata, mining techniques, and uranium and radium concentrations. All of these factors tend to decrease the number of common characteristics among mines that can be used to make general predictions of the effectiveness of specific control measures. Therefore, considerable additional work is needed to establish whether these results can be realized consistently for an appreciable segment of the industry, and to determine methods of bulkheading that might potentially produce any such consistently acceptable results. Only after these facts have been established would EPA be able to propose a standard based on these techniques. In any event, no such rule can be promulgated on the present record because the original proposal considered the use of this form of control and explicitly dismised it as a basis for the standard.

Because the Agency is convinced that the health risks posed by underground uranium mines are significant, EPA has decided to begin developing an emission, design, equipment, work practice, or operational standard to control radon releases from underground uranium mines. An Advance Notice of Proposed Rulemaking announcing this decision is being published simultaneously with this notice.

VIII. Final Determination for Sources EPA Proposed Not To Regulate

EPA previously identified several source categories that emit radionuclides to air but proposed not to regulate them. Final decisions on the need for emission standards for these categories, and the reasons for these decisions, are discussed in the following paragraphs.

A. Coal-Fired Boilers

Large coal-fired boilers are used by utilities and industry to generate electricity and to make process steam and hot water for space heaters and industrial processes. When operating, these boilers emit trace amounts of uranium, radium, thorium, and their decay products found in the feed coal. These radionuclides become incorporated into fly ash and are carried into the air along with the particulate matter these boilers emit. Technology that removes particulates will also limit radionuclide emissions.

Particulate emissions from new utility and new large industrial boilers are controlled by new source performance standards issued under Section 111 of the Clean Air Act reflecting best demonstrated technology. EPA has also proposed new source performance standards for smaller industrial boilers. Existing utility and industrial boilers are regulated for particulate emissions by State implementation plans as required by the Clean Air Act.

EPA proposed not to regulate coal-fired boilers because these existing particulate emission standards also limit radionuclide releases, and result in relatively insignificant risks to nearby individuals and to populations due to radionuclides. The highest dose resulting from this source category is 1 mrem/y to the lung. This is equivalent to an individual lifetime risk of fatal cancer of one in one million. Population risk is estimated to be about two fatal cancers per year, spread over the entire U.S. population. The cost to further reduce radionuclide emissions is greater in comparison to the additional public health protection achieved. In addition, radionuclide emissions will decrease as old plants are replaced with new ones having improved particulate emission controls as required by the Clean Air Act.

Many commenters, mostly industrial groups, strongly supported the determination not to propose regulations for this source category. Several commenters stated that the risks from coal-fired boilers were so low that this fact alone indicated that standards are not needed. The Agency's decision not to regulate is based on both a consideration of the level of risk and on a consideration of total cost and practicality of additional control equipment. Some commenters stated costs should not be considered under section 112 of the Clean Air Act. EPA believes it is not reasonable to avoid considering cost and practicality of control technology; however, the protection of public health was the primary consideration in reaching this decision.

Some commenters raised the question of whether there are some boilers that might burn coal with high uranium content, leading to emission levels far greater than those considered in making this determination. EPA asked for comment on this point and contracted with Los Alamos National Laboratory to investigate the existence of such boilers. The Agency was unable to find boilers with radionuclide emission rates significantly greater than the model facility we studied in detail. In fact, the majority of boilers can be demonstrated to have emissions much lower.

Some commenters stated that the requirements of the Clean Air Act dictate that EPA must propose an emission standard specifically for radionuclides, regardless of other Clean Air Act regulations limiting particulate emissions. EPA believes that to issue a standard that duplicates current regulations is unreasonable. As a practical matter, Clean Air Act regulations limiting particulate emissions from these boilers also limit radionuclide emissions. Hence, these existing regulations protect the public health with an ample margin of safety as far as radionuclide emissions are concerned.

After carefully considering all comments, EPA has decided not to regulate radionuclide emissions from coal-fired boilers at this time. This decision will be periodically reviewed as additional information on the total impact of all hazardous air pollutants from coal-fired boilers becomes available.

B. Phosphate Industry

The phosphate industry processes phosphate rock to produce fertilizers, detergents, animal feeds, and other products. The production of fertilizer

uses approximately 80 percent of the phosphate rock mined in the United States. Phosphate deposits contain elevated quantities of natural radioactivity, principally uranium-238 and members of its decay series. Uranium concentrations in phosphate deposits range from ten to one hundred times the concentration of uranium in other natural rocks and soils.

Phosphate Rock Processing Plants

The processing of phosphate rock in dryers, grinders, and fertilizer plants results in the release of radionuclides into the air in the form of dust particles. Control techniques that remove particulates will also control radionuclide emissions.

Particulate emissions from new or modified phosphate rock drying, grinding, and fertilizer plants are controlled by new source performance standards issued under Section 111 of the Clean Air Act. In the case of fertilizer plants, the new source performance standard for fluoride also provides for effective control of particulates. Existing drying, grinding, and fertilizer plants are regulated for particulate emissions by State implementation plans as required by the Clean Air Act. EPA proposed not to regulate phosphate rock processing facilities because the existing particulate and fluoride emission standards also limit radionuclide releases. The risks to nearby individuals and the total population risks due to radionuclide emissions from these three types of facilities are insignificant. The highest doses resulting from emissions from these facilities are 15 mrem/y to the bone and 7 mrem/y to the lung. This is equivalent to a lifetime individual risk of fatal cancer of one in one hundred thousand. Population risk is from all of these facilities about to 0.02 fatal cancer per year. In addition, there is no potential for emissions to increase; rather, they should decrease as older plants are replaced with new ones subject to new source performance standards.

Comments from the phosphate industry strongly supported EPA's proposal not to regulate phosphate rock processing facilities and further stated that EPA had overestimated the radionuclide emissions from these facilities. EPA agrees that its estimates of radionuclide emissions from these facilities were based on some conservative assumptions and has concluded that this serves to reinforce its decision not to regulate these facilities.

Several commenters stated that standards were needed for phosphate rock processing facilities and that cost should not be considered in reaching a decision on the need for these standards. Even without considering costs, EPA does not agree that standards are needed for these facilities for the reasons just stated.

EPA did not previously make any determination regarding radionuclide standards for phosphate rock calciners at wet process fertilizer plants because information on emissions from these facilities was not available. EPA requested comments on these emissions and asked whether standards were needed. In addition, the Agency conducted emission tests at two of these facilities. EPA has not yet completed its analysis of these emission tests or carried out a risk assessment for these calciners. Therefore, no determination of the need for standards for phosphate rock calciners at wet process fertilizer plants is made at this time.

After considering all comments, EPA has decided to affirm and make final its decision not to regulate radionuclide emissions from phosphate rock processing plants, other than phosphate rock calciners at wet process fertilizer plants. A decision regarding the need for standards for this latter source will be made after completion of the Agency's analyses of emissions and risks from these facilities.

Phosphogypsum Piles

Several comments were received requesting EPA to issue standards under the Clean Air Act for radionuclide emissions from phosphogypsum piles (fertilizer plant waste material). EPA did not propose radionuclide standards for this source because it believed that such wastes would be more appropriately regulated under the Resource Conservation and Recovery Act (Pub. L. 94–580).

After considering all comments, EPA is reevaluating the need for radionuclide standards for this source. Preliminary risk estimates indicate that individual lifetime risks from exposure to air emissions from these piles may be as high as eight in ten thousand. Population risks may be on the order of one fatal cancer per year. The Agency will continue its examination of the need for a standard for this source category.

C. Other Extraction Industries

Almost all industrial operations involving removal and processing of soils and rocks to recover mineral resources release some radionuclides into the air. EPA has conducted studies of airborne radioactive emissions from the mining, milling, and smelting of iron, copper, zinc, clay, limestone, fluorspar, and bauxite. These are relatively large industries and are considered to have the greatest potential for air emissions of radionuclides.

EPA proposed not to regulate these extraction industries because the available data showed that the risks to individuals and populations from radionuclide emissions from these facilities are insignificant. Individual lifetime risks range from one in one hundred million to one in ten thousand. Population risks range from 0.000001 to 0.01 fatal cancer per year.

Most of the comments received were from industry representatives who concurred with EPA's proposal not to regulate these facilities. In their opinion, emissions, doses, and risks were so small that a regulation was unnecessary. No new information was provided to the Agency during the public comment period which indicated a need for standards. Additional Agency studies have confirmed that radionuclide emissions from these sources are low.

After considering all comments, EPA has decided to affirm and make final its decision not to regulate radionuclide emissions from extraction industry facilities.

D. Uranium Fuel Cycle Facilities, Uranium Mill Tailings, and Management of High-Level Radioactive Waste

The uranium fuel cycle consists of operations associated with production of commercial electric power by light water reactors using uranium fuel. It includes nuclear power plants and facilities that mill uranium ore, process uranium, and fabricate and reprocess uranium fuel. EPA has promulgated emission standards for normal operations of the uranium fuel cycle under the Atomic Energy Act (40 CFR Part 190). These standards limit the annual dose equivalent from radionuclide emissions to 25 mrem/y to the whole body and to any organ, with the exception of the thyroid, which may receive 75 mrem/y. EPA standards and their implementation by the NRC require the use of available technology which results in low doses to individuals and populations.

Many commenters, both government and industry, supported EPA's decision not to issue emission standards for this source category. Other commenters felt that the Clean Air Act requires EPA to set emission standards for uranium fuel cycle facilities, regardless of any other standards in force.

The Agency believes that current EPA standards for the uranium fuel cycle provide a level of protection which

satisfies the requirements of the Clean Air Act. An emission standard promulgated under the Clean Air Act would be duplicative with the uranium fuel cycle standard and would not offer any additional public health protection. During the Agency's upcoming review of 40 CFR Part 190, this issue will be reexamined.

Uranium mill tailings remain after uranium is removed from the ore. Many thousands of acres of these tailings exist at both inactive and active uranium mill sites, located mostly in the West. The high concentration of radium-226 in the tailings can result in significant emission or radon-222, a radioactive gas. Under current EPA disposal standards which require long term stabilization of the tailings piles, 95% or more of the random emissions will be controlled. These standards, issued under the authority of the Uranium Mill Tailings Radiation Control Act of 1978 (Pub. L. 95-604), provide a level of public health protection comparable to an air emission standard.

However, commenters noted that randon emissions from the tailings piles at licensed uranium mills are exempted from the requirements of 40 CFR Part 190. They are controlled, instead, by NRC regulations which allow a concentration of 3pCi/1 of radon-222 in unrestricted areas. This value represents a level of risk that may be significant. EPA is publishing, simultaneously with this notice, and Advance Notice of Proposed Rulemaking to consider the need for an emission standard for radon emission from licensed uranium mills.

Highly radioactive liquid or solid wastes from reprocessing spent nuclear fuel, or the spent fuel elements themselves if they are disposed of without reprocessing, are considered high-level radioactive waste. EPA has proposed standards under the Atomic Energy Act to limit public exposure to the radionuclides in this waste prior to disposal and has proposed that operations be conducted to reduce exposures below the standard to the extent reasonably achievable. The Agency expects its standards for the management of high-level radioactive waste to be promulgated in the near future. These standards will control emissions during the operational phase of the disposal site to a level which results in a dose equivalent no greater than 25 mrem/y to the whole body or to any organ, except the thyroid, which may receive a dose as high as 75 mrem/y. These standards will provide a level of public health protection comparable to an emission standard issued under the Clean Air Act.

After consideration of all comments, EPA affirms and makes final its decision not to issue separate standards under the Clean Air Act for radionuclide emissions from the uranium fuel cycle, uranium mill tailings, and management of high-level radioactive waste.

E. Low Energy Accelerators

Accelerators impart energy to charged particles, such as electrons, alpha particles, protons, and neutrons. They are used for a wide variety of applications, including radiography, activation analysis, food sterilization and preservation, and radiation therapy and research. Accelerators, other than those owned by the DOE, operate at comparatively low energy levels and therefore emit very small quantities of radionuclides. The doses and health risks associated with these emissions are extremely low. Lifetime individual risks range from one in ten trillion to one in one billion. Further, there is no potential for the emissions from these facilities to increase significantly.

The Agency proposed not to regulate this category. No comments were received on this proposal, and the Agency is not aware of any new information indicating a need for a standard. Therefore, the Agency affirms and makes final its decision not to regulate radionuclide emissions from low energy accelerators.

IX. Miscellaneous

Docket

The docket is an organized and complete file of all information considered by EPA in this rulemaking. It is a dynamic file, since material is added throughout the rulemaking process. The docket allows interested persons to identify and locate documents so they can effectively participate in the rulemaking process, and it also serves as the record for judicial review.

Transcripts of the hearings, all written statements, the Agency's responses to comments, and other relevant documents have been placed in the docket and are available for inspection and copying during normal working hours.

Dated: October 23, 1984.

William D. Ruckelshaus,

Administrator.

[FR Doc. 84-28453 Filed 10-30-84; 8:45 am]
BILLING CODE 6560-50-M

40 CFR Part 61

[AD-FRL 2694-2a]

National Emission Standards for Hazardous Air Pollutants; Standards for Radon-222 Emissions From Underground Uranium Mines

AGENCY: Environmental Protection Agency (EPA).

ACTION: Advance notice of proposed rulemaking.

SUMMARY: This notice announces the Agency's intent, under Section 112 of the Clean Air Act, as amended, to start a program to consider a standard based on bulkheading or related techniques to control radon emissions from underground uranium mines. This standard could be an emission standard, or a design, equipment, work practice, or operational standard, or a combination thereof. The Agency requests interested parties to submit information and comments relative to controlling these emissions.

DATES: Information received by April 30, 1985 will be of maximum value.

ADDRESS: Comments must be submitted (in duplicate, if possible) to: Central Docket Section (LE-130) Attention: Docket No. A-79-11, Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460.

FOR FURTHER INFORMATION CONTACT: James M. Hardin, (703) 557-8977, Environmental Standards Branch, Criteria and Standards Division (ANR-460), Office of Radiation Programs, Environmental Protection Agency, Washington, D.C. 20460.

SUPPLEMENTARY INFORMATION: This Advance Notice of Proposed Rulemaking (ANPR) serves to inform interested parties that the Agency is considering a rulemaking related to the design and type of equipment, work practices, operational procedures, or to emission standards based on these techniques, to control the radon-222 emissions from underground uranium mines. As of January 1983, there were 139 of these mines located in Arizona, Colorado, New Mexico, Utah, and Wyoming. These mines have a production rate of 6,200 tons of U_3O_8 and account for about 46% of the total production of U_3O_8 in the United States.

The Agency proposed a standard under section 112 of the Clean Air Act in April of 1983 for underground uranium mines that would limit the annual radon-222 concentration in air due to emissions from an underground mine to 0.2 pCi/1 above background in any unrestricted area. The principal method

to meet this standard was considered to be control of land around the mine, since at the time, the Agency believed that no emission reduction measures were practical.

In EPA's most recent evaluation of the risks due to radon-222 emissions from underground uranium mines, the estimated lifetime risk of fatal cancer to nearby individuals ranges from one in one thousand to one in one hundred. The potential exists for an even higher risk in some situations (up to one in ten) for individuals living very close to several horizontal vents or in areas influenced by multiple mine emissions. The fatal cancer risk to the total population from radon-222 emissions from all underground uranium mines is five fatal cancers per year. The Agency considers these risks to be significant and believes action is needed to protect individuals living near underground mines and other populations.

However, analysis of the likely reduction in health risks afforded by the proposed standard showed that, while risks to nearby individuals were reduced by a factor of about ten, the risks to the total population were only negligibly reduced. The lack of population risk reduction was due to the fact that radon releases would not be reduced, they would only be more widely dispersed.

The Agency decided to withdraw its proposed standard for underground uranium mines based on its conclusion that the proposed standard was not authorized by the Clean Air Act and that the limited reduction in population risk would not meet the full intent of section 112 to provide adequate public health protection.

Because radon-222 is a noble gas and the volume of air discharged through mine vents is very large, there is no practical method to remove radon-222 from the mine exhaust air. Adsorption onto activated charcoal is the most widely used method for removing noble gases from a low volume air stream. However, application of this method to the removal of radon-222 from mine ventilation air at the volumes of air that must be treated would require large, complex, unproven systems which would be extremely costly.

Since proposal, EPA has received additional information indicating that work practices, such as bulkheading, are more feasible and cost-effective than originally thought. The Agency has decided to begin development of standards based on bulkheading or similar techniques to control radon releases from underground uranium mines. Interested parties are requested to submit information and comments on the following issues:

(1) Measured or estimated radon-222 releases from underground mines;

(2) Applicable standards for reducing radon emissions, including such practices as bulkheading, sealants, mine pressurization, and backfilling;

(3) Methods of procedures to predict releases of radon-222 without controls and with controls, such as bulkheading, sealants, mine pressurization, and backfilling;

(4) Effectiveness, feasibility and costs of controls;

(5) Methods of determining compliance with design, equipment, work practice, or operational type standards;

(6) Estimates of impacts on nearby individuals and populations due to radon-222 emissions before and after control;

(7) Extent of radon-222 controls now practiced by the industry, including such methods as bulkheading, sealants, mine pressurization, and backfilling; and

(8) Effect on the industry if controls are required.

Dated: October 23, 1984.

William D. Ruckelshaus,

Administrator.

[FR Doc. 84-28439 Filed 10-26-84; 2:13 pm]

BILLING CODE 6560-50-M

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40 CFR Part 61

[AD FRL 2694-2b]

National Emission Standards for Hazardous Air Pollutants; Standards for Radon-222 Emissions from Licensed Uranium Mills

AGENCY: Environmental Protection Agency (EPA).

ACTION: Advance notice of proposed rule making.

SUMMARY: This notice announces the Agency's intent, under section 112 of the Clean Air Act, as amended, to consider development of standards to control radon-222 emissions from licensed uranium mills. The Agency requests interested parties to submit information and comments relative to controlling these emissions.

DATES: Information received by April 30, 1985 will be of maximum value.

ADDRESS: Comments must be submitted (in duplicate, if possible) to: Central Docket Section (LE-130) Attention: Docket No. A-79-11, Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460.

FOR FURTHER INFORMATION CONTACT: James M. Hardin, (703) 557-8977, Environmental Standards Branch, Criteria and Standards Division (ANR-460), Office of Radiation Programs, Environmental Protection Agency, Washington, D.C. 20460.

SUPPLEMENTARY INFORMATION: This Advance Notice of Proposed Rulemaking (ANPR) serves to inform interested parties that the Agency is considering emission standards under the Clean Air Act for licensed uranium ore processing facilities. As of January 1983, there were 27 licensed uranium mills located in Colorado, New Mexico, South Dakota, Texas, Utah, Washington, and Wyoming. These mills have produced a total of over 150 million metric tons of tailings which contain radioactive elements from the uranium decay chain, including radium-226 which decays to radon-222. The latter is a radioactive gas which is emitted from the piles to the ambient air.

EPA issued standards under the Uranium Mill Tailings Radiation Control Act (UMTRCA) (40 CFR Part 192 Subparts D and E) for the management of tailings at locations that are licensed by the Nuclear Regulatory Commission (NRC) or the States under Title II of the UMTRCA. These standards do not specifically limit radon-222 emissions until after closure of the facility. When the UMTRCA standards were promulgated, the Agency stated that it would issue an ANPR for consideration of control of radon emissions from uranium tailings piles during the operational period of a uranium mill. This notice fulfills that commitment.

The Agency issued Environmental Radiation Protection Standards for Nuclear Power Operations (42 FR 2858, January 13, 1977). These standards (40 CFR Part 190) limit the total individual radiation dose caused by emissions from facilities that comprise the uranium fuel cycle, including licensed uranium mills. At the time 40 CFR Part 190 was promulgated, there existed considerable uncertainty about the public health impact of existing levels of radon-222 in the atmosphere, as well as uncertainty about the best method for management of new man-made sources of the gas. The Agency exempted radon-222 from control under 40 CFR Part 190 since at that time the problems associated with radon emissions were considered sufficiently different from those of other radioactive materials associated with the fuel cycle to warrant separate consideration.

Subsequently, standards were proposed under the Clean Air Act (48 FR 15076, April 6, 1983) for NRC licensees, but uranium fuel cycle facilities, which included operating uranium mills, were

excluded because these sources are subject to EPA's 40 CFR Part 190 standard that provided protection equivalent to that of the Clean Air Act. It was noted during the comment period for the Clean Air Act standards that radon-222 emitted from operating uranium mills and their actively used tailings piles are not subject to any current or proposed EPA standards, and that there may be significant risks associated with resulting radon-222 emission.

The Agency is particularly interested in receiving information on the following issues:

(1) Radon-222 emissions from these facilities;

(2) Applicable control options and strategies, including work practices;

(3) Feasibility and cost of control options and strategies;

(4) Local and regional impacts due to emissions of radon-222 from active uranium mills;

(5) Methods of determining compliance with a work practice type of standard; and

(6) Effect on the industry if controls are required.

Dated: October 23, 1984.

William D. Ruckelshaus,

Administrator.

[FR Doc. 84-28449 Filed 10-26-84; 2:14 am]

BILLING CODE 6560-50-M

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 61

[AO-FR-3060-7]

National Emission Standards for Hazardous Air Pollutants (NESHAPs); Standards for Radon-222 Emissions From Licensed Uranium Mill Tailings

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: This final rule establishes work practices that apply to tailings at licensed uranium mill sites. Radon-222 is emitted from these tailings in amounts sufficient to produce a risk to public health. The work practices established here will limit the emissions of radon-222 in accordance with Section 112 of the Clean Air Act.

EFFECTIVE DATE: The final rule is effective on September 24, 1986.

ADDRESSEES: The rulemaking record is contained in Docket No. A-79-11. This docket is available for public inspection between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA's Central Docket Section, West Tower Lobby, Gallery One, Waterside Mall, 401 M Street, SW., Washington, DC 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Terrence A. McLaughlin, Chief, Environmental Standards Branch, Criteria and Standards Division (ANR-460), Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, DC 20460, (202) 475-9610.

SUPPLEMENTARY INFORMATION:

I. Supporting Documents

The draft background information document and draft economic analysis issued in support of the proposed rule have been revised in response to public comments and are now issued in final form titled, respectively, "Background Information Document—Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings" (EPA 520/1-86-009) and "Economic Analysis—Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings" (EPA 520/1-86-010).

The documents contain projections of radon emissions and the resulting risks to nearby individuals and to populations due to the operation of the uranium milling industry, a description of radon control technology and associated costs, and an environmental and economic analysis of the effects of alternative control strategies on the industry.

In addition, the Agency's summary of public comments on the proposed rule, together with the Agency's reply to these comments, are contained in the document "Response to Comments—Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings" (EPA 520/1-86-011).

Single copies of these documents may be obtained from the Program Management Office (ANR-459), Office of Radiation Programs, Environmental Protection Agency, Washington, DC 20460, (202) 475-8386.

II. Basic Terms Used in the Notice

Definitions of basic terms used in this notice are given below:

1. *ALARA*—A practice in radiation protection that encourages radionuclide emissions to be kept "as low as reasonably achievable."

2. *Continuous disposal*—A method of tailings management and disposal in which tailings are dewatered by mechanical methods soon after generation. The dried tailings are then placed in trenches or other disposal areas and immediately covered.

3. *Covered*—Disposal of tailings in accordance with specifications required by regulations appearing at 40 CFR Part 192 and issued under the Uranium Mill Tailings Radiation Control Act (UMTRCA).

4. *Mill tailings*—The waste resulting from conventional milling of uranium ore. Tailings are classified as either sands or slimes depending on particle size. Processing 1 ton of ore produces approximately 1 ton of tailings.

5. *Phased disposal*—A method of tailings management and disposal that uses a series of small impoundments. Tailings are pumped to one impoundment until it is filled and then pumped to the next impoundment. The filled impoundment is actively dewatered, or allowed to dry naturally, and then immediately reclaimed.

6. *Radon*—Radon-222; an inert radioactive gas.

7. *Radon decay products*—The seven principal radionuclides that are produced as radon-222 decays to nonradioactive lead. Radon-222 short-lived decay products means the four radionuclides with half-lives less than 20 minutes produced as radon-222 decays to lead-210.

8. *Single cell disposal*—A method of tailings management that uses a large impoundment designed to contain all tailings generated during the lifetime of the mill. At the end of the mill life the impoundment is actively dewatered or allowed to dry and is then immediately reclaimed.

9. *Tailings pile*—The on-site waste impoundment in which tailings are deposited.

III. Background

A. Industry Description

Uranium milling involves the handling of large quantities of ore containing uranium and its decay products. In this ore, the concentration of uranium and its decay products is about one thousand times greater than in other rocks and soils. Uranium milling recovers the uranium in the ore by mechanical and chemical processes that generate waste tailings. The ore is first crushed, blended, and ground to the proper size for the leaching process, which extracts uranium. Several leaching processes are used, including the use of acid, alkali, and a combination of the two. After uranium is leached from the ore, it is concentrated from the leachate through ion exchange or solvent extraction. The concentrated uranium is then extracted from the concentrating medium, precipitated, dried, and packaged. The depleted ore, in the form of tailings, is pumped to a tailings pile as a slurry.

Since ore generally contains less than 0.5 percent uranium by weight, every ton of ore processed results in almost a ton of tailings. The tailings contain virtually all of the uranium decay products present in the ore, including thorium-230 and radium-226, which decay to radon. Previous risk analyses have shown that radon presents the highest risk of any radionuclide released to air at uranium mills and that the tailings pile is the most significant source of radon.

The 26 licensed uranium mills in the United States are located in Colorado, New Mexico, South Dakota, Texas, Utah, Washington, and Wyoming. In addition, four mills have been licensed but not built. The milling industry is depressed due to a decline in the demand for uranium and competition from low-cost foreign sources. Three mills are actively processing ore, 17 are on standby and could process ore in the future if market conditions improve, and 6 are being decommissioned and will no longer process ore. The 20 licensed mills that are actively processing ore or on standby were considered in the analyses reported in the supporting documentation. These 20 mills have about 35 tailings impoundments associated with them. Recently, three of these mills have indicated to the NRC that they will no longer process ore and intend to reclaim the sites.

Past milling activities have generated about 200 million tons of tailings. Production at conventional mills peaked

in 1980, when 21 mills recovered more than 17 thousand tons of uranium and generated more than 14 million tons of tailings. The industry is currently operating at about 10 percent of capacity due to the depressed market. At this level of production, the industry is recovering about 1.8 thousand tons of uranium and generating about 1.4 million tons of new tailings annually. At full capacity, the industry could generate approximately 14 million tons of tailings a year.

B. Estimates of Exposure and Risk

Exposure estimates are based on radon emissions from tailings piles, since emissions and risks from other parts of a uranium mill are small in comparison. Radon emission rate estimates are based on the radium-226 concentration in the tailings using the relationship of 1 picocurie of radon emitted per square meter per second for each picocurie of radium-226 per gram of tailings. It is assumed that the radium-226 is evenly mixed throughout the tailings and that radon is emitted from all dry exposed surfaces of tailings. The radium-226 content of the tailings is derived from the relationship of one-tenth of one percent of uranium in ore equalling 280 picocuries of radium-226 per gram of ore and the assumption that all the radium-226 in the ore finds its way into the tailings pile.

Standard meteorological transport models are used to estimate radon concentrations in air at various distances from the piles. Exposure to radon decay products is then estimated from the radon concentration in air. The final risk estimates are a product of the units of radon decay product exposure levels and a risk factor that relates risk to a single unit of exposure.

Two measures of human exposure are of particular interest: "nearby individual risk" and "total population impact". The former refers to the estimated increased lifetime risk to individuals who spend their entire life at the location of existing residences where predicted concentrations of the pollutant are highest. Nearby individual risk is expressed as a probability; for example, a risk of one in one thousand means that a person spending his lifetime at the point of maximum exposure has an estimated increased risk of one in one thousand of developing a fatal cancer. Estimates of nearby individual risk are best estimates, and are not upper bound estimates.

The second measure, "total population impact", considers people exposed at all concentrations, low as well as high, and it considers people exposed throughout the United States, as appropriate. It is expressed in terms of annual number of fatal cancer cases and provides a measure of the overall impact on public health. For example, a total population impact of 0.5 fatal cancer cases per year means that emissions of the specific pollutant are predicted to cause one case of cancer every 2 years. As distance from a source increases, risks to specific persons decrease and become extremely small; but, considering the total population exposed, the sums of these risks may be significant.

The two estimates together provide a better description of the magnitude and distribution of risk than either number alone. "Nearby individual risk" gives an estimate of the highest risk, but not how many people may bear that risk. "Total population impact" describes the overall estimated health impact on the entire exposed population, but not how much risk the most exposed persons may bear. For example, two sources of radionuclide or chemical emissions could have similar population impacts but very different maximum individual risks, or vice versa. Both estimates are important and both are used in making risk management decisions. The risk estimates should not be viewed as precise determinations of likely health damage, but rather as a general indication of estimated health risk.

EPA's analysis of risks due to radon emissions from existing uranium tailings piles concluded:

1. Lung cancer, which is caused by the short-lived decay products of radon, is the dominant health hazard from tailings. Estimated effects of gamma radiation and of long-lived decay products of radon are less significant, although high gamma radiation exposures may sometimes occur.

2. Individuals living near an uncontrolled tailings pile are subject to high risks due to radon emitted from tailings. Radon contained in the ambient air enters homes and other structures built near the mill through doors and other openings in the structure. The resulting radon decay products tend to concentrate indoors, thus exposing the occupants to potentially harmful levels of these radionuclides. The EPA estimates that, at present, some persons may be exposed to risks that are as high as one in one hundred. This estimate is based on median risk estimates and an assumed exposure of 70-years during which emission levels remain the same as present values. Of course, this time period is longer than assumed in EPA's "40-year" analysis. Using the 40-year analysis, an exposure posing this level of risk could only occur if an individual remained at that location for the full 70-year period, and the pile presenting that risk was replaced after closure by another pile presenting the same risk factors.

3. Based on models for the risk to all exposed populations (local, regional, and national), about one to five fatal cancers per year are estimated from emissions of radon from tailings at the 20 mill sites being considered here, if no controls are present. If the tailings at all sites were to dry out, it is estimated that the risk could rise to about two to nine fatal cancers per year. However, not all of the piles are expected to dry out at the same time. Approximately one half of these deaths are estimated to occur within 80 kilometers of the tailings piles.

There is substantial uncertainty in these estimates because of uncertainties in the emission rates of radon from tailings sites, in the exposure people will receive from its decay products, and from incomplete knowledge of the effects on people due to these exposures. The values presented here represent best estimates based on current knowledge. Examples of factors leading to possible underestimation of risk include: the use of median rather than upper bound risk factors, ignoring radon sources at a mill site other than the tailings pile, and not considering piles where owners have indicated intent to reclaim their pile but have not done so for long periods. Risks could be overestimated if owners reclaim piles faster than EPA assumes, if radon emissions are smaller due to less radium-226 in a pile than is estimated, or if the radon emanation rate is lower than EPA estimates it to be. Additionally, since these estimates are based on current pile sizes and population distributions, as nearby populations increase or decrease in the future, the estimated impacts would vary. If specific information indicates radon emissions rates were lower, then risk estimates could be lower.

In general, much more is known about the risks from exposure to radiation than exposure to most chemicals. While there is uncertainty in risk estimates from assessments of chemical emissions and radionuclide emissions, there is much less uncertainty in estimates of risk from radionuclide emissions because of the extensive data base on the effects of human exposure to radiation. Therefore, a risk estimate resulting from exposure to radionuclides is likely to be more accurate than the same estimate for chemical exposures.

C. History of Standard Development

The Agency's standards for Nuclear Power Operation (40 CFR Part 190)

issued under the Atomic Energy Act (42 FR 2858 (January 13, 1977)) limit the total individual radiation dose caused by emissions from facilities that make up the uranium fuel cycle, including licensed uranium mills. However, when 40 CFR Part 190 was promulgated, considerable uncertainty existed about the public health impact of existing levels of radon in the air, as well as uncertainty about the best method for management of new man-made sources of radon. The EPA exempted radon from coverage under 40 CFR Part 190 since the problems associated with emissions of this radionuclide were sufficiently different from those of other radioactive materials associated with the fuel cycle to warrant separate consideration.

EPA has also issued standards (48 FR 45926 (October 7, 1983)) for uranium and thorium mill tailings at commercial processing licensed sites under the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), which amends the Atomic Energy Act (AEA). These standards for disposal of tailings require stabilization of tailings on final disposal so that the associated health hazards will be controlled and limited for 1000 years to the extent reasonably achievable, in any case, for at least 200 years. The standards limit releases of radon to the air after disposal, and require measures to limit releases of radionuclides and other hazardous substances to water (40 CFR Part 192, Subparts D and E). In the preamble to these standards, the Agency discussed the relationship between UMTRCA and the Clean Air Act (CAA) and indicated its intent to publish an Advanced Notice of Proposed Rulemaking (ANPR) to consider additional control of radon emissions during the operational phase of mills.

Section 122 of the CAA required EPA to determine whether or not to regulate radioactive pollutants based on an assessment of risks to public health. After seeking public comment (44 FR 21704 (April 11, 1979)), EPA listed airborne emissions of radionuclides as hazardous air pollutants under section 112 of the CAA (44 FR 76738 (December 27, 1979)). Based on that listing, EPA subsequently promulgated standards under section 112 for Department of Energy (DOE) facilities, Nuclear Regulatory Commission (NRC) licensed facilities and non-DOE Federal facilities, elemental phosphorus plants, and underground uranium mines (50 FR 5190 (February 6, 1985 and 50 FR 15386 (April 17, 1985)).

On October 31, 1984, EPA issued its ANPR to inform interested parties that the Agency was considering issuing standards under the CAA to limit radon emissions from licensed uranium mills (49 FR 43916 (October 31, 1984)). Subsequently, EPA entered into a stipulation with the Sierra Club to promulgate such standards, or delist radionuclides, by May 1, 1986. This agreement was entered as a consent order by the United States District Court for the Northern District of California (Civil No. C–84–0856 WHO).

On February 21, 1986, EPA issued proposed standards for radon emissions from licensed uranium mills and announced a public hearing (51 FR 6382 (February 21, 1986)). The hearing was held in Denver, Colorado, on March 25, 1986 (51 FR 8205 (March 10, 1986)). A transcript of the hearing was placed in the Docket and the comment period was extended to April 28, 1986.

Due to the complexity of the proposed rule and the need for an extended comment period, EPA and the Sierra Club entered into a second stipulation to extend the deadline to August 15, 1986. The district court granted the extension on motion of the parties.

IV. Summary of Proposed Standards

As noted earlier, EPA published a proposed rulemaking regarding control of radon-222 emissions from tailings piles at licensed sites on February 21, 1986 (51 FR 6382). That notice announced that EPA was considering various work practice standards for limiting such emissions based on its preliminary conclusions that it is not feasible to set an emissions standard, and that the nature of the risk involved warrants a regulatory response.

In its proposal, EPA presented three work practices, including improved methods for disposal of newly generated tailings, various timing requirements for use of these improved methods, and interim covers. The improved methods of disposal of newly generated tailings were a large, single pile with immediate closure, phased disposal, and continuous disposal involving dewatering and covering of tailings. EPA also stated it was considering alternatives of allowing new tailings to be added to existing piles over a range of times, including 5 years, 10 years, 15 years and an undefinite period of time into the future. (An exception from the latter requirements was proposed where existing tailings impoundments were lined.)

That proposal also discussed two available options for controlling radon-222 emissions from existing piles. It concluded that earthen covers might be placed over dry tailings beaches and embankments constructed of sand tailings. It noted that dry beaches typically cover 60 percent of the total tailings area during the operational phase of a mill and that this percentage could be significantly larger during periods of extended shutdown. It also noted that use of existing tailings piles could be terminated. While a dry out period would ensue during which emissions would unavoidably increase prior to disposal in accordance with Federal standards under UMTRCA, this is an unavoidable result of disposal.

V. Summary of Responses To Comment

The Agency has reviewed all submittals to the docket and testimony given at the public hearing. A complete discussion of all substantive comments and the Agency's response to them appears in "Response to Comments—Proposed Rule for Radon-222 Emissions from Licensed Uranium Mills Tailings" (EPA 500/1–86–011); the document may be obtained from the Program Management Office (ANR–459), Office of Radiation Programs, Environmental Protection Agency, Washington, DC 20460. A summary of major concerns, together with the Agency's responses, are presented below.

Legal and Procedural

Many commenters stated that there is no need for regulation under the CAA because existing regulations developed under the AEA and the UMTRCA and license conditions administered by the NRC and its agreement States adequately protect the public from risk due to radon. The Agency estimates the individual lifetime risk may be as high as 1 in 100, assuming 70 years of exposure. The population risk is estimated to be 1 to 5 deaths per year under current industry and regulatory conditions. The Agency believes that these risks are significant and that there is a need for standards under the CAA to protect public health with an ample margin of safety.

A number of commenters addressed ground water quality and stated that it should not be considered in regulating radon under the CAA. The Agency has not developed this rule to regulate ground water. Ground water protection standards are currently in force and being implemented under the UMTRCA standards (40 CFR Part 192). However, potential effects of various alternatives on ground water were considered as part of the analysis of the impacts of this rule, since EPA has a responsibility to consider the impacts that its rules may have on the total environment. In part, this is done to ensure that regulations do not control pollution in one environmental medium only to degrade

another. Consequently, there may be some additional ground water protection incidental to these standards.

Some commenters stated that EPA should not consider cost and technical feasibility of regulation under section 112 of the CAA. They maintain that the Congressional mandate directs EPA to adopt standards based exclusively on protection of public health. The EPA interprets the requirement of section 112 to establish emission standards at a level which "provides an ample margin of safety" as not implying that these standards must ensure that there is no remaining level of risk. Consequently, the standard being adopted today requires the use of work practices that will reduce radionuclide emissions and therefore risks to the practical minimum. The standard reflects consideration of the magnitude of the risks, the costs and availability of further controls and associated risk reduction potential, and the potential societal impacts of regulatory alternatives. The Agency, in considering the impacts, weighed the estimated risks achieved by and remaining after application of controls and their uncertainties against the costs to achieve the emission reduction and the potential for widespread closure.

Some commenters stated that the Agency must promulgate an emission standard to be consistent with the mill tailings disposal standards (40 CFR Part 192), which are partly in the form of a design standard; an emission rate limit per square meter of pile surface. These comments are based on a misconception of the disposal standards. The disposal standards had multiple environmental goals including preventing misuse of tailings, reducing radon emissions for a long period of time, and protecting ground water. The Agency determined that the best way to accomplish these goals is through the use of a design standard based on a thick barrier. The Agency found that a design standard limiting the rate of radon release was most appropriate given the many variables of location, tailings and earth characteristics. For example, a minimum thickness of barrier might not provide adequate protection under all conditions. The prescribed standard, which requires the release of radon not to exceed an average of 20 picocuries per square meter per second, is a design standard requiring a certain effectiveness from a cover. The Agency stated that the standard was not to be construed as an emission standard, "(T)he standard applies to design. Monitoring for radon after installation of an appropriately designed cover is not required," making it analogous to a work practice standard or design standard authorized under section 112(e). The Agency, thus, finds no inconsistency between the work practice standards for operations and the design standards for disposal.

The NRC questioned why EPA did not issue an emission standard, such as already exists in NRC and State regulations, instead of proposing a work practice standard. The Agency judges that it is not feasible to prescribe an emission standard since most of the radon emitted by a uranium mill comes from the surface of mill tailings piles. A typical pile may be from a few to hundreds of acres in area, and emissions from its surface cannot be controlled through a conveyance designed and constructed to emit or capture radon. It is also not practical to accurately and consistently measure emissions because of the large size of the tailings pile and the continued modifications of the pile that take place during operations. For these and other reasons, a work practice standard is being promulgated. It should be noted that the NRC and State regulations establish a concentration limit at the site boundary in units of quantity per cubic meter of air, but do not directly limit the quantity or rate of radon emissions.

A commenter argued that EPA may not use a phased application of the work practice requirements, since section 112 of the CAA permits only a two-year compliance waiver for the installation of technology to meet an emission standard. However, the two-year compliance waiver discussed by the commenter is not applicable to the standard adopted in this rulemaking. The Administrator has concluded that neither of the available interim work practices, wetting or interim cover, is an appropriate measure to be imposed generally under section 112. Also, as discussed in this notice, the requirements for new tailings impoundments cannot be implemented within two years. Consequently, the two-year period that section 112(c)(1)(b)(ii) provides "for the installation of controls" has no meaning or applicability here. As a result, the Agency has adopted a comprehensive set of risk management requirements for limiting radon emissions that fall under the general category of "design, equipment, work practice, or operational standard[s] . . ." section 112(e). These requirements were designed as an integrated program to require the maximum reduction of long-term cancer incidence attributable to uranium mill tailings piles that can be reasonably achieved. These standards operate in phases. During the first six-year phase, the operator may continue to place tailings on existing piles. In the second phase, this practice is terminated except for certain small piles and for those operators that make a satisfactory, individualized showing of low interim risk. In the third phase, without exception, tailings may only be placed in impoundments meeting size and operating limitations designed to minimize exposed area and associated radon emissions. Taken as a whole, this scheme provides protection of public health that meets the Act's requirements of "an ample margin of safety".

Technical

Several commenters, in commenting on the continuous disposal method, stated that the industry has minimal experience with dewatering sands and no experience with dewatering slimes. The Agency has found that although continuous disposal has never been actually practiced on uranium mill tailings in the United States, it has been proposed by industry as the preferred method of tailings disposal at three sites. These proposals were never put into practice because of the downturn in uranium production. The EPA believes that these proposals, submitted by industry, adequately demonstrate that continuous disposal can be a viable option. It should be noted that the method has been included as an allowable alternative for industry, but is not the sole practice required for new piles. It was included to provide industry with flexibility in the management of new tailings.

Several commenters said that technology to dewater tailings exists, but increased energy and manpower to accomplish this are probably not economically feasible. The Final Background Information Document and the Economic Analysis reflect the additional costs and uncertainties in dewatering tailings for the continuous disposal option. The method has been selected as a suitable work practice that an operator may choose in lieu of phased disposal.

Several commenters stated that EPA's assumption of 40 years of standby is excessive. One commenter stated that the assumption of a 40-year period between the end of an impoundment's useful life and compliance with UMTRCA requirements is reasonable. The EPA judges that a 40-year standby period (which in practice could be several different periods totaling 40 years) before reclamation to Federal standards is a "worst-case" scenario. The Agency has estimated the fatal lung

cancers committed under this scenario to serve as a point of reference and has also evaluated a 20-year standby period scenario. Both periods were considered when the final rule was selected.

Several commenters stated that it would take about 6 years to design, license and construct a new tailings management process. One commenter said it could take more than 10 years, and one commenter said 5 years was sufficient. The EPA agrees that, based on the comments received from the NRC, States, and individual companies, a 3-year period to design, license, and construct a new tailings impoundment is unrealistically short. The Agency judges that a period of 6 years is the time needed to design, permit, and construct a new tailings impoundment. Extensions to allow more time will be available, if due to circumstances beyond their control, mill operators are unable to complete a new impoundment within that period.

Several commenters stated that more accurate site-specific emanation factors should be used as opposed to using the relationship of 1 pCi/m²-s per pCi Ra-226/g tailings. The Agency used a factor of 1 pCi/m²-s per pCi Ra-226/g of tailings for all dry areas and a factor of zero for wet areas. This same factor was used for the UMTRCA rulemaking and is the factor used by NRC. An attempt was made to develop a formula, using site specific characteristics, that would provide a more precise estimate of emissions. However, the formula has not been verified by the Agency's internal review process or by independent experts and data on the site-specific characteristics needed to derive such estimates are not available. For these reasons, the Agency decided to continue the use of the previously accepted factor.

The NRC stated that recent literature indicates that a water cover may not be as effective in reducing radon emissions as previously thought. Recent technical assessments of radon emissions from tailings covered with water are less than 2 percent of emissions from dry tailings. The Agency believes that assuming no emissions from wet tailings as compared to the more accurate 2 percent emission rate is an insignificant error in the context of this rulemaking. The Agency assumed an emission rate of zero for all tailings covered with water or saturated with water in estimating radon emissions.

Risk

A commenter stated that a site-specific rule based on a lifetime risk of one in a million should be set for each mill to determine the allowable exposed surface area. The EPA has not accepted the proposition that the standard must reduce risk to a predefined value, such as a level of one in a million. The EPA believes that it must protect the public with an ample margin of safety and that this requirement provides the Agency with flexibility to consider the magnitude of the risks, the practicality of measures to reduce risks, and other relevant factors. This is a judgment based on many factors specific to the source category under consideration.

Several commenters stated that radon exposure from mill tailings on a regional and national level is overshadowed by background radon sources. Therefore, regional and national risk estimates are meaningless. The EPA agrees that radon exposures due to mill tailings, at locations distant from mill tailings sites, are small compared to exposures from some other large sources. However, it does not follow that it is meaningless to calculate exposure and risk due to emissions from such sites. These calculations are based on procedures generally regarded as sufficiently accurate to support the setting of regulatory standards. The significance of the risk is judged based on the value of the individual and population risk, and the regulatory options are assessed based on the degree of risk reduction and the practicality and reasonableness of control measures.

Many commenters stated that the significance of effects of radon from mill tailings on total population is negligible because there are no proven adverse health effects. The Agency agrees that the adverse health effects due to radon emissions from mill tailings piles cannot be directly measured due to the high incidence of lung cancer from other causes. However, it would be imprudent to use this as a reason not to regulate exposure to carcinogens. The risk estimates were derived from relative risk coefficients, the use of which was recommended by the Agency's Science Advisory Board and represent current scientific knowledge. It is EPA's position that, based on current scientific evidence, excess lung cancers result from radon emitted by tailings piles and that the projected numbers of cancers calculated in the support documents are sufficient to support a rulemaking.

Economic

Several commenters said that the proposed rules will have significant adverse effects on industry's ability to contain costs and will threaten the industry's future. EPA's analysis shows that the control measures for new tailings disposal practices required in this rulemaking are similar in cost to alternative practices already required by existing regulations and, therefore, the control measures required by this rule are not expected to affect the industry's viability. With respect to existing tailings, the major cost of this rule to industry is moving the timetable for final cover for existing piles forward in time because the sooner new work practices are implemented, the sooner industry must undertake the expense of reclamation. Additional costs may arise in those cases where new capacity for tailings disposal will have to be created to replace the capacity lost during disposal of the existing piles. As indicated in the Economic Analysis for this rulemaking, EPA projects that this impact will not threaten the viability of this industry. The Agency concluded that the costs are reasonable in relation to the benefits derived and that this action is consistent with previous Agency actions.

VI. Summary and Rationale of Final Rule

A. Summary

Based on currently available information, EPA has determined that it is not feasible to prescribe an emission standard for radon emissions from uranium mills. Radon is emitted from the surfaces of tailings piles in a manner analogous to fugitive dust emissions and cannot be emitted through a conveyance designed and constructed to capture such radon emissions. Instead, EPA is requiring an improved work practice for the disposal of newly generated tailings and is specifying a date by which all newly generated tailings must be managed by this work practice.

EPA expects that, when tailings can no longer be placed on an existing pile, Federal and State regulatory agencies will promptly move to require disposal of the piles to Federal standards established by the EPA and implemented by the NRC under the AEA as amended by UMTRCA.

This work practice requires that new tailings be disposed of either in impoundments that are no larger than 40 acres or by the use of continuous disposal in which no more than 10 acres of tailings are exposed at any one time. All new tailings impoundments must be designed and constructed to meet this work practice. Using the first alternative would require a series of impoundments, each constructed with earthen dikes or in a excavated pit and each having a liner as required by 40 CFR 192. As each impoundment is filled, it would be dried out and covered with earthen materials immediately. This design permits the use

of a water cover over all tailings during operations without risk of contaminating ground water. The water cover seals in the radon, greatly reducing radon emissions to air. Also, a series of impoundments significantly reduces the amount of unreclaimed tailings at the end of a mill's lifetime because only one or two impoundments would still require closure. By making final reclamation easy, the potential for larger areas of dry tailings to remain uncovered is avoided, and this too, greatly reduces radon emissions.

The second procedure, continuous disposal, is similarly effective. If tailings are dewatered and immediately buried on a continuous basis, radon emissions during the operational phase of the mill are greatly reduced. At the end of the mill's lifetime, only about 10 acres of tailings require final reclamation. There is, thus, no potential for large areas of tailings to remain dry and uncovered as a source of radon emissions. A liner is used to protect ground water.

At mill sites where there are existing tailings piles, this work practice is to be phased in on a reasonable schedule. No later than 2 years after the effective date of this rule, all owners will either certify to the Administrator that they do not intend to build a new tailings impoundment, or if they wish to build new tailings impoundments they must apply to the Administrator for approval to construct. Within 60 days following the Administrator's approval, the owner must apply to the NRC for a license to construct. Following the granting of a license by NRC, construction must begin promptly and must be completed in not less than 30 months. The entire process must be completed by December 31, 1992. If the owner is in compliance with this schedule, new tailings can continue to be placed on existing piles until the new impoundments are ready. Those owners not building new impoundments may also continue to use their existing piles until December 31, 1992.

An exception from the preceding schedule allowing for continued use of an existing tailings pile will be granted upon petition to the Administrator, provided the existing pile meets one of the following conditions: (1) The existing pile is 40 acres or less and is lined or, (2) the combined area of all piles at the site is less than 20 acres. Each exception will last for five years, at which time the owner may request a new exception.

A discretionary extension for all or some of the milestones on the preceding schedule, allowing for continued use of an existing tailings pile, may be granted upon application to the Administrator for one of the following reasons: (1) The owner demonstrates it cannot, due to circumstances beyond its control, complete a new impoundment before a construction schedule milestone date or (2) the owner or operator demonstrates that an extension is consistent with the CAA. To make such a demonstration, the owner must certify that the mill is in compliance with applicable EPA standards and NRC regulations and license conditions, and makes a submittal showing that the public is protected with an ample margin of safety taking into account the size and condition of the pile, risks to nearby individuals and population, length of extension requested, risk reduction practices in effect, and the expected level of future mill activity. An extension may be granted for a period not to exceed 5 years, although the mill owner will be able to apply for more than one extension.

No exception or extension is effective after December 31, 2001 and no new tailings may be placed on any existing tailings pile after that date.

B. Options Considered

In developing this rule, EPA reviewed a variety of options in the light of comments received on its proposal. A fundamental step in this process was recognizing that the opportunities for regulatory response to the risks involved were different for existing tailings and for new tailings. EPA's analysis of regulatory options proceeded on the basis of this recognition.

With respect to tailings that would be generated in the future, EPA recognizes that improved work practices were available that could limit the period during which tailings were exposed prior to disposal. Limiting this exposure would correspondingly limit risk to health. The work practices that EPA examined reduced this exposure in two ways: first, by placing the tailings on sites smaller than is now the practice; second, by placing cover on the tailings continuously or at intervals. EPA analyzed options for new tailings that varied both as a function of size and as a function of time.

With respect to tailings that already existed, EPA's ability to identify work practice improvements that would limit emissions was more limited. The most direct means for reducing exposures, i.e., a permanent thick earth cover or water cover, could conflict with continued use of the pile or exacerbate ground water problems. Measures involving interim or partial use of earth or water covers were also evaluated. These options are described elsewhere in this notice. Indirect means of reducing exposures were also explored. These basically involve limiting the use of the existing pile for deposition of new tailings by limiting the period during which new tailings could be placed on the piles. On analysis, EPA concluded that volume restrictions would prove difficult to administer and that a more feasible approach would be to limit the future use of existing piles. In the end, EPA decided that risk reductions should be reconciled with continuity of mill operations by phasing in the transition to new disposal methods. The best currently available information indicates that it will require about six years for a source to phase in new capacity. The specific options considered are discussed below.

Interim Cover for Existing Piles

The Agency's proposed rule contained an alternative work practice for existing tailings piles consisting of interim earth covers placed on the sides and tops of dry tailings piles. An interim cover on dry tailings acts to reduce emissions of radon. In a wet pile, water acts to prevent radon emissions so that interim covers are not needed for the wet surfaces. Upon reexamination of the interim cover alternatives and after consideration of the comments received on that issue, the Agency has determined that such covers are not an appropriate work practice to be required under this generally applicable rule.

EPA's model of the interim cover alternative used in the analysis of the proposed rule was overly simplistic. Sources of error included the following factors:

1. The model did not consider tailings piles that go on and off standby repeatedly. In these situations, the interim cover is buried under new tailings followed by application of a new interim cover.

2. The model assumed the dry areas of the pile are covered immediately and that the pile remained on standby for an extended period of time. This is unlikely, because regulatory agencies would require the operator to reclaim sooner than 40 years.

3. Maintenance costs for interim covers were ignored.

4. Covering high, steep slopes with 1 meter of earth is a difficult engineering feat and may be more expensive and impractical than the model assumed it to be, and in practice may endanger workers.

5. Slimes may underlie tailings considered to be dry, making such tailings uncoverable because heavy equipment necessary to apply the cover would sink into the pile. If dry tailings cannot be covered, this would reduce benefits.

The Final Background Information Document and Economic Assessment contains a revised model that attempts to account for these factors. The Agency now believes that interim cover is inappropriate as a generally applicable work practice.

The appropriateness of interim cover can only be evaluated on a site-by-site basis. Though its use in some cases would be practicable and could lead to significant risk reduction, in others it would have dubious risk reduction benefits, costs that appear unwarranted in relation to those benefits, and would present hazards to the safety of workers. Moreover, enforcement of a requirement for interim covers would be difficult and controversial because it would not be obvious which parts of the pile are dry enough to cover and whether future operational plans are firm enough so that it is reasonable to delay application of an interim cover.

The Agency believes that in establishing generally applicable standards it should seek permanent solutions rather than temporary ones. Interim earth covers are temporary because they are often covered by new tailings when the mill returns to operation. The new tailings on top of the interim cover release radon, removing the beneficial effect of the cover. The value of the interim earth cover is also lost when the final cover required by Federal Regulations is put in place. Final reclamation normally requires piles with steep sand dams to be recontoured to a more stable shape. Any interim cover would be lost due to mixing with the tailings during the recontouring. A better use for the limited resources available to the producers of uranium would be final disposal consistent with federal standards.

The State of New Mexico expressed concern about severe additional environmental impacts due to the disruption of many additional acres of land to obtain cover material. The NRC raised serious safety concerns for interim covers. The NRC stated that interim covers on dams would interfere with important safety practices, such as movement monitors for tailings dams. They also stated that covering of certain drain portions of the dams could seriously reduce their stability.

In summary, the Agency concluded that requiring operators of existing tailings piles to immediately add and maintain interim earth covers on all dry surfaces is not an appropriate generally applicable work practice.

Phased Disposal

The Agency is selecting phased disposal for new tailings impoundments as one of two alternative work practices required by the final rule because it reduces health risks due to radon from tailings, providing public health protection with an ample margin of safety during the operating lifetime of a uranium mill tailings impoundment. In this disposal scheme, a series of small impoundments is constructed over the lifetime of a mill. Each small impoundment would be constructed with earthen dikes or in an excavated pit and, under existing Federal regulations, must be lined to prevent ground water contamination. After each impoundment fills, it will be dried out and covered with earth as soon as practical. Disposal costs will be spread over the operating life of the mill. The design permits the use of a water cover over most of the tailings, with only a small risk of contaminating ground water.

An important benefit of phased disposal is that it eliminates the difficulties and expense of reclaiming large tailings piles at the end of the impoundment life. By limiting the size of the piles, very large areas of tailings are prevented from becoming exposed to air, drying out, and emitting radon during extended standby periods. At the end of the mill's lifetime, only one or two impoundments will still require reclamation.

These characteristics of phased disposal combine to reduce radon emissions. The liner under the tailings pile helps maintain wetness of the tailings by preventing water from leaching into the ground. This not only protects ground water, but also greatly reduces radon emissions by keeping the tailings wet. Experience with phased disposal shows that the tailings often stay so wet that water must be pumped out of the impoundments.

Since control of radon emissions is achieved by keeping the tailings saturated or covered with water, it is important that impoundment liners have water retention capability. In most cases eligible for this exception, impermeable synthetic liners will be required. However, UMTRCA standards (40 CFR Part 192) allow an exception from the synthetic liner requirement if it is demonstrated that ground water contamination will not occur.

The size of the pile also helps reduce emissions. It does so by reducing the time for the dry out and standby periods that precede final closure, when radon emissions are at their highest. Since the piles are smaller, they dry sooner, and the exposed surface area is reduced. Closure is relatively easy and inexpensive, reducing the incentive for the owner to delay disposal. To further reduce the time before closure, this rule allows a company to operate a maximum of two tailings impoundments at once. Companies can legitimately need two operating piles to work most efficiently (especially when one pile is almost full), but by limiting an owner to only two operating piles, an owner must close its first pile before it opens its third pile (or close its second before it opens the fourth, etc.). This incentive will work to reduce standby periods.

Phased disposal, therefore, is a tailings management system in which tailings are kept wet until they are dried and disposed. Radon emissions are reduced while the pile is in use and while the pile is on standby. This results in a large reduction of the total emissions from mill tailings pile and, therefore, protects public health with an ample margin of safety.

Constructing, filling, and reclaiming tailings impoundments in series costs less than using a single, large impoundment when a reasonable (5%) discount rate is used. This lower cost reflects the lower initial capital expenditures for phased disposal. Further cost savings may be realized in phased disposal by using excavated earth from future impoundments to reclaim filled, dry impoundments.

Phased disposal is the best available demonstrated technology for uranium mill tailings management. The two mills most recently licensed by the Nuclear Regulatory Commission use phased disposal designs.

The Agency also considered a 20-acre limit for each phased disposal impoundment in the proposal (51 FR 6382). One commenter found a 20-acre limit acceptable but stressed the need for economic assessment of size limits. Several commenters argued that the Agency should allow flexibility for site-specific considerations and should not dictate a specific limitation. The Agency evaluated both 20- and 40-acre phased disposal options. It found that the 40-acre impoundment provides about the same health protection as the 20-acre impoundment, but at a slightly lower cost. The Agency concludes that a 40-acre size limit for phased disposal protects health with an ample margin of safety, as required by section 112. The 40-acre impoundment is the maximum size allowed under the rule; an operator can choose to build a smaller one.

The 40-acre phased disposal work practice provides considerable flexibility for construction and operation of tailings impoundments, although all existing rules (including 10 CFR Part 40 and 40 CFR Part 192) must still be followed. For example, under this work

practice, impoundments can be constructed in hollows by building a dam across the hollow and storing the tailings on the upstream side. The standard only limits the total area of any impoundment used for storage of uranium mill tailings; other site-specific design considerations are not affected.

Liners are required at all new uranium tailings impoundments under existing rules (40 CFR Part 192). The tradeoffs between potential problems and the advantages of liners were considered in that previous rulemaking (48 FR 45926).

Continuous Disposal

The Agency selected continuous disposal as an alternative work practice under the final rule because it reduces health risks from radon from tailings to the same extent as phased disposal and provides quick reclamation of the site. This disposal method calls for tailings to be dewatered as they are generated, placed in pits or on pads, and covered with about 3 meters of earthen materials on a continuous basis. Disposal pits or pads would be constructed with impermeable liners. This method would rely on a thick earth cover to reduce radon emissions rather than on water as in the phased method disposal. During operation, no more than 10 acres of tailings could be uncovered at any given time. To assure that the water remaining in the tailings after dewatering (which is never completely effective) and rain water does not seep through the tailings and contaminate ground water, a continuous disposal impoundment is lined in accordance with 40 CFR 192.32. The potential for ground water contamination is negligible.

A second important benefit of continuous disposal is that it would eliminate the difficulties of reclaiming large tailings piles at the end of the impoundment life. By requiring disposal of tailings as they are generated, very large areas of tailings are prevented from being exposed to air, drying out, and emitting radon during extended standby periods.

The technology of continuous disposal has not been demonstrated for uranium mill tailings in the United States. However, the industry has proposed this method for use at three sites. The decline in uranium demand is one of the major reasons why none of these proposals was put into practice. Tailings dewatering systems have been used successfully at nonferrous ore beneficiation mills. The Agency believes that these proposals and experiences demonstrate that continuous disposal can be a viable work practice.

Flexibility is provided to allow designs that can take advantage of site-specific characteristics. For example, there is no requirement that tailings be disposed of below surface level and no restrictions that limit the use of topographical features of a site as tailings dams. However, all existing regulations still apply.

Although the industry commented that continuous disposal is not practical, this is not a persuasive argument, since at least three companies have chosen this method as their preferred disposal method in detailed site design plans and applications. Also, as noted above, dewatering tailings has been performed in other extraction industries. The Agency decided to allow the industry to select either continuous or phased disposal because both methods provide similar levels of radon reduction and either method could be preferable to the other, depending on the specific physical, environmental, or economic conditions that exist at the site.

C. Existing Piles

The regulation of uranium mill tailings disposal piles requires different approaches to new and existing tailings impoundments. From the standpoint of risk reduction, new impoundments can readily be designed and operated in order to achieve substantial reduction of risk at a reasonable cost. EPA, thus, has adopted standards that have the effect of limiting the total exposed surface area during the active phase of an impoundment's existence. Existing impoundments present more difficult regulatory problems. They were constructed over a thirty year period, range in size from a few acres to several hundred acres, and are located in different areas with different topography, soil characteristics, tailings characteristics, and other factors affecting health risks. Consequently, they are not susceptible to a single regulatory scheme of the sort adopted here for new impoundments. In addition, the NRC and their agreement States regulate practices at these sites on a site-by-site basis. For example, the NRC has stated in comments that it typically requires interim cover for the purpose of dust control on appropriate portions of existing piles.

EPA investigated work practices that might be imposed generally upon existing tailings piles that would reduce risks until they are closed and replaced with new piles. As discussed previously, the Agency found that the two principal options, wetting and interim cover, made no sense to impose as across-the-board requirements. While interim cover has theoretical applicability, its risk reduction is not great in many situations, and costs are disproportionate to that limited reduction of risk. Wetting, particularly in unlined impoundments in arid areas of the Southwest, yields some risk reduction but again at a disproportionate cost. Moreover, wetting at unlined impoundments can lead to ground water contamination, exacerbating a problem that several operators are now trying to remedy.

EPA believes that the reasonable course to deal with these impoundments is to adopt requirements that will encourage their closure, in the long term, in accordance with requirements set by EPA and the NRC. At the same time, these requirements must be tempered with flexibility for the particular circumstances of individual impoundments. It is reasonable to do this in light of the wide disparity in risk from different existing impoundments, and the small number of those impoundments.

Accordingly, the final rule generally requires the cessation of disposal of tailings at existing impoundments six years after promulgation of these regulations. The requirement for cessation of disposal will remove any obstacle for the NRC or an agreement state to require, after an appropriate dry out period, final closure of the impoundment, since it can no longer be used for disposal of newly generated tailings. In EPA's view, the risk that will result from this phase in period of continued disposal at existing impoundments is consistent with the protection of public health with an ample margin of safety.

Exception for Existing Lined Impoundments

The Agency has determined that certain existing tailings management impoundments presently meet the requirements of the new work practice standards. Therefore, the Agency is providing an exception from the schedule requirements, which are specified below, for impoundment designs that are no larger than 40 acres and have a liner meeting the specifications of 40 CFR 192.32. This requirement assures that the impoundment has the capability to retain water, thereby keeping tailings wet and greatly reducing radon emissions.

Exception for Small Tailings Piles

The Agency, in its examination of the uranium milling industry, has discovered that each mill is unique and that not all mills present a significant health risk to the public. The Agency found that one of the most important mill characteristics

that affect risk is the size of the mill tailings pile. The Agency also found that mills having combined pile areas smaller than 20 acres have very small radon emissions. The Agency believes that such a mill does not threaten public health. Therefore, the Agency has decided to except them from the 6-year schedule. Such an exception is consistent with protection of public health with an ample margin of safety.

D. Schedule for Standards Implementation

The Agency is requiring that all tailings generated at existing mill sites after December 31, 1992, be managed by one of the work practices specified in the final rule. By phasing out existing tailings piles and requiring new tailings generated at existing mill sites to be placed in impoundments subject to the new work practice, risks to individuals and populations are reduced and the public is protected with an ample margin of safety. The Agency is assuming that, when tailings can no longer be placed on existing piles, Federal and State regulatory agencies will promptly move to require reclamation of the piles to Federal standards established under the AEA through UMTRCA.

The Agency is aware that section 112 has provided for only a 2-year compliance waiver. However, it is impossible to design, license, and build a new tailings impoundment in that short period of time. The operators of existing mills are given the time necessary to install new impoundments. To assure that new tailings impoundments are built and used as soon as practical, the Agency has established a strict schedule with milestones for meeting regulatory requirements and construction of the facility. Industry is provided with sufficient time to prepare new impoundments while, simultaneously, there is a strict timetable that must be met. This timetable is designed to be flexible to assure that if time is saved in one part of the process the impoundment will be ready sooner. The rule also provides an extension mechanism to give operators a chance to have more time if, due to circumstances beyond their control, they are unable to meet the schedule.

The Agency has examined the effect from the continued use of existing piles during the 6 years required for the construction of new tailings impoundments. In performing the analysis of the effect of allowing all mills to operate for 6 years, relevant radon emissions come only from some of the mills. Since EPA's original analysis, 3 of the 20 mills have stated an intent to go to closure and, therefore, are not effected by this standard. The resulting risk from radon emissions in allowing all other mills to operate for 6 years is not significant. The use of these mills for this short time period represents a marginal risk that does not justify the economic waste of requiring a mill owner to build an impoundment that the owner has no intention of using. Because of these low risks, operators of existing piles who want to continue to use their existing piles may do so for the 6-year period.

Any owner or operator of a licensed uranium mill who wishes to continue to use existing tailings impoundments must submit an application to the Administrator for approval to construct a new impoundment or certify that they do not intend to build a new impoundment. This should be done as soon as possible, but no later than 2 years after the effective date of this rule. This period is necessary to provide the time needed for owners to decide whether or not to build a new impoundment and, if they decide to build a new impoundment, it also provides the time needed for the purchase of a site, for the collection of site data and for the design and preparation of licensing material for EPA and NRC. Owners not building new impoundments may continue to use their existing piles until December 31, 1992.

The Agency anticipates an internal review and decision period following submittal of a complete application. After the Agency's approval to construct, the owner or operator must apply to the NRC within 60 days for a license to construct a new tailings impoundment under 10 CFR 40. The Agency anticipates that NRC will act promptly on the application. Following the receipt of a license from the NRC, the owner or operator must then start construction of an impoundment within 90 days, weather permitting, and must complete construction within 30 months.

The Agency proposed alternative schedules of immediate, 10 years, 15 years, and no time limit for mandatory use of work practice standards. Comments from the NRC and the industry agreed that new impoundments probably could be built in 6 years. Although one industry commenter estimated that it would take more than 10 years to finish new impoundments, in general, the record did not support a 10-year option.

E. Schedule Extension

The Agency recognizes that strict adherence to the schedule may not always be possible or reasonable. The Agency may grant an extension for any schedule milestone for certain reasons.

The first reason for the extension is practicality. The Agency is allowing mill owners 6 years to build new impoundments, because it is the Agency's estimate, supported by the record, that 6 years is normally a sufficient time to design, license and build a new uranium mill tailings impoundment. But the Agency recognizes that, due to circumstances beyond the mill owner's control, situations can arise that delay completion. In these situations, the mill owner can apply for a schedule extension to provide him with sufficient time to complete the new impoundment.

There are other reasons why an extension may be required. For example, as previously noted, each mill is unique and individual mills may present small risks to public health. To take care of any of these situations, the Agency may grant an extension, provided that the mill owner can demonstrate that the extension, under conditions existing at the time of the request, is consistent with protection of public health with an ample margin of safety as specified in § 61.252(e). This extension may be granted for any schedule milestone. For example, the Agency expects that extensions would be granted for mills with moderately sized piles and that have no people living nearby. Such mills present small risks to maximally exposed individuals and small risks to regional and national populations. The Agency may grant an extension, conditionally if required, only upon finding that this extension protects public health with an ample margin of safety.

The Agency may grant these extensions based on an examination of factors relating to the overall remaining health risk, including the size, condition, and location of the pile, the length of extension requested, the expected level of future activity, and any risk reduction practices the mill owner has undertaken or pledges to undertake.

VII. Implementation of the Final Rule

Operators of new tailings impoundments constructed after the promulgation date of this rule must apply to the Administrator of EPA for approval to construct a new impoundment pursuant to section 61.07 of the Clean Air Act.

Operators of existing tailings impoundment should follow the implementation plan detailed in § 61.252 (b) or (c). If the Administrator finds, on the basis of any available information that there is a violation of any

requirement of an applicable implementation plan, the Administrator will enforce with remedies described in section 113 of the Act.

Operators of existing tailings piles who wish an exception listed in § 61.252(d) from the schedules listed in § 61.252 (b) or (c) in order to continue to use a pile should write to the Administrator, providing the reason why the exception is warranted. The Administrator will grant, grant with conditions, or deny the exception. If granted, the owner must reapply to EPA every 5 years that it still meets the criteria for exception. If at anytime neither of the exceptions criteria apply, the owner must notify the Agency and immediately cease use of the pile.

Operators of existing tailings piles who wish extensions from the schedule milestones listed in § 61.252 (b) or (c) in order to continue to use an existing tailings pile should write to the Administrator providing the reasons why an extension should be granted, taking care to provide the information requested in § 61.252(e). This must be done at least 1 year before the milestone date for which the extension is requested. The Administrator will grant, grant with conditions, or deny the extension within 9 months. Although multiple extensions may be granted, each extension will last no more than 5 years.

All requests should be sent to the Assistant Administrator for Air and Radiation (ANR–443), U.S. Environmental Protection Agency, 401 M Street, Washington, DC 20460.

No exception or extension will be effective after December 31, 2001. This deadline allows owners of existing tailings impoundments a chance to use those impoundments in those cases where to do so would not endanger public health, while assuring that the system of exceptions and extensions will not be subject to any potential abuse by mill owners. In this way, the rule will cause even greater reduction in radon emissions as phased or continuous disposal methods are implemented.

Nothing in this rule is intended to affect the existing regulatory authority of the NRC. EPA hopes that it will be able to reach an agreement with NRC to allow NRC to take an important role in the implementation and enforcement of this rule. This would allow EPA to take full advantage of NRC's expertise in this field and help minimize the duplication of effort and conserve administrative resources in accord with § 122 of the Clean Air Act.

VIII. Miscellaneous

A. Docket

The docket is an organized and complete file of all information considered by EPA in the development of this proposed standard. The docket allows interested persons to identify and locate documents so they can participate effectively in the rulemaking process. It also serves as the record for judicial review.

Transcripts of the hearings, all written statements, the Agency's response to comments, and other relevant documents are placed in the docket and are available for inspection and copying during normal working hours.

B. Executive Order 12291

Under Executive Order 12291, issued February 17, 1981, EPA must judge whether a rule is a "major rule" and, therefore, subject to the requirement of a Regulatory Impact Analysis. The EPA has determined that this rule is not a major rule as defined in section 1(b) of the Executive Order because the annual effect of the rule on the economy will be less than $100 million per year. Also, it will not cause a major increase in costs or prices for any geographic region. Further, it will not result in any significant adverse effects on competition, employment, investment, productivity, innovation, or the ability of the United States enterprises to compete with foreign enterprises in domestic or foreign markets. Under Executive Order 12291, this rule was submitted to the Office of Management and Budget (OMB) for review. Any comments from OMB to EPA and any response to those comments are included in the docket.

C. Paperwork Reduction Act

The final rule does not impose any reporting or recordkeeping requirements on operators of uranium mills and associated tailings piles.

D. Regulatory Flexibility Analysis

Section 603 of the Regulatory Flexibility Act, 5 U.S.C. 603, requires EPA to prepare and make available for comment an "initial regulatory flexibility analysis" in connection with any rulemaking for which there is a statutory requirement that a general notice of proposed rulemaking be published.

However, section 604(b) of the Regulatory Flexibility Act provides that section 603 "shall not apply to any proposed . . . rule if the head of the Agency certifies that the rule will not, if promulgated have a significant economic impact on a substantial number of small entities."

The EPA believes this final rule will have little or no impact on small business because the total costs associated with the standards will have relatively little impact on the total cost of producing uranium oxide.

For the preceding reasons, I certify that this rule will not have a significant economic impact on a substantial number of small entities.

E. General Provisions

The general provisions of 40 CFR Part 61, Subpart A apply to all sources regulated by this rule, except as otherwise noted.

F. State Implementation and Enforcement of Emission Standards

Under section 112(d)(1) of the CAA, any State may develop and submit to the Administrator a procedure for implementing and enforcing emission standards for hazardous air pollutants for stationary sources located in such State. If the Administrator finds a State's procedure for implementing the standard is adequate, the Federal authority then is delegated to the State. To streamline this procedure, some of EPA's Regional offices have entered into agreements with certain States for "automatic" delegation of new section 112 standards. Under this arrangement, States are delegated authority to implement and enforce all new section 112 standards when they are issued.

The Agency has decided that "automatic" delegation shall not be made for the radionuclide NESHAPs. When EPA entered into these agreements, the State's capabilities and expertise with respect to radionuclides were not considered. Therefore, States must reapply for delegation in the case of radionuclide NESHAPs.

G. Relationship to Other Programs

It is important to note that EPA has authority to regulate mining wastes under the Resource Conservation and Recovery Act (RCRA), as well as the CAA and UMTRCA. Since the considerations under each statute may vary, the regulatory program for uranium mill tailings under the CAA and UMTRCA might well differ from the program EPA intends to develop for mining waste under RCRA. The RCRA program will be tailored to the risks associated with mining wastes and the technical feasibility of various control options (see 51 FR 24496; July 3, 1986).

H. Communications

Communications with the Administrator regarding the reporting and recordkeeping requirements of this

rule, as well as requests for waivers, shall follow the provisions of Part 61.10, except as otherwise noted in this rule.

This rule is effective immediately for new sources and existing facilities. Those facilities that are not in compliance with the final rule based on information currently available to them, may request a compliance waiver from the Administrator under the provisions of section 112(c)(1).

List of Subjects in 40 CFR Part 61

Air pollution control, Hazardous materials, Asbestos, Beryllium, Mercury, Vinyl chloride, Benzene, Arsenic, and Radionuclides.

Dated: August 15, 1986.

Lee M. Thomas,

Administrator.

PART 61—[AMENDED]

Part 61 of Chapter 1 of Title 40 of the Code of Federal Regulations is amended as follows:

1. The authority citation for Part 61 continues to read as follows:

Authority: Secs. 112 and 301(a) Clean Air Act, as amended [42 U.S.C. 7412 (a)].

2. By adding a new Subpart W to read as follows:

Subpart W—National Emission Standard for Radon-222 Emissions From Licensed Uranium Mill Tailings

Sec.
61.250 Applicability.
61.251 Definitions.
61.252 Standard.

Subpart W—National Emission Standard for Radon-222 Emissions From Licensed Uranium Mill Tailings

§ 61.250 Applicability.

This subpart applies to licensed sites that manage uranium byproduct materials during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings. This subpart applies during the period of operation.

§ 61.251 Definitions.

As used in this subpart, all terms not defined here shall have the meaning given them in the Clean Air Act or Subpart A of Part 61. The following terms shall have the following specific meanings:

(a) "Area" means the area covered by the vertical projection of the pile upon the earth's surface.

(b) "Commission" means the Nuclear Regulatory Commission or its Agreement States (where applicable).

(c) "Continuous disposal" means a method of tailings management and disposal in which tailings are dewatered by mechanical methods immediately after generation. The dried tailings are then placed in trenches or other disposal areas and immediately covered to Federal standards.

(d) "Covered" means to cover with earth sufficient to meet Federal standards for the management of uranium byproduct materials pursuant to 40 CFR 192.32.

(e) "Dewatered" means to remove the water from recently produced tailings by mechanical or evaporative methods such that the water content of the tailings does not exceed 30 percent by weight.

(f) "Existing tailings pile" means a tailings pile that is in operation on the effective date of this rule.

(g) "Licensed site" means the area contained within the boundary of a location under the control of persons generating or storing uranium byproduct materials under a license issued by the Commission. This includes such areas licensed by Agreement States, i.e., those States which have entered into an effective agreement under Section 274(b) of the Atomic Energy Act of 1954, as amended.

(h) "New tailings" means uranium tailings produced after the effective date of this rule.

(i) "New tailings impoundment" means any location or structure at which uranium mill tailings are temporarily or permanently stored and which is placed in operation after the promulgation of this rule.

(j) "Operation" means that an impoundment is being used for the continued placement of new tailings or is in standby. An impoundment is in operation from the day that tailings are first placed in the impoundment until the day that final closure begins.

(k) "Owner" means any person who owns or operates a uranium mill or an existing tailings pile or a new impoundment.

(l) "Phased disposal" means a method of tailings management and disposal which uses lined impoundments meeting the requirements of 40 CFR Part 192.32, no greater than 40 acres in area, which immediately filled, upon becoming dried, and covered to Federal standards.

(m) "Uranium byproduct material" or "tailings" means the wastes produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extractions and which remain underground do not constitute byproduct material for the purposes of this subpart.

§ 61.252 Standard.

(a) All new tailings impoundments built after the effective date of this rule shall be designed and constructed to meet one of the two following work practice standards and in the following manner:

(1) Phased disposal in lined tailings impoundments that are no more than 40 acres in area and meet the requirements of 40 CFR 192.32(a). The owner shall have no more than two impoundments in operation at any one site at any one time.

(2) Continuous disposal of tailings such that the tailings are dewatered and immediately disposed with no more than 10 acres of tailings being uncovered at any time and operated in accordance with 40 CFR 192.32(a).

(b) Owners who build new tailings impoundments may continue to place new tailings or waste water associated with milling or mining activities on existing tailings piles only until new tailings impoundments are constructed, and only if the owner is in the process of designing, licensing, and constructing new tailings impoundments in accordance with the following schedule:

(1) As soon as practical, but no later than 2 years after the effective date of this rule, all owners who wish to build new tailings impoundments shall apply to the Administrator for approval to construct under section 61.07. The Administrator shall make a determination to grant or deny any application for approval in accordance with section 61.08, except that the time limitations of subsections (a) and (d) shall not apply.

(2) Within 60 days following the Administrator's approval to construct a new tailings impoundment, the owner shall apply to the Commission for a license to construct a new tailings impoundment.

(3) Following the granting of a license by the Commission, the owner shall begin construction of the new tailings impoundment within 90 days unless seasonal conditions do not permit, in which case construction shall begin at the start of the next construction season. This impoundment shall be completed and shall be ready to receive new tailings within 30 months of the date of licensing by the Commission.

(4) In no event shall new tailings be placed on existing tailings piles after December 31, 1992, unless the owner has received an exception or extension from the Administrator in accordance with paragraphs (d) or (e) of this section.

(c) Owners who do not intend to build a new tailings impoundment must certify to the Administrator as soon as

possible, but no later than 2 years following the effective date of this rule, that they do not intend to build a new impoundment at the mill site. Owners who make this certification will be able to use their existing tailings piles for the deposition of new tailings or waste water associated with milling and mining activities until December 31, 1992, unless they receive an exception or extension from the Administrator in accordance with paragraph (d) or (e) of this section, in which case the owner may continue to use the existing tailings piles as permitted by the terms of the exception or extension.

(d) An exception for continued use of an existing tailings pile shall be granted upon application for approval to the Administrator provided that:

(1) The existing tailings pile is 40 acres or smaller in area and meets the requirements of 40 CFR 192.32(a)(1), or

(2) The combined area of all piles at a licensed site is less than 20 acres.

The Administrator will grant, grant with conditions, or deny the application. If granted, the owner must certify to the Administrator every 5 years that it still meets at least one of the preceding criteria. Following this certification, the Administrator will grant, grant with conditions or deny the exception. At any such time as neither of the two criteria continue to apply, the owner shall so notify the Administrator, and the exception shall terminate.

(e) An owner may apply to the Administrator on an impoundment-by-impoundment basis, for an extension to continue using an existing tailings pile.

(1)(i) An extension may be granted upon a showing that, despite a good faith effort by the owner, it cannot, due to circumstances beyond its control, meet any paragraph (b) schedule deadline.

(ii) An extension may be granted, for any paragraph (b) or (c) schedule deadline at the Administrator's discretion, upon a showing by the owner that the extension is consistent with protection of the public health with an ample margin of safety. To make this showing, the owner must first certify that it is in compliance with applicable existing NRC regulations and license conditions. In addition, the Administrator will also take into account: the size and condition of the pile, the size and location of the nearby population, the length of extension requested, the existence and effectiveness of any risk reduction practices that are or will be taken, and the expected level of future mill activity.

(2) The owner may apply for an extension at any time up to 1 year before the cease-use date. The Administrator will have 9 months from the date of application to grant, grant with conditions or deny the extension. Subject to paragraph (g) of this section, no extension will be granted for longer than 5 years, and no extension pursuant to paragraph (e)(1)(i) shall be granted for any period longer than necessary for the owner to meet applicable paragraph (b) requirements.

(3) The owner may apply for as many extensions as needed. Each extension must be applied for and proven separately.

(4) The Administrator will provide for public notice and comment on all applications for approval of extensions.

(f) All applications for approval of exceptions or extensions shall be sent to the Assistant Administrator for Air and Radiation (ANR-443), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460.

(g) New tailings shall not be placed on any existing tailings pile after December 31, 2001, and no exception or extension shall be effective after that date.

[FR Doc. 88-20193 Filed 9-23-86; 8:45 am]
BILLING CODE 6560-50-M

federal register

Wednesday
April 17, 1985

Part V

Environmental Protection Agency

40 CFR Part 61

National Emission Standards for Hazardous Air Pollutants; Standard for Radon-222 Emissions From Underground Uranium Mines; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 61

[AD-FRL-2814-7]

National Emission Standards for Hazardous Air Pollutants; Standard for Radon-222 Emissions from Underground Uranium Mines

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: The U.S. District Court for the Northern District of California has ordered EPA to promulgate a final standard for airborne emissions of radionuclides from underground uranium mines by April 10, 1985, or to find that radionuclides are clearly not a hazardous air pollutant. This final rule is designed to limit exposure of the public to radon-222 emissions from underground uranium mines.

EFFECTIVE DATE: This final rule is effective on April 17, 1985. For existing sources, the standards shall not apply until 90 days after the effective date.

ADDRESSES: The rulemaking record is contained in Docket No. A-79-11. This docket is available for public inspection between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA's Central Docket Section, West Tower Lobby, Gallery One, Waterside Mall, 401 M Street, SW., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Paul J. Magno, Environmental Standards Branch (ANR-460), Criteria and Standards Division, Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460, (703) 557-0704.

SUPPLEMENTARY INFORMATION:

I. Supporting Documents

A final Background Information Document has been prepared and single copies may be obtained by writing the Program Management Office, Office of Radiation Programs (ANR-458), U.S. Environmental Protection Agency, Washington, D.C. 20460, or by calling (703) 557-9351. Please refer to "Background Information Document: Standard for Radon-222 Emissions to Air from Underground Uranium Mines." This document contains a description of the uranium mining industry, projected exposures and risks to nearby individuals and to the general population, and descriptions of radon-222 control methods.

II. History of Uranium Mine Standard Development

On April 6, 1983, the Agency announced in the **Federal Register** a proposed standard to limit radon-222 emissions from underground uranium mines (48 FR 15076, April 6, 1983). This proposed standard was withdrawn by the Administrator in October 1984 on the basis that it did not meet the legal requirements of section 112 of the Clean Air Act (49 FR 43906, October 31, 1984). The Agency has also received additional technical information that suggested that bulkheads and other techniques to control radon-222 emissions may be feasible. The withdrawal action was taken in response to an order by the U.S. District Court for the Northern District of California compelling EPA, by October 23, 1984, to promulgate standards or make a finding that radionuclides are not a hazardous air pollutant within the context of section 112 of the Clean Air Act.

On December 11, 1984, the Court found the Administrator and the Agency in contempt of its previous order and directed the following remedial actions:

1. (a) Issue within 30 days of the date of the order final radionuclide emission standards for Department of Energy (DOE) facilities, Nuclear Regulatory Commission (NRC)-licensed and non-DOE Federal facilities, and elemental phosphorous plants, and

(b) Issue within 120 days of the date of the order final radionuclide emission standards for underground uranium mines; or

2. Make a finding based on the information presented at hearings during the rulemaking, that radionuclides are clearly not a hazardous air pollutant.

The Agency promulgated final standards for DOE facilities, NRC-licensed and non-DOE Federal facilities, and elemental phosphorous plants on January 17, 1985 (50 CFR 5190, February 6, 1985), although it is noted that the Agency intends to pursue its pending appeal of this portion of the District Court's order. A complete history of the events leading to this action is contained in the **Federal Register** notice announcing the final standards.

On February 21, 1985, EPA published in the **Federal Register** a proposed work practice standard to limit radon-222 emissions from underground uranium mines (50 FR 7280, February 21, 1985). The proposed work practice standard required bulkheading abandoned and temporarily abandoned mine areas to reduce the amount of radon-222 emitted to the above ground air from the mines. Following publication of the proposed standard, EPA conducted a public hearing in Albuquerque, New Mexico, on February 27 and 28, 1985. The public record was held open until March 28, 1985, to allow for written comments to be received, however, EPA asked that comments be submitted as soon as possible to allow the Agency maximum time to consider them. A significant number of comments were received by the Agency on the last day of the public comment period. The short time between the submission of all the public comments and the Court deadline for promulgating the rule allowed the Agency a limited opportunity to respond to all of the comments. The Agency has generally reviewed all of the comments and is responding to the major issues and points in this notice. The Agency did not receive any comments or information subsequent to the public hearing that warranted a dramatic alteration in its approach. Changes made to the final rule in response to points raised in oral and written comments are discussed in the following sections.

III. Summary of the Final Rule

This rule is designed to limit exposure of the public to radon-222 emissions from underground uranium mines. The final rule differs in a number of ways from the proposed rule because of changes the Agency has made in response to public comments. This section provides an overview of the final rule; changes from the proposed rule are noted. The rationale for each of these changes is provided in the following sections of this notice. Both the **Federal Register** notice describing the proposed rule (50 FR 7280) and the Background Information Document provide further information on those portions of the final rule that have not changed from proposal.

The final rule:

(1) Applies to an owner or operator of an active underground uranium mine which has mined or will mine over 100,000 tons of ore during the life of the mine. A mine which will have or has had an annual ore production rate greater than 10,000 tons must also comply with the standard, unless it can be demonstrated that the mine will not exceed a cumulative ore production of 100,000 tons. (The proposed standard did not include the exclusion for mines producing greater than 10,000 tons of ore per year, but with an expected cumulative ore production of less than 100,000 tons.)

(2) Requires that an owner or operator of an underground uranium mine install and maintain bulkheads to isolate all abandoned and temporarily abandoned

areas of the mine. If a negative pressure behind the bulkhead is necessary, then a maximum of 20 percent of the total volume of air contained in the sealed area may be exhausted per day. A mine owner or operator may apply for an alternative standard, if necessary to protect miner health and safety. (The proposed standard did not provide a mine owner or operator the opportunity to seek an alternative standard based on miner health and safety.)

(3) Requires quarterly inspections of bulkheads and quarterly measurements of the air exhaust rate for those bulkheaded areas maintained under negative pressure. (The proposed standard required monthly bulkhead inspections and monthly measurements of the air exhaust rate.)

(4) Requires that any necessary repairs to bulkheads be made within ten days. (The proposed standard required that bulkhead repairs be made within three days.)

(5) Requires an annual certification of compliance with the standard. (The proposed standard required an annual report summarizing the number and volumes of abandoned and temporarily abandoned mine areas; the number of bulkheads maintained; and an estimate of the average amount of air in the bulkheaded areas which is exhausted per day.)

In establishing its final standard for radon-222 emissions from underground uranium mines, EPA had to weigh protection of the public health with protection of the mine personnel. The Agency believes that this standard will not significantly increase the radon decay product concentrations to which the underground miners are exposed. EPA intends to work with the Mine Safety and Health Administration to ensure that implementation of this standard will not jeopardize miner health and safety.

This final standard requires a work practice, i.e., bulkheading, which is commonly used throughout the uranium mining industry to direct fresh air to the working areas of the mine. However, the application of bulkheads to seal worked-out areas for reducing radon-222 emissions from underground mines has not been thoroughly tested. Because of the limited time allowed by the Court order, EPA was unable to completely evaluate bulkheading or other potentially applicable work practices. EPA intends, once this standard is promulgated, to begin long-term studies, as necessary, to evaluate the efficiency of bulkheads and other techniques for decreasing radon-222 emissions from underground uranium mines.

IV. Background Information

A. Industry Description

Uranium mining involves the handling of large quantities of ore containing uranium-238 and its decay products. The concentrations of these radionuclides in ore may be up to one thousand times greater than their concentration in other rocks and soils. Uranium mining is predominantly carried out by either surface (open pit) or underground mining methods, depending on the depth, ore grade, and thickness of the ore deposit. Underground uranium mines have generally accounted for about thirty to forty percent of the uranium oxide production in the United States.

The underground uranium mining industry has undergone substantial changes in recent years due to declining demand and competition from low-cost foreign sources. The total number of underground mines fell from a peak of 300 in 1980 to only six by March 1985. Currently, all underground uranium mining in the United States takes place in the western United States. In general, the mines presently operating are located in relatively remote areas of New Mexico, Colorado, Utah, and Arizona. Further reduction in the number of operating mines is expected during 1985.

Production of uranium oxide by underground mines peaked at 9600 tons in 1980; the industry estimates that uranium oxide production in 1985 will be approximately 1300 tons. EPA estimates that, based on Department of Energy projections of uranium oxide demand, the industry will produce close to 3100 tons of uranium oxide in 1985. The Agency has taken into account both its own and industry projections of uranium oxide production in assessing the risk associated with radon-222 emissions from underground uranium mines.

B. Radionuclide Emissions from Underground Uranium Mines

Radon-222 is the most significant radionuclide emitted to the above ground air from underground uranium mining activities. Radon-222 is released from underground mines in relatively high concentrations through mine ventilation systems. Results of measurement studies made at 27 large underground uranium mines during 1978–1979 showed that radon–222 emissions to air from individual mines ranged from 200 to 30,000 curies per year (Ci/y) with an average of 5600 Ci/y. These mines accounted for approximately 65 percent of the uranium oxide produced by all underground mines in 1978. Based on these measurement results, the total radon-222 emissions from all underground uranium mines in 1978 were about 240,000 curies. EPA estimates emissions of radon-222 will be about 80,000 curies in 1985, based on DOE projections of uranium oxide demand. Using industry projections of uranium oxide production, emissions of radon-222 will be about 35,000 curies in 1985.

It is important to note that the rate of radon-222 emissions from underground uranium mines is highly variable, depending upon a number of interrelated factors, including mine ventilation rates, ore grade, exposed surface area, mining practices, and geologic formations. In addition, these mines can differ significantly in their configuration. The wide diversity among mines makes it difficult to predict emission rates of the effectiveness of emission reduction practices at any given mine.

C. Estimates of Exposure and Risk

The risk associated with emissions from underground uranium mines is primarily due to the short half-life decay products of radon-222. Radon-222 decays into a series of short-lined radionuclides. These decay products readily attach to dust particles that may become lodged in the lung when inhaled, thus irradiating the surrounding cells.

Individuals living near an underground uranium mine can be exposed to increased levels of radon decay products of a result of radon-222 being released from the mine ventilation shafts. Radon-222 contained in the outside atmosphere enters homes and other structures built near the mine exhaust vents through doors and windows, as well as other openings in the structure. The occupants of these structures may then be exposed to potentially harmful levels of radon-222 decay products.

The increased lifetime risk of fatal lung cancer to individuals living near large underground uranium mines from the mine emissions is estimated to range from about one in one thousand to one in one hundred. The potential exists for an increased risk as great as one in ten in some situations, e.g, a person living very close to several horizontal mine vents or in areas influenced by multiple mine emissions. EPA estimates the increase in the fatal cancer risk to the total population from radon-222 emissions from underground uranium mines to have been about one to four fatal cancer cases per year during the peak production period of 1978–1982. With the decrease in the number of operating underground uranium mines, the increased risk of fatal cancer is

expected to range from four-tenths to two fatal cancer cases per year during the period 1983–1990. Based on industry production projections, the increased risk of fatal cancer in 1985 is estimated to range from three-tenths to six-tenths of a fatal cancer case.

Exposure levels are derived from emission estimates, dispersion modelling, and population data. For any given emission rate, dispersion models predict concentrations at different distances from the emission source. By combining those estimated concentrations with census data on population densities, the number of people exposed at different concentrations can be estimated. However, several factors suggest that actual exposure levels to nearby individuals will be lower than those estimated. In estimating exposure, exposed individuals are assumed to be subjected to the emissions for 24 hours every day for 70 years (roughly a lifetime). This does not consider, for instance, the fact that most people in their daily routines move in and out of the specific areas where the concentrations are the highest. In the case of underground uranium mines, the average life of a mine ranges from 10–20 years, although some mines have operated for almost thirty years.

Several commenters expressed concern about the Agency's risk estimates and the need for regulation of this source category. Three specific points were addressed: (1) The risk from radon-222 emissions from underground uranium mines is not of the magnitude necessary to warrant regulation under section 112 of the Clean Air Act, therefore, the Agency should "delist" radionuclides from regulatory consideration under section 112; (2) little evidence exists to indicate health effects result below total exposure levels of one hundred working level months; and (3) the decline in the uranium mining industry significantly deflates the already overestimated health risks presented by the Agency.

The Agency has considered these interrelated issues and has concluded that the "listing" of radionuclides as a hazardous air pollutant within the context of section 112 of the Clean Air Act was entirely appropriate. Section 122 of the Clean Air Act requires the Administrator to review all available relevant information and determine whether emissions of radioactive pollutants to the ambient air will cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health. If the Administrator concludes that emissions of radionuclides meets this criterion, he must list and regulate radionuclides under section 108(a)(1), section 111(b)(1)(A), or, if he finds that radionuclide emissions cause, or contribute to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness, section 112(b)(1)(A) of the Act, or take any combination of such actions.

The Agency believes that emission of radionuclides from underground uranium mines meets the general criterion for an affirmative finding under section 122. Further, the Agency believes that emissions of radionuclides from underground uranium mines meet the criterion for regulation under section 112 of the Act. Specifically, there is no doubt that radionuclides are carcinogenic, mutagenic, and teratogenic. This conclusion is based on extensive scientific evidence derived from studies of both human and animal populations. Underground uranium mines emit radon-222 and its decay products in large quantities. Many studies in the United States and other countries of miners exposed to radon-222 gas and its decay products have presented highly convincing evidence that exposure to these radionuclides causes or contributes to lung cancer.

Estimating the magnitude of the increased risk of developing lung cancer to individuals living near underground uranium mines and to the general population living downwind of the mines is complicated and uncertain. Epidemiological data exist that demonstrate a relationship between cumulative exposure to radon-222 decay products and increased lung cancer risk. There is substantial evidence that relates cummulative exposure of greater than approximately one hundred working level months (WLM) to an increased risk of lung cancer. While some studies based on human data indicate that exposure to less than one hundred WLM increases the risk of lung cancer, these data are less conclusive. There are considerable difficulties in demonstrating increased risk at a statistical confidence level of 95 percent for exposure at relatively low concentrations of radon-222 decay products because a very large study population is needed. It is often difficult to identify appropriate study populations large enough to conduct such studies to examine risks at very low levels.

Cumulative exposure to a person living near an undergound uranium mine due to mine emissions is not likely to exceed twenty WLM over his lifetime. (This assumes exposure to about 0.3 WLM per year for about 70 years.) While this is considerably below cumulative exposures at which we have substantial human evidence relating to lung cancer, the Agency believes that such exposure is not below a threshold at which no signficant health damage could occur. Radiation protection organizations, national authorities, and prestigious scientific committees worldwide use the assumption that there is no threshold below which exposure to radiation does not pose some risk to health. For example, the National Academy of Sciences' Committee on Biological Effects of Ionizing Radiation recommended that health risks from low level exposures to alpha radiation, such as that produced by radon-222 decay products, be estimated by extrapolating risks from higher exposures using a linear nonthreshold model. Therefore, extrapolations from the available miner epidemiological data have been used by EPA to estimate risk at exposure levels caused by radon-222 emissions from underground uranium mines.

Section 112 requires not only a finding that the pollutant at issue is hazardous in the abstract, but also that it poses a public health risk in its from as an air pollutant. By coupling information on radon-222 emissions form mines, air transport models, and health risk models, the Agency estimates that the increased lifetime risk to individuals living near an underground uranium mine could be about one chance in one hundred of incurring lung cancer because of the emissions. For perspective, the current average lifetime risk of developing lung cancer in the United States is about three in one hundred. Clearly, radon-222 emissions from underground uranium mines may significantly affect a nearby individual's lung cancer risk. In addition, several fatal cancers per year may result in the total population due to these emissions, depending on the quantity of ore production each year.

In making its health risk estimates, EPA evaluated the air pollution risk of radon-222 emissions from underground uranium mines based on the magnitude of both current and potential emissions, on observed and estimated ambient radon-222 concentrations, on the proximity of large populations to emitting sources, on estimates of health risk to exposed populations, and on considerations of uncertainties associated with risk estimates. The assessments and the assumptions used to estimate lifetime risks are described

in more detail in the Background Information Document. In addition, a study conducted during the period 1978–1980 by the New Mexico Environmental Improvement Division clearly demonstrated elevated concentrations of radon-222 in air near underground uranium mines in the Ambrosia Lake area of New Mexico.

The Agency believes that there is sufficient evidence to conclude that potential increases in the risk of lung cancer to individuals and the general population due to radon-222 emissions from underground uranium mines may be anticipated to endanger public health and may be anticipated to result in an increase in mortality. Consequently, regulation of this source category under sections 122 and 112 is appropriate.

The Agency also believes that a standard limiting exposure of the public to radon-222 emissions from underground uranium mines is warranted, despite the low number of operating mines. The Congress intended in section 112 that EPA act by a date certain to protect the health of current and future generations from emissions of pollutants that it determined to be hazardous. This is still the Agency's responsibility even if, as some might argue, current production levels have reduced risk. Demand for uranium oxide may increase. In the peak production years, the increase in an individual's lifetime risk of lung cancer from radon-222 emissions from underground uranium mines may have been as high as one in ten to those individuals exposed to mulitiple mine vents and increased population risk may have been as high as four fatal cancers per year. Without a standard such as this, risks to the public, both nationally and regionally, would increase if demand and production of uranium oxide increases.

Section 122 of the Clear Air Act allows EPA to use section 108(a)(1) or section 111(b)(l)(A) in combination with section 112 if the Administrator determines it to be suitable. At this time, the Agency has chosen to regulate radon-222 emissions from underground uranium mines only under section 112. Current information suggests that regulation under these other sections would not significantly improve control of radon-222 emissions from underground uranium mines. Should new information alter this conclusion, the Agency may reconsider its approach to regulating underground uranium mines.

D. Control Technology

Since radon-222 is a noble gas and the volume of air discharged through mine vents is very large, at present there is no practical method to remove radon-222 from the mine exhaust air. Application of conventional methods to remove radon-222 from mine ventilation air at the volumes of air which must be treated would require large, complex, unproven systems that would be extremely costly, i.e., adding at least $18 to $44 to the total cost of producing a pound of uranium oxide. (Currently, the average cost to produce one pound of uranium oxide from an underground mine is about $35.) The industry now employs a number of practices to reduce radon decay product concentrations in the mine to meet occupational exposure standards established by the Mine Safety and Health Administration. These practices, which include bulkheading abandoned areas of the mine, have the effect of reducing radon-222 emissions to the above ground air.

At EPA's request, the U.S. Bureau of Mines evaluated the cost and effectiveness of various work practices in reducing radon-222 emissions. The results of the study suggested that bulkheading could reduce emissions of radon-222 by about 10 to 60 percent. Based on the peak production year, the amount of population risk reduction achieved could range from two-tenths to two fatal cancer cases per year. Estimates for 1983, the most recent year for which actual production data are available, range from one-tenth to one fatal case per year. In 1985, based on industry production projections, the amount of population risk reduction is estimated to range from three-hundredths to three-tenths of a fatal cancer case per year. These are only rough estimates based on installing bulkheads in a presently uncontrolled mine (i.e., a mine with no bulkheads).

Information presented during the public comment period indicates that uncertainty exists as to the amount of radon-222 emission reduction achievable by bulkheading in existing mines. This is in part due to the complexity in the configuration of these mines, past mining practices, and consideration of miner health and safety. The extent to which additional bulkheads can be installed to further reduce radon-222 emissions can only be determined on a case-by-case basis.

Comments from the industry supported EPA's conclusion that bulkheading is the only practical work practice that could be used to reduce radon-222 emissions to the above ground air. Other methods, such as rock sealants and backfilling, may also reduce radon-222 emissions; however, they are not thought to be as cost-effective or practical as bulkheading. After considering all the available information on control technologies, the Agency has concluded that bulkheading abandoned and temporarily abandoned mine areas to seal the radon-222 underground is a practical method of reducing radon-222 emissions from the mines to the above ground air.

E. Bulkheading

Bulkheads are air-restraining barriers used to direct air and prevent contamination or leakage of fresh air going to the active areas of the mine. This practice reduces the radon-222 and decay product concentrations in the active areas of the mine and also reduces the volumes of air needed to ventilate the mine. Bulkheading practices vary among mines; some mines make extensive use of bulkheads, while others use few bulkheads.

A secondary benefit of bulkheading inactive areas of a mine is that radon-222 emanating from the rock surface will decay in the isolated area. Hence, this technique can also reduce radon-222 emissions to the above ground air. The amount of emission reduction achieved is dependent on the volume of inactive areas that are sealed with bulkheads and the amount of air removed from these areas.

The radon-222 in the sealed area behind a bulkhead will build up to relatively high concentrations (i.e., tens of thousands of picocuries per liter), so it is necessary to prevent or minimize any leakage of air from behind the bulkhead into the working areas of the mine. Any such leakage could significantly increase the radon decay product concentration to which the miners are exposed. Therefore, it is often necessary to maintain a negative differential pressure behind the bulkhead to prevent leakage of contaminated air into the active mine airways. This negative pressure is achieved by bleeding (i.e., removing) air from behind the bulkhead into an exhaust airway. For bulkheads to be effective in reducing radon-222 emissions to above ground air, however, the amount of air bleed necessary to maintain an adequate pressure differential across the bulkhead must be minimized. The smaller the air bleed, the more radon-222 will decay behind the bulkhead rather than being released above ground.

V. The Final Standard

The complexity in the structure of underground uranium mines, the uncertainties in the effectiveness of in-mine control techniques, and the lack of suitable control technology to capture

radon-222 being vented from the mines cause the Agency to conclude that an emission standard is not feasible. The effectiveness of techniques for radon-222 emission reduction is not known. This means that predictable, hence measurable, steps toward compliance with a generic emission standard can not be identified. In this instance, section 112(e)(1) of the Clean Air Act allows the Agency to prescribe a work practice or other type standard to control the pollutant. This standard, therefore, requires that bulkheading be used to reduce emissions of radon-222 from the mines. A more thorough description of the individual components of the standard and the rationale follows.

A. Applicability

The standard is applicable to an owner or operator of an active underground uranium mine which has mined or will mine over 100,000 tons of ore during the life of the mine. Mines which have had or will have an annual ore production rate greater than 10,000 tons must also comply with the standard, unless it can be demonstrated that the mine will not exceed a cumulative ore production of 100,000 tons.

An evaluation of radon-222 emissions from underground mines operating in 1978 as a function of cumulative ore production showed that 188 mines or 75 percent of all the mines had a cumulative ore production of less than 100,000 tons. The estimated radon-222 emission rate from each of these mines was less than 200 curies per year, and as a group they contributed only five percent of the total curies emitted by all underground uranium mines in 1978. Since the radon-222 emissions from underground uranium mines with cumulative ore productions of less than 100,000 tons are small, the Agency has concluded that these mines need not be covered by the standard.

One commenter suggested that the Agency eliminate the 100,000 tons of cumulative ore production criterion; another suggested increasing it to 500,000 tons. The Agency has decided to maintain the cutoff at 100,000 tons cumulative ore production in order to include older mines which are likely to have significant emissions of radon-222 due to the large amount of surface area emanating this radionuclide. EPA chose the 100,000 tons cutoff based on the results of the study discussed previously. Ninety-five percent of the radon-222 emissions from underground uranium mines in 1978 were from mines with a cumulative ore production of 100,000 tons or greater.

The annual ore production value of 10,000 tons was selected to ensure that mines which are likely to exceed 100,000 tons of cumulative ore production will be covered by the standard on the effective date of the standard or at the time a new mine begins production. Evidence exists which indicates that mines with an annual ore production rate of 10,000 tons or greater are likely to mine 100,000 tons of ore during their lifetime. The standard allows a mine owner or operator to demonstrate that the mine will not exceed 100,000 tons of cumulative ore production, and, thus, not be subject to the standard.

B. Bulkheading Requirements

Comments generally agreed with the Agency's conclusion that bulkheading is a practical method to reduce radion-222 emissions to the above ground air from underground uranium mines. One commenter suggested that backfilling abandoned areas with mill tailings might also yield some reduction in radon-222 emissions. This final rule, while prescribing bulkheading requirements, allows a mine owner or operator the flexibility to use other methods of radon-222 control, such as backfilling, upon approval by the Administrator.

The standard requires that an owner or operator of an underground uranium mine install and maintain reliable bulkheads to isolate all abandoned and temporarily abandoned areas of the mine. If a negative pressure behind the bulkhead is necessary, then a maximum of 20 percent of the total volume of air contained in the sealed area may be exhausted per day. Many commenters expressed concern about limiting the amount of air which can be drawn from behind a bulkhead to achieve a negative pressure. In some situations, this practice may result in an increase in radon-222 decay product concentrations in the working areas of the mine. In addition, it may be difficult or impractical to measure the amount of air removed from a bulkheaded area. Commenters requested that EPA eliminate the limitation on the amount of air which can be drawn from behind a bulkhead.

EPA does not intend to promulgate a standard which increases miner exposure to radon decay products. However, a limit on the rate of removal of air from behind a bulkhead is necessary to provide sufficient residence time for the radon-222 in the isolated area to decay. A 20 percent per day value was selected as a balance between the need to minimize the rate of air removed from the isolated area and the need to maintain adequate negative pressure to prevent radon-222 from leaking into active mine airways and increasing the radon-222 decay product exposure to the miners. Our analysis estimates that, when the exhaust rate is maintained at 20 percent, approximately 50 percent of the radon-222 trapped behind the bulkhead will decay and thus will not be vented to the above ground air. Reducing the air exhaust rate to 10 percent per day would result in a radon-222 reduction of approximately 65 percent, but we do not have enough information at the present time to know if this will provide adequate protection of the miners.

Industry representatives explained to EPA that the ventilation routes in many existing mines are designed so that air from active areas is exhausted through the inactive areas of the mine. As fresh air is brought into the mine, care is taken to prevent its contamination with radon-222 decay products prior to its reaching the active work areas. Bulkheads are constructed primarily to seal unused portions of the mine adjacent to the intake airways to prevent fresh air from escaping or becoming contaminated. In current practice, the mined-out areas become exhaust airways as the mining process retreats towards intake airways. Therefore, a major portion of the mined-out areas must be kept open to allow passage of air to the exhaust vents. In the case of one mine, ninety-six percent of the mine is inactive areas which serve as exhaust routes for contaminated air. Bulkheading is unlikely to be practical in these inactive areas unless major changes are made in the ventilation schemes of the mines, such as constructing new ventilation shafts. In addition, entering these areas to construct bulkheads may jeopardize the health and safety of the miners because of high concentrations of radon-222 decay products and ground instability. Commenters requested that EPA exempt from the requirements of the standard inaccessible areas and those areas which serve as ventilation passageways.

After hearing the comments discussed above and reviewing the configurations of several existing mines, the Agency has decided to include a provision in the standard to allow mine owners or operators to apply for an alternative standard, if necessary to protect miner health and safety. By including this option, rather than simply eliminating the air exhaust rate limitation and exempting certain areas of a mine based on their function, the Agency hopes to provide incentive to design new mines in such a way as to limit radon-222 emissions to above ground air. Industry

representatives acknowledged at the public hearing that a new mine could be designed to limit the number of inactive areas used as exhaust routes and to maximize the amount of area which could be bulkheaded.

C. Reporting and Recordkeeping

The Agency received numerous comments on the reporting and recordkeeping requirements of the proposed rule. In an effort to minimize the amount of additional time personnel must spend in a mine to meet its standard, EPA has decreased the number and frequency of the reporting and recordkeeping requirements imposed by the final rule. The revisions are as follows:

(1) Inspections The frequency of inspections of bulkhead conditions and measurements of the air exhaust rate for those bulkheaded areas maintained under negative pressure has been reduced from monthly to quarterly. Records of these inspections must be kept at the mine and be available for review by EPA.

(2) Bulkhead repairs The length of time allowed to make necessary repairs to bulkheads has been lengthened from three days to ten days. This change allows mine operators greater flexibility in managing their work force.

(3) Annual report The amount of information that is required to be submitted annually to EPA has been reduced. A mine owner or operator must submit an annual certification of compliance with the final rule. Records of the number and volumes of abandoned and temporarily abandoned areas, the number of bulkheads maintained, and an estimate of the average amount of air in the bulkheaded areas which is exhausted per day must be kept at the mine. Annual submission of this information was required in the proposed rule.

D. Definitions

Based on public comments, several definitions were modified in the final rule.

(1) The definitions of "abandoned mine area" and "temporarily abandoned mine area" have been modified to exempt not only those areas which function as escapeways, but also areas formerly-used as lunchrooms, shops, and transformer or pumping stations. These areas have been exempted because they are nonproduction areas which have low radon-222 emanation rates. In addition, the exemption for ventilation passageways is now limited to ventilation passageways designed to minimize the distance to vents and no longer allows large mined-out areas to function as ventilation passageways. Exempting these areas from the bulkheading requirements would limit the amount of radon-222 emission reduction achieved by the standard. In particular, the Agency wants to ensure that new mines are designed to avoid this practice.

(2) The definition of "active mine" has been modified to include only those mines in which ore or waste material are currently removed by conventional methods. This change was made to exempt slope leaching which does not require workers to enter the mine, except in rare instances.

(3) A definition of "work" has been added to clarify the intent of the standard. For the purposes of the standard, "work" means mining activity done in the usual and ordinary course of developing and operating an underground uranium mine.

VI. Effects of the Final Standard

The deadline imposed by the District Court requires the Agency to promulgate a standard for underground uranium mines based only on the currently available technical information. An accurate estimate of the radon-222 emission reduction achieved by the standard cannot be made with existing information. The bulkheading requirements of the rule are expected to result in a decline in individual and population risks as emissions of radon-222 are reduced. Though the maximum individual risk in particular has not been reduced to levels EPA has selected in other standards, the very short time available for developing this rule, and the possibility that any reduction in risk to the general population might be achievable only by increasing the risk to miners, make it impossible to impose further controls at this time. EPA will continue to investigate this matter to determine the possibility of tightening controls in the future. Since most mines already install bulkheads to reduce ventilation requirements, it is not possible to estimate the incremental radon-222 emission reduction achieved by the standard. EPA intends to gather additional information on the extent and nature of existing bulkheading practices and the efficacy of the standards.

Further, the cost of the standard can only be generally estimated. Because we do not know the extent of present bulkheading practices or what additional bulkheading is practical, we cannot precisely estimate the cost to meet this standard. Limited modelling analysis shows that the cost of installing bulkheads ranges from about one to five cents per pound of uranium oxide produced. Based on the peak production year, the total cost to the industry could range from $200,000 to $1,000,000 per year. Cost to the total industry in the first year is estimated to range from $30,000 to $150,000. Even if these costs are significantly underestimated for some mines, it is highly unlikely that the cost of the standard would exceed one percent of the cost of producing uranium oxide.

EPA intends to begin long-term studies, as necessary, to more thoroughly determine the efficiency and cost of bulkheads and other techniques for decreasing radon-222 emissions to the above ground air from underground uranium mines. Such a study would examine ways to reduce air emissions further without increasing potential exposure to miners. The results of a study may lead to some modification of the Agency's standard.

VII. Miscellaneous

A. Docket

The docket is an organized and complete file of all information considered by EPA in the development of this standard. The docket allows interested persons to identify and locate documents so they can effectively participate in the rulemaking process. It also serves as the record for judicial review. Transcripts of the hearings, all written statements, and other relevant documents are placed in the docket and are available for inspection and copying during normal working hours.

B. General Provisions

The general provisions of 40 CFR Part 61, subpart A apply to all sources regulated by this rule.

C. State Implementation and Enforcement of Emission Standards

D. Communications

Communications with the Administrator regarding the reporting and recordkeeping requirements of this rule, as well as requests for waivers, shall follow the provisions of § 61.10, except as otherwise noted in this rule.

E. Executive Order 12291

Under Executive Order 12291, issued February 17, 1981, EPA must judge whether a rule is a "major rule" and, therefore, requires that a Regulatory Impact Analysis be prepared. EPA has determined that this rule is not a major rule as defined in section 1(b) of the Executive Order because the annual effect of the rule on the economy will be less than $100 million. Also, it will not cause a major increase in costs or prices for any sector of the economy or for any

geographic region. Further, it will not result in any significant adverse effects on competition, employment, investment, productivity, innovation, or the ability of United States enterprises to compete with foreign enterprises in domestic or foreign markets. Under Executive Order 12291, this rule was submitted to the Office of Management and Budget (OMB) for review. Any written comments from OMB to EPA, and responses to those comments, are included in the docket.

F. Paperwork Reduction Act

The information collection requirements contained in this rule have been approved by OMB under the provisions of the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq.* and have been assigned OMB control number 2060–0115.

G. Regulatory Flexibility Analysis

Section 603 of the Regulatory Flexibility Act, 5 U.S.C. 603, requires EPA to prepare and make available for comment an "initial regulatory flexibility analysis" in connection with any rulemaking for which there is a statutory requirement that a general notice of proposed rulemaking be published. The "initial regulatory analysis" describes the effect of the proposed rule on small business entities.

However, section 604(b) of the Regulatory Flexibility Act provides that section 603 "shall not apply to any proposed . . . rule if the head of the Agency certifies that the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities."

EPA believes this final rule will have little or no impact on small business because the total costs associated with the standard will have relatively little impact on the total cost of producing uranium oxide. In addition, the standard will apply only to large, operating underground uranium mines.

For the preceding reasons, I certify that this rule will not have significant economic impact on a substantial number of small entities.

H. Judicial Review

Judicial review of these standards is available only by filing a petition for review in the United States Court of Appeals for the District of Columbia Circuit within 60 days of today's publication date. The requirements established in this notice may not be challenged later in civil or criminal proceedings brought by EPA to enforce them.

List of Subjects in 40 CFR Part 61

Air pollution control, Hazardous materials, Asbestos, Beryllium, Mercury, Vinyl chloride, Benzene, Arsenic, Radionuclides.

Dated: April 10, 1985.

Lee M. Thomas,

Administrator.

Part 61 of Chapter 1 of Title 40 of the Code of Federal Regulations is amended by adding the following Subpart B consisting of §§ 61.20 through 61.28:

PART 61—[AMENDED]

Subpart B—National Emission Standard for Radon-222 Emissions from Underground Uranium Mines

Sec.

Authority: Sec. 112 and 301(a) Clean Air Act, as amended, 42 U.S.C. 7412, 7601(a).

Subpart B—National Emission Standard for Radon-222 Emissions from Underground Uranium Mines

§ 61.20 Applicability.

The provisions of this subpart are applicable to an owner or operator of an active underground uranium mine which:

(a) Has mined or will mine over 100,000 tons of ore during the life of the mine; or

(b) Has had or will have an annual ore production rate greater than 10,000 tons, unless it can be demonstrated that the mine will not exceed a total ore production of 100,000 tons during the life of the mine.

§ 61.21 Definitions.

As used in this subpart, all terms not defined here shall have the meaning given them in the Clean Air Act or in subpart A of Part 61 and the following terms shall have the specific meanings given below:

(a) "Abandoned area" means a deserted mine area in which work has ceased and in which further work is not intended. Areas which function as escapeways, and areas formerly-used as lunchrooms, shops, and transformer or pumping stations are not considered abandoned areas: Except for designated ventilation passageways designed to minimize the distance to vents, worked-out mine areas are considered abandoned areas for the purpose of this subpart.

(b) "Active mine" means an underground uranium mine from which ore or waste material is currently removed by conventional methods.

(c) "Area" means a man-made underground void from which ore or waste has been removed.

(d) "Bulkhead" means an air-restraining barrier constructed for long-term control of radon-222 and radon-222 decay product levels in mine air.

(e) "Inactive mine" is a mine from which uranium ore has been previously removed but which is not an active mine as of the effective date of the standard. Inactive mines which become active mines after the effective date of the standard are considered new sources under the provisions of subparts A and B of this part.

(f) "Modification" as applied to an active underground uranium mine means any major change in the method of operation or mining procedure which will result in an increase in the amount of radon-222 emitted to air. The normal development or operation of an active mine, even though it results in an increase in emissions, is not considered a modification for the purposes of this subpart.

(g) "Temporarily abandoned area" means a mine area in which further work is not intended for at least six months. Areas which function as escapeways, formerly-used lunchrooms, shops, and transformer or pumping stations are not considered abandoned areas. Except for designated ventilation passageways designed to minimize the distance to vents, worked-out mine areas are considered temporarily abandoned areas for the purpose of this subpart if work is not intended in the area for at least six months.

(h) "Underground uranium mine" means a man-made underground excavation made for the purpose of removing material containing uranium for the principal purpose of recovering uranium.

(i) "Work" means mining activity done in the usual and ordinary course of developing and operating a mine.

§ 61.22 Standard.

(a) An owner or operator of an underground uranium mine subject to this subpart shall install and maintain bulkheads to isolate all abandoned and temporarily abandoned areas according to the following requirements:

(1) The bulkhead shall be a structure designed and constructed for long-term control of the isolated area and shall be sealed to minimize air leakage through

the bulkhead. The bulkhead shall be of sufficient structural strength to resist mechancial abuse, blasting shocks, air pressure differentials, and rock movement for an extended period of time in the mine-operating environment. The basic bulkhead structure may consist of a timber or metal stud frame, covered with lumber, expanded metal lath, plywood, or other sheet products. It may be a continuous nonporous membrane or it may support such a membrane. A sealant shall be applied onto the basic structure and in the joints between the structure and the rock to form a continuous seal and radon barrier. The sealant shall be of a type that will provide a protective seal, and will not easily crack or develop holes or leaks. A sealant may consist of coatings of mortar, masonry, latex, uretane foam, or similar materials. A properly constructed and sealed bulkhead shall have no visible cracks or gaps.

(2) If negative pressure behind the bulkhead is used, then a maximum of 20 percent of the total volume of air contained in the isolated area can be exhausted per day.

(3) As mine areas become abandoned or temporarily abandoned after the applicable date of this standard, the mine owner or operator must install a bulkhead in compliance with the provisions of § 61.22(a) within 30 days of the area becoming abandoned or temporarily abandoned.

(b) Upon written application from an owner or operator of an underground uranium mine subject to this subpart, the Administrator may approve alternative bulkhead designs or construction, or other methods for isolating abandoned or temporarily abandoned areas, if such alternatives can be shown to provide isolation of the area equivalent to the requirements of § 61.22(a)(1).

§ 61.23 Alternative Standard.

(a) If compliance with the requirements of § 61.22 will result in increased radon-222 decay product concentrations in the active areas of the mine, will require workers to enter unsafe areas, or will otherwise be impractical to achieve because of unique or unusual circumstances, then the owner or operator of an existing source (i.e., existing active mine) may apply to the Administrator for an alternative standard. The Administrator may establish an alternative standard if the applicant demonstrates that an alternative is necessary to provide for the health and safety of the workers and will minimize the exposure of nearby individuals and the general population to radon-222 decay products, to the extent practical. Applications for an alternative standard shall be made within 90 days of the effective date of the standard and include the following information:

(1) The reasons for requesting an alternative;

(2) A description of the alternative requested;

(3) A description of all measures that have been taken or will be taken by the mine owner or operator to minimize the exposure of nearby individuals and the general population to radon-222 decay products, to the extent practical.

(4) A schedule for complying with the alternative standard.

(b) An inactive mine which again becomes active may request an alternative standard under § 61.23(a). Application for an alternative standard must be submitted as part of an application for approval of construction or modification as required under § 61.07.

(c) Requests for an alternative standard shall be sent to the Assistant Administrator for Air and Radiation (ANR-443), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460.

§ 61.24 Bulkhead Inspection and Testing.

An owner or operator of an underground mine subject to the requirements of § 61.22 shall conduct the following bulkhead inspections and tests:

(a) A visual inspection of the condition of each bulkhead required under § 61.22(a) shall be conducted every three months by a qualified representative of the mine owner or operator to determine if, in his or her judgment, the integrity of the bulkhead is in compliance with the requirements of § 61.22(a)(1). A record of each inspection shall be made in accordance with the requirements of § 61.26.

(b) For bulkheaded areas maintained under negative pressure, measurement of the air exhaust rate from the area shall be made at least every three months to determine compliance with the requirement of § 61.22(a)(2). A record of each exhaust rate measurement shall be made in accordance with the requirements of § 61.26.

(c) Upon written application from an owner or operator of an underground uranium mine subject to this subpart, the Administrator may approve alternative testing and inspection procedures if such alternative procedures can be shown to provide reasonable assurance that the mine is in compliance with the requirements of § 61.22(a).

§ 61.25 Bulkhead Repair.

Bulkheads determined not to be in compliance with the requirements of § 61.22(a) during inspections required under § 61.24 shall be repaired within ten days in accordance with the requirements of § 61.22(a)

§ 61.26 Recordkeeping.

Records of inspections and tests required under § 61.24 shall be maintained as described below. These records shall include a bulkhead identification number and location and the date of each inspection or test.

(a) The results of each inspection required under § 61.24(a) shall be recorded as follows:

(1) A description of the condition of the bulkhead including identification of any damage and the extent of damages.

(2) A determination that the bulkhead is in compliance with the specifications of § 61.22(a) or that repairs are needed.

(b) A record shall be maintained for each bulkhead repaired under the requirements of § 61.25.

(c) A record shall be maintained for each air flow rate measurement conducted under the requirements of § 61.24(b). These records shall show the results of each test and the method used. The percent of the total air volume behind the bulkheaded area which is exhausted per day at the measured flow rate shall be recorded.

(d) Records of inspections and tests shall be maintained at the mine and made available for inspection and copying by the Administrator for a minimum of two years.

(e) A current map or schematic of the mine showing the location of each bulkhead required under § 61.22(a) and the approximate air volume of the isolated area shall be maintained. Each bulkhead shall be assigned an identification number which shall be used in inspections and tests, and the reporting requirements of §§ 61.24 and 61.26. This map shall be kept at the mine and be made available for review by the Administrator.

(Approved by the Office of Management and Budget under the control number 2060-0115)

§ 61.27 Reporting Requirements.

(a) An owner or operator of an underground uranium mine subject to the requirements of this subpart shall submit a certification to the Administrator by March 1, 1986, and annually thereafter. This certification shall be based on information and data concerning the calendar year immediately preceding the required data for submission of the certification and shall consist of a statement that the

bulkheading requirements of § 61.22(a) or any alternative standard established under § 61.23 have been implemented.

(b) If a waiver of compliance is granted, this certification is to be submitted on a date scheduled by the Administrator.

(Approved by the Office of Management and Budget under control number 2060–0115)

§ 61.28 Source Reporting and Waiver Request.

(a) The owner or operator of any existing source, or any new source to which a standard prescribed under this subpart is applicable which had an initial startup which preceded the effective date of a standard prescribed under this subpart shall, within 90 days after the effective date, provide the following information in writing to the Administrator:

(1) Name and address of the owner or operator;

(2) The location of the source;

(3) A brief description of the nature, size, design, and method of operation of the mine including: (i) current or expected annual ore production rates, (ii) current cumulative ore production, (iii) expected cumulative ore production over the life of mine;

(4) The number of abandoned and temporarily abandoned areas in the mine and the number of these areas which are isolated by bulkheads; and

(5) A statement by the owner or operator of the source as to whether he can comply with the standard prescribed in this subpart within 90 days of the effective date.

(b) An owner or operator of an existing underground uranium mine (i.e., existing source) unable to operate in compliance with the standard prescribed under this subpart or lacking sufficient information to apply for an alternative standard within 90 days of the effective date of the standard may request a waiver of compliance with such standard for a period not exceeding two years from the effective date. Any request shall be in writing and shall include the following information:

(1) The reasons for requesting the waiver;

(2) A schedule for achieving compliance with the standard, or if applicable, the alternative standard, including the steps which will be taken to come into compliance including a date by which each step will be achieved; and

(3) Interim emission control steps will be taken during the waiver period.

(c) Changes in the information provided under paragraph (a) of this section shall be provided to the Administrator within 30 days after such change, except that if changes will result from modification of the source, as defined in §§ 61.02, the provisions of § 61.07 and 61.08 are applicable.

[FR Doc. 85–9200 Filed 4–16–85; 8:45 am]
BILLING CODE 6560–50–M

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 61

[AD-FRL-2777-1]

National Emission Standards for Hazardous Air Pollutants; Standard for Radon-222 Emissions From Underground Uranium Mines

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: The U.S. District Court for the Northern District of California has ordered EPA to promulgate a final standard for airborne emissions of radionuclides from underground uranium mines by April 10, 1985, or to find that radionuclides are clearly not a hazardous pollutant. The Agency has chosen to propose a work practice standard which is designed to reduce emissions of radon-222 from underground uranium mines to the atmosphere.

DATES: The record will be held open until March 28, 1985, to allow comments on the testimony presented at the public hearing. However, to allow maximum time for consideration of comments on the proposed rule, they must be received by March 25, 1985. A public hearing on this proposed rule is scheduled for February 27–28, 1985, in Albuquerque, New Mexico. Requests to participate in the hearing should be made by February 25, 1985.

ADDRESSES: Comments should be sent to: Central Docket Section (LE–131), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460, Attention: Docket No. A–79–11.

The hearing will be held at the Albuquerque Convention Center, Picuris-Sandia Room, 401 2nd Street, NW., Albuquerque, N.M. from 9.00 a.m.–5:00 p.m. each day. Requests to participate in the hearing should be made in writing to Richard J. Guimond, Director, Criteria and Standards Division (ANR–460), U.S. Environmental Protection Agency, Washington, D.C. 20460.

All requests should include an outline of the topics to be addressed in the opening statement and the names of the participants. Presentations should be limited to 30 minutes.

The rulemaking record is contained in Docket No. A–79–11. This docket is available for public inspection between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA's Central Docket Section, West Tower Lobby, Gallery One, Waterside Mall, 401 M Street, SW., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Paul J. Magno, Environmental Standards Branch (ANR–460), Criteria and Standards Division, Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460, (703) 557–0704.

SUPPLEMENTARY INFORMATION:

I. Supporting Documents

A draft Background Information Document for the proposed standard has been prepared and single copies may be obtained by writing the Program Management Office, Office of Radiation Programs (ANR–458), U.S. Environmental Protection Agency, Washington, D.C. 20460, or by calling (703) 557–9351. Please refer to "Draft Background Information Document: Proposed Standards for Radon-222 Emissions to Air from Underground Uranium Mines." This document contains a description of the uranium mining industry, projected exposures and risks to nearby individuals and to populations, and descriptions of radon-222 control methods.

II. History of Radionuclide Standards Development

On April 6, 1983, EPA announced in the **Federal Register** its proposed standards for sources of emissions of radionuclides from four categories: (1) Department of Energy (DOE) facilities; (2) Nuclear Regulatory Commission (NRC)-licensed facilities and non-DOE Federal facilities; (3) elemental phosphorus plants; and (4) underground uranium mines.

On February 17, 1984, the Sierra Club filed suit to compel final action in the U.S. District Court for the Northern District of California, pursuant to the citizens' suit provision of the Act (*Sierra Club* v. *Ruckelshaus*, No. 84–0656 WHO). On July 25, 1984, the Court granted Sierra Club's summary judgment motion and ordered EPA to promulgate standards or make a finding that radionuclides are not a hazardous air pollutant within 90 days of the date of the order.

On October 23, 1984, EPA withdrew its proposed standards for radionuclide emissions from the following categories: (1) Elemental phosphorus plants; (2) DOE facilities; (3) NRC-licensed facilities and non-DOE Federal facilities; and (4) underground uranium mines (49 FR 43906, October 31, 1984). The proposed standards for the first three categories were withdrawn because the Administrator determined that current practice provides an ample margin of safety in protecting the public health from the hazards associated with exposure to radionuclides from these sources. In the case of underground uranium mines, the Administrator withdrew the proposed standard because it did not meet the legal requirements of section 112 of the Clean Air Act. Simultaneous with this action, the Agency published an Advance Notice of Proposed Rulemaking for radon-222 emissions from underground uranium mines to solicit additional information on control methods such as bulkheading and other forms of operational controls for radon-222 which would meet the legal requirements of section 112 (49 FR 43915, October 31, 1984). The Agency also published at that time an Advance Notice of Proposed Rulemaking for radon-222 emissions from licensed uranium mills (49 FR 43916, October 31, 1984).

On October 31, 1984, the U.S. District Court, Northern District of California issued an order requiring the Administrator and the Agency to show cause why they should not be held in contempt of the Court's July 25 order. A court hearing was held on November 21, 1984, to consider the issue. In a ruling on December 11, 1984, the Court found the Administrator and the Agency in contempt and ordered the following remedial action:

1. (a) Issue within 30 days of the date of the order final radionuclide emission standards for DOE facilities, NRC-licensed and non-DOE Federal facilities, and elemental phosphorus plants, and

(b) Issue within 120 days of the date of the order final radionuclide emission standards for underground uranium mines; or

2. Make a finding based on the information presented at hearings during the rulemaking, that radionuclides are clearly not a hazardous pollutant.

The Agency promulgated final standards for DOE facilities, NRC-licensed and non-DOE Federal facilities, and elemental phosphorus plants on January 17, 1985 (50 FR 5190, February 6, 1985), although it is noted that the Agency intends to pursue its pending appeal of this portion of the District Court's order. This notice proposes a standard for underground uranium mines in conformance with the District Court's order; EPA intends to promulgate a final standard for underground uranium mines by April 10, 1985, thereby fully complying with the Court's order.

III. Summary of Withdrawal Decision

When the Agency first proposed a standard for underground uranium

mines in April 1983, the available technical information suggested that no practical technology existed for achieving satisfactory reductions in radon-222 emissions to air from underground uranium mines and therefore, an emission standard was not feasible. Nonetheless, the Agency concluded that the magnitude of the risk to nearby individuals and the total population resulting from exposure to radon-222 emissions from these mines warranted regulatory attention. Therefore, the Agency proposed an ambient concentration limit for underground uranium mines that would limit the annual average radon-222 concentration in air due to emissions from an underground mine to an annual average of 0.2 pCi/l above background in any unrestricted area.

Analysis of the likely reduction in health risks afforded by the proposed standard showed that while risks to nearby individuals were reduced about ten-fold, the risks to the total population were only slightly reduced. The lack of population risk reduction is due to the fact that radon-222 releases would not be reduced by the proposed rule; they would only be more widely dispersed.

On October 23, 1984, the Agency withdrew its proposed standard for underground uranium mines. At that time, the Agency issued an Advance Notice of Proposed Rulemaking (ANPR) to solicit information on methods, such as bulkheads, sealants, and mine pressurization, that may be available to control radon-222 emissions from the mines. Comments were requested on a number of specific topics and were to be submitted by April 15, 1985. Although the Agency's current rulemaking effort must be completed before this date to satisfy the District Court's order, EPA is still soliciting the information requested in the ANPR and is extending the deadline for receipt of this information to September 30, 1985. This information will be used by the Agency in its long-term consideration of radon-222 emission controls for underground uranium mines. The results of this study may lead to some modification of the Agency's standard.

IV. Summary of Proposed Standard

Based on currently available information, EPA has determined that it is not feasible to prescribe an emission standard for radon-222 emissions from underground uranium mines. Therefore, EPA is proposing a work practice standard based on bulkheading mined-out and temporarily inactive mine areas to reduce the amount of radon-222 emitted to the atmosphere from the mines. The deadline imposed by the District Court requires the Agency to promulgate a standard for underground uranium mines using only the currently available technical information. Specific estimates of the radon-222 emission reduction achieved by the proposed standard cannot be made with existing information. Further, the cost of these proposed requirements can only be generally estimated. However, the costs are not expected to be substantial since the proposed standard generally reflects techniques that the industry has indicated are already in widespread use. EPA intends, once this standard is promulgated, to begin long-term studies, as necessary, to more thoroughly determine the efficiency and cost of bulkheads and other techniques for decreasing radon-222 emissions from the underground uranium mines.

V. Rationale for the Proposed Standard

A. Industry Description

Uranium mining involves the handling of large quantities of ore containing uranium-238 and its decay products. The concentrations of these radionuclides in ore may be up to one thousand times greater than their concentration in other rocks and soils. Uranium mining is generally carried out by either surface (open pit) or underground mining methods, depending on the depth of the ore deposit. Underground uranium mines accounted for about forty percent of the uranium oxide production in 1983. After mining, the ore is shipped to a uranium mill where the uranium is separated for subsequent use.

The uranium mining industry has undergone substantial changes in recent years due to declining demand and competition from low-cost foreign sources. The total number of all types of uranium mines in operation fell from a peak of 432 in 1979 to 135 in 1983. The number of underground mines fell from 300 in 1979 to 95 in 1983 and 26 by November 1984. By January 1985, only 17 underground uranium mines were operating and further reductions are expected during 1985. Production of uranium oxide by underground mines fell from a peak of 9,600 tons in 1980 to 4,100 tons in 1983.

All uranium mining in the United States takes place in the western United States. In general, the mines are located in relatively remote areas. Of the 26 underground mines operating in November 1984, twelve were in New Mexico, two in Colorado, four in Wyoming, six in Utah, and two in Arizona.

B. Radionuclide Emissions from Underground Uranium Mines

Evaluations of radionuclide emissions from underground uranium mining activities indicate that radon-222 is the most significant radionuclide emitted to the above ground air. Radon-222 decays into a series of short half-lived radionuclides which attach to dust particles that become lodged in the lung when inhaled. Thus, the irradiation of the lung, which increases the risk of lung cancer, is predominantly from radon decay products rather than the precursor radon-222. Radon-222 is released from underground mines in relatively high concentrations through a series of ventilation shafts installed at locations along the mine haulage ways. These shafts are designed to sufficiently ventilate the working areas of the mine to keep miners' exposure to radon decay products below permissible levels.

The rate of radon-222 emissions from underground uranium mines is highly variable and depends upon a number of interrelated factors, such as mine ventilation rates, ore grade, exposed surface area, mining practices, and geolgic formations. In addition, these mines can differ significantly in their configuration; for example, some mines have few tunnels and cross sections, while such features are numerous in other mines. The wide diversity among mines makes it difficult to predict emission rates or the effectives of emission reduction practices at any given mine.

Measurement studies made at 27 large underground mines during 1978–1979 showed that radon-222 emissions to air from individual mines ranged from 200 to 30,000 Ci/y with an average to 5600 Ci/y. These mines accounted for 65 percent of the uranium oxide produced by all underground mines in 1978. Based on these measurements, the total radon-222 emissions from all underground uranium mines in 1978 are estimated to be 235,000 Ci/y.

These studies also evaluated the relationship between mine parameters, such as ore production rate, cumulative ore production, ore grade, mine surface area and mine age, and radon-222 emission rates. Of the parameters evaluated, cumulative production was most directly correlated with radon-222 emissions. An evaluation of radon-222 emissions from underground mines operating in 1978 as a function of cumulative ore production showed that 188 or 75 percent of the mines had a cumulative ore production of less than 100,000 tons. The average estimated radon-222 emission rate from each of

these mines was less than 200 Ci/y, and as a group they contributed only five percent of the total curies emitted by all underground mines in 1978. Since the radon-222 emissions from underground uranium mines with cumulative ore productions of less than 100,000 tons are small, the Agency has concluded that these mines need not be covered by the standard. (Cumulative ore production is that total amount of ore removed from a mine since its inception.) In addition, the Agency has decided that this standard should not apply to mines with an annual production of less than 10,000 tons because the life of many small mines is less than 10 years. Consequently, the total production over the lifetime of the mine would not exceed 100,000 tons.

C. Estimates of Exposure and Risk

Individuals living near an underground uranium mine can be exposed to the increased levels of radon-222 being released from the mine ventilation shafts. Radon-222 contained in the outside atmosphere enters homes and other structures built near the mine exhaust vents through doors and windows, as well as other openings in the structure. The radon decay products tend to concentrate indoors, thus exposing the occupants to potentially harmful levels of these radionuclides. Lifetime risks of fatal cancer to individuals living near an underground uranium mine are estimated to range from about one in one thousand to one in one hundred. The potential exists for even greater risks in some situations, e.g., a person living very close to several horizontal mine vents or in areas influenced by multiple mine emissions. EPA estimates the fatal cancer risk to the total population from radon-222 emissions from underground uranium mines to have been about one to four fatal cancer cases per year during the peak production period of 1978–1982. With the decrease in the number of operating underground uranium mines, the risk of fatal cancer is expected to range from four-tenths to two fatal cancer cases per year during the period 1983–1990.

Exposure levels are derived using emission estimates, dispersion modelling, and population data. For any given level of emissions, diapersion models predict concentrations at different distances from the emission source. By combining those estimated concentrations with census data on population densities, the number of people exposed at different levels can be estimated. Several factors suggest that actual exposure levels to nearby individuals will be lower than those estimated. In estimating exposure, the most exposed individuals are hypothetically subjected to the maximum annual average concentration of the emissions for 24 hours every day for 70 years (roughly a lifetime). This does not consider, for instance, the fact that most people in their daily routines move in and out of the specific areas where the emission concentrations are the highest.

The final risk estimates are the product of the exposure levels and the estimated unit-risk factor. Two summary measures are of particular interest: "nearby individual risk" and "total population impact." The former refers to the estimated increased lifetime risk to individuals who spend their entire life at the point where predicted concentrations of the pollutant at highest. Nearby individual risk is expressed as a probability; a risk of one in one thousand, for example, means that a person spending his lifetime at the point of maximum exposure has an estimated increased risk of developing a fatal cancer of one in one thousand. (For comparison, the average lifetime risk of dying of cancer in the United States is about 165 in 1,000. Eliminating a risk of one in one thousand reduces the overall lifetime risk of contracting a fatal cancer by less than 0.6 percent.) Estimates of nearby individual risk must be interpreted cautiously, however, since people generally do not spend their whole lives at the points of maximum concentrations.

The second measure, "total population impact," considers people exposed at all concentrations, low as well as high, and it considers people exposed throughout the United States, as appropriate. It is expressed in terms of annual number of cancer cases, and provides a measure of the overall impact on public health. A total population impact of 0.5 fatal cancer cases per year, for example, means that emissions of the specific pollutant from the source category are expected to cause one case of cancer every 20 years.

The two estimates together provide a better description of the magnitude and distribution of risk in a community than either number alone. "Nearby individual risk" tells us the highest risk, but not how many people may bear that risk. "Total population impact" describes the overall health impact on the entire exposed population, but not how much risk the most persons may bear. Two sources of radionuclide or chemical emissions could have similar population impacts, but very different maximum individual risks, or vice versa. Both estimates are important and are used in making risk management decisions. The risk estimates should not be viewed as precise estimates of likely health damage, but rather as a general indication of a reasonable upper-limit estimate.

Much more is known about the risks from exposure to radiation than exposure to most chemicals. While there is uncertainty in risk estimates from assessments of chemical emissions and radionuclide emissions, there is likely to be much less uncertainty in estimates of risk from radio-nuclide emissions because of the extensive data base on human exposure to radiation. Therefore, a risk estimate of one in one thousand resulting from exposure to radionuclides is likely to be more accurate than the same estimate for chemical exposures. Estimates of risk from radionuclides is much less likely to exaggerate hypothetical maximum risks than are estimates made for chemical exposure.

As a general perspective regarding radiation exposure, everyone is exposed to background radiation due to cosmic radiation, and to radioactivity in minerals, soils, and even our own bodies. Background radiation levels vary across the United States, but average about 100 mrem/y for each person. There is little that people can do to control exposure to background radiation. Over a lifetime, this exposure is estimated to contribute to a fatal cancer risk of about one or two cases for every one thousand people.

D. Control Technology

Because radon-222 is a noble gas and the volume of air discharged through mine vents is very large, there is no practical method to remove radon-222 from the mine exhaust air. Adsorption onto activated charcoal is the most widely used method for removing noble gases from a low volume air stream. However, application of this method to the removal of radon-222 from mine ventilation air at the volumes of air which must be treated would require large, complex, unproven systems which would be extremely costly (i.e., at least $18 to $44 per pound of uranium oxide produced. Currently, the average cost to produce one pound of uranium oxide is about $35.)

An important consideration for the underground uranium mining industry is worker exposure to radon decay products. The industry now employs a number of practices to reduce radon decay product concentrations in the mine to meet occupational exposure standards established by the Mine Safety and Health Administration. These practices, which include

backfilling abandoned areas of the mines with mill tailings and bulkheading abandoned areas of the mine, also have the effect of reducing radon-222 emissions to the above ground air. EPA wishes to avoid setting a standard to control radon-222 emissions to the air that will increase levels of radon-222 and its decay products within the working areas of the mine itself or that will increase significantly time spent in the mine by mine personnel in meeting the standard.

At EPA's request, the U.S. Bureau of Mines carried out an evaluation of the cost and effectiveness of various work practices in reducing radon-222 emissions. These evaluations were carried out using simple models of actual mines and using a number of assumptions not yet field verified. Data from this study suggests that bulkheading could reduce emissions of radon-222 by about 10 to 60 percent from typical mines at a cost ranging from about $4 to $60 per curie reduced or about $0.01 to $0.05 per pound of uranium oxide produced. Based on the peak production year, the total cost to the industry could range from $200,000 to $1,000,000 per year and the amount of population risk reduction achieved could range from one-tenth to two fatal cancer cases per year. These estimates are only hypothetical and are based on installing bulkheads in a presently uncontrolled mine (i.e., a mine without any bulkheads). Further study is needed to estimate actual costs and risk reduction associated with installing bulkheads in currently operating mines. Other methods examined, such as sealing and backfilling, when used in conjuction with bulkheading, may reduce radon-222 emissions further; however, they are not nearly as cost-effective or practical as bulkheading, nor do they achieve the same results in decreasing radon-222 emissions. After considering all the available information on control technologies, the Agency has concluded that bulkheading worked-out and temporarily inactive mine areas to seal the radon-222 before it is vented to the above ground air is a practical and cost-effective method of reducing radon-222 emissions from the mines.

E. Bulkheading

Bulkheads are air-restraining barriers used to isolate inactive mine areas from active mine areas. Bulkheads are commonly used underground uranium mines to isolate inactive mine areas, thereby reducing the amount of ventilation air needed to adequately protect the miners from exposure to radon decay products. By sealing off inactive areas of a mine, most of the radon-222 emanating from the surfaces of these areas will decay in the isolated area, rather than being released into the active airway of the mine. This will reduce exposure to the miners. If the bulkheads are properly constructed and maintained they can also reduce radon emissions to the above ground air. Bulkheading practices vary among mines; some mines make extensive use of bulkheads, while others use few bulkheads.

Current bulkhead construction practices vary with the type of rock in which the mine is located, the proximity of the bulkhead to exhaust airways, and the ultimate purpose of the bulkhead. There are two functional parts to a bulkhead and each has different requirements. The primary part of the bulkhead is the basic structure that fills most of the opening. This is usually a relatively rigid structure that provides primary resistance to mechanical abuse, blasting shocks, pressure differentials, etc. It may be a continuous nonporous membrane itself, or it may support such a membrane which might be attached to this primary structure or sprayed onto it. The important characteristics of this part of the bulkhead are (1) structural strength, which must be maintained for an extended period in the mine-operating environment; and (2) membrane continuity, i.e., it must not crack or develop holes or leaks in the mine-operating environment.

The second part of a bulkhead is the portion that forms the seal between the primary structure and the rock wall of the opening. This portion must also be maintained through blasting shock waves, rock movement, running water, and other adverse conditions of the mine operating equipment. Any break in the seal will allow the radon-222 captured behind the bulkhead to escape into the mine atmosphere.

Because the radon-222 concentration in the sealed-off area behind a bulkhead will build up to relatively high levels (i.e., tens of thousands of picocuries per liter), it is necessary to prevent or minimize any leakage of air from behind the bulkhead into the working areas of the mine. Any such leakage could significantly increase the radon decay product concentrations to which the miners are exposed.

A typical bulkhead usually consists of a timber or metal stud frame covered with lumber, expanded metal lath, plywood, or other sheet products. The lumber, sheeting or lath is then covered by spraying or troweling a sealant onto the basic structure, the joint between the structure and the rock, and the adjacent rock to form a continuous seal and radon barrier.

Since a completely airtight bulkhead is difficult to construct, and changes in the barometric pressure will cause differential pressures across a bulkhead, it is often necessary to maintain a negative differential pressure behind the bulkhead to prevent leakage of contaminated air into the active mine airways. This negative pressure is achieved by bleeding (i.e., removing) air from behind the bulkhead into an exhaust airway. For bulkheads to be effective in reducing radon-222 emissions to above ground air, however, the amount of air bleed necessary to maintain an adequate pressure differential across the bulkhead must be minimized. The smaller the air bleed, the more radon-222 will decay behind the bulkhead rather than being released above ground. One way to accomplish this is to construct tight bulkheads; with the proper use of sealants, bulkheads can be constructed with relatively low leak rates.

F. The Proposed Standard

The complexity in the structure of underground uranium mines and the lack of suitable control technology to capture radon-222 being vented from the mines causes the Agency to conclude that an emission standard is not feasible. The proposal, therefore, is based on a work practice frequency used by the industry.

The proposed standard would require owners or operators of underground uranium mines to install bulkheads to seal off abandoned mine areas and temporarily inactive mine areas. The standard also limits the amount of air exhausted from a bulkheaded area to less than 20 percent per day of the total volume of air contained in the isolated area. Sealing off unused areas of the mines will result in radon-222 decaying in the isolated areas rather than being discharged into the air.

A limit on the rate of removal of air from behind a bulkhead is necessary to provide sufficient residence time for the radon-222 formed in the sealed area to decay. A 20 percent per day value was selected as a balance between the need to minimize the rate of air removed from the sealed area and the need to maintain adequate negative pressure to prevent radon-222 from leaking into active mine airways and increasing the radon-222 decay product exposures to the miners. Our analysis estimates that radon-222 emissions from a bulkhead area are reduced by approximately 50 percent when the air exhaust rate is maintained at 20 percent per day of the total air

volume in the sealed area. Reducing the air exhaust rate to 10 percent per day would increase the emission reduction to approximately 65 percent, but we do not have enough information at the present time to know if this will provide adequate protection of the miners.

The proposed standard is applicable only to large, operating underground mines, i.e., mines which produce over 10,000 tons/year of ore or which have had a cumulative ore production of greater than 100,000 tons during the life of the mine. Our analysis showed that 95 percent of the radon-222 emissions from underground mines result from large mines with a cumulative ore production greater than 100,000 tons.

Most underground uranium mines already install bulkheads to reduce ventilation requirements and to direct air flow. Therefore, it is not possible to estimate the incremental radon-222 emission reductions achieved by the standard because we do not have sufficient information on the extent and nature of present bulkheading practices. To obtain this information will require extensive additional studies including an evaluation of (a) current bulkheading practices and their effectiveness in reducing radon-222 emissions and (b) alternative practices for further reducing radon-222 emissions. (As discussed previously, available technical information suggests that bulkheading could reduce radon-222 emissions by about 10 to 60 percent, based on installing bulkheads in an uncontrolled mine.)

The proposed standard will not significantly increase the radon decay product concentrations to which the underground miners will be exposed. Although installation of bulkheads and inspections and testing required by the standard will result in some additional worker time in the mines, the Agency believes this additional time will be relatively small and has attempted to limit the amount of testing and inspection required by the standard to minimize any additional worker exposure to radon decay products.

Because we do not know the extent of present bulkheading practices, we cannot precisely estimate the cost to meet the proposed standard. As discussed previously, some mines make use of hundreds of bulkheads, while other mines use very few, if any. Based on our present information, we have concluded that bulkheading is the least costly radon-222 emission control method. Limited modelling analysis shows that the costs of installing bulkheads are relatively small (one to five cents per pound of uranium oxide mined). This represents only 0.03 to 0.14 percent of the estimated $35 average cost to produce uranium oxide. Even if these costs are significantly underestimated for some mines, it is highly unlikely that the cost of the standard would exceed one percent of the cost of producing uranium oxide.

G. Alternative Considered

The Agency considered three alternatives to the standard it is proposing today. The first of these alternatives was a level of 100 mrem/y effective dose equivalent continuous exposure from all sources; a single source would be limited to 25 mrem/y effective dose equivalent. This alternative is consistent with EPA standards recently promulgated to limit radionuclide emissions from Department of Energy (DOE) facilities and Nuclear Regulatory Commission (NRC)-licensees and non-DOE Federal facilities. However, this alternative was rejected because the Agency believed that mine owners and operators were likely to rely on preventing human occupancy near a mine, rather than modifying practices within the mine to reduce emissions of radon-222. While this approach would reduce the risk of fatal cancer to the nearby individuals, it would do nothing to reduce the risk to the general population.

The second of these alternatives was to limit the annual average concentration of radon-222 in air to 3.0 pCi/l above background in any unrestricted area. This is consistent with current NRC regulations. The Agency rejected this alternative because it allows for an extremely high individual lifetime risk of about two in one hundred. In addition, such a standard would also likely be achieved by preventing human occupancy near a mine, rather than reducing emissions.

The last of the alternatives considered was a bulkheading standard similar to today's proposal. However, rather than specifying design requirements for bulkheads, it would specify a maximum leak rate across the bulkhead. The Agency considered this alternative as one possible way to ensure that tight bulkheads are constructed in the mines, thereby maximizing the amount of radon-222 decaying behind the bulkhead. After evaluating the technical aspects of specifying a leak rate, the Agency determined that it would be very difficult to accurately measure the rate of air leaking across the bulkhead. These technical difficulties would make it extremely complicated to determine compliance with the standard.

H. Request for Comments

EPA is particularly interested in receiving comments and recommendations on the following issues and questions:

1. Are the quantities of annual and cumulative ore production used to determine the applicability of the standard reasonable values or would higher or lower values be more appropriate? Is there an alternative way to designate mine size for purposes of defining the applicability of the standard?

2. Are the definitions of "abandoned mine areas," "temporarily abandoned mine areas" and "active mine" used in the proposed standard proper or should they be modified?

3. Are the bulkheading design requirements of the proposed standard adequate to ensure the installation of tight bulkheads? Do the requirements contain sufficient flexibility? Are they too specific or not specific enough?

4. Is the air exhaust rate limit of 20 percent per day of the total air volume behind a bulkhead a reasonable value or would a higher or lower value be more appropriate? Is there an alternative way to express this requirement?

5. Are the frequency of the inspections and tests required by the proposed standard reasonable or should these be more or less frequent? Are the types of inspections and tests appropriate or should other requirements be established?

6. Are the reporting requirements of the proposed rule reasonable? Do they represent the minimum documentation necessary to ensure compliance with the rule? Should particular reporting requirements be omitted; should others be added?

7. Are standards needed for permanently closed and/or temporarily closed underground uranium mines? If so, what type of standards should be considered?

The Agency is also soliciting information regarding the cost of building bulkheads to comply with the proposal and the amount of reduction in radon-222 emissions that may be achieved by the proposal.

VI. Miscellaneous

A. Docket

The docket is an organized and

complete file of all information considered by EPA in the development of this proposed standard. The docket allows interested persons to identify and locate documents so they can effectively participate in the rulemaking process. It also serves as the record for judicial review.

Transcripts of the hearings, all written statements, the Agency's response to comments, and other relevant documents will be placed in the docket and will be available for inspection and copying during normal working hours.

B. Executive Order 12291

Under Executive Order 12291, issued February 17, 1981, EPA must judge whether a rule is a "major rule" and, therefore, requires that a Regulatory Impact Analysis be prepared. EPA has determined that this rule is not a major rule as defined in section 1(b) of the Executive Order because the annual effect of the rule on the economy will be less than $100 million. Also, it will not cause a major increase in costs or prices for any sector of the economy or for any geographic region. Further, it will not result in any significant adverse effects on competition, employment, investment, productivity, innovation, or the ability of United States enterprises to compete with foreign enterprises in domestic or foreign markets. Under Executive Order 12291, this proposed rule was submitted to the Office of Management and Budget (OMB) for review. Any comment from OMB to EPA andy any response to those comments are included in the docket.

C. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget under the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). This proposal, if promulgated, would impose reporting and recordkeeping requirements on the owners and operators of underground uranium mines. EPA requests comments on the reasonableness of the information collection requirements and on the costs involved as compared to other means of compliance determinations. Comments on these requirements should be submitted to Docket No. A-79-11, as well as to the Office of Information and Regulatory Affairs; Office of Management and Budget; 726 Jackson Place, NW.; Washington, D.C. 20503 (Attention: Desk Officer for EPA). The final rule will respond to any OMB or public comments on the information collection requirements.

D. Regulatory Flexibility Analysis

Section 603 of the Regulatory Flexibility Act, 5 U.S.C. 603, requires EPA to prepare and make available for comment an "initial regulatory flexibility analysis" in connection with any rulemaking for which there is a statutory requirement that a general notice of proposed rulemaking be published. The "initial regulatory analysis" describes the effect of the proposed rule on small business entities.

However, section 604(b) of the Regulatory Flexibility Act provides that Section 603 "shall not apply to any proposed . . . rule if the head of the Agency certifies that the rule will not, if promulgated have a significant economic impact on a substantial number of small entities."

EPA believes this proposed rule will have little or no impact on small business because the total costs associated with the standard will have relatively little impact on the total cost of producing uranium oxide. In addition, the standard will only apply to large, operating underground uranium mines. (A small business is one that has 750 employees or less.)

For the preceding reasons, I certify that this rule, if promulgated, will not have significant economic impact on a substantial number of small entities.

List of Subjects in 40 CFR Part 61

Air pollution control, Hazardous materials, Asbestos, Beryllium, Mercury, Vinyl chloride, Benzene, Arsenic, Radionuclides.

Dated: February 15, 1985.

Lee M. Thomas,

Administrator.

PART 61—[AMENDED]

It is proposed to amend Part 61 of Chapter 1 of Title 40 of the Code of Federal Regulations by adding the following:

Subpart B—National Emission Standard for Radon-222 Emissions From Underground Uranium Mines

Sec.

Authority: Sec. 112 and 301(a) Clean Air Act, as amended, 42 U.S.C. 7412, 7601(a).

Subpart B—National Emission Standard for Radon-222 Emissions From Underground Uranium Mines

§ 61.20 Applicability.

The provisions of this subpart are applicable to owners and operators of active underground uranium mines which currently mine or plan to mine over 10,000 tons/year of ore or which have mined greater than 100,000 tons of ore during the life of the mine.

§ 61.21 Definitions.

As used in this subpart, all terms not defined here shall have the meaning given them in the Clean Air Act or in Subpart A of Part 61 and the following terms shall have the specific meanings given below:

(a) "Abandoned area" means a deserted mine area in which further work is not intended except those areas which function as escapeways or ventilation passageways.

(b) "Active mine" means an underground uranium mine from which ore or waste material is actively removed.

(c) "Area" means a manmade underground void from which ore or waste has been removed.

(d) "Bulkhead" means an air-restraining and air pollution control barrier constructed for long-term control of radon-222 and radon-222 decay product levels in mine air.

(3) "Modification" as applied to an underground mine means any major change in the method of operation or mining procedure which will result in an increase in the amount of radon-222 emitted to air. The normal development of a mine, even though it results in an increase in emissions, is not considered a modification for the purposes of this subpart.

(f) "Temporarily abandoned area" means a mine area that has been or will be abandoned for at least six months except those areas which functions as escapeways or ventilation passageways.

(g) "Underground uranium mine" means a manmade underground excavation made for the purpose of removing material containing urnaium for the principal purpose of recovering uranium.

§ 61.22 Standard.

Owners or operators of underground uranium mines subject to this subpart shall install and maintain bulkheads to isolate all abandoned and temporarily abandoned areas according to the requirements of this section.

(a) The bulkhead shall be a structure designed and constructed for long-term

control of the isolated area and shall be sealed to minimize air leakage through the bulkhead. The bulkhead shall be of sufficient structural strength to resist mechanical abuse, blasting shocks, air pressure differentials and rock movement for an extended period of time in the mine-operating environment. The basic bulkhead structure may consist of a timber or metal stud frame, covered with lumber, expanded metal lath, plywood, or other sheet products. It may be a continuous nonporous membrane or it may support such a membrane. A sealant shall be applied onto the basic structure and in the joints between the structure and the rock to form a continuous seal and radon barrier. The sealant shall be of a type that will provide a protective seal, and will not easily crack or develop holes or leaks. A sealant may consist of coatings of mortar, masonry, latex, urethane foam, or similar type materials. A properly constructed and sealed bulkhead shall have no visible cracks or gaps.

(b) If negative pressure behind the bulkhead is used, then a maximum of 20 percent of the total volume of air contained in the sealed area can be exhausted per day.

(c) Upon written application from an owner or operator of an underground uranium mine subject to this subpart, the Administrator may approve alternative bulkheading procedures if such alternative procedures can be shown to provide isolation of the area equivalent to the requirements of paragraph (a) of this subpart.

§ 61.23 Inspection and testing.

The owner or operator of an underground mine subject to the requirements of this subpart shall conduct the following inspections and tests:

(a) A visual inspection of the condition of each bulkhead required under § 61.22 shall be conducted monthly by a qualified representative of the mine owner or operator to determine if, in his or her judgment, the integrity of the bulkhead is in compliance with the requirements of § 61.22(a) A record of each inspection shall be made in accordance with the requirements of § 61.25.

(b) For bulkheaded areas maintained under negative pressure, measurement of the air exhaust rate from the area shall be made at least monthly to determine compliance with the requirement of § 61.22(b). A record of each exhaust rate measurement shall be made in accordance with the requirement of § 61.25.

(c) The mine operator shall also be prepared to demonstrate compliance with the requirements of § 61.22(b) upon request of the Administrator.

(d) Upon written application from an owner or operator of an underground uranium mine subject to this subpart, the Administrator may approve alternative testing and inspection procedures if such alternative procedures can be shown to provide reasonable assurance that the mine is in compliance with the requirements of § 61.22.

§ 61.24 Bulkhead repair.

Bulkheads determined not to be in compliance with the requirements of § 61.22(a) during inspections required under § 61.23 shall be repaired within three days in accordance with the requirements of § 61.22(a).

§ 61.25 Recordkeeping.

Records of inspections and tests required under § 61.23 shall be maintained as described below. These records shall include a bulkhead identifiction number and location and the dates of inspections or tests.

(a) The results of each inspection required under § 61.23(a) shall be recorded as follows:

(1) A description of the condition of the bulkhead including identification of any damage and the extent of damages.

(2) A determination that the bulkhead is in compliance with the specifications of § 61.22(a) or that repairs are needed.

(b) A record shall be maintained for each bulkhead repair carried out under the requirements of § 61.24.

(c) A record shall be maintained for each air flow rate measurement conducted under the requirements of § 61.23(b). These records shall show the results of the tests and the method used. The percent of the total air volume behind the bulkheaded area which is exhausted per day at the measured flow rate shall be recorded.

(d) Records of inspections and tests shall be maintained at the mine and made available for inspection and copying by the Administrator or his designated Agent for a minimum of two years.

(e) A current map or schematic of the mine showing the location of each bulkhead required under § 61.22 and the air volume of the isolated area shall be maintained. Each bulkhead shall be assigned an identification number which shall be used in inspections and tests, and reporting requirements of §§ 61.23 and 61.24. This map shall be kept at the mine and be made available for review by the Administrator or his designated representative.

§ 61.26 Reporting Requirements.

Each owner or operator of an underground mine subject to the requirements of § 61.22 shall comply with the following:

(a) Provide the Administrator annually with a report containing the following information:

(1) The number and approximate volumes of mine areas both abandoned and temporarily abandoned in the previous year.

(2) The number of bulkheads installed to seal off these areas.

(3) The current total number of bulkheads being maintained to meet the requirements of § 61.22.

(4) An estimate of the average amount of air in the bulkheaded areas which is exhausted per day in percent of the total volume per day.

(5) The operator shall also make a statement to the effect that compliance with the testing and inspection requirements of § 61.23 have been or have not been achieved.

(b) This report shall be submitted by March 31, 1986, and annually thereafter. The information included in the report shall be based on data collected during the calendar year immediately preceding the required date of submission of the annual report.

§ 61.27 Source reporting and waiver request.

(a) The owner or operator of any existing source, or any new source to which a standard prescribed under this part is applicable which had an initial startup which preceded the effective date of a standard prescribed under this part shall, within 90 days after the effective date, provide the following information in writing to the Administrator:

(1) Name and address of the owner or operator.

(2) The location of the source.

(3) The type of hazardous pollutants emitted by the stationary source.

(4) A brief description of the nature, size, design, and method of operation of the stationary source including the operating design capacity of such source. Identify each point of emission for each hazardous pollutant.

(5) The number and approximate volume of abandoned and temporarily abandoned area in the mine and the number and approximate volumes of these areas which are sealed by bulkheads.

(6) A statement by the owner or operator of the source as to whether he can comply with the standards prescribed in this part within 90 days of the effective date.

(b) The owner or operator of an existing source unable to operate in compliance with the standard prescribed under this subpart may request a waiver of compliance with such standard for a period not exceeding two years from the effective date. Any request shall be in writing and shall include the following information:

(1) A description of the controls to be installed to comply with the standard.

(2) A compliance schedule, including the date each step toward compliance will be reached. Such list shall include as a minimum the following dates:

(i) Date by which contracts for emission control systems or process modifications will be awarded, or date by which orders will be issued for the purchase of component parts to accomplish emission control or process modification;

(ii) Date of initiation of onsite construction or installation of emission control equipment or process change;

(iii) Date by which onsite construction or installation of emission control equipment or process modification is to be completed; and

(iv) Date by which final compliance is to be achieved.

(3) A description of interim emission control steps which will be taken during the waiver period.

(c) Changes in the information provided under paragraph (a) of this section shall be provided to the Administrator within 30 days after such change, except that if changes will result from modification of the source, as defined in § 61.02, the provisions of §§ 61.07 and 61.08 are applicable.

(d) The format for reporting under this section is included as Appendix A of this part. Advice on reporting the status of compliance may be obtained from the Administrator.

[FR Doc. 85–4298 Filed 2–20–85; 8:45 am]
BILLING CODE 6560–50–M

Title 40—Protection of Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER F—RADIATION PROTECTION PROGRAMS

[FRL 659-6]

PART 190—ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR NUCLEAR POWER OPERATIONS

On May 10, 1974, the Environmental Protection Agency (EPA) published an advance notice of intent to propose environmental radiation protection standards for the uranium fuel cycle (39 FR 16906) and invited public participation. On May 29, 1975, EPA proposed regulations setting forth such standards (40 FR 23420) pursuant to the Atomic Energy Act, as amended, and Reorganization Plan No. 3 of 1970 (35 FR 15623). Numerous written comments were received, and a public hearing was held on March 8–10, 1976 (41 FR 1124 and 41 FR 5349).[1]

These regulations setting forth environmental radiation standards are hereby promulgated in final form. The standards specify the levels below which normal operations of the uranium fuel cycle are determined to be environmentally acceptable. A number of changes have been made in the proposed regulations in response to comments received. These changes modify and clarify the areas of applicability of the standards and their effective dates, and expand the conditions under which variances may be granted. The numerical levels of the standards have been retained as proposed.

The Agency has benefited from extensive public participation during the course of the development of these regulations. Sixteen comment letters were received in response to the Agency's May 10, 1974, notice of intent to propose standards, and 82 comment letters following the publication of proposed regulations on May 29, 1975. Letters were received from a broad cross-section of representatives of the general public, the industry, professional groups, the States, and Federal agencies. In addition, 17 parties participated in three days of public hearings and, in many cases, submitted extensive additional written testimony. In all, the contributed record comprises over 3500 pages. Comment letters, a transcript of the public hearing, and all submitted testimony are available for viewing and copying in the Agency's Public Information Reference Unit, Room 2922, U.S. Environmental Protection Agency, 401 M Street SW., Washington, D.C. 20460. The Agency has considered all of this record in reaching its conclusions for these final regulations.

At the time these standards were proposed, EPA released a Draft Environmental Statement and solicited public comments. A Final Environmental Statement is being made available concurrently with the promulgation of these standards. This statement contains the comments received on both the proposed standards and the draft statement, and EPA's response to these comments. Single copies of the Final Environmental Statement and an additional document containing EPA's detailed responses to testimony received in connection with the public hearing are available from the Director, Criteria and Standards Division (AW-460), Office of Radiation Programs, Environmental Protection Agency, Washington, D.C. 20460. Persons interested in a summary discussion of the background, rationale, interpretation, and significance of these standards should consult the notice proposing these regulations and, for greater detail, the Final Environmental Statement.

Major Issues Raised During Review

Three major issues were raised by commenters. These were: (1) concern that procedures for implementation of the standards would be unnecessarily conservative or costly, (2) disagreement over the need for and cost-effectiveness of control of environmental releases of krypton-85 and other long-lived radionuclides, and (3) disagreement over the form of the relationship between effects on health and radiation dose assumed in deriving these standards.

A large number of commenters expressed the view that implementation would lead to more restrictive control of effluents than intended due to the use of unnecessarily conservative models for source terms, control capability, and environmental transport, and due to requirements for unreasonably large margins between normal operating levels and the standards, especially at sites containing a number of facilities. The authority to regulate fuel cycle facilities under these standards resides in the Nuclear Regulatory Commission (NRC), or, in some cases, the States, under agreements with NRC. The standards have been expressed in terms of the dose to members of the public, rather than to hypothetical receptors, in order to encourage the use of realistic models by the regulatory agency. In addition, the Agency has made its intent regarding realistic implementation clear, as, for example, in the discussion of these matters in the Final Environmental Statement and will continue to do so if necessary as implementation proceeds, to assure that unnecessary conservatism does not occur.

In this regard, the NRC has recently issued a revised set of regulatory guides for light-water-cooled reactors which implement their announced intent to use the most realistic models available when adequate experimental data exist to permit a prudent and scientific determination. These models are intended for use in implementing the recently-issued Appendix I to 10 CFR Part 50, which defines design and operating criteria for single reactor units. EPA has examined Appendix I and the accompanying regulatory guides and agrees that they provide the basis for realistic implementation of these standards for single reactor units. The existence of these requirements, coupled with the realization that most existing reactor licenses are for no more than one or two units on a site, makes it unnecessary, in the Agency's judgment, to reexamine the license conditions of these licensees for compatibility with these standards, unless the nearest neighboring site covered by this standard is within ten miles. In these latter cases small adjustments may be necessary. However, in the vast majority of situations, the sum of all reasonably postulable contributions from sources other than the immediate site will be small compared to these standards and should be ignored in assessing compliance. It would not be reasonable to attempt to incorporate into compliance assessment doses which are small fractions of the uncertainties associated with the determination of doses from the primary source of exposure. The Agency has also concluded that, except under highly improbable circumstances, conformance to these criteria should provide reasonable assurance of compliance with these standards for up to five units on a site. This conclusion is based, among other considerations, upon realistic consideration of anticipated site sizes and the relative location of individual units, as well as the stochastic nature of effluent releases.

A number of commenters, including the NRC, also noted that shutdown of nuclear facilities for minor deviations from the standards would not be reasonable. The Agency agrees, and notes that the use of such an extreme measure is not required under present compliance procedures for licenses issued pursuant to the Atomic Energy Act, and that these regulations do not add such a requirement. A graded scale of action is an appropriate regulatory response for achieving conformance. This may include, for example, requirements for corrective actions, appropriate penalties, and, in extreme cases, cessation of operations. The Agency is confident that the NRC will implement these standards in such a reasonable manner.

Some commenters expressed the view that it was not feasible to monitor con-

[1] In this connection the Agency received requests on behalf of Allied-General Nuclear Services (AGNS) on October 4 and December 2, 1976, for a supplemental hearing on certain aspects of this rulemaking, on the grounds that the Agency is, in part, relying upon information acquired subsequent to the public hearing which, in the view of AGNS, would be an essential basis for the rulemaking but is erroneous. The Agency has reviewed the materials submitted in support of this request and concluded that they would not provide a sufficient basis for altering its conclusions. A response to new matters addressed by this material has been appended to the Agency's commentary on testimony received in connection with the public hearing on these standards. In addition it is noted that the Agency has previously (40 FR 23420) made public its intent " * * * to maintain a continuing review of the appropriateness of these environmental standards * * * and to revise them, if necessary, on the basis of information that develops in the interval." In view of the above, the Agency has concluded that it is neither necessary nor appropriate to grant now the additional public hearing requested. We will, of course, welcome the submission of additional factual data on the matters concerned as it becomes available.

formance with these standards through the use of environmental measurements. The Agency agrees that routine monitoring based exclusively upon environmental measurements would not be a reasonable means for assuring conformance and the regulations do not contain such a requirement. Environmental objectives are generally best achieved through controls exercised at the source. For this reason effluent monitoring is generally preferable and such measurements, when combined with regulatory models for environmental transport, would provide quite adequate demonstration of conformance with the standards for the vast majority of situations, based upon existing experience. However, since varying degrees of conservatism and uncertainty exist in all environmental models, the Agency believes it will often be appropriate to supplement effluent monitoring with confirming environmental measurements, as is now the regulatory practice. In the case of light water reactors, models and monitoring requirements for demonstrating conformance with Appendix I of 10 CFR Part 50 are generally adequate for demonstrating conformance with these standards. Similar models and measurements would, in general, be appropriate for most other types of facilities.

In the special case of possible windblown effluents from mill tailings, the existence of operational measures (e.g., temporary or permanent stabilization) should normally be the criterion used for verifying compliance, in lieu of effluent and environmental monitoring, because of the difficulty associated with such measurements. It should be noted that doses resulting from exposure to radon and its daughters, which are discharged from a mill site (or result from material which has been discharged), are excluded, but that gamma radiation crossing site boundaries from any on-site source is covered.

In situations where members of the public are actually exposed, these standards, in effect, preempt those regulations which are based upon the Federal Radiation Protection Guides (25 FR 4402) insofar as exposure of the public is due to operations defined to be included in the uranium fuel cycle. For example, the dose limits in 10 CFR Part 20 would not be the limiting consideration regarding exposure of members of the public as a result of uranium fuel cycle operations. These standards do not, however, replace application of the Radiation Protection Guides to the regulation of sources not included within the scope of the uranium fuel cycle. Finally, the graded scale of actions established in 1961 (26 FR 9057) for use in implementing the Radiation Protection Guides do not apply to implementation of these standards, but would remain in effect for implementation of radiation protection guides for other radiation sources.

Several commenters expressed the view that a requirement for control of the unrestricted release of krypton to the environment from fuel cycle operations was: (a) beyond the jurisdiction of EPA, (b) unreasonably costly, (c) not achievable by 1983, the proposed implementation date (or, in the view of some commenters, was achievable prior to 1983), or (d) not a reasonable requirement of domestic industry until international agreements are achieved to restrict emissions from foreign sources.

The Agency has concluded that its jurisdiction is clear. Reorganization Plan No. 3 of 1970 specifically transferred to EPA from the Atomic Energy Commission the authority to establish standards for "* * * quantities of radioactive materials in the environment * * *" and attaches no conditions to this authority except a requirement that the standards apply outside the boundaries of licensees.

EPA has carefully reexamined the costs of control systems for krypton and has concluded that a substantial portion of the additional costs presented at the public hearings is correct. This analysis is reviewed in the Final Environmental Statement. However, in spite of these increased costs, the installation of controls for krypton-85 is believed to be justified by the public health benefits achievable. In today's dollars, the cost per unit radiation dose reduction at future reprocessing facilities will be $50–$75 per man-rem for whole body doses, and considerably less than this for doses to other organs. These values are more than an order of magnitude lower than limiting costs now specified in regulations governing the licensing of individual nuclear power reactors. It is recognized that the cost of retrofitting one facility which is expected to be in operation before 1983 will involve greater costs, and the regulatory agency is encouraged to explore means to minimize costs to this facility in its implementation of the standard for this pilot case.

Regarding the achievability of control over the release of krypton-85 to the environment by 1983, it is noted that this or similar control technology is already being offered commercially for nuclear reactors and fuel reprocessing facilities, and is currently being installed, or is on order, at several U.S. reactors and at a foreign fuel reprocessing facility by U.S. suppliers. The Agency, therefore, believes that 1983 is an achievable implementation date. However, a more accelerated schedule is not considered justified, in view of the small amount of reprocessing that will occur before that date and the present lack of operating experience with krypton controls.

Finally, we have examined arguments concerning the need for international agreement prior to the establishment of standards and do not find them persuasive. EPA fully supports the development of international agreements, and is presently participating in the development of international guidance for control of radioactive effluents from the fuel cycle under the auspices of the International Atomic Energy Agency. A number of countries are already committed to or are in the process of committing themselves to control of krypton releases. The Agency supports this trend and has concluded that the control of U.S. releases of krypton-85 is warranted on the basis of reducing its potential worldwide public health impact. In initiating a requirement for this control, the United States fulfills its responsibility, as the world's largest user of nuclear power, to provide leadership in this matter.

A number of commenters suggested that the proposed regulations should be amended to include standards for carbon-14 and, in some cases, other long-lived radionuclides. The Agency has studies of sources and controls for these materials underway and anticipates that proposals for appropriate environmental standards for carbon-14 can be made shortly, with consideration of proposals for other materials following at a later date. However, the knowledge base is not yet sufficient to permit incorporation into these standards now.

Comments were received reflecting many points of view on health effects issues. One group agreed with the Agency's primary reliance on risk estimates provided by the recent report to EPA of the National Academy of Sciences ("The Effects on Populations of Exposure to Low Levels of Ionization," Report of the Advisory Committee on the Biological Effects of Ionizing Radiation, NAS–NRC, 1972). These estimates are primarily based upon a linear interpolation between existing data on human populations and the assumption of no effects at zero dose. Another group believed this model is not sufficiently conservative to adequately protect public health, based upon several investigators' hypotheses concerning the shape of the dose-effect relationship at low doses. A third group believed these estimates to be too conservative at low doses and low dose-rates. Frequent reference was made by the third group to a report of the National Council on Radiation Protection and Measurements (Report No. 43) which implies that radiation standards should not be based upon numerical estimates of health effects, and a recent report of the Nuclear Regulatory Commission (NUREG–75/014) which presents, in addition to risk estimates based upon the National Academy of Sciences report, some lower risk estimates based upon a belief that dose-rate dependent phenomena exist for low linear energy transfer radiation (gamma rays and beta particles) which reduce the carcinogenic effect of radiation to levels lower than those predicted by the linear model. The Agency has examined the evidence for each of the above views and concluded that, while each may have validity under various assumptions or for various specific situations, the weight of currently available scientific evidence supports the continued use of a linear, nonthreshold model for deriving standards to protect public health.

Changes Made in the Proposed Regulations

A number of changes have been made in response to comments received on the proposed regulations. The following describes and provides the reasons for each of these changes:

1. Paragraph 190.02(b) has been changed to delete transportation as an operation covered by these standards and to specifically exclude waste disposal sites, which were previously not mentioned. The Agency is addressing the development of criteria and standards for management of radioactive wastes as a separate matter, as mentioned in the notice proposing these standards.

A number of commenters, including the NRC and the Department of Transportation, pointed out the difficulty of implementing these standards for transportation activities, particularly noting the problems near nuclear facilities. In such cases an apportionment of the dose limits would appear to be necessary in order to avoid unreasonably extensive monitoring requirements for members of the public. Since studies by both EPA and NRC show that most transportation-related doses are expected to remain at small fractions of these standards in any case, the implementation difficulty does not appear to warrant their inclusion in these standards limiting doses to individuals from uranium fuel cycle operations. The Agency will instead address this matter under its broad authority inherited from the former Federal Radiation Council, through the development of more general guidance to all Federal agencies concerning radiation exposure arising from the transportation of all types of radioactive materials, not just those from the uranium fuel cycle.

2. Paragraph 190.02(d) is changed to reflect the definition of "site" implied by Reorganization Plan No. 3 of 1970.

3. Paragraph 190.02(f) is changed by adding the word "spontaneously" to reflect the Agency's original intent.

4. Paragraph 190.02(g) is deleted and subsequent paragraphs in Section 190.02 are renumbered. This paragraph defined uranium ore as ore containing 0.05% or more uranium by weight. As pointed out by one commenter, it is not desirable to exclude ores containing less than this quantity of uranium, since future demand for ore may make the use of such ores economically feasible.

5. Section 190.11 has been broadened to permit a greater degree of discretion to the regulatory agency to develop and apply conditions for the granting of variances. As pointed out by a number of commenters, it is not reasonable to predicate the justification for variances solely on public need for orderly delivery of power. For example, a facility may have installed a control system which, in spite of good faith performance on the part of the supplier and the user, may fail to achieve operational capability on a timely basis, or, once installed may experience operational failure at some time, yet operation of the facility may not be essential to the "orderly delivery of electrical power." In addition, some portions of this standard are predicated upon the use of waste treatment systems not yet in general commercial use. Although in no case should operation continue if safety is compromised, it may easily be that excursions above these standards would occur in such cases to a degree that the added risk to the general public is small and the environmental effect is acceptable in comparison to the economic penalty that would be associated with cessation of operation or the anticipated public health and environmental impact of available alternative sources of power. For this reason, the variance provision has been broadened so that the regulatory agency may, if it deems it to be in the public interest, grant a variance in such situations. It should be noted, however, that the variance provision applies only to temporary and unusual situations. It is expected that continued operation under the variance provision will be predicated upon an approved plan to achieve compliance in an expeditious fashion, that is, in as short a time as is reasonably achievable.

The requirement for public documentation of variances has been clarified and extended to apply to this broadened provision. EPA will not review individual variances or compliance plans, which will be made public in accordance with the provisions of paragraph 190.11(b), but will maintain a general overview through periodic review of the use of this Section.

6. Section 190.12(a) has been changed to provide that the effective date for the standards limiting doses to individuals shall be December 1, 1979, for all operations except the milling of uranium ore, for which the effective date shall be December 1, 1980.

The NRC has carefully examined its existing programs for implementation of Appendix I at light-water-cooled reactors, and the feasibility of integrating implementation of these standards into that on-going process, as well as, in parallel, implementing these standards at other types of fuel cycle facilities through development and promulgation of new regulatory guides and individual license conditions. Finally, there are matters regarding reactors which will require generic treatment, such as the conditions required for compliance when there are multiple units on single sites. It is the conclusion of the NRC, and the Agency concurs, that the originally proposed two-year implementation period is insufficent and that three years will be required to complete this process. The NRC review of these matters regarding implementation has revealed that the case of mills is unique, since better information is required concerning a number of alternatives for stabilization of tailings—both as to their relative merit and the degree of periodic maintenance required. On June 3, 1976, the NRC published (41 FR 22430) a notice of intent to prepare a generic environmental statement on uranium milling operations. This effort will be completed in approximately two years, and includes field measurements with participation of both EPA and NRC personnel. In addition, the NRC issued proposed new effluent reporting requirements at mills on November 17, 1975 (40 FR 53230). In view of the above considerations, it is the jointly agreed upon conclusion of the Agency and NRC that a four-year implementation period is required at mills, rather than the three years provided for all other fuel cycle operations.

7. Section 190.12(b) has been changed to clarify the Agency's original intent that the standards specified in paragraph 190.10(b) apply to radioactive materials produced after the effective date.

The Agency anticipates that promulgation of these standards will serve, in addition to providing for necessary protection of public health, to alleviate some of the uncertainties associated with the design of environmental controls for fuel cycle facilities, and the consequent economic penalties, through stabilizing and providing direction to the process of development of standards and regulations. The economic and inflationary impacts of these regulations have been evaluated in accordance with Executive Order 11821 and it has been determined that an Inflation Impact Statement is not required. (The estimated annual cost of additional effluent controls required by these regulations is in no case greater than ten to twenty million dollars, which is significantly less than the one-hundred million dollar annual cost cut-off established as the minimum for which an Inflation Impact Statement is required.)

Notice is hereby given that pursuant to the Atomic Energy Act of 1954, as amended, and Reorganization Plan No. 3 of 1970 Title 40, Chapter I, of the Code of Federal Regulations is amended by adding a new Subchapter F and Part 190 as set forth below.

Dated: December 28, 1976.

RUSSELL E. TRAIN,
Administrator.

A new Subchapter F, consisting of Part 190, is added to 40 CFR Chapter I as follows:

SUBCHAPTER F—RADIATION PROTECTION PROGRAMS

PART 190—ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR NUCLEAR POWER OPERATIONS

Subpart A—General Provisions

Sec.

Subpart B—Environmental Standards for the Uranium Fuel Cycle

AUTHORITY: Atomic Energy Act of 1954, as amended; Reorganization Plan No. 3, of 1970.

Subpart A—General Provisions

§ 190.01 Applicability.

The provisions of this Part apply to radiation doses received by members of the public in the general environment and to radioactive materials introduced into the general environment as the result of operations which are part of a nuclear fuel cycle.

§ 190.02 Definitions.

(a) "Nuclear fuel cycle" means the operations defined to be associated with the

production of electrical power for public use by any fuel cycle through utilization of nuclear energy.

(b) "Uranium fuel cycle" means the operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel, to the extent that these directly support the production of electrical power for public use utilizing nuclear energy, but excludes mining operations, operations at waste disposal sites, transportation of any radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and by-product materials from the cycle.

(c) "General environment" means the total terrestrial, atmospheric and aquatic environments outside sites upon which any operation which is part of a nuclear fuel cycle is conducted.

(d) "Site" means the area contained within the boundary of a location under the control of persons possessing or using radioactive material on which is conducted one or more operations covered by this Part.

(e) "Radiation" means any or all of the following: alpha, beta, gamma, or X-rays; neutrons; and high-energy electrons, protons, or other atomic particles; but not sound or radio waves, nor visible, infrared, or ultraviolet light.

(f) "Radioactive material" means any material which spontoneously emits radiation.

(g) "Curie" (Ci) means that quantity of radioactive material producing 37 billion nuclear transformations per second. (One millicurie (mCi) = 0.001 Ci.)

(h) "Dose equivalent" means the product of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its spatial distribution in the body. The unit of dose equivalent is the "rem." (One millirem (mrem) = 0.001 rem.)

(i) "Organ" means any human organ exclusive of the dermis, the epidermis, or the cornea.

(j) "Gigawatt-year" refers to the quantity of electrical energy produced at the busbar of a generating station. A gigawatt is equal to one billion watts. A gigawatt-year is equivalent to the amount of energy output represented by an average electric power level of one gigawatt sustained for one year.

(k) "Member of the public" means any individual that can receive a radiation dose in the general environment, whether he may or may not also be exposed to radiation in an occupation associated with a nuclear fuel cycle. However, an individual is not considered a member of the public during any period in which he is engaged in carrying out any operation which is part of a nuclear fuel cycle.

(l) "Regulatory agency" means the the government agency responsible for issuing regulations governing the use of sources of radiation or radioactive materials or emissions therefrom and carrying out inspection and enforcement activities to assure compliance with such regulations.

Subpart B—Environmental Standards for the Uranium Fuel Cycle

§ 190.10 Standards for normal operations.

Operations covered by this Subpart shall be conducted in such a manner as to provide reasonable assurance that:

(a) The annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations.

(b) The total quantity of radioactive materials entering the general environment from the entire uranium fuel cycle, per gigawatt-year of electrical energy produced by the fuel cycle, contains less than 50,000 curies of krypton-85, 5 millicuries of iodine-129, and 0.5 millicuries combined of plutonium-239 and other alpha-emitting transuranic radionuclides with half-lives greater than one year.

§ 190.11 Variances for unusual operations.

The standards specified in § 190.10 may be exceeded if:

(a) The regulatory agency has granted a variance based upon its determination that a temporary and unusual operating condition exists and continued operation is in the public interest, and

(b) Information is promptly made a matter of public record delineating the nature of unusual operating conditions, the degree to which this operation is expected to result in levels in excess of the standards, the basis of the variance, and the schedule for achieving conformance with the standards.

§ 190.12 Effective date.

(a) The standards in § 190.10(a) shall be effective December 1, 1979, except that for doses arising from operations associated with the milling of uranium ore the effective date shall be December 1, 1980.

(b) The standards in § 190.10(b) shall be effective December 1, 1979, except that the standards for krypton-85 and iodine-129 shall be effective January 1, 1983, for any such radioactive materials generated by the fission process after these dates.

[FR Doc.77-393 Filed 1-12-77;8:45 am]

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:39 PM
To: Thornton, Marisa
Subject: FW: References 2.0 - Readable!!??

From: Rosnick, Andrew
Sent: Tuesday, July 08, 2014 3:33 PM
To: Nesky, Anthony
Subject: RE: References 2.0 - Readable!!??

Tony,

Take a look at these and make sure that I did it right, I believe that they are upside down, so just go to view → Rotate View → and then click either clockwise or counter-clockwise twice.

Names are still the same. I will send in 2 separate emails because the data limit was reached on this email.

Andrew

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 2:00 PM
To: Rosnick, Andrew
Subject: FW: References 2.0 - Readable!!??

Please rescan this file—we only got the cover page, and not the whole announcement.

Tony Nesky
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From: Thornton, Marisa
Sent: Tuesday, July 08, 2014 1:28 PM
To: Nesky, Anthony
Subject: RE: References 2.0 - Readable!!??

Should this file be only 1 page? Which is the cover page? What's the correct number for this file FR153865 or FR15385?

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**

- Metadata:
- Title: Work practice standard for Underground Uranium Mines
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: "FR**153865**" "EPA" "work practice standards" "underground uranium mines"

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 12:24 PM
To: Thornton, Marisa
Subject: FW: References 2.0 - Readable!!??

OK, let's try this again--

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

Metadata:

Title: EPA established environmental protection standards

Author: EPA/OAR/Office of Radiation and Indoor Air

Subject: environmental protection standards for nuclear power operations;

Keywords: "FR2858" "EPA" "environmental protection standards," "Atomic Energy Act"

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
    - **FR43906.PDF**
- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn"
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: "FR43906" "EPA" "NESHAPS" "Phosphorous Plants"

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
    - **FR7280.PDF**
- Metadata:
- Title: Final Standards for Elemental Phosphorous Plants DOE-Facilities, and NRC-Licensed Facilities"
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: "FR7280" "EPA" "standards" "Phosphorous Plants" "DOE-Facilities" "NRC-Licensed Facilities"

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**
- Metadata:
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- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: "FR**153865**" "EPA" "work practice standards" "underground uranium mines"

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
    - **FR34056.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radon-222 Emissions from Licensed Uranium Mill Tailings"
- Keywords: "FR**34056**" "EPA" "NESHAP " "Radon-222" "Uranium" " Tailings"

- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
    - **FR9612.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Proposed NESHAP for Radionuclides
- Keywords: "FR**9612**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
    - **FR51654.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of RadionuclidesAuthor:
- EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radionuclides
- Keywords: "**FR51654**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.

- **FR36280.PDF**

- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Final NESHAP for Radionuclides
- Keywords: "**FR36280.**" "EPA" "NESHAP " "radionuclides" "final "rule"

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From: Rosnick, Andrew
Sent: Tuesday, July 08, 2014 12:14 PM
To: Nesky, Anthony
Subject: References 2.0 - Readable!!??

These should work but let me know if there is something wrong!!!

Andrew

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
  - **FR2858.PDF**

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
  - **FR43906.PDF**

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
  - **FR7280.PDF**

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  - **FR153865.PDF**

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
  - **FR34056.PDF**

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- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
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Attachments: FR51654.pdf; FR51654.pdf

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Second Half of the References.

Andrew

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To: Rosnick, Andrew
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- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
    - **FR43906.PDF**
- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn"
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
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- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
    - **FR9612.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule
  Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Proposed NESHAP for Radionuclides
- Keywords: "FR**9612**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
    - **FR51654.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of RadionuclidesAuthor:
- EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radionuclides
- Keywords: "**FR51654**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.
    - **FR36280.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides
- Author: EPA/OAR/Office of Radiation and Indoor Air

- Subject: Final NESHAP for Radionuclides
- Keywords: "**FR36280.**" "EPA" "NESHAP " "radionuclides" "final "rule"

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From: Rosnick, Andrew
Sent: Tuesday, July 08, 2014 12:14 PM
To: Nesky, Anthony
Subject: References 2.0 - Readable!!??

These should work but let me know if there is something wrong!!!

Andrew

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
  - **FR2858.PDF**

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
  - **FR43906.PDF**

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
  - **FR7280.PDF**

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
  - **FR153865.PDF**

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
  - **FR34056.PDF**

- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
    - **FR9612.PDF**

- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
    - **FR51654.PDF**

- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.
    - **FR36280.PDF**

step. Most of these latter commenters believed that the MIR should be the sole criterion for making the acceptable risk decision, and that uncertainties and other factors are best considered in the ample margin of safety step. In so doing, some added that these uncertainties should not be addressed by incorporating unscientific, over-conservative assumptions into the risk assessments.

Response: The EPA believes that it is essential to consider the quality of the information it uses to make decisions when the decisions are being made. Thus, EPA agrees with commenters that stated that it would be inappropriate to evaluate the "safe" level and the "margin of safety" without taking the uncertainties (both scientific and technological) into account. Because EPA has concluded that many factors should be considered in making the acceptable risk decision, the EPA disagrees with commenters who believed that MIR should be the sole criterion for making the acceptable risk decision and that uncertainties and other factors are best considered in the ample margin of safety step.

Comment: When estimates are imprecise, accurate quantified statements of uncertainty are essential; these factors must be actively involved in the decision-making process both for regulations and site-specific permitting decisions.

Response: The EPA has initiated a substantial effort to quantify the uncertainty in its radiation risk estimates. However, until quantitative uncertainty estimates are available, the Agency must base its decisions on the current measures of uncertainty at its disposal.

Comment: It would be inconsistent with the EPA's distinction between risk assessment and risk management for the Agency to deal with bona fide scientific questions at the stage of deciding what probability of contracting cancer is "acceptable." Risk considerations alone should be dealt with in this first step. Moreover, an adequate data base must be established for technical, scientific, and economic considerations before these can be balanced with acceptable risks.

Response: The EPA disagrees that bona fide scientific questions are inappropriate at the risk management step. The EPA's risk assessments are based on what it considers the best available scientific evidence, with conservative but reasonable assumptions made when necessary. At the risk management step, the decisionmakers need to know the uncertainties associated with the risk estimates and the range of scientific opinion regarding the assumptions that have been included in the assessment.

Comment: Some commenters suggested that the proposed rules are improperly based on incomplete technical analyses.

Response: The final rules are the result of extensive research and technical analysis conducted over a period of several years, and, thus, the record underlying the rules is reasonably complete and accurate. Commenters' technical comments, as well as those of other commenters, are incorporated into the record to the extent they proved pertinent. In arriving at the acceptable risk decisions under CAA section 112 for these rules, costs and technological feasibility were not considered. Such were considered along with the health-related factors, however, in determining whether more stringent rules were needed in arriving at the statutorily required ample margin of safety.

Comment: Several commenters have asserted that EPA's risk assessments are not realistic but are worst case estimates. Some commenters objected to EPA's assumption that people living in the vicinity of radionuclide sources were exposed continuously, for a 24 hours per day 70-year lifetime, to predicted long-term ambient radionuclide levels. Commenters maintained that the average lifetime of an industrial facility is considerably less than 70 years, and that few individuals would be expected to live in the same location for their entire lives.

Response: The EPA recognizes that the assumption of 70 years of continuous exposure constitutes a simplification of actual conditions and represents, in part, a policy judgment by EPA, but feels that this assumption is preferable to other alternatives. Although emissions of radionuclides from industrial sources would reasonably be expected to change over time, such changes cannot be predicted with any certainty. In lieu of closing, plants may elect to replace or even expand their operations and subsequently increase their emissions. The 70-year exposure duration represents a steady-state emissions assumption that is consistent with the way in which the measure of carcinogenic strength is expressed (i.e., as the probability of contracting cancer based upon a lifetime [70 year] exposure to a unit concentration). Constraining the analysis to an "average" plant lifetime carries the implication that no one could be exposed for a period longer than the average. Since by definition, some plants would be expected to emit longer than the average, this assumption would tend to underestimate the possible MIR. The EPA agrees that the U.S. population is highly mobile. However, adjusting the exposure assumptions to constrain the possibility of exposure to emissions implies that exposure during the periods away from the residence are zero. In addition, a less-than-lifetime assumption would also have a proportional impact on the estimated MIR, suggesting that no individual could be exposed for 70 years. On balance, EPA believes that the present assumption of continuous exposure is consistent with the steady-state nature of the analysis and with the stated purpose of making plausible, if conservative, estimates of the potential health risks. It is the EPA's opinion that this assumption, while representing in part a policy judgment by EPA, continues to be preferable to adopting a shorter lifetime figure, both in view of the shortcomings of such alternatives and in the absence of compelling evidence to the contrary.

Comment: The EPA should measure the gain in risk reduction made against the costs to reach such gain and compare the benefits against the increased risk borne by workers.

Response: The EPA does consider both the incremental reduction in risk and the costs at the ample margin of safety step. The EPA is unaware of any increase in worker exposure that will be caused by the promulgated NESHAPs.

6. Scope of the Regulations

Comment: Several commenters stated that NESHAPS should be developed for other sources or categories of radionuclide emissions including that from Naturally Occurring Radioactive Materials (NORM) contamination of oil and gas production equipment and in construction materials, and also from naturally occurring radon in the soil that underly residences, schools, businesses and offices. They questioned whether emanation rates of radon (222 and 220) from coal stockpiles, boilers, fly ash, and bottom ash significant for regulation under the NESHAP program.

Response: The EPA believes that the source categories evaluated in this rulemaking represent the sources with the greatest potential for causing unacceptable risks from radionuclide emissions to ambient air. The Agency has examined the potential problem of radon in natural gas provided to homes and found that the transit times allow for the decay of the radon to acceptable levels. Emissions of radon from coal piles and coal ash piles has also been examined, as part of the CERCLA rulemaking on Reportable Quantities,

with similar results. EPA will continue to look at these and other potential sources to see if they are appropriate sources for regulation under section 112. Finally, it must be noted that EPA's authority under CAA Section 112 is limited to the regulation of source categories of toxics to ambient air and, thus, lacks authority to regulate or control naturally ocurring radon in soils that underly homes or businesses under this code section.

Comment: Consideration should be given to the problems presented by overlapping sources, any increase in the number of facilities within each category over time, and the goal of controlling the total incremental pollution for all radionuclide emissions from all source points in all twelve source categories.

Response: The Agency agrees and its policies on acceptable risk levels are based, in part, on assuring that risks caused by overlapping and multiple sources do not result in individuals receiving an unacceptable level of exposure and risk. Explicitly accounting for overlapping and multiple sources of exposure greatly complicates the calculation of exposures and risks. Since concentrations of radionuclides decline rapidly with distance from a source, however, it is highly unlikely that any individual could be the most exposed individual for more than one source. In most cases, members of the public will receive risks less than 1×10^{-6} from more than one source.

Comment: The standards should address cumulative health impacts resulting from exposures to multiple radiological and nonradiological pollutants emitted by the same or multiple sources located in relative proximity to one another.

Response: Although EPA has been unable to quantify cumulative and synergistic health impacts for multiple hazardous materials and sources have not been accurately qualified, it is our judgment that if such effects could be accurately quantified, they would not substantially alter EPA's conclusions in this rulemaking.

Comment: The standards consider only fatal cancers and fail to take into account the entire range of chronic debilitating and incapacitating diseases that may result from radionuclide emissions.

Response: EPA has taken into account the entire range of chronic debilitating and incapacitating diseases that may result from radionuclide emissions.

Comment: Proposed standards are based on what the EPA perceives as achievable rather than a safe level of airborne radioactivity emissions; this is not an appropriate basis for setting air emission standards under the Act.

Response: The EPA believes that its standards ensure an acceptable level of risk to public health with an ample margin of safety as required by the Clean Air Act and the decision in *Vinyl Chloride*. The Agency has established a threshold presumption that lifetime fatal cancer risks to individuals of approximately 1×10^{-4} are acceptable under the *Vinyl Chloride* decision, and has attempted to assure that as many persons as possible do not receive lifetime risks greater than 1×10^{-6}.

Comment: The potential effect of the proposed rule on Federal preemption in the area of regulation of facilities needs to be carefully considered. Nuclear facilities are unique and complex, and consistent regulation is in the best interest of the public. Congress determined that national regulation of nuclear power plants is appropriate in establishing the Atomic Energy Act.

Response: The Agency agrees that consistent regulation is in the interest of the public and has promulgated national emissions standards that apply to nuclear power plants. However, the Clean Air Act does not preempt state standards that are at least as stringent as those set by the Federal Government.

Comment: The consistency of these standards with other existing and proposed radiation standards, for air pathways and other pathways, should be discussed.

Response: As noted in the March 7, 1989 Federal Register notice for the proposed standards, the statutory requirements of CAA section 112 differ from the requirements of other authorities under which the EPA and other regulatory bodies set radiation standards. Therefore, the first priority for EPA is to assure that the regulations promulgated are in accordance with its statutory mandate.

Comment: All facilities that emit similar radionuclides should be held to the same emission standards; a remote facility should not be allowed higher emission rates than an urban facility, nor should a government or municipal facility be allowed higher emission rates than a private or industrial facility.

Response: The EPA's decisionmaking approach in setting final rules assures that all members of the public are adequately protected, regardless of the source of their exposure or their choice of residence in an urban, suburban, rural, or remote area of the country. The EPA believes that different source categories may be treated differently even if they emit similar pollutants, so long as the final standard protects public health with an ample margin of safety.

Comment: The Clean Air Act does not allow for dose standards.

Response: We disagree with those commenters stating that Congress in directing the Agency to set emission standards did not authorize that those standards be set in terms of dose to an individual. CAA section 302(k) defines the term "emission standard" to include limits on the quantity, rate, or concentration of an air pollutant and the Agency views dose standards fully consistent with that definition. In many cases, because there are over two hundred known radionuclides, numerous different ones are emitted from an individual source. In addition, the risk due to each is a further function of many factors such as particle size and exact chemical state. An emission standard for radionuclides based on quantity at the stack would often be complex to the point of impracticality. A dose standard provides a better approach to protecting the public since it allows the establishment of a uniform limit based on consideration of all of the factors related to the particular mix of radionuclides emitted from each source. Moreover, this approach is supported by radiation protection experts and the regulated community.

Comment: Some commenters posit that Clean Air Act Section 112 does not, or should not, authorize EPA to regulate radionuclide air emissions from those sources, or categories of sources, that are already regulated pursuant to the Uranium Mill Tailings Radiation Control Act of 1978, Pub. L. No. 95-604, 92 Stat. 3021 (codified in scattered sections of 42 U.S.C.) ("UMTRCA"). These commenters reason that because UMTRCA was promulgated subsequent to the last comprehensive revisions to the Clean Air Act, and, because UMTRCA's statutory scheme is more specifically focused upon the sources to which it applies than is the Clean Air Act, EPA's authority under CAA Section 112 is, in effect, preempted.

Response: EPA disagrees that it lacks authority to regulate, under CAA Section 112, the radionuclide air emissions of sources also regulated under UMTRCA. Indeed, UMTRCA itself resolves this issue by quite explicitly stating that "[n]othing in this chapter applicable to byproduct material * * * shall affect the authority of the [EPA] under the Clean Air Act of 1970, as amended * * * " 42 U.S.C. section 2022(e). The legislative history is similar: "Authorities of the EPA under other laws would not be abridged by the new requirements." H. Rep. No. 1480,

95th Cong., 2d Sess. 6, reprinted in, 1978 U.S. Code Cong. & Admin. News 7433, 7444. In other words, there is no indication that Congress intended UMTRCA to preempt EPA's regulatory authority under the Clean Air Act; rather Congress expressly contemplated EPA authority to simultaneously regulate under both legislative schemes.

7. Procedural

Comment: Many commenters felt that the affected parties familiar with the proposed standards have not had adequate time to thoroughly review available documents, and many stated that many supporting documents were not available until mid-April. In addition, several stated that the material contained significant errors.

Response: The EPA made every effort to notify affected parties of the rulemaking action, and it timely prepared and distributed the background materials supporting the proposed rules. However, the court order under which this rulemaking has been conducted necessitated strict adherence to the schedule for public comments and hearings. The Agency is not aware of any significant errors in the risk assessment. Where additional or new information was provided or developed during the comment period, it has been incorporated into the Final Environmental Impact Statement (FEIS), also referred to as the Background Information Document (BID).

Comment: The Proposed Rulemaking Notice, published in the Federal Register on March 7, 1989, does not identify those who participated in its preparation. The authors of the Draft Environmental Impact Statement (DEIS) do not appear to represent the kinds of knowledge, experience, and expertise necessary for the task.

Response: The DEIS does identify the ORP staff members who contributed to the development of the background material and indicates that S. Cohen and Associates, Inc., the Office's Technical Support Contractor, provided considerable technical support and analysis. The Agency disagrees strongly that the participants in this effort lack the necessary knowledge, experience, and expertise to prepare the proposal or final rulemaking packages.

Comment: The conclusion of the Regulatory Flexibility Act analysis that this rule will have little or no impact on small businesses because virtually all small businesses regulated under this rule already comply with the proposed standards is unsupported.

Response: The final rule for NRC-Licensed and Non-DOE Federal facilities is the only NESHAP with the potential to affect small businesses. That standard is a baseline standard, which indicates that EPA is unaware of any particular facility that does not comply with the final rule. In doing its risk assessment, EPA looked at model facilities with relatively large emissions for that class of facility to ensure that the risk was not underestimated. Therefore, EPA believes that it is highly unlikely that any small business would have emissions which would exceed the standard.

Comment: An international panel of recognized health professionals and epidemiologist should review and comment on the health effects of these very low levels of proposed radiation protection standards.

Response: The Agency invited comments from all interested parties during the public comment period. Further, it has reviewed and considered the findings and recommendations of the NCRP, the ICRP, UNSCEAR, and the NAS in developing its risk coefficients. Finally, the risk coefficients used in this risk assessment were reviewed and approved by the Agency's Science Advisory Board.

Comment: Even among the various sources proposed for regulation in this rulemaking there does not appear to be an even handed application of the EPA's own analysis. The different regulatory standards proposed by the EPA for the various sources are irrational.

Response: The EPA disagrees. The proposed regulations were developed on a consistent basis for each of the four approaches. For the final rule, the EPA used a single approach to determine the level of each standard it set. The EPA believes that consistency among the standards has been achieved.

Comment: The EPA should defer final action in this rulemaking to permit public comment on the Science Advisory Board's Review of EPA's proposal.

Response: The court imposed schedule for this rulemaking does not permit the Agency to extend the public comment period.

Comment: The EPA should propose its enforcement policy for public review and comment.

Response: The EPA does not plan at this time to create a specific enforcement policy for these rules, but instead currently intends to enforce them in the same manner that it enforces other Clean Air Act standards.

8. Decision to List Under Section 112

The FR notice requested comments on the appropriateness of listing radionuclides as hazardous air pollutants under section 112 of the Act. Comments on this issue ranged from unequivocal support for listing to questions as to the justification for listing under this section of the Act. Many, while not necessarily opposing listing, stated that their particular source or source category should not be regulated under the Act due to the insignificant risks to public health presented, or, in light of the existence of other regulations.

Comment: Several commenters stated that the listing under section 112 is appropriate because a hazardous air pollutant includes those substances that may result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness. The EPA should apply the same risk assessment criteria to radionuclides that are applied to other toxic air pollutants regulated under section 112. Such an approach is the only way that the health protection goals will be achieved.

Response: The EPA agrees that listing under section 112 is appropriate, and it does apply the same approach and criteria to all risk assessments and standard setting under section 112. However, differences in our knowledge about different hazardous materials, differences in the modes of exposure (pathways), and differences in the assessment of exposure lead to different risk assessment methods.

Comment: Many oppose the listing of radionuclides for three main reasons: (1) Radionuclide emissions from all source categories constitute only 1/30th of natural background, which is an insignificant amount; (2) concentrations released into the general environment as a matter of routine emissions do not constitute the degree of hazard which section 112 was meant to regulate; and (3) there is no evidence with respect to the health effects of low level radionuclide emissions.

Response: The EPA believes that its listing of radionuclides as hazardous air pollutants under section 112 is proper and is compelled by both the weight of the scientific evidence and the Administrator's statutory duties under the Act. While the EPA agrees that there is no conclusive human epidemiological data demonstrating health effects at low levels of exposure, we believe that the preponderance of the scientific evidence (both human epidemiology at higher levels of exposure and the data from non-human sources) indicates that the linear non-threshold dose response model is consistent with the available data and its utilization for regulatory purposes is appropriate. The EPA disagrees that the levels of risks posed by releases of radioactive materials into

the air are below those the Congress intended to regulate under section 112. Finally, the EPA does not consider the comparison of the risks posed by man-made sources to the risks from background to be relevant. The level of exposure corresponding to safe with an ample margin of safety, not background, is the appropriate criterion for regulation under section 112. Many risks associated with natural background radiation are relatively high and, thus, are not appropriate as a benchmark for evaluating the need for regulation.

Comment: Some commenters felt that regulation of radionuclides under section 112 is appropriate but that EPA should exempt some categories of industries that are regulated under other authorities, unless the current emissions within the source category can be shown to be unsafe.

Response: The Agency has concluded that for source categories where emissions present or potentially present unacceptable risks, it should not defer to other regulatory authorities.

9. Technological and Economic Factors

Comment: The EPA should not be concerned with availability or feasibility of controls. It should simply establish the requirement and let industry determine how it will meet it.

Response: In determining the safe level, EPA agrees. Thus, at that stage it does not consider either the availability or feasibility of controls. These are considered, however, at the second step ample margin of safety determination. Moreover, where possible, such as with the NESHAP for underground uranium mines, the regulated community is given wide latitude in selecting the combination of controls and/or work practices that will allow them to meet the mandated level of the standard.

Comment: The factors the EPA should consider before requiring control technology include: commercial vendor availability, adaptability from other uses, readily understood and applicable operating principles, costs and health benefits. Availability to U.S. industry should not be based on foreign commercialization.

Response: In general, these are the factors that the EPA considers. However, the EPA sees no reason to automatically preclude a technology solely because it has been developed and commercialized only outside of the U.S.

Comment: A technological development that has been demonstrated to reduce emissions and is in use in or outside the U.S. should be considered available and required.

Response: The EPA agrees that the availability of demonstrated control technology should be considered. However, the requirement of additional controls, at the ample margin of safety step, rests also on consideration of costs and other factors.

Comment: Because of the existing regulatory framework that forces the use of control technology pursuant to the ALARA principle, the nuclear industry is already at a very low level of emissions and further regulation is merely duplicative.

Response: The EPA agrees that the emissions from many segments of the nuclear industry are at low levels. The EPA does not anticipate that facilities with state-of-the art control systems will need additional controls to comply with the limits of the NESHAP. However, EPA does not agree that in all circumstances regulation under CAA section 112 is unnecessary and indeed has determined that final rules are needed for the radionuclide source categories identified.

Comment: The EPA should not promulgate additional radionuclide emission regulations for the uranium fuel cycle (UFC) including nuclear power plants. The industry has a proven record of protecting the public health and safety from airborne radioactive emissions. This results from the conservative design of the facilities, the careful operating philosophy employed in these facilities, and the existing framework of EPA and NRC regulations. The public already enjoys better protection from UFC radionuclide emissions than from almost any other industry's emissions.

Response: As stated in the FR notice, the Administrator has determined that regulation of potentially significant risks should not be deferred to other regulatory authorities. Based on its evaluation of the doses and risks caused by UFC facilities, the EPA does not believe that non-milling facilities will have to modify their operations to comply with the NESHAP. However, EPA has agreed to reconsider the issue of duplication of regulation as described in the discussion on subpart I.

Comment: The DOE is concerned that the EPA has proposed an outdoor radon concentration standard that is far below the level the EPA is willing to allow indoors.

Response: The authorities under which the NESHAPs and indoor radon guidance are promulgated are entirely different. The EPA does not have the authority to mandate indoor radon levels. Its guidance to homeowners is based on a single screening measurement, the protocols for which are designed not to provide an average exposure level but a maximum exposure level. Therefore, comparison with the limits established by the NESHAP is invalid.

Comment: Regulations that have the effect of forcing use of control technology are clearly inappropriate where the technology has not been shown to be currently available.

Response: CAA section 112 requires EPA to set a safe or acceptable level without regard to the availability of control technology. Nevertheless, as a practical matter, while NESHAPs allow for use of new technologies, none of the promulgated NESHAPs requires the development of new technologies.

Comment: A strong regulatory stance by the EPA in requiring pollution controls will act to stimulate innovation, reduce prices via increased sales of control technologies and processes, and reduce risk.

Response: This stimulation of innovation and price competition in the effluent control industry, while a laudable public goal, is not a requirement under section 112 of the Act. Rather, the purpose and focus of NESHAPs is to protect public health with an ample margin of safety.

Comment: EPA should include avoided costs, e.g. possible tort judgments, including punitive damages, in determining the level of the final standard at the ample margin of safety step of the decision-making process.

Response: In theory, the EPA agrees. However, as a practical matter, it is often difficult to arrive at even an approximation of avoided costs when dealing with specific source categories. They are simply too speculative, especially given that the source categories are often comprised of thousands of individual facilities.

Comment: Cost as used in the ample margin of safety discussion should include all of the costs identifiable with the decision; this would include value of the facility, economic effects on the community, and social effects of labor force dislocation.

Response: To the extent that the EPA is able to develop quantitative estimates of these costs they are considered pursuant to the decision-making process. However, as already noted, such costs are often only available, if at all, as rough, qualitative estimates.

Comment: Industry should meet the criteria irrespective of costs or technological feasibility.

Response: The EPA agrees with respect to meeting the levels determined to be "safe." The EPA disagrees with

respect to the determination of the needed ample margin of safety.

Comment: Fundamental fairness prohibits the EPA from imposing controls that cost more than some ceiling amount per estimated death prevented.

Response: Since the *Vinyl Chloride* decision precludes consideration of cost when determining what constitutes "safe," all sources must meet the standards or utilize controls to the degree necessary to bring their emissions into compliance, regardless of the cost.

Comment: EPA has not explained the basis for abandoning the existing regulatory program for uranium mill tailings disposal in favor of regulation under the CAA. The UMTRCA, passed subsequent to the CAA, provides flexibility.

Response: The Administrator has determined not to defer to other regulatory authorities when the risk merits issuance of a NESHAP under section 112 of the Act. However, the requirements of the other regulations must still be met.

Comment: If post-closure emissions are to be actively regulated under the standard, the EPA should address financial assurances for evaluation, monitoring, reporting, facility modification request, and remedial actions.

Response: Given the one-time nature of the post-closure monitoring requirements for phosphogypsum stacks and uranium mill tailings disposal sites, the EPA does not believe that the small financial burden requires specific financial assurance requirements. Details of monitoring and reporting requirements are included in the appropriate Subparts.

Comment: The proposal fails to address the occupational dose increment resulting from the installation, operation, and maintenance of the additional equipment and systems required for compliance; the collective occupational exposures required for some of these additions will be at higher individual doses and of significantly more consequence than the questionable savings in public risk.

Response: The lack of specific instances makes it impossible to fully address this concern. The EPA is not aware of any instance where a NESHAP will require emission controls that will result in a significant occupational exposure. Where controls may be required, for example at elemental phosphorus plants, they supplement or replace existing, less effective, controls. The exposure resulting from installation should be minimal since the process will be shut down, and exposures received during maintenance should be comparable.

Comment: Consideration should be given to whether public welfare would not be improved by diverting moneys from regulatory procedures with no measurable effect on human health, to research efforts, which have resulted in considerable advantages to the public health and well being. Human costs to those dependent on the industry as well as other adverse environmental repercussions caused by a shift away from nuclear power toward more polluting technologies, will far outweigh any theoretical public health benefit.

Response: The suggested cost-benefit determination is outside the purview of the Agency. However, given the concerns of the National Institutes of Health that health care may be affected, EPA has agreed to reconsider this issue.

Comment: The statement that demand for nuclear energy is on the decline due to reduced demand for nuclear generated electricity is fallacious. Also, while the analysis recognizes that these regulations will worsen the already weak position of the domestic uranium industry, it does not examine the adverse effects that will have on the national trade deficit.

Response: Imported uranium is a trivial component of the United States trade deficit.

Comment: The EPA estimates costs associated with the alternative regulatory approaches for each source category but the total fuel cycle cost will be passed through to nuclear utilities and should be assessed on that basis. This includes sources under subparts B, H, I, K, R, S, T, and W.

Response: Costs associated with the final rule are not significant compared with the total fuel cycle costs. There would be no significant impacts.

VIII. Miscellaneous

A. Docket

The docket is an organized and complete file of all information considered by EPA in the development of the standards. The docket allows interested persons to identify and locate documents so they can effectively participate in the rulemaking process. It also serves as the record for judicial review.

Transcripts of the hearings, all written statements, the Agency's response to comments, and other relevant documents have been placed in the docket and are available for inspection and copying during normal working hours.

B. General Provisions

Except where otherwise specifically stated, the general provisions of 40 CFR part 61, subpart A apply to all sources regulated by this rule.

C. Paperwork Reduction Act

The information collection requirements in this final rule have been approved by the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* and have been assigned OMB control number 2060–0191.

D. Executive Order 12291

Under Executive Order 12291, EPA is required to judge whether this regulation is a "major rule" and therefore subject to certain requirements of the Order. The EPA has determined that regulations promulgated today will result in none of the adverse economic effects set forth in section I of the Order as grounds for finding a regulation to be a "major rule." These regulations are not major because (1) nationwide annual compliance costs do not meet the $100 million threshold; (2) the regulations do not significantly increase prices or production costs; and (3) the regulations do not cause significant adverse effects on domestic competition, employment, investment, productivity, innovation, or competition in foreign markets.

All of the final regulations presented in this notice were submitted to OMB for review as required by Executive Order 12291. Any written comments from OMB to EPA and any written EPA response to those comments has been included in the docket.

E. Regulatory Flexibility Analysis

Section 603 of the Regulatory Flexibility Act, 5 U.S.C. 603, requires EPA to prepare and make available for comment an "initial regulatory flexibility analysis" in connection with any rulemaking for which there is a statutory requirement that a general notice of proposed rulemaking be published. The "initial regulatory flexibility analysis" describes the effect of the proposed rule on small business entities.

However, section 604(b) of the Regulatory Flexibility Act provides that section 603 "shall not apply to any proposed . . . rule if the head of the Agency certifies that the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities."

EPA believes that virtually all small businesses are currently in compliance with these rules. In addition, EPA has placed reporting exemptions in the rule

for NRC-licensees to limit the amount of paperwork that would be required by the smaller operators. Therefore, this rule will have little or no impact on small businesses. A small business is one that has 750 employees or fewer.

For the preceding reasons, I certify that this rule will not have significant economic impact on a substantial number of small entities.

List of Subjects in 40 CFR Part 61

Air pollution control, Arsenic, Asbestos, Beryllium, Benzene, Incorporation by reference, Mercury, Radionuclides, Vinyl chloride.

Dated: October 31, 1989.

William G. Rosenberg,

Acting Administrator.

Part 61 of chapter I of title 40 of the Code of Federal Regulations is amended as follows:

PART 61—[AMENDED]

1. The authority citation for part 61 continues to read as follows:

Authority: 42 U.S.C. 7401, 7412, 7414, 7416, 7601.

2. Part 61 is amended by revising subparts B, H, I, K and W and by adding subparts R and T to read as follows. These subparts are effective December 15, 1989. Subpart I is stayed until March 15, 1989.

Subpart B—National Emission Standards for Radon Emissions From Underground Uranium Mines

Sec.

§ 61.20 Designation of facilities.

The provisions of this subpart are applicable to the owner or operator of an active underground uranium mine which:

(a) Has mined, will mine or is designed to mine over 100,000 tons of ore during the life of the mine; or

(b) Has had or will have an annual ore production rate greater than 10,000 tons, unless it can be demonstrated to EPA that the mine will not exceed total ore production of 100,000 tons during the life of the mine.

§ 61.21 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Active mine* means an underground uranium mine which is being ventilated to allow workers to enter the mine for any purpose.

(b) *Effective dose equivalent* means the sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. The method for calculating effective dose equivalent and the definition of reference man are outlined in the International Commission on Radiological Protection's Publication No. 26.

(c) *Underground uranium mine* means a man-made underground excavation made for the purpose of removing material containing uranium for the principal purpose of recovering uranium.

§ 61.22 Standard.

Emissions of radon-222 to the ambient air from an underground uranium mine shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/y.

§ 61.23 Determining compliance.

(a) Compliance with the emission standard in this subpart shall be determined and the effective dose equivalent calculated by the EPA computer code COMPLY-R. An underground uranium mine owner or operator shall calculate the source terms to be used for input into COMPLY-R by conducting testing in accordance with the procedures described in Appendix B, Method 115, or

(b) Owners or operators may demonstrate compliance with the emission standard in this subpart through the use of computer models that are equivalent to COMPLY-R provided that the model has received prior approval from EPA headquarters. EPA may approve a model in whole or in part and may limit its use to specific circumstances.

§ 61.24 Annual Reporting Requirements.

(a) The mine owner or operator shall annually calculate and report the results of the compliance calculations in section 61.23 and the input parameters used in making the calculation. Such report shall cover the emissions of a calendar year and shall be sent to EPA by March 31 of the following year. Each report shall also include the following information:

(1) The name and location of the mine.

(2) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(3) The results of the emissions testing conducted and the dose calculated using the procedures in § 61.23.

(4) A list of the stacks or vents or other points where radioactive materials are released to the atmosphere, including their location, diameter, flow rate, effluent temperature and release height.

(5) A description of the effluent controls that are used on each stack, vent, or other release point and the effluent controls used inside the mine, and an estimate of the efficiency of each control method or device.

(6) Distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk, and meat.

(7) The values used for all other user-supplied input parameters for the computer models (e.g., meteorological data) and the source of these data.

(8) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(b) If the facility is not in compliance with the emission standard of § 61.22 in the calendar year covered by the report, the facility must then commence reporting to the Administrator on a monthly basis the information listed in paragraph (a) of this section for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (a) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree the report will describe the facilities performance under the terms of the decree.

(c) The first report will cover the emissions of calendar year 1990.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.25 Recordkeeping requirements.

The owner or operator of a mine must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. In addition, the documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. These records must be kept at the mine or by the owner or operator for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.26 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart H—National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities

Sec.

§ 61.90 Designation of facilities.

The provisions of this subpart apply to operations at any facility owned or operated by the Department of Energy that emits any radionuclide other than radon-222 and radon-220 into the air, except that this subpart does not apply to disposal at facilities subject to 40 CFR part 191, subpart B or 40 CFR part 192.

§ 61.91 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or 40 CFR part 61, subpart A. The following terms shall have the following specific meanings:

(a) *Effective dose equivalent* means the sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. For purposes of this subpart, doses caused by radon-222 and its respective decay products formed after the radon is released from the facility are not included. The method for calculating effective dose equivalent and the definition of reference man are outlined in the International Commission on Radiological Protection's Publication No. 26.

(b) *Facility* means all buildings, structures and operations on one contiguous site.

(c) *Radionuclide* means a type of atom which spontaneously undergoes radioactive decay.

(d) *Residence* means any home, house, apartment building, or other place of dwelling which is occupied during any portion of the relevant year.

§ 61.92 Standard.

Emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.

§ 61.93 Emission monitoring and test procedures.

(a) To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated using EPA approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval. DOE facilities for which the maximally exposed individual lives within 3 kilometers of all sources of emissions in the facility, may use EPA's COMPLY model and associated procedures for determining dose for purposes of compliance.

(b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or other procedures for which EPA has granted prior approval:

(1) Effluent flow rate measurements shall be made using the following methods:

(i) Reference Method 2 of Appendix A to part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

(ii) Reference Method 2A of Appendix A to part 60 shall be used to measure flow rates through pipes and small vents.

(iii) The frequency of the flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rate measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

(i) Reference Method 1 of Appendix A part 60 shall be used to select monitoring or sampling sites.

(ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSIN13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1) (incorporated by reference—see § 61.18) The requirements for continuous sampling are applicable to batch processes when the unit is in operation. Periodic sampling (grab samples) may be used only with EPA's prior approval. Such approval may be granted in cases where continuous sampling is not practical and radionuclide emission rates are relatively constant. In such cases, grab samples shall be collected with sufficient frequency so as to provide a representative sample of the emissions.

(iii) Radionuclides shall be collected and measured using procedures based on the principles of measurement described in Appendix B, Method 114. Use of methods based on principles of measurement different from those described in Appendix B, Method 114 must have prior approval from the Administrator. EPA reserves the right to approve measurement procedures.

(iv) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(3) When it is impractical to measure the effluent flow rate at an existing source in accordance with the requirements of paragraph (b)(1) of this section or to monitor or sample an effluent stream at an existing source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) of this section, the facility owner or operator may use alternative effluent flow rate measurement procedures or site

selection and sample extraction procedures provided that:

(i) It can be shown that the requirements of paragraph (b) (1) or (2) of this section are impractical for the effluent stream.

(ii) The alternative procedure will not significantly underestimate the emissions.

(iii) The alternative procedure is fully documented.

(iv) The owner or operator has received prior approval from EPA.

(4)(i) Radionuclide emission measurements in conformance with the requirements of paragraph (b) of this section shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured. With prior EPA approval, DOE may determine these emissions through alternative procedures. For other release points which have a potential to release radionuclides into the air, periodic confirmatory measurements shall be made to verify the low emissions.

(ii) To determine whether a release point is subject to the emission measurement requirements of paragraph (b) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air for the purposes of this section, the estimated radionuclide release rates shall be based on the discharge of the effluent stream that would result if all pollution control equipment did not exist, but the facilities operations were otherwise normal.

(5) Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standard if the owner or operator meets the following criteria:

(i) The air at the point of measurement shall be continuously sampled for collection of radionuclides.

(ii) Those radionuclides released from the facility, which are the major contributors to the effective dose equivalent must be collected and measured as part of the environmental measurement program.

(iii) Radionuclide concentrations which would cause an effective dose equivalent of 10% of the standard shall be readily detectable and distinguishable from background.

(iv) Net measured radionuclide concentrations shall be compared to the concentration levels in Table 2 of Appendix E to determine compliance with the standard. In the case of multiple radionuclides being released from a facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2, and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 for each radionuclide is less than 1.

(v) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(vi) Use of environmental measurements to demonstrate compliance with the standard is subject to prior approval of EPA. Applications for approval shall include a detailed description of the sampling and analytical methodology and show how the above criteria will be met.

§ 61.94 Compliance and reporting.

(a) Compliance with this standard shall be determined by calculating the highest effective dose equivalent to any member of the public at any offsite point where there is a residence, school, business or office. The owners or operators of each facility shall submit an annual report to both EPA headquarters and the appropriate regional office by June 30 which includes the results of the monitoring as recorded in DOE's Effluent Information System and the dose calculations required by § 61.93(a) for the previous calendar year.

(b) In addition to the requirements of paragraph (a) of this section, an annual report shall include the following information:

(1) The name and location of the facility.

(2) A list of the radioactive materials used at the facility.

(3) A description of the handling and processing that the radioactive materials undergo at the facility.

(4) A list of the stacks or vents or other points where radioactive materials are released to the atmosphere.

(5) A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each control device.

(6) Distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk, and meat.

(7) The values used for all other user-supplied input parameters for the computer models (e.g., meteorological data) and the source of these data.

(8) A brief description of all construction and modifications which were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived under § 61.96 and associated documentation developed by DOE to support the waiver. EPA reserves the right to require that DOE send to EPA all the information that normally would be required in an application to construct or modify, following receipt of the description and supporting documentation.

(9) Each report shall be signed and dated by a corporate officer or public official in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(c) If the facility is not in compliance with the emission limits of § 61.92 in the calendar year covered by the report, then the facility must commence reporting to the Administrator on a monthly basis the information listed in paragraph (b) of this section, for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (b) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree, the report will describe the facilities performance under the terms of the decree.

(d) In those instances where the information requested is classified, such information will be made available to EPA separate from the report and will be handled and controlled according to

applicable security and classification regulations and requirements.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.95 Recordkeeping requirements.

All facilities must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine effective dose equivalent. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. These records must be kept at the site of the facility for at least five years and, upon request, be made available for inspection by the Administrator, or his authorized representative.

§ 61.96 Applications to construct or modify.

In addition to any activity that is defined as construction under 40 CFR part 61, subpart A, any fabrication, erection or installation of a new building or structure within a facility that emits radionuclides is also defined as new construction for purposes of 40 CFR part 61, subpart A.

(b) An application for approval under § 61.07 or notification of startup under § 61.09 does not need to be filed for any new construction of or modification within an existing facility if the effective dose equivalent, caused by all emissions from the new construction or modification, is less than 1% of the standard prescribed in § 61.92. For purposes of this paragraph the effective dose equivalent shall be calculated using the source term derived using Appendix D as input to the dispersion and other computer models described in § 61.93. DOE may, with prior approval from EPA, use another procedure for estimating the source term for use in this paragraph. A facility is eligible for this exemption only if, based on its last annual report, the facility is in compliance with this subpart.

(c) Conditions to approvals granted under § 61.08 will not contain requirements for post approval reporting on operating conditions beyond those specified in § 61.94.

§ 61.97 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart I—National Emission Standards for Radionuclide Emissions From Facilities Licensed by the Nuclear Regulatory Commission and Federal Facilities Not Covered by Subpart H

Sec.

§ 61.100 Applicability.

The provisions of this subpart apply to Nuclear Regulatory Commission-licensed facilities and to facilities owned or operated by any Federal agency other than the Department of Energy, except that this subpart does not apply to disposal at facilities regulated under 40 CFR part 191, subpart B, or to any uranium mill tailings pile after it has been disposed of under 40 CFR part 192, or to low energy accelerators, or to any NRC-licensee that possesses and uses radionuclides only in the form of sealed sources.

§ 61.101 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Agreement State* means a State with which the Atomic Energy Commission or the Nuclear Regulatory Commission has entered into an effective agreement under subsection 274(b) of the Atomic Energy Act of 1954, as amended.

(b) *Effective dose equivalent* means the sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. For purposes of this subpart doses caused by radon-222 and its decay products formed after the radon is released from the facility are not included. The method for calculating effective dose equivalent and the definition of reference man are outlined in the International Commission on Radiological Protection's Publication No. 26.

(c) *Facility* means all buildings, structures and operations on one contiguous site.

(d) *Federal facility* means any facility owned or operated by any department, commission, agency, office, bureau or other unit of the government of the United States of America except for facilities owned or operated by the Department of Energy.

(e) *NRC-licensed facility* means any facility licensed by the Nuclear Regulatory Commission or any Agreement State to receive title to, receive, possess, use, transfer, or deliver any source, by-product, or special nuclear material.

(f) *Radionuclide* means a type of atom which spontaneously undergoes radioactive decay.

§ 61.102 Standard.

(a) Emissions of radionuclides, including iodine, to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.

(b) Emissions of iodine to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 3 mrem/yr.

§ 61.103 Determining compliance.

(a) Compliance with the emission standard in this subpart shall be determined through the use of either the EPA computer code COMPLY or the alternative requirements of Appendix E. Facilities emitting radionuclides not listed in COMPLY or Appendix E shall contact EPA to receive the information needed to determine dose. The source terms to be used for input into COMPLY shall be determined through the use of the measurement procedures listed in § 61.107 or the emission factors in Appendix D or through alternative procedures for which EPA has granted prior approval; or,

(b) Facilities may demonstrate compliance with the emission standard in this subpart through the use of computer models that are equivalent to COMPLY, provided that the model has received prior approval from EPA headquarters. Any facility using a model other than COMPLY must file an annual report. EPA may approve an alternative model in whole or in part and may limit its use to specific circumstances.

§ 61.104 Reporting requirements.

(a) The owner or operator of a facility subject to this subpart must submit an annual report to the EPA covering the emissions of a calendar year by March 31 of the following year.

(1) The report or application for approval to construct or modify as

required by 40 CFR part 61, subpart A and § 61.106, must provide the following information:

(i) The name of the facility.

(ii) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(iii) The location of the facility, including suite and/or building number, street, city, county, state, and zip code.

(iv) The mailing address of the facility, if different from item (iii).

(v) A list of the radioactive materials used at the facility.

(vi) A description of the handling and processing that the radioactive materials undergo at the facility.

(vii) A list of the stacks or vents or other points where radioactive materials are released to the atmosphere.

(viii) A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each device.

(ix) Distances from the point of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk, and meat.

(x) The effective dose equivalent calculated using the compliance procedures in § 61.103.

(xi) The physical form and quantity of each radionuclide emitted from each stack, vent or other release point, and the method(s) by which these quantities were determined.

(xii) The volumetric flow, diameter, effluent temperature, and release height for each stack, vent or other release point where radioactive materials are emitted, the method(s) by which these were determined.

(xiii) The height and width of each building from which radionuclides are emitted.

(xiv) The values used for all other user-supplied input parameters (e.g., meteorological data) and the source of these data.

(xv) A brief description of all construction and modifications which were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived under section 61.106, and associated documentation developed by the licensee to support the waiver. EPA reserves the right to require that the licensee send to EPA all the information that normally would be required in an application to construct or modify, following receipt of the description and supporting documentation.

(xvi) Each report shall be signed and dated by a corporate officer or public official in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(b) Facilities emitting radionuclides in an amount that would cause less than 10% of the dose standard in § 61.102, as determined by the compliance procedures from § 61.103(a), are exempt from the reporting requirements of § 61.104(a). Facilities shall annually make a new determination whether they are exempt from reporting.

(c) If the facility is not in compliance with the emission limits of § 61.102 in the calendar year covered by the report, the facility must report to the Administrator on a monthly basis the information listed in paragraph (a) of this section, for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (a) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree the report will describe the facilities performance under the terms of the decree.

(d) The first report will cover the emissions of calendar year 1990.

§ 61.105 Recordkeeping requirements.

The owner or operator of any facility must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard, and, if claimed, qualification for exemption from reporting. These records must be kept at the site of the facility for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.106 Applications to construct or modify.

(a) In addition to any activity that is defined as construction under 40 CFR part 61, subpart A, any fabrication, erection or installation of a new building or structure within a facility is also defined as new construction for purposes of 40 CFR part 61, subpart A.

(b) An application under § 61.07 does not need to be filed for any new construction of or modification within an existing facility if one of the following conditions is met:

(1) The effective dose equivalent calculated by using methods described in § 61.103, that is caused by all emissions from the facility including those potentially emitted by the proposed new construction or modification, is less than 10% of the standard prescribed in § 61.102.

(2) The effective dose equivalent calculated by using methods described in § 61.103, that is caused by all emissions from the new construction or modification, is less than 1% of the limit prescribed in § 61.102. A facility is eligible for this exemption only if the facility, based on its last annual report, is in compliance with this subpart.

§ 61.107 Emission determination.

(a) Facility owners or operators may, in lieu of monitoring, estimate radionuclide emissions in accordance with Appendix D, or other procedure for which EPA has granted prior approval.

(b) Radionuclide emission rates from point sources (e.g. stacks or vents) shall be measured in accordance with the following requirements:

(1) Effluent flow rate measurements shall be made using the following methods:

(i) Reference Method 2 of Appendix A to part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

(ii) Reference Method 2A of Appendix A to part 60 shall be used to measure flow rates through pipes and small vents.

(iii) The frequency of the flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rate measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

(2) Radionuclides shall be directly monitored or extracted, collected, and measured using the following methods:

(i) Reference Method 1 of Appendix A part 60 shall be used to select monitoring or sampling sites.

(ii) The effluent stream shall be directly monitored continuously using an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSIN13.1–1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1) (incorporated by reference—see § 61.18). The requirements for continuous sampling are applicable to batch processes when the unit is in operation. Periodic sampling (grab samples) may be used only with EPA's prior approval. Such approval may be granted in cases where continuous sampling is not practical and radionuclide emission rates are relatively constant. In such cases, grab samples shall be collected with sufficient frequency so as to provide a representative sample of the emissions.

(iii) Radionuclides shall be collected and measured using procedures based on the principles of measurement described in Appendix B, Method 114. Use of methods based on principles of measurement different from those described in Appendix B, Method 114 must have prior approval from the Administrator. EPA reserves the right to approve alternative measurement procedures in whole or in part.

(iv) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(3) When it is impractical to measure the effluent flow rate at an existing source in accordance with the requirements of paragraph (b)(1) of this section or to monitor or sample an effluent stream at an existing source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) of this section, the facility owner or operator may use alternative effluent flow rate measurement procedures or site selection and sample extraction procedures provided that:

(i) It can be shown that the requirements of paragraphs (b) (1) and (2) of this section are impractical for the effluent stream.

(ii) The alternative procedure will not significantly underestimate the emissions.

(iii) The alternative procedure is fully documented

(iv) The owner or operator has received prior approval from EPA.

(4)(i) Radionuclide emission measurements in conformance with the requirements of paragraph (b) of this section shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured. For other release points which have a potential to release radionuclides into the air, periodic confirmatory measurements should be made to verify the low emissions.

(ii) To determine whether a release point is subject to the emission measurement requirements of paragraph (b) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air, the estimated radionuclide release rates shall be based on the discharge of the uncontrolled effluent stream into the air.

(5) Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standards if the owner or operator meets the following criteria:

(i) The air at the point of measurement shall be continuously sampled for collection of radionuclides.

(ii) Those radionuclides released from the facility, which are the major contributors to the effective dose equivalent must be collected and measured as part of the environmental measurements program.

(iii) Radionuclide concentrations which would cause an effective dose equivalent greater than or equal to 10% of the standard shall be readily detectable and distinguishable from background.

(iv) Net measured radionuclide concentrations shall be compared to the concentration levels in Table 2 of Appendix E to determine compliance with the standard. In the case of multiple radionuclides being released from a facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2 and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 for each radionuclide is less than 1.

(v) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(vi) Use of environmental measurements to demonstrate compliance with the standard is subject to prior approval of EPA. Applications for approval shall include a detailed description of the sampling and analytical methodology and show how the above criteria will be met.

(c) The following facilities may use either the methodologies and quality assurance programs described in paragraph (b) of this section or may use the following:

(1) Nuclear power reactors may determine their radionuclide emissions in conformance with the Effluent Technical Specifications contained in their Operating License issued by the Nuclear Regulatory Commission. In addition, they may conduct a quality assurance program as described in the Nuclear Regulatory Commission's Regulatory Guide 4.15 dated February 1979.

(2) Fuel processing and fabrication plants and uranium hexafluoride plants may determine their emissions in conformance with the Nuclear Regulatory Commission's Regulatory Guide 4.16 dated December 1985. In addition, they may conduct a quality assurance program as described in the Nuclear Regulatory Commission's Regulatory Guide 4.15 dated February 1979.

(3) Uranium mills may determine their emissions in conformance with the Nuclear Regulatory Commission's Regulatory Guide 4.14 dated April 1980. In addition, they may conduct a quality assurance program as described in the Nuclear Regulatory Commission's Regulatory Guide 4.15 dated February 1979.

61.108 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart K—National Emission Standards for Radionuclide Emissions From Elemental Phosphorus Plants

Sec.

§ 61.120 Applicability.

The provisions of this subpart are applicable to owners or operators of calciners and nodulizing kilns at elemental phosphorus plants.

§61.121 Definitions.

(a) *Elemental phosphorus plant* or *plant* means any facility that processes phosphate rock to produce elemental phosphorus. A plant includes all buildings, structures, operations, calciners and nodulizing kilns on one contiguous site.

(b) *Calciner* or *Nodulizing kiln* means a unit in which phosphate rock is heated to high temperatures to remove organic material and/or to convert it to a nodular form. For the purpose of this subpart, calciners and nodulizing kilns are considered to be similar units.

§ 61.122 Emission standard.

Emissions of polonium-210 to the ambient air from all calciners and nodulizing kilns at an elemental phosphorus plant shall not exceed a total of 2 curies a year.

§ 61.123 Emission testing.

(a) Each owner or operator of an elemental phosphorus plant shall test emissions from the plant within 90 days of the effective date of this standard and annually thereafter. The Administrator may temporarily or permanently waive the annual testing requirement or increase the frequency of testing, if the Administrator determines that more testing is required.

(b) The Administrator shall be notified at least 30 days prior to an emission test so that EPA may, at its option, observe the test.

(c) An emission test shall be conducted at each operational calciner or nodulizing kiln. If emissions from a calciner or nodulizing kiln are discharged through more than one stack, then an emission test shall be conducted at each stack and the total emission rate from the calciner or kiln shall be the sum of the emission rates from each of the stacks.

(d) Each emission test shall consist of three sampling runs that meet the requirements of § 61.125. The phosphate rock processing rate during each run shall be recorded. An emission rate in curies per metric ton of phosphate rock processed shall be calculated for each run. The average of all three runs shall apply in computing the emission rate for the test. The annual polonium-210 emission rate from a calciner or nodulizing kiln shall be determined by multiplying the measured polonium-210 emission rate in curies per metric ton of phosphate rock processed by the annual phosphate rock processing rate in metric tons. In determining the annual phosphate rock processing rate, the values used for operating hours and operating capacity shall be values that will maximize the expected processing rate. For determining compliance with the emission standard of § 61.122, the total annual emission rate is the sum of the annual emission rates for all operating calciners and nodulizing kilns.

(e) If the owner or operator changes his operation in such a way as to increase his emissions of polonium-210, such as changing the type of rock processed, the temperature of the calciners or kilns, or increasing the annual phosphate rock processing rate, then a new emission test, meeting the requirements of this section, shall be conducted within 45 days under these conditions.

(f) Each owner or operator of an elemental phosphorus plant shall furnish the Administrator with a written report of the results of the emission test within 60 days of conducting the test. The report must provide the following information:

(1) The name and location of the facility.

(2) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(3) A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each device.

(4) The results of the testing, including the results of each sampling run completed.

(5) The values used in calculating the emissions and the source of these data.

(6) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.124 Recordkeeping requirements.

The owner or operator of any plant must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used in emission testing. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the results of the emission testing. These records must be kept at the site of the plant for at least five years and, upon request, be made available for inspection by the Administrator, or his authorized representative.

§ 61.125 Test methods and procedures.

(a) Each owner or operator of a source required to test emissions under § 61.123, unless an equivalent or alternate method has been approved by the Administrator, shall use the following test methods:

(1) Test Method 1 of Appendix A to 40 CFR part 60 shall be used to determine sample and velocity traverses;

(2) Test Method 2 of Appendix A to 40 CFR part 60 shall be used to determine velocity and volumetric flow rate;

(3) Test Method 3 of Appendix A to 40 CFR part 60 shall be used for gas analysis;

(4) Test Method 5 of Appendix A to 40 CFR part 60 shall be used to collect particulate matter containing the polonium-210; and

(5) Test Method 111 of Appendix B to 40 CFR part 61 shall be used to determine the polonium-210 emissions.

§ 61.126 Monitoring of operations.

(a) The owner or operator of any source subject to this subpart using a wet-scrubbing emission control device shall install, calibrate, maintain, and operate a monitoring device for the continuous measurement of the pressure loss of the gas stream through the scrubber. The monitoring device must be certified by the manufacturer to be accurate within ±250 pascal (±1 inch of water). Records of these measurements shall be maintained at the source and made available for inspection by the Administrator, or his authorized representative for a minimum of 5 years.

(b) The owner or operator of any source subject to this subpart using an electrostatic precipitator control device shall install, calibrate, maintain, and operate a monitoring device for the continuous measurement of the primary and secondary current and the voltage in each electric field. Records of these measurements shall be maintained at the source and made available for inspection by the Administrator, or his authorized representative for a minimum of 5 years.

(c) For the purpose of conducting an emission test under § 61.123, the owner or operator of any source subject to the provisions of this subpart shall install, calibrate, maintain, and operate a device for measuring the phosphate rock feed to any affected calciner or nodulizing kiln. The measuring device used must be accurate to within ±5 percent of the mass rate over its operating range. Records of these measurements shall be maintained at the source and made available for inspection by the Administrator, or his authorized representative for a minimum of 5 years.

§ 61.127 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart Q—National Emission Standards for Radon Emissions From Department of Energy Facilities

Sec.
61.190 Designation of facilities.
61.191 Definitions.
61.192 Standard.
61.193 Exemption from the reporting and testing requirements of 40 CFR 61.10.

§ 61.190 Designation of facilities.

The provisions of this subpart apply to the design and operation of all storage and disposal facilities for radium-containing material (i.e., byproduct material as defined under section 11.e(2) of the Atomic Energy Act of 1954 (as amended)) that are owned or operated by the Department of Energy that emit radon-222 into air, including these facilities: The Feed Materials Production Center, Fernald, Ohio; the Niagara Falls Storage Site, Lewiston, New York; the Weldon Spring Site, Weldon Spring, Missouri; the Middlesex Sampling Plant, Middlesex, New Jersey; the Monticello Uranium Mill Tailings Pile, Monticello, Utah. This subpart does not apply to facilities listed in, or designated by the Secretary of Energy under Title I of the Uranium Mill Tailings Control Act of 1978.

§ 61.191 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Facility* means all buildings, structures and operations on one contiguous site.

(b) *Source* means any building, structure, pile, impoundment or area used for interim storage or disposal that is or contains waste material containing radium in sufficient concentration to emit radon-222 in excess of this standard prior to remedial action.

§ 61.192 Standard.

No source at a Department of Energy facility shall emit more than 20 pCi/m^2–s of radon-222 as an average for the entire source, into the air. This requirement will be part of any Federal Facilities Agreement reached between Environmental Protection Agency and Department of Energy.

§ 61.193 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart R—National Emission Standards for Radon Emissions From Phosphogypsum Stacks

Sec.
61.200 Designation of facilities.
61.201 Definitions.
61.202 Standard.
61.203 Radon monitoring and compliance procedures.
61.204 Recordkeeping requirements.
61.205 Exemption from the reporting and testing requirements of 40 CFR 61.10.

§ 61.200 Designation of facilities.

The provisions of this subpart apply to the owners and operators of the phosphogypsum that is produced as a result of phosphorus fertilizer production and all that is contained in existing phosphogypsum stacks.

§ 61.201 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Inactive stack* means a stack to which no further routine additions of phosphogypsum will be made and which is no longer used for water management associated with the production of phosphogypsum. If a stack has not been used for either purpose for two years it is presumed to be inactive.

(b) *Phosphogypsum stacks* or *stacks* are piles of waste from phosphorus fertilizer production containing phosphogypsum. Stacks shall also include phosphate mines that are used for the disposal of phosphogypsum.

§ 61.202 Standard.

All phosphogypsum shall be disposed of in stacks or in phosphate mines which shall not emit more than 20 pCi/m^2–s of radon-222 into the air.

§ 61.203 Radon monitoring and compliance procedures.

(a) Sixty days following the date at which a stack becomes an inactive stack, or ninety days after the effective date of this rule if the stack is already inactive, the owners or operators of inactive phosphogypsum stacks shall test the stacks in accordance with the procedures described in 40 CFR part 61, Appendix B, Method 115. EPA shall be notified at least 30 days prior to an emissions test so that EPA may, at its option, observe the test. If meteorological conditions are such that a test cannot be properly conducted, then the owner or operator shall notify EPA and test as soon as conditions permit.

(b) Ninety days after the testing is required, the owner or operator shall provide EPA with a report detailing the actions taken and the results of the radon-222 flux testing. Each report shall also include the following information:

(1) The name and location of the facility,

(2) A list of the stacks at the facility including the size and dimensions of the stack,

(3) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different),

(4) A description of the control measures taken to decrease the radon flux from the source and any actions taken to insure the long term effectiveness of the control measures, and

(5) The results of the testing conducted, including the results of each measurement.

(6) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(c) If year-long measurements are made in accordance with Method 115 Appendix B to part 61 this report shall include the results of the first measurement period and provide a schedule for the measurement frequency to be used. An additional report containing all the information in

paragraph (b) of this section shall be submitted ninety days after completion of the final measurements.

(d) If at any point an owner or operator once again uses a stack for the disposal of phosphogypsum or for water management, the stack ceases to be in inactive status and the owner or operator must notify EPA in writing within 45 days. When the owner or operator ceases to use the stack it will once again become inactive and require retesting and reporting.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.204 Recordkeeping requirements.

An owner or operator subject to this subpart must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. This documentation should be sufficient to allow an independent auditor to verify the correctness of the determination made concerning the facility's compliance with the standard. These records must be kept by the owner or operator for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.205 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart T—National Emission Standards for Radon Emissions From the Disposal of Uranium Mill Tailings

Sec.

§ 61.220 Designation of facilities.

The provisions of this subpart apply to the owners and operators of all sites that are used for the disposal of tailings, and that managed residual radioactive material or uranium byproduct materials during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings, that are listed in, or designated by the Secretary of Energy under Title I of the Uranium Mill Tailings Control Act of 1978 or regulated under Title II of the Uranium Mill Tailings Control Act of 1978.

§ 61.221 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Long term stabilization* means the addition of material on a uranium mill tailings pile for purpose of ensuring compliance with the requirements of 40 CFR 192.02(a) or 192.32(b)(i). These actions shall be considered complete when the Nuclear Regulatory Commission determines that the requirements of 40 CFR 192.02(a) or 192.32(b)(i) have been met.

(b) *Operational* means a uranium mill tailings pile that is licensed to accept additional tailings, and those tailings can be added without violating subpart W or any other Federal, state or local rule or law. A pile cannot be considered operational if it is filled to capacity or the mill it accepts tailings from has been dismantled or otherwise decommissioned.

(c) *Uranium byproduct material* or *tailings* means the waste produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction and which remain underground do not constitute byproduct material for the purposes of this subpart.

§ 61.222 Standard.

(a) Radon-222 emissions to the ambient air from uranium mill tailings pile that are no longer operational shall not exceed 20 pCi/m^2-s of radon-222.

(b) Once a uranium mill tailings pile or impoundment ceases to be operational it must be disposed of and brought into compliance with this standard within two years of the effective date or within two years of the day it ceases to be operational whichever is later. If it is not physically possible for a mill owner or operator to complete disposal within that time, EPA shall, after consultation with the mill owner or operator, establish a compliance agreement which will assure that disposal will be completed as quickly as possible.

§ 61.223 Compliance procedures.

(a) Sixty days following the completion of covering the pile to limit radon emissions but prior to the long term stabilization of the pile, the owners or operators of uranium mill tailings shall conduct testing for all piles within the facility in accordance with the procedures described in 40 CFR part 61, Appendix B, Method 115, or other procedures for which EPA has granted prior approval.

(b) Ninety days after the testing is required, each facility shall provide EPA with a report detailing the actions taken and the results of the radon-222 flux testing. EPA shall be notified at least 30 days prior to an emission test so that EPA may, at its option, observe the test. If meteorological conditions are such that a test cannot be properly conducted, then the owner or operator shall notify EPA and test as soon as conditions permit. Each report shall also include the following information:

(1) The name and location of the facility.

(2) A list of the piles at the facility.

(3) A description of the control measures taken to decrease the radon flux from the source and any actions taken to insure the long term effectiveness of the control measures.

(4) The results of the testing conducted, including the results of each measurement.

(5) Each report shall be signed and dated by a corporate officer or public official in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(c) If year long measurements are made in accordance with Method 115 of Appendix B of part 61, this report shall include the results of the first measurement period and provide a schedule for the measurement frequency to be used. An additional report shall be submitted ninety days after completion of the final measurements.

(d) If long term stabilization has begun before the effective date of the rule then testing may be conducted at any time, up to 60 days after the long term stabilization is completed.

(e) If the testing demonstrates that the pile meets the requirement of § 61.222(a) and long term stabilization has been completed then the pile is considered disposed for purposes of this rule.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.224 Recordkeeping requirements.

The owner or operator must maintain records documenting the source of input

parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. The Administrator shall be kept apprised of the location of these records and the records must be kept for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.225 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart W—National Emission Standards for Radon Emissions From Operating Mill Tailings

Sec.

§ 61.250 Designation of facilities.

The provisions of this subpart apply to owners or operators of facilities licensed to manage uranium byproduct materials during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings. This subpart does not apply to the disposal of tailings.

§ 61.251 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or 40 CFR part 61, subpart A. The following terms shall have the following specific meanings:

(a) *Area* means the vertical projection of the pile upon the earth's surface.

(b) *Continuous disposal* means a method of tailings management and disposal in which tailings are dewatered by mechanical methods immediately after generation. The dried tailings are then placed in trenches or other disposal areas and immediately covered to limit emissions consistent with applicable Federal standards.

(c) *Dewatered* means to remove the water from recently produced tailings by mechanical or evaporative methods such that the water content of the tailings does not exceed 30 percent by weight.

(d) *Existing impoundment* means any uranium mill tailings impoundment which is licensed to accept additional tailings and is in existence as of December 15, 1989.

(e) *Operation* means that an impoundment is being used for the continued placement of new tailings or is in standby status for such placement. An impoundment is in operation from the day that tailings are first placed in the impoundment until the day that final closure begins.

(f) *Phased disposal* means a method of tailings management and disposal which uses lined impoundments which are filled and then immediately dried and covered to meet all applicable Federal standards.

(g) *Uranium byproduct material or tailings* means the waste produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction and which remain underground do not constitute byproduct material for the purposes of this subpart.

§ 61.252 Standard.

(a) Radon-222 emissions to the ambient air from an existing uranium mill tailings pile shall not exceed 20 pCi/m^2-s of radon-222.

(b) After December 15, 1989, no new tailings impoundment can be built unless it is designed, constructed and operated to meet one of the two following work practices:

(1) Phased disposal in lined tailings impoundments that are no more than 40 acres in area and meet the requirements of 40 CFR 192.32(a) as determined by the Nuclear Regulatory Commission. The owner or operator shall have no more than two impoundments, including existing impoundments, in operation at any one time.

(2) Continuous disposal of tailings such that tailings are dewatered and immediately disposed with no more than 10 acres uncovered at any time and operated in accordance with § 192.32(a) as determined by the Nuclear Regulatory Commission.

(c) All mill owners or operators shall comply with the provisions of 40 CFR 192.32(a) in the operation of tailings piles, the exemption for existing piles in 40 CFR 192.32(a) notwithstanding.

§ 61.253 Determining compliance.

Compliance with the emission standard in this subpart shall be determined annually through the use of Method 115 of Appendix B. When measurements are to be made over a one year period, EPA shall be provided with a schedule of the measurement frequency to be used. The schedule may be submitted to EPA prior to or after the first measurement period. EPA shall be notified 30 days prior to any emissions test so that EPA may, at its option, observe the test.

§ 61.254 Annual reporting requirements.

(a) The owners or operators of operating existing mill impoundments shall report the results of the compliance calculations required in § 61.253 and the input parameters used in making the calculation for each calendar year shall be sent to EPA by March 31 of the following year. Each report shall also include the following information:

(1) The name and location of the mill.

(2) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(3) The results of the testing conducted, including the results of each measurement.

(4) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(b) If the facility is not in compliance with the emission limits of § 61.252 in the calendar year covered by the report, then the facility must commence reporting to the Administrator on a monthly basis the information listed in paragraph (a) of this section, for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (a) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree, the report will describe the facilities performance under the terms of the decree.

(c) The first report will cover the emissions of calendar year 1990.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.255 Recordkeeping requirements.

The owner or operator of the mill must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. In addition, the documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. These records must be kept at the mill for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.256 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

§ 61.03 [Amended]

3. By adding to the list of System International units of measure in § 61.03(a) an entry for "m^2" following "m=meter" to read as follows:

m^2=square meter

4. By adding to the list of other units of measure in § 61.03(b) an entry for "Ci" following "cc"; an entry for "pC;" following "oz"; and an entry for "mrem" following "ml" to read as follows:

Ci=curie

* * * * *

mrem=millirem=10^{-3} rem

* * * * *

pCi=picocurie=10^{-12} curie

5. Section 61.18 is amended by adding paragraph (c) to read as follows:

§ 61.18 Incorporations by reference.

* * * * *

(c) The following material is available for purchase from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

(1) ANSI N13.1—1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities." IBR approved for §§ 61.93(b)(2)(ii); 61.107(b)(2)(ii); and Method 114, par. 2.1 of Appendix B to part 61.

Appendix B to Part 61—[Amended]

6. By amending Method 111 of Appendix B as follows:

a. Section 4.1 is revised to read as follows:

4.1 Sample Preparation.

The glass fiber filter and acetone rinse from Method 5 of Appendix A to 40 CFR part 60 are combined and dissolved as described below.

4.1.1 Add polonium-209 tracer to the acetone rinse in the glass beaker from Method 5 in an amount approximately equal to the amount of polonium-210 expected in the total particulate sample. Add 16 M nitric acid to the beaker to digest and loosen the residue.

4.1.2 Transfer the residue from the glass beaker to a teflon beaker containing the glass fiber filter. Rinse the glass beaker with 16 M nitric acid. If necessary reduce the volume in the beaker by evaporation until all of the nitric acid from the glass beaker has been transferred to the teflon beaker.

4.1.3 Add 30 ml of 29 M hydrofluoric acid to the teflon beaker and evaporate to near dryness on a hot plate in a properly operating hood. Caution: Do not allow the residue to go to dryness and overheat; this will result in loss of polonium.

4.1.4 Repeat step 4.1.3 until filter is dissolved.

4.1.5 Add 100 ml of 16 M nitric acid to the residue in the teflon beaker and evaporate to near dryness. Caution: Do not allow the residue to go to dryness.

4.1.6 Add 50 ml of 16 M nitric acid and 10 ml of 12 M perchloric acid to the teflon beaker and heat until dense fumes of perchloric acid are evolved.

4.1.7 Repeat steps 4.1.3 to 4.1.6 as necessary until sample is completely dissolved.

4.1.8 Add 10 ml of 12 M hydrochloric acid and evaporate to dryness. Repeat additions and evaporations several times.

4.1.9 Transfer the sample to a 250 ml volumetric flask and dilute to volume with 3 M hydrochloric acid.

b. Section 4.4.2 is removed and sections 4.4.3 through 4.4.8 are redesignated as sections 4.4.2 through 4.4.7 respectively.

c. In section 5.1, Equation 111-3 is amended by removing "A=picocuries of polonium-210 per filter" and adding "A= picocuries of polonium-210 in the particulate sample".

d. In section 5.2, Equation 111-4 is amended by revising the entry for "A=" to read "A= picocuries of polonium-210 in the particulate sample as determined by A in Equation 111-3".

e. Section 9.1.2 is removed.

7. By adding Method 114 to the methods in Appendix B to part 61 to read as follows:

Method 114—Test Methods for Measuring Radionuclide Emissions from Stationary Sources

1. Purpose and Background

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling and; (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

2. Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable sorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1—1969 shall be followed in using filter media to collect particulates (incorporated by reference—see § 61.18).

2.2 Radionuclides as Gases.

2.2.1 The Radionuclide Tritium (H-3). Tritium in the form of water vapor is collected from the extracted effluent sample by sorption, condensation or dissolution techniques. Appropriate collectors may include silica gel, molecular sieves, and ethylene glycol or water bubblers.

Tritium in the gaseous form may be measured directly in the sample stream using Method B–1, collected as a gas sample or may be oxidized using a metal catalyst to tritiated water and collected as described above.

2.2.2 Radionuclides of Iodine. Iodine is collected from an extracted sample by sorption or dissolution techniques. Appropriate collectors may include charcoal, impregnated charcoal, metal zeolite and caustic solutions.

2.2.3 Radionuclides of Argon, Krypton and Xenon. Radionuclides of these elements are either measured directly by an in-line or off-line monitor, or are collected from the extracted sample by low temperature sorption techniques. Appropriate sorbers may include charcoal or metal zeolite.

2.2.4 Radionuclides of Oxygen, Carbon, Nitrogen and Radon. Radionuclides of these elements are measured directly using an in-line or off-line monitor. Radionuclides of carbon in the form of carbon dioxide may be collected by dissolution in caustic solutions.

2.3 Definition of Terms

In-line monitor means a continuous measurement system in which the detector is placed directly in or adjacent to the effluent stream. This may involve either gross radioactivity measurements or specific radionuclide measurements. Gross measurements shall be made in conformance with the conditions specified in Methods A–4, B–2 and G–4.

Off-line monitor means a measurement system in which the detector is used to continuously measure an extracted sample of the effluent stream. This may involve either gross radioactivity measurements or specific radionuclide measurements. Gross measurements shall be made in conformance with the conditions specified in Methods A–4, B–2 and G–4.

Sample collection means a procedure in which the radionuclides are removed from an extracted sample of the effluent using a collection media. These collection media include filters, absorbers, bubblers and condensers. The collected sample is analyzed using the methods described in Section 3.

3. Radionuclide Analysis Methods

A series of methods based on "principles of measurement" are described which are applicable to the analysis of radionuclides collected from airborne effluent streams at stationary sources. These methods are applicable only under the conditions stated and within the limitations described. Some methods specify that only a single radionuclide be present in the sample or the chemically separated sample. This condition should be interpreted to mean that no other radionuclides are present in quantities which would interfere with the measurement.

Also identified (Table 1) are methods for a selected list of radionuclides. The listed radionuclides are those which are most commonly used and which have the greatest potential for causing dose to members of the public. Use of methods based on principles of measurement other than those described in this section must be approved in advance of use by the Administrator. For radionuclides not listed in Table 1, any of the described methods may be used provided the user can demonstrate that the applicability conditions of the method have been met.

The type of method applicable to the analysis of a radionuclide is dependent upon the type of radiation emitted, i.e., alpha, beta or gamma. Therefore, the methods described below are grouped according to principles of measurements for the analysis of alpha, beta and gamma emitting radionuclides.

3.1 Methods for Alpha Emitting Radionuclides

3.1.1 Method A–1, Radiochemistry-Alpha Spectrometry.

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemical techniques. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a very thin film by electrodeposition or by coprecipitation on a very small amount of carrier, such as lanthanum fluoride. The deposited element is then counted with an alpha spectrometer. The activity of the nuclide of interest is measured by the number of alpha counts in the appropriate energy region. A correction for chemical yield and counting efficiency is made using a standardized radioactive nuclide (tracer) of the same element. If a radioactive tracer is not available for the element of interest, a predetermined chemical yield factor may be used.

Applicability: This method is applicable for determining the activity of any alpha-emitting radionuclide, regardless of what other radionuclides are present in the sample provided the chemical separation step produces a very thin sample and removes all other radionuclides which could interfere in the spectral region of interest. APHA–605(2), ASTM–D–3972(13).

3.1.2 Method A–2, Radiochemistry-Alpha Counting.

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemistry. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a thin film and counted with a alpha counter. A correction for chemical yield (if necessary) is made. The alpha count rate measures the total activity of all emitting radionuclides of the separated element.

Applicability: This method is applicable for the measurement of any alpha-emitting radionuclide, provided no other alpha emitting radionuclide is present in the separated sample. It may also be applicable for determining compliance, when other radionuclides of the separated element are present, provided that the calculated emission rate is assigned to the radionuclide which could be present in the sample that has the highest dose conversion factor. IDO–12096(18).

3.1.3 Method A–3, Direct Alpha Spectrometry.

Principle: The sample, collected on a suitable filter, is counted directly on an alpha spectrometer. The sample must be thin enough and collected on the surface of the filter so that any absorption of alpha particle energy in the sample or the filter, which would degrade the spectrum, is minimal.

Applicability: This method is applicable to simple mixtures of alpha emitting radionuclides and only when the amount of particulates collected on the filter paper are relatively small and the alpha spectra is adequately resolved. Resolutions should be 50 keV (FWHM) or better, ASTM–D–3084(16).

3.1.4 Method A–4, Direct Alpha Counting (Gross alpha determination).

Principle: The sample, collected on a suitable filter, is counted with an alpha counter. The sample must be thin enough so that self-absorption is not significant and the filter must be of such a nature that the particles are retained on the surface.

Applicability: Gross alpha determinations may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, or the identity and isotopic ratio of the radionuclides in the sample are well-known, and (2) measurements using either Method A–1, A–2 or A–5 have shown that this method provides a reasonably accurate measurement of the emission rate. Gross alpha measurements are applicable to unidentified mixtures of radionuclides only for the purposes and under the conditions described in section 3.7. APHA–601(3), ASTM–D–1943(10).

3.1.5 Method A–5, Chemical Determination of Uranium.

Principle: Uranium may be measured chemically by either colorimetry or fluorometry. In both procedures, the sample is dissolved, the uranium is oxidized to the hexavalent form and extracted into a suitable solvent. Impurities are removed from the solvent layer. For colorimetry, dibenzoylmethane is added, and the uranium is measured by the absorbance in a colorimeter. For fluorometry, a portion of the solution is fused with a sodium fluoride-lithium fluoride flux and the uranium is determined by the ultraviolet activated fluorescence of the fused disk in a fluorometer.

Applicability: This method is applicable to the measurements of emission rates of uranium when the isotopic ratio of the uranium radionuclides is well known. ASTM–E–318(15), ASTM–D–2907(14).

3.1.6 Method A–6, Radon-222—Continuous Gas Monitor.

Principle: Radon-222 is measured directly in a continuously extracted sample stream by passing the air stream through a calibrated scintillation cell. Prior to the scintillation cell, the air stream is treated to remove particulates and excess moisture. The alpha particles from radon-222 and its decay products strike a zinc sulfide coating on the inside of the scintillation cell producing light pulses. The light pulses are detected by a photomultiplier tube which generates electrical pulses. These pulses are processed by the system electronics and the read out is in pCi/l of radon-222.

Applicability: This method is applicable to the measurement of radon-222 in effluent

streams which do not contain significant quantities of radon-220. Users of this method should calibrate the monitor in a radon calibration chamber at least twice per year. The background of the monitor should also be checked periodically by operating the instrument in a low radon environment. EPA 520/1-89-009(24).

3.1.7 Method A-7, Radon-222-Alpha Track Detectors

Principle: Radon-222 is measured directly in the effluent stream using alpha track detectors (ATD). The alpha particles emitted by radon-222 and its decay products strike a small plastic strip and produce submicron damage tracks. The plastic strip is placed in a caustic solution that accentuates the damage tracks which are counted using a microscope or automatic counting system. The number of tracks per unit area is correlated to the radon concentration in air using a conversion factor derived from data generated in a radon calibration facility.

Applicability: Prior approval from EPA is required for use of this method. This method is only applicable to effluent streams which do not contain significant quantities of radon-220, unless special detectors are used to discriminate against radon-220. This method may be used only when ATDs have been demonstrated to produce data comparable to data obtained with Method A-6. Such data should be submitted to EPA when requesting approval for the use of this method. EPA 520/1-89-009(24).

3.2 Methods for Gaseous Beta Emitting Radionuclides.

3.2.1 Method B-1, Direct Counting in Flow-Through Ionization Chambers.

Principle: An ionization chamber containing a specific volume of gas which flows at a given flow rate through the chamber is used. The sample (effluent stream sample) acts as the counting gas for the chamber. The activity of the radionuclide is determined from the current measured in the ionization chamber.

Applicability: This method is applicable for measuring the activity of a gaseous beta-emitting radionuclide in an effluent stream that is suitable as a counting gas, when no other beta-emitting nuclides are present. DOE/EP-0096(17), NCRP-58(23).

3.2.2 Method B-2, Direct Counting With In-line or Off-line Beta Detectors.

Principle: The beta detector is placed directly in the effluent stream (in-line) or an extracted sample of the effluent stream is passed through a chamber containing a beta detector (off-line). The activities of the radionuclides present in the effluent stream are determined from the beta count rate, and a knowledge of the radionuclides present and the relationship of the gross beta count rate and the specific radionuclide concentration.

Applicability: This method is applicable only to radionuclides with maximum beta particle energies greater then 0.2 MeV. This method may be used to measure emissions of specific radionuclides only when it is known that the sample contains only a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. Specific radionuclide analysis of periodic grab samples may be used to identify the types and quantities of radionuclides present and to establish the relationship between specific radionuclide analyses and gross beta count rates.

This method is applicable to unidentified mixtures of gaseous radionuclides only for the purposes and under the conditions described in section 3.7.

3.3 Methods for Non-Gaseous Beta Emitting Radionuclides.

3.3.1 Method B-3, Radiochemistry-Beta Counting.

Principle: The element of interest is separated from other elements, and from the sample matrix by radiochemistry. This may involve precipitation, distillation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet, and counted with a beta counter. Corrections for chemical yield, and decay (if necessary) are made. The beta count rate determines the total activity of all radionuclides of the separated element. This method may also involve the radiochemical separation and counting of a daughter element, after a suitable period of ingrowth, in which case it is specific for the parent nuclide.

Applicability: This method is applicable for measuring the activity of any beta-emitting radionuclide, with a maximum energy greater than 0.2 MeV, provided no other radionuclide is present in the separated sample. APHA-608(5).

3.3.2 Method B-4, Direct Beta Counting (Gross beta determination).

Principle: The sample, collected on a suitable filter, is counted with a beta counter. The sample must be thin enough so that self-absorption corrections can be made.

Applicability: Gross beta measurements are applicable only to radionuclides with maximum beta particle energies greater than 0.2 MeV. Gross beta measurements may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, and (2) measurements made using Method B-3 show reasonable agreement with the gross beta measurement. Gross beta measurements are applicable to mixtures of radionuclides only for the purposes and under the conditions described in section 3.7. APHA-602(4), ASTM-D-1890(11).

3.3.3 Method B-5, Liquid Scintillation Spectrometry.

Principle: An aliquot of a collected sample or the result of some other chemical separation or processing technique is added to a liquid scintillation "cocktail" which is viewed by photomultiplier tubes in a liquid scintillation spectrometer. The spectrometer is adjusted to establish a channel or "window" for the pulse energy appropriate to the nuclide of interest. The activity of the nuclide of interest is measured by the counting rate in the appropriate energy channel. Corrections are made for chemical yield where separations are made.

Applicability: This method is applicable to any beta-emitting nuclide when no other radionuclide is present in the sample or the separated sample provided that it can be incorporated in the scintillation cocktail. This method is also applicable for samples which contain more than one radionuclide but only when the energies of the beta particles are sufficiently separated so that they can be resolved by the spectrometer. This method is most applicable to the measurement of low-energy beta emitters such as tritium and carbon-14. APHA-609(6), EML-LV-539-17(19).

3.4 Gamma Emitting Radionuclides

3.4.1 Method G-1, High Resolution Gamma Spectrometry.

Principle: The sample is counted with a high resolution gamma detector, usually either a Ge(Li) or a high purity Ge detector, connected to a multichannel analyzer or computer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclide. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separations may be made prior to counting but are usually not necessary.

Applicability: This method is applicable to the measurement of any gamma emitting radionuclide with gamma energies greater than 20 keV. It can be applied to complex mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gases. The method may also be applied to the analysis of gaseous gamma emitting radionuclides directly in an effluent stream by passing the stream through a chamber or cell containing the detector. ASTM-3649(9), IDO-12096(18).

3.4.2 Method G-2, Low Resolution Gamma Spectrometry.

Principle: The sample is counted with a low resolution gamma detector, a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube and connected to a multichannel analyzer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclides. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separation may be used prior to counting to obtain less complex gamma spectra if needed.

Applicability: This method is applicable to the measurement of gamma emitting radionuclides with energies greater than 100 keV. It can be applied only to relatively simple mixtures of gamma emitting radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector. ASTM-D-2459(12), EMSL-LV-0539-17(19).

3.4.3 Method G-3, Single Channel Gamma Spectrometry.

Principle: The sample is counted with a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube connected to a single channel analyzer. The activity of a gamma emitting radionuclide is

determined from the gamma counts in the energy range for which the counter is set.

Applicability: This method is applicable to the measurement of a single gamma emitting radionuclide. It is not applicable to mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector.

3.4.4 Method G–4, Gross Gamma Counting.

Principle: The sample is counted with a gamma detector usually a thallium activated sodium iodine crystal. The detector is coupled to a photomultiplier tube and gamma rays above a specific threshold energy level are counted.

Applicability: Gross gamma measurements may be used to measure emissions of specific radionuclides only when it is known that the sample contains a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. When gross gamma measurements are used to determine emissions of specific radionuclides periodic measurements using Methods G–1 or G–2 should be made to demonstrate that the gross gamma measurements provide reliable emission data. This method may be applied to analysis of gaseous radionuclides directly in an effluent stream by placing the detector directly in or adjacent to the effluent stream or passing an extracted sample of the effluent stream through a chamber or cell containing the detector.

3.5 Counting Methods. All of the above methods with the exception of Method A–5 involve counting the radiation emitted by the radionuclide. Counting methods applicable to the measurement of alpha, beta and gamma radiations are listed below. The equipment needed and the counting principles involved are described in detail in ASTM–3648[8].

3.5.1 Alpha Counting:

• *Gas Flow Proportional Counters.* The alpha particles cause ionization in the counting gas and the resulting electrical pulses are counted. These counters may be windowless or have very thin windows.

• *Scintillation Counters.* The alpha particles transfer energy to a scintillator resulting in a production of light photons which strike a photomultiplier tube converting the light photons to electrical pulses which are counted. The counters may involve the use of solid scintillation materials such as zinc sulfide or liquid scintillation solutions.

• *Solid-State Counters.* Semiconductor materials, such as silicon surface-barrier p-n junctions, act as solid ionization chambers. The alpha particles interact which the detector producing electron hole pairs. The charged pair is collected by an applied electrical field and the resulting electrical pulses are counted.

• *Alpha Spectrometers.* Semiconductor detectors used in conjunction with multichannel analyzers for energy discrimination.

3.5.2 Beta Counting:

• *Ionization Chambers.* These chambers contain the beta-emitting nuclide in gaseous form. The ionization current produced is measured.

• *Geiger-Muller (GM) Counters or Gas Flow Proportional Counters.* The beta particles cause ionization in the counting gas and the resulting electrical pulses are counted. Proportional gas flow counters which are heavily shielded by lead or other metal, and provided with an anti-coincidence shield to reject cosmic rays, are called low background beta counters.

• *Scintillation Counters.* The beta particles transfer energy to a scintillator resulting in a production of light photons, which strike a photomultiplier tube converting the light photon to electrical pulses which are counted. This may involve the use of anthracene crystals, plastic scintillator, or liquid scintillation solutions with organic phosphors.

• *Liquid Scintillation Spectrometers.* Liquid scintillation counters which use two photomultiplier tubes in coincidence to reduce background counts. This counter may also electronically discriminate among pulses of a given range of energy.

3.5.3 Gamma Counting:

• *Low-Resolution Gamma Spectrometers.* The gamma rays interact with thallium activated sodium iodide or cesium iodide crystal resulting in the release of light photons which strike a photomultiplier tube converting the light pulses to electrical pulses proportional to the energy of the gamma ray. Multi-channel analyzers are used to separate and store the pulses according to the energy absorbed in the crystal.

• *High-Resolution gamma Spectrometers.* Gamma rays interact with a lithium-drifted (Ge(Li)) or high-purity germanium (HPGe) semiconductor detectors resulting in a production of electron-hole pairs. The charged pair is collected by an applied electrical field. A very stable low noise preamplifier amplifies the pulses of electrical charge resulting from the gamma photon interactions. Multichannel analyzers or computers are used to separate and store the pulses according to the energy absorbed in the crystal.

• *Single Channel Analyzers.* Thallium activated sodium iodide crystals used with a single window analyzer. Pulses from the photomultiplier tubes are separated in a single predetermined energy range.

3.5.4 Calibration of Counters. Counters are calibrated for specific radionuclide measurements using a standard of the radionuclide under either identical or very similar conditions as the sample to be counted. For gamma spectrometers a series of standards covering the energy range of interest may be used to construct a calibration curve relating gamma energy to counting efficiency.

In those cases where a standard is not available for a radionuclide, counters may be calibrated using a standard with energy characteristics as similar as possible to the radionuclide to be measured. For gross alpha and beta measurements of the unidentified mixtures of radionuclides, alpha counters are calibrated with a natural uranium standard and beta counters with a cesium-137 standard. The standard must contain the same weight and distribution of solids as the samples, and be mounted in an identical manner. If the samples contain variable amounts of solids, calibration curves relating weight of solids present to counting efficiency are prepared. Standards other than those prescribed may be used provided it can be shown that such standards are more applicable to the radionuclide mixture measured.

3.6 Radiochemical Methods for Selected Radionuclides. Methods for a selected list of radionuclides are listed in Table 1. The radionuclides listed are those which are most commonly used and which have the greatest potential for causing doses to members of the public. For radionuclides not listed in Table 1, methods based on any of the applicable "principles of measurement" described in section 3.1 through 3.4 may be used.

3.7 Applicability of Gross Alpha and Beta Measurements to Unidentified Mixtures of Radionuclides. Gross alpha and beta measurements may be used as a screening measurement as a part of an emission measurement program to identify the need to do specific radionuclide analyses or to confirm or verify that unexpected radionuclides are not being released in significant quantities.

Gross alpha (Method A–4) or gross beta (Methods B–2 or B–4) measurements may also be used for the purpose of comparing the measured concentrations in the effluent stream with the limiting "Concentration Levels for Environmental Compliance" in Table 2 of Appendix E. For unidentified mixtures, the measured concentration value shall be compared with the lowest environmental concentration limit for any radionuclide which is not known to be absent from the effluent stream.

TABLE 1.—LIST OF APPROVED METHODS FOR SPECIFIC RADIONUCLIDES

Radionuclide	Approved methods of analysis
Am-241	A–1, A–2, A–3, A–4
Ar-41	B–1, B–2, G–1, G–2, G–3, G–4
Ba-140	G–1, G–2, G–3, G–4
Br-82	G–1, G–2, G–3, G–4
C-11	B–1, B–2, G–1, G–2, G–3, G–4
C-14	B–5
Ca-45	B–3, B–4, B–5
Ce-144	G–1, G–2, G–3, G–4
Cm-244	A–1, A–2, A–3, A–4
Co-60	G–1, G–2, G–3, G–4
Cr-51	G–1, G–2, G–3, G–4
Cs-134	G–1, G–2, G–3, G–4
Cs-137	G–1, G–2, G–3, G–4
Fe-55	B–5, G–1
Fe-59	G–1, G–2, G–3, G–4
Ga-67	G–1, G–2, G–3, G–4
H-3 (H_2O)	B–5
H-3 (gas)	B–1
I-123	G–1, G–2, G–3, G–4
I-125	G–1
I-131	G–1, G–2, G–3, G–4
In-113m	G–1, G–2, G–3, G–4
Ir-192	G–1, G–2, G–3, G–4
Kr-85	B–1, B–2, B–5, G–1, G–2, G–3, G–4
Kr-87	B–1, B–2, G–1, G–2, G–3, G–4

TABLE 1.—LIST OF APPROVED METHODS FOR SPECIFIC RADIONUCLIDES—Continued

Radionuclide	Approved methods of analysis
Kr-88	B-1, B-2, G-1, G-2, G-3, G-4
Mn-54	G-1, G-2, G-3, G-4
Mo-99	G-1, G-2, G-3, G-4
N-13	B-1, B-2, G-1, G-2, G-3, G-4
O-15	B-1, B-2, G-1, G-2, G-3, G-4
P-32	B-3, B-4, B-5
Pm-147	B-3, B-4, B-5
Po-210	A-1, A-2, A-3, A-4
Pu-238	A-1, A-2, A-3, A-4
Pu-239	A-1, A-2, A-3, A-4
Pu-240	A-1, A-2, A-3, A-4
S-35	B-5
Se-75	G-1, G-2, G-3, G-4
Sr-90	B-3, B-4, B-5
Tc-99	B-3, B-4, B-5
Te-201	G-1, G-2, G-3, G-4
Uranium (total alpha)	A-1, A-2, A-3, A-4
Uranium (Isotopic)	A-1, A-3
Uranium (Natural)	A-5
Xe-133	G-1
Yb-169	G-1, G-2, G-3, G-4
Zn-65	G-1, G-2, G-3, G-4

4. Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure, functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rationale for site selections.

4.3.2 A description of sampling probes and representativeness of the samples.

4.3.3 A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures and frequency of calibration.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

4.3.7 A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions.

4.5 A quality control program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates, spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified.

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage and analysis.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

4.8 A corrective action program shall be established including criteria for when corrective action is needed, what corrective actions will be taken and who is responsible for taking the corrective action.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits and description of corrective actions.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

5. References

(1) American National Standards Institute, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities", ANSI-N13.1-1969, American National Standards Institute, New York, New York (1969).

(2) American Public Health Association, "Methods of Air Sampling", 2nd Edition, Method 605, "Tentative Method of Analysis for Plutonium Content of Atmospheric Particulate Matter". American Public Health Association, New York, NY (1977).

(3) Ibid, Method 601, "Tentative Method of Analysis for Gross Alpha Radioactivity Content of the Atmosphere".

(4) Ibid, Method 602, "Tentative Method of the Analysis for Gross Beta Radioactivity Content of the Atmosphere".

(5) Ibid, Method 608, "Tentative Method of Analysis for Strontium-90 Content of Atmospheric Particulate Matter".

(6) Ibid, Method 609, "Tentative Method of Analysis for Tritium Content of the Atmosphere".

(7) Ibid, Method 603, "Tentative Method of Analysis for Iodine-131 Content of the Atmosphere".

(8) American Society for Testing and Materials, 1986 Annual Book ASTM Standards, Designation D-3648-78, "Standard Practices for the Measurement of Radioactivity". American Society for Testing and Materials, Philadelphia, PA (1986).

(9) Ibid, Designation D-3649-85, "Standard Practice for High Resolution Gamma Spectrometry".

(10) Ibid, Designation D-1943-81, "Standard Test Method for Alpha Particle Radioactivity of Water".

(11) Ibid, Designation D-1890-81, "Standard Test Method for Beta Particle Radioactivity of Water".

(12) Ibid, Designation D-2459-72, "Standard Test Method for Gamma Spectrometry of Water".

(13) Ibid, Designation D-3972-82, "Standard Test Method for Isotopic Uranium in Water by Radiochemistry".

(14) Ibid, Designation D-2907-83, "Standard Test Methods for Microquantities of Uranium in Water by Fluorometry".

(15) Ibid, Designation E-318, "Standard Test Method for Uranium in Aqueous Solutions by Colorimetry".

(16) Ibid, Designation D-3084-75, "Standard Practice for Alpha Spectrometry of Water".

(17) Corley, J.P. and C.D. Corbit, "A Guide for Effluent Radiological Measurements at DOE Installations", DOE/EP-0096, Pacific Northwest Laboratories, Richland, Washington (1983).

(18) Department of Energy, "RESL Analytical Chemistry Branch Procedures Manual", IDO-12096, U.S. Department of Energy, Idaho Falls, Idaho (1982).

(19) Environmental Protection Agency, "Radiochemical Analytical Procedures for Analysis of Environmental Samples", EMSL-LV-0539-17, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada (1979).

(20) Environmental Protection Agency, "Radiochemistry Procedures Manual", EPA 520/5-84-006, Eastern Environmental Radiation Facility, Montgomery, Alabama (1984).

(21) National Council on Radiation Protection and Measurements, NCRP Report

No. 50, "Environmental Radiation Measurements", National Council on Radiation Protection and Measurement, Bethesda, Maryland (1976).

(22) Ibid, Report No. 47, "Tritium Measurement Techniques". (1976).

(23) Ibid, Report No. 58 "A Handbook of Radioactivity Measurement Procedures" (1985).

(24) Environmental Protection Agency, "Indoor Radon and Radon Decay Product Measurement Protocols", EPA 520/1–89–009, U.S. Environmental Protection Agency, Washington, DC (1989).

8. By adding Method 115 to the list of methods in Appendix B to part 61 to read as follows:

Method 115—Monitoring for Radon-222 Emissions

This Appendix describes the monitoring methods which must be used in determining the radon-222 emissions from underground uranium mines, uranium mill tailings piles, phosphogypsum stacks, and other piles of waste material emitting radon.

1. Radon-222 Emissions from Underground Uranium Mine Vents

1.1 Sampling Frequency and Calculation of Emissions. Radon-222 emissions from underground uranium mine vents shall be determined using one of the following methods:

1.1.1 Continuous Measurement. These measurements shall be made and the emissions calculated as follows:

(a) The radon-222 concentration shall be continuously measured at each mine vent whenever the mine ventilation system is operational.

(b) Each mine vent exhaust flow rate shall be measured at least 4 times per year.

(c) A weekly radon-222 emission rate for the mine shall be calculated and recorded weekly as follows:

$$A_w = C_1Q_1T_1 + C_2Q_2T_2 + \ldots C_iQ_iT_i$$

Where:

A_w = Total radon-222 emitted from the mine during week (Ci)

C_i = Average radon-222 concentration in mine vent i(Ci/m^3)

Q_i = Volumetric flow rate from mine vent i(m^3/hr)

T_i = Hours of mine ventilation system operation during week for mine vent i(hr)

(d) The annual radon-222 emission rate is the sum of the weekly emission rates during a calendar year.

1.1.2 Periodic Measurement. This method is applicable only to mines that continuously operate their ventilation system except for extended shutdowns. Mines which start up and shut down their ventilation system frequently must use the continuous measurement method describe in Section 1.1.1 above. Emission rates determined using periodic measurements shall be measured and calculated as follows:

(a) The radon-222 shall be continuously measured at each mine vent for at least one week every three months.

(b) Each mine vent exhaust flow rate shall be measured at least once during each of the radon-222 measurement periods.

(c) A weekly radon-222 emission rate shall be calculated for each weekly period according to the method described in Section 1.1.1. In this calculation T = 168 hr.

(d) The annual radon-222 emission rate from the mine should be calculated as follows:

$$A_y = \frac{52 - W_s}{n} \quad (A_{w1} + A_{w2} + \ldots A_{wi})$$

Where:

A_y = Annual radon-222 emission rate from the mine(Ci)

A_{wi} = Weekly radon-222 emission rate during the measurement period i (Ci)

n = Number of weekly measurement periods per year

W_s = Number of weeks during the year that the mine ventilation system is shut down in excess of 7 consecutive days, i.e. the sum of the number of weeks each shut down exceeds 7 days

1.2 Test Methods and Procedures

Each underground mine required to test its emissions, unless an equivalent or alternative method has been approved by the Administrator, shall use the following test methods:

1.2.1 Test Method 1 of Appendix A to part 60 shall be used to determine velocity traverses. The sampling point in the duct shall be either the centroid of the cross section or the point of average velocity.

1.2.2 Test Method 2 of Appendix A to part 60 shall be used to determine velocity and volumetric flow rates.

1.2.3 Test Methods A–6 or A–7 of Appendix B, Method 114 to part 61 shall be used for the analysis of radon–222. Use of Method A–7 requires prior approval of EPA based on conditions described in Appendix B.

1.2.4 A quality assurance program shall be conducted in conformance with the programs described for Continuous Radon Monitors and Alpha Track Detectors in EPA 520/1–89–009. (2)

2. Radon–222 Emissions from Uranium Mill Tailings Piles

2.1 Measurement and Calculation of Radon Flux from Uranium Mill Tailings Piles.

2.1.1 Frequency of Flux Measurement. A single set of radon flux measurements may be made, or if the owner or operator chooses, more frequent measurements may be made over a one year period. These measurements may involve quarterly, monthly or weekly intervals. All radon measurements shall be made as described in paragraphs 2.1.2 through 2.1.6 except that for measurements made over a one year period, the requirement of paragraph 2.1.4(c) shall not apply. The mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each measurement period. The weather conditions, moisture content of the tailings and area of the pile covered by water existing at the time of the measurement shall be chosen so as to provide measurements representative of the long term radon flux from the pile and shall be subject to EPA review and approval.

2.1.2 Distribution of Flux Measurements. The distribution and number of radon flux measurements required on a pile will depend on clearly defined areas of the pile (called regions) that can have significantly different radon fluxes due to surface conditions. The mean radon flux shall be determined for each individual region of the pile. Regions that shall be considered for operating mill tailings piles are:

(a) Water covered areas,

(b) Water saturated areas (beaches),

(c) Dry top surface areas, and

(d) Sides, except where earthen material is used in dam construction.

For mill tailings after disposal the pile shall be considered to consist of only one region.

2.1.3 Number of Flux Measurements. Radon flux measurements shall be made within each region on the pile, except for those areas covered with water. Measurements shall be made at regularly spaced locations across the surface of the region, realizing that surface roughness will prohibit measurements in some areas of a region. The minimum number of flux measurements considered necessary to determine a representative mean radon flux value for each type of region on an operating pile is:

(a) Water covered area—no measurements required as radon flux is assumed to be zero,

(b) Water saturated beaches—100 radon flux measurements,

(c) Loose and dry top surface—100 radon flux measurements,

(d) Sides—100 radon flux measurements, except where earthern material is used in dam construction.

For a mill tailings pile after disposal which consists of only one region a minimum of 100 measurements are required.

2.1.4 Restrictions to Radon Flux Measurements. The following restrictions are placed on making radon flux measurements:

(a) Measurements shall not be initiated within 24 hours of a rainfall.

(b) If a rainfall occurs during the 24 hour measurements period, the measurement is invalid if the seal around the lip of the collector has washed away or if the collector is surrounded by water.

(c) Measurements shall not be performed if the ambient temperature is below 35°F or if the ground is frozen.

2.1.5 Areas of Pile Regions. The approximate area of each region of the pile shall be determined in units of square meters.

2.1.6 Radon Flux Measurement. Measuring radon flux involves the adsorption of radon on activated charcoal in a large-area collector. The radon collector is placed on the surface of the pile area to be measured and allowed to collect radon for a time period of 24 hours. The radon collected on the charcoal is measured by gamma–ray spectroscopy. The detailed measurement procedure provided in Appendix A of EPA 520/5–85–0029(1) shall be used to measure the radon flux on uranium mill tailings, except the surface of the tailings shall not be penetrated by the lip of the radon collector as directed in the procedure, rather the collector shall be

carefully positioned on a flat surface with soil or tailings used to seal the edge.

2.1.7 Calculations. The mean radon flux for each region of the pile and for the total pile shall be calculated and reported as follows:

(a) The individual radon flux calculations shall be made as provided in Appendix A EPA 86 (1). The mean radon flux for each region of the pile shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

(b) The mean radon flux for the total uranium mill tailings pile shall be calculated as follows.

$$J_s = \frac{J_1A_1 + \ldots J_2A_2 \ldots J_iA_i}{A_t}$$

Where:
J_s = Mean flux for the total pile (pCi/m^2-s)
J_i = Mean flux measured in region i (pCi/m^2-s)
A_i = Area of region i (m^2)
A_t = Total area of the pile (m^2)

2.1.8 Reporting. The results of individual flux measurements, the approximate locations on the pile, and the mean radon flux for each region and the mean radon flux for the total stack shall be included in the emission test report. Any condition or unusual event that occurred during the measurements that could significantly affect the results should be reported.

3.0 Radon-222 Emissions from Phosphogypsum Stacks.

3.1 Measurement and Calculation of the Mean Radon Flux. Radon flux measurements shall be made on phosphogypsum stacks as described below:

3.1.1 Frequency of Measurements. A single set of radon flux measurements may be made after the phosphogypsum stack becomes inactive, or if the owner or operator chooses, more frequent measurements may be made over a one year period. These measurements may involve quarterly, monthly or weekly intervals. All radon measurements shall be made as described in paragraphs 3.1.2 through 3.1.6 except that for measurements made over a one year period, the requirement of paragraph 3.1.4(c) shall not apply. For measurements made over a one year period, the radon flux shall be the arithmetic mean of the mean radon flux for each measurement period.

3.1.2 Distribution and Number of Flux Measurements. The distribution and number of radon flux measurements required on a stack will depend on clearly defined areas of the stack (called regions) that can have significantly different radon fluxes due to surface conditions. The mean radon flux shall be determined for each individual region of the stack. Regions that shall be considered are:

(a) Water covered areas,
(b) Water saturated areas (beaches),
(c) Loose and dry top surface areas,
(d) Hard-packed roadways, and
(e) Sides.

3.1.3 Number of Flux Measurements. Radon flux measurements shall be made within each region on the phosphogypsum stack, except for those areas covered with water. Measurements shall be made at regularly spaced locations across the surface of the region, realizing that surface roughness will prohibit measurements in some areas of a region. The minimum number of flux measurements considered necessary to determine a representative mean radon flux value for each type of region is:

(a) Water covered area—no measurements required as radon flux is assumed to be zero,
(b) Water saturated beaches—50 radon flux measurements,
(c) Loose and dry top surface—100 radon flux measurements,
(d) Hard-packed roadways—50 radon flux measurements, and
(e) Sides—100 radon flux measurements.

A minimum of 300 measurements are required. A stack that has no water cover can be considered to consist of two regions, top and sides, and will require a minimum of only 200 measurements.

3.1.4 Restrictions to Radon Flux Measurements. The following restrictions are placed on making radon flux measurements:

(a) Measurements shall not be initiated within 24 hours of a rainfall.
(b) If a rainfall occurs during the 24 hour measurement period, the measurement is invalid if the seal around the lip of the collector has washed away or if the collector is surrounded by water.
(c) Measurements shall not be performed if the ambient temperature is below 35 °F or if the ground is frozen.

3.1.5 Areas of Stack Regions. The approximate area of each region of the stack shall be determined in units of square meters.

3.1.6 Radon Flux Measurements. Measuring radon flux involves the adsorption of radon on activated charcoal in a large-area collector. The radon collector is placed on the surface of the stack area to be measured and allowed to collect radon for a time period of 24 hours. The radon collected on the charcoal is measured by gamma-ray spectroscopy. The detailed measurement procedure provided in Appendix A of EPA 520/5-85-0029(1) shall be used to measure the radon flux on phosphogypsum stacks, except the surface of the phosphogypsum shall not be penetrated by the lip of the radon collector as directed in the procedure, rather the collector shall be carefully positioned on a flat surface with soil or phosphogypsum used to seal the edge.

3.1.7 Calculations. The mean radon flux for each region of the phosphogypsum stack and for the total stack shall be calculated and reported as follows:

(a) The individual radon flux calculations shall be made as provided in Appendix A EPA 86 (1). The mean radon flux for each region of the stack shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

(b) The mean radon flux for the total phosphogypsum stack shall be calculated as follows.

$$J_s = \frac{J_1A_1 + J_2A_2 + \ldots J_iA_i}{A_t}$$

Where:
J_s = Mean flux for the total stack (pCi/m^2-s)
J_i = Mean flux measured in region i (pCi/m^2-s)
A_i = Area of region i (m^2)
A_t = Total area of the stack

3.1.8 Reporting. The results of individual flux measurements, the approximate locations on the stack, and the mean radon flux for each region and the mean radon flux for the total stack shall be included in the emission test report. Any condition or unusual event that occurred during the measurements that could significantly affect the results should be reported.

4.0 Quality Assurance Procedures for Measuring Rn-222 Flux

A. Sampling Procedures

Records of field activities and laboratory measurements shall be maintained. The following information shall be recorded for each charcoal canister measurement:

(a) Site
(b) Name of pile
(c) Sample location
(d) Sample ID number
(e) Date and time on
(f) Date and time off
(g) Observations of meteorological conditions and comments

Records shall include all applicable information associated with determining the sample measurement, calculations, observations, and comments.

B. Sample Custody

Custodial control of all charcoal samples exposed in the field shall be maintained in accordance with EPA chain-of-custody field procedures. A control record shall document all custody changes that occur between the field and laboratory personnel.

C. Calibration Procedures and Frequency

The radioactivity of two standard charcoal sources, each containing a carefully determined quantity of radium-226 uniformly distributed through 180g of activated charcoal, shall be measured. An efficiency factor is computed by dividing the average measured radioactivity of the two standard charcoal sources, minus the background, in cpm by the known radioactivity of the charcoal sources in dpm. The same two standard charcoal sources shall be counted at the beginning and at the end of each day's counting as a check of the radioactivity counting equipment. A background count using unexposed charcoal should also be made at the beginning and at the end of each counting day to check for inadvertent contamination of the detector or other changes affecting the background. The unexposed charcoal comprising the blank is changed with each new batch of charcoal used.

D. Internal Quality Control Checks and Frequency

The charcoal from every tenth exposed canister shall be recounted. Five percent of the samples analyzed shall be either blanks (charcoal having no radioactivity added) or

samples spiked with known quantities of radium-226.

E. Data Precision, Accuracy, and Completeness

The precision, accuracy, and completeness of measurements and analyses shall be within the following limits for samples measuring greater than 1.0 $pCi/m^3 - s$.

(a) Precision: 10%

(b) Accuracy: ±10%

(c) Completeness: at least 85% of the measurements must yield useable results.

5.0 References

(1) Hartley, J.N. and Freeman, H.D., "Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida," U.S. Environmental Protection Agency Report, EPA 520/5–85–029, January 1986.

(2) Environmental Protection Agency, "Indoor Radon and Radon Decay Product Measurement Protocols", EPA 520/1–89–009, U.S. Environmental Protection Agency, Washington, DC. (1989).

9. By adding Appendix D to part 61 to read as follows:

Appendix D to Part 61—Methods for Estimating Radionuclide Emissions

1. Purpose and Background

Facility owners or operators may estimate radionuclide emissions to the atmosphere for dose calculations instead of measuring emissions. Particulate emissions from mill tailings piles should be estimated using the procedures listed in reference #2. All other emissions may be estimated by using the "Procedures" listed below, or using the method described in reference #1.

2. Procedure

To estimate emissions to the atmosphere:

(a) Determine the amount (in curies) used at facilities for the period under consideration. Radioactive materials in sealed packages that remain unopened, and have not leaked during the assessment period should not be included in the calculation.

(b) Multiply the amount used by the following factors which depend on the physical state of the radionuclide. They are:

(i) 1 for gases;

(ii) 10^{-3} for liquids or particulate solids; and

(iii) 10^{-6} for solids.

If any nuclide is heated to a temperature of 100 degrees Celsius or more, boils at a temperature of 100 degrees Celsius or less, or is intentionally dispersed into the environment, it must be considered to be a gas.

(c) If a control device is installed between the place of use and the point of release, multiply emissions from (b) by an adjustment factor. These are presented in Table 1.

TABLE 1.—ADJUSTMENT TO EMISSION FACTORS FOR EFFLUENT CONTROLS

Controls	Types of radionuclides controlled	Adjustment factor to emissions	Comments and conditions
HEPA filters	Particulates	0.01	Not applicable to gaseous radionuclides; periodic testing is prudent to ensure high removal efficiency.
Fabric filter	Particulates	0.1	Monitoring would be prudent to guard against tears in filter.
Sintered metal	Particulates	1	Insufficient data to make recommendation.
Activated carbon filters	Iodine gas	0.1	Efficiency is time dependent; monitoring is necessary to ensure effectiveness.
Douglas bags: Held one week or longer for decay	Xenon	0.5/wk	Based on xenon half-life of 5.3 days;
Douglas bags: Released within one week	Xenon	1	Provides no reduction of exposure to general public.
Venturi scrubbers	Particulates	0.05	Although venturis may remove gases, variability in gaseous removal efficiency dictates adjustment factor for particulates only.
	Gases	1	
Packed bed scrubbers	Gases	0.1	Not applicable to particulates.
Electrostatic precipitators	Particulates	0.05	Not applicable for gaseous radionuclides
Xenon traps	Xenon	0.1	Efficiency is time dependent; monitoring is necessary to ensure effectiveness.
Fume hoods	All	1	Provides no reduction to general public exposures.
Vent stacks	All	1	Generally provides no reduction of exposure to general public.

References

(1) Environmental Protection Agency, "A Guide for Determining Compliance with the Clean Air Act Standards for Radionuclides Emissions from NRC-Licensed and Non-DOE Federal Facilities", EPA 520/1–89–002, January 1989.

(2) Nuclear Regulatory Commission, "Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations", U.S. Nuclear Regulatory Commission Regulatory Guide 3.59, March 1987.

10. By adding Appendix E part 61 to read as follows:

Appendix E to Part 61—Compliance Procedures Methods for Determining Compliance With Subpart I

1. Purpose and Background

This Appendix provides simplified procedures to reduce the burden on Nuclear Regulatory Commission (NRC) licensees, and non-Department of Energy Federal facilities in determining compliance with 40 CFR part 61, subpart I. The procedures consist of a series of increasingly more stringent steps, depending on the facility's potential to exceed the standard.

First, a facility can be found in compliance if the quantity of radioactive material possessed during the year is less than that listed in a table of annual possession quantities. A facility will also be in compliance if the average annual radionuclide emission concentration is less than that listed in a table of air concentration levels. If the facility is not in compliance by these tables, it can establish compliance by estimating a dose using screening procedure developed by the National Council on Radiation Protection and Measurements with a radiological source term derived using EPA approved emission factors. These procedures are described in a "Guide for Determining Compliance with the Clean Air Act Standards for Radionuclide Emissions From NRC-Licenced and Non-DOE Federal Facilities."

A user-friendly computer program called COMPLY has been developed to reduce the burden on the regulated community. The Agency has also prepared a "User's Guide for the COMPLY Code" to assist the regulated community in using the code, and in handling more complex situations such as multiple release points. The basis for these compliance procedures are provided in "Background Information Document: Procedures Approved for Demonstrating Compliance with 40 CFR part 61, subpart I". The compliance model is the highest level in the COMPLY computer code and provides for the most realistic assessment of dose by allowing the use of site-specific information.

2. Table of Annual Possession Quantity

(a) Table 1 may be used for determining if facilities are in compliance with the standard. The possession table can only be used if the following conditions are met:

(i) No person lives within 10 meters of any release point; and

(ii) No milk, meat, or vegetables are produced within 100 meters of any release point.

(b) Procedures described in Reference (1) shall be used to determine compliance or exemption from reporting by use of Table 2.

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
Ac-225	9.6E−05	9.6E−02	9.6E+01
Ac-227	1.6E−07	1.6E−04	1.6E−01
Ac-228	3.4E−03	3.4E+00	3.4E+03
Ag-106	1.6E+00	1.6E+03	1.6E+06
Ag-106m	2.6E−03	2.6E+00	2.6E+03
Ag-108m	6.5E−06	6.5E−03	6.5E+00
Ag-110m	9.4E−05	9.4E−02	9.4E+01
Ag-111	6.7E−02	6.7E+01	6.7E+04
Al-26	4.0E−06	4.0E−03	4.0E+00
Am-241	2.3E−06	2.3E−03	2.3E+00
Am-242	1.8E−02	1.8E+01	1.8E+04
Am-242m	2.5E−06	2.5E−03	2.5E+00
Am-243	2.3E−06	2.3E−03	2.3E+00
Am-244	4.6E−02	4.6E+01	4.6E+04
Am-245	7.0E+00	7.0E+03	7.0E+06
Am-246	9.8E−01	9.8E+02	9.8E+05
Ar-37	1.4E+06		
Ar-41	1.4E+00		
As-72	2.9E−02	2.9E+01	2.9E+04
As-73	6.0E−02	6.0E+01	6.0E+04
As-74	4.3E−03	4.3E+00	4.3E+03
As-76	8.8E−02	8.8E+01	8.8E+04
As-77	7.9E−01	7.9E+02	7.9E+05
At-211	1.0E−02	1.0E+01	1.0E+04
Au-193	4.2E−01	4.2E+02	4.2E+05
Au-194	3.5E−02	3.5E+01	3.5E+04
Au-195	3.3E−03	3.3E+00	3.3E+03
Au-198	4.6E−02	4.6E+01	4.6E+04
Au-199	1.5E−01	1.5E+02	1.5E+05
Ba-131	1.0E−02	1.0E+01	1.0E+04
Ba-133	4.9E−05	4.9E−02	4.9E+01
Ba-133m	9.3E−02	9.3E+01	9.3E+04
Ba-135m	5.8E−01	5.8E+02	5.8E+05
Ba-139	4.7E+00	4.7E+03	4.7E+06
Ba-140	2.1E−03	2.1E+00	2.1E+03
Ba-141	1.3E+00	1.3E+03	1.3E+06
Ba-142	1.1E+00	1.1E+03	1.1E+06
Be-7	2.3E−02	2.3E+01	2.3E+04
Be-10	3.0E−03	3.0E+00	3.0E+03
Bi-206	3.1E−03	3.1E+00	3.1E+03
Bi-207	8.4E−06	8.4E−03	8.4E+00
Bi-210	4.2E−03	4.2E+00	4.2E+03
Bi-212	4.7E−02	4.7E+01	4.7E+04
Bi-213	6.0E−02	6.0E+01	6.0E+04
Bi-214	1.4E−01	1.4E+02	1.4E+05
Bk-249	7.0E−04	7.0E−01	7.0E+02
Bk-250	1.0E−01	1.0E+02	1.0E+05
Br-77	7.5E−02	7.5E+01	7.5E+04
Br-80	1.2E+01	1.2E+04	1.2E+07
Br-80m	1.5E+00	1.5E+03	1.5E+06
Br-82	1.6E−02	1.6E+01	1.6E+04
Br-83	9.9E+00	9.9E+03	9.9E+06
Br-84	5.6E−01	5.6E+02	5.6E+05
C-11	1.3E+00	1.3E+03	1.3E+06
C-14	2.9E−01	2.9E+02	2.9E+05
Ca-41	2.7E−02	2.7E+01	2.7E+04
Ca-45	5.8E−02	5.8E+01	5.8E+04
Ca-47	1.1E−02	1.1E+01	1.1E+04
Cd-109	5.0E−03	5.0E+00	5.0E+03
Cd-113	3.3E−04	3.3E−01	3.3E+02
Cd-113m	4.4E−04	4.4E−01	4.4E+02
Cd-115	5.4E−02	5.4E+01	5.4E+04
Cd-115m	1.0E−02	1.0E+01	1.0E+04
Cd-117	5.6E−02	5.6E+01	5.6E+04
Cd-117m	1.3E−01	1.3E+02	1.3E+05
Ce-139	2.6E−03	2.6E+00	2.6E+03
Ce-141	1.8E−02	1.8E+01	1.8E+04
Ce-143	1.0E−01	1.0E+02	1.0E+05
Ce-144	1.7E−03	1.7E+00	1.7E+03
Cf-248	2.0E−05	2.0E−02	2.0E+01
Cf-249	1.7E−06	1.7E−03	1.7E+00
Cf-250	4.0E−06	4.0E−03	4.0E+00
Cf-251	1.7E−06	1.7E−03	1.7E+00
Cf-252	6.4E−06	6.4E−03	6.4E+00
Cf-253	3.3E−04	3.3E−01	3.3E+02

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE—Continued

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
Cl-254	3.6E−06	3.6E−03	3.6E+00
Cl-36	1.9E−04	1.9E−01	1.9E+02
Cl-38	6.5E−01	6.5E+02	6.5E+05
Cm-242	6.0E−05	6.0E−02	6.0E+01
Cm-243	3.3E−06	3.3E−03	3.3E+00
Cm-244	4.2E−06	4.2E−03	4.2E+00
Cm-245	2.3E−06	2.3E−03	2.3E+00
Cm-246	2.3E−06	2.3E−03	2.3E+00
Cm-247	2.3E−06	2.3E−03	2.3E+00
Cm-248	6.4E−07	6.4E−04	6.4E−01
Cm-249	4.6E+00	4.6E+03	4.6E+06
Cm-250	1.1E−07	1.1E−04	1.1E−01
Co-56	2.4E−04	2.4E−01	2.4E+02
Co-57	1.6E−03	1.6E+00	1.6E+03
Co-58	9.0E−04	9.0E−01	9.0E+02
Co-58m	1.7E−01	1.7E+02	1.7E+05
Co-60	1.6E−05	1.6E−02	1.6E+01
Co-60m	4.0E+00	4.0E+03	4.0E+06
Co-61	3.8E+00	3.8E+03	3.8E+06
Cr-49	9.0E−01	9.0E+02	9.0E+05
Cr-51	6.3E−02	6.3E+01	6.3E+04
Cs-129	1.5E−01	1.5E+02	1.5E+05
Cs-131	2.8E−01	2.8E+02	2.8E+05
Cs-132	1.3E−02	1.3E+01	1.3E+04
Cs-134	5.2E−05	5.2E−02	5.2E+01
Cs-134m	3.2E−01	3.2E+02	3.2E+05
Cs-135	2.4E−02	2.4E+01	2.4E+04
Cs-136	2.1E−03	2.1E+00	2.1E+03
Cs-137	2.3E−05	2.3E−02	2.3E+01
Cs-138	4.4E−01	4.4E+02	4.4E+05
Cu-61	4.0E−01	4.0E+02	4.0E+05
Cu-64	5.2E−01	5.2E+02	5.2E+05
Cu-67	1.5E−01	1.5E+02	1.5E+05
Dy-157	4.4E−01	4.4E+02	4.4E+05
Dy-165	5.6E+00	5.6E+03	5.6E+06
Dy-166	8.1E−02	8.1E+01	8.1E+04
Er-169	4.0E−01	4.0E+02	4.0E+05
Er-171	3.6E−01	3.6E+02	3.6E+05
Es-253	2.6E−04	2.6E−01	2.6E+02
Es-254	2.3E−05	2.3E−02	2.3E+01
Es-254m	1.8E−03	1.8E+00	1.8E+03
Eu-152	1.6E−05	1.6E−02	1.6E+01
Eu-152m	3.5E−01	3.5E+02	3.5E+05
Eu-154	2.0E−05	2.0E−02	2.0E+01
Eu-155	5.2E−04	5.2E−01	5.2E+02
Eu-156	3.2E−03	3.2E+00	3.2E+03
F-18	5.6E−01	5.6E+02	5.6E+05
Fe-52	4.9E−02	4.9E+01	4.9E+04
Fe-55	1.4E−01	1.4E+02	1.4E+05
Fe-59	1.3E−03	1.3E+00	1.3E+03
Fm-254	1.8E−02	1.8E+01	1.8E+04
Fm-255	4.0E−03	4.0E+00	4.0E+03
Fr-223	1.4E−01	1.4E+02	1.4E+05
Ga-66	5.6E−02	5.6E+01	5.6E+04
Ga-67	1.1E−01	1.1E+02	1.1E+05
Ga-68	7.6E−01	7.6E+02	7.6E+05
Ga-72	3.6E−02	3.6E+01	3.6E+04
Gd-152	4.4E−06	4.4E−03	4.4E+00
Gd-153	2.0E−03	2.0E+00	2.0E+03
Gd-159	6.8E−01	6.8E+02	6.8E+05
Ge-68	2.3E−04	2.3E−01	2.3E+02
Ge-71	2.6E+00	2.6E+03	2.6E+06
Ge-77	1.0E−01	1.0E+02	1.0E+05
H-3	1.5E+01	1.5E+04	1.5E+07
Hf-181	2.5E−03	2.5E+00	2.5E+03
Hg-193m	9.5E−02	9.5E+01	9.5E+04
Hg-197	2.4E−01	2.4E+02	2.4E+05
Hg-197m	2.5E−01	2.5E+02	2.5E+05
Hg-203	5.2E−03	5.2E+00	5.2E+03
Ho-166	2.8E−01	2.8E+02	2.8E+05
Ho-166m	6.0E−06	6.0E−03	6.0E+00
I-123	4.9E−01	4.9E+02	4.9E+05
I-124	9.3E−03	9.3E+00	9.3E+03
I-125	6.2E−03	6.2E+00	6.2E+03

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE—Continued

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
I-126	3.7E−03	3.7E+00	3.7E+03
I-128	9.3E+00	9.3E+03	9.3E+06
I-129	2.6E−04	2.6E−01	2.6E+02
I-130	4.6E−02	4.6E+01	4.6E+04
I-131	6.7E−03	6.7E+00	6.7E+03
I-132	2.0E−01	2.0E+02	2.0E+05
I-133	6.7E−02	6.7E+01	6.7E+04
I-134	3.2E−01	3.2E+02	3.2E+05
I-135	1.2E−01	1.2E+02	1.2E+05
In-111	4.9E−02	4.9E+01	4.9E+04
In-113m	2.1E+00	2.1E+03	2.1E+06
In-114m	4.9E−03	4.9E+00	4.9E+03
In-115	2.7E−04	2.7E−01	2.7E+02
In-115m	1.4E+00	1.4E+03	1.4E+06
In-116m	3.5E−01	3.5E+02	3.5E+05
In-117	1.3E+00	1.3E+03	1.3E+06
In-117m	7.6E−02	7.6E+01	7.6E+04
Ir-190	3.5E−03	3.5E+00	3.5E+03
Ir-192	9.7E−04	9.7E−01	9.7E+02
Ir-194	2.5E−01	2.5E+02	2.5E+05
Ir-194m	1.5E−04	1.5E−01	1.5E+02
K-40	6.8E−05	6.8E−02	6.8E+01
K-42	2.9E−01	2.9E+02	2.9E+05
K-43	6.0E−02	6.0E+01	6.0E+04
K-44	4.9E−01	4.9E+02	4.9E+05
Kr-79	7.0E+00		
Kr-81	1.8E+02		
Kr-83m	2.0E+04		
Kr-85	8.4E+02		
Kr-85m	1.1E+01		
Kr-87	2.0E+00		
Kr-88	4.2E−01		
La-140	1.6E−02	1.6E+01	1.6E+04
La-141	1.1E+00	1.1E+03	1.1E+06
La-142	2.3E−01	2.3E+02	2.3E+05
Lu-177	1.4E−01	1.4E+02	1.4E+05
Lu-177m	3.5E−04	3.5E−01	3.5E+02
Mg-28	2.1E−02	2.1E+01	2.1E+04
Mn-52	3.5E−03	3.5E+00	3.5E+03
Mn-52m	5.2E−01	5.2E+02	5.2E+05
Mn-53	5.7E−02	5.7E+01	5.7E+04
Mn-54	2.5E−04	2.5E−01	2.5E+02
Mn-56	2.5E−01	2.5E+02	2.5E+05
Mo-93	1.5E−03	1.5E+00	1.5E+03
Mo-99**	5.7E−02	5.7E+01	5.7E+04
Mo-101	8.4E−01	8.4E+02	8.4E+05
Na-22	3.2E−05	3.2E−02	3.2E+01
Na-24	2.6E−02	2.6E+01	2.6E+04
Nb-90	2.5E−02	2.5E+01	2.5E+04
Nb-93m	1.2E−02	1.2E+01	1.2E+04
Nb-94	6.0E−06	6.0E−03	6.0E+00
Nb-95	2.3E−03	2.3E+00	2.3E+03
Nb-95m	2.0E−02	2.0E+01	2.0E+04
Nb-96	2.5E−02	2.5E+01	2.5E+04
Nb-97	1.0E+00	1.0E+03	1.0E+06
Nd-147	3.0E−02	3.0E+01	3.0E+04
Nd-149	1.1E+00	1.1E+03	1.1E+06
Ni-56	2.0E−03	2.0E+00	2.0E+03
Ni-57	2.1E−02	2.1E+01	2.1E+04
Ni-59	2.2E−02	2.2E+01	2.2E+04
Ni-63	1.4E−01	1.4E+02	1.4E+05
Ni-65	7.0E−01	7.0E+02	7.0E+05
Np-235	3.0E−02	3.0E+01	3.0E+04
Np-237	1.8E−06	1.8E−03	1.8E+00
Np-238	1.9E−02	1.9E+01	1.9E+04
Np-239	1.0E−01	1.0E+02	1.0E+05
Np-240	6.5E−01	6.5E+02	6.5E+05
Np-240m	4.7E+00	4.7E+03	4.7E+06
Os-185	9.2E−04	9.2E−01	9.2E+02
Os-191m	9.0E−01	9.0E+02	9.0E+05
Os-191	3.8E−02	3.8E+01	3.8E+04
Os-193	2.9E−01	2.9E+02	2.9E+05
P-32	1.7E−02	1.7E+01	1.7E+04
P-33	1.2E−01	1.2E+02	1.2E+05

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE—Continued

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
Pa-230	6.3E−04	6.3E−01	6.3E+02
Pa-231	8.3E−07	8.3E−04	8.3E−01
Pa-233	9.3E−03	9.3E+00	9.3E+03
Pa-234	9.3E−02	9.3E+01	9.3E+04
Pb-203	8.3E−02	8.3E+01	8.3E+04
Pb-205	1.2E−02	1.2E+01	1.2E+04
Pb-209	1.1E+01	1.1E+04	1.1E+07
Pb-210	5.5E−05	5.5E−02	5.5E+01
Pb-211	1.2E−01	1.2E+02	1.2E+05
Pb-212	6.0E−03	6.0E+00	6.0E+03
Pb-214	1.2E−01	1.2E+02	1.2E+05
Pd-103	2.1E−01	2.1E+02	2.1E+05
Pd-107	8.2E−02	8.2E+01	8.2E+04
Pd-109	9.4E−01	9.4E+02	9.4E+05
Pm-143	7.6E−04	7.6E−01	7.6E+02
Pm-144	1.1E−04	1.1E−01	1.1E+02
Pm-145	5.2E−04	5.2E−01	5.2E+02
Pm-146	4.4E−05	4.4E−02	4.4E+01
Pm-147	2.6E−02	2.6E+01	2.6E+04
Pm-148	1.7E−02	1.7E+01	1.7E+04
Pm-148m	7.6E−04	7.6E−01	7.6E+02
Pm-149	2.8E−01	2.8E+02	2.8E+05
Pm-151	1.2E−01	1.2E+02	1.2E+05
Po-210	9.3E−05	9.3E−02	9.3E+01
Pr-142	2.8E−01	2.8E+02	2.8E+05
Pr-143	1.0E−01	1.0E+02	1.0E+05
Pr-144	1.5E+01	1.5E+04	1.5E+07
Pt-191	6.4E−02	6.4E+01	6.4E+04
Pt-193	2.1E−02	2.1E+01	2.1E+04
Pt-193m	4.8E−01	4.8E+02	4.8E+05
Pt-195m	1.4E−01	1.4E+02	1.4E+05
Pt-197	1.1E+00	1.1E+03	1.1E+06
Pt-197m	3.6E+00	3.6E+03	3.6E+06
Pu-236	7.0E−06	7.0E−03	7.0E+00
Pu-237	2.3E−02	2.3E+01	2.3E+04
Pu-238	2.7E−06	2.7E−03	2.7E+00
Pu-239	2.5E−06	2.5E−03	2.5E+00
Pu-240	2.5E−06	2.5E−03	2.5E+00
Pu-241	1.3E−04	1.3E−01	1.3E+02
Pu-242	2.5E−06	2.5E−03	2.5E+00
Pu-243	3.8E+00	3.8E+03	3.8E+06
Pu-244	2.4E−06	2.4E−03	2.4E+00
Pu-245	2.1E−01	2.1E+02	2.1E+05
Pu-246	4.8E−03	4.8E+00	4.8E+03
Ra-223	1.3E−04	1.3E−01	1.3E+02
Ra-224	3.2E−04	3.2E−01	3.2E+02
Ra-225	1.3E−04	1.3E−01	1.3E+02
Ra-226	5.5E−06	5.5E−03	5.5E+00
Ra-228	1.3E−05	1.3E−02	1.3E+01
Rb-81	4.2E−01	4.2E+02	4.2E+05
Rb-83	1.4E−03	1.4E+00	1.4E+03
Rb-84	2.0E−03	2.0E+00	2.0E+03
Rb-86	1.7E−02	1.7E+01	1.7E+04
Rb-87	1.0E−02	1.0E+01	1.0E+04
Rb-88	1.7E+00	1.7E+03	1.7E+06
Rb-89	6.4E−01	6.4E+02	6.4E+05
Re−184	1.8E−03	1.8E+00	1.8E+03
Re-184m	3.6E−04	3.6E−01	3.6E+02
Re-186	1.9E−01	1.9E+02	1.9E+05
Re-187	9.3E+00	9.3E+03	9.3E+06
Re-188	3.7E−01	3.7E+02	3.7E+05
Rh-103m	1.7E+02	1.7E+05	1.7E+08
Rh-105	3.4E−01	3.4E+02	3.4E+05
Ru-97	8.3E−02	8.3E+01	8.3E+04
Ru-103	3.1E−03	3.1E+00	3.1E+03
Ru-105	2.9E−01	2.9E+02	2.9E+05
Ru-106	5.9E−04	5.9E−01	5.9E+02
S-35	7.5E−02	7.5E+01	7.5E+04
Sb-117	2.0E+00	2.0E+03	2.0E+06
Sb-122	3.9E−02	3.9E+01	3.9E+04
Sb-124	6.0E−04	6.0E−01	6.0E+02
Sb-125	1.4E−04	1.4E−01	1.4E+02
Sb-126	1.8E−03	1.8E+00	1.8E+03
Sb-126m	7.6E−01	7.6E+02	7.6E+05
Sb-127	2.0E−02	2.0E+01	2.0E+04
Sb-129	1.8E−01	1.8E+02	1.8E+05
Sc-44	1.4E−01	1.4E+02	1.4E+05
Sc-46	4.0E−04	4.0E−01	4.0E+02
Sc-47	1.1E−01	1.1E+02	1.1E+05
Sc-48	1.1E−02	1.1E+01	1.1E+04
Sc-49	1.0E+01	1.0E+04	1.0E+07
Se-73	1.6E−01	1.6E+02	1.6E+05
Se-75	1.1E−03	1.1E+00	1.1E+03
Se-79	6.9E−03	6.9E+00	6.9E+03
Si-31	4.7E+00	4.7E+03	4.7E+06
Si-32	7.2E−04	7.2E−01	7.2E+02
Sm-147	1.4E−05	1.4E−02	1.4E+01
Sm-151	3.5E−02	3.5E+01	3.5E+04
Sm-153	2.4E−01	2.4E+02	2.4E+05
Sn-113	1.9E−03	1.9E+00	1.9E+03
Sn-117m	2.3E−02	2.3E+01	2.3E+04
Sn-119m	2.8E−02	2.8E+01	2.8E+04
Sn-123	1.8E−02	1.8E+01	1.8E+04
Sn-125	7.2E−03	7.2E+00	7.2E+03
Sn-126	4.7E−06	4.7E−03	4.7E+00
Sr-82	1.9E−03	1.9E+00	1.9E+03
Sr-85	1.9E−03	1.9E+00	1.9E+03
Sr-85m	1.5E+00	1.5E+03	1.5E+06
Sr-87m	1.2E+00	1.2E+03	1.2E+06
Sr-89	2.1E−02	2.1E+01	2.1E+04
Sr-90	5.2E−04	5.2E−01	5.2E+02
Sr-91	1.2E−01	1.2E+02	1.2E+05
Sr-92	2.5E−01	2.5E+02	2.5E+05
Ta-182	4.4E−04	4.4E−01	4.4E+02
Tb-157	2.2E−03	2.2E+00	2.2E+03
Tb-160	8.4E−04	8.4E−01	8.4E+02
Tc-95	9.0E−02	9.0E+01	9.0E+04
Tc-95m	1.4E−03	1.4E+00	1.4E+03
Tc-96	5.6E−03	5.6E+00	5.6E+03
Tc-96m	7.0E−01	7.0E+02	7.0E+05
Tc-97	1.5E−03	1.5E+00	1.5E+03
Tc-97m	7.2E−02	7.2E+01	7.2E+04
Tc-98	6.4E−06	6.4E−03	6.4E+00
Tc-99	9.0E−03	9.0E+00	9.0E+03
Tc-99m	1.4E+00	1.4E+03	1.4E+06
Tc-101	3.8E+00	3.8E+03	3.8E+06
Te-121	6.0E−03	6.0E+00	6.0E+03
Te-121m	5.3E−04	5.3E−01	5.3E+02
Te-123	1.2E−03	1.2E+00	1.2E+03
Te-123m	2.7E−03	2.7E+00	2.7E+03
Te-125m	1.5E−02	1.5E+01	1.5E+04
Te-127	2.9E+00	2.9E+03	2.9E+06
Te-127m	7.3E−03	7.3E+00	7.3E+03
Te-129	6.5E+00	6.5E+03	6.5E+06
Te-129m	6.1E−03	6.1E+00	6.1E+03
Te-131	9.4E−01	9.4E+02	9.4E+05
Te-131m	1.8E−02	1.8E+01	1.8E+04
Te-132	6.2E−03	6.2E+00	6.2E+03
Te-133	1.2E+00	1.2E+03	1.2E+06
Te-133m	2.9E−01	2.9E+02	2.9E+05
Te-134	4.4E−01	4.4E+02	4.4E+05
Th-226	3.0E−02	3.0E+01	3.0E+04
Th-227	6.4E−05	6.4E−02	6.4E+01
Th-228	2.9E−06	2.9E−03	2.9E+00
Th-229	4.9E−07	4.9E−04	4.9E−01
Th-230	3.2E−06	3.2E−03	3.2E+00
Th-231	8.4E−01	8.4E+02	8.4E+05
Th-232	6.0E−07	6.0E−04	6.0E−01
Th-234	2.0E−02	2.0E+01	2.0E+04
Ti-44	5.2E−06	5.2E−03	5.2E+00
Ti-45	4.0E−01	4.0E+02	4.0E+05
Tl-200	4.4E−02	4.4E+01	4.4E+04
Tl-201	1.8E−01	1.8E+02	1.8E+05
Tl-202	1.0E−02	1.0E+01	1.0E+04
Tl-204	2.5E−02	2.5E+01	2.5E+04
Tm-170	2.4E−02	2.4E+01	2.4E+04
Tm-171	5.9E−02	5.9E+01	5.9E+04
U-230	5.0E−05	5.0E−02	5.0E+01
U-231	1.4E−01	1.4E+02	1.4E+05
U-232	1.3E−06	1.3E−03	1.3E+00
U-233	7.6E−06	7.6E−03	7.6E+00
U-234	7.6E−06	7.6E−03	7.6E+00
U-235	7.0E−06	7.0E−03	7.0E+00
U-236	8.4E−06	8.4E−03	8.4E+00
U-237	4.7E−02	4.7E+01	4.7E+04
U-238	8.6E−06	8.6E−03	8.6E+00
U-239	8.3E+00	8.3E+03	8.3E+06
U-240	1.8E−01	1.8E+02	1.8E+05
V-48	1.4E−03	1.4E+00	1.4E+03
V-49	1.3E+00	1.3E+03	1.3E+06
W-181	1.1E−02	1.1E+01	1.1E+04
W-185	1.6E−01	1.6E+02	1.6E+05
W-187	1.1E−01	1.1E+02	1.1E+05
W-188	1.0E−02	1.0E+01	1.0E+04
Xe-122	7.6E−02	7.6E+01	7.6E+04
Xe-123	1.6E+00	1.6E+03	1.6E+06
Xe-125	6.0E−01		
Xe-127	7.0E+00		
Xe-129m	7.6E+01		
Xe-131m	2.2E+02		
Xe-133	5.2E+01		
Xe-133m	6.0E+01		
Xe-135	7.6E+00		
Xe-135m	4.2E+00		
Xe-138	9.9E−01		
Y-86	2.8E−02	2.8E+01	2.8E+04
Y-87	2.3E−02	2.3E+01	2.3E+04
Y-88	2.5E−04	2.5E−01	2.5E+02
Y-90	1.1E−01	1.1E+02	1.1E+05
Y-90m	4.3E−01	4.3E+02	4.3E+05
Y-91	1.8E−02	1.8E+01	1.8E+04
Y-91m	1.6E+00	1.6E+03	1.6E+06
Y-92	7.0E−01	7.0E+02	7.0E+05
Y-93	3.8E−01	3.8E+02	3.8E+05
Yb-169	5.5E−03	5.5E+00	5.5E+03
Yb-175	2.1E−01	2.1E+02	2.1E+05
Zn-62	8.6E−02	8.6E+01	8.6E+04
Zn-65	4.4E−04	4.4E−01	4.4E+02
Zn-69	2.7E+01	2.7E+04	2.7E+07
Zn-69m	2.0E−01	2.0E+02	2.0E+05
Zr-86	2.4E−02	2.4E+01	2.4E+04
Zr-88	2.7E−04	2.7E−01	2.7E+02
Zr-89	1.6E−02	1.6E+01	1.6E+04
Zr-93	2.8E−03	2.8E+00	2.8E+03
Zr-95	6.4E−04	6.4E−01	6.4E+02
Zr-97	4.6E−02	4.6E+01	4.6E+04

*Radionuclides boiling at 100 °C or less, or exposed to a temperature of 100 °C, must be considered a gas. Capsules containing radionuclides in liquid or powder form can be considered to be solids.

**Mo-99 contained in a generator to produce Technetium-99 can be assumed to be a solid.

3. Table of Concentration Levels

(a) Table 2 may be used for determining if facilities are in compliance with the standard.

1. The concentration table as applied to emission estimates can only be used if all releases are from point sources and concentrations have been measured at the stack or vent using EPA-approved methods, and the distance between each stack or vent and the nearest resident is greater than 3 times the diameter of the stack or vent. Procedures provided in Ref. (1) shall be used to determine compliance or exemption from reporting by use of Table 2.

2. The concentration table may be used to determine compliance with the standard based on environmental measurements provided these measurements are made in conformance with the requirements of § 61.107(b)(5).

4. NCRP Screening Model

The procedures described in Reference (4) may be used to determine doses to members of the general public from emissions of radionuclides to the atmosphere. Both the total dose from all radionuclides emitted, and the dose caused by radioactive iodine must be considered in accordance with the procedures in Ref. (1).

5. The COMPLY Computer Code

The COMPLY computer code may be used to determine compliance with subpart I. The compliance model in the COMPLY computer code may be used to determine the dose to members of the general public from emissions of radionuclides to the atmosphere. The EPA may add radionuclides to all or any part of COMPLY to cover radionuclides that may be used by the regulated community.

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Ac-225	9.1E−14	Bi-207	1.0E−14
Ac-227	1.6E−16	Bi-210	2.9E−13
Ac-228	3.7E−12	Bi-212	5.6E−11
Ag-106	1.9E−09	Bi-213	7.1E−11
Ag-106m	1.2E−12	Bi-214	1.4E−10
Ag-108m	7.1E−15	Bk-249	5.6E−13
Ag-110m	9.1E−14	Bk-250	9.1E−11
Ag-111	2.5E−12	Br-77	4.2E−11
Al-26	4.8E−15	Br-80	1.4E−08
Am-241	1.9E−15	Br-80m	1.8E−09
Am-242	1.5E−11	Br-82	1.2E−11
Am-242m	2.0E−15	Br-83	1.2E−08
Am-243	1.8E−15	Br-84	6.7E−10
Am-244	4.0E−11	C-11	1.5E−09
Am-245	8.3E−09	C-14	1.0E−11
Am-246	1.2E−09	Ca-41	4.2E−13
Ar-37	1.6E−03	Ca-45	1.3E−12
Ar-41	1.7E−09	Ca-47	2.4E−12
As-72	2.4E−11	Cd-109	5.9E−13
As-73	1.1E−11	Cd-113	9.1E−15
As-74	2.2E−12	Cd-113m	1.7E−14
As-76	5.0E−11	Cd-115	1.6E−11
As-77	1.6E−10	Cd-115m	8.3E−13
At-211	1.1E−11	Cd-117	6.7E−11
Au-193	3.8E−10	Cd-117m	1.6E−10
Au-194	3.2E−11	Ce-139	2.6E−12
Au-195	3.1E−12	Ce-141	6.3E−12
Au-198	2.1E−11	Ce-143	3.0E−11
Au-199	4.8E−11	Ce-144	6.2E−13
Ba-131	7.1E−12	Cf-248	1.8E−14
Ba-133	5.9E−14	Cf-249	1.4E−15
Ba-133m	5.9E−11	Cf-250	3.2E−15
Ba-135m	1.8E−10	Cf-251	1.4E−15
Ba-139	5.6E−09	Cf-252	5.6E−15
Ba-140	1.3E−12	Cf-253	3.1E−13
Ba-141	1.4E−09	Cf-254	3.0E−15

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Ba-142	1.3E−09	Cl-36	2.7E−15
Be-7	2.3E−11	Cl-38	7.7E−10
Be-10	1.6E−12	Cm-242	5.3E−14
Bi-206	2.3E−12	Cm-243	2.6E−15
Cm-244	3.3E−15	Eu-156	1.9E−12
Cm-245	1.8E−15	F-18	6.7E−10
Cm-246	1.9E−15	Fe-52	5.6E−11
Cm-247	1.9E−15	Fe-55	9.1E−12
Cm-248	5.0E−16	Fe-59	6.7E−13
Cm-249	3.7E−09	Fm-254	2.0E−11
Cm-250	9.1E−17	Fm-255	4.3E−12
Co-56	1.8E−13	Fr-223	3.3E−11
Co-57	1.3E−12	Ga-66	6.2E−11
Co-58	6.7E−13	Ga-67	7.1E−11
Co-58m	1.2E−10	Ga-68	9.1E−10
Co-60	1.7E−14	Ga-72	3.8E−11
Co-60m	4.3E−09	Gd-152	5.0E−15
Co-61	4.5E−09	Gd-153	2.1E−12
Cr-49	1.1E−09	Gd-159	2.9E−10
Cr-51	3.1E−11	Ge-68	2.0E−13
Cs-129	1.4E−10	Ge-71	2.4E−10
Cs-131	3.3E−11	Ge-77	1.0E−10
Cs-132	4.8E−12	H-3	1.5E−09
Cs-134	2.7E−14	Hf-181	1.9E−12
Cs-134m	1.7E−10	Hg-193m	1.0E−10
Cs-135	4.0E−13	Hg-197	8.3E−11
Cs-136	5.3E−13	Hg-197m	1.1E−10
Cs-137	1.9E−14	Hg-203	1.0E−12
Cs-138	5.3E−10	Ho-166	7.1E−11
Cu-61	4.8E−10	Ho-166m	7.1E−15
Cu-64	5.3E−10	I-123	4.3E−10
Cu-67	5.0E−11	I-124	6.2E−13
Dy-157	5.0E−10	I-125	1.2E−13
Dy-165	6.7E−09	I-126	1.1E−13
Dy-166	1.1E−11	I-128	1.1E−08
Er-169	2.9E−11	I-129	9.1E−15
Er-171	4.0E−10	I-130	4.5E−11
Es-253	2.4E−13	I-131	2.1E−13
Es-254	2.0E−14	I-132	2.3E−10
Es-254m	1.8E−12	I-133	2.0E−11
Eu-152	2.0E−14	I-134	3.8E−10
Eu-152m	3.6E−10	I-135	1.2E−10
Eu-154	2.3E−14	In-111	3.6E−11
Eu-155	5.9E−13	In-113m	2.5E−09
In-114m	9.1E−13	Nb-95	2.2E−12
In-115	7.1E−14	Nb-95m	1.4E−11
In-115m	1.6E−09	Nb-96	2.4E−11
In-116m	4.2E−10	Nb-97	1.2E−09
In-117	1.6E−09	Nd-147	7.7E−12
In-117m	9.1E−11	Nd-149	7.1E−10
Ir-190	2.6E−12	Ni-56	1.7E−12
Ir-192	9.1E−13	Ni-57	1.8E−11
Ir-194	1.1E−10	Ni-59	1.5E−11
Ir-194m	1.7E−13	Ni-63	1.4E−11
K-40	2.7E−14	Ni-65	8.3E−10
K-42	2.6E−10	Np-235	2.5E−11
K-43	6.2E−11	Np-237	1.2E−15
K-44	5.9E−10	Np-238	1.4E−11
Kr-79	6.3E−09	Np-239	3.8E−11
Kr-81	2.1E−07	Np-240	7.7E−10
Kr-83m	2.3E−05	Np-240m	5.6E−09
Kr-85	1.0E−06	Os-185	1.0E−12
Kr-85m	1.3E−08	Os-191m	2.9E−10

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Kr-87	2.4E−09	Os-191	1.1E−11
Kr-88	5.0E−10	Os-193	9.1E−11
La-140	1.2E−11	P-32	3.3E−13
La-141	7.7E−10	P-33	2.4E−12
La-142	2.7E−10	Pa-230	3.2E−13
Lu-177	2.4E−11	Pa-231	5.9E−16
Lu-177m	3.6E−13	Pa-233	4.8E−12
Mg-28	1.5E−11	Pa-234	1.1E−10
Mn-52	2.8E−12	Pb-203	6.2E−11
Mn-52m	6.2E−10	Pb-205	5.6E−12
Mn-53	1.5E−11	Pb-209	1.3E−08
Mn-54	2.8E−13	Pb-210	2.8E−15
Mn-56	2.9E−10	Pb-211	1.4E−10
Mo-93	1.1E−12	Pb-212	6.3E−12
Mo-99	1.4E−11	Pb-214	1.2E−10
Mo-101	1.0E−09	Pd-103	3.8E−11
Na-22	2.6E−14	Pd-107	3.1E−11
Na-24	2.6E−11	Pd-109	4.8E−10
Nb-90	2.6E−11	Pm-143	9.1E−13
Nb-93m	1.0E−11	Pm-144	1.3E−13
Nb-94	7.1E−15	Pm-145	6.2E−13
Pm-146	5.3E−14	Re-184m	3.7E−13
Pm-147	1.1E−11	Re-186	1.8E−11
Pm-148	5.0E−12	Re-187	2.6E−10
Pm-148m	6.7E−13	Re-188	1.7E−10
Pm-149	4.2E−11	Rh-103m	2.1E−07
Pm-151	7.1E−11	Rh-105	1.3E−10
Po-210	7.1E−15	Ru-97	6.7E−11
Pr-142	1.1E−10	Ru-103	2.6E−12
Pr-143	7.1E−12	Ru-105	2.8E−10
Pr-144	1.8E−08	Ru-106	3.4E−13
Pt-191	4.3E−11	S-35	1.3E−12
Pt-193	1.8E−11	Sb-117	2.4E−09
Pt-193m	4.8E−11	Sb-122	1.4E−11
Pt-195m	3.2E−11	Sb-124	5.3E−13
Pt-197	4.0E−10	Sb-125	1.6E−13
Pt-197m	2.6E−09	Sb-126	1.4E−12
Pu-236	5.9E−15	Sb-126m	9.1E−10
Pu-237	1.9E−11	Sb-127	7.1E−12
Pu-238	2.1E−15	Sb-129	7.7E−11
Pu-239	2.0E−15	Sc-44	1.7E−10
Pu-240	2.0E−15	Sc-46	4.2E−13
Pu-241	1.0E−13	Sc-47	3.8E−11
Pu-242	2.0E−15	Sc-48	9.1E−12
Pu-243	4.2E−09	Sc-49	1.2E−08
Pu-244	2.0E−15	Se-73	1.7E−10
Pu-245	2.1E−10	Se-75	1.7E−13
Pu-248	2.2E−12	Se-79	1.1E−13
Ra-223	4.2E−14	Si-31	5.6E−09
Ra-224	1.5E−13	Si-32	3.4E−14
Ra-225	5.0E−14	Sm-147	1.4E−14
Ra-226	3.3E−15	Sm-151	2.1E−11
Ra-228	5.9E−15	Sm-153	5.9E−11
Rb-81	5.0E−10	Sn-113	1.4E−12
Rb-83	3.4E−13	Sn-117m	5.6E−12
Rb-84	3.6E−13	Sn-119m	5.3E−12
Rb-86	5.6E−13	Sn-123	1.1E−12
Rb-87	1.6E−13	Sn-125	1.7E−12
Rb-88	2.1E−09	Sn-126	5.3E−15
Rb-89	7.1E−10	Sr-82	6.2E−13
Re-184	1.5E−12	Sr-85	1.8E−12
Sr-85m	1.6E−09	Th-232	6.2E−16
Sr-87m	1.4E−09	Th-234	2.2E−12
Sr-89	1.8E−12	Ti-44	6.2E−15

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Sr-90	1.9E−14	Ti-45	4.8E−10
Sr-91	9.1E−11	Tl-200	4.5E−11
Sr-92	2.9E−10	Tl-201	1.0E−10
Ta-182	4.5E−13	Tl-202	5.0E−12
Tb-157	2.5E−12	Tl-204	1.2E−12
Tb-160	7.7E−13	Tm-170	3.3E−12
Tc-95	1.0E−10	Tm-171	2.6E−11
Tc-95m	1.4E−12	U-230	1.5E−14
Tc-96	5.6E−12	U-231	4.2E−11
Tc-96m	6.7E−10	U-232	1.3E−15
Tc-97	7.1E−13	U-233	7.1E−15
Tc-97m	7.1E−12	U-234	7.7E−15
Tc-98	6.7E−15	U-235	7.1E−15
Tc-99	1.4E−13	U-236	7.7E−15
Tc-99m	1.7E−09	U-237	1.0E−11
Tc-101	4.5E−09	U-238	6.3E−15
Te-121	1.0E−12	U-239	4.3E−09
Te-121m	1.2E−13	U-240	1.3E−10
Te-123	1.4E−13	V-48	1.0E−12
Te-123m	2.0E−13	V-49	1.6E−10
Te-125m	3.6E−13	W-181	6.7E−12
Te-127	1.0E−09	W-185	2.6E−12
Te-127m	1.5E−13	W-187	7.7E−11
Te-129	7.7E−09	W-188	5.3E−13
Te-129m	1.4E−13	Xe-122	9.1E−11

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Te-131	9.1E−11	Xe-123	1.6E−09
Te-131m	1.0E−12	Xe-125	1.1E−11
Te-132	7.1E−13	Xe-127	8.3E−09
Te-133	9.1E−10	Xe-129m	9.1E−08
Te-133m	2.2E−10	Xe-131m	2.6E−07
Te-134	5.3E−10	Xe-133	6.2E−08
Th-226	3.4E−11	Xe-133m	7.1E−08
Th-227	3.8E−14	Xe-135	9.1E−09
Th-228	3.1E−15	Xe-135m	5.0E−09
Th-229	5.3E−16	Xe-138	1.2E−09
Th-230	3.4E−15	Y-86	3.0E−11
Th-231	2.9E−10	Y-87	1.7E−11
Y-88	2.7E−13	Zn-65	9.1E−14
Y-90	1.3E−11	Zn-69	3.2E−08
Y-90m	1.9E−10	Zn-69m	1.7E−10
Y-91	2.1E−12	Zr-86	2.4E−11
Y-91m	1.3E−09	Zr-88	3.1E−13
Y-92	8.3E−10	Zr-89	1.3E−11
Y-93	2.9E−10	Zr-93	2.6E−12
Yb-169	3.7E−12	Zr-95	6.7E−13
Yb-175	4.3E−11	Zr-97	3.8E−11
Zn-62	9.1E−11		

6. References

(1) Environmental Protection Agency, "A Guide for Determining Compliance with the Clean Air Act Standards for Radionuclides Emissions from NRC-Licensed and Non-DOE Federal Facilities", EPA 520/1–89–002, October 1989.

(2) Environmental Protection Agency, "User's Guide for the COMPLY Code", EPA 520/1–89–003, October 1989.

(3) Environmental Protection Agency, "Background Information Document: Procedures Approved for Demonstrating Compliance with 40 CFR part 61, subpart I", EPA 520/1–89–001, January 1989.

(4) National Council on Radiation Protection and Measurement, "Screening Techniques for Determining Compliance with Environmental Standards" NCRP Commentary No. 3, Revision of January 1989 with addendum of October, 1989.

[FR Doc. 89–26330 Filed 12–11–89; 11:12 am]

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step. Most of these latter commenters believed that the MIR should be the sole criterion for making the acceptable risk decision, and that uncertainties and other factors are best considered in the ample margin of safety step. In so doing, some added that these uncertainties should not be addressed by incorporating unscientific, over-conservative assumptions into the risk assessments.

Response: The EPA believes that it is essential to consider the quality of the information it uses to make decisions when the decisions are being made. Thus, EPA agrees with commenters that stated that it would be inappropriate to evaluate the "safe" level and the "margin of safety" without taking the uncertainties (both scientific and technological) into account. Because EPA has concluded that many factors should be considered in making the acceptable risk decision, the EPA disagrees with commenters who believed that MIR should be the sole criterion for making the acceptable risk decision and that uncertainties and other factors are best considered in the ample margin of safety step.

Comment: When estimates are imprecise, accurate quantified statements of uncertainty are essential; these factors must be actively involved in the decision-making process both for regulations and site-specific permitting decisions.

Response: The EPA has initiated a substantial effort to quantify the uncertainty in its radiation risk estimates. However, until quantitative uncertainty estimates are available, the Agency must base its decisions on the current measures of uncertainty at its disposal.

Comment: It would be inconsistent with the EPA's distinction between risk assessment and risk management for the Agency to deal with bona fide scientific questions at the stage of deciding what probability of contracting cancer is "acceptable." Risk considerations alone should be dealt with in this first step. Moreover, an adequate data base must be established for technical, scientific, and economic considerations before these can be balanced with acceptable risks.

Response: The EPA disagrees that bona fide scientific questions are inappropriate at the risk management step. The EPA's risk assessments are based on what it considers the best available scientific evidence, with conservative but reasonable assumptions made when necessary. At the risk management step, the decisionmakers need to know the uncertainties associated with the risk estimates and the range of scientific opinion regarding the assumptions that have been included in the assessment.

Comment: Some commenters suggested that the proposed rules are improperly based on incomplete technical analyses.

Response: The final rules are the result of extensive research and technical analysis conducted over a period of several years, and, thus, the record underlying the rules is reasonably complete and accurate. Commenters' technical comments, as well as those of other commenters, are incorporated into the record to the extent they proved pertinent. In arriving at the acceptable risk decisions under CAA section 112 for these rules, costs and technological feasibility were not considered. Such were considered along with the health-related factors, however, in determining whether more stringent rules were needed in arriving at the statutorily required ample margin of safety.

Comment: Several commenters have asserted that EPA's risk assessments are not realistic but are worst case estimates. Some commenters objected to EPA's assumption that people living in the vicinity of radionuclide sources were exposed continuously, for a 24 hours per day 70-year lifetime, to predicted long-term ambient radionuclide levels. Commenters maintained that the average lifetime of an industrial facility is considerably less than 70 years, and that few individuals would be expected to live in the same location for their entire lives.

Response: The EPA recognizes that the assumption of 70 years of continuous exposure constitutes a simplification of actual conditions and represents, in part, a policy judgment by EPA, but feels that this assumption is preferable to other alternatives. Although emissions of radionuclides from industrial sources would reasonably be expected to change over time, such changes cannot be predicted with any certainty. In lieu of closing, plants may elect to replace or even expand their operations and subsequently increase their emissions. The 70-year exposure duration represents a steady-state emissions assumption that is consistent with the way in which the measure of carcinogenic strength is expressed (i.e., as the probability of contracting cancer based upon a lifetime [70 year] exposure to a unit concentration). Constraining the analysis to an "average" plant lifetime carries the implication that no one could be exposed for a period longer than the average. Since by definition, some plants would be expected to emit longer than the average, this assumption would tend to underestimate the possible MIR. The EPA agrees that the U.S. population is highly mobile. However, adjusting the exposure assumptions to constrain the possibility of exposure to emissions implies that exposure during the periods away from the residence are zero. In addition, a less-than-lifetime assumption would also have a proportional impact on the estimated MIR, suggesting that no individual could be exposed for 70 years. On balance, EPA believes that the present assumption of continuous exposure is consistent with the steady-state nature of the analysis and with the stated purpose of making plausible, if conservative, estimates of the potential health risks. It is the EPA's opinion that this assumption, while representing in part a policy judgment by EPA, continues to be preferable to adopting a shorter lifetime figure, both in view of the shortcomings of such alternatives and in the absence of compelling evidence to the contrary.

Comment: The EPA should measure the gain in risk reduction made against the costs to reach such gain and compare the benefits against the increased risk borne by workers.

Response: The EPA does consider both the incremental reduction in risk and the costs at the ample margin of safety step. The EPA is unaware of any increase in worker exposure that will be caused by the promulgated NESHAPs.

6. Scope of the Regulations

Comment: Several commenters stated that NESHAPS should be developed for other sources or categories of radionuclide emissions including that from Naturally Occurring Radioactive Materials (NORM) contamination of oil and gas production equipment and in construction materials, and also from naturally occurring radon in the soil that underly residences, schools, businesses and offices. They questioned whether emanation rates of radon (222 and 220) from coal stockpiles, boilers, fly ash, and bottom ash significant for regulation under the NESHAP program.

Response: The EPA believes that the source categories evaluated in this rulemaking represent the sources with the greatest potential for causing unacceptable risks from radionuclide emissions to ambient air. The Agency has examined the potential problem of radon in natural gas provided to homes and found that the transit times allow for the decay of the radon to acceptable levels. Emissions of radon from coal piles and coal ash piles has also been examined, as part of the CERCLA rulemaking on Reportable Quantities,

with similar results. EPA will continue to look at these and other potential sources to see if they are appropriate sources for regulation under section 112. Finally, it must be noted that EPA's authority under CAA Section 112 is limited to the regulation of source categories of toxics to ambient air and, thus, lacks authority to regulate or control naturally ocurring radon in soils that underly homes or businesses under this code section.

Comment: Consideration should be given to the problems presented by overlapping sources, any increase in the number of facilities within each category over time, and the goal of controlling the total incremental pollution for all radionuclide emissions from all source points in all twelve source categories.

Response: The Agency agrees and its policies on acceptable risk levels are based, in part, on assuring that risks caused by overlapping and multiple sources do not result in individuals receiving an unacceptable level of exposure and risk. Explicitly accounting for overlapping and multiple sources of exposure greatly complicates the calculation of exposures and risks. Since concentrations of radionuclides decline rapidly with distance from a source, however, it is highly unlikely that any individual could be the most exposed individual for more than one source. In most cases, members of the public will receive risks less than 1×10^{-6} from more than one source.

Comment: The standards should address cumulative health impacts resulting from exposures to multiple radiological and nonradiological pollutants emitted by the same or multiple sources located in relative proximity to one another.

Response: Although EPA has been unable to quantify cumulative and synergistic health impacts for multiple hazardous materials and sources have not been accurately qualified, it is our judgment that if such effects could be accurately quantified, they would not substantially alter EPA's conclusions in this rulemaking.

Comment: The standards consider only fatal cancers and fail to take into account the entire range of chronic debilitating and incapacitating diseases that may result from radionuclide emissions.

Response: EPA has taken into account the entire range of chronic debilitating and incapacitating diseases that may result from radionuclide emissions.

Comment: Proposed standards are based on what the EPA perceives as achievable rather than a safe level of airborne radioactivity emissions; this is not an appropriate basis for setting air emission standards under the Act.

Response: The EPA believes that its standards ensure an acceptable level of risk to public health with an ample margin of safety as required by the Clean Air Act and the decision in *Vinyl Chloride*. The Agency has established a threshold presumption that lifetime fatal cancer risks to individuals of approximately 1×10^{-4} are acceptable under the *Vinyl Chloride* decision, and has attempted to assure that as many persons as possible do not receive lifetime risks greater than 1×10^{-6}.

Comment: The potential effect of the proposed rule on Federal preemption in the area of regulation of facilities needs to be carefully considered. Nuclear facilities are unique and complex, and consistent regulation is in the best interest of the public. Congress determined that national regulation of nuclear power plants is appropriate in establishing the Atomic Energy Act.

Response: The Agency agrees that consistent regulation is in the interest of the public and has promulgated national emissions standards that apply to nuclear power plants. However, the Clean Air Act does not preempt state standards that are at least as stringent as those set by the Federal Government.

Comment: The consistency of these standards with other existing and proposed radiation standards, for air pathways and other pathways, should be discussed.

Response: As noted in the March 7, 1989 Federal Register notice for the proposed standards, the statutory requirements of CAA section 112 differ from the requirements of other authorities under which the EPA and other regulatory bodies set radiation standards. Therefore, the first priority for EPA is to assure that the regulations promulgated are in accordance with its statutory mandate.

Comment: All facilities that emit similar radionuclides should be held to the same emission standards; a remote facility should not be allowed higher emission rates than an urban facility, nor should a government or municipal facility be allowed higher emission rates than a private or industrial facility.

Response: The EPA's decisionmaking approach in setting final rules assures that all members of the public are adequately protected, regardless of the source of their exposure or their choice of residence in an urban, suburban, rural, or remote area of the country. The EPA believes that different source categories may be treated differently even if they emit similar pollutants, so long as the final standard protects public health with an ample margin of safety.

Comment: The Clean Air Act does not allow for dose standards.

Response: We disagree with those commenters stating that Congress in directing the Agency to set emission standards did not authorize that those standards be set in terms of dose to an individual. CAA section 302(k) defines the term "emission standard" to include limits on the quantity, rate, or concentration of an air pollutant and the Agency views dose standards fully consistent with that definition. In many cases, because there are over two hundred known radionuclides, numerous different ones are emitted from an individual source. In addition, the risk due to each is a further function of many factors such as particle size and exact chemical state. An emission standard for radionuclides based on quantity at the stack would often be complex to the point of impracticality. A dose standard provides a better approach to protecting the public since it allows the establishment of a uniform limit based on consideration of all of the factors related to the particular mix of radionuclides emitted from each source. Moreover, this approach is supported by radiation protection experts and the regulated community.

Comment: Some commenters posit that Clean Air Act Section 112 does not, or should not, authorize EPA to regulate radionuclide air emissions from those sources, or categories of sources, that are already regulated pursuant to the Uranium Mill Tailings Radiation Control Act of 1978, Pub. L. No. 95-604, 92 Stat. 3021 (codified in scattered sections of 42 U.S.C.) ("UMTRCA"). These commenters reason that because UMTRCA was promulgated subsequent to the last comprehensive revisions to the Clean Air Act, and, because UMTRCA's statutory scheme is more specifically focused upon the sources to which it applies than is the Clean Air Act, EPA's authority under CAA Section 112 is, in effect, preempted.

Response: EPA disagrees that it lacks authority to regulate, under CAA Section 112, the radionuclide air emissions of sources also regulated under UMTRCA. Indeed, UMTRCA itself resolves this issue by quite explicitly stating that "[n]othing in this chapter applicable to byproduct material * * * shall affect the authority of the [EPA] under the Clean Air Act of 1970, as amended * * * " 42 U.S.C. section 2022(e). The legislative history is similar: "Authorities of the EPA under other laws would not be abridged by the new requirements." H. Rep. No. 1480,

95th Cong., 2d Sess. 6, reprinted in, 1978 U.S. Code Cong. & Admin. News 7433, 7444. In other words, there is no indication that Congress intended UMTRCA to preempt EPA's regulatory authority under the Clean Air Act; rather Congress expressly contemplated EPA authority to simultaneously regulate under both legislative schemes.

7. Procedural

Comment: Many commenters felt that the affected parties familiar with the proposed standards have not had adequate time to thoroughly review available documents, and many stated that many supporting documents were not available until mid-April. In addition, several stated that the material contained significant errors.

Response: The EPA made every effort to notify affected parties of the rulemaking action, and it timely prepared and distributed the background materials supporting the proposed rules. However, the court order under which this rulemaking has been conducted necessitated strict adherence to the schedule for public comments and hearings. The Agency is not aware of any significant errors in the risk assessment. Where additional or new information was provided or developed during the comment period, it has been incorporated into the Final Environmental Impact Statement (FEIS), also referred to as the Background Information Document (BID).

Comment: The Proposed Rulemaking Notice, published in the Federal Register on March 7, 1989, does not identify those who participated in its preparation. The authors of the Draft Environmental Impact Statement (DEIS) do not appear to represent the kinds of knowledge, experience, and expertise necessary for the task.

Response: The DEIS does identify the ORP staff members who contributed to the development of the background material and indicates that S. Cohen and Associates, Inc., the Office's Technical Support Contractor, provided considerable technical support and analysis. The Agency disagrees strongly that the participants in this effort lack the necessary knowledge, experience, and expertise to prepare the proposal or final rulemaking packages.

Comment: The conclusion of the Regulatory Flexibility Act analysis that this rule will have little or no impact on small businesses because virtually all small businesses regulated under this rule already comply with the proposed standards is unsupported.

Response: The final rule for NRC-Licensed and Non-DOE Federal facilities is the only NESHAP with the potential to affect small businesses. That standard is a baseline standard, which indicates that EPA is unaware of any particular facility that does not comply with the final rule. In doing its risk assessment, EPA looked at model facilities with relatively large emissions for that class of facility to ensure that the risk was not underestimated. Therefore, EPA believes that it is highly unlikely that any small business would have emissions which would exceed the standard.

Comment: An international panel of recognized health professionals and epidemiologist should review and comment on the health effects of these very low levels of proposed radiation protection standards.

Response: The Agency invited comments from all interested parties during the public comment period. Further, it has reviewed and considered the findings and recommendations of the NCRP, the ICRP, UNSCEAR, and the NAS in developing its risk coefficients. Finally, the risk coefficients used in this risk assessment were reviewed and approved by the Agency's Science Advisory Board.

Comment: Even among the various sources proposed for regulation in this rulemaking there does not appear to be an even handed application of the EPA's own analysis. The different regulatory standards proposed by the EPA for the various sources are irrational.

Response: The EPA disagrees. The proposed regulations were developed on a consistent basis for each of the four approaches. For the final rule, the EPA used a single approach to determine the level of each standard it set. The EPA believes that consistency among the standards has been achieved.

Comment: The EPA should defer final action in this rulemaking to permit public comment on the Science Advisory Board's Review of EPA's proposal.

Response: The court imposed schedule for this rulemaking does not permit the Agency to extend the public comment period.

Comment: The EPA should propose its enforcement policy for public review and comment.

Response: The EPA does not plan at this time to create a specific enforcement policy for these rules, but instead currently intends to enforce them in the same manner that it enforces other Clean Air Act standards.

8. Decision to List Under Section 112

The FR notice requested comments on the appropriateness of listing radionuclides as hazardous air pollutants under section 112 of the Act. Comments on this issue ranged from unequivocal support for listing to questions as to the justification for listing under this section of the Act. Many, while not necessarily opposing listing, stated that their particular source or source category should not be regulated under the Act due to the insignificant risks to public health presented, or, in light of the existence of other regulations.

Comment: Several commenters stated that the listing under section 112 is appropriate because a hazardous air pollutant includes those substances that may result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness. The EPA should apply the same risk assessment criteria to radionuclides that are applied to other toxic air pollutants regulated under section 112. Such an approach is the only way that the health protection goals will be achieved.

Response: The EPA agrees that listing under section 112 is appropriate, and it does apply the same approach and criteria to all risk assessments and standard setting under section 112. However, differences in our knowledge about different hazardous materials, differences in the modes of exposure (pathways), and differences in the assessment of exposure lead to different risk assessment methods.

Comment: Many oppose the listing of radionuclides for three main reasons: (1) Radionuclide emissions from all source categories constitute only 1/30th of natural background, which is an insignificant amount; (2) concentrations released into the general environment as a matter of routine emissions do not constitute the degree of hazard which section 112 was meant to regulate; and (3) there is no evidence with respect to the health effects of low level radionuclide emissions.

Response: The EPA believes that its listing of radionuclides as hazardous air pollutants under section 112 is proper and is compelled by both the weight of the scientific evidence and the Administrator's statutory duties under the Act. While the EPA agrees that there is no conclusive human epidemiological data demonstrating health effects at low levels of exposure, we believe that the preponderance of the scientific evidence (both human epidemiology at higher levels of exposure and the data from non-human sources) indicates that the linear non-threshold dose response model is consistent with the available data and its utilization for regulatory purposes is appropriate. The EPA disagrees that the levels of risks posed by releases of radioactive materials into

the air are below those the Congress intended to regulate under section 112. Finally, the EPA does not consider the comparison of the risks posed by man-made sources to the risks from background to be relevant. The level of exposure corresponding to safe with an ample margin of safety, not background, is the appropriate criterion for regulation under section 112. Many risks associated with natural background radiation are relatively high and, thus, are not appropriate as a benchmark for evaluating the need for regulation.

Comment: Some commenters felt that regulation of radionuclides under section 112 is appropriate but that EPA should exempt some categories of industries that are regulated under other authorities, unless the current emissions within the source category can be shown to be unsafe.

Response: The Agency has concluded that for source categories where emissions present or potentially present unacceptable risks, it should not defer to other regulatory authorities.

9. Technological and Economic Factors

Comment: The EPA should not be concerned with availability or feasibility of controls. It should simply establish the requirement and let industry determine how it will meet it.

Response: In determining the safe level, EPA agrees. Thus, at that stage it does not consider either the availability or feasibility of controls. These are considered, however, at the second step ample margin of safety determination. Moreover, where possible, such as with the NESHAP for underground uranium mines, the regulated community is given wide latitude in selecting the combination of controls and/or work practices that will allow them to meet the mandated level of the standard.

Comment: The factors the EPA should consider before requiring control technology include: commercial vendor availability, adaptability from other uses, readily understood and applicable operating principles, costs and health benefits. Availability to U.S. industry should not be based on foreign commercialization.

Response: In general, these are the factors that the EPA considers. However, the EPA sees no reason to automatically preclude a technology solely because it has been developed and commercialized only outside of the U.S.

Comment: A technological development that has been demonstrated to reduce emissions and is in use in or outside the U.S. should be considered available and required.

Response: The EPA agrees that the availability of demonstrated control technology should be considered. However, the requirement of additional controls, at the ample margin of safety step, rests also on consideration of costs and other factors.

Comment: Because of the existing regulatory framework that forces the use of control technology pursuant to the ALARA principle, the nuclear industry is already at a very low level of emissions and further regulation is merely duplicative.

Response: The EPA agrees that the emissions from many segments of the nuclear industry are at low levels. The EPA does not anticipate that facilities with state-of-the art control systems will need additional controls to comply with the limits of the NESHAP. However, EPA does not agree that in all circumstances regulation under CAA section 112 is unnecessary and indeed has determined that final rules are needed for the radionuclide source categories identified.

Comment: The EPA should not promulgate additional radionuclide emission regulations for the uranium fuel cycle (UFC) including nuclear power plants. The industry has a proven record of protecting the public health and safety from airborne radioactive emissions. This results from the conservative design of the facilities, the careful operating philosophy employed in these facilities, and the existing framework of EPA and NRC regulations. The public already enjoys better protection from UFC radionuclide emissions than from almost any other industry's emissions.

Response: As stated in the FR notice, the Administrator has determined that regulation of potentially significant risks should not be deferred to other regulatory authorities. Based on its evaluation of the doses and risks caused by UFC facilities, the EPA does not believe that non-milling facilities will have to modify their operations to comply with the NESHAP. However, EPA has agreed to reconsider the issue of duplication of regulation as described in the discussion on subpart I.

Comment: The DOE is concerned that the EPA has proposed an outdoor radon concentration standard that is far below the level the EPA is willing to allow indoors.

Response: The authorities under which the NESHAPs and indoor radon guidance are promulgated are entirely different. The EPA does not have the authority to mandate indoor radon levels. Its guidance to homeowners is based on a single screening measurement, the protocols for which are designed not to provide an average exposure level but a maximum exposure level. Therefore, comparison with the limits established by the NESHAP is invalid.

Comment: Regulations that have the effect of forcing use of control technology are clearly inappropriate where the technology has not been shown to be currently available.

Response: CAA section 112 requires EPA to set a safe or acceptable level without regard to the availability of control technology. Nevertheless, as a practical matter, while NESHAPs allow for use of new technologies, none of the promulgated NESHAPs requires the development of new technologies.

Comment: A strong regulatory stance by the EPA in requiring pollution controls will act to stimulate innovation, reduce prices via increased sales of control technologies and processes, and reduce risk.

Response: This stimulation of innovation and price competition in the effluent control industry, while a laudable public goal, is not a requirement under section 112 of the Act. Rather, the purpose and focus of NESHAPs is to protect public health with an ample margin of safety.

Comment: EPA should include avoided costs, e.g. possible tort judgments, including punitive damages, in determining the level of the final standard at the ample margin of safety step of the decision-making process.

Response: In theory, the EPA agrees. However, as a practical matter, it is often difficult to arrive at even an approximation of avoided costs when dealing with specific source categories. They are simply too speculative, especially given that the source categories are often comprised of thousands of individual facilities.

Comment: Cost as used in the ample margin of safety discussion should include all of the costs identifiable with the decision; this would include value of the facility, economic effects on the community, and social effects of labor force dislocation.

Response: To the extent that the EPA is able to develop quantitative estimates of these costs they are considered pursuant to the decision-making process. However, as already noted, such costs are often only available, if at all, as rough, qualitative estimates.

Comment: Industry should meet the criteria irrespective of costs or technological feasibility.

Response: The EPA agrees with respect to meeting the levels determined to be "safe." The EPA disagrees with

respect to the determination of the needed ample margin of safety.

Comment: Fundamental fairness prohibits the EPA from imposing controls that cost more than some ceiling amount per estimated death prevented.

Response: Since the *Vinyl Chloride* decision precludes consideration of cost when determining what constitutes "safe," all sources must meet the standards or utilize controls to the degree necessary to bring their emissions into compliance, regardless of the cost.

Comment: EPA has not explained the basis for abandoning the existing regulatory program for uranium mill tailings disposal in favor of regulation under the CAA. The UMTRCA, passed subsequent to the CAA, provides flexibility.

Response: The Administrator has determined not to defer to other regulatory authorities when the risk merits issuance of a NESHAP under section 112 of the Act. However, the requirements of the other regulations must still be met.

Comment: If post-closure emissions are to be actively regulated under the standard, the EPA should address financial assurances for evaluation, monitoring, reporting, facility modification request, and remedial actions.

Response: Given the one-time nature of the post-closure monitoring requirements for phosphogypsum stacks and uranium mill tailings disposal sites, the EPA does not believe that the small financial burden requires specific financial assurance requirements. Details of monitoring and reporting requirements are included in the appropriate Subparts.

Comment: The proposal fails to address the occupational dose increment resulting from the installation, operation, and maintenance of the additional equipment and systems required for compliance; the collective occupational exposures required for some of these additions will be at higher individual doses and of significantly more consequence than the questionable savings in public risk.

Response: The lack of specific instances makes it impossible to fully address this concern. The EPA is not aware of any instance where a NESHAP will require emission controls that will result in a significant occupational exposure. Where controls may be required, for example at elemental phosphorus plants, they supplement or replace existing, less effective, controls. The exposure resulting from installation should be minimal since the process will be shut down, and exposures received during maintenance should be comparable.

Comment: Consideration should be given to whether public welfare would not be improved by diverting moneys from regulatory procedures with no measurable effect on human health, to research efforts, which have resulted in considerable advantages to the public health and well being. Human costs to those dependent on the industry as well as other adverse environmental repercussions caused by a shift away from nuclear power toward more polluting technologies, will far outweigh any theoretical public health benefit.

Response: The suggested cost-benefit determination is outside the purview of the Agency. However, given the concerns of the National Institutes of Health that health care may be affected, EPA has agreed to reconsider this issue.

Comment: The statement that demand for nuclear energy is on the decline due to reduced demand for nuclear generated electricity is fallacious. Also, while the analysis recognizes that these regulations will worsen the already weak position of the domestic uranium industry, it does not examine the adverse effects that will have on the national trade deficit.

Response: Imported uranium is a trivial component of the United States trade deficit.

Comment: The EPA estimates costs associated with the alternative regulatory approaches for each source category but the total fuel cycle cost will be passed through to nuclear utilities and should be assessed on that basis. This includes sources under subparts B, H, I, K, R, S, T, and W.

Response: Costs associated with the final rule are not significant compared with the total fuel cycle costs. There would be no significant impacts.

VIII. Miscellaneous

A. Docket

The docket is an organized and complete file of all information considered by EPA in the development of the standards. The docket allows interested persons to identify and locate documents so they can effectively participate in the rulemaking process. It also serves as the record for judicial review.

Transcripts of the hearings, all written statements, the Agency's response to comments, and other relevant documents have been placed in the docket and are available for inspection and copying during normal working hours.

B. General Provisions

Except where otherwise specifically stated, the general provisions of 40 CFR part 61, subpart A apply to all sources regulated by this rule.

C. Paperwork Reduction Act

The information collection requirements in this final rule have been approved by the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* and have been assigned OMB control number 2060–0191.

D. Executive Order 12291

Under Executive Order 12291, EPA is required to judge whether this regulation is a "major rule" and therefore subject to certain requirements of the Order. The EPA has determined that regulations promulgated today will result in none of the adverse economic effects set forth in section I of the Order as grounds for finding a regulation to be a "major rule." These regulations are not major because (1) nationwide annual compliance costs do not meet the $100 million threshold; (2) the regulations do not significantly increase prices or production costs; and (3) the regulations do not cause significant adverse effects on domestic competition, employment, investment, productivity, innovation, or competition in foreign markets.

All of the final regulations presented in this notice were submitted to OMB for review as required by Executive Order 12291. Any written comments from OMB to EPA and any written EPA response to those comments has been included in the docket.

E. Regulatory Flexibility Analysis

Section 603 of the Regulatory Flexibility Act, 5 U.S.C. 603, requires EPA to prepare and make available for comment an "initial regulatory flexibility analysis" in connection with any rulemaking for which there is a statutory requirement that a general notice of proposed rulemaking be published. The "initial regulatory flexibility analysis" describes the effect of the proposed rule on small business entities.

However, section 604(b) of the Regulatory Flexibility Act provides that section 603 "shall not apply to any proposed . . . rule if the head of the Agency certifies that the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities."

EPA believes that virtually all small businesses are currently in compliance with these rules. In addition, EPA has placed reporting exemptions in the rule

for NRC-licensees to limit the amount of paperwork that would be required by the smaller operators. Therefore, this rule will have little or no impact on small businesses. A small business is one that has 750 employees or fewer.

For the preceding reasons, I certify that this rule will not have significant economic impact on a substantial number of small entities.

List of Subjects in 40 CFR Part 61

Air pollution control, Arsenic, Asbestos, Beryllium, Benzene, Incorporation by reference, Mercury, Radionuclides, Vinyl chloride.

Dated: October 31, 1989.

William G. Rosenberg,

Acting Administrator.

Part 61 of chapter I of title 40 of the Code of Federal Regulations is amended as follows:

PART 61—[AMENDED]

1. The authority citation for part 61 continues to read as follows:

Authority: 42 U.S.C. 7401, 7412, 7414, 7416, 7601.

2. Part 61 is amended by revising subparts B, H, I, K and W and by adding subparts R and T to read as follows. These subparts are effective December 15, 1989. Subpart I is stayed until March 15, 1989.

Subpart B—National Emission Standards for Radon Emissions From Underground Uranium Mines

Sec.

§ 61.20 Designation of facilities.

The provisions of this subpart are applicable to the owner or operator of an active underground uranium mine which:

(a) Has mined, will mine or is designed to mine over 100,000 tons of ore during the life of the mine; or

(b) Has had or will have an annual ore production rate greater than 10,000 tons, unless it can be demonstrated to EPA that the mine will not exceed total ore production of 100,000 tons during the life of the mine.

§ 61.21 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Active mine* means an underground uranium mine which is being ventilated to allow workers to enter the mine for any purpose.

(b) *Effective dose equivalent* means the sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. The method for calculating effective dose equivalent and the definition of reference man are outlined in the International Commission on Radiological Protection's Publication No. 26.

(c) *Underground uranium mine* means a man-made underground excavation made for the purpose of removing material containing uranium for the principal purpose of recovering uranium.

§ 61.22 Standard.

Emissions of radon-222 to the ambient air from an underground uranium mine shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/y.

§ 61.23 Determining compliance.

(a) Compliance with the emission standard in this subpart shall be determined and the effective dose equivalent calculated by the EPA computer code COMPLY-R. An underground uranium mine owner or operator shall calculate the source terms to be used for input into COMPLY-R by conducting testing in accordance with the procedures described in Appendix B, Method 115, or

(b) Owners or operators may demonstrate compliance with the emission standard in this subpart through the use of computer models that are equivalent to COMPLY-R provided that the model has received prior approval from EPA headquarters. EPA may approve a model in whole or in part and may limit its use to specific circumstances.

§ 61.24 Annual Reporting Requirements.

(a) The mine owner or operator shall annually calculate and report the results of the compliance calculations in section 61.23 and the input parameters used in making the calculation. Such report shall cover the emissions of a calendar year and shall be sent to EPA by March 31 of the following year. Each report shall also include the following information:

(1) The name and location of the mine.

(2) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(3) The results of the emissions testing conducted and the dose calculated using the procedures in § 61.23.

(4) A list of the stacks or vents or other points where radioactive materials are released to the atmosphere, including their location, diameter, flow rate, effluent temperature and release height.

(5) A description of the effluent controls that are used on each stack, vent, or other release point and the effluent controls used inside the mine, and an estimate of the efficiency of each control method or device.

(6) Distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk, and meat.

(7) The values used for all other user-supplied input parameters for the computer models (e.g., meteorological data) and the source of these data.

(8) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(b) If the facility is not in compliance with the emission standard of § 61.22 in the calendar year covered by the report, the facility must then commence reporting to the Administrator on a monthly basis the information listed in paragraph (a) of this section for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (a) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree the report will describe the facilities performance under the terms of the decree.

(c) The first report will cover the emissions of calendar year 1990.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.25 Recordkeeping requirements.

The owner or operator of a mine must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. In addition, the documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. These records must be kept at the mine or by the owner or operator for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.26 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart H—National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities

Sec.

§ 61.90 Designation of facilities.

The provisions of this subpart apply to operations at any facility owned or operated by the Department of Energy that emits any radionuclide other than radon-222 and radon-220 into the air, except that this subpart does not apply to disposal at facilities subject to 40 CFR part 191, subpart B or 40 CFR part 192.

§ 61.91 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or 40 CFR part 61, subpart A. The following terms shall have the following specific meanings:

(a) *Effective dose equivalent* means the sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. For purposes of this subpart, doses caused by radon-222 and its respective decay products formed after the radon is released from the facility are not included. The method for calculating effective dose equivalent and the definition of reference man are outlined in the International Commission on Radiological Protection's Publication No. 26.

(b) *Facility* means all buildings, structures and operations on one contiguous site.

(c) *Radionuclide* means a type of atom which spontaneously undergoes radioactive decay.

(d) *Residence* means any home, house, apartment building, or other place of dwelling which is occupied during any portion of the relevant year.

§ 61.92 Standard.

Emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.

§ 61.93 Emission monitoring and test procedures.

(a) To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated using EPA approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval. DOE facilities for which the maximally exposed individual lives within 3 kilometers of all sources of emissions in the facility, may use EPA's COMPLY model and associated procedures for determining dose for purposes of compliance.

(b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or other procedures for which EPA has granted prior approval:

(1) Effluent flow rate measurements shall be made using the following methods:

(i) Reference Method 2 of Appendix A to part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

(ii) Reference Method 2A of Appendix A to part 60 shall be used to measure flow rates through pipes and small vents.

(iii) The frequency of the flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rate measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

(i) Reference Method 1 of Appendix A part 60 shall be used to select monitoring or sampling sites.

(ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSIN13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1) (incorporated by reference—see § 61.18) The requirements for continuous sampling are applicable to batch processes when the unit is in operation. Periodic sampling (grab samples) may be used only with EPA's prior approval. Such approval may be granted in cases where continuous sampling is not practical and radionuclide emission rates are relatively constant. In such cases, grab samples shall be collected with sufficient frequency so as to provide a representative sample of the emissions.

(iii) Radionuclides shall be collected and measured using procedures based on the principles of measurement described in Appendix B, Method 114. Use of methods based on principles of measurement different from those described in Appendix B, Method 114 must have prior approval from the Administrator. EPA reserves the right to approve measurement procedures.

(iv) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(3) When it is impractical to measure the effluent flow rate at an existing source in accordance with the requirements of paragraph (b)(1) of this section or to monitor or sample an effluent stream at an existing source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) of this section, the facility owner or operator may use alternative effluent flow rate measurement procedures or site

selection and sample extraction procedures provided that:

(i) It can be shown that the requirements of paragraph (b) (1) or (2) of this section are impractical for the effluent stream.

(ii) The alternative procedure will not significantly underestimate the emissions.

(iii) The alternative procedure is fully documented.

(iv) The owner or operator has received prior approval from EPA.

(4)(i) Radionuclide emission measurements in conformance with the requirements of paragraph (b) of this section shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured. With prior EPA approval, DOE may determine these emissions through alternative procedures. For other release points which have a potential to release radionuclides into the air, periodic confirmatory measurements shall be made to verify the low emissions.

(ii) To determine whether a release point is subject to the emission measurement requirements of paragraph (b) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air for the purposes of this section, the estimated radionuclide release rates shall be based on the discharge of the effluent stream that would result if all pollution control equipment did not exist, but the facilities operations were otherwise normal.

(5) Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standard if the owner or operator meets the following criteria:

(i) The air at the point of measurement shall be continuously sampled for collection of radionuclides.

(ii) Those radionuclides released from the facility, which are the major contributors to the effective dose equivalent must be collected and measured as part of the environmental measurement program.

(iii) Radionuclide concentrations which would cause an effective dose equivalent of 10% of the standard shall be readily detectable and distinguishable from background.

(iv) Net measured radionuclide concentrations shall be compared to the concentration levels in Table 2 of Appendix E to determine compliance with the standard. In the case of multiple radionuclides being released from a facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2, and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 for each radionuclide is less than 1.

(v) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(vi) Use of environmental measurements to demonstrate compliance with the standard is subject to prior approval of EPA. Applications for approval shall include a detailed description of the sampling and analytical methodology and show how the above criteria will be met.

§ 61.94 Compliance and reporting.

(a) Compliance with this standard shall be determined by calculating the highest effective dose equivalent to any member of the public at any offsite point where there is a residence, school, business or office. The owners or operators of each facility shall submit an annual report to both EPA headquarters and the appropriate regional office by June 30 which includes the results of the monitoring as recorded in DOE's Effluent Information System and the dose calculations required by § 61.93(a) for the previous calendar year.

(b) In addition to the requirements of paragraph (a) of this section, an annual report shall include the following information:

(1) The name and location of the facility.

(2) A list of the radioactive materials used at the facility.

(3) A description of the handling and processing that the radioactive materials undergo at the facility.

(4) A list of the stacks or vents or other points where radioactive materials are released to the atmosphere.

(5) A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each control device.

(6) Distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk, and meat.

(7) The values used for all other user-supplied input parameters for the computer models (e.g., meteorological data) and the source of these data.

(8) A brief description of all construction and modifications which were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived under § 61.96 and associated documentation developed by DOE to support the waiver. EPA reserves the right to require that DOE send to EPA all the information that normally would be required in an application to construct or modify, following receipt of the description and supporting documentation.

(9) Each report shall be signed and dated by a corporate officer or public official in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(c) If the facility is not in compliance with the emission limits of § 61.92 in the calendar year covered by the report, then the facility must commence reporting to the Administrator on a monthly basis the information listed in paragraph (b) of this section, for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (b) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree, the report will describe the facilities performance under the terms of the decree.

(d) In those instances where the information requested is classified, such information will be made available to EPA separate from the report and will be handled and controlled according to

applicable security and classification regulations and requirements.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.95 Recordkeeping requirements.

All facilities must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine effective dose equivalent. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. These records must be kept at the site of the facility for at least five years and, upon request, be made available for inspection by the Administrator, or his authorized representative.

§ 61.96 Applications to construct or modify.

In addition to any activity that is defined as construction under 40 CFR part 61, subpart A, any fabrication, erection or installation of a new building or structure within a facility that emits radionuclides is also defined as new construction for purposes of 40 CFR part 61, subpart A.

(b) An application for approval under § 61.07 or notification of startup under § 61.09 does not need to be filed for any new construction of or modification within an existing facility if the effective dose equivalent, caused by all emissions from the new construction or modification, is less than 1% of the standard prescribed in § 61.92. For purposes of this paragraph the effective dose equivalent shall be calculated using the source term derived using Appendix D as input to the dispersion and other computer models described in § 61.93. DOE may, with prior approval from EPA, use another procedure for estimating the source term for use in this paragraph. A facility is eligible for this exemption only if, based on its last annual report, the facility is in compliance with this subpart.

(c) Conditions to approvals granted under § 61.08 will not contain requirements for post approval reporting on operating conditions beyond those specified in § 61.94.

§ 61.97 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart I—National Emission Standards for Radionuclide Emissions From Facilities Licensed by the Nuclear Regulatory Commission and Federal Facilities Not Covered by Subpart H

Sec.

§ 61.100 Applicability.

The provisions of this subpart apply to Nuclear Regulatory Commission-licensed facilities and to facilities owned or operated by any Federal agency other than the Department of Energy, except that this subpart does not apply to disposal at facilities regulated under 40 CFR part 191, subpart B, or to any uranium mill tailings pile after it has been disposed of under 40 CFR part 192, or to low energy accelerators, or to any NRC-licensee that possesses and uses radionuclides only in the form of sealed sources.

§ 61.101 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Agreement State* means a State with which the Atomic Energy Commission or the Nuclear Regulatory Commission has entered into an effective agreement under subsection 274(b) of the Atomic Energy Act of 1954, as amended.

(b) *Effective dose equivalent* means the sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. For purposes of this subpart doses caused by radon-222 and its decay products formed after the radon is released from the facility are not included. The method for calculating effective dose equivalent and the definition of reference man are outlined in the International Commission on Radiological Protection's Publication No. 26.

(c) *Facility* means all buildings, structures and operations on one contiguous site.

(d) *Federal facility* means any facility owned or operated by any department, commission, agency, office, bureau or other unit of the government of the United States of America except for facilities owned or operated by the Department of Energy.

(e) *NRC-licensed facility* means any facility licensed by the Nuclear Regulatory Commission or any Agreement State to receive title to, receive, possess, use, transfer, or deliver any source, by-product, or special nuclear material.

(f) *Radionuclide* means a type of atom which spontaneously undergoes radioactive decay.

§ 61.102 Standard.

(a) Emissions of radionuclides, including iodine, to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.

(b) Emissions of iodine to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 3 mrem/yr.

§ 61.103 Determining compliance.

(a) Compliance with the emission standard in this subpart shall be determined through the use of either the EPA computer code COMPLY or the alternative requirements of Appendix E. Facilities emitting radionuclides not listed in COMPLY or Appendix E shall contact EPA to receive the information needed to determine dose. The source terms to be used for input into COMPLY shall be determined through the use of the measurement procedures listed in § 61.107 or the emission factors in Appendix D or through alternative procedures for which EPA has granted prior approval; or,

(b) Facilities may demonstrate compliance with the emission standard in this subpart through the use of computer models that are equivalent to COMPLY, provided that the model has received prior approval from EPA headquarters. Any facility using a model other than COMPLY must file an annual report. EPA may approve an alternative model in whole or in part and may limit its use to specific circumstances.

§ 61.104 Reporting requirements.

(a) The owner or operator of a facility subject to this subpart must submit an annual report to the EPA covering the emissions of a calendar year by March 31 of the following year.

(1) The report or application for approval to construct or modify as

required by 40 CFR part 61, subpart A and § 61.106, must provide the following information:

(i) The name of the facility.

(ii) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(iii) The location of the facility, including suite and/or building number, street, city, county, state, and zip code.

(iv) The mailing address of the facility, if different from item (iii).

(v) A list of the radioactive materials used at the facility.

(vi) A description of the handling and processing that the radioactive materials undergo at the facility.

(vii) A list of the stacks or vents or other points where radioactive materials are released to the atmosphere.

(viii) A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each device.

(ix) Distances from the point of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk, and meat.

(x) The effective dose equivalent calculated using the compliance procedures in § 61.103.

(xi) The physical form and quantity of each radionuclide emitted from each stack, vent or other release point, and the method(s) by which these quantities were determined.

(xii) The volumetric flow, diameter, effluent temperature, and release height for each stack, vent or other release point where radioactive materials are emitted, the method(s) by which these were determined.

(xiii) The height and width of each building from which radionuclides are emitted.

(xiv) The values used for all other user-supplied input parameters (e.g., meteorological data) and the source of these data.

(xv) A brief description of all construction and modifications which were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived under section 61.106, and associated documentation developed by the licensee to support the waiver. EPA reserves the right to require that the licensee send to EPA all the information that normally would be required in an application to construct or modify, following receipt of the description and supporting documentation.

(xvi) Each report shall be signed and dated by a corporate officer or public official in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(b) Facilities emitting radionuclides in an amount that would cause less than 10% of the dose standard in § 61.102, as determined by the compliance procedures from § 61.103(a), are exempt from the reporting requirements of § 61.104(a). Facilities shall annually make a new determination whether they are exempt from reporting.

(c) If the facility is not in compliance with the emission limits of § 61.102 in the calendar year covered by the report, the facility must report to the Administrator on a monthly basis the information listed in paragraph (a) of this section, for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (a) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree the report will describe the facilities performance under the terms of the decree.

(d) The first report will cover the emissions of calendar year 1990.

§ 61.105 Recordkeeping requirements.

The owner or operator of any facility must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard, and, if claimed, qualification for exemption from reporting. These records must be kept at the site of the facility for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.106 Applications to construct or modify.

(a) In addition to any activity that is defined as construction under 40 CFR part 61, subpart A, any fabrication, erection or installation of a new building or structure within a facility is also defined as new construction for purposes of 40 CFR part 61, subpart A.

(b) An application under § 61.07 does not need to be filed for any new construction of or modification within an existing facility if one of the following conditions is met:

(1) The effective dose equivalent calculated by using methods described in § 61.103, that is caused by all emissions from the facility including those potentially emitted by the proposed new construction or modification, is less than 10% of the standard prescribed in § 61.102.

(2) The effective dose equivalent calculated by using methods described in § 61.103, that is caused by all emissions from the new construction or modification, is less than 1% of the limit prescribed in § 61.102. A facility is eligible for this exemption only if the facility, based on its last annual report, is in compliance with this subpart.

§ 61.107 Emission determination.

(a) Facility owners or operators may, in lieu of monitoring, estimate radionuclide emissions in accordance with Appendix D, or other procedure for which EPA has granted prior approval.

(b) Radionuclide emission rates from point sources (e.g. stacks or vents) shall be measured in accordance with the following requirements:

(1) Effluent flow rate measurements shall be made using the following methods:

(i) Reference Method 2 of Appendix A to part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

(ii) Reference Method 2A of Appendix A to part 60 shall be used to measure flow rates through pipes and small vents.

(iii) The frequency of the flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rate measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

(2) Radionuclides shall be directly monitored or extracted, collected, and measured using the following methods:

(i) Reference Method 1 of Appendix A part 60 shall be used to select monitoring or sampling sites.

(ii) The effluent stream shall be directly monitored continuously using an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSIN13.1–1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1) (incorporated by reference—see § 61.18). The requirements for continuous sampling are applicable to batch processes when the unit is in operation. Periodic sampling (grab samples) may be used only with EPA's prior approval. Such approval may be granted in cases where continuous sampling is not practical and radionuclide emission rates are relatively constant. In such cases, grab samples shall be collected with sufficient frequency so as to provide a representative sample of the emissions.

(iii) Radionuclides shall be collected and measured using procedures based on the principles of measurement described in Appendix B, Method 114. Use of methods based on principles of measurement different from those described in Appendix B, Method 114 must have prior approval from the Administrator. EPA reserves the right to approve alternative measurement procedures in whole or in part.

(iv) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(3) When it is impractical to measure the effluent flow rate at an existing source in accordance with the requirements of paragraph (b)(1) of this section or to monitor or sample an effluent stream at an existing source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) of this section, the facility owner or operator may use alternative effluent flow rate measurement procedures or site selection and sample extraction procedures provided that:

(i) It can be shown that the requirements of paragraphs (b) (1) and (2) of this section are impractical for the effluent stream.

(ii) The alternative procedure will not significantly underestimate the emissions.

(iii) The alternative procedure is fully documented

(iv) The owner or operator has received prior approval from EPA.

(4)(i) Radionuclide emission measurements in conformance with the requirements of paragraph (b) of this section shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured. For other release points which have a potential to release radionuclides into the air, periodic confirmatory measurements should be made to verify the low emissions.

(ii) To determine whether a release point is subject to the emission measurement requirements of paragraph (b) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air, the estimated radionuclide release rates shall be based on the discharge of the uncontrolled effluent stream into the air.

(5) Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standards if the owner or operator meets the following criteria:

(i) The air at the point of measurement shall be continuously sampled for collection of radionuclides.

(ii) Those radionuclides released from the facility, which are the major contributors to the effective dose equivalent must be collected and measured as part of the environmental measurements program.

(iii) Radionuclide concentrations which would cause an effective dose equivalent greater than or equal to 10% of the standard shall be readily detectable and distinguishable from background.

(iv) Net measured radionuclide concentrations shall be compared to the concentration levels in Table 2 of Appendix E to determine compliance with the standard. In the case of multiple radionuclides being released from a facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2 and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 for each radionuclide is less than 1.

(v) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

(vi) Use of environmental measurements to demonstrate compliance with the standard is subject to prior approval of EPA. Applications for approval shall include a detailed description of the sampling and analytical methodology and show how the above criteria will be met.

(c) The following facilities may use either the methodologies and quality assurance programs described in paragraph (b) of this section or may use the following:

(1) Nuclear power reactors may determine their radionuclide emissions in conformance with the Effluent Technical Specifications contained in their Operating License issued by the Nuclear Regulatory Commission. In addition, they may conduct a quality assurance program as described in the Nuclear Regulatory Commission's Regulatory Guide 4.15 dated February 1979.

(2) Fuel processing and fabrication plants and uranium hexafluoride plants may determine their emissions in conformance with the Nuclear Regulatory Commission's Regulatory Guide 4.16 dated December 1985. In addition, they may conduct a quality assurance program as described in the Nuclear Regulatory Commission's Regulatory Guide 4.15 dated February 1979.

(3) Uranium mills may determine their emissions in conformance with the Nuclear Regulatory Commission's Regulatory Guide 4.14 dated April 1980. In addition, they may conduct a quality assurance program as described in the Nuclear Regulatory Commission's Regulatory Guide 4.15 dated February 1979.

61.108 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart K—National Emission Standards for Radionuclide Emissions From Elemental Phosphorus Plants

Sec.

§ 61.120 Applicability.

The provisions of this subpart are applicable to owners or operators of calciners and nodulizing kilns at elemental phosphorus plants.

§61.121 Definitions.

(a) *Elemental phosphorus plant* or *plant* means any facility that processes phosphate rock to produce elemental phosphorus. A plant includes all buildings, structures, operations, calciners and nodulizing kilns on one contiguous site.

(b) *Calciner* or *Nodulizing kiln* means a unit in which phosphate rock is heated to high temperatures to remove organic material and/or to convert it to a nodular form. For the purpose of this subpart, calciners and nodulizing kilns are considered to be similar units.

§ 61.122 Emission standard.

Emissions of polonium-210 to the ambient air from all calciners and nodulizing kilns at an elemental phosphorus plant shall not exceed a total of 2 curies a year.

§ 61.123 Emission testing.

(a) Each owner or operator of an elemental phosphorus plant shall test emissions from the plant within 90 days of the effective date of this standard and annually thereafter. The Administrator may temporarily or permanently waive the annual testing requirement or increase the frequency of testing, if the Administrator determines that more testing is required.

(b) The Administrator shall be notified at least 30 days prior to an emission test so that EPA may, at its option, observe the test.

(c) An emission test shall be conducted at each operational calciner or nodulizing kiln. If emissions from a calciner or nodulizing kiln are discharged through more than one stack, then an emission test shall be conducted at each stack and the total emission rate from the calciner or kiln shall be the sum of the emission rates from each of the stacks.

(d) Each emission test shall consist of three sampling runs that meet the requirements of § 61.125. The phosphate rock processing rate during each run shall be recorded. An emission rate in curies per metric ton of phosphate rock processed shall be calculated for each run. The average of all three runs shall apply in computing the emission rate for the test. The annual polonium-210 emission rate from a calciner or nodulizing kiln shall be determined by multiplying the measured polonium-210 emission rate in curies per metric ton of phosphate rock processed by the annual phosphate rock processing rate in metric tons. In determining the annual phosphate rock processing rate, the values used for operating hours and operating capacity shall be values that will maximize the expected processing rate. For determining compliance with the emission standard of § 61.122, the total annual emission rate is the sum of the annual emission rates for all operating calciners and nodulizing kilns.

(e) If the owner or operator changes his operation in such a way as to increase his emissions of polonium-210, such as changing the type of rock processed, the temperature of the calciners or kilns, or increasing the annual phosphate rock processing rate, then a new emission test, meeting the requirements of this section, shall be conducted within 45 days under these conditions.

(f) Each owner or operator of an elemental phosphorus plant shall furnish the Administrator with a written report of the results of the emission test within 60 days of conducting the test. The report must provide the following information:

(1) The name and location of the facility.

(2) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(3) A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each device.

(4) The results of the testing, including the results of each sampling run completed.

(5) The values used in calculating the emissions and the source of these data.

(6) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.124 Recordkeeping requirements.

The owner or operator of any plant must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used in emission testing. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the results of the emission testing. These records must be kept at the site of the plant for at least five years and, upon request, be made available for inspection by the Administrator, or his authorized representative.

§ 61.125 Test methods and procedures.

(a) Each owner or operator of a source required to test emissions under § 61.123, unless an equivalent or alternate method has been approved by the Administrator, shall use the following test methods:

(1) Test Method 1 of Appendix A to 40 CFR part 60 shall be used to determine sample and velocity traverses;

(2) Test Method 2 of Appendix A to 40 CFR part 60 shall be used to determine velocity and volumetric flow rate;

(3) Test Method 3 of Appendix A to 40 CFR part 60 shall be used for gas analysis;

(4) Test Method 5 of Appendix A to 40 CFR part 60 shall be used to collect particulate matter containing the polonium-210; and

(5) Test Method 111 of Appendix B to 40 CFR part 61 shall be used to determine the polonium-210 emissions.

§ 61.126 Monitoring of operations.

(a) The owner or operator of any source subject to this subpart using a wet-scrubbing emission control device shall install, calibrate, maintain, and operate a monitoring device for the continuous measurement of the pressure loss of the gas stream through the scrubber. The monitoring device must be certified by the manufacturer to be accurate within ±250 pascal (±1 inch of water). Records of these measurements shall be maintained at the source and made available for inspection by the Administrator, or his authorized representative for a minimum of 5 years.

(b) The owner or operator of any source subject to this subpart using an electrostatic precipitator control device shall install, calibrate, maintain, and operate a monitoring device for the continuous measurement of the primary and secondary current and the voltage in each electric field. Records of these measurements shall be maintained at the source and made available for inspection by the Administrator, or his authorized representative for a minimum of 5 years.

(c) For the purpose of conducting an emission test under § 61.123, the owner or operator of any source subject to the provisions of this subpart shall install, calibrate, maintain, and operate a device for measuring the phosphate rock feed to any affected calciner or nodulizing kiln. The measuring device used must be accurate to within ±5 percent of the mass rate over its operating range. Records of these measurements shall be maintained at the source and made available for inspection by the Administrator, or his authorized representative for a minimum of 5 years.

§ 61.127 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart Q—National Emission Standards for Radon Emissions From Department of Energy Facilities

Sec.
61.190 Designation of facilities.
61.191 Definitions.
61.192 Standard.
61.193 Exemption from the reporting and testing requirements of 40 CFR 61.10.

§ 61.190 Designation of facilities.

The provisions of this subpart apply to the design and operation of all storage and disposal facilities for radium-containing material (i.e., byproduct material as defined under section 11.e(2) of the Atomic Energy Act of 1954 (as amended)) that are owned or operated by the Department of Energy that emit radon-222 into air, including these facilities: The Feed Materials Production Center, Fernald, Ohio; the Niagara Falls Storage Site, Lewiston, New York; the Weldon Spring Site, Weldon Spring, Missouri; the Middlesex Sampling Plant, Middlesex, New Jersey; the Monticello Uranium Mill Tailings Pile, Monticello, Utah. This subpart does not apply to facilities listed in, or designated by the Secretary of Energy under Title I of the Uranium Mill Tailings Control Act of 1978.

§ 61.191 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Facility* means all buildings, structures and operations on one contiguous site.

(b) *Source* means any building, structure, pile, impoundment or area used for interim storage or disposal that is or contains waste material containing radium in sufficient concentration to emit radon-222 in excess of this standard prior to remedial action.

§ 61.192 Standard.

No source at a Department of Energy facility shall emit more than 20 pCi/m^2–s of radon-222 as an average for the entire source, into the air. This requirement will be part of any Federal Facilities Agreement reached between Environmental Protection Agency and Department of Energy.

§ 61.193 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart R—National Emission Standards for Radon Emissions From Phosphogypsum Stacks

Sec.
61.200 Designation of facilities.
61.201 Definitions.
61.202 Standard.
61.203 Radon monitoring and compliance procedures.
61.204 Recordkeeping requirements.
61.205 Exemption from the reporting and testing requirements of 40 CFR 61.10.

§ 61.200 Designation of facilities.

The provisions of this subpart apply to the owners and operators of the phosphogypsum that is produced as a result of phosphorus fertilizer production and all that is contained in existing phosphogypsum stacks.

§ 61.201 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Inactive stack* means a stack to which no further routine additions of phosphogypsum will be made and which is no longer used for water management associated with the production of phosphogypsum. If a stack has not been used for either purpose for two years it is presumed to be inactive.

(b) *Phosphogypsum stacks* or *stacks* are piles of waste from phosphorus fertilizer production containing phosphogypsum. Stacks shall also include phosphate mines that are used for the disposal of phosphogypsum.

§ 61.202 Standard.

All phosphogypsum shall be disposed of in stacks or in phosphate mines which shall not emit more than 20 pCi/m^2–s of radon-222 into the air.

§ 61.203 Radon monitoring and compliance procedures.

(a) Sixty days following the date at which a stack becomes an inactive stack, or ninety days after the effective date of this rule if the stack is already inactive, the owners or operators of inactive phosphogypsum stacks shall test the stacks in accordance with the procedures described in 40 CFR part 61, Appendix B, Method 115. EPA shall be notified at least 30 days prior to an emissions test so that EPA may, at its option, observe the test. If meteorological conditions are such that a test cannot be properly conducted, then the owner or operator shall notify EPA and test as soon as conditions permit.

(b) Ninety days after the testing is required, the owner or operator shall provide EPA with a report detailing the actions taken and the results of the radon-222 flux testing. Each report shall also include the following information:

(1) The name and location of the facility,

(2) A list of the stacks at the facility including the size and dimensions of the stack,

(3) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different),

(4) A description of the control measures taken to decrease the radon flux from the source and any actions taken to insure the long term effectiveness of the control measures, and

(5) The results of the testing conducted, including the results of each measurement.

(6) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(c) If year-long measurements are made in accordance with Method 115 Appendix B to part 61 this report shall include the results of the first measurement period and provide a schedule for the measurement frequency to be used. An additional report containing all the information in

paragraph (b) of this section shall be submitted ninety days after completion of the final measurements.

(d) If at any point an owner or operator once again uses a stack for the disposal of phosphogypsum or for water management, the stack ceases to be in inactive status and the owner or operator must notify EPA in writing within 45 days. When the owner or operator ceases to use the stack it will once again become inactive and require retesting and reporting.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.204 Recordkeeping requirements.

An owner or operator subject to this subpart must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. This documentation should be sufficient to allow an independent auditor to verify the correctness of the determination made concerning the facility's compliance with the standard. These records must be kept by the owner or operator for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.205 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart T—National Emission Standards for Radon Emissions From the Disposal of Uranium Mill Tailings

Sec.

§ 61.220 Designation of facilities.

The provisions of this subpart apply to the owners and operators of all sites that are used for the disposal of tailings, and that managed residual radioactive material or uranium byproduct materials during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings, that are listed in, or designated by the Secretary of Energy under Title I of the Uranium Mill Tailings Control Act of 1978 or regulated under Title II of the Uranium Mill Tailings Control Act of 1978.

§ 61.221 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or subpart A of part 61. The following terms shall have the following specific meanings:

(a) *Long term stabilization* means the addition of material on a uranium mill tailings pile for purpose of ensuring compliance with the requirements of 40 CFR 192.02(a) or 192.32(b)(i). These actions shall be considered complete when the Nuclear Regulatory Commission determines that the requirements of 40 CFR 192.02(a) or 192.32(b)(i) have been met.

(b) *Operational* means a uranium mill tailings pile that is licensed to accept additional tailings, and those tailings can be added without violating subpart W or any other Federal, state or local rule or law. A pile cannot be considered operational if it is filled to capacity or the mill it accepts tailings from has been dismantled or otherwise decommissioned.

(c) *Uranium byproduct material* or *tailings* means the waste produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction and which remain underground do not constitute byproduct material for the purposes of this subpart.

§ 61.222 Standard.

(a) Radon-222 emissions to the ambient air from uranium mill tailings pile that are no longer operational shall not exceed 20 pCi/m^2-s of radon-222.

(b) Once a uranium mill tailings pile or impoundment ceases to be operational it must be disposed of and brought into compliance with this standard within two years of the effective date or within two years of the day it ceases to be operational whichever is later. If it is not physically possible for a mill owner or operator to complete disposal within that time, EPA shall, after consultation with the mill owner or operator, establish a compliance agreement which will assure that disposal will be completed as quickly as possible.

§ 61.223 Compliance procedures.

(a) Sixty days following the completion of covering the pile to limit radon emissions but prior to the long term stabilization of the pile, the owners or operators of uranium mill tailings shall conduct testing for all piles within the facility in accordance with the procedures described in 40 CFR part 61, Appendix B, Method 115, or other procedures for which EPA has granted prior approval.

(b) Ninety days after the testing is required, each facility shall provide EPA with a report detailing the actions taken and the results of the radon-222 flux testing. EPA shall be notified at least 30 days prior to an emission test so that EPA may, at its option, observe the test. If meteorological conditions are such that a test cannot be properly conducted, then the owner or operator shall notify EPA and test as soon as conditions permit. Each report shall also include the following information:

(1) The name and location of the facility.

(2) A list of the piles at the facility.

(3) A description of the control measures taken to decrease the radon flux from the source and any actions taken to insure the long term effectiveness of the control measures.

(4) The results of the testing conducted, including the results of each measurement.

(5) Each report shall be signed and dated by a corporate officer or public official in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(c) If year long measurements are made in accordance with Method 115 of Appendix B of part 61, this report shall include the results of the first measurement period and provide a schedule for the measurement frequency to be used. An additional report shall be submitted ninety days after completion of the final measurements.

(d) If long term stabilization has begun before the effective date of the rule then testing may be conducted at any time, up to 60 days after the long term stabilization is completed.

(e) If the testing demonstrates that the pile meets the requirement of § 61.222(a) and long term stabilization has been completed then the pile is considered disposed for purposes of this rule.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.224 Recordkeeping requirements.

The owner or operator must maintain records documenting the source of input

parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. This documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. The Administrator shall be kept apprised of the location of these records and the records must be kept for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.225 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

Subpart W—National Emission Standards for Radon Emissions From Operating Mill Tailings

Sec.

§ 61.250 Designation of facilities.

The provisions of this subpart apply to owners or operators of facilities licensed to manage uranium byproduct materials during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings. This subpart does not apply to the disposal of tailings.

§ 61.251 Definitions.

As used in this subpart, all terms not defined here have the meaning given them in the Clean Air Act or 40 CFR part 61, subpart A. The following terms shall have the following specific meanings:

(a) *Area* means the vertical projection of the pile upon the earth's surface.

(b) *Continuous disposal* means a method of tailings management and disposal in which tailings are dewatered by mechanical methods immediately after generation. The dried tailings are then placed in trenches or other disposal areas and immediately covered to limit emissions consistent with applicable Federal standards.

(c) *Dewatered* means to remove the water from recently produced tailings by mechanical or evaporative methods such that the water content of the tailings does not exceed 30 percent by weight.

(d) *Existing impoundment* means any uranium mill tailings impoundment which is licensed to accept additional tailings and is in existence as of December 15, 1989.

(e) *Operation* means that an impoundment is being used for the continued placement of new tailings or is in standby status for such placement. An impoundment is in operation from the day that tailings are first placed in the impoundment until the day that final closure begins.

(f) *Phased disposal* means a method of tailings management and disposal which uses lined impoundments which are filled and then immediately dried and covered to meet all applicable Federal standards.

(g) *Uranium byproduct material or tailings* means the waste produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction and which remain underground do not constitute byproduct material for the purposes of this subpart.

§ 61.252 Standard.

(a) Radon-222 emissions to the ambient air from an existing uranium mill tailings pile shall not exceed 20 pCi/m^2-s of radon-222.

(b) After December 15, 1989, no new tailings impoundment can be built unless it is designed, constructed and operated to meet one of the two following work practices:

(1) Phased disposal in lined tailings impoundments that are no more than 40 acres in area and meet the requirements of 40 CFR 192.32(a) as determined by the Nuclear Regulatory Commission. The owner or operator shall have no more than two impoundments, including existing impoundments, in operation at any one time.

(2) Continuous disposal of tailings such that tailings are dewatered and immediately disposed with no more than 10 acres uncovered at any time and operated in accordance with § 192.32(a) as determined by the Nuclear Regulatory Commission.

(c) All mill owners or operators shall comply with the provisions of 40 CFR 192.32(a) in the operation of tailings piles, the exemption for existing piles in 40 CFR 192.32(a) notwithstanding.

§ 61.253 Determining compliance.

Compliance with the emission standard in this subpart shall be determined annually through the use of Method 115 of Appendix B. When measurements are to be made over a one year period, EPA shall be provided with a schedule of the measurement frequency to be used. The schedule may be submitted to EPA prior to or after the first measurement period. EPA shall be notified 30 days prior to any emissions test so that EPA may, at its option, observe the test.

§ 61.254 Annual reporting requirements.

(a) The owners or operators of operating existing mill impoundments shall report the results of the compliance calculations required in § 61.253 and the input parameters used in making the calculation for each calendar year shall be sent to EPA by March 31 of the following year. Each report shall also include the following information:

(1) The name and location of the mill.

(2) The name of the person responsible for the operation of the facility and the name of the person preparing the report (if different).

(3) The results of the testing conducted, including the results of each measurement.

(4) Each report shall be signed and dated by a corporate officer in charge of the facility and contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

(b) If the facility is not in compliance with the emission limits of § 61.252 in the calendar year covered by the report, then the facility must commence reporting to the Administrator on a monthly basis the information listed in paragraph (a) of this section, for the preceding month. These reports will start the month immediately following the submittal of the annual report for the year in noncompliance and will be due 30 days following the end of each month. This increased level of reporting will continue until the Administrator has determined that the monthly reports are no longer necessary. In addition to all the information required in paragraph (a) of this section, monthly reports shall also include the following information:

(1) All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.

(2) If the facility is under a judicial or administrative enforcement decree, the report will describe the facilities performance under the terms of the decree.

(c) The first report will cover the emissions of calendar year 1990.

(Approved by the Office of Management and Budget under Control Number 2060-0191.)

§ 61.255 Recordkeeping requirements.

The owner or operator of the mill must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. In addition, the documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard. These records must be kept at the mill for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§ 61.256 Exemption from the reporting and testing requirements of 40 CFR 61.10.

All facilities designated under this subpart are exempt from the reporting requirements of 40 CFR 61.10.

§ 61.03 [Amended]

3. By adding to the list of System International units of measure in § 61.03(a) an entry for "m^2" following "m=meter" to read as follows:

m^2=square meter

4. By adding to the list of other units of measure in § 61.03(b) an entry for "Ci" following "cc"; an entry for "pC;" following "oz"; and an entry for "mrem" following "ml" to read as follows:

Ci=curie

* * * * *

mrem=millirem=10^{-3} rem

* * * * *

pCi=picocurie=10^{-12} curie

5. Section 61.18 is amended by adding paragraph (c) to read as follows:

§ 61.18 Incorporations by reference.

* * * * *

(c) The following material is available for purchase from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

(1) ANSI N13.1—1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities." IBR approved for §§ 61.93(b)(2)(ii); 61.107(b)(2)(ii); and Method 114, par. 2.1 of Appendix B to part 61.

Appendix B to Part 61—[Amended]

6. By amending Method 111 of Appendix B as follows:

a. Section 4.1 is revised to read as follows:

4.1 Sample Preparation.

The glass fiber filter and acetone rinse from Method 5 of Appendix A to 40 CFR part 60 are combined and dissolved as described below.

4.1.1 Add polonium-209 tracer to the acetone rinse in the glass beaker from Method 5 in an amount approximately equal to the amount of polonium-210 expected in the total particulate sample. Add 16 M nitric acid to the beaker to digest and loosen the residue.

4.1.2 Transfer the residue from the glass beaker to a teflon beaker containing the glass fiber filter. Rinse the glass beaker with 16 M nitric acid. If necessary reduce the volume in the beaker by evaporation until all of the nitric acid from the glass beaker has been transferred to the teflon beaker.

4.1.3 Add 30 ml of 29 M hydrofluoric acid to the teflon beaker and evaporate to near dryness on a hot plate in a properly operating hood. Caution: Do not allow the residue to go to dryness and overheat; this will result in loss of polonium.

4.1.4 Repeat step 4.1.3 until filter is dissolved.

4.1.5 Add 100 ml of 16 M nitric acid to the residue in the teflon beaker and evaporate to near dryness. Caution: Do not allow the residue to go to dryness.

4.1.6 Add 50 ml of 16 M nitric acid and 10 ml of 12 M perchloric acid to the teflon beaker and heat until dense fumes of perchloric acid are evolved.

4.1.7 Repeat steps 4.1.3 to 4.1.6 as necessary until sample is completely dissolved.

4.1.8 Add 10 ml of 12 M hydrochloric acid and evaporate to dryness. Repeat additions and evaporations several times.

4.1.9 Transfer the sample to a 250 ml volumetric flask and dilute to volume with 3 M hydrochloric acid.

b. Section 4.4.2 is removed and sections 4.4.3 through 4.4.8 are redesignated as sections 4.4.2 through 4.4.7 respectively.

c. In section 5.1, Equation 111-3 is amended by removing "A=picocuries of polonium-210 per filter" and adding "A= picocuries of polonium-210 in the particulate sample".

d. In section 5.2, Equation 111-4 is amended by revising the entry for "A=" to read "A= picocuries of polonium-210 in the particulate sample as determined by A in Equation 111-3".

e. Section 9.1.2 is removed.

7. By adding Method 114 to the methods in Appendix B to part 61 to read as follows:

Method 114—Test Methods for Measuring Radionuclide Emissions from Stationary Sources

1. Purpose and Background

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling and; (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

2. Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable sorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1—1969 shall be followed in using filter media to collect particulates (incorporated by reference—see § 61.18).

2.2 Radionuclides as Gases.

2.2.1 The Radionuclide Tritium (H-3). Tritium in the form of water vapor is collected from the extracted effluent sample by sorption, condensation or dissolution techniques. Appropriate collectors may include silica gel, molecular sieves, and ethylene glycol or water bubblers.

Tritium in the gaseous form may be measured directly in the sample stream using Method B–1, collected as a gas sample or may be oxidized using a metal catalyst to tritiated water and collected as described above.

2.2.2 Radionuclides of Iodine. Iodine is collected from an extracted sample by sorption or dissolution techniques. Appropriate collectors may include charcoal, impregnated charcoal, metal zeolite and caustic solutions.

2.2.3 Radionuclides of Argon, Krypton and Xenon. Radionuclides of these elements are either measured directly by an in-line or off-line monitor, or are collected from the extracted sample by low temperature sorption techniques. Appropriate sorbers may include charcoal or metal zeolite.

2.2.4 Radionuclides of Oxygen, Carbon, Nitrogen and Radon. Radionuclides of these elements are measured directly using an in-line or off-line monitor. Radionuclides of carbon in the form of carbon dioxide may be collected by dissolution in caustic solutions.

2.3 Definition of Terms

In-line monitor means a continuous measurement system in which the detector is placed directly in or adjacent to the effluent stream. This may involve either gross radioactivity measurements or specific radionuclide measurements. Gross measurements shall be made in conformance with the conditions specified in Methods A–4, B–2 and G–4.

Off-line monitor means a measurement system in which the detector is used to continuously measure an extracted sample of the effluent stream. This may involve either gross radioactivity measurements or specific radionuclide measurements. Gross measurements shall be made in conformance with the conditions specified in Methods A–4, B–2 and G–4.

Sample collection means a procedure in which the radionuclides are removed from an extracted sample of the effluent using a collection media. These collection media include filters, absorbers, bubblers and condensers. The collected sample is analyzed using the methods described in Section 3.

3. Radionuclide Analysis Methods

A series of methods based on "principles of measurement" are described which are applicable to the analysis of radionuclides collected from airborne effluent streams at stationary sources. These methods are applicable only under the conditions stated and within the limitations described. Some methods specify that only a single radionuclide be present in the sample or the chemically separated sample. This condition should be interpreted to mean that no other radionuclides are present in quantities which would interfere with the measurement.

Also identified (Table 1) are methods for a selected list of radionuclides. The listed radionuclides are those which are most commonly used and which have the greatest potential for causing dose to members of the public. Use of methods based on principles of measurement other than those described in this section must be approved in advance of use by the Administrator. For radionuclides not listed in Table 1, any of the described methods may be used provided the user can demonstrate that the applicability conditions of the method have been met.

The type of method applicable to the analysis of a radionuclide is dependent upon the type of radiation emitted, i.e., alpha, beta or gamma. Therefore, the methods described below are grouped according to principles of measurements for the analysis of alpha, beta and gamma emitting radionuclides.

3.1 Methods for Alpha Emitting Radionuclides

3.1.1 Method A–1, Radiochemistry-Alpha Spectrometry.

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemical techniques. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a very thin film by electrodeposition or by coprecipitation on a very small amount of carrier, such as lanthanum fluoride. The deposited element is then counted with an alpha spectrometer. The activity of the nuclide of interest is measured by the number of alpha counts in the appropriate energy region. A correction for chemical yield and counting efficiency is made using a standardized radioactive nuclide (tracer) of the same element. If a radioactive tracer is not available for the element of interest, a predetermined chemical yield factor may be used.

Applicability: This method is applicable for determining the activity of any alpha-emitting radionuclide, regardless of what other radionuclides are present in the sample provided the chemical separation step produces a very thin sample and removes all other radionuclides which could interfere in the spectral region of interest. APHA–605(2), ASTM–D–3972(13).

3.1.2 Method A–2, Radiochemistry-Alpha Counting.

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemistry. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a thin film and counted with a alpha counter. A correction for chemical yield (if necessary) is made. The alpha count rate measures the total activity of all emitting radionuclides of the separated element.

Applicability: This method is applicable for the measurement of any alpha-emitting radionuclide, provided no other alpha emitting radionuclide is present in the separated sample. It may also be applicable for determining compliance, when other radionuclides of the separated element are present, provided that the calculated emission rate is assigned to the radionuclide which could be present in the sample that has the highest dose conversion factor. IDO–12096(18).

3.1.3 Method A–3, Direct Alpha Spectrometry.

Principle: The sample, collected on a suitable filter, is counted directly on an alpha spectrometer. The sample must be thin enough and collected on the surface of the filter so that any absorption of alpha particle energy in the sample or the filter, which would degrade the spectrum, is minimal.

Applicability: This method is applicable to simple mixtures of alpha emitting radionuclides and only when the amount of particulates collected on the filter paper are relatively small and the alpha spectra is adequately resolved. Resolutions should be 50 keV (FWHM) or better, ASTM–D–3084(16).

3.1.4 Method A–4, Direct Alpha Counting (Gross alpha determination).

Principle: The sample, collected on a suitable filter, is counted with an alpha counter. The sample must be thin enough so that self-absorption is not significant and the filter must be of such a nature that the particles are retained on the surface.

Applicability: Gross alpha determinations may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, or the identity and isotopic ratio of the radionuclides in the sample are well-known, and (2) measurements using either Method A–1, A–2 or A–5 have shown that this method provides a reasonably accurate measurement of the emission rate. Gross alpha measurements are applicable to unidentified mixtures of radionuclides only for the purposes and under the conditions described in section 3.7. APHA–601(3), ASTM–D–1943(10).

3.1.5 Method A–5, Chemical Determination of Uranium.

Principle: Uranium may be measured chemically by either colorimetry or fluorometry. In both procedures, the sample is dissolved, the uranium is oxidized to the hexavalent form and extracted into a suitable solvent. Impurities are removed from the solvent layer. For colorimetry, dibenzoylmethane is added, and the uranium is measured by the absorbance in a colorimeter. For fluorometry, a portion of the solution is fused with a sodium fluoride-lithium fluoride flux and the uranium is determined by the ultraviolet activated fluorescence of the fused disk in a fluorometer.

Applicability: This method is applicable to the measurements of emission rates of uranium when the isotopic ratio of the uranium radionuclides is well known. ASTM–E–318(15), ASTM–D–2907(14).

3.1.6 Method A–6, Radon-222—Continuous Gas Monitor.

Principle: Radon-222 is measured directly in a continuously extracted sample stream by passing the air stream through a calibrated scintillation cell. Prior to the scintillation cell, the air stream is treated to remove particulates and excess moisture. The alpha particles from radon-222 and its decay products strike a zinc sulfide coating on the inside of the scintillation cell producing light pulses. The light pulses are detected by a photomultiplier tube which generates electrical pulses. These pulses are processed by the system electronics and the read out is in pCi/l of radon-222.

Applicability: This method is applicable to the measurement of radon-222 in effluent

streams which do not contain significant quantities of radon-220. Users of this method should calibrate the monitor in a radon calibration chamber at least twice per year. The background of the monitor should also be checked periodically by operating the instrument in a low radon environment. EPA 520/1-89-009(24).

3.1.7 Method A-7, Radon-222-Alpha Track Detectors

Principle: Radon-222 is measured directly in the effluent stream using alpha track detectors (ATD). The alpha particles emitted by radon-222 and its decay products strike a small plastic strip and produce submicron damage tracks. The plastic strip is placed in a caustic solution that accentuates the damage tracks which are counted using a microscope or automatic counting system. The number of tracks per unit area is correlated to the radon concentration in air using a conversion factor derived from data generated in a radon calibration facility.

Applicability: Prior approval from EPA is required for use of this method. This method is only applicable to effluent streams which do not contain significant quantities of radon-220, unless special detectors are used to discriminate against radon-220. This method may be used only when ATDs have been demonstrated to produce data comparable to data obtained with Method A-6. Such data should be submitted to EPA when requesting approval for the use of this method. EPA 520/1-89-009(24).

3.2 Methods for Gaseous Beta Emitting Radionuclides.

3.2.1 Method B-1, Direct Counting in Flow-Through Ionization Chambers.

Principle: An ionization chamber containing a specific volume of gas which flows at a given flow rate through the chamber is used. The sample (effluent stream sample) acts as the counting gas for the chamber. The activity of the radionuclide is determined from the current measured in the ionization chamber.

Applicability: This method is applicable for measuring the activity of a gaseous beta-emitting radionuclide in an effluent stream that is suitable as a counting gas, when no other beta-emitting nuclides are present. DOE/EP-0096(17), NCRP-58(23).

3.2.2 Method B-2, Direct Counting With In-line or Off-line Beta Detectors.

Principle: The beta detector is placed directly in the effluent stream (in-line) or an extracted sample of the effluent stream is passed through a chamber containing a beta detector (off-line). The activities of the radionuclides present in the effluent stream are determined from the beta count rate, and a knowledge of the radionuclides present and the relationship of the gross beta count rate and the specific radionuclide concentration.

Applicability: This method is applicable only to radionuclides with maximum beta particle energies greater then 0.2 MeV. This method may be used to measure emissions of specific radionuclides only when it is known that the sample contains only a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. Specific radionuclide analysis of periodic grab samples may be used to identify the types and quantities of radionuclides present and to establish the relationship between specific radionuclide analyses and gross beta count rates.

This method is applicable to unidentified mixtures of gaseous radionuclides only for the purposes and under the conditions described in section 3.7.

3.3 Methods for Non-Gaseous Beta Emitting Radionuclides.

3.3.1 Method B-3, Radiochemistry-Beta Counting.

Principle: The element of interest is separated from other elements, and from the sample matrix by radiochemistry. This may involve precipitation, distillation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet, and counted with a beta counter. Corrections for chemical yield, and decay (if necessary) are made. The beta count rate determines the total activity of all radionuclides of the separated element. This method may also involve the radiochemical separation and counting of a daughter element, after a suitable period of ingrowth, in which case it is specific for the parent nuclide.

Applicability: This method is applicable for measuring the activity of any beta-emitting radionuclide, with a maximum energy greater than 0.2 MeV, provided no other radionuclide is present in the separated sample. APHA-608(5).

3.3.2 Method B-4, Direct Beta Counting (Gross beta determination).

Principle: The sample, collected on a suitable filter, is counted with a beta counter. The sample must be thin enough so that self-absorption corrections can be made.

Applicability: Gross beta measurements are applicable only to radionuclides with maximum beta particle energies greater than 0.2 MeV. Gross beta measurements may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, and (2) measurements made using Method B-3 show reasonable agreement with the gross beta measurement. Gross beta measurements are applicable to mixtures of radionuclides only for the purposes and under the conditions described in section 3.7. APHA-602(4), ASTM-D-1890(11).

3.3.3 Method B-5, Liquid Scintillation Spectrometry.

Principle: An aliquot of a collected sample or the result of some other chemical separation or processing technique is added to a liquid scintillation "cocktail" which is viewed by photomultiplier tubes in a liquid scintillation spectrometer. The spectrometer is adjusted to establish a channel or "window" for the pulse energy appropriate to the nuclide of interest. The activity of the nuclide of interest is measured by the counting rate in the appropriate energy channel. Corrections are made for chemical yield where separations are made.

Applicability: This method is applicable to any beta-emitting nuclide when no other radionuclide is present in the sample or the separated sample provided that it can be incorporated in the scintillation cocktail. This method is also applicable for samples which contain more than one radionuclide but only when the energies of the beta particles are sufficiently separated so that they can be resolved by the spectrometer. This method is most applicable to the measurement of low-energy beta emitters such as tritium and carbon-14. APHA-609(6), EML-LV-539-17(19).

3.4 Gamma Emitting Radionuclides

3.4.1 Method G-1, High Resolution Gamma Spectrometry.

Principle: The sample is counted with a high resolution gamma detector, usually either a Ge(Li) or a high purity Ge detector, connected to a multichannel analyzer or computer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclide. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separations may be made prior to counting but are usually not necessary.

Applicability: This method is applicable to the measurement of any gamma emitting radionuclide with gamma energies greater than 20 keV. It can be applied to complex mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gases. The method may also be applied to the analysis of gaseous gamma emitting radionuclides directly in an effluent stream by passing the stream through a chamber or cell containing the detector. ASTM-3649(9), IDO-12096(18).

3.4.2 Method G-2, Low Resolution Gamma Spectrometry.

Principle: The sample is counted with a low resolution gamma detector, a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube and connected to a multichannel analyzer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclides. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separation may be used prior to counting to obtain less complex gamma spectra if needed.

Applicability: This method is applicable to the measurement of gamma emitting radionuclides with energies greater than 100 keV. It can be applied only to relatively simple mixtures of gamma emitting radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector. ASTM-D-2459(12), EMSL-LV-0539-17(19).

3.4.3 Method G-3, Single Channel Gamma Spectrometry.

Principle: The sample is counted with a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube connected to a single channel analyzer. The activity of a gamma emitting radionuclide is

determined from the gamma counts in the energy range for which the counter is set.

Applicability: This method is applicable to the measurement of a single gamma emitting radionuclide. It is not applicable to mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector.

3.4.4 Method G–4, Gross Gamma Counting.

Principle: The sample is counted with a gamma detector usually a thallium activated sodium iodine crystal. The detector is coupled to a photomultiplier tube and gamma rays above a specific threshold energy level are counted.

Applicability: Gross gamma measurements may be used to measure emissions of specific radionuclides only when it is known that the sample contains a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. When gross gamma measurements are used to determine emissions of specific radionuclides periodic measurements using Methods G–1 or G–2 should be made to demonstrate that the gross gamma measurements provide reliable emission data. This method may be applied to analysis of gaseous radionuclides directly in an effluent stream by placing the detector directly in or adjacent to the effluent stream or passing an extracted sample of the effluent stream through a chamber or cell containing the detector.

3.5 Counting Methods. All of the above methods with the exception of Method A–5 involve counting the radiation emitted by the radionuclide. Counting methods applicable to the measurement of alpha, beta and gamma radiations are listed below. The equipment needed and the counting principles involved are described in detail in ASTM–3648[8].

3.5.1 Alpha Counting:

• *Gas Flow Proportional Counters.* The alpha particles cause ionization in the counting gas and the resulting electrical pulses are counted. These counters may be windowless or have very thin windows.

• *Scintillation Counters.* The alpha particles transfer energy to a scintillator resulting in a production of light photons which strike a photomultiplier tube converting the light photons to electrical pulses which are counted. The counters may involve the use of solid scintillation materials such as zinc sulfide or liquid scintillation solutions.

• *Solid-State Counters.* Semiconductor materials, such as silicon surface-barrier p-n junctions, act as solid ionization chambers. The alpha particles interact which the detector producing electron hole pairs. The charged pair is collected by an applied electrical field and the resulting electrical pulses are counted.

• *Alpha Spectrometers.* Semiconductor detectors used in conjunction with multichannel analyzers for energy discrimination.

3.5.2 Beta Counting:

• *Ionization Chambers.* These chambers contain the beta-emitting nuclide in gaseous form. The ionization current produced is measured.

• *Geiger-Muller (GM) Counters or Gas Flow Proportional Counters.* The beta particles cause ionization in the counting gas and the resulting electrical pulses are counted. Proportional gas flow counters which are heavily shielded by lead or other metal, and provided with an anti-coincidence shield to reject cosmic rays, are called low background beta counters.

• *Scintillation Counters.* The beta particles transfer energy to a scintillator resulting in a production of light photons, which strike a photomultiplier tube converting the light photon to electrical pulses which are counted. This may involve the use of anthracene crystals, plastic scintillator, or liquid scintillation solutions with organic phosphors.

• *Liquid Scintillation Spectrometers.* Liquid scintillation counters which use two photomultiplier tubes in coincidence to reduce background counts. This counter may also electronically discriminate among pulses of a given range of energy.

3.5.3 Gamma Counting:

• *Low-Resolution Gamma Spectrometers.* The gamma rays interact with thallium activated sodium iodide or cesium iodide crystal resulting in the release of light photons which strike a photomultiplier tube converting the light pulses to electrical pulses proportional to the energy of the gamma ray. Multi-channel analyzers are used to separate and store the pulses according to the energy absorbed in the crystal.

• *High-Resolution gamma Spectrometers.* Gamma rays interact with a lithium-drifted (Ge(Li)) or high-purity germanium (HPGe) semiconductor detectors resulting in a production of electron-hole pairs. The charged pair is collected by an applied electrical field. A very stable low noise preamplifier amplifies the pulses of electrical charge resulting from the gamma photon interactions. Multichannel analyzers or computers are used to separate and store the pulses according to the energy absorbed in the crystal.

• *Single Channel Analyzers.* Thallium activated sodium iodide crystals used with a single window analyzer. Pulses from the photomultiplier tubes are separated in a single predetermined energy range.

3.5.4 Calibration of Counters. Counters are calibrated for specific radionuclide measurements using a standard of the radionuclide under either identical or very similar conditions as the sample to be counted. For gamma spectrometers a series of standards covering the energy range of interest may be used to construct a calibration curve relating gamma energy to counting efficiency.

In those cases where a standard is not available for a radionuclide, counters may be calibrated using a standard with energy characteristics as similar as possible to the radionuclide to be measured. For gross alpha and beta measurements of the unidentified mixtures of radionuclides, alpha counters are calibrated with a natural uranium standard and beta counters with a cesium-137 standard. The standard must contain the same weight and distribution of solids as the samples, and be mounted in an identical manner. If the samples contain variable amounts of solids, calibration curves relating weight of solids present to counting efficiency are prepared. Standards other than those prescribed may be used provided it can be shown that such standards are more applicable to the radionuclide mixture measured.

3.6 Radiochemical Methods for Selected Radionuclides. Methods for a selected list of radionuclides are listed in Table 1. The radionuclides listed are those which are most commonly used and which have the greatest potential for causing doses to members of the public. For radionuclides not listed in Table 1, methods based on any of the applicable "principles of measurement" described in section 3.1 through 3.4 may be used.

3.7 Applicability of Gross Alpha and Beta Measurements to Unidentified Mixtures of Radionuclides. Gross alpha and beta measurements may be used as a screening measurement as a part of an emission measurement program to identify the need to do specific radionuclide analyses or to confirm or verify that unexpected radionuclides are not being released in significant quantities.

Gross alpha (Method A–4) or gross beta (Methods B–2 or B–4) measurements may also be used for the purpose of comparing the measured concentrations in the effluent stream with the limiting "Concentration Levels for Environmental Compliance" in Table 2 of Appendix E. For unidentified mixtures, the measured concentration value shall be compared with the lowest environmental concentration limit for any radionuclide which is not known to be absent from the effluent stream.

TABLE 1.—LIST OF APPROVED METHODS FOR SPECIFIC RADIONUCLIDES

Radionuclide	Approved methods of analysis
Am-241	A–1, A–2, A–3, A–4
Ar-41	B–1, B–2, G–1, G–2, G–3, G–4
Ba-140	G–1, G–2, G–3, G–4
Br-82	G–1, G–2, G–3, G–4
C-11	B–1, B–2, G–1, G–2, G–3, G–4
C-14	B–5
Ca-45	B–3, B–4, B–5
Ce-144	G–1, G–2, G–3, G–4
Cm-244	A–1, A–2, A–3, A–4
Co-60	G–1, G–2, G–3, G–4
Cr-51	G–1, G–2, G–3, G–4
Cs-134	G–1, G–2, G–3, G–4
Cs-137	G–1, G–2, G–3, G–4
Fe-55	B–5, G–1
Fe-59	G–1, G–2, G–3, G–4
Ga-67	G–1, G–2, G–3, G–4
H-3 (H_2O)	B–5
H-3 (gas)	B–1
I-123	G–1, G–2, G–3, G–4
I-125	G–1
I-131	G–1, G–2, G–3, G–4
In-113m	G–1, G–2, G–3, G–4
Ir-192	G–1, G–2, G–3, G–4
Kr-85	B–1, B–2, B–5, G–1, G–2, G–3, G–4
Kr-87	B–1, B–2, G–1, G–2, G–3, G–4

TABLE 1.—LIST OF APPROVED METHODS FOR SPECIFIC RADIONUCLIDES—Continued

Radionuclide	Approved methods of analysis
Kr-88	B-1, B-2, G-1, G-2, G-3, G-4
Mn-54	G-1, G-2, G-3, G-4
Mo-99	G-1, G-2, G-3, G-4
N-13	B-1, B-2, G-1, G-2, G-3, G-4
O-15	B-1, B-2, G-1, G-2, G-3, G-4
P-32	B-3, B-4, B-5
Pm-147	B-3, B-4, B-5
Po-210	A-1, A-2, A-3, A-4
Pu-238	A-1, A-2, A-3, A-4
Pu-239	A-1, A-2, A-3, A-4
Pu-240	A-1, A-2, A-3, A-4
S-35	B-5
Se-75	G-1, G-2, G-3, G-4
Sr-90	B-3, B-4, B-5
Tc-99	B-3, B-4, B-5
Te-201	G-1, G-2, G-3, G-4
Uranium (total alpha)	A-1, A-2, A-3, A-4
Uranium (Isotopic)	A-1, A-3
Uranium (Natural)	A-5
Xe-133	G-1
Yb-169	G-1, G-2, G-3, G-4
Zn-65	G-1, G-2, G-3, G-4

4. Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure, functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rationale for site selections.

4.3.2 A description of sampling probes and representativeness of the samples.

4.3.3 A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures and frequency of calibration.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

4.3.7 A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions.

4.5 A quality control program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates, spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified.

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage and analysis.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

4.8 A corrective action program shall be established including criteria for when corrective action is needed, what corrective actions will be taken and who is responsible for taking the corrective action.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits and description of corrective actions.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

5. References

(1) American National Standards Institute, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities", ANSI-N13.1-1969, American National Standards Institute, New York, New York (1969).

(2) American Public Health Association, "Methods of Air Sampling", 2nd Edition, Method 605, "Tentative Method of Analysis for Plutonium Content of Atmospheric Particulate Matter". American Public Health Association, New York, NY (1977).

(3) Ibid, Method 601, "Tentative Method of Analysis for Gross Alpha Radioactivity Content of the Atmosphere".

(4) Ibid, Method 602, "Tentative Method of the Analysis for Gross Beta Radioactivity Content of the Atmosphere".

(5) Ibid, Method 608, "Tentative Method of Analysis for Strontium-90 Content of Atmospheric Particulate Matter".

(6) Ibid, Method 609, "Tentative Method of Analysis for Tritium Content of the Atmosphere".

(7) Ibid, Method 603, "Tentative Method of Analysis for Iodine-131 Content of the Atmosphere".

(8) American Society for Testing and Materials, 1986 Annual Book ASTM Standards, Designation D-3648-78, "Standard Practices for the Measurement of Radioactivity". American Society for Testing and Materials, Philadelphia, PA (1986).

(9) Ibid, Designation D-3649-85, "Standard Practice for High Resolution Gamma Spectrometry".

(10) Ibid, Designation D-1943-81, "Standard Test Method for Alpha Particle Radioactivity of Water".

(11) Ibid, Designation D-1890-81, "Standard Test Method for Beta Particle Radioactivity of Water".

(12) Ibid, Designation D-2459-72, "Standard Test Method for Gamma Spectrometry of Water".

(13) Ibid, Designation D-3972-82, "Standard Test Method for Isotopic Uranium in Water by Radiochemistry".

(14) Ibid, Designation D-2907-83, "Standard Test Methods for Microquantities of Uranium in Water by Fluorometry".

(15) Ibid, Designation E-318, "Standard Test Method for Uranium in Aqueous Solutions by Colorimetry".

(16) Ibid, Designation D-3084-75, "Standard Practice for Alpha Spectrometry of Water".

(17) Corley, J.P. and C.D. Corbit, "A Guide for Effluent Radiological Measurements at DOE Installations", DOE/EP-0096, Pacific Northwest Laboratories, Richland, Washington (1983).

(18) Department of Energy, "RESL Analytical Chemistry Branch Procedures Manual", IDO-12096, U.S. Department of Energy, Idaho Falls, Idaho (1982).

(19) Environmental Protection Agency, "Radiochemical Analytical Procedures for Analysis of Environmental Samples", EMSL-LV-0539-17, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada (1979).

(20) Environmental Protection Agency, "Radiochemistry Procedures Manual", EPA 520/5-84-006, Eastern Environmental Radiation Facility, Montgomery, Alabama (1984).

(21) National Council on Radiation Protection and Measurements, NCRP Report

No. 50, "Environmental Radiation Measurements", National Council on Radiation Protection and Measurement, Bethesda, Maryland (1976).

(22) Ibid, Report No. 47, "Tritium Measurement Techniques". (1976).

(23) Ibid, Report No. 58 "A Handbook of Radioactivity Measurement Procedures" (1985).

(24) Environmental Protection Agency, "Indoor Radon and Radon Decay Product Measurement Protocols", EPA 520/1–89–009, U.S. Environmental Protection Agency, Washington, DC (1989).

8. By adding Method 115 to the list of methods in Appendix B to part 61 to read as follows:

Method 115—Monitoring for Radon-222 Emissions

This Appendix describes the monitoring methods which must be used in determining the radon-222 emissions from underground uranium mines, uranium mill tailings piles, phosphogypsum stacks, and other piles of waste material emitting radon.

1. Radon-222 Emissions from Underground Uranium Mine Vents

1.1 Sampling Frequency and Calculation of Emissions. Radon-222 emissions from underground uranium mine vents shall be determined using one of the following methods:

1.1.1 Continuous Measurement. These measurements shall be made and the emissions calculated as follows:

(a) The radon-222 concentration shall be continuously measured at each mine vent whenever the mine ventilation system is operational.

(b) Each mine vent exhaust flow rate shall be measured at least 4 times per year.

(c) A weekly radon-222 emission rate for the mine shall be calculated and recorded weekly as follows:

$$A_w = C_1Q_1T_1 + C_2Q_2T_2 + \ldots C_iQ_iT_i$$

Where:

A_w = Total radon-222 emitted from the mine during week (Ci)

C_i = Average radon-222 concentration in mine vent i(Ci/m^3)

Q_i = Volumetric flow rate from mine vent i(m^3/hr)

T_i = Hours of mine ventilation system operation during week for mine vent i(hr)

(d) The annual radon-222 emission rate is the sum of the weekly emission rates during a calendar year.

1.1.2 Periodic Measurement. This method is applicable only to mines that continuously operate their ventilation system except for extended shutdowns. Mines which start up and shut down their ventilation system frequently must use the continuous measurement method describe in Section 1.1.1 above. Emission rates determined using periodic measurements shall be measured and calculated as follows:

(a) The radon-222 shall be continuously measured at each mine vent for at least one week every three months.

(b) Each mine vent exhaust flow rate shall be measured at least once during each of the radon-222 measurement periods.

(c) A weekly radon-222 emission rate shall be calculated for each weekly period according to the method described in Section 1.1.1. In this calculation T = 168 hr.

(d) The annual radon-222 emission rate from the mine should be calculated as follows:

$$A_y = \frac{52 - W_s}{n} \quad (A_{w1} + A_{w2} + \ldots A_{wi})$$

Where:

A_y = Annual radon-222 emission rate from the mine(Ci)

A_{wi} = Weekly radon-222 emission rate during the measurement period i (Ci)

n = Number of weekly measurement periods per year

W_s = Number of weeks during the year that the mine ventilation system is shut down in excess of 7 consecutive days, i.e. the sum of the number of weeks each shut down exceeds 7 days

1.2 Test Methods and Procedures

Each underground mine required to test its emissions, unless an equivalent or alternative method has been approved by the Administrator, shall use the following test methods:

1.2.1 Test Method 1 of Appendix A to part 60 shall be used to determine velocity traverses. The sampling point in the duct shall be either the centroid of the cross section or the point of average velocity.

1.2.2 Test Method 2 of Appendix A to part 60 shall be used to determine velocity and volumetric flow rates.

1.2.3 Test Methods A–6 or A–7 of Appendix B, Method 114 to part 61 shall be used for the analysis of radon–222. Use of Method A–7 requires prior approval of EPA based on conditions described in Appendix B.

1.2.4 A quality assurance program shall be conducted in conformance with the programs described for Continuous Radon Monitors and Alpha Track Detectors in EPA 520/1–89–009. (2)

2. Radon–222 Emissions from Uranium Mill Tailings Piles

2.1 Measurement and Calculation of Radon Flux from Uranium Mill Tailings Piles.

2.1.1 Frequency of Flux Measurement. A single set of radon flux measurements may be made, or if the owner or operator chooses, more frequent measurements may be made over a one year period. These measurements may involve quarterly, monthly or weekly intervals. All radon measurements shall be made as described in paragraphs 2.1.2 through 2.1.6 except that for measurements made over a one year period, the requirement of paragraph 2.1.4(c) shall not apply. The mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each measurement period. The weather conditions, moisture content of the tailings and area of the pile covered by water existing at the time of the measurement shall be chosen so as to provide measurements representative of the long term radon flux from the pile and shall be subject to EPA review and approval.

2.1.2 Distribution of Flux Measurements. The distribution and number of radon flux measurements required on a pile will depend on clearly defined areas of the pile (called regions) that can have significantly different radon fluxes due to surface conditions. The mean radon flux shall be determined for each individual region of the pile. Regions that shall be considered for operating mill tailings piles are:

(a) Water covered areas,

(b) Water saturated areas (beaches),

(c) Dry top surface areas, and

(d) Sides, except where earthen material is used in dam construction.

For mill tailings after disposal the pile shall be considered to consist of only one region.

2.1.3 Number of Flux Measurements. Radon flux measurements shall be made within each region on the pile, except for those areas covered with water. Measurements shall be made at regularly spaced locations across the surface of the region, realizing that surface roughness will prohibit measurements in some areas of a region. The minimum number of flux measurements considered necessary to determine a representative mean radon flux value for each type of region on an operating pile is:

(a) Water covered area—no measurements required as radon flux is assumed to be zero,

(b) Water saturated beaches—100 radon flux measurements,

(c) Loose and dry top surface—100 radon flux measurements,

(d) Sides—100 radon flux measurements, except where earthern material is used in dam construction.

For a mill tailings pile after disposal which consists of only one region a minimum of 100 measurements are required.

2.1.4 Restrictions to Radon Flux Measurements. The following restrictions are placed on making radon flux measurements:

(a) Measurements shall not be initiated within 24 hours of a rainfall.

(b) If a rainfall occurs during the 24 hour measurements period, the measurement is invalid if the seal around the lip of the collector has washed away or if the collector is surrounded by water.

(c) Measurements shall not be performed if the ambient temperature is below 35°F or if the ground is frozen.

2.1.5 Areas of Pile Regions. The approximate area of each region of the pile shall be determined in units of square meters.

2.1.6 Radon Flux Measurement. Measuring radon flux involves the adsorption of radon on activated charcoal in a large-area collector. The radon collector is placed on the surface of the pile area to be measured and allowed to collect radon for a time period of 24 hours. The radon collected on the charcoal is measured by gamma–ray spectroscopy. The detailed measurement procedure provided in Appendix A of EPA 520/5–85–0029(1) shall be used to measure the radon flux on uranium mill tailings, except the surface of the tailings shall not be penetrated by the lip of the radon collector as directed in the procedure, rather the collector shall be

carefully positioned on a flat surface with soil or tailings used to seal the edge.

2.1.7 Calculations. The mean radon flux for each region of the pile and for the total pile shall be calculated and reported as follows:

(a) The individual radon flux calculations shall be made as provided in Appendix A EPA 86 (1). The mean radon flux for each region of the pile shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

(b) The mean radon flux for the total uranium mill tailings pile shall be calculated as follows.

$$J_s = \frac{J_1A_1 + \ldots J_2A_2 \ldots J_iA_i}{A_t}$$

Where:
J_s = Mean flux for the total pile (pCi/m^2-s)
J_i = Mean flux measured in region i (pCi/m^2-s)
A_i = Area of region i (m^2)
A_t = Total area of the pile (m^2)

2.1.8 Reporting. The results of individual flux measurements, the approximate locations on the pile, and the mean radon flux for each region and the mean radon flux for the total stack shall be included in the emission test report. Any condition or unusual event that occurred during the measurements that could significantly affect the results should be reported.

3.0 Radon-222 Emissions from Phosphogypsum Stacks.

3.1 Measurement and Calculation of the Mean Radon Flux. Radon flux measurements shall be made on phosphogypsum stacks as described below:

3.1.1 Frequency of Measurements. A single set of radon flux measurements may be made after the phosphogypsum stack becomes inactive, or if the owner or operator chooses, more frequent measurements may be made over a one year period. These measurements may involve quarterly, monthly or weekly intervals. All radon measurements shall be made as described in paragraphs 3.1.2 through 3.1.6 except that for measurements made over a one year period, the requirement of paragraph 3.1.4(c) shall not apply. For measurements made over a one year period, the radon flux shall be the arithmetic mean of the mean radon flux for each measurement period.

3.1.2 Distribution and Number of Flux Measurements. The distribution and number of radon flux measurements required on a stack will depend on clearly defined areas of the stack (called regions) that can have significantly different radon fluxes due to surface conditions. The mean radon flux shall be determined for each individual region of the stack. Regions that shall be considered are:

(a) Water covered areas,
(b) Water saturated areas (beaches),
(c) Loose and dry top surface areas,
(d) Hard-packed roadways, and
(e) Sides.

3.1.3 Number of Flux Measurements. Radon flux measurements shall be made within each region on the phosphogypsum stack, except for those areas covered with water. Measurements shall be made at regularly spaced locations across the surface of the region, realizing that surface roughness will prohibit measurements in some areas of a region. The minimum number of flux measurements considered necessary to determine a representative mean radon flux value for each type of region is:

(a) Water covered area—no measurements required as radon flux is assumed to be zero,
(b) Water saturated beaches—50 radon flux measurements,
(c) Loose and dry top surface—100 radon flux measurements,
(d) Hard-packed roadways—50 radon flux measurements, and
(e) Sides—100 radon flux measurements.

A minimum of 300 measurements are required. A stack that has no water cover can be considered to consist of two regions, top and sides, and will require a minimum of only 200 measurements.

3.1.4 Restrictions to Radon Flux Measurements. The following restrictions are placed on making radon flux measurements:

(a) Measurements shall not be initiated within 24 hours of a rainfall.
(b) If a rainfall occurs during the 24 hour measurement period, the measurement is invalid if the seal around the lip of the collector has washed away or if the collector is surrounded by water.
(c) Measurements shall not be performed if the ambient temperature is below 35 °F or if the ground is frozen.

3.1.5 Areas of Stack Regions. The approximate area of each region of the stack shall be determined in units of square meters.

3.1.6 Radon Flux Measurements. Measuring radon flux involves the adsorption of radon on activated charcoal in a large-area collector. The radon collector is placed on the surface of the stack area to be measured and allowed to collect radon for a time period of 24 hours. The radon collected on the charcoal is measured by gamma-ray spectroscopy. The detailed measurement procedure provided in Appendix A of EPA 520/5-85-0029(1) shall be used to measure the radon flux on phosphogypsum stacks, except the surface of the phosphogypsum shall not be penetrated by the lip of the radon collector as directed in the procedure, rather the collector shall be carefully positioned on a flat surface with soil or phosphogypsum used to seal the edge.

3.1.7 Calculations. The mean radon flux for each region of the phosphogypsum stack and for the total stack shall be calculated and reported as follows:

(a) The individual radon flux calculations shall be made as provided in Appendix A EPA 86 (1). The mean radon flux for each region of the stack shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

(b) The mean radon flux for the total phosphogypsum stack shall be calculated as follows.

$$J_s = \frac{J_1A_1 + J_2A_2 + \ldots J_iA_i}{A_t}$$

Where:
J_s = Mean flux for the total stack (pCi/m^2-s)
J_i = Mean flux measured in region i (pCi/m^2-s)
A_i = Area of region i (m^2)
A_t = Total area of the stack

3.1.8 Reporting. The results of individual flux measurements, the approximate locations on the stack, and the mean radon flux for each region and the mean radon flux for the total stack shall be included in the emission test report. Any condition or unusual event that occurred during the measurements that could significantly affect the results should be reported.

4.0 Quality Assurance Procedures for Measuring Rn-222 Flux

A. Sampling Procedures

Records of field activities and laboratory measurements shall be maintained. The following information shall be recorded for each charcoal canister measurement:

(a) Site
(b) Name of pile
(c) Sample location
(d) Sample ID number
(e) Date and time on
(f) Date and time off
(g) Observations of meteorological conditions and comments

Records shall include all applicable information associated with determining the sample measurement, calculations, observations, and comments.

B. Sample Custody

Custodial control of all charcoal samples exposed in the field shall be maintained in accordance with EPA chain-of-custody field procedures. A control record shall document all custody changes that occur between the field and laboratory personnel.

C. Calibration Procedures and Frequency

The radioactivity of two standard charcoal sources, each containing a carefully determined quantity of radium-226 uniformly distributed through 180g of activated charcoal, shall be measured. An efficiency factor is computed by dividing the average measured radioactivity of the two standard charcoal sources, minus the background, in cpm by the known radioactivity of the charcoal sources in dpm. The same two standard charcoal sources shall be counted at the beginning and at the end of each day's counting as a check of the radioactivity counting equipment. A background count using unexposed charcoal should also be made at the beginning and at the end of each counting day to check for inadvertent contamination of the detector or other changes affecting the background. The unexposed charcoal comprising the blank is changed with each new batch of charcoal used.

D. Internal Quality Control Checks and Frequency

The charcoal from every tenth exposed canister shall be recounted. Five percent of the samples analyzed shall be either blanks (charcoal having no radioactivity added) or

samples spiked with known quantities of radium-226.

E. Data Precision, Accuracy, and Completeness

The precision, accuracy, and completeness of measurements and analyses shall be within the following limits for samples measuring greater than 1.0 $pCi/m^3 - s$.

(a) Precision: 10%

(b) Accuracy: ±10%

(c) Completeness: at least 85% of the measurements must yield useable results.

5.0 References

(1) Hartley, J.N. and Freeman, H.D., "Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida," U.S. Environmental Protection Agency Report, EPA 520/5–85–029, January 1986.

(2) Environmental Protection Agency, "Indoor Radon and Radon Decay Product Measurement Protocols", EPA 520/1–89–009, U.S. Environmental Protection Agency, Washington, DC. (1989).

9. By adding Appendix D to part 61 to read as follows:

Appendix D to Part 61—Methods for Estimating Radionuclide Emissions

1. Purpose and Background

Facility owners or operators may estimate radionuclide emissions to the atmosphere for dose calculations instead of measuring emissions. Particulate emissions from mill tailings piles should be estimated using the procedures listed in reference #2. All other emissions may be estimated by using the "Procedures" listed below, or using the method described in reference #1.

2. Procedure

To estimate emissions to the atmosphere:

(a) Determine the amount (in curies) used at facilities for the period under consideration. Radioactive materials in sealed packages that remain unopened, and have not leaked during the assessment period should not be included in the calculation.

(b) Multiply the amount used by the following factors which depend on the physical state of the radionuclide. They are:

(i) 1 for gases;

(ii) 10^{-3} for liquids or particulate solids; and

(iii) 10^{-6} for solids.

If any nuclide is heated to a temperature of 100 degrees Celsius or more, boils at a temperature of 100 degrees Celsius or less, or is intentionally dispersed into the environment, it must be considered to be a gas.

(c) If a control device is installed between the place of use and the point of release, multiply emissions from (b) by an adjustment factor. These are presented in Table 1.

TABLE 1.—ADJUSTMENT TO EMISSION FACTORS FOR EFFLUENT CONTROLS

Controls	Types of radionuclides controlled	Adjustment factor to emissions	Comments and conditions
HEPA filters	Particulates	0.01	Not applicable to gaseous radionuclides; periodic testing is prudent to ensure high removal efficiency.
Fabric filter	Particulates	0.1	Monitoring would be prudent to guard against tears in filter.
Sintered metal	Particulates	1	Insufficient data to make recommendation.
Activated carbon filters	Iodine gas	0.1	Efficiency is time dependent; monitoring is necessary to ensure effectiveness.
Douglas bags: Held one week or longer for decay	Xenon	0.5/wk	Based on xenon half-life of 5.3 days;
Douglas bags: Released within one week	Xenon	1	Provides no reduction of exposure to general public.
Venturi scrubbers	Particulates	0.05	Although venturis may remove gases, variability in gaseous removal efficiency dictates adjustment factor for particulates only.
	Gases	1	
Packed bed scrubbers	Gases	0.1	Not applicable to particulates.
Electrostatic precipitators	Particulates	0.05	Not applicable for gaseous radionuclides
Xenon traps	Xenon	0.1	Efficiency is time dependent; monitoring is necessary to ensure effectiveness.
Fume hoods	All	1	Provides no reduction to general public exposures.
Vent stacks	All	1	Generally provides no reduction of exposure to general public.

References

(1) Environmental Protection Agency, "A Guide for Determining Compliance with the Clean Air Act Standards for Radionuclides Emissions from NRC-Licensed and Non-DOE Federal Facilities", EPA 520/1–89–002, January 1989.

(2) Nuclear Regulatory Commission, "Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations", U.S. Nuclear Regulatory Commission Regulatory Guide 3.59, March 1987.

10. By adding Appendix E part 61 to read as follows:

Appendix E to Part 61—Compliance Procedures Methods for Determining Compliance With Subpart I

1. Purpose and Background

This Appendix provides simplified procedures to reduce the burden on Nuclear Regulatory Commission (NRC) licensees, and non-Department of Energy Federal facilities in determining compliance with 40 CFR part 61, subpart I. The procedures consist of a series of increasingly more stringent steps, depending on the facility's potential to exceed the standard.

First, a facility can be found in compliance if the quantity of radioactive material possessed during the year is less than that listed in a table of annual possession quantities. A facility will also be in compliance if the average annual radionuclide emission concentration is less than that listed in a table of air concentration levels. If the facility is not in compliance by these tables, it can establish compliance by estimating a dose using screening procedure developed by the National Council on Radiation Protection and Measurements with a radiological source term derived using EPA approved emission factors. These procedures are described in a "Guide for Determining Compliance with the Clean Air Act Standards for Radionuclide Emissions From NRC-Licenced and Non-DOE Federal Facilities."

A user-friendly computer program called COMPLY has been developed to reduce the burden on the regulated community. The Agency has also prepared a "User's Guide for the COMPLY Code" to assist the regulated community in using the code, and in handling more complex situations such as multiple release points. The basis for these compliance procedures are provided in "Background Information Document: Procedures Approved for Demonstrating Compliance with 40 CFR part 61, subpart I". The compliance model is the highest level in the COMPLY computer code and provides for the most realistic assessment of dose by allowing the use of site-specific information.

2. Table of Annual Possession Quantity

(a) Table 1 may be used for determining if facilities are in compliance with the standard. The possession table can only be used if the following conditions are met:

(i) No person lives within 10 meters of any release point; and

(ii) No milk, meat, or vegetables are produced within 100 meters of any release point.

(b) Procedures described in Reference (1) shall be used to determine compliance or exemption from reporting by use of Table 2.

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
Ac-225	9.6E−05	9.6E−02	9.6E+01
Ac-227	1.6E−07	1.6E−04	1.6E−01
Ac-228	3.4E−03	3.4E+00	3.4E+03
Ag-106	1.6E+00	1.6E+03	1.6E+06
Ag-106m	2.6E−03	2.6E+00	2.6E+03
Ag-108m	6.5E−06	6.5E−03	6.5E+00
Ag-110m	9.4E−05	9.4E−02	9.4E+01
Ag-111	6.7E−02	6.7E+01	6.7E+04
Al-26	4.0E−06	4.0E−03	4.0E+00
Am-241	2.3E−06	2.3E−03	2.3E+00
Am-242	1.8E−02	1.8E+01	1.8E+04
Am-242m	2.5E−06	2.5E−03	2.5E+00
Am-243	2.3E−06	2.3E−03	2.3E+00
Am-244	4.6E−02	4.6E+01	4.6E+04
Am-245	7.0E+00	7.0E+03	7.0E+06
Am-246	9.8E−01	9.8E+02	9.8E+05
Ar-37	1.4E+06		
Ar-41	1.4E+00		
As-72	2.9E−02	2.9E+01	2.9E+04
As-73	6.0E−02	6.0E+01	6.0E+04
As-74	4.3E−03	4.3E+00	4.3E+03
As-76	8.8E−02	8.8E+01	8.8E+04
As-77	7.9E−01	7.9E+02	7.9E+05
At-211	1.0E−02	1.0E+01	1.0E+04
Au-193	4.2E−01	4.2E+02	4.2E+05
Au-194	3.5E−02	3.5E+01	3.5E+04
Au-195	3.3E−03	3.3E+00	3.3E+03
Au-198	4.6E−02	4.6E+01	4.6E+04
Au-199	1.5E−01	1.5E+02	1.5E+05
Ba-131	1.0E−02	1.0E+01	1.0E+04
Ba-133	4.9E−05	4.9E−02	4.9E+01
Ba-133m	9.3E−02	9.3E+01	9.3E+04
Ba-135m	5.8E−01	5.8E+02	5.8E+05
Ba-139	4.7E+00	4.7E+03	4.7E+06
Ba-140	2.1E−03	2.1E+00	2.1E+03
Ba-141	1.3E+00	1.3E+03	1.3E+06
Ba-142	1.1E+00	1.1E+03	1.1E+06
Be-7	2.3E−02	2.3E+01	2.3E+04
Be-10	3.0E−03	3.0E+00	3.0E+03
Bi-206	3.1E−03	3.1E+00	3.1E+03
Bi-207	8.4E−06	8.4E−03	8.4E+00
Bi-210	4.2E−03	4.2E+00	4.2E+03
Bi-212	4.7E−02	4.7E+01	4.7E+04
Bi-213	6.0E−02	6.0E+01	6.0E+04
Bi-214	1.4E−01	1.4E+02	1.4E+05
Bk-249	7.0E−04	7.0E−01	7.0E+02
Bk-250	1.0E−01	1.0E+02	1.0E+05
Br-77	7.5E−02	7.5E+01	7.5E+04
Br-80	1.2E+01	1.2E+04	1.2E+07
Br-80m	1.5E+00	1.5E+03	1.5E+06
Br-82	1.6E−02	1.6E+01	1.6E+04
Br-83	9.9E+00	9.9E+03	9.9E+06
Br-84	5.6E−01	5.6E+02	5.6E+05
C-11	1.3E+00	1.3E+03	1.3E+06
C-14	2.9E−01	2.9E+02	2.9E+05
Ca-41	2.7E−02	2.7E+01	2.7E+04
Ca-45	5.8E−02	5.8E+01	5.8E+04
Ca-47	1.1E−02	1.1E+01	1.1E+04
Cd-109	5.0E−03	5.0E+00	5.0E+03
Cd-113	3.3E−04	3.3E−01	3.3E+02
Cd-113m	4.4E−04	4.4E−01	4.4E+02
Cd-115	5.4E−02	5.4E+01	5.4E+04
Cd-115m	1.0E−02	1.0E+01	1.0E+04
Cd-117	5.6E−02	5.6E+01	5.6E+04
Cd-117m	1.3E−01	1.3E+02	1.3E+05
Ce-139	2.6E−03	2.6E+00	2.6E+03
Ce-141	1.8E−02	1.8E+01	1.8E+04
Ce-143	1.0E−01	1.0E+02	1.0E+05
Ce-144	1.7E−03	1.7E+00	1.7E+03
Cf-248	2.0E−05	2.0E−02	2.0E+01
Cf-249	1.7E−06	1.7E−03	1.7E+00
Cf-250	4.0E−06	4.0E−03	4.0E+00
Cf-251	1.7E−06	1.7E−03	1.7E+00
Cf-252	6.4E−06	6.4E−03	6.4E+00
Cf-253	3.3E−04	3.3E−01	3.3E+02

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE—Continued

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
Cl-254	3.6E−06	3.6E−03	3.6E+00
Cl-36	1.9E−04	1.9E−01	1.9E+02
Cl-38	6.5E−01	6.5E+02	6.5E+05
Cm-242	6.0E−05	6.0E−02	6.0E+01
Cm-243	3.3E−06	3.3E−03	3.3E+00
Cm-244	4.2E−06	4.2E−03	4.2E+00
Cm-245	2.3E−06	2.3E−03	2.3E+00
Cm-246	2.3E−06	2.3E−03	2.3E+00
Cm-247	2.3E−06	2.3E−03	2.3E+00
Cm-248	6.4E−07	6.4E−04	6.4E−01
Cm-249	4.6E+00	4.6E+03	4.6E+06
Cm-250	1.1E−07	1.1E−04	1.1E−01
Co-56	2.4E−04	2.4E−01	2.4E+02
Co-57	1.6E−03	1.6E+00	1.6E+03
Co-58	9.0E−04	9.0E−01	9.0E+02
Co-58m	1.7E−01	1.7E+02	1.7E+05
Co-60	1.6E−05	1.6E−02	1.6E+01
Co-60m	4.0E+00	4.0E+03	4.0E+06
Co-61	3.8E+00	3.8E+03	3.8E+06
Cr-49	9.0E−01	9.0E+02	9.0E+05
Cr-51	6.3E−02	6.3E+01	6.3E+04
Cs-129	1.5E−01	1.5E+02	1.5E+05
Cs-131	2.8E−01	2.8E+02	2.8E+05
Cs-132	1.3E−02	1.3E+01	1.3E+04
Cs-134	5.2E−05	5.2E−02	5.2E+01
Cs-134m	3.2E−01	3.2E+02	3.2E+05
Cs-135	2.4E−02	2.4E+01	2.4E+04
Cs-136	2.1E−03	2.1E+00	2.1E+03
Cs-137	2.3E−05	2.3E−02	2.3E+01
Cs-138	4.4E−01	4.4E+02	4.4E+05
Cu-61	4.0E−01	4.0E+02	4.0E+05
Cu-64	5.2E−01	5.2E+02	5.2E+05
Cu-67	1.5E−01	1.5E+02	1.5E+05
Dy-157	4.4E−01	4.4E+02	4.4E+05
Dy-165	5.6E+00	5.6E+03	5.6E+06
Dy-166	8.1E−02	8.1E+01	8.1E+04
Er-169	4.0E−01	4.0E+02	4.0E+05
Er-171	3.6E−01	3.6E+02	3.6E+05
Es-253	2.6E−04	2.6E−01	2.6E+02
Es-254	2.3E−05	2.3E−02	2.3E+01
Es-254m	1.8E−03	1.8E+00	1.8E+03
Eu-152	1.6E−05	1.6E−02	1.6E+01
Eu-152m	3.5E−01	3.5E+02	3.5E+05
Eu-154	2.0E−05	2.0E−02	2.0E+01
Eu-155	5.2E−04	5.2E−01	5.2E+02
Eu-156	3.2E−03	3.2E+00	3.2E+03
F-18	5.6E−01	5.6E+02	5.6E+05
Fe-52	4.9E−02	4.9E+01	4.9E+04
Fe-55	1.4E−01	1.4E+02	1.4E+05
Fe-59	1.3E−03	1.3E+00	1.3E+03
Fm-254	1.8E−02	1.8E+01	1.8E+04
Fm-255	4.0E−03	4.0E+00	4.0E+03
Fr-223	1.4E−01	1.4E+02	1.4E+05
Ga-66	5.6E−02	5.6E+01	5.6E+04
Ga-67	1.1E−01	1.1E+02	1.1E+05
Ga-68	7.6E−01	7.6E+02	7.6E+05
Ga-72	3.6E−02	3.6E+01	3.6E+04
Gd-152	4.4E−06	4.4E−03	4.4E+00
Gd-153	2.0E−03	2.0E+00	2.0E+03
Gd-159	6.8E−01	6.8E+02	6.8E+05
Ge-68	2.3E−04	2.3E−01	2.3E+02
Ge-71	2.6E+00	2.6E+03	2.6E+06
Ge-77	1.0E−01	1.0E+02	1.0E+05
H-3	1.5E+01	1.5E+04	1.5E+07
Hf-181	2.5E−03	2.5E+00	2.5E+03
Hg-193m	9.5E−02	9.5E+01	9.5E+04
Hg-197	2.4E−01	2.4E+02	2.4E+05
Hg-197m	2.5E−01	2.5E+02	2.5E+05
Hg-203	5.2E−03	5.2E+00	5.2E+03
Ho-166	2.8E−01	2.8E+02	2.8E+05
Ho-166m	6.0E−06	6.0E−03	6.0E+00
I-123	4.9E−01	4.9E+02	4.9E+05
I-124	9.3E−03	9.3E+00	9.3E+03
I-125	6.2E−03	6.2E+00	6.2E+03

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE—Continued

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
I-126	3.7E−03	3.7E+00	3.7E+03
I-128	9.3E+00	9.3E+03	9.3E+06
I-129	2.6E−04	2.6E−01	2.6E+02
I-130	4.6E−02	4.6E+01	4.6E+04
I-131	6.7E−03	6.7E+00	6.7E+03
I-132	2.0E−01	2.0E+02	2.0E+05
I-133	6.7E−02	6.7E+01	6.7E+04
I-134	3.2E−01	3.2E+02	3.2E+05
I-135	1.2E−01	1.2E+02	1.2E+05
In-111	4.9E−02	4.9E+01	4.9E+04
In-113m	2.1E+00	2.1E+03	2.1E+06
In-114m	4.9E−03	4.9E+00	4.9E+03
In-115	2.7E−04	2.7E−01	2.7E+02
In-115m	1.4E+00	1.4E+03	1.4E+06
In-116m	3.5E−01	3.5E+02	3.5E+05
In-117	1.3E+00	1.3E+03	1.3E+06
In-117m	7.6E−02	7.6E+01	7.6E+04
Ir-190	3.5E−03	3.5E+00	3.5E+03
Ir-192	9.7E−04	9.7E−01	9.7E+02
Ir-194	2.5E−01	2.5E+02	2.5E+05
Ir-194m	1.5E−04	1.5E−01	1.5E+02
K-40	6.8E−05	6.8E−02	6.8E+01
K-42	2.9E−01	2.9E+02	2.9E+05
K-43	6.0E−02	6.0E+01	6.0E+04
K-44	4.9E−01	4.9E+02	4.9E+05
Kr-79	7.0E+00		
Kr-81	1.8E+02		
Kr-83m	2.0E+04		
Kr-85	8.4E+02		
Kr-85m	1.1E+01		
Kr-87	2.0E+00		
Kr-88	4.2E−01		
La-140	1.6E−02	1.6E+01	1.6E+04
La-141	1.1E+00	1.1E+03	1.1E+06
La-142	2.3E−01	2.3E+02	2.3E+05
Lu-177	1.4E−01	1.4E+02	1.4E+05
Lu-177m	3.5E−04	3.5E−01	3.5E+02
Mg-28	2.1E−02	2.1E+01	2.1E+04
Mn-52	3.5E−03	3.5E+00	3.5E+03
Mn-52m	5.2E−01	5.2E+02	5.2E+05
Mn-53	5.7E−02	5.7E+01	5.7E+04
Mn-54	2.5E−04	2.5E−01	2.5E+02
Mn-56	2.5E−01	2.5E+02	2.5E+05
Mo-93	1.5E−03	1.5E+00	1.5E+03
Mo-99**	5.7E−02	5.7E+01	5.7E+04
Mo-101	8.4E−01	8.4E+02	8.4E+05
Na-22	3.2E−05	3.2E−02	3.2E+01
Na-24	2.6E−02	2.6E+01	2.6E+04
Nb-90	2.5E−02	2.5E+01	2.5E+04
Nb-93m	1.2E−02	1.2E+01	1.2E+04
Nb-94	6.0E−06	6.0E−03	6.0E+00
Nb-95	2.3E−03	2.3E+00	2.3E+03
Nb-95m	2.0E−02	2.0E+01	2.0E+04
Nb-96	2.5E−02	2.5E+01	2.5E+04
Nb-97	1.0E+00	1.0E+03	1.0E+06
Nd-147	3.0E−02	3.0E+01	3.0E+04
Nd-149	1.1E+00	1.1E+03	1.1E+06
Ni-56	2.0E−03	2.0E+00	2.0E+03
Ni-57	2.1E−02	2.1E+01	2.1E+04
Ni-59	2.2E−02	2.2E+01	2.2E+04
Ni-63	1.4E−01	1.4E+02	1.4E+05
Ni-65	7.0E−01	7.0E+02	7.0E+05
Np-235	3.0E−02	3.0E+01	3.0E+04
Np-237	1.8E−06	1.8E−03	1.8E+00
Np-238	1.9E−02	1.9E+01	1.9E+04
Np-239	1.0E−01	1.0E+02	1.0E+05
Np-240	6.5E−01	6.5E+02	6.5E+05
Np-240m	4.7E+00	4.7E+03	4.7E+06
Os-185	9.2E−04	9.2E−01	9.2E+02
Os-191m	9.0E−01	9.0E+02	9.0E+05
Os-191	3.8E−02	3.8E+01	3.8E+04
Os-193	2.9E−01	2.9E+02	2.9E+05
P-32	1.7E−02	1.7E+01	1.7E+04
P-33	1.2E−01	1.2E+02	1.2E+05

TABLE 1.—ANNUAL POSSESSION QUANTITIES FOR ENVIRONMENTAL COMPLIANCE—Continued

[Annual Possession Quantities (Ci/yr)]

Radionuclide	Gaseous form*	Liquid/powder forms	Solid form*
Pa-230	6.3E−04	6.3E−01	6.3E+02
Pa-231	8.3E−07	8.3E−04	8.3E−01
Pa-233	9.3E−03	9.3E+00	9.3E+03
Pa-234	9.3E−02	9.3E+01	9.3E+04
Pb-203	8.3E−02	8.3E+01	8.3E+04
Pb-205	1.2E−02	1.2E+01	1.2E+04
Pb-209	1.1E+01	1.1E+04	1.1E+07
Pb-210	5.5E−05	5.5E−02	5.5E+01
Pb-211	1.2E−01	1.2E+02	1.2E+05
Pb-212	6.0E−03	6.0E+00	6.0E+03
Pb-214	1.2E−01	1.2E+02	1.2E+05
Pd-103	2.1E−01	2.1E+02	2.1E+05
Pd-107	8.2E−02	8.2E+01	8.2E+04
Pd-109	9.4E−01	9.4E+02	9.4E+05
Pm-143	7.6E−04	7.6E−01	7.6E+02
Pm-144	1.1E−04	1.1E−01	1.1E+02
Pm-145	5.2E−04	5.2E−01	5.2E+02
Pm-146	4.4E−05	4.4E−02	4.4E+01
Pm-147	2.6E−02	2.6E+01	2.6E+04
Pm-148	1.7E−02	1.7E+01	1.7E+04
Pm-148m	7.6E−04	7.6E−01	7.6E+02
Pm-149	2.8E−01	2.8E+02	2.8E+05
Pm-151	1.2E−01	1.2E+02	1.2E+05
Po-210	9.3E−05	9.3E−02	9.3E+01
Pr-142	2.8E−01	2.8E+02	2.8E+05
Pr-143	1.0E−01	1.0E+02	1.0E+05
Pr-144	1.5E+01	1.5E+04	1.5E+07
Pt-191	6.4E−02	6.4E+01	6.4E+04
Pt-193	2.1E−02	2.1E+01	2.1E+04
Pt-193m	4.8E−01	4.8E+02	4.8E+05
Pt-195m	1.4E−01	1.4E+02	1.4E+05
Pt-197	1.1E+00	1.1E+03	1.1E+06
Pt-197m	3.6E+00	3.6E+03	3.6E+06
Pu-236	7.0E−06	7.0E−03	7.0E+00
Pu-237	2.3E−02	2.3E+01	2.3E+04
Pu-238	2.7E−06	2.7E−03	2.7E+00
Pu-239	2.5E−06	2.5E−03	2.5E+00
Pu-240	2.5E−06	2.5E−03	2.5E+00
Pu-241	1.3E−04	1.3E−01	1.3E+02
Pu-242	2.5E−06	2.5E−03	2.5E+00
Pu-243	3.8E+00	3.8E+03	3.8E+06
Pu-244	2.4E−06	2.4E−03	2.4E+00
Pu-245	2.1E−01	2.1E+02	2.1E+05
Pu-246	4.8E−03	4.8E+00	4.8E+03
Ra-223	1.3E−04	1.3E−01	1.3E+02
Ra-224	3.2E−04	3.2E−01	3.2E+02
Ra-225	1.3E−04	1.3E−01	1.3E+02
Ra-226	5.5E−06	5.5E−03	5.5E+00
Ra-228	1.3E−05	1.3E−02	1.3E+01
Rb-81	4.2E−01	4.2E+02	4.2E+05
Rb-83	1.4E−03	1.4E+00	1.4E+03
Rb-84	2.0E−03	2.0E+00	2.0E+03
Rb-86	1.7E−02	1.7E+01	1.7E+04
Rb-87	1.0E−02	1.0E+01	1.0E+04
Rb-88	1.7E+00	1.7E+03	1.7E+06
Rb-89	6.4E−01	6.4E+02	6.4E+05
Re−184	1.8E−03	1.8E+00	1.8E+03
Re-184m	3.6E−04	3.6E−01	3.6E+02
Re-186	1.9E−01	1.9E+02	1.9E+05
Re-187	9.3E+00	9.3E+03	9.3E+06
Re-188	3.7E−01	3.7E+02	3.7E+05
Rh-103m	1.7E+02	1.7E+05	1.7E+08
Rh-105	3.4E−01	3.4E+02	3.4E+05
Ru-97	8.3E−02	8.3E+01	8.3E+04
Ru-103	3.1E−03	3.1E+00	3.1E+03
Ru-105	2.9E−01	2.9E+02	2.9E+05
Ru-106	5.9E−04	5.9E−01	5.9E+02
S-35	7.5E−02	7.5E+01	7.5E+04
Sb-117	2.0E+00	2.0E+03	2.0E+06
Sb-122	3.9E−02	3.9E+01	3.9E+04
Sb-124	6.0E−04	6.0E−01	6.0E+02
Sb-125	1.4E−04	1.4E−01	1.4E+02
Sb-126	1.8E−03	1.8E+00	1.8E+03
Sb-126m	7.6E−01	7.6E+02	7.6E+05
Sb-127	2.0E−02	2.0E+01	2.0E+04
Sb-129	1.8E−01	1.8E+02	1.8E+05
Sc-44	1.4E−01	1.4E+02	1.4E+05
Sc-46	4.0E−04	4.0E−01	4.0E+02
Sc-47	1.1E−01	1.1E+02	1.1E+05
Sc-48	1.1E−02	1.1E+01	1.1E+04
Sc-49	1.0E+01	1.0E+04	1.0E+07
Se-73	1.6E−01	1.6E+02	1.6E+05
Se-75	1.1E−03	1.1E+00	1.1E+03
Se-79	6.9E−03	6.9E+00	6.9E+03
Si-31	4.7E+00	4.7E+03	4.7E+06
Si-32	7.2E−04	7.2E−01	7.2E+02
Sm-147	1.4E−05	1.4E−02	1.4E+01
Sm-151	3.5E−02	3.5E+01	3.5E+04
Sm-153	2.4E−01	2.4E+02	2.4E+05
Sn-113	1.9E−03	1.9E+00	1.9E+03
Sn-117m	2.3E−02	2.3E+01	2.3E+04
Sn-119m	2.8E−02	2.8E+01	2.8E+04
Sn-123	1.8E−02	1.8E+01	1.8E+04
Sn-125	7.2E−03	7.2E+00	7.2E+03
Sn-126	4.7E−06	4.7E−03	4.7E+00
Sr-82	1.9E−03	1.9E+00	1.9E+03
Sr-85	1.9E−03	1.9E+00	1.9E+03
Sr-85m	1.5E+00	1.5E+03	1.5E+06
Sr-87m	1.2E+00	1.2E+03	1.2E+06
Sr-89	2.1E−02	2.1E+01	2.1E+04
Sr-90	5.2E−04	5.2E−01	5.2E+02
Sr-91	1.2E−01	1.2E+02	1.2E+05
Sr-92	2.5E−01	2.5E+02	2.5E+05
Ta-182	4.4E−04	4.4E−01	4.4E+02
Tb-157	2.2E−03	2.2E+00	2.2E+03
Tb-160	8.4E−04	8.4E−01	8.4E+02
Tc-95	9.0E−02	9.0E+01	9.0E+04
Tc-95m	1.4E−03	1.4E+00	1.4E+03
Tc-96	5.6E−03	5.6E+00	5.6E+03
Tc-96m	7.0E−01	7.0E+02	7.0E+05
Tc-97	1.5E−03	1.5E+00	1.5E+03
Tc-97m	7.2E−02	7.2E+01	7.2E+04
Tc-98	6.4E−06	6.4E−03	6.4E+00
Tc-99	9.0E−03	9.0E+00	9.0E+03
Tc-99m	1.4E+00	1.4E+03	1.4E+06
Tc-101	3.8E+00	3.8E+03	3.8E+06
Te-121	6.0E−03	6.0E+00	6.0E+03
Te-121m	5.3E−04	5.3E−01	5.3E+02
Te-123	1.2E−03	1.2E+00	1.2E+03
Te-123m	2.7E−03	2.7E+00	2.7E+03
Te-125m	1.5E−02	1.5E+01	1.5E+04
Te-127	2.9E+00	2.9E+03	2.9E+06
Te-127m	7.3E−03	7.3E+00	7.3E+03
Te-129	6.5E+00	6.5E+03	6.5E+06
Te-129m	6.1E−03	6.1E+00	6.1E+03
Te-131	9.4E−01	9.4E+02	9.4E+05
Te-131m	1.8E−02	1.8E+01	1.8E+04
Te-132	6.2E−03	6.2E+00	6.2E+03
Te-133	1.2E+00	1.2E+03	1.2E+06
Te-133m	2.9E−01	2.9E+02	2.9E+05
Te-134	4.4E−01	4.4E+02	4.4E+05
Th-226	3.0E−02	3.0E+01	3.0E+04
Th-227	6.4E−05	6.4E−02	6.4E+01
Th-228	2.9E−06	2.9E−03	2.9E+00
Th-229	4.9E−07	4.9E−04	4.9E−01
Th-230	3.2E−06	3.2E−03	3.2E+00
Th-231	8.4E−01	8.4E+02	8.4E+05
Th-232	6.0E−07	6.0E−04	6.0E−01
Th-234	2.0E−02	2.0E+01	2.0E+04
Ti-44	5.2E−06	5.2E−03	5.2E+00
Ti-45	4.0E−01	4.0E+02	4.0E+05
Tl-200	4.4E−02	4.4E+01	4.4E+04
Tl-201	1.8E−01	1.8E+02	1.8E+05
Tl-202	1.0E−02	1.0E+01	1.0E+04
Tl-204	2.5E−02	2.5E+01	2.5E+04
Tm-170	2.4E−02	2.4E+01	2.4E+04
Tm-171	5.9E−02	5.9E+01	5.9E+04
U-230	5.0E−05	5.0E−02	5.0E+01
U-231	1.4E−01	1.4E+02	1.4E+05
U-232	1.3E−06	1.3E−03	1.3E+00
U-233	7.6E−06	7.6E−03	7.6E+00
U-234	7.6E−06	7.6E−03	7.6E+00
U-235	7.0E−06	7.0E−03	7.0E+00
U-236	8.4E−06	8.4E−03	8.4E+00
U-237	4.7E−02	4.7E+01	4.7E+04
U-238	8.6E−06	8.6E−03	8.6E+00
U-239	8.3E+00	8.3E+03	8.3E+06
U-240	1.8E−01	1.8E+02	1.8E+05
V-48	1.4E−03	1.4E+00	1.4E+03
V-49	1.3E+00	1.3E+03	1.3E+06
W-181	1.1E−02	1.1E+01	1.1E+04
W-185	1.6E−01	1.6E+02	1.6E+05
W-187	1.1E−01	1.1E+02	1.1E+05
W-188	1.0E−02	1.0E+01	1.0E+04
Xe-122	7.6E−02	7.6E+01	7.6E+04
Xe-123	1.6E+00	1.6E+03	1.6E+06
Xe-125	6.0E−01		
Xe-127	7.0E+00		
Xe-129m	7.6E+01		
Xe-131m	2.2E+02		
Xe-133	5.2E+01		
Xe-133m	6.0E+01		
Xe-135	7.6E+00		
Xe-135m	4.2E+00		
Xe-138	9.9E−01		
Y-86	2.8E−02	2.8E+01	2.8E+04
Y-87	2.3E−02	2.3E+01	2.3E+04
Y-88	2.5E−04	2.5E−01	2.5E+02
Y-90	1.1E−01	1.1E+02	1.1E+05
Y-90m	4.3E−01	4.3E+02	4.3E+05
Y-91	1.8E−02	1.8E+01	1.8E+04
Y-91m	1.6E+00	1.6E+03	1.6E+06
Y-92	7.0E−01	7.0E+02	7.0E+05
Y-93	3.8E−01	3.8E+02	3.8E+05
Yb-169	5.5E−03	5.5E+00	5.5E+03
Yb-175	2.1E−01	2.1E+02	2.1E+05
Zn-62	8.6E−02	8.6E+01	8.6E+04
Zn-65	4.4E−04	4.4E−01	4.4E+02
Zn-69	2.7E+01	2.7E+04	2.7E+07
Zn-69m	2.0E−01	2.0E+02	2.0E+05
Zr-86	2.4E−02	2.4E+01	2.4E+04
Zr-88	2.7E−04	2.7E−01	2.7E+02
Zr-89	1.6E−02	1.6E+01	1.6E+04
Zr-93	2.8E−03	2.8E+00	2.8E+03
Zr-95	6.4E−04	6.4E−01	6.4E+02
Zr-97	4.6E−02	4.6E+01	4.6E+04

*Radionuclides boiling at 100 °C or less, or exposed to a temperature of 100 °C, must be considered a gas. Capsules containing radionuclides in liquid or powder form can be considered to be solids.

**Mo-99 contained in a generator to produce Technetium-99 can be assumed to be a solid.

3. Table of Concentration Levels

(a) Table 2 may be used for determining if facilities are in compliance with the standard.

1. The concentration table as applied to emission estimates can only be used if all releases are from point sources and concentrations have been measured at the stack or vent using EPA-approved methods, and the distance between each stack or vent and the nearest resident is greater than 3 times the diameter of the stack or vent. Procedures provided in Ref. (1) shall be used to determine compliance or exemption from reporting by use of Table 2.

2. The concentration table may be used to determine compliance with the standard based on environmental measurements provided these measurements are made in conformance with the requirements of § 61.107(b)(5).

4. NCRP Screening Model

The procedures described in Reference (4) may be used to determine doses to members of the general public from emissions of radionuclides to the atmosphere. Both the total dose from all radionuclides emitted, and the dose caused by radioactive iodine must be considered in accordance with the procedures in Ref. (1).

5. The COMPLY Computer Code

The COMPLY computer code may be used to determine compliance with subpart I. The compliance model in the COMPLY computer code may be used to determine the dose to members of the general public from emissions of radionuclides to the atmosphere. The EPA may add radionuclides to all or any part of COMPLY to cover radionuclides that may be used by the regulated community.

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Ac-225	9.1E−14	Bi-207	1.0E−14
Ac-227	1.6E−16	Bi-210	2.9E−13
Ac-228	3.7E−12	Bi-212	5.6E−11
Ag-106	1.9E−09	Bi-213	7.1E−11
Ag-106m	1.2E−12	Bi-214	1.4E−10
Ag-108m	7.1E−15	Bk-249	5.6E−13
Ag-110m	9.1E−14	Bk-250	9.1E−11
Ag-111	2.5E−12	Br-77	4.2E−11
Al-26	4.8E−15	Br-80	1.4E−08
Am-241	1.9E−15	Br-80m	1.8E−09
Am-242	1.5E−11	Br-82	1.2E−11
Am-242m	2.0E−15	Br-83	1.2E−08
Am-243	1.8E−15	Br-84	6.7E−10
Am-244	4.0E−11	C-11	1.5E−09
Am-245	8.3E−09	C-14	1.0E−11
Am-246	1.2E−09	Ca-41	4.2E−13
Ar-37	1.6E−03	Ca-45	1.3E−12
Ar-41	1.7E−09	Ca-47	2.4E−12
As-72	2.4E−11	Cd-109	5.9E−13
As-73	1.1E−11	Cd-113	9.1E−15
As-74	2.2E−12	Cd-113m	1.7E−14
As-76	5.0E−11	Cd-115	1.6E−11
As-77	1.6E−10	Cd-115m	8.3E−13
At-211	1.1E−11	Cd-117	6.7E−11
Au-193	3.8E−10	Cd-117m	1.6E−10
Au-194	3.2E−11	Ce-139	2.6E−12
Au-195	3.1E−12	Ce-141	6.3E−12
Au-198	2.1E−11	Ce-143	3.0E−11
Au-199	4.8E−11	Ce-144	6.2E−13
Ba-131	7.1E−12	Cf-248	1.8E−14
Ba-133	5.9E−14	Cf-249	1.4E−15
Ba-133m	5.9E−11	Cf-250	3.2E−15
Ba-135m	1.8E−10	Cf-251	1.4E−15
Ba-139	5.6E−09	Cf-252	5.6E−15
Ba-140	1.3E−12	Cf-253	3.1E−13
Ba-141	1.4E−09	Cf-254	3.0E−15

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Ba-142	1.3E−09	Cl-36	2.7E−15
Be-7	2.3E−11	Cl-38	7.7E−10
Be-10	1.6E−12	Cm-242	5.3E−14
Bi-206	2.3E−12	Cm-243	2.6E−15
Cm-244	3.3E−15	Eu-156	1.9E−12
Cm-245	1.8E−15	F-18	6.7E−10
Cm-246	1.9E−15	Fe-52	5.6E−11
Cm-247	1.9E−15	Fe-55	9.1E−12
Cm-248	5.0E−16	Fe-59	6.7E−13
Cm-249	3.7E−09	Fm-254	2.0E−11
Cm-250	9.1E−17	Fm-255	4.3E−12
Co-56	1.8E−13	Fr-223	3.3E−11
Co-57	1.3E−12	Ga-66	6.2E−11
Co-58	6.7E−13	Ga-67	7.1E−11
Co-58m	1.2E−10	Ga-68	9.1E−10
Co-60	1.7E−14	Ga-72	3.8E−11
Co-60m	4.3E−09	Gd-152	5.0E−15
Co-61	4.5E−09	Gd-153	2.1E−12
Cr-49	1.1E−09	Gd-159	2.9E−10
Cr-51	3.1E−11	Ge-68	2.0E−13
Cs-129	1.4E−10	Ge-71	2.4E−10
Cs-131	3.3E−11	Ge-77	1.0E−10
Cs-132	4.8E−12	H-3	1.5E−09
Cs-134	2.7E−14	Hf-181	1.9E−12
Cs-134m	1.7E−10	Hg-193m	1.0E−10
Cs-135	4.0E−13	Hg-197	8.3E−11
Cs-136	5.3E−13	Hg-197m	1.1E−10
Cs-137	1.9E−14	Hg-203	1.0E−12
Cs-138	5.3E−10	Ho-166	7.1E−11
Cu-61	4.8E−10	Ho-166m	7.1E−15
Cu-64	5.3E−10	I-123	4.3E−10
Cu-67	5.0E−11	I-124	6.2E−13
Dy-157	5.0E−10	I-125	1.2E−13
Dy-165	6.7E−09	I-126	1.1E−13
Dy-166	1.1E−11	I-128	1.1E−08
Er-169	2.9E−11	I-129	9.1E−15
Er-171	4.0E−10	I-130	4.5E−11
Es-253	2.4E−13	I-131	2.1E−13
Es-254	2.0E−14	I-132	2.3E−10
Es-254m	1.8E−12	I-133	2.0E−11
Eu-152	2.0E−14	I-134	3.8E−10
Eu-152m	3.6E−10	I-135	1.2E−10
Eu-154	2.3E−14	In-111	3.6E−11
Eu-155	5.9E−13	In-113m	2.5E−09
In-114m	9.1E−13	Nb-95	2.2E−12
In-115	7.1E−14	Nb-95m	1.4E−11
In-115m	1.6E−09	Nb-96	2.4E−11
In-116m	4.2E−10	Nb-97	1.2E−09
In-117	1.6E−09	Nd-147	7.7E−12
In-117m	9.1E−11	Nd-149	7.1E−10
Ir-190	2.6E−12	Ni-56	1.7E−12
Ir-192	9.1E−13	Ni-57	1.8E−11
Ir-194	1.1E−10	Ni-59	1.5E−11
Ir-194m	1.7E−13	Ni-63	1.4E−11
K-40	2.7E−14	Ni-65	8.3E−10
K-42	2.6E−10	Np-235	2.5E−11
K-43	6.2E−11	Np-237	1.2E−15
K-44	5.9E−10	Np-238	1.4E−11
Kr-79	6.3E−09	Np-239	3.8E−11
Kr-81	2.1E−07	Np-240	7.7E−10
Kr-83m	2.3E−05	Np-240m	5.6E−09
Kr-85	1.0E−06	Os-185	1.0E−12
Kr-85m	1.3E−08	Os-191m	2.9E−10

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Kr-87	2.4E−09	Os-191	1.1E−11
Kr-88	5.0E−10	Os-193	9.1E−11
La-140	1.2E−11	P-32	3.3E−13
La-141	7.7E−10	P-33	2.4E−12
La-142	2.7E−10	Pa-230	3.2E−13
Lu-177	2.4E−11	Pa-231	5.9E−16
Lu-177m	3.6E−13	Pa-233	4.8E−12
Mg-28	1.5E−11	Pa-234	1.1E−10
Mn-52	2.8E−12	Pb-203	6.2E−11
Mn-52m	6.2E−10	Pb-205	5.6E−12
Mn-53	1.5E−11	Pb-209	1.3E−08
Mn-54	2.8E−13	Pb-210	2.8E−15
Mn-56	2.9E−10	Pb-211	1.4E−10
Mo-93	1.1E−12	Pb-212	6.3E−12
Mo-99	1.4E−11	Pb-214	1.2E−10
Mo-101	1.0E−09	Pd-103	3.8E−11
Na-22	2.6E−14	Pd-107	3.1E−11
Na-24	2.6E−11	Pd-109	4.8E−10
Nb-90	2.6E−11	Pm-143	9.1E−13
Nb-93m	1.0E−11	Pm-144	1.3E−13
Nb-94	7.1E−15	Pm-145	6.2E−13
Pm-146	5.3E−14	Re-184m	3.7E−13
Pm-147	1.1E−11	Re-186	1.8E−11
Pm-148	5.0E−12	Re-187	2.6E−10
Pm-148m	6.7E−13	Re-188	1.7E−10
Pm-149	4.2E−11	Rh-103m	2.1E−07
Pm-151	7.1E−11	Rh-105	1.3E−10
Po-210	7.1E−15	Ru-97	6.7E−11
Pr-142	1.1E−10	Ru-103	2.6E−12
Pr-143	7.1E−12	Ru-105	2.8E−10
Pr-144	1.8E−08	Ru-106	3.4E−13
Pt-191	4.3E−11	S-35	1.3E−12
Pt-193	1.8E−11	Sb-117	2.4E−09
Pt-193m	4.8E−11	Sb-122	1.4E−11
Pt-195m	3.2E−11	Sb-124	5.3E−13
Pt-197	4.0E−10	Sb-125	1.6E−13
Pt-197m	2.6E−09	Sb-126	1.4E−12
Pu-236	5.9E−15	Sb-126m	9.1E−10
Pu-237	1.9E−11	Sb-127	7.1E−12
Pu-238	2.1E−15	Sb-129	7.7E−11
Pu-239	2.0E−15	Sc-44	1.7E−10
Pu-240	2.0E−15	Sc-46	4.2E−13
Pu-241	1.0E−13	Sc-47	3.8E−11
Pu-242	2.0E−15	Sc-48	9.1E−12
Pu-243	4.2E−09	Sc-49	1.2E−08
Pu-244	2.0E−15	Se-73	1.7E−10
Pu-245	2.1E−10	Se-75	1.7E−13
Pu-248	2.2E−12	Se-79	1.1E−13
Ra-223	4.2E−14	Si-31	5.6E−09
Ra-224	1.5E−13	Si-32	3.4E−14
Ra-225	5.0E−14	Sm-147	1.4E−14
Ra-226	3.3E−15	Sm-151	2.1E−11
Ra-228	5.9E−15	Sm-153	5.9E−11
Rb-81	5.0E−10	Sn-113	1.4E−12
Rb-83	3.4E−13	Sn-117m	5.6E−12
Rb-84	3.6E−13	Sn-119m	5.3E−12
Rb-86	5.6E−13	Sn-123	1.1E−12
Rb-87	1.6E−13	Sn-125	1.7E−12
Rb-88	2.1E−09	Sn-126	5.3E−15
Rb-89	7.1E−10	Sr-82	6.2E−13
Re-184	1.5E−12	Sr-85	1.8E−12
Sr-85m	1.6E−09	Th-232	6.2E−16
Sr-87m	1.4E−09	Th-234	2.2E−12
Sr-89	1.8E−12	Ti-44	6.2E−15

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Sr-90	1.9E−14	Ti-45	4.8E−10
Sr-91	9.1E−11	Tl-200	4.5E−11
Sr-92	2.9E−10	Tl-201	1.0E−10
Ta-182	4.5E−13	Tl-202	5.0E−12
Tb-157	2.5E−12	Tl-204	1.2E−12
Tb-160	7.7E−13	Tm-170	3.3E−12
Tc-95	1.0E−10	Tm-171	2.6E−11
Tc-95m	1.4E−12	U-230	1.5E−14
Tc-96	5.6E−12	U-231	4.2E−11
Tc-96m	6.7E−10	U-232	1.3E−15
Tc-97	7.1E−13	U-233	7.1E−15
Tc-97m	7.1E−12	U-234	7.7E−15
Tc-98	6.7E−15	U-235	7.1E−15
Tc-99	1.4E−13	U-236	7.7E−15
Tc-99m	1.7E−09	U-237	1.0E−11
Tc-101	4.5E−09	U-238	6.3E−15
Te-121	1.0E−12	U-239	4.3E−09
Te-121m	1.2E−13	U-240	1.3E−10
Te-123	1.4E−13	V-48	1.0E−12
Te-123m	2.0E−13	V-49	1.6E−10
Te-125m	3.6E−13	W-181	6.7E−12
Te-127	1.0E−09	W-185	2.6E−12
Te-127m	1.5E−13	W-187	7.7E−11
Te-129	7.7E−09	W-188	5.3E−13
Te-129m	1.4E−13	Xe-122	9.1E−11

TABLE 2.—CONCENTRATION LEVELS FOR ENVIRONMENTAL COMPLIANCE—Continued

Radionuclide	Concentration (Ci/m³)	Radionuclide	Concentration (Ci/m³)
Te-131	9.1E−11	Xe-123	1.6E−09
Te-131m	1.0E−12	Xe-125	1.1E−11
Te-132	7.1E−13	Xe-127	8.3E−09
Te-133	9.1E−10	Xe-129m	9.1E−08
Te-133m	2.2E−10	Xe-131m	2.6E−07
Te-134	5.3E−10	Xe-133	6.2E−08
Th-226	3.4E−11	Xe-133m	7.1E−08
Th-227	3.8E−14	Xe-135	9.1E−09
Th-228	3.1E−15	Xe-135m	5.0E−09
Th-229	5.3E−16	Xe-138	1.2E−09
Th-230	3.4E−15	Y-86	3.0E−11
Th-231	2.9E−10	Y-87	1.7E−11
Y-88	2.7E−13	Zn-65	9.1E−14
Y-90	1.3E−11	Zn-69	3.2E−08
Y-90m	1.9E−10	Zn-69m	1.7E−10
Y-91	2.1E−12	Zr-86	2.4E−11
Y-91m	1.3E−09	Zr-88	3.1E−13
Y-92	8.3E−10	Zr-89	1.3E−11
Y-93	2.9E−10	Zr-93	2.6E−12
Yb-169	3.7E−12	Zr-95	6.7E−13
Yb-175	4.3E−11	Zr-97	3.8E−11
Zn-62	9.1E−11		

6. References

(1) Environmental Protection Agency, "A Guide for Determining Compliance with the Clean Air Act Standards for Radionuclides Emissions from NRC-Licensed and Non-DOE Federal Facilities", EPA 520/1–89–002, October 1989.

(2) Environmental Protection Agency, "User's Guide for the COMPLY Code", EPA 520/1–89–003, October 1989.

(3) Environmental Protection Agency, "Background Information Document: Procedures Approved for Demonstrating Compliance with 40 CFR part 61, subpart I", EPA 520/1–89–001, January 1989.

(4) National Council on Radiation Protection and Measurement, "Screening Techniques for Determining Compliance with Environmental Standards" NCRP Commentary No. 3, Revision of January 1989 with addendum of October, 1989.

[FR Doc. 89–26330 Filed 12–11–89; 11:12 am]

BILLING CODE 6560–50–M

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:40 PM
To: Thornton, Marisa
Subject: FW: Additional Reference
Attachments: SubpartWHist&Basis-final.pdf

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 2:09 PM
To: Thornton, Marisa
Subject: Additional Reference

Dear Marisa:

Here is one more reference for that page. It already appears on the webpage as follows--

SC&A (S. Cohen and Associates) 2011. "Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings, Task 4 – Detailed Risk Estimates,"
Contract Number EP-D-10-042, Work Assignment No. 1-04, Task 4, SC&A, Inc., Vienna, Virginia, March 25, 2011.

Metadata:

Title: "Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings, Task 4 – Detailed Risk Estimates
Author: USEPA/OAR/Office of Air and Radiation
Subject: Detailed Risk Estimates for Subpart W Revision
Keywords: "NESHAP", "Subpart W", "Risk Assessment" "Risk Estimates"

Tony Nesky
Center for Radiation Information and Outreach
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From: Thornton, Marisa
Sent: Tuesday, July 08, 2014 2:02 PM
To: Nesky, Anthony
Subject: RE: References 2.0 - Readable!!??

I'm basically done but I'm in a mtg until 3:30pm. Just send the corrections.

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 2:00 PM
To: Thornton, Marisa
Subject: RE: References 2.0 - Readable!!??

Please keep working on it, and I'll check the whole web page.

Tony Nesky
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From: Thornton, Marisa
Sent: Tuesday, July 08, 2014 1:58 PM
To: Nesky, Anthony
Subject: RE: References 2.0 - Readable!!??

I didn't check the other files. This one just stood out.

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 1:57 PM
To: Thornton, Marisa
Subject: RE: References 2.0 - Readable!!??

No, we'll need to rescan it.

Tony Nesky
Center for Radiation Information and Outreach
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From: Thornton, Marisa
Sent: Tuesday, July 08, 2014 1:28 PM
To: Nesky, Anthony
Subject: RE: References 2.0 - Readable!!??

Should this file be only 1 page? Which is the cover page? What's the correct number for this file FR153865 or FR15385?

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**
- Metadata:
- Title: Work practice standard for Underground Uranium Mines
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: "FR**153865**" "EPA" "work practice standards" "underground uranium mines"

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 12:24 PM
To: Thornton, Marisa
Subject: FW: References 2.0 - Readable!!??

OK, let's try this again--

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

Metadata:

Title: EPA established environmental protection standards

Author: EPA/OAR/Office of Radiation and Indoor Air

Subject: environmental protection standards for nuclear power operations;

Keywords: “FR2858” “EPA” “environmental protection standards,” “Atomic Energy Act”

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
    - **FR43906.PDF**
- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn”
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR43906” “EPA” “NESHAPS” “Phosphorous Plants”

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
    - **FR7280.PDF**
- Metadata:
- Title: Final Standards for Elemental Phosphorous Plants DOE-Facilities, and NRC-Licensed Facilities”
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR7280” “EPA” “standards” “Phosphorous Plants” “DOE-Facilities” “NRC-Licensed Facilities”

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**
- Metadata:
- Title: Work practice standard for Underground Uranium Mines
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: “FR**153865**” “EPA” “work practice standards” “underground uranium mines”

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
    - **FR34056.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radon-222 Emissions from Licensed Uranium Mill Tailings"
- Keywords: "FR**34056**" "EPA" "NESHAP " "Radon-222" "Uranium" " Tailings"

- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
    - **FR9612.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule
  Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Proposed NESHAP for Radionuclides
- Keywords: "FR**9612**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
    - **FR51654.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of RadionuclidesAuthor:
- EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radionuclides
- Keywords: "**FR51654**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.
    - **FR36280.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Final NESHAP for Radionuclides
- Keywords: "**FR36280.**" "EPA" "NESHAP " "radionuclides" "final "rule"

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From: Rosnick, Andrew
Sent: Tuesday, July 08, 2014 12:14 PM
To: Nesky, Anthony
Subject: References 2.0 - Readable!!??

These should work but let me know if there is something wrong!!!

Andrew

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
    - **FR43906.PDF**

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
    - **FR7280.PDF**

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
    - **FR34056.PDF**

- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
    - **FR9612.PDF**

- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
    - **FR51654.PDF**

- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.
    - **FR36280.PDF**

Final Report

History and Basis of NESHAPs and Subpart W

Prepared by

S. Cohen & Associates
1608 Spring Hill Road, Suite 400
Vienna, VA 22182

Under

Contract Number EP-D-05-002
Work Assignment No. 4-11, Task 4

Prepared for

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Reid J. Rosnick
Work Assignment Manager

September 25, 2008

In accordance with the *Quality Assurance Project Plan: Technical and Regulatory Support to Develop a Rulemaking to Modify the NESHAP Subpart W Standard for Radon Emissions from Operating Uranium Mills (40 CFR 61.25)*, this document has been reviewed and approved by the following individuals:

Work Assignment Task Manager:	Harry Pettengill *Harry Pettengill*	Date: 09/25/2008
Project Manager:	Abe Zeitoun *Abe Zeitoun*	Date: 09/25/2008
Corporate Quality Assurance Mgr:	Gregory Beronja *Gregory Beronja*	Date: 09/25/2008
Work Assignment QA Manager:	Stephen L. Ostrow *Stephen Ostrow*	Date: 09/25/2008

TABLE OF CONTENTS

1.0 INTRODUCTION

On December 15, 1989, the Environmental Protection Agency's (EPA) Office of Radiation and Indoor Air (ORIA) promulgated a National Emission Standard for Hazardous Air Pollutant (NESHAP) for radon emissions from operating uranium mill tailings (Subpart W). Section 112(q) of the Clean Air Act (CAA), as amended, requires the EPA to review, and if appropriate, revise or update the Subpart W standard on a timely basis (10-year interval). To date, EPA has not revisited this standard since its promulgation and now desires to do so. The purpose of this work assignment is to provide essential technical and regulatory support necessary for EPA to review the technical basis on which the standard was based and the decision-making process that was used to determine the requirements of the standard. Furthermore, this effort will assist the EPA in determining the appropriateness of the standard for this type of pollutant, and to decide if modification of Subpart W is warranted.

The facilities covered by Subpart W are uranium mills licensed and regulated by the U.S. Nuclear Regulatory Commission (NRC) or its Agreement States. There are two separate standards outlined in Subpart W. The first states that existing sources must ensure emissions from tailings impoundments not exceed 20 pCi/m^2-sec of radon-222 (Rn-222). The second prescribes a work practice specifying one of two types of impoundment structures that new sources must construct to handle tailings during operations. The work practice also applies to operations at existing sources once their existing impoundments can no longer accept additional tailings. As part of these two standards, Subpart W also requires that existing sources file an annual report of the facility's emissions.

The standard as promulgated was a health-based standard. It is important to review how the initial standard was developed and to ascertain if it is still valid. Furthermore, it needs to be determined if the standard requires revision to satisfy the requirements in CAA Section 112(d), which requires a technology-based standard. It is also important to determine if this type of standard is appropriate for this type of pollutant.

The reports collected for this review include the original risk assessment material used by EPA to develop the Subpart W standard, including the final rulemaking package for Subpart W (FR 1989), the background information document (BID) for the Subpart W rulemaking (EPA 1989, Volumes 1 and 2), and the economic impact analysis for the Subpart W rulemaking (EPA 1989, Volume 3). This regulatory information was evaluated and compared and contrasted to current risk assessment modeling methodologies. The purpose of this report is to illuminate the differences, if any, and detail what impact this information would have on the original radon risk standard as provided in Subpart W.

2.0 BACKGROUND ON THE DEVELOPMENT OF RADIONUCLIDE NESHAPS

In the following subsections, we present a brief history of the development of environmental radiation protection standards by the EPA, with particular emphasis on the development of radionuclide NESHAPs.

2.1 The 1977 Amendments to the Clean Air Act

On January 13, 1977, the EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA) (FR 1977). The standards, Title 40, Part 190, of the *Code of Federal Regulations* (40 CFR 190), which covered all licensed facilities that are part of the uranium fuel cycle, established an annual limit of exposure and the requirement that licensees keep all exposures "as low as reasonably achievable" (ALARA). Because of the uncertainties associated with the risk of inhaled radon, the standards exempted Rn-222 from the annual limit.

After the promulgation of 40 CFR 190, the 1977 amendments to the Clean Air Act (CAA) were passed. These amendments included the requirement that the Administrator of the EPA determine whether or not radionuclides should be regulated under the Act.

In December of 1979, the Agency published its determination in the *Federal Register* (FR 1979) that radionuclides constitute a hazardous air pollutant within the meaning of Section 112(a)(1). As was stated in the *Federal Register*, radionuclides are known to cause cancer and genetic defects, and contribute to air pollution that may be anticipated to result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness. The Agency further determined that the risks posed by emissions of radionuclides into the ambient air warranted regulation, and listed radionuclides as a hazardous air pollutant under Section 112.

Section 112(b)(1)(B) requires the Administrator to establish NESHAPs as a "level which (in the judgment of the Administrator) provides an ample margin of safety to protect the public health" or find that they are not hazardous and delist them.

2.2 Regulatory Activities between 1979 and 1987

To support the development of radionuclide NESHAPs, the Agency developed a BID to characterize "source categories" of facilities that emit radionuclides into ambient air (EPA 1979). For each source category, information needed to characterize the exposure of the public was developed. This included characterization of the facilities included in the source category (numbers, locations, proximity of nearby individuals); radionuclide source terms [curie/year (Ci/y)] release rates by radionuclide, solubility class, and particle size); release point data (stack height, volumetric flow, area size); and effluent controls (type, efficiency). Doses to nearby individuals and regional populations caused by releases from either actual of model facilities were estimated using the computer codes AIRDOSE-EPA and DARTAB.

In 1983, the EPA proposed radionuclide NESHAPs for four source categories based on the results reported in a new BID (EPA 1983). The four source categories for which NESHAPs were proposed were Department of Energy (DOE) and Non-NRC-Licensed Federal Facilities, NRC-Licensed Facilities, Elemental Phosphorus Plants, and Underground Uranium Mines. For all of the other source categories that it had considered in its BID (i.e., coal-fired boilers, the phosphate industry, other extraction industries, uranium fuel-cycle facilities, uranium mill tailings, high-level waste disposal, and low-energy accelerators), the Agency found that NESHAPs were not necessary. In reaching this conclusion, the EPA found that (1) the levels of radionuclide emissions did not cause a significant dose to nearby individuals or the regional populations,

(2) the costs of additional effluent controls were not cost effective, or (3) existing regulations under other authorities were sufficient to keep emissions at an acceptable level.

During the public comment period on the proposed NESHAPs, the Agency completed its rulemaking efforts under the Uranium Mill Tailings Remedial Control Act (UMTRCA) to establish standards (40 CFR 192) for the disposal of uranium mill tailings. With respect to the emission of Rn-222, the UMTRCA standards established a design standard calling for a Rn-222 flux rate of no more than 20 pCi/m^2-sec.

In February of 1984, the Sierra Club sued the EPA in the U.S. District Court for Northern California (Sierra Club v. Ruckelshaus, No. 84-0656) (EPA 1989), demanding that the Agency promulgate final NESHAPs or delist radionuclides as a hazardous air pollutant. The court sided with the Sierra Club and ordered the EPA to promulgate final regulations. In October of 1984, the EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, finding that existing control practices protected the public health with an ample margin of safety (FR 1984). The EPA also withdrew the NESHAP for Underground Uranium Mines, but stated its intention to promulgate a different standard, and published an Advance Notice of Proposed Rulemaking (ANPR) to solicit additional information on control methods. It also published an ANPR for licensed uranium mills. Finally, the *Federal Register* notice affirmed the decision not to regulate the other source categories identified in the proposed rule, with the exception that it was doing further studies of phosphogypsum stacks to see if a standard was needed.

In December of 1984, the District Court for Northern California found the EPA's action withdrawing the NESHAPs to be in contempt of its order. Given the ruling, the EPA issued the final BID (EPA 1984) and promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities in February of 1985 (FR 1985a), and a work practice standard for Underground Uranium Mines in April (FR 1985b).

The Environmental Defense Fund (EDF), the Natural Resources Defense Council (NRDC), and the Sierra Club (SC) filed court petitions seeking review of the October 1984 final decision not to regulate the source categories identified above, the February 1985 NESHAPs, and the April 1985 NESHAP. The American Mining Congress (AMC) also filed a petition seeking judicial review of the NESHAP for underground uranium mines.

On September 24, 1986, the Agency issued a final NESHAP for Operating Uranium Mill Tailings, establishing an emission standard of 20 pCi/m^2-sec for Rn-222 and a work practice standard requiring that new tailings be disposed of in small impoundments or by continuous disposal. The justifications for the work practices included the fact that while large impoundments did not pose an unacceptable risk during active operations, the cyclical nature of the uranium milling industry could lead to prolonged periods of plant stand-by and the risk that the tailing impoundments could experience significant drying with the resulting increase in Rn-222 emissions. Furthermore, the two acceptable work practices were believed to actually save the industry the significant costs of constructing and closing large impoundments before they were completely filled. With the promulgation of the NESHAP for Operating Uranium Mill

Tailings, releases of radionuclides to air during operations and tailings disposal at uranium mills were covered by three EPA regulations, 40 CFR 190, 40 CFR 192, and 40 CFR 61, Subpart W.

In November of 1986, the AMC and the EDF filed petitions challenging the NESHAP for operating uranium mill tailings.

2.3 Regulatory Activities between 1987 and 1989

While the petitions filed by the EDF, NRDC, SC, and AMC were still before the courts, a decision by the U.S. District Court for the District of Columbia in NRDC v. EPA (FR 1989), found that the Administrator had impermissibly considered costs and technological feasibility in promulgating the NESHAP for Vinyl Chloride. The court outlined a two-step decision process that it would find acceptable, first establishing a standard based solely on an acceptable level of risk, and then considering additional factors, such as costs to establish the "ample margin of safety." Given the Court's decision, the Agency reviewed how it had conducted all its NESHAP rulemakings and requested that the Court grant it a voluntary remand for its radionuclide NESHAPs. As part of an agreement with the Court and the NRDC, the Agency agreed to reconsider all issues that were currently being litigated, and it agreed that it would explicitly consider the need for a NESHAP for two additional source categories; radon from phosphogypsum stacks and radon from DOE facilities. The subsequent reconsideration became know as the radionuclide NESHAPs reconsideration rulemaking.

2.4 1989 Radionuclide NESHAPs Reconsideration Rulemaking

In the radionuclide NESHAPs reconsideration rulemaking, the Administrator relied on a "bright line" approach for determining whether or not a source category required a NESHAP. Namely, no NESHAP was required if all individuals exposed to the radionuclide emissions from the facilities in the source category were at a life-time cancer risk of less than 1 in 1,000,000, and less than 1 fatal cancer per year was estimated to be incurred in the population. For source categories that did not meet this "bright line" exclusion, a two-step multi-factor approach to setting the emission standards was adopted.

The first step established a presumptively acceptable emissions level corresponding to a maximum individual risk (MIR) of about 1 in 10,000 life-time cancer risk, with the vast majority of exposed individuals at a lifetime risk lower than 1 in 1,000,000, and with the total fatal cancers per year in the exposed population of less than 1. If the baseline emissions from a source category met these criteria, they were presumptively adequately safe. If they did not meet these criteria, then the Administrator was compelled by his non-discretionary duty to provide adequate safety to determine an emission limit that would correspond to risks that were adequately safe.

After baseline emissions were determined to be adequately safe, or an adequately safe alternative limit defined, the analysis moved to the second step, where reduced risks for alternative emission limits were evaluated, along with the technological feasibility and costs estimated to be associated with reaching lower levels. In the two-step approach, the Administrator retained the discretion to decide whether or not the NESHAP should be set at these lower limits.

As with previous radionuclide NESHAPs, exposures were estimated using a combination of actual site data and model or representative facilities and computer models. For all radionuclides other than Rn-222, the CAP88 computer code, which included updates to AIRDOSE-EPA and DARTAB, and the addition of RADRISK, was used to calculate total effective dose equivalent and lifetime fatal cancer risk, and the distribution of risks in the exposed populations. For Rn-222, the CAP88 computer codes were used to established ambient concentrations (pCi/m^3) in each of the sectors in a 0-80 km radius of the source. The concentration within each sector was then converted to working level months (WLMs), based on a 0.70 equilibrium fraction between Rn-222 and its decay products, and a respiration rate appropriate to members of the general public. Using risk factors derived from human epidemiological studies, the WLM exposure data were converted to risks.

Of the NESHAPs promulgated in 1989, those for Phosphogypsum Stacks (Subpart R), Radon from DOE Facilities (Subpart Q), and Operating Uranium Mills Tailings Disposal (Subpart T) are the most relevant for comparison with Subpart W, in that they all address the emission of Rn-222 from relatively large area sources. Furthermore, the basic post-disposal Rn-222 emission limit is consistent at 20 pCi/m^2-s. Regarding the operational phase, no standard was deemed to be necessary for phosphogypsum stacks, since the large ponds that cover most to the top of the stacks and are part of the plants normal operation to control Rn-222 emissions to an acceptable level. For DOE facilities, there is no operational phase, as all these site are simply storage sites for radon-emitting wastes that were generated in the past (most as part of the Manhattan Project). The NESHAP for disposal of uranium mill tailings (Subpart T) was determined to be necessary by the Administrator to assure that the tailings did not remain unreclaimed for long periods of time, as was possible under the UMTRCA standard (40 CFR 192). Additionally, the design standard of the UMTRCA regulations were enhanced by the requirement that the 20 pCi/m^2-sec Rn-222 design standard be demonstrated to have been achieved by post-disposal radon monitoring.

3.0 BASIS FOR THE SUBPART W RISK ASSESSMENT

3.1 Existing Impoundments

As noted previously, the NESHAP for operating uranium mill tailings addressed both existing and future tailings impoundments. For the existing impoundments, the radon emissions and estimated risks were developed using site-specific data for each of the 12 mills that were operating or operable at the time the assessment was made. These data included the average radium-226 (Ra-226) content of the tailings; the overall dimensions and areas of the impoundments (developed from licensing data and areal photographs); areas of dry (unsaturated) tailings; the existing populations within 5 km of the centers of the impoundments (identified by field enumeration); 5–80 km populations derived from U.S. Census tract data; meteorological data (joint frequency distributions) from nearby weather stations; mixing heights; and annual precipitation rates.

The CAP88 codes were used to estimate airborne concentrations based on the calculated Rn-222 source term for each facility. Radon-222 source terms were estimated on the assumption that a Rn-222 flux of 1 pCi/m^2 -sec results for each 1 pCi/g Ra-226 in the tailings and the areas of dried

tailings at each site. The radon flux rate of 1 pCi/m^2-sec per pCi/g Ra-226 was derived based on both theoretical radon diffusion equations and the available radon emissions measurements.

For each sector in the 0–80 km grid around each facility, the estimated Rn-222 airborne concentration was converted to cumulative WLMs assuming a 0.70 equilibrium fraction between radon and its decay products, an average respiration rate appropriate for members of the general public, and the assumption of continuous exposure over a 70-year lifetime. Using a risk coefficient of 760 fatalities/10^6 WLM, lifetime risk, fatal cancers per year, and the risk distribution were calculated for the exposed population.

The baseline risk assessment for existing uranium tailings showed MIR of 3×10^{-5}, with 0.0043 committed cancers in the 2 million persons living within 80 km of the mills. The distribution of the cancer risk showed that 240 persons were at risks between 1×10^{-5} and 1×10^{-4}, and 60,000 were at risks between 1×10^{-6} and 1×10^{-5}. The remainder of the population of about 2 million were at a risk of less than 1×10^{-6}. Based on these findings, the EPA concluded that baseline risks were acceptable.

The decision on an ample margin of safety considered all of the risk data presented above plus costs, scientific uncertainty, and the technical feasibility of control technology necessary to lower emissions from operating uranium mill tailings piles. As the risks from existing emissions were very low, the EPA determined that an emission standard of 20 pCi/m^2-sec, which represented current emissions, was all that was necessary to provide the ample margin of safety. The necessity for the standard was explained by the need to assure that mills continued the current control practice of keeping tailings wet and/or covered. Finally, in order to assure that groundwater was not adversely affected by continued operation of existing piles that were not synthetically lined or clay lined, the NESHAP ended the exemption to the requirements of 40 CFR 192.32(a), which protects water supplies from contamination.

3.2 New Impoundments

The risk assessment for new mill tailings impoundments was based on a set of model mills, defined so that the impact of alternative disposal strategies could be evaluated. For the purpose of estimating the risks, the model mills were characterized to reflect operating mills, and the dispersion modeling and population exposures were based on the arid conditions and sparse population density that characterize existing impoundments in the southwestern states.

The results of the modeling exercise indicated an MIR of 1.6×10^{-4}, a fatal cancer incidence of 0.014 per year, and only 200 persons at a risk greater than 1×10^{-4}. Given the numerous uncertainties in establishing the parameters for the risk assessment and in modeling actual emissions and exposures, the Administrator found that the baseline emissions for new tailings impoundments met the criteria for presumptively safe.

The decision on an ample margin of safety for new tailings considered two alternatives to the baseline of one large impoundment; phased disposal using a series of small impoundments and continuous disposal. The evaluation of these alternatives showed a modest reduction in the MIR and the number of fatal cancers per year, but a significant increase in the number of individuals at a lifetime risk of less than 1×10^{-6}. The costs estimated for the two alternatives showed that

phased disposal would lead to an incremental cost of $6.3 million, while continuous disposal was believed to actually result in a modest cost saving of $1 million.

Given the large uncertainties associated with the risk and economic assessments performed for the new tailing impoundments, and considering the boom and bust cycles that the uranium industry has experienced, the Administrator determined that a work practice standard was necessary to prevent the risks from increasing if an impoundment were allowed to become dry. Finally, although continuous disposal showed slightly lower over-all risks and costs than phased disposal, the Administrator recognized that it was not a proven technology for disposal of uranium mills tailings. Therefore, he determined that the work practice standard should allow for either phased disposal (limited to 40-acre impoundments, with a maximum of 2 impoundments open at any one time) or continuous disposal.

4.0 COMPARISON OF THE NESHAPS RISK ASSESSMENT WITH CURRENT RISK ASSESSMENT APPROACHES

Since it is neither feasible nor practical to directly measure the exposure of individuals in the 0–80-km area surrounding an emission source, risk assessments rely on modeling exposures. The essential elements in assessing the risk from a source emitting Rn-222 to the ambient air are as follows:

- The source term (Ci/y)
- The dispersion of the Rn-222 from the source to the receptor
- The ingrowth and depletion of the short-lived Rn-222 decay products from the source to the receptor
- The location of the receptors within the assessment area
- The duration of the receptors' exposures
- The fatal cancer risk/unit of exposure (risk/cumulative WLM)

The following paragraphs discuss how each of these elements were derived for the risk assessments performed in support of the Subpart W rulemaking and suggest where different values might be used if the assessments were performed now.

The source terms for existing impoundments were based on radon flux rates (pCi/m^2), Ra-226 concentrations in the tailings, and the areas of unsaturated tailings exposed at each site. The radon flux rate that was used, 1 pCi/m^2 Rn-222/pCi/g Ra-226, was selected based on theoretical diffusion rates from thick sources. As diffusion rates depend on the porosity of the matrix and its moisture content, the specific rate that was selected was chosen to reflect site conditions that pertain in the southwestern part of the country where the industry is concentrated. The concentrations of Ra-226 in the tailings reflect measurement data, while the areas of unsaturated tailings were estimated based on both photographs of the impoundments and information

supplied by the industry during the public comment period. Given that the NESHAP imposed an annual requirement for the facilities to measure and report their Rn-222 emissions, it should now be possible to develop the source term for each mill based on measurement data. If this approach were to be taken, it would be necessary to know the configuration of the impoundment during each measurement period.

The dispersion of the Rn-222 from the tailings impoundments to the receptors in the assessment area were estimated using the AIRDOSE-EPA model in the CAP88 assessment code. AIRDOSE-EPA uses a Gaussian plume dispersion model to calculate air concentrations at the locations of the receptors. The model uses meteorological data (in the form of joint frequency distributions of wind speed and direction by stability class), annual precipitation rate, and lid height supplied by the user, and it accounts for removal from the plume by dry deposition and scavenging. The model allows for the source to be characterized as either a point source or an area source, and allows the user to input the effective release height. For the risk assessments, impoundments were characterized as area sources with an effective release height of 1 meter. As on-site meteorological data were not available, joint frequency data representing long-term averages were obtained from the nearest weather station. Annual precipitation rates and lid heights were site-specific.

While the EPA has developed a number of dispersion models, including some that are more sophisticated than the AIRDOSE-EPA model, the AIRDOSE-EPA model is preferred for assessments involving radionuclides. When its predicted concentrations have been benchmarked against measured values, it has demonstrated good agreement; in fact, it has often surpassed the performance of more "sophisticated" models.

The ingrowth and decay of the Rn-222 decay products is very important to estimating the risks from Rn-222 exposure. When the Rn-222 emanates from the tailings, the fraction of its short-lived decay products is zero, as they are retained in the tailings matrix. However, their ingrowth begins immediately, and theoretically could reach 100% (total equilibrium) at some distance. As a practical matter, 100% ingrowth is unlikely to ever be attained, due to dry deposition and scavenging during plume transport. For the Subpart W assessments, the equilibrium fraction of decay products was set at 0.70. The equilibrium fraction of 0.70 is appropriate for distances beyond approximately 15,000 meters from the impoundments (where the majority of the exposed populations are located) and assumes that an individual spends 75% of their time indoors. For individuals nearer to the impoundments than 15,000 meters, the assumption of a 0.70 equilibrium fractions will over-state their exposure and resulting risk.

Since the NESHAP Subpart W was promulgated, there has been a great deal of work done to better characterize the appropriate equilibrium fraction for assessing exposure to Rn-222. In general, these studies suggest a somewhat lower fraction than was used in the Subpart W assessments, which would have the effect of lowering the estimated risks (UNSCEAR 2000).

The locations of the receptors in the 80-km assessment area around each site were determined in one of two ways. For the 0–5 km radius, actual site visits were conducted, and the populations in each of 16 directions were determined for distances of 0.5, 1.0, 1.5, 2.0, 2.5, and 5.0 km. For distances between 5 and 80 km, increments of 5 km and 10 km were used, and U.S. Census tract data were used to estimate the population in each sector.

Locating the nearby receptors by actual enumeration is seldom possible when conducting risk assessments. Generally, the best that can be done is to identify nearby sectors where persons are presumed to reside. Using the U.S. Census tract data to populate the 5–80 km assessment grid, while not perfect, as it places all of the tract's population at the centroid of the tract, is as accurate a means of calculating collective exposure as we have.

For the NESHAPs risk assessment, individuals in the population are presumed to experience a constant level of exposure over a 70-year period (i.e., lifetime). While the Agency has often been criticized for making this assumption, it has repeatedly found that it is appropriate for evaluating radiation risks where age at exposure is an important factor in the over-all risk.

The final step in the assessment of the risks from Rn-222 released from operating uranium mill tailings impoundments is to correlate the exposures with risk. For almost all radionuclide risk assessments, the risk is based on dosimetry models. However, for Rn-222, it is based on epidemiology. Specifically, based largely on work presented by the Nation Council on Radiation Protection (NCRP 1984) and the International Commission on Radiological Protection (ICRP 1977), the NESHAP used a risk of 760 fatal cancers/10^6 cumulative WLM (reflecting a risk coefficient of 7.6×10^{-4}/WLM).

As with the equilibrium fraction, considerable additional studies have been conducted to determine the appropriate risk coefficient for Rn-222. EPA's current recommended risk coefficient is 5.38×10^{-4} per WLM. This value is based primarily on the National Academy of Sciences Report BEIR VI (NAS 1999). The EPA recommended risk coefficient is reported in Section VI of "EPA Assessment of Risks from Radon in Homes," EPA 402-R-03-003, June 2003. Table 10 of that report, reproduced below, provides a more detailed breakdown of the risks.

Table 10: Estimates of risk per WLM by smoking category and gender for a stationary population in which 53% of males and 41% of females are ES (Authors note: In this table, ES refers to ever smoked and NS refers to never smoked).

Gender	Smoking Category	Risk per WLM[a] (10-4)	Expected Life Span (years)
Male	ES	10.6	71.5
	NS	1.74	72.8
	ES and NS	6.40	72.1
Female	ES	8.81	78.0
	NS	1.61	79.4
	ES and NS	4.39	78.8
Male & Female	ES	9.68	74.2
	NS	1.67	76.4
	ES and NS	5.38	75.4

[a] Based on 1990 adult (ages greater than or equal to 19 y) ever smoked prevalence data (58.7 males and 42.3 females are ES) and assumption that 37% males and 36% females or children (ages < 18y) will become ES).

If the risk assessments for Subpart W were done today, the over-all risks that would be estimated would likely be somewhat lower than those estimated in 1989.

5.0 CONCLUSIONS

The risk assessments that were performed for the NESHAP for Operating Uranium Mill Tailings were based on the best data and science that were available at the time. While it is unlikely that the over-all risk profile would change significantly if the assessments were redone today, additional data and new scientific findings have become available. Most significantly, measured emissions data should be available, and the current scientific consensus on both equilibrium fractions and the radon risk coefficient could be used in the assessment.

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Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:40 PM
To: Thornton, Marisa
Subject: FW: References 2.0 - Readable!!??

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 2:00 PM
To: Thornton, Marisa
Subject: RE: References 2.0 - Readable!!??

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From: Nesky, Anthony
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Subject: RE: References 2.0 - Readable!!??

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From: Thornton, Marisa
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- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**
- Metadata:
- Title: Work practice standard for Underground Uranium Mines
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: "FR**153865**" "EPA" "work practice standards" "underground uranium mines"

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- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

Metadata:

Title: EPA established environmental protection standards

Author: EPA/OAR/Office of Radiation and Indoor Air

Subject: environmental protection standards for nuclear power operations;

Keywords: "FR2858" "EPA" "environmental protection standards," "Atomic Energy Act"

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- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn"
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: "FR43906" "EPA" "NESHAPS" "Phosphorous Plants"

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- Author: EPA/OAR/Office of Radiation and Indoor Air

- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR7280” “EPA” “standards” “Phosphorous Plants” “DOE-Facilities” “NRC-Licensed Facilities”

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- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: “FR**153865**” “EPA” “work practice standards” “underground uranium mines”

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- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radon-222 Emissions from Licensed Uranium Mill Tailings”
- Keywords: “FR**34056**” “EPA” “NESHAP “ “Radon-222” “Uranium” “ Tailings”

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- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Proposed NESHAP for Radionuclides
- Keywords: “FR**9612**” “EPA” “NESHAP “ “radionuclides”

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- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of RadionuclidesAuthor:
- EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radionuclides
- Keywords: “**FR51654**” “EPA” “NESHAP “ “radionuclides”

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    - **FR36280.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Final NESHAP for Radionuclides
- Keywords: "**FR36280.**" "EPA" "NESHAP " "radionuclides" "final "rule"

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Andrew

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

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    - **FR36280.PDF**

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    - **FR2858.PDF**

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Title: EPA established environmental protection standards

Author: EPA/OAR/Office of Radiation and Indoor Air

Subject: environmental protection standards for nuclear power operations;

Keywords: “FR2858” “EPA” “environmental protection standards,” “Atomic Energy Act”

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
    - **FR43906.PDF**
- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn”
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR43906” “EPA” “NESHAPS” “Phosphorous Plants”

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- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
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    - **FR9612.PDF**
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  Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Proposed NESHAP for Radionuclides
- Keywords: "FR**9612**" "EPA" "NESHAP " "radionuclides"

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    - **FR51654.PDF**
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- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Final NESHAP for Radionuclides
- Keywords: "**FR36280.**" "EPA" "NESHAP " "radionuclides" "final "rule"

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

From: Rosnick, Andrew
Sent: Tuesday, July 08, 2014 12:14 PM
To: Nesky, Anthony
Subject: References 2.0 - Readable!!??

These should work but let me know if there is something wrong!!!

Andrew

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

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    - **FR36280.PDF**

federal register

Wednesday
April 17, 1985

Part V

Environmental Protection Agency

40 CFR Part 61

National Emission Standards for Hazardous Air Pollutants; Standard for Radon-222 Emissions From Underground Uranium Mines; Final Rule

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:40 PM
To: Thornton, Marisa
Subject: FW: References

From: Thornton, Marisa
Sent: Tuesday, July 08, 2014 11:35 AM
To: Nesky, Anthony
Subject: RE: References

Tony are these documents on the GPO website?

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 11:15 AM
To: Thornton, Marisa
Subject: RE: References

OK, I'm having him rescan them. I'll send them to you as soon as possible.

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Sent: Tuesday, July 08, 2014 10:13 AM
To: Thornton, Marisa; Romero, Carmen
Cc: Rosnick, Reid; Herrenbruck, Glenna
Subject: FW: References
Importance: High

Dear Carmen and Marisa:

We have a few Federal Register Notices to add to the list of references you prepared for Subpart W— http://epastage.epa.gov/staging1/rpd/neshaps/subpartw/eiareferences.html

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Author: EPA/OAR/Office of Radiation and Indoor Air

Subject: environmental protection standards for nuclear power operations;

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    - **FR43906.PDF**

- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn"
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Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:40 PM
To: Thornton, Marisa
Subject: FW: Could you please give me a call to go over some details about the hearing in September?

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 12:26 PM
To: Diaz, Angelique
Subject: Could you please give me a call to go over some details about the hearing in September?

Dear Angelique:

Whitney gave me her feedback on the scope of work for the hearings, and I have incorporated in the document, and am ready to push forward. I still have a couple of questions for you. Could you please give me a call at your earliest convenience—or if you prefer—let me know when to call you? Thanks!

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

From: Diaz, Angelique
Sent: Monday, June 23, 2014 3:24 PM
To: Nesky, Anthony
Cc: Rosnick, Reid
Subject: Court Reporter Needed?

It has come to my attention that a court reporter is needed for the Subpart W public hearing. Let me know what kind of help you need from Region 8 in identifying one. I am told that for previous hearings HQ provided the money and the Region found the reporter.

Thanks,
Angelique

Angelique D. Diaz, Ph.D.
Environmental Engineer
Air Program, USEPA/Region 8
1595 Wynkoop Street (8P-AR)
Denver, CO 80202-1129
Office: 303.312.6344
Fax: 303.312.6064
diaz.angelique@epa.gov

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Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

From: Thornton, Marisa
Sent: Tuesday, July 08, 2014 11:11 AM
To: Nesky, Anthony
Subject: RE: References

I deleted those files because they are empty.

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 11:10 AM
To: Thornton, Marisa
Subject: RE: References

I'll have to have Andrew re-scan them. Can you go ahead and add the links, and I'll send the files as soon as I can? Thanks!

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

From: Thornton, Marisa
Sent: Tuesday, July 08, 2014 11:09 AM
To: Nesky, Anthony
Subject: RE: References

All the PDFs you sent are empty.

From: Nesky, Anthony
Sent: Tuesday, July 08, 2014 10:13 AM
To: Thornton, Marisa; Romero, Carmen
Cc: Rosnick, Reid; Herrenbruck, Glenna
Subject: FW: References
Importance: High

Dear Carmen and Marisa:

We have a few Federal Register Notices to add to the list of references you prepared for Subpart W—
http://epastage.epa.gov/staging1/rpd/neshaps/subpartw/eiareferences.html

You can match the PDF file with the reference using the info below. Please hyperlink the document titles like the other references. I have provided metadata for each file.

Thanks for your help!

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

Metadata:

Title: EPA established environmental protection standards

Author: EPA/OAR/Office of Radiation and Indoor Air

Subject: environmental protection standards for nuclear power operations;

Keywords: “FR2858” “EPA” “environmental protection standards,” “Atomic Energy Act”

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
    - **FR43906.PDF**
- Metadata:
- Title: NESHAPS for Elemental Phosphorous Plants withdrawn”
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR43906” “EPA” “NESHAPS” “Phosphorous Plants”

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
    - **FR7280.PDF**
- Metadata:
- Title: Final Standards for Elemental Phosphorous Plants DOE-Facilities, and NRC-Licensed Facilities”
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Withdrawal of NESHAPS for Elemental Phosphorous Plants environmental protection standards for nuclear power operations;
- Keywords: “FR7280” “EPA” “standards” “Phosphorous Plants” “DOE-Facilities” “NRC-Licensed Facilities”

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**
- Metadata:
- Title: Work practice standard for Underground Uranium Mines
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Work practice standard for Underground Uranium Mines
- Keywords: “FR**153865**” “EPA” “work practice standards” “underground uranium mines”

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
    - **FR34056.PDF**
- Metadata:

- Title: National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radon-222 Emissions from Licensed Uranium Mill Tailings"
- Keywords: "FR**34056**" "EPA" "NESHAP " "Radon-222" "Uranium" " Tailings"

- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
    - **FR9612.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Proposed NESHAP for Radionuclides
- Keywords: "FR**9612**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
    - **FR51654.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of RadionuclidesAuthor:
- EPA/OAR/Office of Radiation and Indoor Air
- Subject: NESHAP for Radionuclides
- Keywords: "**FR51654**" "EPA" "NESHAP " "radionuclides"

- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.
    - **FR36280.PDF**
- Metadata:
- Title: National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides
- Author: EPA/OAR/Office of Radiation and Indoor Air
- Subject: Final NESHAP for Radionuclides
- Keywords: "**FR36280.**" "EPA" "NESHAP " "radionuclides" "final "rule"

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:40 PM
To: Thornton, Marisa
Subject: FW: Responses to Ute Mountain Ute Consultation Questions

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From: Peake, Tom
Sent: Tuesday, July 08, 2014 12:54 PM
To: Harrison, Jed; Childers, Pat; Rosnick, Reid; Edwards, Jonathan; Perrin, Alan; Schultheisz, Daniel; Cherepy, Andrea; Diaz, Angelique; Laumann, Sara
Cc: Rosencrantz, Ingrid
Subject: RE: Responses to Ute Mountain Ute Consultation Questions

Though we may meet in Denver, please delete "in the Denver area" because we have not confirmed that, plus we may meet in another area as well. Also, let's keep the commitment general in that we plan to consult with the tribes without being specific. If they want to offer suggestions, great.

Suggestion
For 40 CFR 192 we plan to invite the tribes to provide input through the consultation process and we are also looking into other options that would allow tribes to provide input.

Thanks.
Tom

From: Harrison, Jed
Sent: Tuesday, July 08, 2014 11:43 AM
To: Childers, Pat; Rosnick, Reid; Edwards, Jonathan; Perrin, Alan; Peake, Tom; Schultheisz, Daniel; Cherepy, Andrea; Diaz, Angelique; Laumann, Sara
Subject: RE: Responses to Ute Mountain Ute Consultation Questions

Thanks Pat . . . you beat me to this . . . the advantage of a 3 hr time difference!

The only suggestion I have is that we should specifically address the "including, but not limited to, the anticipated revision to 40 C.F.R. Part 192)." part of the question. Adding on to what Pat drafted, I'd just add another sentence:

Consultation at EPA consists of four phases: Identification, Notification, Input, and Follow-up: We are currently receiving your input ~~to~~ through this consultation and any formal comments you submit as part of the Subpart W rulemaking process. As part of the Follow-up phase, EPA will provide feedback to all tribes involved in the consultation to explain how their input was considered in the final action. With respect to 40 CFR Part 192, we envision public meetings in the Denver area, informational webinars, and an invitation to all tribes offering consultation to provide input.

Note: This is my understanding of the planned process. My recommendation based upon the interest of the Spokane tribe regarding Subpart W is that you "cast a wider net" in your announcements and webinars, and send invitation letters to all tribes to participate in consultation on 40 CFR 192. Pat and I can help ensure that your announcements and webinars are widely distributed.

jed

Jed Harrison SENIOR ADVISOR FOR TRIBAL AFFAIRS
U.S. ENVIRONMENTAL PROTECTION AGENCY
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(702) 784 8218 MOBILE: (702) 494 7050

4220 S. MARYLAND PARKWAY
BLDG. D, SUITE 800
LAS VEGAS, NEVADA 89119

From: Childers, Pat
Sent: Tuesday, July 08, 2014 6:31 AM
To: Rosnick, Reid; Edwards, Jonathan; Perrin, Alan; Peake, Tom; Schultheisz, Daniel; Harrison, Jed; Cherepy, Andrea; Diaz, Angelique; Laumann, Sara
Subject: RE: Responses to Ute Mountain Ute Consultation Questions

Reid,

My thoughts in blue for item 1 and 2.

EPA, INDIAN TRIBES, AND EXECUTIVE ORDER 13175

1. Executive Order 13175 states that the Subpart W rulemaking action does not have "tribal implications" because the rulemaking does not impose regulatory requirements on tribal governments. Please be prepared to discuss how the following issues impact the EPA's Executive Order 13175 analysis:

We are sensitive to the unique situation of the Tribe. As such, we have been in contact since May 2010 when EPA visited the Tribe in White Mesa. We gave a presentation where we gave our outline of the process of revising the Subpart W rule. We have a dedicated website that list many documents that have been used to revise the rule. We hold quarterly stakeholder conference calls to gather information and questions that focus our thinking. Additionally, this consultation also helps us gather information in order to craft a better rule. NOTE: WE NEED SOME WORDS FROM THE TRIBAL FOLKS AND THE EJ FOLKS.

The Executive Order specifies that each Agency must have an accountable process to ensure meaningful and timely input by tribal officials in the development of regulatory policies that

have tribal implications. The EPA Policy on Consultation and Coordination with Indian tribes is spelled out in our policy dated May 4, 2011(http://www.epa.gov/indian/pdf/cons-and-coord-with-indian-tribes-policy.pdf)
The original analysis statement that "the rulemaking does not impose regulatory requirements on tribal governments reflects that the rulemaking is not placing additional economic burden on the tribe. However recognizing the information that you have provided us concerning the unique situation of the tribe, we are honoring your request for consultation.

2. Please be prepared to discuss how the EPA will address Tribal concerns during this Subpart W rulemaking and related rulemaking processes (including, but not limited to, the anticipated revision to 40 C.F.R. Part 192).

RESPONSE: We welcome all comments from the Tribe, and as with this consultation, will be prepared to address any and all comments made by the Tribe.

Consultation at EPA consists of four phases: Identification, Notification, Input, and Follow-up: We are currently receiving your input through this consultation and any formal comments you submit as part of the rulemaking process. As part of the Follow-up phase, EPA will provide feedback to all tribes involved in the consultation to explain how their input was considered in the final action.

From: Rosnick, Reid
Sent: Monday, July 07, 2014 6:18 PM
To: Edwards, Jonathan; Perrin, Alan; Peake, Tom; Schultheisz, Daniel; Harrison, Jed; Cherepy, Andrea; Childers, Pat; Diaz, Angelique; Laumann, Sara
Subject: Responses to Ute Mountain Ute Consultation Questions
Importance: High

All,

Attached are the responses (in red) to the questions generated by the Ute Mountain Ute Tribe in preparation for our consultation this Thursday. Please take a look and provide any comments you have by COB Tuesday July 8. Thanks

Reid

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Reid J. Rosnick
US Environmental Protection Agency
Radiation Protection Division
202.343.9563
rosnick.reid@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:40 PM
To: Thornton, Marisa
Subject: FW: docket
Attachments: DocumentSearchResults.doc

From: Miller, Beth
Sent: Tuesday, July 08, 2014 11:27 AM
To: Rosnick, Reid
Subject: docket

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

Document Search Results

Docket Id	Document Id	Title	Date Received	Phase	Typ
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0001	National Emission Standards: Radon Emissions from Operating Mill Tailings	05/02/2014	Posted	PROPOSE RULES
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0002	Surface Water Hydrology Considerations in predicting radon releases from water-covered areas of uranium tailings ponds	11/17/2009	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0003	Radon releases from Austrailian uranium mining and millng projects: assessing the UNSCEAR approach	11/17/2009	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0004	Minutes from December 3, 2009 stake holder conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0005	Minutes from January 5, 2010 conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0006	Minutes from April 6, 2010 stakeholders conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0007	Minutes from July 6, 2010 stakeholders conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0008	Minutes from October 5, 2010 stakeholders conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0009	Minutes from January 5, 2011 stakeholders conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0010	Minutes from April 7, 2011 stakeholders conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA

EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0011	Minutes from July 7, 2011 stakeholders conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0012	Minutes from October 6, 2011 stakeholders conference call	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0013	April 26, 2007 Notice of Intent to sue	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0014	Civil Suit filed against USEPA for failure to review/revise Subpart W in a timely fashion	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0015	History of NESHAPS and Subpart W Report 9/25/2008	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0016	Tailings Impoundment Technologies Report 9/25/2008	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0017	Review of Method 115 Report 9/25/2008	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0018	Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida [EPA-520/5-85-029] January 1986	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0019	Quality Assurance Project Plan (QAPP)	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0020	2009 Settlement Agreement between EPA and Plaintiffs	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0021	Letter to plaintiffs regarding settlement agreement on November 3, 2009	01/04/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0022	Work Plan for Risk Assessments	01/05/2012	Posted	SUPPORT & RELATE MATERIA

EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0023	Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Assessment for Lincoln Park/Cotter Uranium Mill	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0024	Comments by Steven H. Brown, CHP, SENES Consultants Limited 11/7/2010	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0025	NRC/NMA Uranium Recovery Workshop	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0026	National Mining Association 2008	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0027	Meeting material from presentation in Canon City, Colorado - June 30, 2009	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0028	National Mining Association 2009	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0029	Meeting material from presentation in Rapid City, South Dakota - October 1, 2009	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0030	Notes from meeting with National Mining Association	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0031	National Mining Association 2010	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0032	NESHAP Subpart W Activities An Internet Webinar - National Webinar	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0033	Tuba City Arizona Uranium Stakeholders	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0034	Uranium Recovery Workshop April 29 - 30, 2008	01/05/2012	Posted	SUPPORT & RELATE MATERIA

EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0035	Uranium Recovery Workshop April 29 - 30, 2008	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0036	Uranium Recovery Workshop July 1-2, 2009	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0037	Uranium Recovery Workshop July 1-2, 2009	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0038	Uranium Recovery Workshop July 1-2, 2009	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0039	Uranium Recovery Workshop July 1-2, 2009	01/05/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0040	National Emission Standards for Hazardous Air Pollutants; Standards for Radionuclides April 6 1983 Proposed Rule	01/06/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0041	Federal Register 40 CFR Part 61 192.32 a	01/06/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0042	October 31, 1984 ANPR Radionuclides	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0043	40 CFR Part 61 General Requirements	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0044	Background Information Document for Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings [EPA 520/1-86-009]	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0045	National Emission Standards for Hazardous Air Pollutants (NESHAPs), Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings. September 24, 1986 Final Rule	01/09/2012	Posted	SUPPORT & RELATE MATERIA

EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0046	Draft Environmental Impact Statement (EIS) for Proposed NESHAPS for Radionuclides	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0047	March 7, 1989 Proposed Rule, National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0048	Risk Assessment Methodology, Environmental Impact Statement (EIS), NESHAPS for Radionuclides (1)	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0049	Risk Assessments Methodology, Environmental Impact Statement (EIS), NESHAPS for Radionuclides (2)	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0050	Risk Assessments Methodology, Environmental Impact Statement (EIS), NESHAPS for Radionuclides (3)	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0051	December 15, 1989 Final Rule, National Emission Standards for Hazardous Air Pollutants; Radionuclides	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0052	Method 115-Monitoring for Radon-222 Emissions	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0053	Subpart T Rescission	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0054	40 CFR Part 61 192.32 a Errata	01/09/2012	Posted	SUPPORT & RELATE MATERIA

EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0055	40 CFR Part 61 General Requirements Errata	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0056	EPA Procedures for Determining Confidential Business Information	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0057	October 17 2000 Errata	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0058	NRC's In-Situ Leach Facility Standard Review Plan	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0059	IAEA Uranium Mill Tailings Report	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0060	USEPA Contract Number EP-D-05-002	01/09/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0061	Letter to Angelique Diaz, USEPA from Frank Filas, Environmental Manager, Energy Fuels Resources Corporation on August 31, 2010	01/10/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0062	Pinon Ridge Mill: Application for Approval of Construction of Tailings Facility	01/10/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0063	Evaporation Pond Design Report Pinon Ridge Project Montrose County, Colorado	01/10/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0064	Letter to Energy Fuels Resources Corporation from Steven H. Brown, SENES Consultants Limited on August 30, 2010	01/10/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0065	Raffinate Characterization Pinon Ridge Mill Montrose County, Colorado	01/10/2012	Posted	SUPPORT & RELATE MATERIA

EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0066	Section 114 Letters/Responses	01/13/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0067	Comparison of CAP88 calculations from SC&A and the EPA web version of CAP88	01/26/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0068	Sheep Mountain Uranium Project	02/07/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0069	Status of Cell 3 at the White Mesa mill	02/07/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0070	Construction of An Environmental Radon Monitoring System Using CR-39 Nuclear Track Detectors	04/18/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0071	Letter from Kennecott Uranium Company to Mr. Reid Rosnick	05/02/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0072	Surface Water hydrology considerations in predicting radon releases from water-covered areas of uranium tailings ponds	05/31/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0073	Uranium Mill Tailings Radon Flux Calculations	05/31/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0074	Radon Emissions from Tailings and Evaporation Ponds	05/31/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0075	Minutes from January 5, 2012 Conference Call	05/31/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0076	Minutes from April 5, 2012 Conference Call	05/31/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0077	Colorado Citizens Against Toxic Waste (CCAT) Concerns about Cotter Uranium Mill	05/31/2012	Posted	SUPPORT & RELATE MATERIA

EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0078	November 10, 2011 Risk Assessment Revision for 40 CFR Part 61 Subpart W - Radon Emissions from Operating Mill Tailings	05/31/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0079	Risk Assessment Model Selection Methodology	05/31/2012	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0080	Minutes from July 5, 2012	07/29/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0081	Minutes from October 4, 2012	07/29/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0082	Minutes from January 3, 2013 conference call	07/29/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0083	Minutes from April 3, 2013	07/29/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0084	Minutes from July 11, 2013	07/29/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0085	Experimental Determination of Radon Fluxes over Water	07/29/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0086	Subpart W-EIA-BID	07/30/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0087	Risk Assessment Revision for 40 CFR Part 61 Subpart W â€“	09/12/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0088	Record of Communication, May 16, 2013	09/17/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0089	Subpart W Stakeholders Conference Call of October 17, 2013	10/24/2013	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0090	Subpart W Stakeholders Conference Call of January 2, 2014	01/07/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0091	Meeting presentation to Office of Management and	01/09/2014	Posted	SUPPORT & RELATE MATERIA

		Budget by members of the National Mining Association			
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0092	Subpart W Interagency comments under EOs 12866 and 13563	01/13/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0093	OMB questions on BID EIA	01/13/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0094	E.O. 12866 review - draft	01/13/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0095	Recommended Procedures for Measuring Radon Fluxes from Disposal Sites for Residual Radioactive Materials	02/12/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0096	Subpart W Stakeholders Conference Call	04/22/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0097	Memo to the docket	05/28/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0098	Memorandum to docket regarding 6-3-14 meeting with UTE Mountain Ute Tribe	06/04/2014	Posted	SUPPORT & RELATE MATERIA
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0099	Comment submitted by Sarah Fields, Uranium Watch	06/10/2014	Posted	PUBLIC SUBMISS
EPA-HQ-OAR-2008-0218	EPA-HQ-OAR-2008-0218-0100	Uranium Watch	06/11/2014	Posted	SUPPORT & RELATE MATERIA

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:53 PM
To: Thornton, Marisa
Subject: FW: Completed and Corrected Subpart W Message

From: Diaz, Angelique
Sent: Monday, July 07, 2014 9:00 AM
To: Reid Rosnick
Subject: FW: Completed and Corrected Subpart W Message

FYI

Pretty much what she stated during our conference call.

Angelique D. Diaz, Ph.D.
Environmental Engineer
Air Program, USEPA/Region 8
1595 Wynkoop Street (8P-AR)
Denver, CO 80202-1129
Office: 303.312.6344
Fax: 303.312.6064
diaz.angelique@epa.gov

From: sarah@uraniumwatch.org [mailto:sarah@uraniumwatch.org]
Sent: Saturday, July 05, 2014 5:32 AM
To: Diaz, Angelique
Subject: Completed and Corrected Subpart W Message

Dear Angelique,

My letter below accidentally got sent to you before I had finished it.
————————————

Saying that the liquid uranium mill impoundments are regulated under Subpart W is like saying that a state regulates the speed of vehicles on the road: but, there are no specific speed limits, no speed limit signs, no authority checking on how fast vehicles travel, and no one issuing speeding tickets.

Putting together recent White Mesa Mill data (2012 and 2013) on the radium content of the liquid impoundments at White Mesa and the EPA claim that there are 7 pCi/m^2-sec for every 1,000 pCi/L of radium, the radon emissions are way beyond the zero or even minimal radon emission levels.

http://www.radiationcontrol.utah.gov/Uranium_Mills/denison/tailingswastewater_rpt.htm

Based on the gross radium alpha for 2013 (from 14,600 to 81,900 pCi/L), and the EPA

estimate of radon emissions per 1,000 pCi/L of radium, I get radon fluxes of from 102 to 573.3 pCi/m^2-sec for Cells 1, 3, 4A, and 4B. Maybe there is some error in these calculations? Too bad the EPA did not obtain the recent data on the radium content of the White Mesa liquid impoundments and plug that data into the formula on page 17 of the 2010 Evaporation Pond Risk Assessment (which the EPA did not even make publicly available when they noticed the proposed rule in May).

Also, the EPA never followed up on the May 2009 request for information on the White Mesa liquid impoundments after there was no response. (I am assuming that if there had been a response, the EPA would have made it available. Maybe that is a generous assumption.)

EPA's claim that Shootaring Canyon Mill has a synthetically lined impoundment is blatantly false. Relevant Shootaring Canyon documents state that the impoundment has a compacted clay liner. It is right there in the reclamation plan that is on the Utah Div. of Radiation Control Web Site and in historic NRC records.

Not surprising that there are no CAA Section 114 letters and responses for Shootaring Canyon and Sweetwater Mills, so who knows where the EPA got the idea that the Shootaring Canyon Mill tailings impoundment had a synthetic liner. Guess someone thought no member of the public would bother to check it out.

The Subpart W Proposed Rule is a fundamentally dishonest document. It is full of misinformation and partial information, and is not legally defensible. The EPA should be ashamed.

Sincerely,

Sarah Fields
Program Director
Uranium Watch
PO Box 344
Moab, Utah 84532

A

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:53 PM
To: Thornton, Marisa
Subject: FW: NESHAP Subpart W

From: Niebling, William
Sent: Monday, July 07, 2014 3:44 PM
To: Rosnick, Reid
Cc: Edwards, Jonathan; Perrin, Alan; Peake, Tom
Subject: RE: NESHAP Subpart W

Thanks, Reid. Very helpful background!

From: Rosnick, Reid
Sent: Friday, June 27, 2014 6:19 AM
To: Niebling, William
Cc: Edwards, Jonathan; Perrin, Alan; Peake, Tom
Subject: NESHAP Subpart W

William,

Jon Edwards asked me to send you some information on NESHAP Subpart W. As luck would have it, I just gave a generalized briefing to the National Tribal Air Association. It will give you a brief update on the proposed rule, as well as the outreach we have performed over the past four years. Please feel free to contact me if you have further questions or comments.

Reid

_____

Reid J. Rosnick
US Environmental Protection Agency
Radiation Protection Division
202.343.9563
rosnick.reid@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:52 PM
To: Thornton, Marisa
Subject: FW: We need to get copies of two references

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:52 PM
To: Rosnick, Reid
Subject: We need to get copies of two references

SC&A (S. Cohen and Associates) 2011. "Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings, Task 4 – Detailed Risk Estimates,"
Contract Number EP-D-10-042, Work Assignment No. 1-04, Task 4, SC&A, Inc., Vienna, Virginia, March 25, 2011

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:40 PM
To: Thornton, Marisa
Subject: FW: FR Notice for Subpart W

From: Rosnick, Reid
Sent: Tuesday, July 08, 2014 11:15 AM
To: Lee, Raymond
Subject: RE: FR Notice for Subpart W

GREAT! Thanks!

From: Lee, Raymond
Sent: Tuesday, July 08, 2014 11:15 AM
To: Rosnick, Reid
Subject: RE: FR Notice for Subpart W

Sure did Reid! We got everything uploaded into CMS yesterday eve and I am going to drop off the package today over to OAR.

Sent by EPA Wireless E-mail Services

From: Rosnick, Reid
Sent: Tuesday, July 8, 2014 6:19 AM
To: Lee, Raymond
Subject: FR Notice for Subpart W

Hi Ray,

Did you get everything you needed for the FR notice to extend the comment period for Subpart W?

Reid

_____
Reid J. Rosnick
US Environmental Protection Agency
Radiation Protection Division
202.343.9563
rosnick.reid@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:53 PM
To: Thornton, Marisa
Subject: FW: Opening Statement for Consultation
Attachments: Opening Statement.docx

From: Rosnick, Reid
Sent: Sunday, July 06, 2014 11:59 AM
To: Edwards, Jonathan; Perrin, Alan; Peake, Tom; Schultheisz, Daniel
Subject: Opening Statement for Consultation

All,

As you know, we don't have much experience in consultations. I don't know if there will be an exchange of opening statements, but just in case, attached is an opening statement that Mike can use to start things off on Thursday. For the UMUT consultation. This is something we can share with Mike at his briefing on Wednesday. Any comments are appreciated. I hope to have the answers to the questions the tribe provided by no later than tomorrow. Thanks

Reid

_____
Reid J. Rosnick
US Environmental Protection Agency
Radiation Protection Division
202.343.9563
rosnick.reid@epa.gov

Opening Statement

Mr. Chairman, Council members,

Thank you for allowing us to meet with you today. As you know, EPA's policy is to consult on a government-to-government basis with federally recognized tribes when EPA actions and decisions may affect tribal interests. Consultation is a process of meaningful communication and coordination between EPA and tribal officials prior to EPA taking actions or implementing decisions that may affect tribes. EPA recognizes the federal government's trust responsibility, which derives from the historical relationship between the federal government and Indian tribes as expressed in certain treaties and federal Indian law.

One of the primary goals of our policy is to fully implement both the Executive Order and the 1984 Indian Policy, with the ultimate goal of strengthening the consultation, coordination, and partnership between tribal governments and EPA. EPA's fundamental objective in carrying out its responsibilities in Indian country is to protect human health and the environment. The most basic result of this full implementation is that EPA takes an expansive view of the need for consultation in line with the 1984 Policy's directive to consider tribal interests whenever EPA takes an action that "may affect" tribal interests.

The Office of Air and Radiation takes very seriously its responsibility to strengthen the government-to-government dialogue with tribes regarding proposed actions and/or decisions in a manner intended to secure meaningful and timely tribal input. Our relationship with the tribe dates back to May 2011, when we visited White Mesa and held a meeting with the tribe to discuss our plans for revising Subpart W.

For the purposes of today's consultation, it is important to note the Subpart W rule is a proposed rule. As such, we welcome any comments, additions and/or corrections that you may have. We look at all relevant comments in crafting the final rule. We look forward to our dialogue today.

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:53 PM
To: Thornton, Marisa
Subject: FW: Subpart W Rulemaking

From: sarah@uraniumwatch.org [mailto:sarah@uraniumwatch.org]
Sent: Friday, July 04, 2014 10:09 PM
To: Diaz, Angelique
Subject: Subpart W Rulemaking

Dear Angelique,

Saying that the liquid uranium mill impoundments are regulated under Subpart W is like saying that a community regulates the speed of vehicles on the road, but there are no specific speed limits, no speed limit signs, no authority checking on how fast vehicles travel, and no one issuing speeding tickets.

Putting together recent White Mesa Mill data (20012 and 2013) on the radium content of the liquid impoundments at White Mesa with the EPA claim that there are 7 pCi/m2-sec for every pCi/L of radium, the radon emissions are way beyond the zero or even minimal radon emission levels. But, EPA never followed up on the May 2009 request for information on the White Mesa liquid impoundments after there was no reponse. (I am assuming that if there had been a response, the EPA would have made it available. Maybe that is a generous assumption.)

EPA's claim that Shootaring Canyon Mill has a synthetically lined impoundment is blatantly false. All relevant Shootaring Canyon documents state that the impoundment has a compacted clay liner.

Not surprising that there are no CAA Section 114 letters and responses for Shootaring Canyon and Sweetwater Mills, so who knows where the EPA got the idea that the Shootaring Canyon Mill's impoundment had a synthetic liner.

The Subpart W Proposed Rule is a fundamentally dishonest document.
The S

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:53 PM
To: Thornton, Marisa
Subject: FW: Completed and Corrected Subpart W Message

From: sarah@uraniumwatch.org [mailto:sarah@uraniumwatch.org]
Sent: Saturday, July 05, 2014 7:32 AM
To: Diaz, Angelique
Subject: Completed and Corrected Subpart W Message

Dear Angelique,

My letter below accidentally got sent to you before I had finished it.

————————————

Saying that the liquid uranium mill impoundments are regulated under Subpart W is like saying that a state regulates the speed of vehicles on the road: but, there are no specific speed limits, no speed limit signs, no authority checking on how fast vehicles travel, and no one issuing speeding tickets.

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http://www.radiationcontrol.utah.gov/Uranium_Mills/denison/tailingswastewater_rpt.htm

Based on the gross radium alpha for 2013 (from 14,600 to 81,900 pCi/L), and the EPA estimate of radon emissions per 1,000 pCi/L of radium, I get radon fluxes of from 102 to 573.3 pCi/m^2-sec for Cells 1, 3, 4A, and 4B. Maybe there is some error in these calculations? Too bad the EPA did not obtain the recent data on the radium content of the White Mesa liquid impoundments and plug that data into the formula on page 17 of the 2010 Evaporation Pond Risk Assessment (which the EPA did not even make publicly available when they noticed the proposed rule in May).

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Not surprising that there are no CAA Section 114 letters and responses for Shootaring Canyon and Sweetwater Mills, so who knows where the EPA got the idea that the Shootaring Canyon Mill tailings impoundment had a synthetic liner. Guess

someone thought no member of the public would bother to check it out.

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It is full of misinformation and partial information, and is not legally defensible.
The EPA should be ashamed.

Sincerely,

Sarah Fields
Program Director
Uranium Watch
PO Box 344
Moab, Utah 84532

A

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:54 PM
To: Thornton, Marisa
Subject: FW: UMUT consultation question 22 and call information for next week
Attachments: NESHAPS Question 22 Supplement.pdf

From: Scott Clow [mailto:redhare@fone.net]
Sent: Thursday, July 03, 2014 1:53 PM
To: Rosnick, Reid
Cc: sclow@utemountain.org; chawkins@utemountain.org
Subject: UMUT consultation question 22 and call information for next week

Hi Reid,
As we discussed on our call last week, here is supplemental information regarding question #22 on the consultation questions document. We are preparing an analysis of the calculation and variables used in it and that is almost done. If it isn't ready to go out today I will send it this weekend or Monday at the latest.

Conference Call information for next week:
Dial-in: (866)249-5325
Code: 370741

Have great weekend
Scott

Supplement to UMUT Question 22

22. The EPA's analysis that using liquids to cover tailings cells "has been sufficient to limit the amount of radon emitted from the ponds, in many cases, to almost zero" is insufficient to demonstrate that Tailings Cell 1 at the WMM has a radon flux of "almost zero" (or even under 20 pCi/m2-s).

    Based on the information and questions below, please provide the EPA's specific analysis of the calculated radon emissions from Tailings Cell 1, Tailings Cell 4B, and Roberts Pond at the WMM. Please then explain how EPA calculates the dose to the White Mesa Tribal community (considering radon emissions from Tailings Cell 1 and 4B and Roberts Pond, along with radon emissions from "conventional" impoundments 2, 3, and 4A).

    a. The proposed rulemaking recognizes that covering tailings impoundments with water does not reduce radon emissions to zero (and that the radon flux above some evaporation ponds can be significant/exceed 20 pCi/m2-s.[1]
    b. The proposed rulemaking contemplates the use of radium-laden "process water" to provide liquid covers on non-conventional impoundments, but does not address whether the use of radium-laden process water increases the radon emissions from a non-conventional impoundment. The EPA analysis justifying the use of the 1 meter water cover relies on the assumption that the water cover is not laden with radium.[2] The EPA analysis also calculates significant radon flux from non-conventional impoundments containing radium-laden water. Please justify the EPA's position that 1 m of radium-laden process water can decrease radon flux from tailings impoundments like Tailings Cell 1 at WMM to zero.
    c. The EPA's analysis of radon emissions from liquid-covered impoundments recognizes that there are significant radon emissions during the transfer of radium-laden waters to and between tailings impoundments and during enhanced evaporation sprays,[3] but it does not calculate or address these emissions for conventional mills like the WMM.
    d. Using the radon flux equation contained in Section 4.0 of the Radon Emissions from Evaporation Ponds report along with the actual radium content[4] in Tailings Cell 1, the Tribe's initial calculation on the radon flux from Tailings Cell 1 is 327 pCi/m2-s (not including emissions during transfer into Cell 1 or during enhanced evaporation sprays).[5]

[added after June 15, 2014 meeting]

[1] S. Cohen & Associates, Risk Assessment Revision for 40 CFR Part 61 Subpart W—Radon Emission from Operating Mill Tailings, Task 5—Radon Emission from Evaporation Ponds. Pages iv, v, 26.
[2] See Proposed Rulemaking at 25393.
[3] S. Cohen & Associates, Risk Assessment Revision for 40 CFR Part 61 Subpart W—Radon Emission from Operating Mill Tailings, Task 5—Radon Emission from Evaporation Ponds. Pages 21-24.
[4] To determine the actual radium content, the Tribe used the 32,700 pCi/L Gross Radium Alpha concentration provided in the in the 2013 Annual Tailings Report.
[5] See Calculation Brief (attached).

e. The EPA's analysis includes a discussion of how to control radium in evaporation ponds using dilution methods or barium chloride treatment.[6] This analysis notes that dilution of evaporation ponds is only a temporary solution to control radon emissions from radium-laden water.[7] Please explain what alternatives the EPA has developed or may develop to control radon emissions from radium-laden tailings ponds (like Tailings Cell 1 at the WMM).

[6] S. Cohen & Associates, Risk Assessment Revision for 40 CFR Part 61 Subpart W—Radon Emission from Operating Mill Tailings, Task 5—Radon Emission from Evaporation Ponds. Pages 25-26.
[7] S. Cohen & Associates, Risk Assessment Revision for 40 CFR Part 61 Subpart W—Radon Emission from Operating Mill Tailings, Task 5—Radon Emission from Evaporation Ponds. Page 26.

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:54 PM
To: Thornton, Marisa
Subject: FW: UMUT consultation question 17
Attachments: NESHAPS Question 17 Supplement.pdf; Roberts Pond Google Image.jpg; Roberts Pond Relining Report.pdf

From: Scott Clow [mailto:redhare@fone.net]
Sent: Thursday, July 03, 2014 1:43 PM
To: Rosnick, Reid
Cc: sclow@utemountain.org; chawkins@utemountain.org
Subject: UMUT consultation question 17

Hi Reid,
As we discussed on our call last week, here is supplemental information regarding question #17 on the consultation questions document.
Scott

From: <HRR91851@aol.com>
To: <lmorton@utah.gov>
Date: Thu, Feb 19, 2004 12:14 PM
Subject: Supporting infomation for GWDP

Loren:

Attached are several items in response to our meeting of last week.

1) An Introductory paragraph(s) from Dave to be inserted at the beginning of the Statement of Basis. Dave suggested this be placed as the second section on the first page of the SoB. It's probably a bit longer than needed but Dave feels it is important to give the reader a clear understanding of the site and the history.

2) Coordinates for the Ore Storage Pad and elevations for liner and operating pool on Roberts Pond.

3) Description of the clean out and re-lining of Roberts Pond.

We still own you some additional items and will forward things to you as they become available.

Thanks

Harold R. Roberts

Coordinates of Feedstock Storage Area

	East	North
NW	2,579,990	323,600
NE	2,580,925	323,595
SE	2,580,920	322,140
SW	2,580,420	322,140
1	2,580,410	322,815
2	2,580,085	323,040
3	2,580,085	323,120
4	2,580,285	323,315
5	2,579,990	323,415

Mill Area Retention Basin

Top of Liner Elevation	5626 msl
Lowest point on FML	5618 msl
Maximum solution level (freeboard limit)	5624 msl
Maximum solution level (operating limit)	5623 msl

Mill Area Retention Basin

In May of 2002, the decision was made to clean out and re-line the Mill area retention basin, commonly referred to as Roberts Pond. The decision was based on concerns about the integrity of the Hypalon liner, and concerns that the build up of solids in the pond from 22 years of operation had reduced the usable capacity and freeboard to unacceptable levels. The initial plan was to clean the solids from the pond and then inspect the liner and make repairs as necessary. Once cleanout activities began it became obvious that the Hypalon liner would not be salvageable due to damage from the heavy equipment. At that time the decision was made to totally clean out the pond, verify the area as radiologically clean and reline the pond with 60 mil HDPE.

The cleanout activities involved use of a long-boom track hoe and 10-ton haul trucks. The excavated material was placed on the ore pad because the residual uranium values were determined to be sufficient to justify processing with the upcoming milling campaign. Excavation of the pond area continued until all the visible residues and liner material were removed from the area. The next phase of the cleanup involved the use of a small "Bobcat" type loader to remove small areas of visible contamination. Materials were determined to be contaminated by use of a Eberline Model 3 with a 44-9 beta-gamma detector which also detects surface alpha contamination, an Eberline ESP-1 with AC3-7 alpha probe, and a Ludlum Model 19 micro R meter. This was the initial radiological check to determine cleanup of the pond area. The pond area is relatively small, less than 0.5 acre, so it was easy to physically check the entire pond bottom and side slope areas. For comparison purposes, background readings were taken in areas outside of the pond area known to be uncontaminated. After all the contaminated materials were determined to be removed from the pond area, a 10 foot by 10 foot grid was established and soil samples were obtained and analyzed for uranium. Because the solutions historically present in the pond were from process spills and overflows, it was very unlikely that there would be thorium or radium values in the pond unless they were accompanied by significantly higher uranium values; therefore uranium was chosen as the indicator for final clean up of the pond area. After sample results were verified the pond area was designated as radiologically clean.

In preparation for liner installation, the bottom of the pond was cleaned of all large oversize rock and was rolled with a smooth drum roller to provide a suitable surface for the HDPE liner. The pond side slopes were also raked clean to ensure a suitable surface for the liner. As additional protection for the liner material, geo-textile material salvaged from the Cell 4A tailings pond was installed over the entire pond bottom prior to liner placement. A single 60 mil HDPE liner, in roll widths of 22.5 feet, was then installed in the pond. Based on the approved QA/QC plan and the total length of field seam in the installation, three (3) destructive tests (1 per 500 feet) were conducted on the liner field seams. The entire length of field seams were also tested by use of air pressure and a vacuum box where necessary. In addition to the destructive and non-destruction testing of the seams, all liner panels were visually inspected for signs of damage or stress caused

by the installation process, with repairs completed and tested as necessary.

Site History

The White Mesa Mill was constructed in 1979-1980 and licensed by the United States Nuclear Regulatory Commission ("NRC") as a uranium milling facility in May, 1980 under Source Material License SUA - 1358.

Groundwater is located under the site in two zones: the perched groundwater zone; and the regional aquifer. The perched groundwater zone is located in the Burro Canyon Formation, approximately 83 to 109 feet below surface in the area of the Mill's tailings cells. Perched groundwater at the site has a generally low quality due to high total dissolved solids in the range of 1,200 to 5,000 milligrams per liter, and is used primarily for stock watering and irrigation in the areas upgradient (north) of the site. The regional aquifer in the area is found in the Entrada and Navajo Sandstones, which are separated from the perched aquifer by approximately 1,000 to 1,100 feet of materials having a low average vertical permeability. Groundwater within this system is under artesian pressure in the vicinity of the Mill site.

Under the initial NRC groundwater monitoring program for the site, up to 20 chemical and radiological constituents in up to 13 wells were monitored from 1979 to 1997. After a review of over 14 years of quarterly data, NRC authorized the Mill to switch to Point of Compliance ("POC") monitoring in 1997, which the Mill currently performs. Under the Mill's POC monitoring program, the number of monitoring wells was reduced to six monitoring wells, each of which is completed in the perched groundwater zone of the Burro Canyon formation. These wells were considered by the Mill and NRC to be the closest of the existing monitoring wells to the point of compliance, being the downgradient edge of the Mill's tailings cells. In addition, the number of chemical and radiological parameters was reduced to four: chloride, nickel, potassium and uranium, which were considered by the Mill and NRC to be the most dependable indicators of water quality and potential cell failure.

The Mill and NRC determined that the spatial variability of the ground water quality precludes the definition of background ground water quality over the large areal extent of the Mill site. Because of this variable groundwater chemistry, comparison of individual well groundwater chemistries to a single background groundwater well was determined not to be an appropriate method of monitoring potential disposal cell leakage or groundwater impacts.

As a result, the POC program for the Mill involves determination of background concentrations and comparisons to the background concentration on a well by well basis, or intra-well approach, for each of the four parameters in each of the six POC monitoring wells using a statistical methodology endorsed by EPA and approved by NRC.

Since 1979, the Mill has never received a violation under its NRC groundwater monitoring program.

In 1999, the Mill and the Executive Secretary commenced an annual split sampling program at the site, which was performed independently of NRC's groundwater monitoring program. Under the split sampling program, all historic wells at the site are sampled for a comprehensive suite of chemical and radiological constituents. These wells include NRC's POC wells, but also other wells that have been installed on site over the years and are no longer included in NRC's POC monitoring program.

During the split sampling event in May, 1999, an unusually high level of chloroform was discovered in one monitoring well. This well, MW-4, monitors the water in the perched zone, and is located cross-gradient from the Mill's tailings impoundments on the eastern portion of the Mill site. This monitoring well is not one of the NRC's POC monitoring wells, so this chloroform contamination was not picked up under the Mill's NRC groundwater monitoring program.

On August 23, 1999, while acknowledging that this contamination does not threaten groundwater resources in the regional aquifer, because the aquifer is separated from the perched zone by some 1,000 feet of low-permeability rocks, the State of Utah issued a Corrective Action Order requiring IUC to investigate the source and extent of chloroform contamination and, if necessary, to develop a corrective action plan to address the chloroform contamination. IUC is currently performing investigations and taking actions in accordance with the Corrective Action Order.

To date, under the Corrective Action Order, IUC has installed 20 temporary monitoring wells in the perched groundwater zone at the site in the area that has been impacted by the chloroform contamination. This area is in the eastern portion of the site and is cross-gradient or upgradient from the Mill's tailings cells. Low concentrations of other volatile and semi-volatile organic compounds have also been detected in some of these chloroform investigation wells. Investigations by independent experts retained by IUC and characterization sampling from these temporary monitoring wells appear to indicate that the source of this contamination is not from Mill operations or from the Mill's tailings cells, but rather from a temporary laboratory facility that was located at the Mill site prior to construction and operation of the Mill, and that disposed of laboratory wastes, including chloroform and other volatile organic and semi-volatile organic compounds into an inspected and approved disposal leach field, and/or from septic tank drainfields that serviced both laboratory operations and sanitary sewage prior to construction of the Mill's tailings cells. Further investigations are ongoing, and the Executive Secretary is evaluating the data and analysis provided by IUC to verify the results and conclusions of IUC's investigations to date and to consider all other potential sources of this contamination on the site. In addition, interim measures have been instituted by IUC in order to contain the contamination and to pump contaminated groundwater into the Mill's tailings cells. A final corrective action plan, if necessary, has not yet been developed.

Upon the State of Utah becoming an Agreement State for uranium mills, which is expected to occur in the second quarter of 2004, the State of Utah will assume NRC's

primary regulatory responsibility over the Mill, including the responsibility over the Mill's groundwater monitoring program. The Mill's NRC-issued Source Materials License will be replaced by a State of Utah Radioactive Materials License; all of the NRC's groundwater monitoring requirements in the Mill's existing Source Materials License will be replaced by the provisions of the Utah Water Quality Act, Utah Rule R317-6 and this Groundwater Quality Discharge Permit.

In order to comply with the Utah Water Quality Act and Utah Rule R317-6, the Executive Secretary has determined that a number of changes and enhancements to the Mill's existing groundwater monitoring program will be required, including expanding the number of monitoring wells under the program, and by increasing the number of groundwater monitoring parameters. Other enhancements include the addition of various Discharge Minimization Technologies (DMTs), improved cell design for new tailings cells and a review of the existing Mill Reclamation Plan to ensure that it satisfies the requirements of the Utah Water Quality Act. In addition, as part of this permit, IUC is required to submit a Background Water Quality Report to enable the Executive Secretary to verify IUC's and NRC's determinations of natural background concentrations for the various monitoring parameters and to verify IUC and NRC's findings to date that Mill operations have not impacted groundwater.

Supplement to UMUT Question 17

17. [As previously drafted]: The WMM is currently authorized to temporarily place liquid 11(e)(2) byproduct material in "Roberts Pond" (before pumping the liquid into Tailings Cells 1 and 4B). Does Roberts Pond meet the proposed definition of a "non-conventional impoundment"? *See* pages 25390, 25393 of the proposed rulemaking (addressing "holding" and "collection" ponds). Please explain how EPA has assessed the Radon-222 emissions from Roberts Pond and from the regular transfer of process water from Roberts Pond to Tailings Cells 1 and 4B.

Redrafted question (after discussion on 6/26/14)

17. The WMM is currently authorized to operate "Roberts Pond" as a "wastewater pond" to store and transfer process water, spill/overflow water, and other wastewater fluids at the White Mesa Mill facility.[1] The WMM is required to monitor water level elevations in Roberts Pond and to remove excess wastewater into Tailings Cell 1.[2] The WMM is not required to maintain a minimum level of liquid in Roberts Pond, which means that the Roberts Pond does not always have a water cover over the built-up solid tailings in Roberts Pond. The WMM is required to reclaim and decommission Roberts Pond at the time of the mill site closure.[3] A Google Earth aerial photograph of Roberts Pond is attached.

    a. Does a wastewater pond that is authorized to temporarily receive 11(e)(2) byproduct material and other wastewater material (like Roberts Pond) fit under the proposed definition of non-conventional impoundments (and fall under Subpart W)?

    b. Please explain how the EPA has assessed Radon-222 emissions from ponds (like Roberts Pond) that regularly transfer liquid 11(e)(2) byproduct material into other tailings impoundments. Please address both the emissions that occur during the transfer of the liquids and the emissions from the built-up solid tailings left in the pond.

List of Background Documents

1. 2011 Statement of Basis. Excerpts sent electronically, full document on disc.
2. Roberts Pond Relining Report.

[1] Utah Division of Radiation Control, February 2011. Groundwater Water Quality Discharge Permit, Statement of Basis: For a Uranium Milling Facility At White Mesa, South of Blanding Utah. Page 10; Harold R. Roberts, Roberts Pond Relining Report.

[2] Utah Division of Radiation Control, February 2011. Groundwater Water Quality Discharge Permit, Statement of Basis: For a Uranium Milling Facility At White Mesa, South of Blanding Utah. Page 10, 24, 30.

[3] Utah Division of Radiation Control, February 2011. Groundwater Water Quality Discharge Permit, Statement of Basis: For a Uranium Milling Facility At White Mesa, South of Blanding Utah. Page 10.

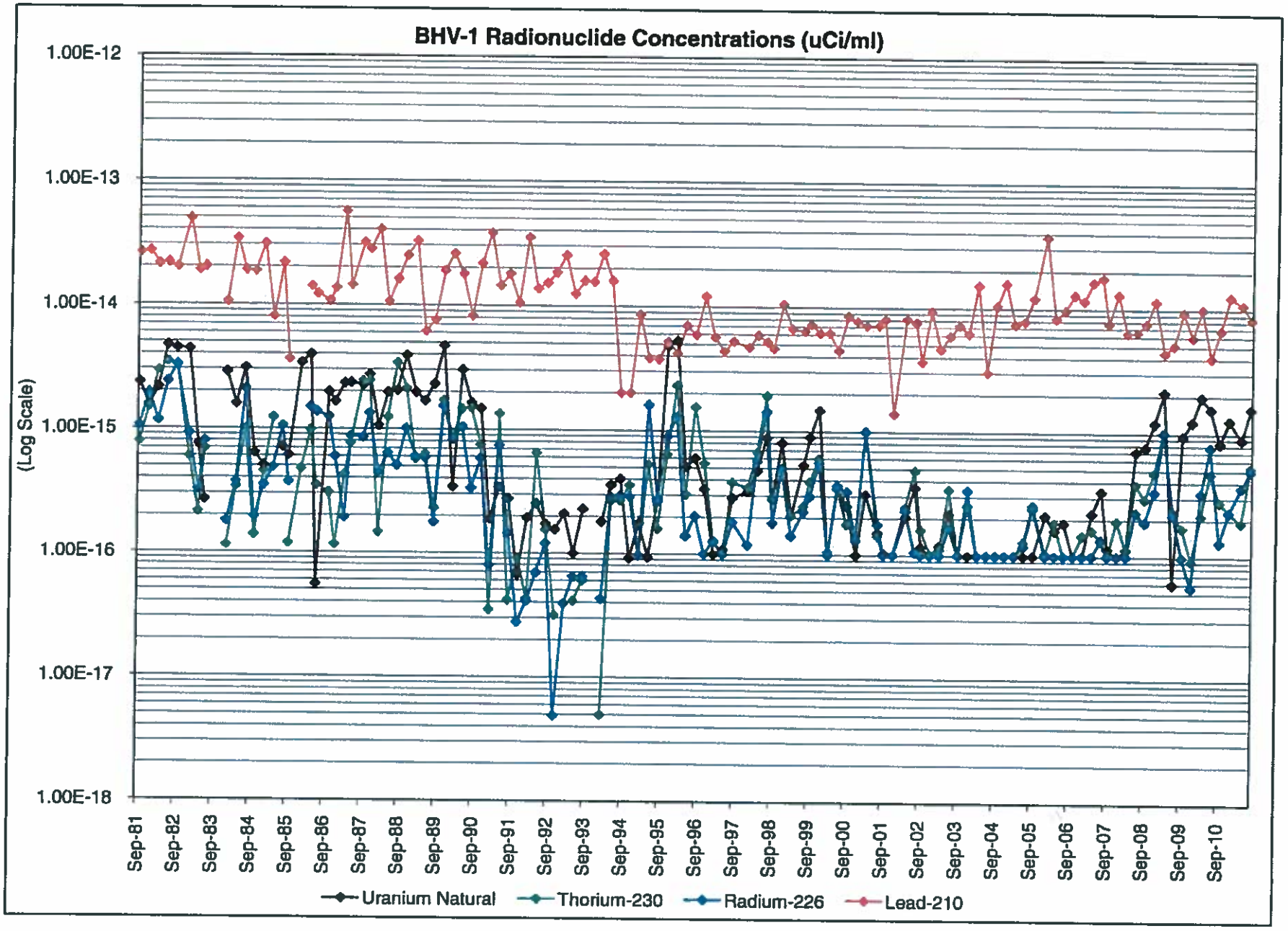

N
Google earth
1997
Imagery Date: 6/25/2013 37°32'05.70" N 109°30'28.51" W elev 5619 ft eye alt 9063 ft

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:54 PM
To: Thornton, Marisa
Subject: FW: UMUT consultation question 7
Attachments: 2013 Annual Tailings Wastewater Sampling Report.pdf; GW Statement of Basis.pdf; NESHAPS Question 7 Supplement.pdf; Semi Annual Effluent Report 2011.pdf

From: Scott Clow [mailto:redhare@fone.net]
Sent: Thursday, July 03, 2014 1:42 PM
To: Rosnick, Reid
Cc: sclow@utemountain.org; chawkins@utemountain.org
Subject: UMUT consultation question 7

Hi Reid,
As we discussed on our call last week, here is supplemental information regarding question #7 on the consultation questions document.
Scott


BHV-1 Radionuclide Concentrations (uCi/ml)
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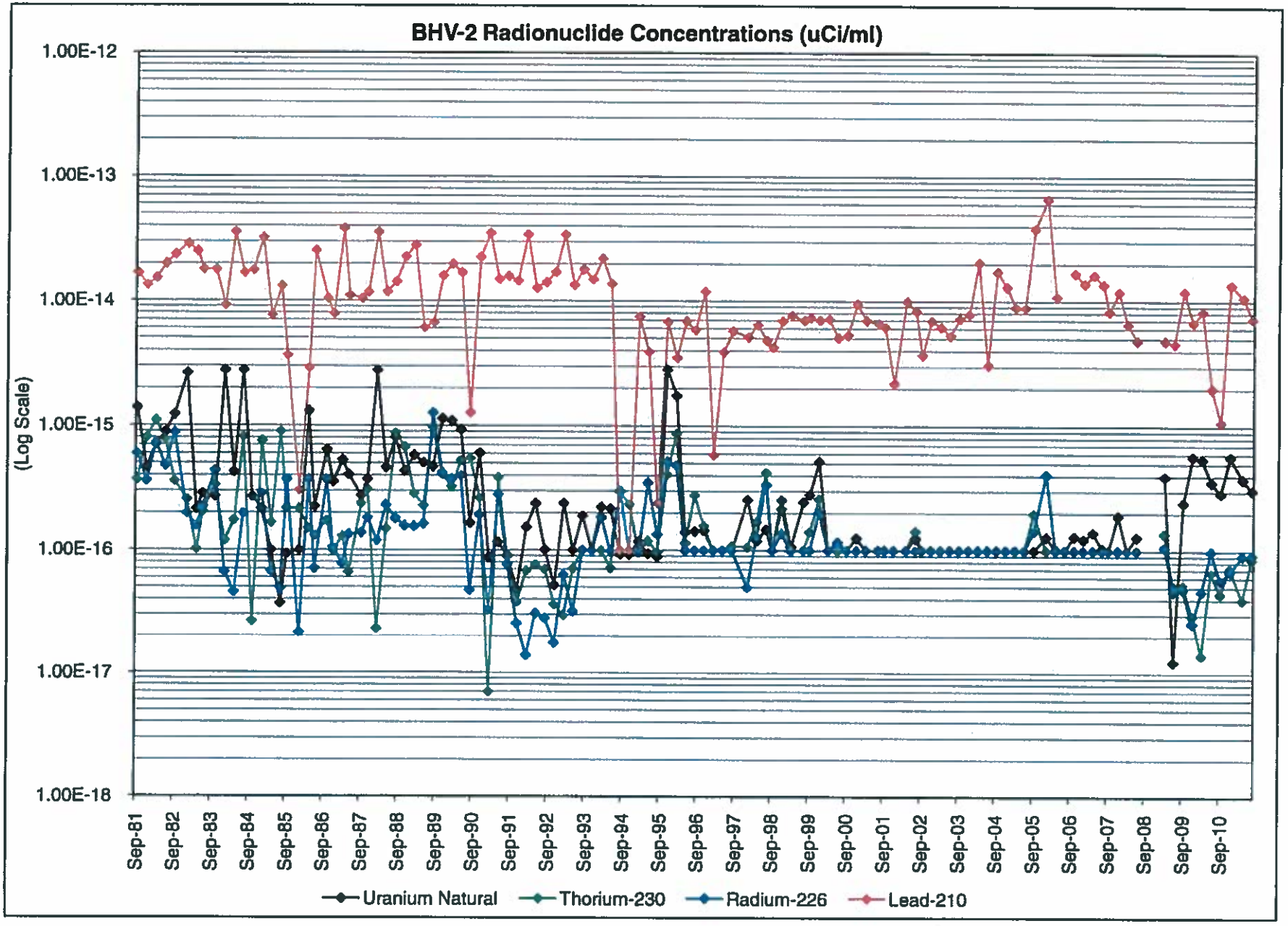
1.00E-13
1.00E-14
1.00E-15
1.00E-16
1.00E-17
1.00E-18
(Log Scale)
Sep-81
Sep-82
Sep-83
Sep-84
Sep-85
Sep-86
Sep-87
Sep-88
Sep-89
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Uranium Natural
Thorium-230
Radium-226
Lead-210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(Log Scale)
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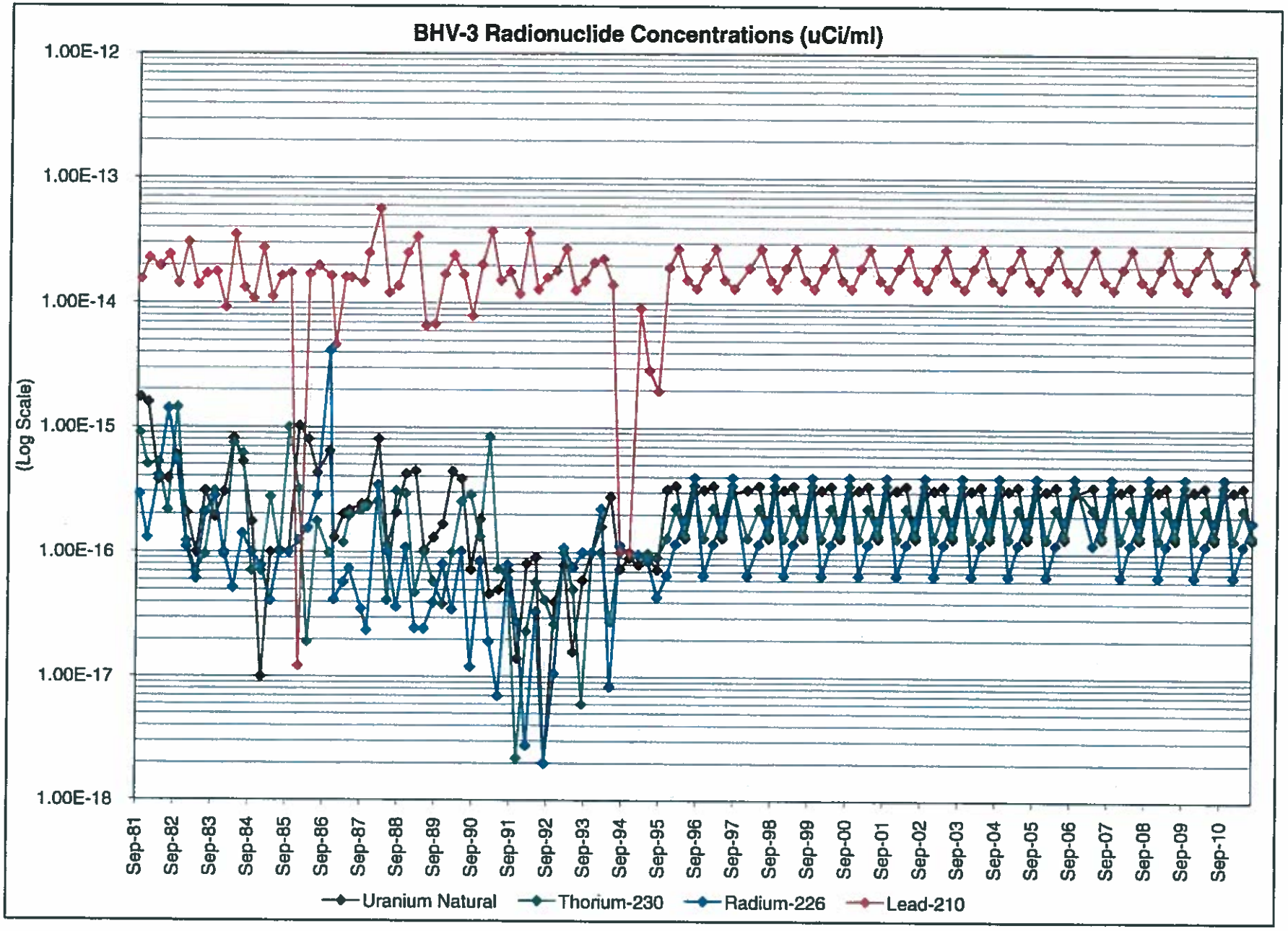
Sep-83
Sep-84
Sep-85
Sep-86
Sep-87
Sep-88
Sep-89
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Uranium Natural
Thorium-230
Radium-226
Lead-210


BHV-3 Radionuclide Concentrations (uCi/ml)
(Log Scale)
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1.00E-14
1.00E-15
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1.00E-17
1.00E-18
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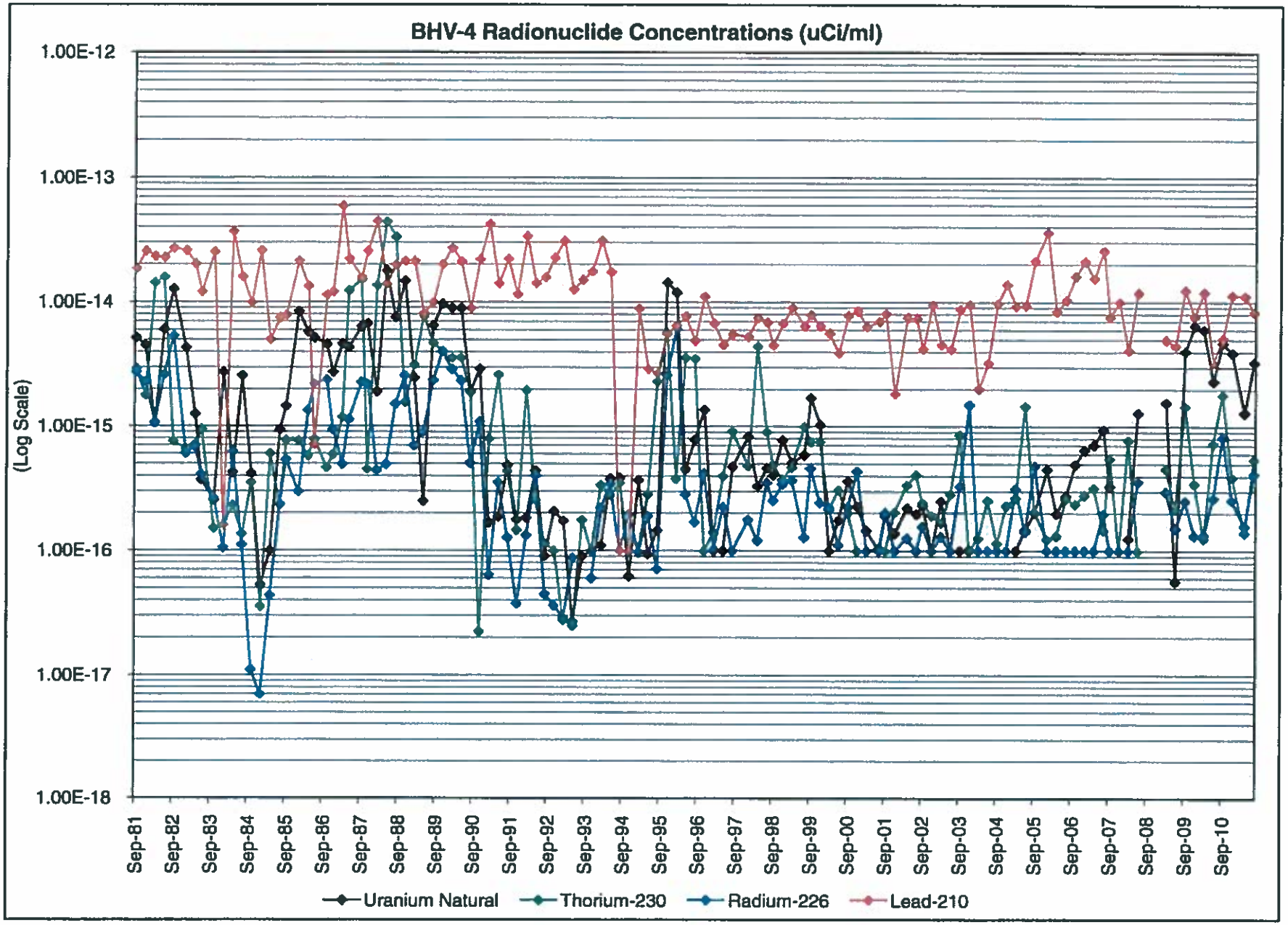
Sep-82
Sep-83
Sep-84
Sep-85
Sep-86
Sep-87
Sep-88
Sep-89
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Uranium Natural
Thorium-230
Radium-226
Lead-210


BHV-4 Radionuclide Concentrations (uCi/ml)
(Log Scale)
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1.00E-14
1.00E-15
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1.00E-17
1.00E-18
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Sep-83
Sep-84
Sep-85
Sep-86
Sep-87
Sep-88
Sep-89
Sep-90
Sep-91
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Sep-97
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Sep-00
Sep-01
Sep-02
Sep-03
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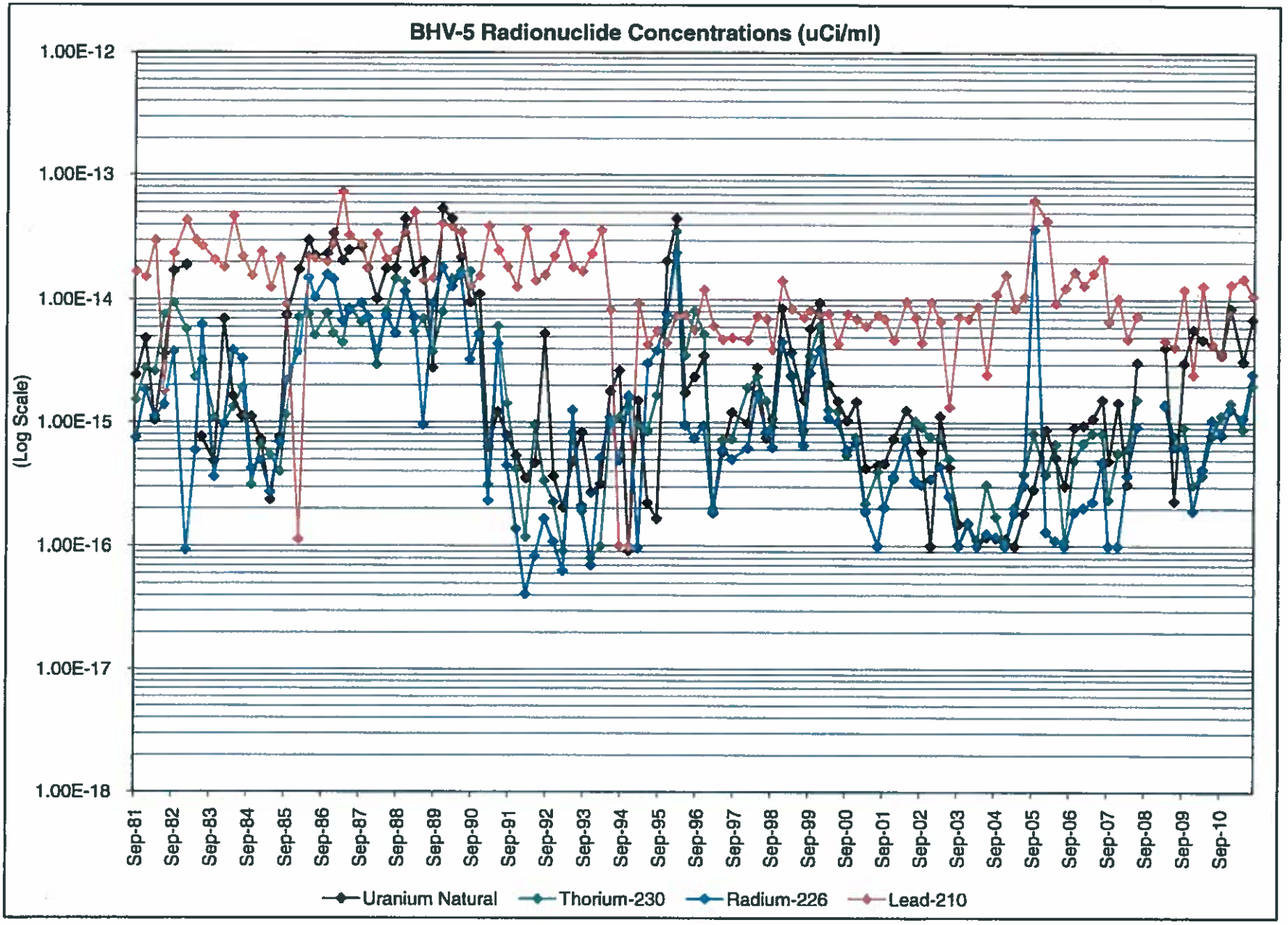
Sep-08
Sep-09
Sep-10
Uranium Natural
Thorium-230
Radium-226
Lead-210


BHV-5 Radionuclide Concentrations (uCi/ml)
(Log Scale)
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1.00E-14
1.00E-15
1.00E-16
1.00E-17
1.00E-18
Sep-81
Sep-82
Sep-83
Sep-84
Sep-85
Sep-86
Sep-87
Sep-88
Sep-89
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
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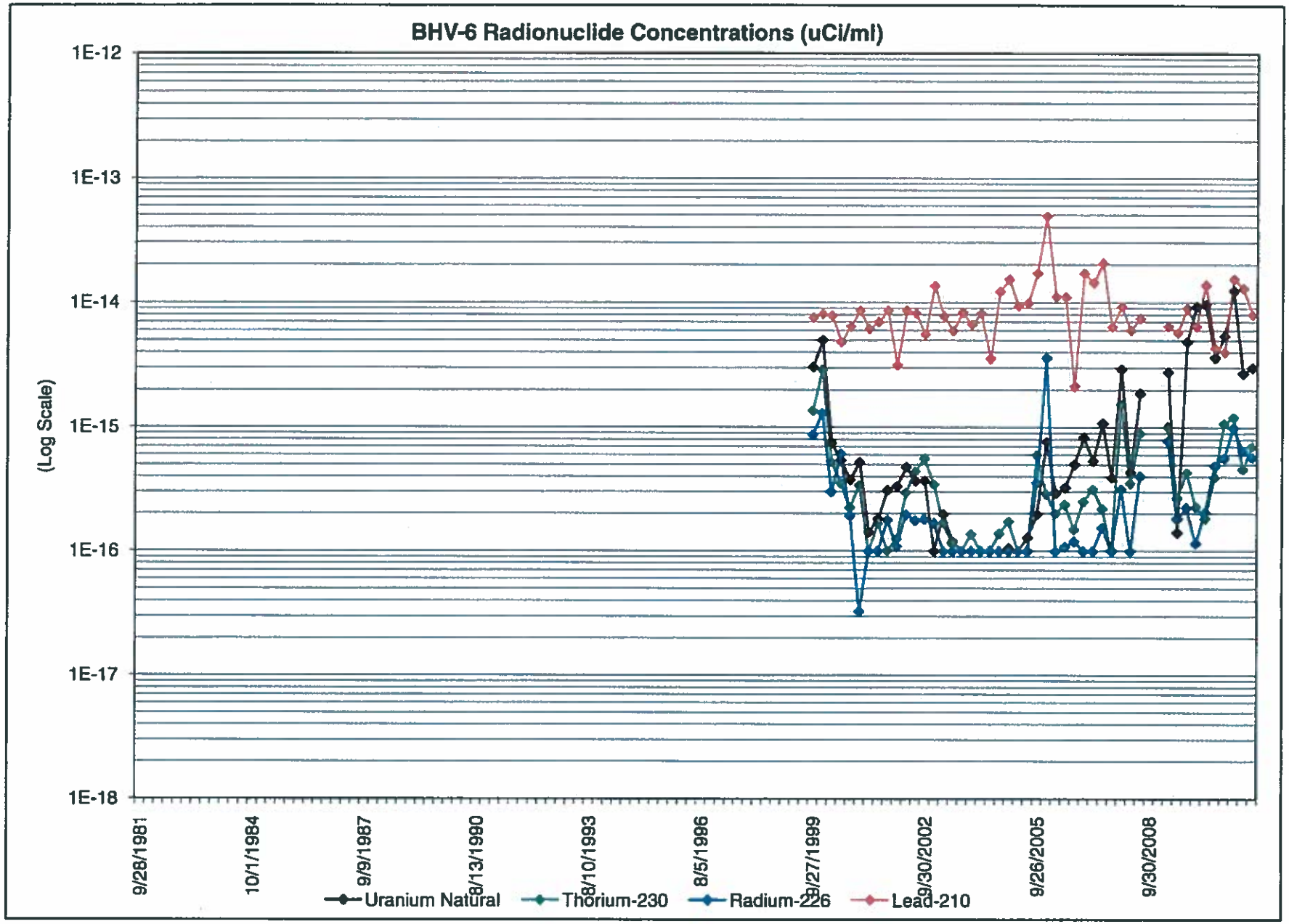
Sep-08
Sep-09
Sep-10
Uranium Natural
Thorium-230
Radium-226
Lead-210


BHV-6 Radionuclide Concentrations (uCi/ml)
1E-12
1E-13
1E-14
1E-15
1E-16
1E-17
1E-18
(Log Scale)
9/28/1981
10/1/1984
9/9/1987
8/13/1990
8/10/1993
8/5/1996
9/27/1999
9/30/2002
9/26/2005
9/30/2008
Uranium Natural
Thorium-230
Radium-226
Lead-210

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Helena, MT 877-472-0711 • Billings, MT 800-735-4489 • Casper, WY 888-235-0515
Gillette, WY 866-686-7175 • Rapid City, SD 888-672-1225 • College Station, TX 888-690-2218

ANALYTICAL SUMMARY REPORT

May 29, 2011

Denison Mines USA Corp
6425 S Hwy 191
Blanding, UT 84511

Workorder No.: C11040259

Project Name: 1st Quarter BHV Air 2011

Energy Laboratories, Inc. Casper WY received the following 6 samples for Denison Mines USA Corp on 4/7/2011 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C11040259-001	BHV-1	04/04/11 00:00	04/07/11	Filter	Composite of two or more samples Metals, Total Digestion, Total Metals Lead 210 Radium 226 Thorium, Isotopic
C11040259-002	BHV-2	04/04/11 00:00	04/07/11	Filter	Same As Above
C11040259-003	BHV-4	04/04/11 00:00	04/07/11	Filter	Same As Above
C11040259-004	BHV-5	04/04/11 00:00	04/07/11	Filter	Same As Above
C11040259-005	BHV-6	04/04/11 00:00	04/07/11	Filter	Same As Above
C11040259-006	Blank	04/04/11 00:00	04/07/11	Filter	Same As Above

This report was prepared by Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

Interim Branch Manager

Digitally signed by
Steve Carlston
Date: 2011.05.29 17:45:42 -06:00

CLIENT: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011
Sample Delivery Group: C11040259

Report Date: 05/29/11

CASE NARRATIVE

ORIGINAL SAMPLE SUBMITTAL(S)
All original sample submittals have been returned with the data package.

SAMPLE TEMPERATURE COMPLIANCE: 4°C (±2°C)
Temperature of samples received may not be considered properly preserved by accepted standards. Samples that are hand delivered immediately after collection shall be considered acceptable if there is evidence that the chilling process has begun.

GROSS ALPHA ANALYSIS
Method 900.0 for gross alpha and gross beta is intended as a drinking water method for low TDS waters. Data provided by this method for non potable waters should be viewed as inconsistent.

RADON IN AIR ANALYSIS
The desired exposure time is 48 hours (2 days). The time delay in returning the canister to the laboratory for processing should be as short as possible to avoid excessive decay. Maximum recommended delay between end of exposure to beginning of counting should not exceed 8 days.

SOIL/SOLID SAMPLES
All samples reported on an as received basis unless otherwise indicated.

ATRAZINE, SIMAZINE AND PCB ANALYSIS
Data for PCBs, Atrazine and Simazine are reported from EPA 525.2. PCB data reported by ELI reflects the results for seven individual Aroclors. When the results for all seven are ND (not detected), the sample meets EPA compliance criteria for PCB monitoring.

SUBCONTRACTING ANALYSIS
Subcontracting of sample analyses to an outside laboratory may be required. If so, ENERGY LABORATORIES will utilize its branch laboratories or qualified contract laboratories for this service. Any such laboratories will be indicated within the Laboratory Analytical Report.

BRANCH LABORATORY LOCATIONS
eli-b - Energy Laboratories, Inc. - Billings, MT
eli-g - Energy Laboratories, Inc. - Gillette, WY
eli-h - Energy Laboratories, Inc. - Helena, MT
eli-r - Energy Laboratories, Inc. - Rapid City, SD
eli-t - Energy Laboratories, Inc. - College Station, TX

CERTIFICATIONS:
USEPA: WY00002, Radiochemical WY00937; FL-DOH NELAC: E87641, Radiochemical E871017; California: 02118CA; Oregon: WY200001; Utah: 3072350515; Virginia: 00057; Washington: C1903

ISO 17025 DISCLAIMER:
The results of this Analytical Report relate only to the items submitted for analysis.

ENERGY LABORATORIES, INC. - CASPER,WY certifies that certain method selections contained in this report meet requirements as set forth by the above accrediting authorities. Some results requested by the client may not be covered under these certifications. All analysis data to be submitted for regulatory enforcement should be certified in the sample state of origin. Please verify ELI's certification coverage by visiting www.energylab.com

ELI appreciates the opportunity to provide you with this analytical service. For additional information and services visit our web page www.energylab.com.
Tests associated with analyst identified as ELI-CS were subcontracted to Energy Laboratories, 415 Graham Rd., College Station, TX, EPA Number TX01520.

HIGH VOLUME AIR SAMPLING REPORT

CLIENT: Denison Mines USA Corp
REPORT DATE: May 29, 2011
PROJECT: 1st Quarter BHV Air 2011

SAMPLE ID: BHV-1

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11040259-001	^{nat}U	9.01E-16	N/A	N/A	1E-16	9E-14	1.00E+00
First Quarter 2011	^{230}Th	1.90E-16	2E-17	3E-18	1E-16	3E-14	6.32E-01
Air Volume in mLs	^{226}Ra	3.64E-16	2E-17	2E-18	1E-16	9E-13	4.04E-02
1.35E+11	^{210}Pb	1.09E-14	1E-16	8E-17	2E-15	6E-13	1.82E+00

+LLD's are from Reg. Guide 4.14
*Effluent Concentration from the NEW 10 CFR Part 20 - Appendix B - Table 2
Year for Natural Uranium
Year for Thorium-230
Week for Radium-226
Day for Lead-210

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011
Lab ID: C11040259-001
Client Sample ID BHV-1

Report Date: 05/29/11
Collection Date: 04/04/11
DateReceived: 04/07/11
Matrix: Filter

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
TRACE METALS							
Uranium	0.179	mg/filter		0.0003		SW6020	04/13/11 18:40 / sml
Uranium, Activity	121	pCi/Filter		0.2		SW6020	04/13/11 18:40 / sml
RADIONUCLIDES - TOTAL							
Lead 210	1470	pCi/Filter				E909.0	05/17/11 05:59 / eli-cs
Lead 210 precision (±)	19	pCi/Filter				E909.0	05/17/11 05:59 / eli-cs
Lead 210 MDC	11	pCi/Filter				E909.0	05/17/11 05:59 / eli-cs
Radium 226	49.1	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 precision (±)	2.0	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 MDC	0.3	pCi/Filter				E903.0	04/25/11 23:45 / trs
Thorium 230	26	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 precision (±)	2.6	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 MDC	0.35	pCi/Filter				E908.0	05/02/11 13:56 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

HIGH VOLUME AIR SAMPLING REPORT

CLIENT: Denison Mines USA Corp
REPORT DATE: May 29, 2011
PROJECT: 1st Quarter BHV Air 2011

SAMPLE ID: BHV-2

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11040259-002	^{nat}U	3.79E-16	N/A	N/A	1E-16	9E-14	4.21E-01
First Quarter 2011	^{230}Th	4.01E-17	6E-18	2E-18	1E-16	3E-14	1.34E-01
Air Volume in mLs	^{226}Ra	9.11E-17	8E-18	2E-18	1E-16	9E-13	1.01E-02
1.31E+11	^{210}Pb	1.06E-14	1E-16	8E-17	2E-15	6E-13	1.76E+00

+LLD's are from Reg. Guide 4.14
*Effluent Concentration from the NEW 10 CFR Part 20 - Appendix B - Table 2
Year for Natural Uranium
Year for Thorium-230
Week for Radium-226
Day for Lead-210

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011
Lab ID: C11040259-002
Client Sample ID BHV-2

Report Date: 05/29/11
Collection Date: 04/04/11
DateReceived: 04/07/11
Matrix: Filter

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
TRACE METALS							
Uranium	0.0735	mg/filter		0.0003		SW6020	04/13/11 18:45 / sml
Uranium, Activity	49.8	pCi/Filter		0.2		SW6020	04/13/11 18:45 / sml
RADIONUCLIDES - TOTAL							
Lead 210	1390	pCi/Filter				E909.0	05/17/11 12:36 / eli-cs
Lead 210 precision (±)	17	pCi/Filter				E909.0	05/17/11 12:36 / eli-cs
Lead 210 MDC	9.9	pCi/Filter				E909.0	05/17/11 12:36 / eli-cs
Radium 226	12.0	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 precision (±)	1.0	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 MDC	0.3	pCi/Filter				E903.0	04/25/11 23:45 / trs
Thorium 230	5.3	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 precision (±)	0.83	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 MDC	0.29	pCi/Filter				E908.0	05/02/11 13:56 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

HIGH VOLUME AIR SAMPLING REPORT

CLIENT: Denison Mines USA Corp
REPORT DATE: May 29, 2011
PROJECT: 1st Quarter BHV Air 2011

SAMPLE ID: BHV-4

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11040259-003	^{nat}U	1.29E-15	N/A	N/A	1E-16	9E-14	1.44E+00
First Quarter 2011	^{230}Th	1.40E-16	2E-17	3E-18	1E-16	3E-14	4.66E-01
Air Volume in mLs	^{226}Ra	1.58E-16	1E-17	3E-18	1E-16	9E-13	1.75E-02
1.25E+11	^{210}Pb	1.11E-14	1E-16	8E-17	2E-15	6E-13	1.86E+00

+L.L.D's are from Reg. Guide 4.14
*Effluent Concentration from the NEW 10 CFR Part 20 - Appendix B - Table 2
Year for Natural Uranium
Year for Thorium-230
Week for Radium-226
Day for Lead-210

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011
Lab ID: C11040259-003
Client Sample ID BHV-4

Report Date: 05/29/11
Collection Date: 04/04/11
DateReceived: 04/07/11
Matrix: Filter

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
TRACE METALS							
Uranium	0.239	mg/filter		0.0003		SW6020	04/13/11 18:49 / sml
Uranium, Activity	162	pCi/Filter		0.2		SW6020	04/13/11 18:49 / sml
RADIONUCLIDES - TOTAL							
Lead 210	1400	pCi/Filter				E909.0	05/17/11 14:47 / eli-cs
Lead 210 precision (±)	17	pCi/Filter				E909.0	05/17/11 14:47 / eli-cs
Lead 210 MDC	9.9	pCi/Filter				E909.0	05/17/11 14:47 / eli-cs
Radium 226	19.7	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 precision (±)	1.4	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 MDC	0.4	pCi/Filter				E903.0	04/25/11 23:45 / trs
Thorium 230	18	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 precision (±)	2.0	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 MDC	0.35	pCi/Filter				E908.0	05/02/11 13:56 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

HIGH VOLUME AIR SAMPLING REPORT

CLIENT: Denison Mines USA Corp
REPORT DATE: May 29, 2011
PROJECT: 1st Quarter BHV Air 2011

SAMPLE ID: BHV-5

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11040259-004	^{nat}U	3.20E-15	N/A	N/A	1E-16	9E-14	3.56E+00
First Quarter 2011	^{230}Th	8.89E-16	8E-17	3E-18	1E-16	3E-14	2.96E+00
Air Volume in mLs	^{226}Ra	1.10E-15	3E-17	2E-18	1E-16	9E-13	1.22E-01
1.32E+11	^{210}Pb	1.48E-14	2E-16	7E-17	2E-15	6E-13	2.46E+00

+LLD's are from Reg. Guide 4.14
*Effluent Concentration from the NEW 10 CFR Part 20 - Appendix B - Table 2
Year for Natural Uranium
Year for Thorium-230
Week for Radium-226
Day for Lead-210

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011
Lab ID: C11040259-004
Client Sample ID BHV-5

Report Date: 05/29/11
Collection Date: 04/04/11
DateReceived: 04/07/11
Matrix: Filter

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
TRACE METALS							
Uranium	0.624	mg/filter		0.0003		SW6020	04/13/11 19:09 / sml
Uranium, Activity	423	pCi/Filter		0.2		SW6020	04/13/11 19:09 / sml
RADIONUCLIDES - TOTAL							
Lead 210	1950	pCi/Filter				E909.0	05/17/11 16:59 / eli-cs
Lead 210 precision (±)	20	pCi/Filter				E909.0	05/17/11 16:59 / eli-cs
Lead 210 MDC	9.9	pCi/Filter				E909.0	05/17/11 16:59 / eli-cs
Radium 226	145	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 precision (±)	3.6	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 MDC	0.3	pCi/Filter				E903.0	04/25/11 23:45 / trs
Thorium 230	117	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 precision (±)	10	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 MDC	0.38	pCi/Filter				E908.0	05/02/11 13:56 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

HIGH VOLUME AIR SAMPLING REPORT

CLIENT: Denison Mines USA Corp
REPORT DATE: May 29, 2011
PROJECT: 1st Quarter BHV Air 2011

SAMPLE ID: BHV-6

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11040259-005	^{234}U	2.70E-15	N/A	N/A	1E-16	9E-14	3.00E+00
First Quarter 2011	^{230}Th	4.62E-16	4E-17	3E-18	1E-16	3E-14	1.54E+00
Air Volume in mLs	^{226}Ra	6.51E-16	2E-17	2E-18	1E-16	9E-13	7.24E-02
1.32E+11	^{210}Pb	1.29E-14	1E-16	7E-17	2E-15	6E-13	2.14E+00

+LLD's are from Reg. Guide 4.14
*Effluent Concentration from the NEW 10 CFR Part 20 - Appendix B - Table 2
Year for Natural Uranium
Year for Thorium-230
Week for Radium-226
Day for Lead-210

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011
Lab ID: C11040259-005
Client Sample ID BHV-6

Report Date: 05/29/11
Collection Date: 04/04/11
DateReceived: 04/07/11
Matrix: Filter

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
TRACE METALS							
Uranium	0.527	mg/filter		0.0003		SW6020	04/13/11 19:13 / sml
Uranium, Activity	356	pCi/Filter		0.2		SW6020	04/13/11 19:13 / sml
RADIONUCLIDES - TOTAL							
Lead 210	1700	pCi/Filter				E909.0	05/17/11 19:11 / eli-cs
Lead 210 precision (±)	19	pCi/Filter				E909.0	05/17/11 19:11 / eli-cs
Lead 210 MDC	9.8	pCi/Filter				E909.0	05/17/11 19:11 / eli-cs
Radium 226	86.0	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 precision (±)	2.8	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 MDC	0.3	pCi/Filter				E903.0	04/25/11 23:45 / trs
Thorium 230	61	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 precision (±)	5.8	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 MDC	0.37	pCi/Filter				E908.0	05/02/11 13:56 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

HIGH VOLUME AIR SAMPLING REPORT

CLIENT: Denison Mines USA Corp
REPORT DATE: May 29, 2011
PROJECT: 1st Quarter BHV Air 2011

SAMPLE ID: Blank

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11040259-006	^{nat}U	1.22E-17	N/A	N/A	1E-16	9E-14	1.35E-02
First Quarter 2011	^{230}Th	5.84E-19	2E-18	3E-18	1E-16	3E-14	1.95E-03
Air Volume in mLs	^{226}Ra	5.16E-18	2E-18	3E-18	1E-16	9E-13	5.73E-04
1.36E+11	^{210}Pb	-4.51E-17	4E-17	7E-17	2E-15	6E-13	-7.51E-03

Note: This sample uses 136,000,000 L of air volume for comparison purposes.

+LLD's are from Reg. Guide 4.14
*Effluent Concentration from the NEW 10 CFR Part 20 - Appendix B - Table 2
Year for Natural Uranium
Year for Thorium-230
Week for Radium-226
Day for Lead-210

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011
Lab ID: C11040259-006
Client Sample ID Blank

Report Date: 05/29/11
Collection Date: 04/04/11
DateReceived: 04/07/11
Matrix: Filter

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
TRACE METALS							
Uranium	0.0024	mg/filter		0.0003		SW6020	04/13/11 19:17 / sml
Uranium, Activity	1.7	pCi/Filter		0.2		SW6020	04/13/11 19:17 / sml
RADIONUCLIDES - TOTAL							
Lead 210	-6	pCi/Filter	U			E909.0	05/17/11 21:23 / eli-cs
Lead 210 precision (±)	5.8	pCi/Filter				E909.0	05/17/11 21:23 / eli-cs
Lead 210 MDC	9.9	pCi/Filter				E909.0	05/17/11 21:23 / eli-cs
Radium 226	0.7	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 precision (±)	0.3	pCi/Filter				E903.0	04/25/11 23:45 / trs
Radium 226 MDC	0.3	pCi/Filter				E903.0	04/25/11 23:45 / trs
Thorium 230	0.08	pCi/Filter	U			E908.0	05/02/11 13:56 / dmf
Thorium 230 precision (±)	0.30	pCi/Filter				E908.0	05/02/11 13:56 / dmf
Thorium 230 MDC	0.37	pCi/Filter				E908.0	05/02/11 13:56 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011

Report Date: 05/29/11
Work Order: C11040259

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0										Batch: R145159
Sample ID: LCS-29538		Laboratory Control Sample				Run: TENNELEC-3_110419A				04/25/11 23:45
Radium 226		12.2	pCi/Filter		101	70	130			
Sample ID: MB-29538	3	Method Blank				Run: TENNELEC-3_110419A				04/25/11 23:44
Radium 226		0.03	pCi/Filter							U
Radium 226 precision (±)		0.1	pCi/Filter							
Radium 226 MDC		0.2	pCi/Filter							
Sample ID: C11040296-001HMS		Sample Matrix Spike				Run: TENNELEC-3_110419A				04/26/11 01:24
Radium 226		10	pCi/L		101	70	130			
Sample ID: C11040296-001HMSD		Sample Matrix Spike Duplicate				Run: TENNELEC-3_110419A				04/26/11 01:24
Radium 226		9.2	pCi/L		93	70	130	8.7	24.1	

Qualifiers:

RL - Analyte reporting limit.
MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.
U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011

Report Date: 05/29/11
Work Order: C11040259

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E908.0										Batch: R145606
Sample ID: LCS-29538		Laboratory Control Sample				Run: EGG-ORTEC_110428B				05/02/11 13:56
Thorium 230		10.9	pCi/Filter		111	70	130			
Sample ID: MB-29538	3	Method Blank				Run: EGG-ORTEC_110428B				05/02/11 13:56
Thorium 230		-0.08	pCi/Filter							U
Thorium 230 precision (±)		0.07	pCi/Filter							
Thorium 230 MDC		0.1	pCi/Filter							
Sample ID: C11040257-001AMS		Sample Matrix Spike				Run: EGG-ORTEC_110428B				05/02/11 13:56
Thorium 230		56.4	pCi/Filter		109	70	130			
Sample ID: C11040257-001AMSD		Sample Matrix Spike Duplicate				Run: EGG-ORTEC_110428B				05/02/11 13:56
Thorium 230		57.7	pCi/Filter		112	70	130	2.4	31.8	

Qualifiers:

RL - Analyte reporting limit.
MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.
U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011

Report Date: 05/29/11
Work Order: C11040259

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E909.0										Batch: T_13784
Sample ID: C11040259-001AMSD		Sample Matrix Spike Duplicate				Run: SUB-T40416				05/17/11 10:24
Lead 210		2250	pCi/Filter		73	70	130	4.4	13.6	
Sample ID: C11040259-001AMS		Sample Matrix Spike				Run: SUB-T40416				05/17/11 08:11
Lead 210		2160	pCi/Filter		65	70	130			S
- Spike response is outside of the acceptance range for this analysis. Since the LCS and the RPD for the MS MSD pair are acceptable, the response is considered to be matrix related. The batch is approved.										
Sample ID: LCS-13784		Laboratory Control Sample				Run: SUB-T40416				05/17/11 03:47
Lead 210		279	pCi/Filter		80	70	130			
Sample ID: MB-13784	3	Method Blank				Run: SUB-T40416				05/17/11 01:35
Lead 210		-4	pCi/Filter							U
Lead 210 precision (±)		6	pCi/Filter							
Lead 210 MDC		10	pCi/Filter							

Qualifiers:

RL - Analyte reporting limit.
MDC - Minimum detectable concentration
U - Not detected at minimum detectable concentration

ND - Not detected at the reporting limit.
S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Denison Mines USA Corp
Project: 1st Quarter BHV Air 2011

Report Date: 05/29/11
Work Order: C11040259

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: 29538
Sample ID: MB-29538		Method Blank				Run: ICPMS4-C_110413A				04/13/11 18:28
Uranium		4E-05	mg/filter							
Sample ID: LCS2-29538		Laboratory Control Sample				Run: ICPMS4-C_110413A				04/13/11 18:32
Uranium		0.107	mg/filter	0.00030	107	85	115			
Sample ID: C11040259-006AMS		Sample Matrix Spike				Run: ICPMS4-C_110413A				04/13/11 19:21
Uranium		0.0588	mg/filter	0.00030	113	75	125			
Sample ID: C11040259-006AMSD		Sample Matrix Spike Duplicate				Run: ICPMS4-C_110413A				04/13/11 19:26
Uranium		0.0585	mg/filter	0.00030	112	75	125	0.4	20	

Qualifiers:

RL - Analyte reporting limit.
MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

C11040259

Denison Mines USA Corp

Login completed by: Halley Ackerman
Reviewed by: BL2000\kschroeder
Reviewed Date: 4/14/2011

Date Received: 4/7/2011
Received by: ha
Carrier name: 2Day

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature:	NA °C		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

None

Chain of Custody and Analytical Request Record

ENERGY LABORATORIES

PLEASE PRINT (Provide as much information as possible.)

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
Denison Mines	1ST Quarter	State: UT	Yes ☑ No ☐
Report Mail Address:	**Contact Name:** Phone/Fax:	**Email:**	**Sampler: (Please Print)**
P.O Box 809 Blanding UT 84511	Ryan Palmer 678-2221		Tanner Holliday
Invoice Address:	**Invoice Contact & Phone:**	**Purchase Order:**	**Quote/Bottle Order:**
Same	Same		

Special Report/Formats:

☐ DW ☐ EDD/EDT (Electronic Data)
☐ POTW/WWTP Format: _____
☐ State: _____ ☐ LEVEL IV
☐ Other: _____ ☐ NELAC

Number of Containers
Sample Type: A Air W Water S Soils/Solids V Vegetation B Bioassay O Other DW - Drinking Water

ANALYSIS REQUESTED

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	UNAT	Th-230	Ra-226	Pb-210	SEE ATTACHED
1 BHV-1	1/3/11 4-4-11		13-A	X	X	X	X	
2 BHV-2				X	X	X	X	
3 BHV-4				X	X	X	X	
4 BHV-5				X	X	X	X	
5 BHV-6				X	X	X	X	
6 Blank	1/3/11 4/4/11		13-A	X	X	X	X	
7								
8								
9								
10								

Standard Turnaround (TAT)

RUSH

Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

Comments:

Shipped by: UPS Next 2DA

Cooler ID(s): Box

Receipt Temp: N/A °C

On Ice: Y N

Custody Seal: On Bottle Y N; On Cooler Y N; Intact Y N; Signature Match Y N

LABORATORY USE ONLY

C1040159

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Ryan Palmer	4.5.2011 1100				
Relinquished by (print):	Date/Time:	Signature	Received by (print):	Date/Time:	Signature:
			Received by Laboratory:	Date/Time: 4-7-11 915	Signature:

Sample Disposal: Return to Client: _____ Lab Disposal: _____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES
www.energylab.com
Analytical Excellence Since 1952
Helena, MT 877-472-0711 • Billings, MT 800-735-4489 • Casper, WY 888-235-0515
Gillette, WY 866-686-7175 • Rapid City, SD 888-672-1225 • College Station, TX 888-690-2218

ANALYTICAL SUMMARY REPORT

August 07, 2011

Denison Mines USA Corp
6425 S Hwy 191
Blanding, UT 84511

Workorder No.: C11070215
Project Name: 2nd Quarter BHV Air 2011

Energy Laboratories, Inc. Casper WY received the following 6 samples for Denison Mines USA Corp on 7/7/2011 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C11070215-001	BHV-1	07/04/11 00:00	07/07/11	Filter	Composite of two or more samples Metals, Total Digestion, Total Metals Lead 210 Radium 226 Thorium, Isotopic
C11070215-002	BHV-2	07/04/11 00:00	07/07/11	Filter	Same As Above
C11070215-003	BHV-4	07/04/11 00:00	07/07/11	Filter	Same As Above
C11070215-004	BHV-5	07/04/11 00:00	07/07/11	Filter	Same As Above
C11070215-005	BHV-6	07/04/11 00:00	07/07/11	Filter	Same As Above
C11070215-006	Blank	07/04/11 00:00	07/07/11	Filter	Same As Above

This report was prepared by Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing. All samples are reported on an as received basis unless otherwise indicated. Samples corrected for dry weight indicate units that have -dry appended.

If you have any questions regarding these test results, please call.

Report Approved By: Interim Branch Manager

Digitally signed by
Steve Carlston
Date: 2011.08.07 13:58:26 -06:00

CLIENT: Denison Mines USA Corp
Project: 2nd Quarter BHV Air 2011
Sample Delivery Group: C11070215

Report Date: 08/07/11

CASE NARRATIVE

ORIGINAL SAMPLE SUBMITTAL(S)
All original sample submittals have been returned with the data package.

SAMPLE TEMPERATURE COMPLIANCE: 4°C (±2°C)
Temperature of samples received may not be considered properly preserved by accepted standards. Samples that are hand delivered immediately after collection shall be considered acceptable if there is evidence that the chilling process has begun.

GROSS ALPHA ANALYSIS
Method 900.0 for gross alpha and gross beta is intended as a drinking water method for low TDS waters. Data provided by this method for non potable waters should be viewed as inconsistent.

RADON IN AIR ANALYSIS
The desired exposure time is 48 hours (2 days). The time delay in returning the canister to the laboratory for processing should be as short as possible to avoid excessive decay. Maximum recommended delay between end of exposure to beginning of counting should not exceed 8 days.

SOIL/SOLID SAMPLES
All samples reported on an as received basis unless otherwise indicated.

ATRAZINE, SIMAZINE AND PCB ANALYSIS
Data for PCBs, Atrazine and Simazine are reported from EPA 525.2. PCB data reported by ELI reflects the results for seven individual Aroclors. When the results for all seven are ND (not detected), the sample meets EPA compliance criteria for PCB monitoring.

SUBCONTRACTING ANALYSIS
Subcontracting of sample analyses to an outside laboratory may be required. If so, ENERGY LABORATORIES will utilize its branch laboratories or qualified contract laboratories for this service. Any such laboratories will be indicated within the Laboratory Analytical Report.

BRANCH LABORATORY LOCATIONS
eli-b - Energy Laboratories, Inc. - Billings, MT
eli-g - Energy Laboratories, Inc. - Gillette, WY
eli-h - Energy Laboratories, Inc. - Helena, MT
eli-r - Energy Laboratories, Inc. - Rapid City, SD
eli-t - Energy Laboratories, Inc. - College Station, TX

CERTIFICATIONS:
USEPA: WY00002, Radiochemical WY00937; FL-DOH NELAC: E87641, Radiochemical E871017; California: 02118CA; Oregon: WY200001; Utah: 3072350515; Virginia: 00057; Washington: C1903

ISO 17025 DISCLAIMER:
The results of this Analytical Report relate only to the items submitted for analysis.

ENERGY LABORATORIES, INC. - CASPER,WY certifies that certain method selections contained in this report meet requirements as set forth by the above accrediting authorities. Some results requested by the client may not be covered under these certifications. All analysis data to be submitted for regulatory enforcement should be certified in the sample state of origin. Please verify ELI's certification coverage by visiting www.energylab.com

ELI appreciates the opportunity to provide you with this analytical service. For additional information and services visit our web page www.energylab.com.
Tests associated with analyst identified as ELI-CS were subcontracted to Energy Laboratories, 415 Graham Rd., College Station, TX, EPA Number TX01520.

HIGH VOLUME AIR SAMPLING REPORT

CLIENT: Denison Mines USA Corp
REPORT DATE: August 7, 2011
PROJECT: 2nd Quarter BHV Air 2011

SAMPLE ID: BHV-1

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11040259-001	^{nat}U	9.01E-16	N/A	N/A	1E-16	9E-14	1.00E+00
First Quarter 2011	^{230}Th	1.90E-16	2E-17	3E-18	1E-16	3E-14	6.32E-01
Air Volume in mLs	^{226}Ra	3.64E-16	2E-17	2E-18	1E-16	9E-13	4.04E-02
1.35E+11	^{210}Pb	1.09E-14	1E-16	8E-17	2E-15	6E-13	1.82E+00

Quarter/Date Sampled Air Volume	Radionuclide	Concentration µCi/mL	Counting Precision µCi/mL	MDC µCi/mL	L.L.D.+ µCi/mL	Effluent Conc.* µCi/mL	% Effluent Concentration
C11070215-001	^{nat}U	1.59E-15	N/A	N/A	1E-16	9E-14	1.77E+00
Second Quarter 2011	^{230}Th	5.31E-16	5E-17	4E-18	1E-16	3E-14	1.77E+00
Air Volume in mLs	^{226}Ra	4.99E-16	2E-17	3E-18	1E-16	9E-13	5.54E-02
1.38E+11	^{210}Pb	8.38E-15	2E-16	1E-16	2E-15	6E-13	1.40E+00

+LLD's are from Reg. Guide 4.14
*Effluent Concentration from the NEW 10 CFR Part 20 - Appendix B - Table 2
Year for Natural Uranium
Year for Thorium-230
Week for Radium-226
Day for Lead-210

Supplement to UMUT Question 7

7. On page 25390 of the proposed rulemaking, the EPA states: "We presently have no data or information that shows any other HAPs being emitted from these impoundments." Please provide a response to the following initial questions, data, and information regarding other HAPs that may be emitted from the WMM.

   a. The WMM's 10 C.F.R. § 40.65 environmental airborne particulate monitoring program monitors for natural uranium (Uranium-238, Uranium-234, Uranium-235), Thorium-230, Radium-226, and Lead-210.[1] This air monitoring program has detected all four isotopes at all of the air monitoring stations.[2] Additionally, the WMM has identified Lead-210, Thorium-230, Thorium-232, Polonium-210, Radium-226, and Radium-228 in wastewater samples from the tailings impoundments.[3] This indicates that sources at the WMM (including the tailings impoundments, stackhouses, ore pad, ore grinder, and the Mill yard)[4] are emitting radionuclides other than Radon-222.
   b. The WMM processes uranium ore. During the uranium storage and milling processes, there may be more than three dozen radioactive isotopes present at the WMM facility (including actinium, astatine, bismuth, francium, lead, polonium, protactinium, radium, radon, thallium, thorium, and uranium).[5] This indicates that sources at the WMM (including the tailings impoundments, stackhouses, ore pad, ore grinder, and the Mill yard)[6] are emitting radionuclides other than Radon-222.
   c. The WMM's uranium milling process uses significant quantities of chemicals (sodium chlorate is used during ore oxidation; sulfuric acid and flocculants are used during the leaching and clarification; secondary amines/kerosene, tri-alkyl amines/tributyl phosphate modifier, and quaternary ammonium compounds/alcohol are used during the solvent extraction; chlorides and sulfates are used during pregnant liquor stripping; and ammonia hydroxide and sodium hydroxide during yellowcake precipitation).[7] During the storage and use of these chemicals, and after these chemicals are disposed in the tailings impoundments, there may be significant emissions of HAPs at the WMM.

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[1]Denison Mine (USA) Corporation. August 31, 2011. White Mesa Mill Radioactive License UT900479. Semi-Annual Effluent Report. Denver, Colorado. Page 2.

[2] Denison Mine (USA) Corporation. August 31, 2011. White Mesa Mill Radioactive License UT900479. Semi-Annual Effluent Report. Denver, Colorado. Graphs and Report.

[3]Energy Fuels Resources (USA) Inc. November 1, 2013. White Mesa Uranium Mill, 2013 Annual Tailings Cells Wastewater Sampling Report.

[4] Dames & Moore. January 30, 1978. Environmental Report, White Mesa Uranium Project, San Juan County, Utah for Energy Fuels Nuclear, Inc. Appendix H excerpt.

[5] U.S. Environmental Protection Agency. February 2014. Technical and Regulatory Support to Develop a Rulemaking to Potentially Modify the NESHAP Subpart W Standard for Radon Emissions from Operating Uranium Mills (40 CFR 61.250). Office of Radiation and Indoor Air. Washington, DC. Figure 12 on Page 44; Nuclear Forensic Search Project. http://metadata.berkeley.edu/nuclear-forensics/Decay%20Chains.html; Retrieved June 26, 2014. University of California-Berkeley.

[6 6] Dames & Moore. January 30, 1978. Environmental Report, White Mesa Uranium Project, San Juan County, Utah for Energy Fuels Nuclear, Inc. Appendix H excerpt.

[8] Utah Division of Radiation Control. December 1, 2004. Groundwater Water Quality Discharge Permit, Draft Statement of Basis: For a Uranium Milling Facility At White Mesa, South of Blanding Utah. Page 11.

d. The WMM processes alternate feed materials. During the alternate feed storage and milling processes, other radioactive isotopes, non-metal compounds, and other regulated HAPs may be emitted from the WMM.
e. The WMM processes vanadium ore. Vanadium is considered to be dangerous to life and health by both the Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health, and may be listed as a HAP in the future.[8] The WMM's vanadium recovery process uses a significant quantity of chemicals (sodium chlorate is used during the redox/pH adjustment; kerosene and secondary amines are used during the solvent extraction; soda ash is used during the vanadium pregnant liquor stripping process; and ammonia hydroxide is used during the vanadium precipitation).[9] This indicates that the vanadium recovery process results in the emission of HAPs other than Radon-222 from the WMM facility.

List of Background Documents

1. Semi-Annual Effluent Report, 2011. Excerpts sent electronically, full document on disc.
2. 2013 Annual Tailings Cells Wastewater Sampling Report. Excerpts sent electronically, full document on disc.
3. Groundwater Water Quality Discharge Permit, Draft Statement of Basis. Excerpts sent electronically, full document on disc.
4. 1978 Dames & Moore. Excerpts sent electronically, full document on disc.

[9] Occupational Safety and Health Administration. Retrieved June 26, 2014. Occupational Safety and Health Guidelines for Vanadium Pentoxide. https://www.osha.gov/dts/chemicalsampling/data/CH_275000.html; National Institute for Occupational Safety and Health. Retrieved June 26, 2014. Documentation for Immediately Dangerous to Life or Health Concentrations, Vanadium Dust. http://www.cdc.gov/niosh/idlh/vandust.html.

[10] Utah Division of Radiation Control. December 1, 2004. Groundwater Water Quality Discharge Permit, Draft Statement of Basis: For a Uranium Milling Facility At White Mesa, South of Blanding Utah. Page 11.

Table 3. Summary of White Mesa Milling Processes and Reagents Added.

	Process Step	Actual and Potential Contaminants Added		
Uranium Milling Operations [1]	Ore Oxidation		Sodium chlorate ($NaClO_3$) [6,000 lb/day] [2]	
	Uranium Leaching and Clarification [3]	Sulfuric acid (H_2SO_4) [392,000 lb/day] [2]	Flocculants [600 lb/day] [2]	
	Solvent Extraction	Secondary amines with aliphatic side chains [84 lb/day] [4]	High molecular weight tri-alkyl amines	Quaternary ammonium compounds
		Kerosene [1,596 lb/day] [4]	Tributyl phosphate modifier	Long chain alcohols
	Pregnant Liquor Stripping	Chlorides (NaCl) [15,000 lb/day] [2]	Sulfates	
	Yellowcake Precipitation	Ammonia hydroxide (NH_3OH) [2,000 lb/day] [5]	Sodium hydroxide (NaOH)	
Copper Recovery [6]				
Vanadium Recovery [7]	Redox / pH Adjustment	Sodium chlorate ($NaClO_3$) [6,000 lb/day] [2]		
	Solvent Extraction	Kerosene [1,596 lb/day] [4]	Secondary amines with aliphatic side chains [84 lb/day] [4]	
	Pregnant Liquor Stripping	Soda Ash (Na_2CO_3) solution [10,000 GWQS[2] lb/day] [2]		
	Vanadium Precipitation	Ammonia hydroxide (NH_3OH) [2,000 lb/day] [5]		

Footnotes:

1) For additional information on common acid leach circuit processes at conventional uranium mills, see EPA, 1995, pp. 22-25.
2) Total daily pounds used of each reagent at the IUC White Mesa uranium mill is listed in brackets [], as provided in the 5/28/99 IUC report, p. A-8, Table A-1 and the 1/30/78 Dames and Moore Report, p. 3-5 and Plates 3.2-1 (uranium milling process), 3.2-2 (copper recovery), and 3.2-3 (vanadium recovery). Both of these documents detail use of manganese oxide [30,000 lb/day] in three process steps, including: 1) uranium ore oxidation, 2) uranium leaching and clarification, and 3) copper recovery (leaching). However, use of manganese oxide was listed in these original mill documents as an option in case the preferred oxidizer, sodium chlorate, was not available or was not economic. History of the mill shows that concerns about price or availability of sodium chlorate never materialized, hence manganese oxide was never used in any of these three process (personal communication, Mr. Harold Roberts, 11/15/04).
3) Also known as the uraniferous ion stabilization step (EPA, 1995, pp. 22-25).
4) Total "organic" used daily = 1,680 lb/day, of which kerosene is reported to be 95% (ibid.) DRC staff then assumed that remainder of the "organic" used in the solvent extraction circuit = amine type compounds used for anionic solvent extraction in the kerosene carrier (84 lb/day).
5) IUC reports only ammonia (NH^3) used in the yellowcake precipitation step [5/28/99 IUC report, p. A-8, Table A-1 and 1/30/78 Dames and Moore Report, p. 3-5 and Plate 3.2-1 (uranium milling process)]. However, once in an aqueous form, the ammonia likely occurs as ammonia hydroxide in solution.
6) Copper recovery was once envisioned for the White Mesa mill (1/30/78 Dames and Moore Report, pp. 3-6 and 7, and Plate 3.2-2), however it was never implemented (personal communication, Mr. Harold Roberts, 10/15/04).
7) Vanadium recovery information for White Mesa mill from 1/30/78 Dames and Moore Report, pp. 3-7 to 10, and Plate 3.2-3.

Table 4. Ranking of Reported White Mesa Mill Reagents*

Reagent	Daily Consumption (lb/day)
Sulfuric acid (H_2SO_4)	392,000
Chlorides (NaCl)	15,000
Soda Ash (Na_2CO_3)	10,000
Sodium chlorate ($NaClO_3$)	6,000
Ammonia	2,000
Kerosene	1,596
Flocculants	600
Amines (uranium extraction solvent)	84

* From Table 3, above.

1980 – 2003 IUC/NRC Tailings Wastewater Samples*[1]

Constituent	Minimum	Maximum
pH (Std units)	0.7	2.33
Nutrients (mg/L)		
Ammonia (N)	3.0	13900
Nitrite (N)	<100	<100
Nitrate (N)	24	24
Nitrate+Nitrite (N)	17.0	49.2
Phosphorus – total	88.1	620
TKN (N)	4900	5300
Inorganics (mg/L)		
Bicarbonate (HCO3)	<5	<5
Bromide	<500	<500
Carbonate (CO3)	<1	<5
Chloride	2110	8000
Cyanide – total	0.022	0.022
Fluoride	0.02	4400
Phosphate	<500	<500
Silica	110	400
Sulfate	29800	190000
Sulfide	<5	<5
TDS	43100	189000
TOC	76.0	81
TSS	31.0	115
Metals (mg/l)		
Aluminum	330	2530
Antimony	<20	<20
Arsenic	0.3	440
Barium	1.021	0.1
Beryllium	0.347	0.78
Boron	3.5	11.3
Cadmium	1.64	6.6
Calcium	90.0	630
Chromium	1.0	13
Cobalt	14.0	120
Copper	72.2	740
Iron	1080	3400
Gallium	<30	<30
Lead	0.21	6.0
Lithium	<10	<20
Magnesium	1800	7900
Manganese	74.0	222
Mercury	0.0008	17.6
Molybdenum	0.44	240
Nickel	7.2	370
Potassium	219.0	828
Selenium	0.18	2.4
Silver	0.005	0.14
Sodium	1400	10000
Strontium	3.6	14
Thallium	0.7	45
Tin	<5	<5
Titanium	6.5	33.3
Uranium	5.0	154
Vanadium	136	510
Zinc	50	1300
Zirconium	2.3	38.5
Radiologics (pCi/L)		
Gross Alpha	14000	189000
Gross Beta	74	116000
Lead-210	680	20700
Thorium-230	3650	76640
Thorium-232	49	121
Polonium-210	1410	1410
Radium-226	40	1690
Radium-228	1.9	1.9

1980 – 2003 IUC/NRC Tailings Wastewater Samples*[1]

Constituent	Minimum	Maximum
Total Radium	42	1700
Selected VOCs (ug/L)		
Acetone	28	514
Benzene	<5	<5
2-butanone (MEK)	11	15.13
Carbon Disulfide	16	16
Carbon Tetrachloride	<5	<5
Chloroform	6	16.84
1,1-Dichloroethane	<5	<5
1,2-Dichloroethane	<5	<5
Dichloromethane	10	11
Tetrahydofuran	N/A	N/A
Toluene	<5	6.25
Vinyl Chloride	<10	<10
Xylene (total)	<5	<5
Selected Semivolatiles (ug/L)		
Benzo(a)pyrene	<10	<10
Bis(2-ethylhexyl)phthalate	1	1
Chrysene	<10	<10
Diethyl phthalate	<10	18.1
Dimethylphthalate	2.7	2.7
Di-n-butylphthalate	1.08	1.08
Fluoranthene	<10	<10
2-Methylnaphthalene	<10	<10
Naphthalene	2.44	2.44
Phenol	<10	38.4

*Reproduced from the Utah Division of Radiation Control Groundwater Quality Discharge Permit, Statement of Basis for a Uranium Mining Facility at White Mesa, South of Blanding, Utah, dated December 1, 2004.

[1]The data in the Utah Division of Radiation Control Groundwater Quality Discharge Permit, Statement of Basis are based on historical data collected from Cell 1, Cell 2, and Cell 3. The date of collection reflects which cells were operational at the time of sampling. The location of the samples and date of collection is referenced in the Statement of Basis.

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:55 PM
To: Thornton, Marisa
Subject: FW: Comment period extension for "Subpart W" rule

From: McCabe, Janet
Sent: Wednesday, July 02, 2014 10:23 PM
To: Flynn, Mike
Cc: Shaw, Betsy; Stewart, Lori; Edwards, Jonathan; Cherepy, Andrea
Subject: RE: Comment period extension for "Subpart W" rule

Ok, Mike. thanks for the heads up. No problem on my end.

From: Flynn, Mike
Sent: Wednesday, July 2, 2014 11:47 AM
To: McCabe, Janet
Cc: Shaw, Betsy; Stewart, Lori; Edwards, Jonathan; Cherepy, Andrea
Subject: Comment period extension for "Subpart W" rule

Janet,

Just wanted to let you know that I just signed off on an FR Notice headed your way to extend the comment period on the “Subpart W” proposal, the NESHAP Amendments for Uranium Mill Tailings.
As a reminder, this proposal revises the radon emission standards and work practices for operating uranium mill tailings impoundments.

We received several requests to extend the comment period, which currently closes on July 31. As you know, we also are working with OGC on an issue raised by the litigant and also have received a request for Tribal consultation from the Ute Mountain Ute Tribe. We’ve consulted with OGC on the timing to address these various requests/issues , and are recommending a 90 day comment extension.

Please let me know if you have any questions or concerns.

Thanks, Mike

Mike Flynn, Director
Office of Radiation & Indoor Air
U.S. EPA
202-343-9356

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:55 PM
To: Thornton, Marisa
Subject: FW: Comment period extension for "Subpart W" rule

From: Edwards, Jonathan
Sent: Thursday, July 03, 2014 6:32 AM
To: Rosnick, Reid; Peake, Tom; Schultheisz, Daniel
Cc: Perrin, Alan
Subject: Fw: Comment period extension for "Subpart W" rule

FYI

From: McCabe, Janet
Sent: Wednesday, July 2, 2014 10:22:34 PM
To: Flynn, Mike
Cc: Shaw, Betsy; Stewart, Lori; Edwards, Jonathan; Cherepy, Andrea
Subject: RE: Comment period extension for "Subpart W" rule

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Thanks, Mike

Mike Flynn, Director
Office of Radiation & Indoor Air
U.S. EPA

202-343-9356

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:55 PM
To: Thornton, Marisa
Subject: FW: please invite Sue and Pat Childers to Mike's pre-brief on Ute

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From: Peake, Tom
Sent: Thursday, July 03, 2014 8:21 AM
To: Rosnick, Reid
Cc: Schultheisz, Daniel
Subject: please invite Sue and Pat Childers to Mike's pre-brief on Ute

Reid,
Jon would like to have Sue, and potentially Pat Childers and/or somebody from OITA at the Ute pre-brief with Mike.
Can you get in touch with these folks?
Thanks.

Tom Peake
US EPA Radiation Protection Division
Director, Center for Waste Management and Regulations
phone: 202-343-9765

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:55 PM
To: Thornton, Marisa
Subject: FW: Requesting announcements for NTOC talking points

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From: Childers, Pat
Sent: Thursday, July 03, 2014 8:41 AM
To: Drinkard, Andrea; Colon, Toni; King, Melanie; Tapia, Rosalva; Rosnick, Reid; Mckelvey, Laura
Cc: Wilson, Erika; Harrison, Jed
Subject: FW: Requesting announcements for NTOC talking points

Hi All.

Request for Admin talkers for a July 24 meeting with Tribes deadline Tuesday (gulp).

I think 111(d), Tribal Minor Source Review are the top two with DERA and Uranium also being of high level interest. **Can folks pull from existing materials** and send me the key bullets of interest to the tribes. Let me know if there are other topics we should include. **To me by 12:31 pm on Tuesday please.**

Andrea, I was going to coordinate through me but will gladly bow to your office. It seems like OITA should be going through you and your equivalents on these type of requests or at least tying you in.

Pat

From: Childers, Pat
Sent: Thursday, July 03, 2014 8:25 AM
To: McInnis, Marissa; EPA HICS
Cc: Koslow, Karin; Ingram, Paige; Baca, Andrew
Subject: RE: Requesting announcements for NTOC talking points

111(d) and tribal Minor New Source review talking points would be key and I will work with staff to get these to you. Perhaps DERA and Uranium as well.

Did anything come up during yesterdays call that may also warrant inclusion? I was out, yesterday. unfortunately many of the staff will be out today, Friday and will be surprised with this as a quick turn around for Monday but we will get it done, I think I have talkers for most of these.

Pat

From: McInnis, Marissa

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:54 PM
To: Thornton, Marisa
Subject: FW: Comment period extension for "Subpart W" rule

From: Edwards, Jonathan
Sent: Thursday, July 03, 2014 10:52 AM
To: Rosnick, Reid
Subject: Re: Comment period extension for "Subpart W" rule

You enjoy the holiday too. You've worked hard on this rule. Burgers and beer! --Jon

---

From: Rosnick, Reid
Sent: Thursday, July 3, 2014 6:32:44 AM
To: Edwards, Jonathan
Subject: RE: Comment period extension for "Subpart W" rule

Thanks, Jon.

Now, go enjoy your holiday!!

Reid

From: Edwards, Jonathan
Sent: Thursday, July 03, 2014 6:32 AM
To: Rosnick, Reid; Peake, Tom; Schultheisz, Daniel
Cc: Perrin, Alan
Subject: Fw: Comment period extension for "Subpart W" rule

FYI

From: McCabe, Janet
Sent: Wednesday, July 2, 2014 10:22:34 PM
To: Flynn, Mike
Cc: Shaw, Betsy; Stewart, Lori; Edwards, Jonathan; Cherepy, Andrea
Subject: RE: Comment period extension for "Subpart W" rule

Ok, Mike. thanks for the heads up. No problem on my end.

From: Flynn, Mike
Sent: Wednesday, July 2, 2014 11:47 AM
To: McCabe, Janet
Cc: Shaw, Betsy; Stewart, Lori; Edwards, Jonathan; Cherepy, Andrea
Subject: Comment period extension for "Subpart W" rule

Janet,

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We received several requests to extend the comment period, which currently closes on July 31. As you know, we also are working with OGC on an issue raised by the litigant and also have received a request for Tribal consultation from the Ute Mountain Ute Tribe. We’ve consulted with OGC on the timing to address these various requests/issues , and are recommending a 90 day comment extension.

Please let me know if you have any questions or concerns.

Thanks, Mike

Mike Flynn, Director
Office of Radiation & Indoor Air
U.S. EPA
202-343-9356

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:57 PM
To: Thornton, Marisa
Subject: FW: References
Attachments: FR2858.pdf; FR7280.pdf; FR9612.pdf; FR15385.pdf; FR34056.pdf; FR36280.pdf; FR43906.pdf; FR51654.pdf

---

From: Rosnick, Andrew
Sent: Wednesday, July 02, 2014 3:52 PM
To: Nesky, Anthony
Subject: References

Here is the list of references with the name of the accompanying PDF file below it. All corresponding PDF files are attached.

Andrew

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
    - **FR2858.PDF**

- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
    - **FR43906.PDF**

- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
    - **FR7280.PDF**

- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
    - **FR153865.PDF**

- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
    - **FR34056.PDF**

- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
    - **FR9612.PDF**

- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
    - **FR51654.PDF**

- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.
    - **FR36280.PDF**

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:58 PM
To: Thornton, Marisa
Subject: FW: TCOTS - Monthly TCA Notification: Jul/2014

From: Dona Harris [mailto:Harris.Dona@epamail.epa.gov] **On Behalf Of** Office of International and Tribal Affairs
Sent: Tuesday, July 01, 2014 1:56 PM
To: Mckelvey, Laura; Colon, Toni; Childers, Pat; Tapia, Rosalva; Hodges, Carson; January, Elizabeth; Snyder, Jessica; Mahanta, Benita; Robinson, Caren; Binder, Jonathan; Jonesi, Fran; Jackson, Elizabeth; Harris, Dona; Koslow, Karin; Rodia, Monica; Sims, JaniceHQ; Wright, Felicia; Stover, Michael; Herbst, John; Jonathan, Grant; Evangelista, Pat; Gallagher, Theresa; Berrios, Lisa; Ambutas, Kestutis; Mulford, Eloise; Kracher, Christina; Hight, Ira; Gee, Randy; Hamilton, Heather; Slugantz, Lynn; Harris, Jennifer; Pasqua, Gilbert; Ebbert, Laura
Subject: TCOTS - Monthly TCA Notification: Jul/2014

Dear Colleagues:

This automated report Is being generated by EPA's Tribal Consultation Opportunities Tracking System To provide Tribal Consultation Advisors with a listing of "Published" consultations starting this month.

We hope that you find this report as a useful communication tool that can be Shared With your tribal government contacts.

#	Start	Topic	Lead Office	Contact	Scope	End
1	07/10/2014	Notification of Consultation on National Emission Standards for Hazardous Air Pollutants - Operating Uranium Mill Tailings Piles (40 CFR 61, Subpart W)	OAR	Reid Rosnick 202-343-9563 Rosnick.Reid@epamail.epa.gov	Regional	07/31/2014

For additional details, please refer to the Tribal Portal Web site at this location:

Tribal Portal

Additional Links:

TCOTS Under Development Report

TCOTS Dashboard

Cordially,

***** Please do not reply to this message, it is an automated system notification *****

Dona M. Harris
American Indian Environmental Office
Office of International and Tribal Affairs
wk(202) 564-6633
harris.dona@epa.gov
http://www.epa.gov/indian/

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:58 PM
To: Thornton, Marisa
Subject: FW: Please print out and scan these references

From: Rosnick, Andrew
Sent: Wednesday, July 02, 2014 11:40 AM
To: Nesky, Anthony
Subject: RE: Please print out and scan these references

All of the references have been printed and scanned with the exception of one which I could not find:

- FR (Federal Register) 1979. EPA determination that radionuclides constitute a hazardous air pollutant within the meaning of section 112(a)(1), Volume 44, p. 78738, December 27, 1979.

Andrew

From: Nesky, Anthony
Sent: Tuesday, July 01, 2014 11:56 AM
To: Rosnick, Andrew
Subject: Please print out and scan these references

Thanks for your help!

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.
- FR (Federal Register) 1979. EPA determination that radionuclides constitute a hazardous air pollutant within the meaning of section 112(a)(1), Volume 44, p. 78738, December 27, 1979.
- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.

Tony Nesky

Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:58 PM
To: Thornton, Marisa
Subject: FW: Comment period extension for "Subpart W" rule

From: Flynn, Mike
Sent: Wednesday, July 02, 2014 11:48 AM
To: McCabe, Janet
Cc: Shaw, Betsy; Stewart, Lori; Edwards, Jonathan; Cherepy, Andrea
Subject: Comment period extension for "Subpart W" rule

Janet,

Just wanted to let you know that I just signed off on an FR Notice headed your way to extend the comment period on the “Subpart W” proposal, the NESHAP Amendments for Uranium Mill Tailings.
As a reminder, this proposal revises the radon emission standards and work practices for operating uranium mill tailings impoundments.

We received several requests to extend the comment period, which currently closes on July 31. As you know, we also are working with OGC on an issue raised by the litigant and also have received a request for Tribal consultation from the Ute Mountain Ute Tribe. We’ve consulted with OGC on the timing to address these various requests/issues , and are recommending a 90 day comment extension.

Please let me know if you have any questions or concerns.

Thanks, Mike

Mike Flynn, Director
Office of Radiation & Indoor Air
U.S. EPA
202-343-9356

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:57 PM
To: Thornton, Marisa
Subject: FW: Please print out and scan these references

From: Nesky, Anthony
Sent: Wednesday, July 02, 2014 1:58 PM
To: Rosnick, Andrew
Subject: RE: Please print out and scan these references

Thanks! Could you please give the scans consistent file names (eg. FR78738) and send them to me? To help Marissa or Carmen put these on the web, please copy and paste the reference list below and incidate which file goes with it according to the pattern below—

FR (Federal Register) 1979. EPA determination that radionuclides constitute a hazardous air pollutant within the meaning of section 112(a)(1), Volume 44, p. 78738, December 27, 1979.
File name: FR78738.pdf

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

From: Rosnick, Andrew
Sent: Wednesday, July 02, 2014 11:40 AM
To: Nesky, Anthony
Subject: RE: Please print out and scan these references

All of the references have been printed and scanned with the exception of one which I could not find:

- FR (Federal Register) 1979. EPA determination that radionuclides constitute a hazardous air pollutant within the meaning of section 112(a)(1), Volume 44, p. 78738, December 27, 1979.

Andrew

From: Nesky, Anthony
Sent: Tuesday, July 01, 2014 11:56 AM
To: Rosnick, Andrew
Subject: Please print out and scan these references

Thanks for your help!

- FR (Federal Register) 1977. EPA established environmental protection standards for nuclear power operations pursuant to its authority under the Atomic Energy Act (AEA), Volume 42, p. 2858,January 13, 1977.

- FR (Federal Register) 1979. EPA determination that radionuclides constitute a hazardous air pollutant within the meaning of section 112(a)(1), Volume 44, p. 78738, December 27, 1979.
- FR (Federal Register) 1984. EPA withdrew the proposed NESHAPs for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities. Volume 49, p. 43906. October 23, 1984.
- FR (Federal Register) 1985a. EPA promulgated final standards for Elemental Phosphorus Plants, DOE-Facilities, and NRC-Licensed Facilities, Volume 50, p. 7280, February 8, 1985.
- FR (Federal Register) 1985b. EPA established a work practice standard for Underground Uranium Mines, Volume 50, p. 15385, April 17, 1985.
- FR (Federal Register) 1986. 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings; Final Rule, Volume 51, p. 34056, September 24, 1986.
- FR (Federal Register) 1989a. National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing, Volume 54, pp. 9612–9668, March 7, 1989.
- FR (Federal Register) 1989b. National Emission Standards for Hazardous Air Pollutants; Radionuclides, Volume 54, p. 51654, December 15, 1989.
- FR (Federal Register) 1994. National Emission Standards for Hazardous Air Pollutants; Final Rule, Volume 59, p. 36280, July 15, 1994.

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:58 PM
To: Thornton, Marisa
Subject: FW: Is this reference in the Subpart W Docket?
Attachments: EPA-HQ-OAR-2008-0218-0078.pdf

From: Miller, Beth
Sent: Tuesday, July 01, 2014 1:20 PM
To: Nesky, Anthony
Subject: RE: Is this reference in the Subpart W Docket?

Here you go.

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

From: Nesky, Anthony
Sent: Tuesday, July 01, 2014 11:11 AM
To: Miller, Beth
Subject: Is this reference in the Subpart W Docket?

Dear Beth:

Is this reference below in the Subpart W Docket? If so, could I get an electronic copy of it?

SC&A (S. Cohen and Associates) 2011. "Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings, Task 4 – Detailed Risk Estimates,"

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings

Task 4 – Detailed Risk Estimates

Prepared by:

S. Cohen & Associates
1608 Spring Hill Road, Suite 400
Vienna, VA 22182

under

Contract Number EP-D-10-042
Work Assignment No. 1-06, Task 5

Prepared for:

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Brian Littleton
Work Assignment Manager

November 10, 2011

In accordance with the *Quality Assurance Project Plan: Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings*, this document has been reviewed and approved by the following individuals:

Work Assignment Task Manager:	_____ Stephen F. Marschke	Date: _____
Work Assignment Task Manager:	_____ Abe Zeitoun	Date: _____
Corporate Quality Assurance Manager/Work Assignment Quality Assurance Manager:	_____ Stephen L. Ostrow	Date: _____

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

CBR	Crow Butte Resources, Inc.
CFR	Code of Federal Regulations
Ci	Curie
CCD	Counter-Current Decantation
CofA	Court of Appeals
CPP	Central Processing Plant
Dir	Direction
E	East
EA	Environmental Assessment
ENE	East Northeast
ESE	East Southeast
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FGR	Federal Guidance Report
HRI	Hydro Resources, Inc.
HUP	Highland Uranium Project
ICRP	International Commission on Radiological Protection
ISL	in-situ leach
km	kilometer
KUC	Kennecott Uranium Company
LCF	Latent Cancer Fatalities
lbs	pounds
m	meter
N	North
NE	North East
NNE	North Northeast
NNW	North Northwest
NW	North West
NESAPS	National Emission Standards for Hazardous Air Pollutants
NMELC	New Mexico Environmental Law Center
NNW	North Northwest
NRC	Nuclear Regulatory Commission
NUREG	NUclear REGulatory report
NW	North West
NWS	National Weather Service
ORIA	Office of Radiation and Indoor Air
ORNL	Oak Ridge National Laboratory
Pb-210	Lead-210
ppm	parts per million
Ra-226	Radium-226
RAI	Request of Additional Information
RMEI	Reasonably Maximally Exposed Individual

ACRONYMS AND ABBREVIATIONS (Continued)

Rn-222	Radon-222
R&D	Research and Development
s	second
S	South
SAG	semi-autogenous grinding
SE	South East
SR	Smith Ranch
SR-HUP	Smith Ranch-Highland Uranium Project
SSE	South Southeast
sq	square
SSW	South Southwest
SW	Southwest
SX	Solvent Extraction
TCEQ	Texas Commission on Environmental Quality
TDH	Texas Department of Health
TDSHS	Texas Department of State Health Services
TEDE	Total Effective Dose Equivalent
TNRCC	Texas Natural Resource Conservation Commission
TRRC	Texas Railroad Commission
U-238	Uranium-238
U_3O_8	Triuranium octoxide (yellow cake)
URI	Uranium Resources, Inc.
V_2O_5	vanadium pentoxide
W	West
WNW	West Northwest
WSW	West Southwest
yr	year

EXECUTIVE SUMMARY

The Office of Radiation and Indoor Air (ORIA) promulgated National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for radon emissions from operating uranium mill tailings impoundments (Subpart W) on December 15, 1989 (FR 1989). In support of Subpart W, as well as other portions of radiolonuclide NESHAPs, ORIA published a three volume Environmental Impact Statement (EIS) that provided: 1) a detailed description of the Agency's procedures and methods for estimating radiation dose and risk due to radionuclide emissions to the air (EPA 1989a), 2) detailed risk estimates for each source of emissions (EPA 1989b, EPA 1989c), and 3) detailed economic assessments for each source of emissions (EPA 1989d).

The purpose of this Work Assignment is to revise the risk assessment for the NESHAPs for radionuclides from uranium facilities. The information developed in this Work Assignment will be used by the Environmental Protection Agency (EPA or the Agency) in the determination of whether the existing standards for Subpart W need revising, and, if so, what may represent reasonable revisions to the standard.

The uranium facilities that were analyzed are listed in Table ES-1 and include three existing conventional mines/mills, five in-situ leach mines, and two generic sites assumed to be the location of conventional mines/mills.

Table ES-1: Uranium Sites Analyzed

Mill / Mine	Type	State	Regulator	Latitude			Longitude		
				deg	min	sec	deg	min	sec
Cañon City Mill	Conventional	CO	State	38	23	46	-105	13	45
Crow Butte	In-Situ Leach	NE	NRC	42	38	41	-103	21	8
Western Generic	Conventional	NM	NRC	35	31	37	-107	52	52
Alta Mesa 1, 2, 3	In-Situ Leach	TX	State	26	53	59	-98	18	29
Kingsville Dome 1,3	In-Situ Leach	TX	State	27	24	54	-97	46	51
White Mesa Mill	Conventional	UT	State	37	34	26	-109	28	40
Eastern Generic	Conventional	VA	NRC	38	36	0	-78	1	11
Smith Ranch - Highland	In-Situ Leach	WY	NRC	43	3	12	-105	41	8
Christensen / Irigaray	In-Situ Leach	WY	NRC	43	48	15	-106	2	7
Sweetwater Mill	Conventional	WY	NRC	42	3	7	-107	54	41

In Task 3 of this Work Assignment, an evaluation of existing computer models that could be used to perform this dose/risk assessment was performed. As a result of that evaluation, it was determined to use the CAP88 computer program, which is based on the AIRDOS and RADRISK computer programs (Trinity 2007) that were used in the original 1989 Subpart W evaluation (EPA 1989a). Discussion on why CAP88 was selected for this assessment can be found in SC&A 2010.

In order to perform the dose/risk analysis, three types of data were necessary: 1) the distribution of the population living within 80 kilometers of each site, 2) the meteorological data at each site, particularly the wind speed, wind direction, and stability class, and 3) the amount of radon annually released from the site.

Normally, the population doses and risks are calculated out to a distance of 80 kilometers (50 miles) from the site. Therefore, it was necessary to know the population to a distance of 80 kilometers from each site in each of the 16 compass directions. This information is not normally available from U.S. Census Bureau data. However, in 1973, the EPA wrote a computer program, SECPOP (Sandia 2003), which would convert census block data into the desired 80-kilometer population estimates for any specific latitude and longitude within the continental United States. The Nuclear Regulatory Commission (NRC) adopted this program to perform citing reviews for license applications, and has updated the program to use the 2000 census data. The SECPOP program was used to estimate the population distribution around each site; that population was then modified to account for changes in the population from 2000 to 2010.

For those sites where site-specific meteorological data were identified, those site-specific data were used. For other sites, CAP88 is provided with a weather library of meteorological data from over 350 National Weather Service (NWS) stations. For sites without site-specific meteorological data, data from the NWS station nearest the site were used.

Annual radon release estimates were determined for each site based on the available documentation for the site. For example, some sites reported their estimated radon release in their semi-annual release reports, while other sites calculated their radon release as part of their license application or renewal application. Finally, for some sites, the annual radon release estimates were obtained from the NRC-produced site-specific Environmental Assessment. If multiple documents provided radon release estimates for a particular site, the estimate from the most recent document was used. Likewise, if both theoretical and actual radon release values were identified for a site, the actual radon release value was given preference.

Table ES-2 presents the reasonably maximally exposed individual (RMEI) and population doses and risks due to the maximum radon releases estimated for each uranium site. The maximum radon releases were used to calculate the doses in order to be able to compare the results to regulatory criteria. For example, 10CFR § 20.1301 “Dose limits for individual members of the public” restricts the total effective dose equivalent (TEDE) to individual members of the public from the licensed operation to less than 100 mrem per year. 10CFR § 20.1301 (e) additionally stipulates a licensee must also comply with the, “provisions of EPA's generally applicable environmental radiation standards in 40 CFR part 190 shall comply with those standards.” However, discharges of radon and its daughters are specifically excepted from compliance with the dose criteria of 40 CFR § 190.10(a).

Table ES-2: Calculated Maximum Total Annual RMEI, Population Dose and Risk

Uranium Site	Maximum Radon Release (Ci/yr)	Annual Dose		LCF[(a)] Risk (yr^{-1})	
		Population (person-rem)	RMEI (mrem)	Population	RMEI
Sweetwater	2,075	0.5	1.2	2.9E-06	6.0E-07
White Mesa	1,750	5.2	12.0	3.4E-05	6.4E-06
Cañon City	269	49.2	10.3	3.1E-04	5.4E-06
Smith Ranch - Highlands	36,500	3.7	1.5	2.3E-05	7.7E-07
Crow Butte	8,885	2.7	3.3	1.7E-05	1.7E-06
Christensen / Irigaray	1,600	3.8	1.9	2.4E-05	9.9E-07
Alta Mesa	740	21.6	11.5	1.3E-04	6.1E-06
Kingsville Dome	6,958	58.0	11.3	3.8E-04	6.1E-06
Eastern Generic	1,750	200.3	28.2	1.4E-03	1.6E-05
Western Generic	1,750	5.1	6.0	2.7E-04	7.7E-06

[(a)]Latent Cancer Fatalities

Table ES-3 presents the RMEI and population doses and risks due to the average radon releases estimated for each uranium site. The risks were based on average radon releases in order to make it easier to convert these annual risk values into lifetime risk values, by simply multiplying the Table ES-3 values by the number of years that the facility operates for the population risk or by the length of time that the individual lives next to the facility for the RMEI risk.

Table ES-3: Calculated Average Total Annual RMEI, Population Dose and Risk

Uranium Site	Average Radon Release (Ci/yr)	Annual Dose		LCF[(a)] Risk (yr^{-1})	
		Population (person-mrem)	RMEI (rem)	Population	RMEI
Sweetwater	1,204	0.3	0.7	1.7E-06	3.5E-07
White Mesa	1,388	3.0	7.0	2.0E-05	3.7E-06
Cañon City	146	28.6	6.0	1.8E-04	3.1E-06
Smith Ranch - Highlands	21,100	2.2	0.9	1.3E-05	4.5E-07
Crow Butte	4,467	1.6	1.9	1.0E-05	1.0E-06
Christensen / Irigaray	1,040	2.2	1.1	1.4E-05	5.7E-07
Alta Mesa	472	12.5	6.7	7.6E-05	3.6E-06
Kingsville Dome	1,291	33.6	6.6	2.2E-04	3.5E-06
Eastern Generic	1,388	116.3	16.4	7.9E-04	9.2E-06
Western Generic	1,388	3.0	3.5	1.6E-04	4.4E-06

[(a)]Latent Cancer Fatalities

1.0 INTRODUCTION AND BACKGROUND

The National Emission Standards for Hazardous Air Pollutants (NESHAPs) includes radon emissions for uranium mill tailings (40 CFR Part 61 Subpart W – National Emission Standards for Radon Emissions from Operating Mill Tailings – December 15, 1989). At the time of the standard's promulgation, the overwhelming numbers of uranium processing facilities were conventional acid or alkaline leach mills. Radon emissions from these facilities were primarily from the dried out portions of large (greater than 100-acre) tailings ponds. With the promulgation of Subpart W, this large area source was reduced by the requirements to limit the size of new tailings areas to either 40 acres for phased disposal or 10 acres for continuous disposal (40 CFR 61 Subpart W). Additionally, and more importantly, economic and other considerations have led commercial uranium recovery companies to submit license applications/ amendments to develop, upgrade or restart a significant number of in-situ leach (ISL) facilities (NRC 2009).

Table 1: Uranium Sites Analyzed

Mill / Mine	Type	State	Regulator	Latitude			Longitude		
				deg	min	sec	deg	min	sec
Cañon City Mill	Conventional	CO	State	38	23	46	-105	13	45
Crow Butte	In-Situ Leach	NE	NRC	42	38	41	-103	21	8
Churchrock	In-Situ Leach	NM	NRC	35	31	41	-108	44	33
Crownpoint	In-Situ Leach	NM	NRC	35	40	41	-108	9	4
Western Generic	Conventional	NM	NRC	35	31	37	-107	52	52
Alta Mesa 1, 2, 3	In-Situ Leach	TX	State	26	53	59	-98	18	29
Kingsville Dome 1,3	In-Situ Leach	TX	State	27	24	54	-97	46	51
Vasquez	In-Situ Leach	TX	State	31	58	6	-99	54	6
White Mesa Mill	Conventional	UT	State	37	34	26	-109	28	40
Eastern Generic	Conventional	VA	NRC	38	36	0	-78	1	11
Smith Ranch - Highland	In-Situ Leach	WY	NRC	43	3	12	-105	41	8
Christensen / Irigaray	In-Situ Leach	WY	NRC	43	48	15	-106	2	7
Sweetwater Mill	Conventional	WY	NRC	42	3	7	-107	54	41

In Section 2.0, detailed risk assessments were performed for all but three of the uranium sites listed in Table 1. The reasons for not analyzing three sites (Churchrock, Crownpoint, and Vasquez) are described below.

The Crownpoint and Churchrock uranium deposits, San Juan Basin, New Mexico, are currently being developed by Uranium Resources, Inc. (URI) and its subsidiary Hydro Resources, Inc. (HRI). Both deposits will be developed using advanced ISL mining techniques. URI/HRI currently has about 37.834 million pounds of U_3O_8 (14,583 tonnes U) of estimated recoverable reserves at Crownpoint/Churchrock. In March, 1997, a Final Environmental Impact Statement (FEIS) for the Crownpoint/Churchrock sites was completed by the NRC (NRC 1997), which recommends the issuance of an operating license. In January 1998, HRI was granted Source Material License SUA-1580 by the NRC for uranium production at the Crownpoint/Churchrock Uranium Project. Although the license was granted, the project has been delayed due to depressed uranium prices and litigation. In December 2002, the NRC found that, since the renewal application had been timely filed by HRI, the Crownpoint/Churchrock license would not

expire until final action had been taken by the NRC on the SUA-1580 renewal application. Regarding the litigation, in March 2010, the United States Court of Appeals, Tenth Circuit denied the intervener's petition for review and upheld the NRC's licensing decision in all respects (CofA 2010). In September 2010, the New Mexico Environmental Law Center (NMELC) filed an appeal to the U.S. Supreme Court (Docket No. 10-368). On November 15, 2010, the United States Supreme Court denied NMELC's petition to review the Appeal Court's ruling, after which URI indicated that construction of the Crownpoint/Churchrock facilities should begin in 2012, with production in 2013. Since, to date, there have been no radon releases from the Crownpoint/Churchrock Uranium Project, it was determined that a detailed radon risk assessment for this licensed site should not be performed.

The Vasquez uranium site is an ISL mine owned by URI and located in southwestern Duval County in South Texas. For the site, URI holds the Texas Natural Resource Conservation Commission's Underground Injection Control Permit: UR03050. The site is also covered by the Texas Department of Health's radioactive materials license: L06353. The Vasquez ISL mine was commissioned in October 2004, and reached peak production output in 2005. In 2006 and 2007, production at Vasquez declined, with 78,600 pounds of uranium in 2007 and 36,600 pounds in 2008. The last well field at Vasquez was fully depleted of its economically recoverable reserves in October 2008, and the project is now undergoing restoration. Vasquez did not have a processing plant; rather the uranium loaded resin from Vasquez was delivered to the Kingsville Dome central plant for processing. Since the Vasquez ISL mine is no longer active, it was determined that a detailed radon risk assessment for this site should not be performed. (URI 2010a, URI 2010b)

1.1 Dose Calculation Methodology

As part of this Work Assignment, the various computer models that could be used to calculate the doses and risks due to the operation of conventional and ISL uranium mines were evaluated. Seven computer programs were considered to be used for this risk assessment: CAP88, RESRAD-OFFISTE, MILDOS, GENII, MEPAS, AIRDOS, and AERMOD. A detailed selection process was used to select the program from the first five programs listed. AIRDOS was not included in the detailed selection process, since it is no longer an independent program, but has been incorporated into CAP88. Because it only calculates atmospheric dispersion, but not radiological doses or risks, AERMOD was also not included in the detailed selection. Each of the five programs were given a score of between 0 and 5 for each of the 12 following criteria: 1) Exposure Pathways Modeled, 2) Population Dose/Risk Capability, 3) Dose Factors Used, 4) Risk Factors Used, 5) Meteorological Data Processing, 6) Source Term Calculations, 7) Verification and Validation, 8) Ease of Use/User Friendly, 9) Documentation, 10) Sensitivity Analysis Capability, and 12)Probabilistic Analysis Capability. Also, each criterion had a weighting factor of between 1 and 2. The total weighted score was calculated for each code, and CAP88 was selected for use in this evaluation. SC&A 2010 presents the details of this program selection process. CAP88 was developed in 1988 from the AIRDOS, RADRISK, and DARTAB computer programs, which had been developed for the EPA at the Oak Ridge National Laboratory (ORNL) (Trinity 2007).

CAP88, which stands for "Clean Air Act Assessment Package-1988," is used to demonstrate compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) applicable to radionuclides. CAP88 calculates the doses and risk to the reasonably maximally exposed individual (RMEI) and as well as the surrounding population. Exposure pathways evaluated by CAP88 are: inhalation, air immersion, ingestion of vegetables, meat, and milk, and ground surface exposure. CAP88 uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from up to six emitting sources. The sources may be either elevated stacks, such as a smokestack, or uniform area sources, such as a pile of uranium mill tailings. Plume rise can be calculated assuming either a momentum or buoyant-driven plume. Assessments are done for a circular grid of distances and directions for a radius of up to 80 kilometers (50 miles) around the facility. The Gaussian plume model produces results that agree with experimental data as well as any model, is fairly easy to work with, and is consistent with the random nature of turbulence. CAP88 incorporates dose and risk factors from Federal Guidance Report 13 (FGR 13, EPA 1999) in place of the RADRISK data that were used in previous versions. The FGR 13 factors are based on the methods in Publication 72 of the International Commission on Radiological Protection (ICRP 1972). A description of the mathematical models used by CAP88 is provided in the CAP88 Users Manual (Trinity 2007).

CAP88 requires the distribution of the population surrounding the site and the characteristics of the local meteorology. The methodology used to estimate the population distributions is described in the following section, Section 1.2, while the estimated distributions are presented in the Section 2.0 site-specific subsections. For those sites where site-specific meteorological data were identified, site-specific data were used. For other sites, CAP88 is provided with a weather library of meteorological data from over 350 National Weather Service (NWS) stations. For sites without site-specific meteorological data, the data from the NWS station nearest the site were used, as described in the Section 2.0 site-specific subsections.

Additionally, CAP88 requires much data that is radionuclide-independent and usually independent of the site being analyzed. Table 2 is a listing of the radionuclide- and site-independent parameters, along with the default values that are provided with CAP88 and that were used for these uranium site dose and risk analyses.

Table 2: Values for CAP88 Site Independent Parameters

Parameter (Units)	Value
Human Inhalation Rate	
Cubic centimeters/hr	9.17E+05
Soil Parameters	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
Buildup Times	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+02

Table 2: Values for CAP88 Site Independent Parameters

Parameter (Units)	Value
Delay Times	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
Weathering	
Removal rate constant for physical loss (per hr)	2.90E-03
Crop Exposure Duration	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
Agricultural Productivity	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy vegetables for human consumption (kg/sq m)	7.16E-01
Fallout Interception Fractions	
Vegetables	2.00E-01
Pasture	5.70E-01
Grazing Parameters	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01
Animal Feed Consumption Factors	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
Dairy Productivity	
Milk production of cow (L/day)	1.10E+01
Meat Animal Slaughter Parameters	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
Decontamination	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
Fractions Grown In Garden Of Interest	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
Ingestion Ratios:	
Immediate Surrounding Area/Total Within Area	
Vegetables	7.00E-01
Meat	4.40E-01
Milk	4.00E-01
Minimum Ingestion Fractions From Outside Area (Actual fractions of food types from outside area can be greater than the minimum fractions listed below.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00

Table 2: Values for CAP88 Site Independent Parameters

Parameter (Units)	Value
Human Food Utilization Factors	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01

1.2 Methodology to Estimate 2010 Population

In order to calculate the dose and risk to the population surrounding the uranium site, it is necessary to know the distribution of the surrounding population at each site. Normally, the population doses and risks are calculated out to a distance of 80-kilometers (50-miles) from the site. Therefore, it is necessary to know the population to a distance of 80-kilometers from each site in each of the 16 compass directions. This information is not normally available from census data to the degree of specificity needed in this assessment. However, in 1973, the EPA wrote a computer program, SECPOP, that would convert census block data into the desired 80-kilometer population estimates for any specific latitude and longitude within the continental United States (Sandia 2003). The NRC adopted this program to perform siting reviews for license applications, and has updated the program to use the 2000 census data.

The latitude and longitude for each uranium site listed in Table 1 was entered into SECPOP, which calculated the 80-kilometer, 16-sector 2000 population distribution for each site. The SECPOP-calculated population distributions are provided in the site-specific subsections of Section 2.0.

It was desired to use 2010 population data rather than the 2000 census data available in SECPOP. The U.S. Census Bureau has estimates of the population in every county for each year from 2001 though 2009 (http://www.census.gov/popest/counties/files/CO-EST2009-ALLDATA.csv). For each uranium site, the 2000 census data and 2009 estimate were used to calculate an annual population adjustment factor specific for the county in which the site is located. That annual adjustment factor was then used to calculate an adjustment factor to bring the SECPOP population distribution from 2000 to 2010.

Table 3: 2000 to 2010 Population Adjustment Factors

Site	State	County	Population		Factor	
			2000	2009	Annual	2010
Cañon City Mill	CO	Fremont	46145	47815	0.0040	1.04
Crow Butte	NE	Dawes	9060	8735	-0.0041	0.96
Western Generic	NM	McKinley	74798	70513	-0.0065	0.94
Alta Mesa 1, 2, 3	TX	Brooks	7976	7377	-0.0086	0.92
Kingsville Dome 1,3	TX	Kleberg	31549	30647	-0.0032	0.97
White Mesa Mill	UT	San Juan	14413	15049	0.0048	1.05
Eastern Generic	VA	Culpeper	34262	46502	0.0345	1.40
Smith Ranch – Highland	WY	Converse	12052	13578	0.0133	1.14
Christensen / Irigaray	WY	Campbell	33698	43967	0.0300	1.34
Sweetwater Mill	WY	Sweetwater	37613	41226	0.0102	1.11

2.0 DETAILED RISK ESTIMATES

For each uranium site that is analyzed, this section presents a brief description, including an aerial view of the site, followed by the population distribution surrounding the site and the assumptions made concerning food production. The meteorological data used to analyze each site are presented next. Lastly, the methodology used to estimate the annual radon released from each site is discussed and the radon release presented.

2.1 Sweetwater[1]

The Sweetwater Uranium Project, the only conventional mill remaining in Wyoming, consists of a mill and ancillary structures and is located some 65 km northwest of the Town of Rawlins, in south-central Wyoming's Great Divide Basin. The mill was constructed in 1979 and 1980 and NRC source materials license SUA-1350 (Docket Number: 40-8584) was obtained in February 1979 to permit processing of uranium ore. The mill operated between 1981 and 1983 and has been on standby status since mid-1983. During its three years of operation, the Sweetwater facility produced a total of 1,292,000 lbs of U_3O_8 from a total of 2,340,535 tons of ore (sourced from an adjacent, now depleted ore body which has since been reclaimed), at a reported recovery rate of 90%. Operations at Sweetwater are currently suspended; however, the license has been renewed, and is currently set to expire on November 10, 2014. The Kennecott Uranium Company (KUC) operates and manages the Sweetwater Uranium Project for the Green Mountain Mining Venture. With the continued increase in the price of uranium, KUC may either sell or restart the Sweetwater mill, shown in Figure 1.

[1] The description of the Sweetwater site was abstracted from various sources, including KUC 1994, KUC 2004, and Uranium One 2006, while the aerial view of the Sweetwater site was obtained from Google Maps.

Figure 1: Sweetwater – Aerial View

2.1.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Sweetwater site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 4. To adjust the 2000 population data to 2010, the CAP88 Sweetwater population dose was multiplied by 1.11, see Section 1.2 and Table 3.

Table 4: Sweetwater Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	3	0
WNW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	3

Table 4: Sweetwater Population Data

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	0	3	75	26	0	0
NNW	0	0	2	37	0	7
NW	0	0	0	0	0	19
WNW	0	0	0	0	0	0
W	0	2	0	2	0	0
WSW	0	0	0	0	0	0
SW	0	0	0	2	102	1
SSW	2	47	0	3	0	0
S	0	0	256	0	2	0
SSE	0	2	2	0	12	0
SE	0	3	43	0	0	0
ESE	0	5	7	137	9097	430
E	3	11	18	5	0	3
ENE	3	0	19	16	0	5
NE	10	97	3	6	7	13
NNE	3	0	0	29	21	0

The agricultural productivity factors for Wyoming were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Sweetwater site population dose calculation.

Beef Cattle Density (cattle/km^2):	5.12
Milk Cattle Density (cow/km^2):	0.0579
Land Cultivated for Vegetable Crops:	0.159%

The distance and direction to the RMEI were identified in the Revised Environmental Report (KUC 1994) as:

> The nearest resident is approximately 17 air miles northeast of the Site and the nearest town is Bairoil, located approximately 22 air miles northeast of the Site. [KUC 1994, page 1-1]

Notice, that the Table 4 SECPOP estimate places the nearest individual at a distance of 5 km to 10 km in the NW direction. To calculate the RMEI dose and risk for this study, the Table 4 RMEI distance and direction were used.

2.1.2 Meteorology

The CAP88 computer program is provided with a weather library of meteorological data from over 350 NWS stations. For the Sweetwater site, the CAP88-provided meteorological data for the period 1983 through 1987 was obtained from the site's Revised Environmental Report (KUC 1994) and the associated MILDOS analysis (EnecoTech 1994). Table 5 shows the directional-dependent average wind speed for each stability class, while Table 6 gives the stability class frequency.

Table 5: Sweetwater Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	0.000	1.812	2.477	7.722	5.786	2.497	0.000
NNW	0.000	1.423	2.153	7.706	5.898	2.328	0.000
NW	0.000	1.696	1.780	6.684	6.140	2.475	0.000
WNW	0.000	1.501	1.740	6.256	5.517	2.432	0.000
W	0.000	1.365	1.667	6.705	5.685	2.294	0.000
WSW	0.000	1.918	1.897	7.114	5.984	2.410	0.000
SW	0.000	2.045	2.380	6.838	5.788	2.797	0.000
SSW	0.000	1.825	1.982	7.633	5.820	2.955	0.000
S	0.000	1.042	1.177	7.021	6.227	2.171	0.000
SSE	0.000	1.042	1.026	8.634	7.032	1.384	0.000
SE	0.000	1.822	2.446	8.762	5.876	2.981	0.000
ESE	0.000	1.984	2.553	9.262	6.150	3.028	0.000
E	0.000	1.708	2.681	8.078	5.647	2.606	0.000
ENE	0.000	1.851	2.583	8.400	6.069	2.666	0.000
NE	0.000	1.507	2.422	8.611	6.027	2.714	0.000
NNE	0.000	1.549	2.438	8.144	5.963	2.709	0.000

Table 6: Sweetwater Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (frequency)						
	A	B	C	D	E	F	G
N	0.0000	0.0203	0.1677	0.5699	0.0624	0.1797	0.0000
NNW	0.0000	0.0266	0.1551	0.5723	0.0650	0.1811	0.0000
NW	0.0000	0.0197	0.2033	0.4704	0.0827	0.2240	0.0000
WNW	0.0000	0.0275	0.1880	0.3991	0.0753	0.3100	0.0000
W	0.0000	0.0248	0.1914	0.4613	0.0794	0.2430	0.0000
WSW	0.0000	0.0217	0.1591	0.5108	0.0690	0.2394	0.0000
SW	0.0000	0.0177	0.1398	0.4836	0.0945	0.2644	0.0000
SSW	0.0000	0.0234	0.1128	0.4580	0.1166	0.2893	0.0000
S	0.0000	0.0096	0.1540	0.3018	0.0882	0.4464	0.0000
SSE	0.0000	0.0222	0.0630	0.7737	0.0670	0.0741	0.0000
SE	0.0000	0.0080	0.0269	0.7848	0.0716	0.1087	0.0000
ESE	0.0000	0.0021	0.0542	0.7959	0.0542	0.0935	0.0000
E	0.0000	0.0103	0.0913	0.7018	0.0569	0.1397	0.0000
ENE	0.0000	0.0114	0.0960	0.6874	0.0683	0.1370	0.0000
NE	0.0000	0.0102	0.0859	0.7059	0.0680	0.1301	0.0000
NNE	0.0000	0.0089	0.1197	0.6475	0.0712	0.1527	0.0000
TOTAL	0.0000	0.0156	0.1269	0.6039	0.0713	0.1821	0.0000

2.1.3 Radon Release

Even though KUC provides the NRC with semi-annual effluent reports for the Sweetwater site, as required by 10CFR §40.65, radon releases are not included. Rather, KUC provides the upwind and downwind radon concentrations. Thus, in order to perform the risk assessment, it

was necessary to refer to the Revised Environmental Report (KUC 1994) for a Sweetwater site-specific radon source term. The following information on radon releases was taken from Section 3.4 of the Sweetwater Revised Environmental Report (KUC 1994).

Ore Stockpiles, Crushing and Grinding

> A total of 604.6 Ci/year of radon is estimated to be released by ore handling, including both radon release from the mill exhaust stack and the ore loading area at the grizzly. [KUC 1994, page 3-9]

Leaching

> The leach tanks are covered and are also equipped with a vent system. The air in the tanks will have small concentrations of radon-222 and sulfuric acid mist. This air will be vented through a wet scrubber (…). Exhaust from the scrubber will contain traces of radon-222. [KUC 1994, page 3-9]

Counter-Current Decantation (CCD) Thickening

> Some water vapor, acid mist, and minor amounts of radon-222 will escape into the atmosphere from the open thickeners. [KUC 1994, page 3-11]

> In accordance with 40 CFR 61, the tailings impoundments will be 40 acres in area at capacity and no more than two impoundments will be operated at any one time. Radon-222 emissions will be minimized from the tailings impoundment, by keeping the tailings in the operating cell wet. When operations are complete, the final surface area of the six reclaimed impoundments and the original impoundment, to be used as an evaporation pond, is estimated to be approximately 280 acres. Assuming the maximum allowable emission of 20.0 $pCi/m^2/sec$ after reclamation, annual radon-222 emissions can be no more than 714 Ci/year for the six proposed impoundments and the existing impoundment, combined. [KUC 1994, page 3-11]

Solvent Extraction

Section 3.4 of the Revised Environmental Report does not provide any radon source term for the solvent extraction phase.

Precipitation

> Air from the yellowcake precipitators, and thickener area will be passed through a wet scrubber and vented to the atmosphere from stack S-6 (…). The exhaust gases will contain approximately 80 - 120 ppm ammonia and traces of radon-222. [KUC 1994, page 3-12]

In addition to the source term discussion provided in Section 3.4, the Revised Environmental Report provides estimated annual radon releases for the facility during operation at specific release points in Table 5.2-1, which has been reproduced in this report as Table 7. Unlike Section 3.4, which is specific to the mill area, Table 5.2-1 includes the radon releases from "the

six proposed [in 1994] 40-acre tailings cells, and the existing [in 1994] tailings cell." From Table 7, it can be seen that including the radon contribution from the tailing cells results in a time-dependent annual radon release.

Table 7: Sweetwater Radon Release

Source		Radon Release (Ci/yr)
Dryer		—
Ore Receiving		604.6
Leaching		—
Ore Handling and Storage		—
Ore Dust		—
Tailings	Yr. 1-3	1001
	Yr. 4-6	2861
	Yr. 7-9	2963
	Yr. 10-12	3065
	Yr. 13-15	3167
	Yr. 16-18	3269
	Yr. 19-21	2370
	Yr. 22-24	714

Source: KUC 1994, Table 5.2-1

It should also be noted that the tailing cell radon releases shown in Table 7 were based on an assumed radon flux of 20 pCi/m^2-s from each of the covered cells or impoundments. To demonstrate compliance with 40CFR Part 61, Subpart W, KUC has annually conducted testing on the facility's tailings impoundment for radon emissions (KUC 2004). The results of that testing are shown in Table 8. In addition to showing the measured radon flux, Table 8 also shows what the largest annual radon tailing release would be, based on the measured flux, as opposed to using the 40CFR §61.252 standard of 20 pCi/m^2-s.

Table 8: Sweetwater Radon Flux Testing Results

Test Date	Radon Flux (pCi/m^2-s)	Yr. 16-18 Tailings Release (Ci/yr)
7-Aug-90	9.00	1471
13-Aug-91	5.10	834
5-Aug-92	5.60	915
24-Aug-93	5.00	817
23-Aug-94	5.00	817
15-Aug-95	3.59	587
13-Aug-96	5.47	894
26-Aug-97	4.23	691
11-Aug-98	2.66	435
10-Aug-99	1.27	208

Table 8: Sweetwater Radon Flux Testing Results

Test Date	Radon Flux (pCi/m^2-s)	Yr. 16-18 Tailings Release (Ci/yr)
8-Aug-00	4.05	662
15-Aug-01	6.98	1141
14-Aug-02	4.10	670
13-Aug-03	7.11	1162

Source: KUC 2004, Appendix 6, Page 1

Based on the radon release data provided in Table 7 and Table 8, several annual radon releases may be calculated:

§61.252 Standard, Maximum	3,874	Ci/yr
§61.252 Standard, Average	3,031	Ci/yr
Measured, Maximum	2,075	Ci/yr
Measured, Average	1,204	Ci/yr

2.1.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Sweetwater site are shown in Table 9.

Table 9: Sweetwater Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	2075	1204
RMEI (7500m NW)	Dose (mrem/yr)	5.6E-04	1.2E+00	6.7E-01
	LCF Risk (yr^{-1})	2.9E-10	6.0E-07	3.5E-07
Population	Dose (person-rem/yr)	2.3E-04	4.9E-01	2.8E-01
	LCF Risk (yr^{-1})	1.4E-09	2.9E-06	1.7E-06

2.2 White Mesa[2]

The White Mesa mill is a fully licensed, conventional uranium processing mill with a vanadium co-product recovery circuit, shown in Figure 2. Located six miles south of Blanding, Utah, in the southeastern part of the state, White Mesa is the only conventional uranium mill currently operating in the United States. The White Mesa mill is licensed by the state of Utah (Radioactive Materials License: UT1900479), and is owned and operated by Denison Mines (USA). Construction of the White Mesa mill started in 1979, and conventionally mined

[2] The description of the White Mesa site was abstracted from various sources, including Denison 2007 and Melbye 2008, while the aerial view of the White Mesa site was obtained from Google Maps.

uranium/vanadium ore was first processed in May 1980. To date, White Mesa has produced over 30 million pounds of U_3O_8 and 33 million pounds of V_2O_5.

Figure 2: White Mesa – Aerial View

Operations at White Mesa begin with weighting, receiving, sampling, and stockpiling of conventional ore and other feed materials from various offsite sources. Mine ore, as well as stockpiled crushed ore, is fed into the semi-autogenous grinding (SAG) mill. The ground feed material, stored as a wet slurry in one of two agitated tanks, is then fed to the first stage of leach. The two-stage acid leach is followed by the recovery of uranium bearing pregnant solution in a CCD system. Once the pregnant solution is clarified, it is pumped to the solvent extraction (SX) circuit. Vanadium, when recovered, is stripped from the barren uranium raffinate, also using a solvent extraction circuit. Both uranium and vanadium are precipitated in their respective circuits, followed by drying and packaging.

2.2.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the White Mesa site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 10. To adjust the 2000 population data to 2010, the CAP88 White Mesa population dose was multiplied by 1.05, see Section 1.2 and Table 3.

Table 10: White Mesa Population Data

Dir	Distance (km)						
	0 to 1	**1 to 2**	**2 to 3**	**3 to 4**	**4 to 5**	**5 to 10**	**10 to 20**
N	0	0	3	69	567	2813	73
NNW	0	0	0	0	0	24	0
NW	0	0	52	0	0	0	0
WNW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WSW	0	0	0	0	0	1	0
SW	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
S	0	0	0	0	0	7	247
SSE	0	5	0	0	0	0	40
SE	0	0	0	0	0	0	12
ESE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ENE	0	14	0	0	0	0	0
NE	0	0	0	0	180	0	1
NNE	0	0	0	79	0	25	16

Dir	Distance (km)					
	20 to 30	**30 to 40**	**40 to 50**	**50 to 60**	**60 to 70**	**70 to 80**
N	0	0	6	4	0	28
NNW	0	0	0	0	16	0
NW	0	0	0	0	0	0
WNW	0	0	0	0	0	0
W	0	8	8	2	0	2
WSW	0	0	0	0	0	0
SW	0	2	0	88	352	195
SSW	0	195	163	19	175	367
S	1	307	105	264	488	617
SSE	62	710	431	116	159	539
SE	83	232	860	340	14	5
ESE	3	8	22	140	231	3045
E	0	2	135	130	463	1361
ENE	7	26	88	1046	168	6
NE	10	100	91	165	66	6
NNE	61	2035	51	9	8	1

The agricultural productivity factors for Utah were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the White Mesa site population dose calculation.

Beef Cattle Density (cattle/km^2):	2.84
Milk Cattle Density (cow/km^2):	0.446
Land Cultivated for Vegetable Crops:	0.183%

The distance and direction to the RMEI were identified in the Cell 4B dose assessment (SENES 2008) as:

> … the nearest "potential" resident is approximately 1.2 miles (1.9 km) north of the Mill, near the location of air monitoring station BHV-I. The nearest actual resident is located approximately 1.6 miles (2.5 km) north of the mill. [SENES 2008, page 5-3]

Notice that the Table 10 SECPOP estimate places the nearest individuals to White Mesa at a distance of 1 to 2 km in the SSE and ENE directions. To calculate the RMEI dose and risk for this study, the Table 10 RMEI distances and directions were used, since they are closer than the nearest actual resident.

2.2.2 Meteorology

The White Mesa mill has an onsite meteorological monitoring station that records wind speed, wind direction, and stability class. This onsite meteorological data were used by Denison to formulate a joint frequency distribution for the dose calculations performed as part of their White Mesa license renewal application. For this risk assessment, the meteorological data from the license renewal application was reformatted so that it could be processed by the CAP88 auxiliary program, WINDGET (Trinity 2007), which generated a meteorological data file in the format required by CAP88 (i.e., a .WND file). Table 11 shows the directional-dependent average wind speed for each stability class that was used in this risk assessment, while Table 12 gives the stability class frequency.

Table 11: White Mesa Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	2.727	4.293	5.984	7.051	3.651	1.924	0.000
NNW	2.670	4.234	5.430	5.673	3.186	1.857	0.000
NW	2.495	4.375	5.509	6.080	2.818	1.793	0.000
WNW	2.341	3.914	4.958	5.741	3.011	1.650	0.000
W	2.065	3.635	5.898	5.238	2.980	1.684	0.000
WSW	2.086	3.598	5.089	5.043	2.779	1.745	0.000
SW	1.833	3.217	4.058	4.495	3.280	1.956	0.000
SSW	2.130	3.399	3.697	4.366	4.326	2.229	0.000
S	1.993	3.388	4.827	5.115	4.516	2.343	0.000
SSE	2.245	4.794	6.375	7.140	4.766	2.429	0.000
SE	2.384	4.103	6.302	7.199	4.302	2.289	0.000
ESE	2.378	4.104	5.912	5.791	3.457	2.178	0.000
E	2.381	4.290	6.150	7.401	3.951	2.222	0.000
ENE	2.571	4.617	6.414	7.725	4.031	1.915	0.000
NE	2.773	4.565	6.196	7.945	4.018	1.957	0.000
NNE	2.910	4.580	6.102	8.225	4.523	2.077	0.000

Table 12: White Mesa Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	0.2581	0.2125	0.1837	0.2509	0.0372	0.0576	0.0000
NNW	0.3351	0.2376	0.1578	0.1507	0.0319	0.0869	0.0000
NW	0.3286	0.1690	0.1314	0.2253	0.0282	0.1174	0.0000
WNW	0.3637	0.1318	0.0727	0.1545	0.0500	0.2273	0.0000
W	0.3938	0.0933	0.0622	0.1088	0.0778	0.2642	0.0000
WSW	0.3098	0.1059	0.0784	0.1726	0.0588	0.2745	0.0000
SW	0.1223	0.0526	0.0782	0.3912	0.1579	0.1977	0.0000
SSW	0.0334	0.0193	0.0405	0.4585	0.3331	0.1151	0.0000
S	0.0473	0.0164	0.0327	0.4064	0.3273	0.1700	0.0000
SSE	0.0595	0.0280	0.0653	0.5449	0.1272	0.1750	0.0000
SE	0.0794	0.0451	0.1155	0.4567	0.1119	0.1913	0.0000
ESE	0.1575	0.0822	0.1575	0.3390	0.0788	0.1849	0.0000
E	0.1749	0.0933	0.1399	0.3907	0.0787	0.1224	0.0000
ENE	0.1885	0.1195	0.1747	0.3839	0.0529	0.0805	0.0000
NE	0.1781	0.1557	0.2380	0.3383	0.0359	0.0539	0.0000
NNE	0.1888	0.1958	0.2118	0.3247	0.0380	0.0410	0.0000
TOTAL	0.1560	0.0999	0.1161	0.3595	0.1397	0.1287	0.0000

2.2.3 Radon Release

SENES 2008 presents the results of a dose assessment that was performed to quantify the dose impact from the proposed development of new tailings Cell 4B. Two sources of uranium ore are considered for processing by the White Mesa mill: Colorado Plateau (0.25% U_3O_8 and 1.5% V_2O_5) and Arizona Strip (0.637% U_3O_8 and no V_2O_5). For both ores, Section 4 of SENES 2008 documents the source term, including radon, from each area of the White Mesa mill, and is summarized below.

Grinder

> The Rn-222 concentration in the ore was assumed to be equal to the U-238 concentration. The Rn-222 released during wet grinding is 92.7 and 236 Ci/yr for Colorado Plateau and Arizona Strip ore, respectively. [SENES 2008, page 4-3]

Ore Dump to Grizzly

SENES 2008 does not indicate any radon release from the grizzly (i.e., screener).

Yellowcake Stacks

> Since the ore processing steps reject nearly all the radium to the tailings, very little radon is released during the production of yellowcake. No significant radon releases occur during yellowcake drying and packaging, since only about 0.1% of the original Ra-226 in the ore is found in yellowcake. Therefore, the amount of Rn-222 emitted from the yellowcake stack was assumed to be negligible. [SENES 2008, page 4-4]

Vanadium Stack

> …, the emissions from the remaining radionuclides [including radon] were assumed to be negligible and in any event would likely be discharged to the tailings cells. [SENES 2008, page 4-4]

Ore Pads

> Rn-222 will be produced in the ore pads from the decay of Ra-226. The estimated annual radon release rate from the ore pads is 375 and 956 Ci/yr for Colorado Plateau and Arizona Strip ore, respectively. [SENES 2008, page 4-5]

Active Tailings Cells

> …, the total annual radon release rates for active tailings cell 3 and 4A and 4B were estimated to be 179 Ci/yr for tailings cell 3 and 102 Ci/yr for each of tailings cells 4A and 4B. These estimates are extremely conservative because it was assumed that the radon release rate of 20 pCi/m^2s (…) occurred over the entire area of each cell. [SENES 2008, page 4-7]

Inactive Tailings Cells

> …, the total annual radon release from the tailings cells 2 and 3 with interim soil covers were 85.3 and 89.4 Ci/yr, respectively. [SENES 2008, page 4-7]

Table 13 summarizes the SENES 2008 annual radon release from the White Mesa uranium mill.

Table 13: White Mesa Radon Release

Source	Radon Release (Ci/yr)	
	Colorado Plateau	Arizona Strip
Grinding	92.7	236
Ore Dump to Grizzly	—	
Ore Pads	375	956
North Yellowcake Stack	—	
South Yellowcake Stack	—	
Tailing Cell 2: Interim Soil Cover	85.3	
Tailing Cell 3: Interim Soil Cover	89.4	
Tailing Cell 3: Active	179	
Tailing Cell 4A: Active	102	
Tailing Cell 4B: Active	102	
Vanadium Stack	—	N/A
Total	1,025	1,750

Source: SENES 2008, Tables 4.5-1 and 4.5-2

2.2.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the White Mesa site are shown in Table 14.

Table 14: White Mesa Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	**Maximum**	**Average**
		1	1750	1388
RMEI (1500m SSE)	Dose (mrem/yr)	5.8E-03	1.2E+01	7.0E+00
	LCF Risk (yr^{-1})	3.1E-09	6.4E-06	3.7E-06
Population	Dose (person-rem/yr)	2.5E-03	5.2E+00	3.0E+00
	LCF Risk (yr^{-1})	1.6E-08	3.4E-05	2.0E-05

2.3 Cañon City[3]

The Cañon City mill, shown in Figure 3, is located approximately two miles south of downtown Cañon City in Fremont County, Colorado. The community of Lincoln Park borders the site to the north and the housing developments of Dawson Ranch, Wolf Park, and Eagle Heights are located along the mill's western boundary. The 2,500-acre site includes two inactive mills, ore stockpile areas, a partially reclaimed tailings pond disposal area (i.e., the old ponds area), and a current tailings pond disposal area (i.e., the lined "main impoundment area"). A large portion of the site is used to store waste products in the impoundment area.

[3] The description of the Cañon City site was abstracted from various sources, including CDPHE 2007, Cotter 2010, and ATSDR 2010, while the aerial view of the Cañon City site was obtained from Google Maps.

Figure 3: Cañon City – Aerial View

The Cañon City mill, which is owned by the Cotter Corporation, began operations in 1958, extracting uranium ore using an alkaline leach process. At that time, the mill was licensed by the U.S. Atomic Energy Agency; currently it is licensed by the state of Colorado (Radioactive Materials License: Colo. 369-01). In 1979, the facility switched to an acid leach process for extracting uranium. Cotter suspended primary operations in 1987, and only limited and intermittent processing occurred until the facility resumed operations in 1999 with a modified alkaline-leaching capability until 2001. Cotter refabricated the mill circuits between 2002 and 2005 to operate using an acid process, since March 2006 the mill has been in storage. Current accelerated efforts to close down contaminated facilities at the Cañon City site may be aimed at clearing a path for possible uranium processing in the future and do not indicate that Cotter plans to leave the 2,600-acre site. There is indication that Cotter is planning a $200-million rebuild of the mill by 2014, when it expects to treat ore from the Mount Taylor mine in New Mexico.

2.3.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Cañon City site by SECPOP and used in CAP88 for population dose

calculations, is shown in Table 15. To adjust the 2000 population data to 2010, the CAP88 Cañon City population dose was multiplied by 1.04, see Section 1.2 and Table 3.

Table 15: Cañon City Population Data

Dir	Distance (km)					
	0 to 1	**1 to 2**	**2 to 3**	**3 to 4**	**4 to 5**	**5 to 10**
N	0	18	37	915	1198	9911
NNW	0	0	20	114	1699	1663
NW	0	0	105	0	20	0
WNW	0	16	38	0	0	0
W	0	71	27	0	0	0
WSW	0	0	0	0	30	0
SW	0	0	0	0	0	7
SSW	0	0	0	0	0	0
S	0	0	0	0	0	0
SSE	0	0	0	9	0	8
SE	0	0	0	0	0	32
ESE	0	0	0	0	0	1484
E	0	0	0	0	0	2040
ENE	0	0	0	106	52	2961
NE	0	0	31	679	295	1939
NNE	0	0	138	942	1046	4365
Dir	**Distance (km)**					
	20 to 30	**30 to 40**	**40 to 50**	**50 to 60**	**60 to 70**	**70 to 80**
N	4	1310	1083	2224	5576	450
NNW	4	46	369	347	251	132
NW	93	61	43	102	55	117
WNW	0	39	41	41	6061	1261
W	196	225	315	996	290	901
WSW	637	136	169	32	249	152
SW	205	812	106	13	726	134
SSW	341	737	261	0	98	15
S	145	5	253	145	180	155
SSE	295	56	699	1683	754	160
SE	107	236	506	513	1104	36
ESE	16	1688	8507	90006	10649	1976
E	1350	1081	6010	14530	20	84
ENE	733	12	43	3498	203	578
NE	7	215	1369	111270	191995	52423
NNE	38	627	99	15816	66131	34794

The agricultural productivity factors for Colorado were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Cañon City site population dose calculation.

Beef Cattle Density (cattle/km^2):	1.13
Milk Cattle Density (cow/km^2):	0.35
Land Cultivated for Vegetable Crops:	1.39%

The distance and direction to the RMEI were identified in the Agency for Toxic Substances and Disease Registry's public health assessment (ATSDR 2010) as:

> The nearest residence is about 0.25 miles from the mill [ATSDR 2010, page 1].

Notice that the Table 15 SECPOP estimate places the nearest individuals to Cañon City at a distance of 1 to 2 km in the North, West, and WNW directions. Through analysis using CAP88 the RMEI was found to be located 1 to 2 km North. To calculate the RMEI dose and risk for this study, the Table 15 RMEI distances and directions were used, since the public health assessment did not specify the direction to the nearest resident.

2.3.2 Meteorology

The CAP88 computer program is provided with a weather library of meteorological data from over 350 NWS stations. For the Cañon City site, the CAP88-provided weather data for Colorado Springs, CO (CAP88 File: 93037.WND) were used. The period of record for this data included the years 1988 through 1992. Table 16 shows the directional dependent average wind speed for each stability class, while Table 17 gives the stability class frequency, used in the Cañon City analysis.

Table 16: Cañon City Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	1.900	2.710	4.450	5.320	3.570	1.950	0.000
NNW	1.830	2.880	4.610	5.480	3.760	2.030	0.000
NW	1.950	2.980	4.310	5.200	3.760	2.070	0.000
WNW	1.850	2.820	3.760	4.690	3.700	2.020	0.000
W	1.880	2.360	3.450	4.390	3.650	2.030	0.000
WSW	1.640	2.190	3.490	4.660	3.550	2.020	0.000
SW	1.880	2.440	3.220	4.960	3.740	2.230	0.000
SSW	1.850	2.120	3.970	5.170	3.960	2.300	0.000
S	2.030	2.030	4.200	6.540	4.010	2.250	0.000
SSE	1.480	2.340	3.790	7.000	3.940	2.150	0.000
SE	2.030	2.120	3.590	6.710	3.740	2.080	0.000
ESE	2.020	2.200	3.320	6.500	3.570	1.930	0.000
E	1.880	1.870	3.750	6.120	3.470	1.840	0.000
ENE	1.880	2.330	3.730	6.030	3.470	1.860	0.000
NE	2.030	2.400	3.480	6.020	3.450	1.840	0.000
NNE	1.780	2.720	4.200	5.960	3.410	1.860	0.000

Table 17: Cañon City Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	0.0116	0.1188	0.2367	0.4935	0.0654	0.0741	0.0000
NNW	0.0071	0.0907	0.2116	0.5325	0.0851	0.0730	0.0000
NW	0.0123	0.0988	0.2017	0.4892	0.1146	0.0833	0.0000
WNW	0.0164	0.1108	0.1983	0.3762	0.1622	0.1362	0.0000
W	0.0154	0.1102	0.1597	0.3290	0.1767	0.2090	0.0000
WSW	0.0085	0.0823	0.1231	0.3181	0.1974	0.2706	0.0000
SW	0.0044	0.0474	0.0783	0.2728	0.2647	0.3324	0.0000
SSW	0.0021	0.0220	0.0577	0.2310	0.3668	0.3204	0.0000
S	0.0021	0.0190	0.0658	0.4320	0.2807	0.2004	0.0000
SSE	0.0023	0.0226	0.0603	0.6097	0.1893	0.1159	0.0000
SE	0.0017	0.0307	0.0855	0.5660	0.1750	0.1410	0.0000
ESE	0.0045	0.0585	0.1043	0.5250	0.1552	0.1525	0.0000
E	0.0108	0.0861	0.1416	0.4909	0.1250	0.1457	0.0000
ENE	0.0204	0.1346	0.1629	0.4512	0.0858	0.1451	0.0000
NE	0.0180	0.1876	0.1914	0.4188	0.0725	0.1118	0.0000
NNE	0.0149	0.1415	0.2149	0.4723	0.0712	0.0852	0.0000
TOTAL	0.0074	0.0678	0.1321	0.4401	0.1863	0.1664	0.0000

2.3.3 Radon Release

Cotter Corporation does not include the site's radon release in its semi-annual effluent reports that are prepared for the Colorado Department of Public Health and Environment. However, until recently, the reports did include the results of radon flux measurements for the Primary and Secondary Impoundments in their semi-annual effluent reports. The radon flux measurements can be used to calculate an annual radon release following the guidance provided in Quinn 2010. This was done, and the resulting annual radon releases from 1999 through 2009 are tabulated in Table 18 and shown graphically in Figure 4.

Table 18: Cañon City Annual Radon Release

Year	Radon Flux (pCi/m^2-s)	Radon Release (Ci/y)
1999	13.2	180
2000	7.7	105
2001	7.9	108
2002	15.9	217
2003	5.8	79
2004	6.2	85
2005	7.6	104
2006	6.1	83
2007	14	191
2008	19.7	269
2009	13.4	183

Sources: Cotter 2007, Figure 4-19; Cain 2008, page 47; Cain 2010, page 50

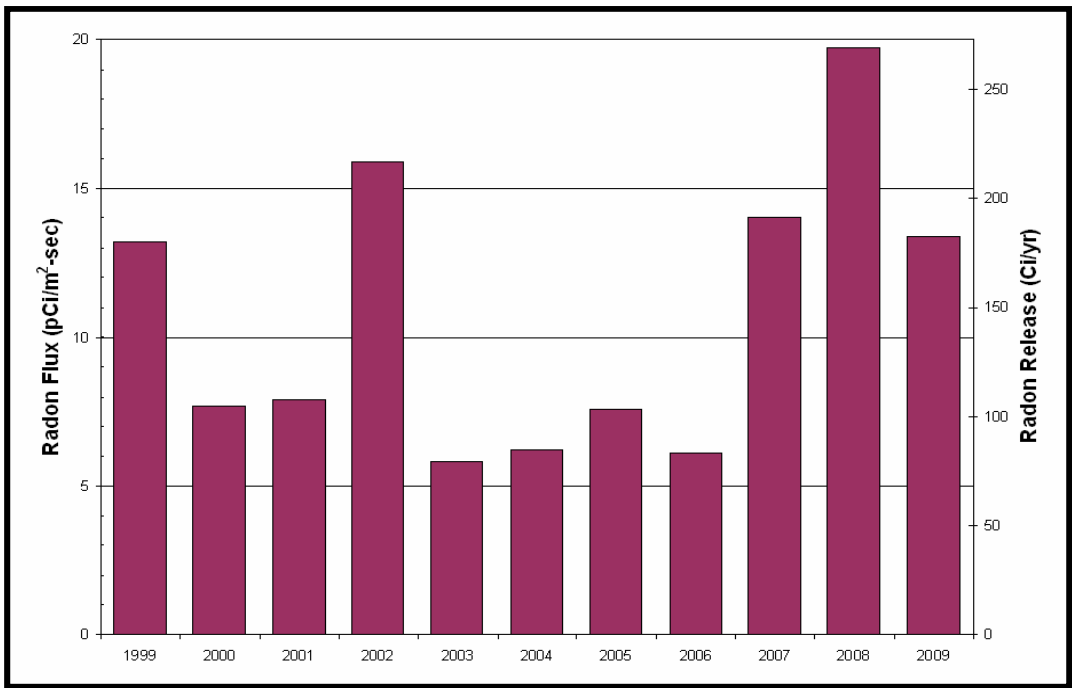

Figure 4: Cañon City Radon Flux and Annual Release

Although the radon releases given in Table 18 and Figure 4 are only from the impoundments, it is assumed that other onsite sources of radon would be small by comparison. The basis for this assumption is that no milling operations have occurred at Cañon City since 2005, and there is not likely much uranium onsite to act as a source of radon. This is supported by the monthly release rates for uranium, thorium, and radium, which are very low. Finally, Cotter 2010 points out that the offsite radon daughter (i.e., ^{210}Pb) concentrations (which are measured and reported in the semiannual effluent reports) are consistent with what would be expected from non-Cañon City Milling Facility radon:

> Results for ^{210}Pb at all monitoring locations are controlled by regional ^{222}Rn concentrations and do not exhibit discernible effects from milling facility activities. [Cotter 2010, page 5-4]

2.3.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Cañon City site are shown in Table 19.

Table 19: Cañon City Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	269	146
RMEI (1500m N)	Dose (mrem/yr)	5.0E-03	1.0E+01	6.0E+00
	LCF Risk (yr^{-1})	2.6E-09	5.4E-06	3.1E-06
Population	Dose (person-rem/yr)	2.4E-02	4.9E+01	2.9E+01
	LCF Risk (yr^{-1})	1.5E-07	3.1E-04	1.8E-04

2.4 Smith Ranch – Highland[4]

Power Resources Incorporated (PRI), a wholly owned subsidiary of the Cameco Corporation, operates the Highland and Smith Ranch ISL uranium mines located in eastern Wyoming, approximately 16 miles north of Glenrock in Converse County. In 1987, ISL facilities were constructed at the Highland mine, and commercial production began a year later. Cameco acquired PRI in 1997. The first ISL pilot operation began in 1981 at the Smith Ranch; the second operation began in 1984. Commercial ISL facilities were constructed in 1996 and began producing a year later. Cameco then acquired the Smith Ranch from Rio Algom Mining Corporation in 2002 and consolidated the Highland and Smith Ranch operations (the Highland license, SUA-1511, was integrated into the license: SUA-1548). The Highland and Smith Ranch mines are currently the largest operated uranium production facilities in the United States, with lifetime production capacities of two million pounds of uranium from each facility. Proven and probable reserves total 5.9 million pounds of U_3O_8, and in 2009, production was 1.8 million pounds of U_3O_8.

The permit area for the combined Smith Ranch – Highland properties contains 30,760 acres. The main facilities at the Smith Ranch – Highland Uranium Project (SR-HUP), besides the well fields, include the two yellowcake processing plant sites and related facilities that are located within the former Bill Smith Mine site (Smith Ranch Main Office Central Processing Plant [CPP] Complex) and the former Exxon Highland Mine site (HUP Central Plant/Office Complex). Since 2002, the HUP facilities have been on stand-by status, although in the future it may be used as a resin stripping, elution, and precipitation facility. All yellowcake processing, office, and related activities currently are occurring at Smith Ranch, shown in Figure 5. In association with the Smith Ranch CPP is a lined, two-celled evaporation pond to assist with wastewater disposal. Additional lined evaporation ponds consisting of 5- to 15-acre cells may be constructed as needed. Waste water is also disposed at two deep disposal wells at Smith Ranch and one deep disposal well at Highland.

[4] The description of the Smith Ranch – Highland site was abstracted from various sources, including RAMC 1999, Trihydro 2005, Melbye 2008, Cameco 2009, and Cameco 2010b, while the aerial view of the Smith Ranch – Highland site was obtained from Google Maps.

Figure 5: Smith Ranch – Aerial View

2.4.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Smith Ranch – Highland site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 20. To adjust the 2000 population data to 2010, the CAP88 Smith Ranch – Highland population dose was multiplied by 1.14, see Section 1.2 and Table 3.

Table 20: Smith Ranch – Highland Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	0	0	0	10
NNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	6
SW	0	0	0	0	0	0	33
SSW	0	0	0	0	0	0	133
S	0	0	0	0	0	0	19
SSE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	9
ESE	0	0	0	0	0	0	0
E	0	0	0	0	0	2	0
ENE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	4
NNE	0	0	0	0	0	0	6

Table 20: Smith Ranch – Highland Population Data

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	7	5	13	30	4	172
NNW	2	3	14	10	10	11
NW	0	0	0	17	590	31
WNW	0	0	13	3	6	2
W	0	0	2	304	24	123
WSW	37	216	926	42155	20374	756
SW	2418	137	179	63	66	32
SSW	893	25	27	5	0	0
S	80	37	33	6	5	4
SSE	77	388	586	88	35	63
SE	19	1234	5161	78	106	54
ESE	16	5	21	29	22	44
E	5	8	5	16	20	13
ENE	0	21	30	3	21	12
NE	9	0	14	14	4	19
NNE	4	14	9	3	33	1299

The agricultural productivity factors for Wyoming were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Smith Ranch – Highland site population dose calculation.

Beef Cattle Density (cattle/km^2):	5.12
Milk Cattle Density (cow/km^2):	0.0579
Land Cultivated for Vegetable Crops:	0.159%

The distance and direction to the RMEI were identified in the Smith Ranch – Highland license application (PRI 2003) as:

> … the Sundquist (Smith) Ranch located approximately 2.6 miles southwest of the Smith Ranch Main Office/CPP site, the Vollman Ranch well located approximately 1.5 miles east of Satellite No. 3 and the Fowler Ranch well located just north of the permit area approximately 2.5 miles north of the Highland Central Plant. [PRI 2003, page 2-3]

Notice, that the Table 20 SECPOP estimate places the nearest individual to Smith Ranch – Highland at a distance of 5 to 10 km in the East direction. This location was found through analysis using CAP88 to be the location of the RMEI. To calculate the RMEI dose and risk for this study, the Table 20 RMEI distance and direction were used.

2.4.2 Meteorology

The CAP88 computer program is provided with a weather library of meteorological data from over 350 NWS stations. For the Smith Ranch – Highland site, the CAP88-provided weather data for Casper, WY (CAP88 File: CPR0335.WND) were used. The period of record for this data included the years 1967 through 1971. Table 21 shows the directional dependent average wind

speed for each stability class, while Table 22 gives the stability class frequency used in the Smith Ranch – Highland analysis.

Table 21: Smith Ranch – Highland Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	1.372	2.360	3.774	5.971	3.088	1.804	0.000
NNW	1.855	2.243	3.408	4.058	3.145	1.862	0.000
NW	1.972	2.493	3.522	4.613	3.354	2.059	0.000
WNW	1.991	2.361	3.922	5.109	3.762	1.924	0.000
W	1.585	2.354	3.613	5.489	3.668	2.019	0.000
WSW	1.178	2.558	3.731	4.958	3.653	2.147	0.000
SW	1.991	2.901	3.740	5.331	3.461	2.056	0.000
SSW	1.725	2.656	3.756	5.648	3.423	2.160	0.000
S	1.972	2.687	3.938	5.565	3.384	1.943	0.000
SSE	1.991	2.699	4.561	4.794	3.367	2.064	0.000
SE	0.772	3.216	3.909	6.086	3.344	2.104	0.000
ESE	1.972	2.827	4.075	6.414	3.521	2.041	0.000
E	1.837	2.846	4.651	6.724	3.865	2.010	0.000
ENE	1.725	2.973	4.670	7.288	4.105	2.073	0.000
NE	1.178	2.691	5.089	8.261	4.040	1.959	0.000
NNE	1.672	2.809	4.477	8.494	3.971	1.924	0.000

Table 22: Smith Ranch – Highland Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (frequency)						
	A	B	C	D	E	F	G
N	0.0093	0.1614	0.1547	0.4633	0.0849	0.1264	0.0000
NNW	0.0904	0.1825	0.1474	0.3184	0.1325	0.1289	0.0000
NW	0.0115	0.1378	0.1499	0.4327	0.1466	0.1214	0.0000
WNW	0.0109	0.0631	0.1201	0.5322	0.1641	0.1095	0.0000
W	0.0067	0.0608	0.1044	0.5708	0.1438	0.1135	0.0000
WSW	0.0092	0.0366	0.0886	0.5864	0.1417	0.1376	0.0000
SW	0.0072	0.0404	0.0644	0.6413	0.1314	0.1152	0.0000
SSW	0.0084	0.0388	0.0585	0.6700	0.1046	0.1197	0.0000
S	0.0037	0.0385	0.0691	0.5697	0.1331	0.1860	0.0000
SSE	0.0084	0.0694	0.0792	0.4323	0.1598	0.2509	0.0000
SE	0.0061	0.0442	0.0914	0.4621	0.1687	0.2275	0.0000
ESE	0.0109	0.0439	0.0937	0.4982	0.1641	0.1892	0.0000
E	0.0081	0.0372	0.0843	0.4802	0.2302	0.1600	0.0000
ENE	0.0031	0.0175	0.0636	0.6527	0.1984	0.0647	0.0000
NE	0.0017	0.0165	0.0400	0.8454	0.0730	0.0233	0.0000
NNE	0.0044	0.0224	0.0438	0.8422	0.0546	0.0327	0.0000
TOTAL	0.0066	0.0389	0.0717	0.6385	0.1394	0.1049	0.0000

2.4.3 Radon Release

Tables 3 and 4 of Savignac 2007 provide the data necessary to use NUREG-1569 (NRC 2003), Appendix D to calculate the radon released from the various Smith Ranch – Highland well fields during both production and restoration, respectively. Using the Savignac 2007 data, Table 23 presents the calculated well field annual radon releases during both production and restoration. The reason that the annual restoration radon release is greater than the production release for all the well fields, except well field SW, is because the restoration purge rate is greater. Thus, there is less time for radiological decay to reduce the amount of radon prior to its release.

Table 23: Smith Ranch – Highland Well Field Annual Radon Release

Well Field	Radon Release (Ci/yr)						
	Production				Restoration		
	Purge	Vent	IX	Total	Purge	Vent	Total
C	19	1,544	2.3	1,565	157	1,537	1,694
D	6	257	2.3	266	26	256	282
Dext	4	772	2.3	779	79	768	848
E	2	1,011	2.3	1,016	103	1,006	1,109
F	8	4,230	2.3	4,241	455	4,207	4,662
H	1	2,207	2.3	2,210	225	2,195	2,420
I	28	2,206	2.3	2,236	225	2,195	2,420
1	185	983	8.7	1,177	794	952	1,745
2	126	674	3.4	803	217	669	886
3	237	1,275	6.9	1,518	806	1,245	2,051
4/4A	185	1,001	8.2	1,195	334	994	1,328
(SR)15	62	2,572	2.3	2,636	239	2,562	2,801
(SR)15A	58	2,388	2.2	2,448	206	2,380	2,586
(HUP)J	40	2,389	2.2	2,431	245	2,378	2,624
(HUP)K	41	844	2.4	887	94	841	935
SW	4,727	3,615	1.1	8,343	311	3,846	4,157

Cameco 2009 presents a revised estimated schedule for Smith Ranch – Highland well field activities, which has been reproduced below as Figure 6.

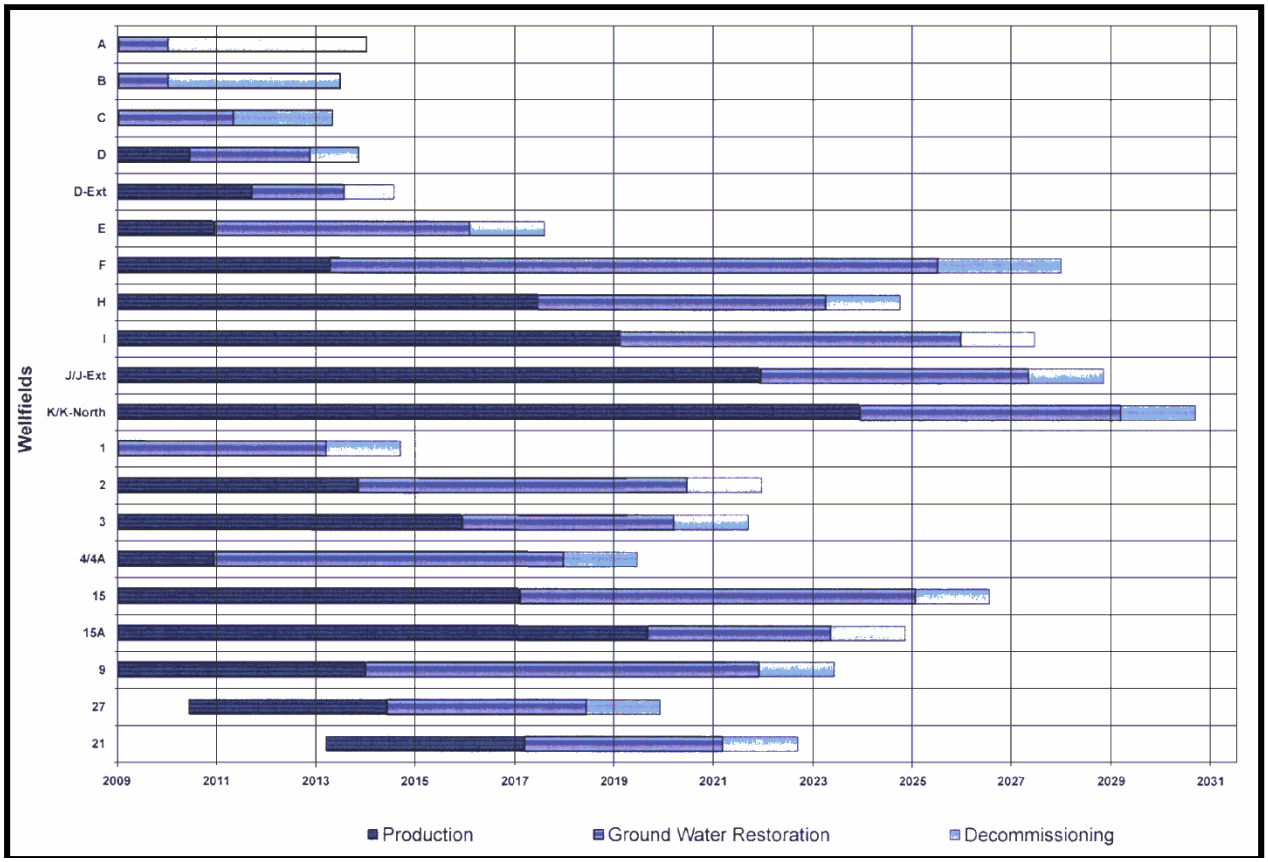

Figure 6: Smith Ranch – Highland – Estimated Time Table of Mining Related Activities

Figure 6 is used in conjunction with Table 23 to calculate the site-wide annual radon release over the Smith Ranch – Highlands estimated operating life. Figure 7 shows these calculated Smith Ranch – Highland radon releases.

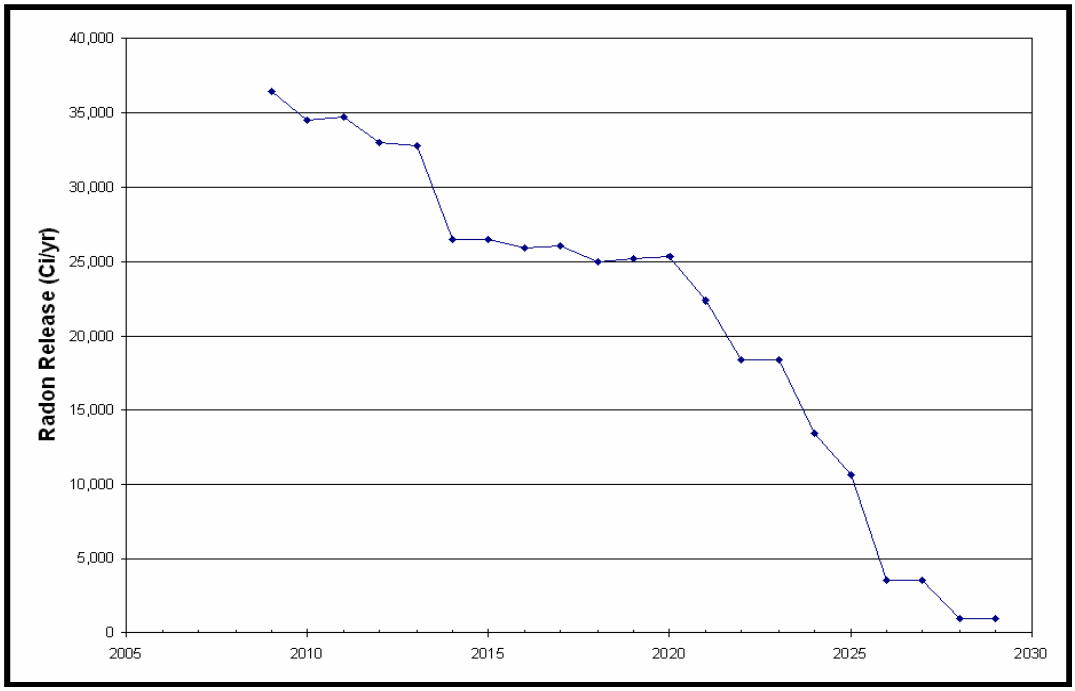

Figure 7: Smith Ranch – Highland – Total Estimated Radon Release by Year

The calculated maximum Smith Ranch – Highland annual radon release from all well fields either in production or restoration occurs in 2009 and is 36,500 Ci, while the average annual radon release from 2009 to 2029 is 21,100 Ci.

2.4.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Smith Ranch – Highland site are shown in Table 24.

Table 24: Smith Ranch – Highland Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	36,500	21,100
RMEI (7500m E)	Dose (mrem/yr)	7.2E-04	1.5E+00	8.6E-01
	LCF Risk (yr^{-1})	3.7E-10	7.7E-07	4.5E-07
Population	Dose (person-rem/yr)	1.8E-03	3.7E+00	2.2E+00
	LCF Risk (yr^{-1})	1.1E-08	2.3E-05	1.3E-05

2.5 Crow Butte[5]

The Crow Butte Project site is located in west central Dawes County, Nebraska, just north and west of the Pine Ridge Area. The Crow Butte Project site, shown in Figure 8, is about 4.0 miles southeast of the City of Crawford via Squaw Creek Road. What is now the Crow Butte Project was originally developed by Wyoming Fuel Corporation, which constructed a R&D facility at the site in 1986; commercial operations began in 1991. The project was subsequently acquired and is now owned and operated by Crow Butte Resources, Inc. (CBR), known as the Ferret Exploration Company of Nebraska until May 1994. It is the first uranium mine in Nebraska and has reserves of 5.9 million pounds of U_3O_8 (2,270 tonnes U), resources of 8.5 million pounds of U_3O_8 (3,270 tonnes U), and an annual capacity of 2 million pounds of U_3O_8.

Figure 8: Crow Butte – Aerial View

Most of the following description of the Crow Butte ISL process was taken from the license renewal application (CBR 2007). Uranium is recovered by ISL from the Chadron Sandstone at a depth that varies from 400 feet to 900 feet. The overall width of the mineralized area varies from 1000 feet to 5000 feet. The ore body ranges from less than 0.05 percent to greater than 0.5 percent U_3O_8, with an average grade estimated at 0.26 percent equivalent U_3O_8. The ISL process at Crow Butte uses gaseous oxygen or hydrogen peroxide to oxidize the uranium, and bicarbonate for dissolution. The uranium-bearing solution that results from the leaching of uranium underground is recovered from the well field and the uranium is extracted in the process plant. The plant process consists of the following steps:

- Loading of uranium complexes onto ion exchange resin;
- Reconstitution of the solution by the addition of carbonate and an oxidizer;

[5] The description of the Crow Butte site was abstracted from various sources, including CBR 2007, Melbye 2008, CBR 2009, and Cameco 2010a, while the aerial view of the Crow Butte site was obtained from Google Maps.

- Elution of the uranium complexes from the resin; and
- Drying and packaging of the uranium.

The radon-222 is contained in the pregnant lixiviant that comes from the well field to the process plant. The majority of this radon is released in the ion exchange columns and process tanks. These vessels are covered and vented to a manifold, which are in turn exhausted to atmosphere outside the building through stacks.

2.5.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Crow Butte site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 25. To adjust the 2000 population data to 2010, the CAP88 Crow Butte population dose was multiplied by 0.96, see Section 1.2 and Table 3.

Table 25: Crow Butte Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	0	0	19	20
NNW	0	0	0	1	0	34	39
NW	0	0	0	1	0	1140	33
WNW	0	0	4	0	0	20	12
W	0	3	0	0	0	24	20
WSW	0	2	0	5	0	7	21
SW	0	0	0	6	0	0	25
SSW	0	0	0	0	1	10	18
S	0	0	0	0	0	0	41
SSE	0	0	0	0	12	0	22
SE	0	0	0	0	0	10	12
ESE	0	1	0	0	0	0	43
E	0	0	0	0	0	0	6
ENE	0	0	0	15	0	9	32
NE	0	0	0	0	0	7	42
NNE	0	0	0	0	0	5	147

Table 25: Crow Butte Population Data

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	0	3	22	88	187	232
NNW	3	7	13	22	37	80
NW	26	24	4	23	0	51
WNW	25	35	22	22	28	37
W	27	26	295	35	72	25
WSW	22	8	9	29	35	34
SW	13	7	46	14	14	26
SSW	17	14	22	12	88	355
S	29	42	40	34	8	239
SSE	37	80	1148	209	268	5496
SE	14	94	134	182	495	3841
ESE	43	60	35	178	131	70
E	70	263	101	889	162	1193
ENE	203	598	101	86	109	3858
NE	59	5588	55	29	166	1904
NNE	1	17	11	17	81	103

The agricultural productivity factors for Nebraska were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Crow Butte site population dose calculation.

Beef Cattle Density (cattle/km^2):	35.
Milk Cattle Density (cow/km^2):	0.878
Land Cultivated for Vegetable Crops:	2.39%

The distance and direction to the RMEI were identified in the CBR's response to NRC's request for additional information (RAI) (CBR 2009) regarding the Crow Butte license renewal application as:

> Two dwelling units are within 0.62 mile [ENE and ESE], and another five dwelling units are within 1.24 miles of the center point of the License Area. [CBR 2009, Section 2.2.3.4]

Notice that the Table 25 SECPOP estimate places the nearest individuals to Crow Butte at a distance of 1 to 2 km in the West, WSW, and ESE directions. Through analysis using CAP88 the RMEI was found to be located 1 to 2 km in the WSW direction. To calculate the RMEI dose and risk for this study, the Table 25 RMEI distances and directions were used, since they are consistent with the RAI response information (i.e., 0.62 mile is equal to 1 km in the ESE direction, and 1.24 miles is about 2 km).

2.5.2 Meteorology

The Crow Butte ISL site has a meteorological monitoring station that records wind speed, wind direction, and stability class. This onsite meteorological data were used by CBR to formulate a joint frequency distribution for the dose calculations performed as part of the Crow Butte license

renewal application. For this risk assessment, the meteorological data from the license renewal application were reformatted so that it could be processed by the CAP88 auxiliary program, WINDGET (Trinity 2007), which generated a meteorological data file in the format required by CAP88 (i.e., a .WND file). Table 26 shows the directional-dependent average wind speed for each stability class that was used in this risk assessment for the Crow Butte site, while Table 27 gives the stability class frequency.

Table 26: Crow Butte Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	3.702	5.309	5.269	8.323	3.824	2.504	0.000
NNW	4.259	5.031	7.395	7.497	3.340	2.364	0.000
NW	3.890	5.313	6.946	6.680	3.971	2.243	0.000
WNW	3.251	4.099	6.033	5.610	3.801	1.897	0.000
W	3.208	4.558	6.026	6.968	3.559	1.643	0.000
WSW	3.400	4.658	6.596	6.267	3.786	1.869	0.000
SW	3.381	4.672	6.051	6.886	3.936	2.446	0.000
SSW	3.594	4.399	5.726	7.469	3.882	2.095	0.000
S	3.844	5.053	5.848	6.572	3.401	1.826	0.000
SSE	3.898	5.988	5.852	8.053	3.356	1.682	0.000
SE	4.106	5.996	5.821	9.384	4.293	2.160	0.000
ESE	4.322	4.833	5.447	8.553	4.029	2.311	0.000
E	4.296	5.217	5.643	8.225	3.246	2.105	0.000
ENE	4.024	5.198	4.985	7.496	4.094	2.192	0.000
NE	3.804	4.493	5.118	6.580	4.179	2.347	0.000
NNE	4.550	4.719	4.820	7.136	3.594	2.568	0.000

Table 27: Crow Butte Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (frequency)						
	A	B	C	D	E	F	G
N	0.0229	0.0336	0.0608	0.5833	0.1758	0.1236	0.0000
NNW	0.0349	0.0462	0.0908	0.5105	0.2089	0.1087	0.0000
NW	0.0885	0.1017	0.1610	0.3487	0.1788	0.1213	0.0000
WNW	0.0605	0.1256	0.1596	0.2897	0.1589	0.2058	0.0000
W	0.1169	0.0716	0.4700	0.1658	0.0878	0.0879	0.0000
WSW	0.1062	0.1419	0.2329	0.3233	0.1250	0.0708	0.0000
SW	0.0833	0.1149	0.1570	0.4925	0.1229	0.0294	0.0000
SSW	0.1098	0.0898	0.1157	0.5296	0.1157	0.0395	0.0000
S	0.1463	0.1528	0.1463	0.3110	0.1425	0.1010	0.0000
SSE	0.0825	0.1194	0.1369	0.5582	0.0695	0.0335	0.0000
SE	0.0332	0.0615	0.0780	0.7436	0.0521	0.0315	0.0000
ESE	0.0677	0.1026	0.0720	0.5913	0.1089	0.0574	0.0000
E	0.0823	0.1161	0.1263	0.4623	0.1055	0.1075	0.0000
ENE	0.0372	0.0696	0.1450	0.5163	0.1518	0.0801	0.0000
NE	0.0281	0.0439	0.0930	0.5189	0.1994	0.1166	0.0000
NNE	0.0244	0.0400	0.0874	0.4574	0.2123	0.1785	0.0000
TOTAL	0.0559	0.0730	0.1152	0.5100	0.1510	0.0948	0.0000

2.5.3 Radon Release

Regarding radon release from the Crow Butte site, the application for license renewal (CBR 2007) stated:

> The only radioactive airborne effluent at the Crow Butte Project is radon-222 gas. As yellowcake drying and packaging is carried out using a vacuum dryer, there are no airborne effluents from that system.
>
> The radon-222 is contained in the pregnant lixiviant that comes from the wellfield to the process plant. The majority of this radon is released in the ion exchange columns and process tanks. These vessels are covered and vented to a manifold, which are in turn exhausted to atmosphere outside the building through stacks. The manifolds are equipped with an exhausting fan. [CBR 2007, Section 1.8.1]

As required by 10 CFR § 40.65 and License SUA-1534 Condition Number 12.1, the estimated release of radon from process operations is reported in the semi-annual reports. Table 28 contains annual calculated radon releases from the Crow Butte Project Facility since 1994, as does Figure 9.

Table 28: Crow Butte Radon Release to the Environment

Year	Release (Ci/yr)	Year	Release (Ci/yr)
1995	3,537	2001	4,633
1996	3,997	2002	4,675
1997	4,175	2003	4,615
1998	4,740	2004	4,671
1999	4,674	2005	4,517
2000	4,760	2006	4,607

Source: CBR 2009, Table 5.8-8

Table 29: Crow Butte Modeled Radon Release

Source	Release (Ci/yr)
Plant Vent	4,603
Satellite Plant Vent	342
MU-2-4 (restoration)	350
MU-5	454
MU-6&8	908
MU 7&9	908
North Trend Well Field	1,320
Total	8,885

Source: CBR 2007, Table 7.12-5

CBR 2007 used MILDOS-Area to model the emission rate of radon from the Crow Butte Project, including the North Trend Well Field. Those modeled radon emission rates are shown in Table 29, which consists of a flow of 5000 gpm in the up-flow ion exchange columns in the existing plant, along with the proposed 4000 gpm of flow treated in the pressurized down-flow ion exchange columns. Notice that the modeled radon release rate is about twice as that reported as the estimated radon release rate.

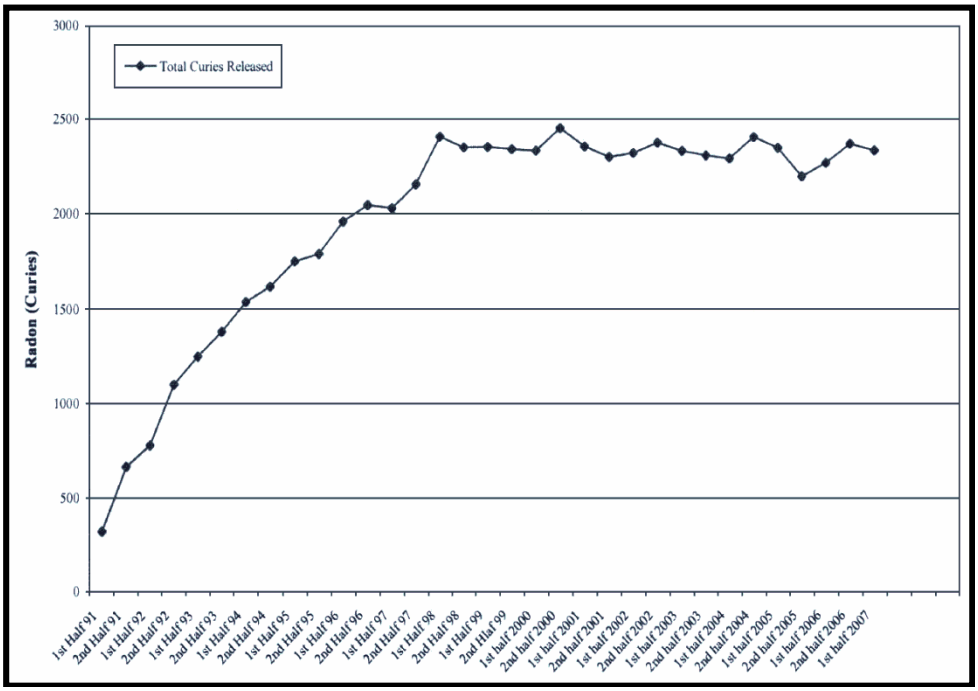

Figure 9: Crow Butte Total Estimated Semi-Annual Radon Release (1991-2007)

For the Crow Butte Project, the maximum annual radon release rate was assumed to be 8,885 Ci, while the average annual release rate is 4,467 Ci.

2.5.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Crow Butte site are shown in Table 30.

Table 30: Crow Butte Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	8,885	4,467
RMEI (1500m WSW)	Dose (mrem/yr)	1.6E-03	3.3E+00	1.9E+00
	LCF Risk (yr^{-1})	8.4E-10	1.7E-06	1.0E-06
Population	Dose (person-rem/yr)	1.3E-03	2.7E+00	1.6E+00
	LCF Risk (yr^{-1})	8.4E-09	1.7E-05	1.0E-05

2.6 Christensen / Irigaray[6]

The Christensen / Irigaray Ranch project is an ISL uranium mining operation located approximately 55 miles southeast of Buffalo, Wyoming, and 51 miles northeast of Midwest, Wyoming. The project is actually composed of two ISL sites (7 miles apart) containing well fields or facilities within approximately 687 acres. The first area, generally referred to as the Irigaray site or the Irigaray CPP, is located in southeast Johnson County, Wyoming (see Figure 10). The uranium deposit is one of many located in the Powder River Basin in northeast Wyoming. The property consists of approximately twenty-eight square miles. The second area is the Christensen Ranch well field and satellite operation (ion exchange plant), shown in Figure 11, which is located approximately 13 miles southeast of the Irigaray site. The Christensen Ranch operations consist of approximately 14,000 acres in Johnson and Campbell Counties, Wyoming.

In August 1978, the NRC issued one license, SUA-1341, which covers both areas of the Christensen / Irigaray Ranch project. The site operated intermittently until June 2000, when all mining activities were suspended due to low uranium prices. In April 2007, the mine owner, Cogema Mining, Inc., requested an amendment to the license to return the facility to an operating status. The NRC subsequently approved the licensee's request by a license amendment dated September 30, 2008. In December 2009, Cogema Mining was sold to Uranium One, Inc.

In anticipation of plant startup, the licensee began implementing operations-related environmental monitoring during October 2008. When the plant resumes operation, the first mine unit that will be placed into service will be Christensen Ranch mine unit 7. At the time of the inspection, the well field data package for this mine unit was being reviewed by the State of Wyoming. The construction of the mine unit was approximately half complete. The monitor

[6] The description of the Christensen / Irigaray site was abstracted from various sources, including Melbye 2008, NRC 2008, and NRC 2010, while the aerial views of the Christensen / Irigaray site were obtained from Google Maps.

well ring and some of the main trunk lines had been installed. In the near future, the licensee plans to develop Christensen Ranch mine units 8-9. Future well fields may include Christensen Ranch mine units 10-12.

Since the site was returned to operational status September 30, 2008, with the intent of returning to uranium production, plans to decommission the CPP at Irigaray were stopped, and, instead, the plant will be refurbished for a return to operation. Surface reclamation of the well fields at Irigaray will continue, as there is no intent to reopen them for production. The satellite processing plant at Christensen Ranch will be used for operations, as uranium production has not occurred at several permitted well fields at Christensen Ranch. The Irigaray CPP may also be used for final processing of uranium from the Moore Ranch and Uranium One's other uranium projects in the Powder River Basin.

Figure 10: Irigaray – Aerial View

Figure 11: Christensen – Aerial View

2.6.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Christensen / Irigaray site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 31. To adjust the 2000 population data to 2010, the CAP88 Christensen / Irigaray population dose was multiplied by 1.34, see Section 1.2 and Table 3.

Table 31: Christensen / Irigaray Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	6
WNW	0	0	0	0	0	0	7
W	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	30
SW	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSE	0	0	0	0	0	1	10
SE	0	0	0	1	0	0	0
ESE	0	0	0	0	0	3	5
E	0	0	0	0	0	0	1
ENE	0	0	0	0	0	0	7
NE	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	7

Table 31: Christensen / Irigaray Population Data

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	0	0	12	18	17	8
NNW	0	0	3	5	24	16
NW	0	0	0	26	151	2135
WNW	0	0	0	16	36	34
W	0	24	109	39	23	27
WSW	54	24	277	55	19	13
SW	4	0	11	0	21	8
SSW	34	3	600	2	13	0
S	14	4	0	3	8	0
SSE	2	0	20	5	4	25
SE	0	8	29	9	17	14
ESE	13	7	77	7	5	49
E	3	0	1417	91	20	8
ENE	31	2	39	52	16	28
NE	38	11	150	459	23517	5049
NNE	0	8	66	407	403	118

The agricultural productivity factors for Wyoming were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Christensen / Irigaray site population dose calculation.

Beef Cattle Density (cattle/km^2):	5.12
Milk Cattle Density (cow/km^2):	0.0579
Land Cultivated for Vegetable Crops:	0.159%

The distance and direction to the RMEI were identified in Cogema's response to NRC's RAI (Cogema 2010) regarding the Christensen / Irigaray license renewal application as:

> The nearest residence to the IR site is 4 miles to the north (the Brubaker ranch) and the nearest residence to CR is the John Christensen ranch located 3 miles southeast of the CR plant site. Both are ranch housing with a population of 5 or less. [Cogema 2010, Section 5.2]

Notice that the Table 31 SECPOP estimate places the nearest individual to Christensen / Irigaray at a distance of 3 to 4 km in the SE direction. This location was found to be the location of the RMEI through analysis using CAP88. Since it is slightly closer, the Table 31 RMEI distance and direction were used to calculate the RMEI dose and risk for this study.

2.6.2 Meteorology

The CAP88 computer program is provided with a weather library of meteorological data from over 350 NWS stations. For the Christensen / Irigaray site, the CAP88-provided weather data for Casper, WY (CAP88 File: 24089.WND) were used. The period of record for this data

included the years 1988 through 1992. Table 32 shows the directional-dependent average wind speed for each stability class, while Table 33 gives the stability class frequency, used in the Christensen / Irigaray analysis.

Table 32: Christensen / Irigaray Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	2.070	2.820	4.040	5.620	3.160	1.960	0.000
NNW	2.080	2.760	3.260	4.620	3.160	1.920	0.000
NW	1.990	2.920	3.340	4.670	3.160	1.820	0.000
WNW	2.210	2.650	4.080	5.340	3.580	2.150	0.000
W	1.940	2.680	4.100	5.730	3.780	2.080	0.000
WSW	2.070	3.020	4.050	5.110	3.520	2.120	0.000
SW	1.930	2.990	3.830	5.190	3.410	2.170	0.000
SSW	2.060	2.870	3.750	5.830	3.520	2.180	0.000
S	1.770	2.900	3.970	5.510	3.450	2.150	0.000
SSE	2.190	2.520	3.530	5.120	3.270	2.150	0.000
SE	2.270	3.030	4.100	5.560	3.470	2.200	0.000
ESE	2.070	3.110	4.560	6.220	3.450	2.190	0.000
E	2.020	2.890	4.720	6.500	3.820	2.150	0.000
ENE	1.970	3.100	5.200	7.080	4.100	2.200	0.000
NE	2.170	2.980	5.500	8.420	4.010	2.210	0.000
NNE	1.970	2.990	5.000	8.290	3.740	2.110	0.000

Table 33: Christensen / Irigaray Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (frequency)						
	A	B	C	D	E	F	G
N	0.0135	0.2097	0.1742	0.3958	0.0973	0.1095	0.0000
NNW	0.0276	0.2452	0.2063	0.2690	0.1188	0.1331	0.0000
NW	0.0302	0.1927	0.2094	0.3469	0.1073	0.1134	0.0000
WNW	0.0083	0.1102	0.1352	0.4937	0.1515	0.1010	0.0000
W	0.0036	0.0671	0.1110	0.5846	0.1395	0.0943	0.0000
WSW	0.0088	0.0549	0.0995	0.5699	0.1414	0.1254	0.0000
SW	0.0061	0.0557	0.0861	0.5939	0.1350	0.1232	0.0000
SSW	0.0056	0.0431	0.0616	0.6628	0.1138	0.1130	0.0000
S	0.0061	0.0469	0.0886	0.5403	0.1474	0.1707	0.0000
SSE	0.0046	0.0541	0.0913	0.3999	0.2038	0.2462	0.0000
SE	0.0015	0.0535	0.0963	0.4190	0.1955	0.2343	0.0000
ESE	0.0063	0.0391	0.1045	0.4612	0.1511	0.2379	0.0000
E	0.0028	0.0336	0.0921	0.4964	0.2166	0.1586	0.0000
ENE	0.0013	0.0178	0.0720	0.6031	0.2275	0.0783	0.0000
NE	0.0008	0.0099	0.0444	0.8381	0.0813	0.0254	0.0000
NNE	0.0028	0.0318	0.0732	0.7946	0.0614	0.0361	0.0000
TOTAL	0.0041	0.0424	0.0820	0.6227	0.1437	0.1051	0.0000

2.6.3 Radon Release

Table 34 presents annual calculated radon release estimates for the Christensen / Irigaray site for the period 1995 to 2000, the last production run prior to entering exclusively into restoration. Table 34 summarizes the information presented in the semi-annual effluent reports over that time period. Calculation of the semi-annual radon release was suspended after year 2000 (Cogema 2008).

The source terms used to estimate radon-222 releases from the facility include two well fields in production, two restoration well fields, one new well field, and the satellite processing facility. The radon-222 releases from these source terms are calculated using methods similar to those described in NUREG-1569, Appendix D. For the Christensen Ranch area, mine units 10-12 and 7 were chosen based on their proximity to site boundaries and predominant wind directions. A summary of estimated radon-222 releases from the Facility is presented in Table 35.

Table 34: Christensen / Irigaray Environmental Radon Release Summary

Year	Radon Release (Ci/yr)	
	Irigaray	Christensen Ranch
1995	58.5	739.8
1996	63.9	1125.1
1997	71.0	1231.7
1998	69.6	1384.4
1999	132.8	711.4
2000	214.5	434.0

Source: Cogema 2008, Table 5.13

Table 35: Christensen / Irigaray Estimated Radon Release

Source	Release (Ci/yr)
Production	281
Restoration	257
Drilling	0.04
Resin Transfer	0.42
Total	538.46

Source: Cogema 2008, Table 7.3-2

For the Christensen / Irigaray site, the maximum annual radon release rate was assumed to be 1,600 Ci, while the average annual release rate is 1,040 Ci.

2.6.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Christensen / Irigaray site are shown in Table 36.

Table 36: Christensen / Irigaray Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	1,600	1,040
RMEI (3500m SE)	Dose (mrem/yr)	9.1E-04	1.9E+00	1.1E+00
	LCF Risk (yr^{-1})	4.8E-10	9.9E-07	5.7E-07
Population	Dose (person-rem/yr)	1.8E-03	3.8E+00	2.2E+00
	LCF Risk (yr^{-1})	1.2E-08	2.4E-05	1.4E-05

2.7 Alta Mesa 1,2,3[7]

The Alta Mesa Project uranium deposits, located in southern Brooks County, Texas, were discovered in the mid-1970s, and some exploration drilling and monitor well installation were started in the 80s and early 90s. However, due to low uranium prices, the project was not developed. When Uranium Resources Inc. began licensing the Alta Mesa Project, the Texas Natural Resource Conservation Commission (TNRCC) was the regulatory agency. In 1998, Uranium Resources Inc. received permit number UR03060 from the TNRCC. Due to the depressed uranium market, URI abandoned the project in 1999, which was then continued by Mesteña Uranium LLC. Licensing and permitting effort proceeded to 2002. In 2002, the Texas Department of Health, Bureau of Radiation Control issued material license number L05360 for the operation of the Alta Mesa in situ uranium mine to Mesteña Uranium. Development activities began in late 2004, and construction of the production facilities began in January 2005. Despite challenges due to three hurricanes, and short supplies of materials, equipment, and trained personnel, the Alta Mesa Project started, as planned, in October 2005. The Alta Mesa Project produced 480,000 lbs of U_3O_8 in 2009, and plans to produce about 650,000 lbs of U_3O_8 in 2010.

In 2007, the responsibility for source material recovery (i.e., uranium surface mining activities) licensing was transferred to the Texas Department of State Health Services (TDSHS) to the Texas Commission on Environmental Quality (TCEQ). The Texas Railroad Commission (TRRC) retains responsibility for permitting for exploration wells for uranium mining.

The uranium mineralization occurs at depths from 150 to 500+ feet deep in different sandstone units of the Pliocene Goliad Formation, with an average thickness of 14.3 feet. The majority of the mineable reserves as of 1994 had been found in a sandstone unit designated the Middle C Sand Unit, with ore quality mineralization ranging from 420 to 480 feet deep. The uranium occurs along multiple, relatively continuous oxidation-reduction fronts that range in width from 50 to 200+ feet wide. The Alta Mesa uranium deposit has an average ore grade of 0.096% U_3O_8. The Alta Mesa Project, shown in Figure 12, uses conventional ion exchange precipitation processes and a low-temperature, zero-emission rotary vacuum dryer. The facility and well fields are designed for flexibility of operations.

[7] The description of the Alta Mesa site was abstracted from various sources, including Tanner and Goranson 2007, Melbye 2008, and McNeill 2010, while the aerial view of the Alta Mesa site was obtained from Google Maps.

Figure 12: Alta Mesa – Aerial View

2.7.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Alta Mesa site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 37. To adjust the 2000 population data to 2010, the CAP88 Alta Mesa population dose was multiplied by 0.92, see Section 1.2 and Table 3.

Table 37: Alta Mesa 1,2,3 Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	0	0	2	0
NNW	0	0	6	0	0	0	0
NW	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
W	0	0	6	0	0	0	0
WSW	0	0	0	0	0	0	9
SW	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	51
S	0	0	0	0	0	10	38
SSE	0	0	0	0	0	0	0
SE	0	0	0	0	0	41	0
ESE	0	0	0	0	0	14	0
E	0	0	69	0	0	79	198
ENE	0	0	0	0	0	6	112
NE	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	11	17	197	577	184	2454
NNW	6	0	73	106	309	41
NW	7	13	0	4748	339	482
WNW	0	14	5	25	28	30
W	22	3	0	26	16	84
WSW	0	114	21	44	78	19
SW	239	149	155	47	502	20610
SSW	462	13	38	33	2458	17761
S	81	56	103	2305	65220	201974
SSE	3	56	1058	6732	41029	66913
SE	25	60	34	69	7733	9454
ESE	6	0	0	65	26	404
E	18	0	8	48	0	0
ENE	18	4	3	8	8	24
NE	3	42	201	36	1542	5971
NNE	5	4518	2862	3377	48	3089

The agricultural productivity factors for Texas were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Alta Mesa site population dose calculation.

Beef Cattle Density (cattle/km^2):	19
Milk Cattle Density (cow/km^2):	0.53
Land Cultivated for Vegetable Crops:	0.577%

According to Mestena 2000, Table 3.2, the nearest resident to the Alta Mesa site is located about 2.5 km in the WSW direction. Table 37 also shows the nearest resident as being 2 to 3 km from

the site, but in the NNW, West, and East directions. Through analysis using CAP88, the RMEI was identified to be located 2 to 3 km in the NNW direction.

2.7.2 Meteorology

The U.S. Naval Air Base in Kingsville, which is much closer to the site than any of the NWS stations (45miles northeast), collects meteorological data, including wind speed, wind direction, and stability class. Meteorological data from the Kingsville Naval Air Base were used by Mestena Uranium to formulate a joint frequency distribution for the dose calculations performed as part of the Alta Mesa license application. For this risk assessment, the meteorological data from the Alta Mesa license application were reformatted so that they could be processed by the CAP88 auxiliary program, WINDGET (Trinity 2007), which generated a meteorological data file in the format required by CAP88 (i.e., a .WND file). Table 38 shows the directional-dependent average wind speed for each stability class that was used in this risk assessment for the Alta Mesa site, while Table 39 gives the stability class frequency.

Table 38: Alta Mesa / Kingsville Dome Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	2.012	3.266	5.985	7.300	4.983	2.017	0.000
NNW	1.743	3.518	5.521	7.872	5.115	2.003	0.000
NW	2.000	3.566	6.077	7.482	5.107	1.975	0.000
WNW	1.823	3.648	5.834	7.200	4.799	1.659	0.000
W	1.680	2.995	5.338	5.648	4.244	1.533	0.000
WSW	1.488	2.699	4.844	5.468	3.866	1.341	0.000
SW	1.439	2.713	4.849	5.512	4.025	1.601	0.000
SSW	1.300	2.720	4.888	6.149	4.340	1.624	0.000
S	2.208	2.618	4.761	6.445	4.705	1.633	0.000
SSE	1.826	2.395	5.180	6.390	4.763	1.659	0.000
SE	2.556	2.373	5.205	6.202	4.782	1.642	0.000
ESE	2.556	2.924	4.545	6.220	4.388	1.695	0.000
E	1.027	1.982	4.278	4.734	4.203	1.542	0.000
ENE	1.029	1.762	3.991	3.652	6.112	1.462	0.000
NE	1.826	3.573	4.278	5.487	3.962	1.344	0.000
NNE	1.814	2.600	5.346	6.672	4.431	1.945	0.000

Table 39: Alta Mesa / Kingsville Dome Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (frequency)						
	A	B	C	D	E	F	G
N	0.0162	0.0700	0.1047	0.4226	0.1090	0.2775	0.0000
NNW	0.0146	0.0529	0.0762	0.4792	0.1186	0.2585	0.0000
NW	0.0091	0.0354	0.0771	0.4761	0.1313	0.2710	0.0000
WNW	0.0060	0.0474	0.1093	0.4900	0.0947	0.2526	0.0000
W	0.0201	0.0745	0.1079	0.3680	0.0769	0.3526	0.0000
WSW	0.0176	0.0876	0.1120	0.4117	0.0694	0.3017	0.0000
SW	0.0092	0.0676	0.1025	0.5021	0.0816	0.2370	0.0000
SSW	0.0085	0.0756	0.1033	0.5325	0.0657	0.2144	0.0000
S	0.0084	0.0471	0.0879	0.5084	0.0913	0.2568	0.0000
SSE	0.0040	0.0493	0.0830	0.4447	0.0741	0.3448	0.0000
SE	0.0045	0.0523	0.0751	0.3448	0.0726	0.4507	0.0000
ESE	0.0081	0.0724	0.1158	0.2966	0.0553	0.4517	0.0000
E	0.0242	0.1773	0.0492	0.1892	0.0375	0.5226	0.0000
ENE	0.0244	0.1323	0.0997	0.1670	0.0082	0.5683	0.0000
NE	0.0189	0.1679	0.1463	0.3258	0.0619	0.2792	0.0000
NNE	0.0389	0.1298	0.1531	0.3888	0.0518	0.2377	0.0000
TOTAL	0.0121	0.0617	0.0949	0.4520	0.0945	0.2848	0.0000

2.7.3 Radon Release

The only information identified regarding radon release from the Alta Mesa Project was contained within the June 2000 radiological assessment performed for the project (Mestena 2000). The following is the radiological assessment's description of the Alta Mesa radon release.

> Radon gas will be emitted at the central facility when the circulating fluids are brought into equilibrium with the ambient atmosphere. The emission points will be all open tankage, resin columns and processing equipment.
>
> Two centralized discharge areas of radon gas were modeled, one centered on the production area of the process pad (Production Pad) and one centered on the restoration area of the process pad (Restoration Pad). An additional point source for radon was modeled based on the center of the pond receiving purge water (Purge Pond).
>
> Additional radon gas will be emitted at the wellfields because of well field venting and other small releases. These sites were modeled as small area sources centered on points within each wellfield which represented a one year production element. [Mestena 2000, Appendix 1]

The Alta Mesa annual radon release, as presented in the radiological assessment (Mestena 2000), is shown in Table 40.

Table 40: Alta Mesa Annual Radon Source Term

Source	Release (Ci/yr)
Well field 1a	5.2
Well field 1b	6.05
Well field 2a	4.81
Well field 2b	5.09
Well field 3a	1.67
Well field 3b	2.5
Well field 4	2.09
Process Pad	617.5
Restoration Pad	88.35
Purge Pond	6.5
Total	739.8

Source: Mestena 2000, Attachment 1

The radon releases given in Table 40 are design basis values; and, as such, are based on the Alta Mesa uranium production capacity of 1,500,000 lbs per year. As stated above, the amount of uranium produced at Alta Mesa has been somewhat less than its production capacity. Table 41 gives the Alta Mesa annual radon release as a function of the amount of uranium produced.

Table 41: Alta Mesa Radon Release by Uranium Production

Year	Uranium Production (lbs/yr)	Radon Release (Ci/yr)
2007	956,000	471
2009	480,000	237
2010	650,000	321
Capacity	1,500,000	740

2.7.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Alta Mesa site are shown in Table 42.

Table 42: Alta Mesa Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	740	472
RMEI (2500m NNW)	Dose (mrem/yr)	5.6E-03	1.2E+01	6.7E+00
	LCF Risk (yr^{-1})	3.0E-09	6.1E-06	3.6E-06
Population	Dose (person-rem/yr)	1.0E-02	2.2E+01	1.3E+01
	LCF Risk (yr^{-1})	6.3E-08	1.3E-04	7.6E-05

2.8 Kingsville Dome 1,3[8]

Uranium Resources, Inc.'s (URI's) Kingsville Dome property consists of mineral leases from private landowners on about 2,354 acres located in central Kleberg County, Texas. An aerial view of the Kingsville Dome site is shown in Figure 13. For the Kingsville Dome site, URI holds the TNRCC's Underground Injection Control Permit: UR02827; the site is also covered by the Texas Department of Health's radioactive materials license: L06353. At Kingsville Dome, multiple satellites feed a central processing plant at a rate of 400,000 pounds of U_3O_8 (154 tonnes U) per year (targeting between 1 and 2 million pounds of U_3O_8 (385-770 tonnes U) annually). Initial production commenced in May 1988 and continued until July 1999, when depressed uranium prices led to the suspension of production. URI resumed production at Kingsville Dome in April 2006 and produced 94,100 pounds of uranium in 2006, 338,100 pounds in 2007, 254,000 pounds in 2008, and 56,000 pounds in 2009. In the second quarter of 2009, due to depressed pricing, production at Kingsville Dome was shut-down to conserve the in-place reserve base until higher prices could be realized.

Figure 13: Kingsville Dome – Aerial View

[8] The description of the Kingsville Dome site was abstracted from various sources, including Melbye 2008, URI 2010a, and URI 2010b while the aerial view of the Kingsville Dome site was obtained from Google Maps.

2.8.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Kingsville Dome site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 43. To adjust the 2000 population data to 2010, the CAP88 Kingsville Dome population dose was multiplied by 0.97, see Section 1.2 and Table 3.

Table 43: Kingsville Dome 1,3 Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	0	0	54	3796
NNW	0	0	0	0	0	0	21
NW	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WSW	0	0	82	0	0	0	0
SW	0	0	3	0	0	87	393
SSW	0	0	0	0	0	37	189
S	0	0	0	0	0	41	248
SSE	0	0	0	0	0	240	512
SE	0	0	0	0	138	0	0
ESE	0	0	66	0	0	461	288
E	0	0	0	39	27	677	409
ENE	0	0	0	91	30	369	265
NE	0	0	0	0	0	537	18252
NNE	0	0	7	0	0	74	7920

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	1134	1242	2185	3921	2450	8983
NNW	330	1026	19092	24698	4509	14441
NW	276	296	60486	159467	14418	15036
WNW	0	77	2009	29018	305	181
W	0	0	6	0	0	0
WSW	0	0	0	0	0	0
SW	0	0	0	0	0	0
SSW	30	0	0	0	0	0
S	148	5	0	51	5	30
SSE	80	6	4	0	172	8
SE	25	613	68	8	160	235
ESE	0	1724	6133	99	26	22
E	0	2495	503	189	301	276
ENE	0	26	469	259	2036	125
NE	0	649	23849	6994	1116	52
NNE	126	302	1209	1430	3988	750

The agricultural productivity factors for Texas were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Kingsville Dome site population dose calculation.

Beef Cattle Density (cattle/km^2):	19
Milk Cattle Density (cow/km^2):	0.53
Land Cultivated for Vegetable Crops:	0.577%

According to TBRC 1988, Table S6.9-2, the nearest downwind resident to the Kingsville Dome site is located about 1.35 km in the West direction, and the nearest resident is located 0.44 km in the East direction. Table 43 also shows the nearest residents to the Kingsville Dome site as being about 2 to 3 km from the site, but in the WSW, ESE, and NNE directions. Through analysis using CAP88, the RMEI was found to be located 2 to 3 km in the NNW direction.

2.8.2 Meteorology

Because of the close proximity of the Kingsville Dome site to the Alta Mesa site (less than 50 miles) and because Kingsville Naval Air Base is the closest meteorological station to both, the meteorological data used for the Kingsville Dome site are the same as that used for the Alta Mesa site. Table 38 shows the directional-dependent average wind speed for each stability class that was used in this risk assessment for the Kingsville Dome site, while Table 39 gives the stability class frequency.

2.8.3 Radon Release

The only information identified regarding radon release from the Kingsville Dome site was in the Environmental Assessment (EA) prepared by the Texas Department of Health (TDH 1988). In the Kingsville Dome EA, the TDH estimated the annual radon release to be 6,958 Ci. If this radon release rate is assumed to correspond to the Kingsville Dome uranium production capacity, then the reported uranium production rates may be used to estimate the radon released for other years. This has been done, with the results shown in Table 44.

Table 44: Kingsville Dome Radon Release by Uranium Production

Year	Uranium Production (lbs/yr)	Radon Release (Ci/yr)
2006	94,100	655
2007	338,100	2,352
2008	254,000	1,767
2009	56,000	390
Capacity	1,000,000	6,958

The maximum annual radon release from the Kingsville Dome site is assumed to be 6,958 Ci, while the average annual release is 1,291 Ci.

2.8.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Kingsville Dome site are shown in Table 45.

Table 45: Kingsville Dome Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	6958	1291
RMEI (2500 NNW)	Dose (mrem/yr)	5.5E-03	1.1E+01	6.6E+00
	LCF Risk (yr^{-1})	2.9E-09	6.1E-06	3.5E-06
Population	Dose (person-rem/yr)	2.8E-02	5.8E+01	3.4E+01
	LCF Risk (yr^{-1})	1.8E-07	3.8E-04	2.2E-04

2.9 Eastern Generic Site – Virginia

Due to its many uranium deposits, as shown in Figure 14, the state of Virginia was selected for the location of the Eastern Generic site. In the early 1980s, uranium mining leases were obtained for 40,000 uranium-rich acres in Pittsylvania County and 16,000 acres in Fauquier, Madison, Culpeper, and Orange counties. Additionally, uranium deposits were discovered in Nelson County (UFV 2010). Because of its high population density and its past experience as a uranium mine lease site, Culpeper County was selected as the Eastern Generic site location within Virginia.

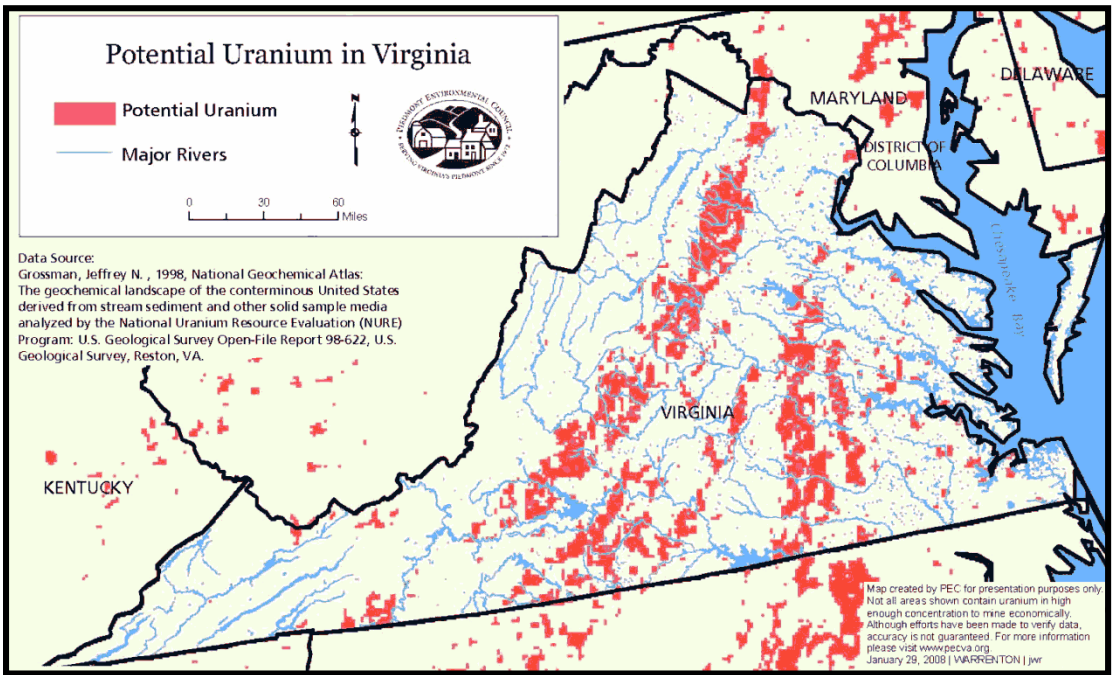

Figure 14: Potential Uranium in Virginia

The actual Eastern Generic site location within Culpeper County was selected so that there would be no population located within 1 km of the site. Figure 15 shows the approximate location of the Eastern Generic site, located in the northern portion of Virginia's Culpeper County.

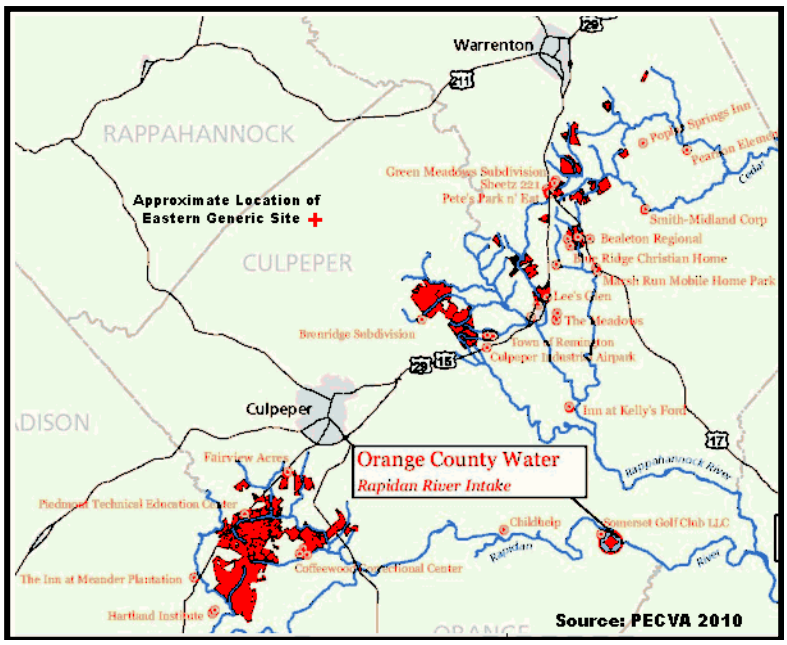

Figure 15: Approximate Location of the Eastern Generic Site

As shown in Figure 15, the Eastern Generic site is located north of the city of Culpeper and southwest of the city of Warrenton in an uninhabited area. Also, the areas in red on Figure 15 denote areas that have had uranium mine leases in the past.

2.9.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Eastern Generic site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 46. To adjust the 2000 population data to 2010, the CAP88 Eastern Generic population dose was multiplied by 1.40, see Section 1.2 and Table 3.

Table 46: Eastern Generic Site (Virginia) Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	5	160	442	588
NNW	0	11	154	0	2	816	1072
NW	0	0	0	125	76	741	2358
WNW	0	0	0	0	38	457	2105
W	0	0	0	38	0	367	2077
WSW	0	0	8	28	2	159	1608
SW	0	0	10	0	0	730	953
SSW	0	0	0	332	55	623	4037
S	0	0	0	0	0	841	10192
SSE	0	0	0	0	0	542	2474
SE	0	0	213	0	0	545	1393
ESE	0	0	143	0	130	187	598
E	0	0	197	38	35	135	349
ENE	0	0	147	1	31	176	711
NE	0	0	0	0	30	175	938
NNE	0	0	9	16	63	91	523

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	931	3140	2718	5208	36454	23280
NNW	1714	3578	3065	5089	16570	12798
NW	8464	4721	9451	11662	114035	115934
WNW	7907	8202	55966	135173	247760	367208
W	5161	2433	4498	69279	132991	40611
WSW	2868	4336	17263	58995	13734	5773
SW	1204	6574	9500	66863	23680	4796
SSW	651	3098	2808	4588	5366	7093
S	1947	3289	2997	2925	6611	4356
SSE	2407	4923	3356	6393	6092	41432
SE	2420	2990	5214	11763	17293	45571
ESE	1026	176	1095	10894	6452	50227
E	287	5893	7017	4870	11750	10706
ENE	446	3733	1566	8154	4049	1475
NE	542	2114	1487	13550	1098	1816
NNE	1160	17008	8288	19156	18827	6533

The agricultural productivity factors for Virginia were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Eastern Generic site population dose calculation.

Beef Cattle Density (cattle/km^2):	13.1
Milk Cattle Density (cow/km^2):	1.84
Land Cultivated for Vegetable Crops:	0.87%

The Eastern Generic site was selected so that there would be no population within 1 km of the site. Thus, the RMEI at the Eastern Generic site is located 1 to 2 km from the site in the NNW direction, as shown in Table 46.

2.9.2 Meteorology

The CAP88 computer program is provided with a weather library of meteorological data from over 350 NWS stations. For the Eastern Generic site, the CAP88-provided weather data for Gordonsville, VA (CAP88 File: GVE0824.WND) were used. The period of record for this data includes the years 1956 through 1960. Table 47 shows the directional-dependent average wind speed for each stability class, while Table 48 gives the stability class frequency, used in the Eastern Generic analysis.

Table 47: Eastern Generic Site (Virginia) Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	1.184	1.737	2.755	2.990	2.955	1.102	0.000
NNW	1.132	1.852	2.758	2.860	2.878	1.108	0.000
NW	1.170	1.542	2.067	2.420	2.704	1.070	0.000
WNW	1.172	1.433	2.263	2.400	3.093	1.049	0.000
W	1.141	1.473	2.120	2.163	2.678	1.028	0.000
WSW	1.177	1.876	2.622	2.463	2.935	1.086	0.000
SW	1.076	1.740	2.839	2.819	2.949	1.089	0.000
SSW	1.177	1.975	3.334	3.646	3.384	1.138	0.000
S	1.174	1.912	2.781	3.343	3.210	1.098	0.000
SSE	1.278	2.144	3.260	3.730	3.479	1.116	0.000
SE	1.204	1.990	3.147	4.179	3.569	1.133	0.000
ESE	1.238	2.327	3.518	5.455	4.076	1.164	0.000
E	1.197	1.917	3.220	4.912	3.887	1.140	0.000
ENE	1.201	2.030	3.276	4.479	3.784	1.131	0.000
NE	1.196	1.871	3.054	3.468	3.330	1.099	0.000
NNE	1.197	2.102	3.273	3.985	3.333	1.114	0.000

Table 48: Eastern Generic Site (Virginia) Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (frequency)						
	A	B	C	D	E	F	G
N	0.0224	0.0863	0.1225	0.3226	0.0791	0.3672	0.0000
NNW	0.0238	0.0788	0.1438	0.3242	0.0874	0.3421	0.0000
NW	0.0424	0.1049	0.1395	0.3309	0.0502	0.3321	0.0000
WNW	0.1047	0.1644	0.1440	0.3753	0.0276	0.1840	0.0000
W	0.0709	0.1887	0.1336	0.3718	0.0215	0.2134	0.0000
WSW	0.0528	0.1127	0.1576	0.4373	0.0502	0.1893	0.0000
SW	0.0206	0.0857	0.1223	0.4187	0.0629	0.2898	0.0000
SSW	0.0132	0.0509	0.0951	0.5464	0.0594	0.2350	0.0000
S	0.0108	0.0397	0.0722	0.4681	0.0522	0.3570	0.0000
SSE	0.0091	0.0519	0.0728	0.2914	0.0626	0.5122	0.0000
SE	0.0179	0.0404	0.0862	0.2618	0.0774	0.5163	0.0000
ESE	0.0159	0.0619	0.1244	0.4009	0.1222	0.2748	0.0000
E	0.0292	0.0641	0.1222	0.3285	0.1067	0.3492	0.0000
ENE	0.0290	0.1081	0.1642	0.3326	0.0826	0.2835	0.0000
NE	0.0288	0.0982	0.1551	0.3305	0.0670	0.3203	0.0000
NNE	0.0198	0.0820	0.1513	0.4027	0.0777	0.2664	0.0000
TOTAL	0.0231	0.0767	0.1219	0.3784	0.0716	0.3282	0.0000

2.9.3 Radon Release

It is assumed that a conventional uranium mine and mill would be located at the Eastern Generic site, and that the annual radon release from the Eastern Generic site would be similar to the radon released from the conventional mill located at White Mesa (see Section 2.2.3). Thus, the Eastern Generic site annual radon release was estimated to range from 1,025 to 1,750 Ci.

2.9.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Eastern Generic site are shown in Table 49.

Table 49: Eastern Generic Site Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	1750	1388
RMEI (500m SSE)	Dose (mrem/yr)	1.4E-02	2.8E+01	1.6E+01
	LCF Risk (yr^{-1})	7.6E-09	1.6E-05	9.2E-06
Population	Dose (person-rem/yr)	9.7E-02	2.0E+02	1.2E+02
	LCF Risk (yr^{-1})	6.6E-07	1.4E-03	7.9E-04

2.10 Western Generic Site – New Mexico[9]

The Grants Uranium Region in New Mexico is a world premier uranium mining district, having produced over 350 million pounds of uranium. During the 1970s, a conventional uranium mine and mill were developed by a joint venture between Long Island Lighting Company, a New York utility, and Bokum Resources Corporation. In addition to deposit development drilling, a shaft was sunk to a depth of 1,842 feet, a 2,200 ton-per-day uranium processing mill was constructed on site, and a tailings disposal site was excavated, all fully permitted. Due to the collapse in the uranium market in the early 1980s, development was halted, the deposit remains un-mined, and the mill was dismantled in 2001. According to Nuclear Regulatory Commission records, the source material license was terminated in 1988 following multiple inspections, which confirmed that no ore was ever produced or processed at the site. Although the mill has been removed, much of the infrastructure remains in place, including electric power, 1,800+ acre-feet of industrial-use water rights, the 1,842 shaft, and the previously permitted and partially completed tailings disposal site. The site is currently being considered for redevelopment as a conventional uranium mine and mill.

The Bokum mill was designed to accommodate 2,200 tons of ore feed per day. Metallurgical studies and yearly production were based on an average mill feed of 0.12% U_3O_8. Grinding was to be accomplished by a semi-autogenous mill and a rod mill. A two-stage sulfuric acid leach circuit was to be utilized. Liquid-solid separation was to use six stages of counter-current decantation, with clarification of overflows from inter-stage thickening. Solvent extraction and stripping for solubilization and removal of uranium was to be employed, and ammonia was to be used to precipitate the U_3O_8 as yellowcake.

The site of the former Bokum mine and mill was selected as the Western Generic site. It was assumed that a conventional mine and mill similar to the mine and mill previously proposed and partially constructed, but updated to reflect current 2010 technology, would be constructed.

2.10.1 Population and Food Production

The 80-kilometer population distribution in each of the 16 principal compass directions, which was calculated for the Western Generic site by SECPOP and used in CAP88 for population dose calculations, is shown in Table 50. To adjust the 2000 population data to 2010, the CAP88 Western Generic population dose was multiplied by 0.94, see Section 1.2 and Table 3.

[9] The description of the Western Generic site was abstracted from various sources, including Alief 2010, NE 2008a, and NE 2008b.

Table 50: Western Generic Site (New Mexico) Population Data

Dir	Distance (km)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 20
N	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	2
SW	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
S	0	0	0	0	0	0	24
SSE	0	0	0	0	0	2	341
SE	0	0	0	0	0	8	45
ESE	0	0	0	0	0	2	298
E	0	0	0	0	2	12	259
ENE	0	0	0	0	0	49	163
NE	0	0	0	7	1	43	365
NNE	0	0	0	4	4	14	36

Dir	Distance (km)					
	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80
N	0	4	0	1	65	206
NNW	38	294	108	468	177	693
NW	77	0	18	228	555	588
WNW	4	0	95	254	1311	308
W	0	0	0	0	7	7
WSW	0	0	0	5	3	74
SW	169	0	0	724	1951	1215
SSW	28	618	23	2285	1226	44
S	116	2674	10176	449	17	1
SSE	274	617	18	29	125	126
SE	1126	643	1	0	489	815
ESE	534	2110	269	77	15	756
E	700	511	982	2009	2928	19973
ENE	177	162	550	836	314	1318
NE	1302	1683	425	230	22	35
NNE	96	0	32	19	377	254

The agricultural productivity factors for New Mexico were taken from Appendix C of the CAP88 User's Manual, as shown below, and used in the Western Generic site population dose calculation.

Beef Cattle Density (cattle/km^2):	4.13
Milk Cattle Density (cow/km^2):	0.114
Land Cultivated for Vegetable Crops:	0.138%

As indicated in Table 50, for the Western Generic site, the nearest individual is located between 3 and 4 km in the NE and NNE directions, which is consistent with NEI 2008, which states that the nearest downwind resident is at about 2.5 miles. Through analysis with CAP88, the RMEI was identified to be located 2 to 3 km in the NNW direction.

2.10.2 Meteorology

The CAP88 computer program is provided with a weather library of meteorological data from over 350 NWS stations. For the Western Generic site, the CAP88-provided weather data for Grants, NM (CAP88 File: GNT1246.WND) were used. The period of record for this data is limited to the year 1954. Table 51 shows the directional-dependent average wind speed for each stability class, while Table 52 gives the stability class frequency, used in the Western Generic analysis.

Table 51: Western Generic Site (New Mexico) Arithmetic Average Wind Speeds (Wind Towards)

Dir	Pasquill Stability Class (m/s)						
	A	B	C	D	E	F	G
N	1.324	2.175	3.366	4.871	3.773	1.202	0.000
NNW	0.772	1.518	3.561	5.734	3.664	1.368	0.000
NW	1.271	1.951	3.733	5.719	3.751	1.278	0.000
WNW	1.183	2.088	4.141	5.835	3.697	1.337	0.000
W	0.772	1.792	2.944	3.982	3.155	0.888	0.000
WSW	0.772	4.373	4.373	4.008	4.373	1.372	0.000
SW	0.772	1.410	1.610	2.594	3.299	1.149	0.000
SSW	0.772	2.347	3.163	4.907	3.933	1.176	0.000
S	1.088	1.772	3.251	5.126	4.035	1.286	0.000
SSE	1.104	1.537	3.505	5.737	4.217	1.497	0.000
SE	1.099	1.526	3.142	5.306	4.213	1.393	0.000
ESE	1.246	1.954	3.378	6.231	4.191	1.515	0.000
E	1.324	1.732	3.819	6.684	4.040	1.419	0.000
ENE	1.183	2.174	5.214	7.451	4.189	1.496	0.000
NE	0.993	1.938	3.978	6.664	3.800	1.294	0.000
NNE	1.141	2.658	4.743	6.129	3.630	1.255	0.000

Table 52: Western Generic Site (New Mexico) Frequencies of Stability Classes (Wind Towards)

Dir	Pasquill Stability Class (frequency)						
	A	B	C	D	E	F	G
N	0.0277	0.0653	0.1118	0.2731	0.1517	0.3705	0.0000
NNW	0.0169	0.0555	0.0852	0.3901	0.1569	0.2954	0.0000
NW	0.0367	0.1338	0.1667	0.3783	0.0887	0.1959	0.0000
WNW	0.0179	0.1259	0.1877	0.4097	0.0661	0.1926	0.0000
W	0.0650	0.2801	0.1804	0.2975	0.0295	0.1474	0.0000
WSW	0.1381	0.0410	0.2127	0.1866	0.0410	0.3806	0.0000
SW	0.0875	0.2602	0.0852	0.1832	0.0665	0.3174	0.0000
SSW	0.0754	0.1447	0.1156	0.3106	0.0452	0.3085	0.0000
S	0.0464	0.1383	0.1320	0.2285	0.1295	0.3254	0.0000
SSE	0.0290	0.1021	0.1406	0.2746	0.1637	0.2899	0.0000
SE	0.0103	0.0722	0.1104	0.1905	0.2485	0.3682	0.0000
ESE	0.0188	0.0387	0.0695	0.2171	0.3169	0.3391	0.0000
E	0.0111	0.0827	0.0998	0.3827	0.1368	0.2869	0.0000
ENE	0.0238	0.0680	0.1257	0.4770	0.1423	0.1633	0.0000
NE	0.0486	0.1099	0.1260	0.4649	0.0564	0.1943	0.0000
NNE	0.0437	0.1148	0.1547	0.4117	0.0758	0.1992	0.0000
TOTAL	0.0258	0.0932	0.1243	0.3070	0.1679	0.2817	0.0000

2.10.3 Radon Release

It was assumed that a conventional uranium mill would be located at the Western Generic site, as that was the type of mill that was licensed to operate there in the 1990s. As such, it was decided to use the annual radon release from the White Mesa site for the Western Generic site (see Section 2.2.3). Thus, the Western Generic site annual radon release was estimated to range from 1,025 to 1,750 Ci.

2.10.4 Risk Estimates

The RMEI and population doses and risks calculated by CAP88 for the Western Generic site are shown in Table 53.

Table 53: Western Generic Site Risk Assessment Results

Receptor / Impact		Radon Release (Ci/yr)		
		Unitized	Maximum	Average
		1	1,750	1,388
RMEI (3500m NNW)	Dose (mrem/yr)	2.9E-03	6.0E+00	3.5E+00
	LCF Risk (yr^{-1})	3.7E-09	7.7E-06	4.4E-06
Population	Dose (person-rem/yr)	2.5E-03	5.1E+00	3.0E+00
	LCF Risk (yr^{-1})	1.3E-07	2.7E-04	1.6E-04

3.0 SUMMARY OF RESULTS

Table 54 shows the cumulative population within 80 kilometers of each site. Table 54 reveals a difference between the least populated site, Sweetwater, and the most populated site, the Eastern Generic site, of more than a factor of 200. If all other factors were equal (e.g., meteorology, radon release), this population difference would be directly reflected in the CAP88-calculated population doses. It is also interesting to note that while the Cañon City site has only about a third of the 80-km population of the Eastern Generic site, the Cañon City site has the largest population living within 10 km.

Table 54: Cumulative 2000 Population Data

Uranium Site	Distance (km)						
	0 to 1	0 to 5	0 to 10	0 to 20	0 to 40	0 to 60	0 to 80
Sweetwater	0	0	3	6	197	885	10,604
White Mesa	0	969	3,839	4,228	8,080	12,363	20,675
Crow Butte	0	51	1,336	1,869	9,324	13,251	32,676
Christensen / Irigaray	0	1	5	78	362	4,366	36,192
Western Generic	0	18	148	1,681	15,638	35,949	71,944
Smith Ranch – Highlands	0	0	2	222	5,882	55,739	79,694
Kingsville Dome	0	483	3,060	35,353	45,963	388,110	457,735
Alta Mesa	0	81	233	641	6,606	29,610	478,440
Cañon City	0	7,606	32,016	41,028	52,485	313,574	691,284
Eastern Generic	0	2,097	9,124	41,100	156,443	727,294	2,129,665

Table 54 also shows that for all of the sites analyzed, there are no people living within one kilometer of any site, and for the Sweetwater and Smith Ranch – Highland sites, the closest resident (i.e., the RMEI) is located about 7.5 km away. Table 55 compares the current actual location of the nearest resident (as determined by SECPOP) to the hypothetical worst case location (i.e., the nearest location in the most prevalent wind direction). As expected, if the distant RMEI's were to be relocated nearer the site (e.g., Sweetwater and Smith Ranch – Highland), their doses would increase significantly. In addition, changing the direction of the RMEI can have a significant effect on the dose. For example, moving the Sweetwater RMEI to the worst-case location means changing both his/her distance and direction and results in an increase of about a factor of 250, but moving the Smith Ranch – Hignland RMEI to the worst-case location means only changing his/her distance, and the dose increase is much less at only a factor of about 80.

Table 55: Comparison of Current RMEI Location Dose/Risk to Worst-Case Location Dose/Risk

Uranium Site	Current RMEI Location			Worst Case Location		Increase
	Distance (km)	Direction	Dispersion (sec/m^3)	Direction	Dispersion (sec/m^3)	
Sweetwater	7.5	NW	6.63E-08	ENE	1.65E-05	248.9
White Mesa	1.5	SSE	1.19E-06	SSW	1.73E-05	14.5
Cañon City	1.5	N	9.29E-07	S	1.63E-05	17.6
Smith Ranch - Highlands	7.5	E	1.46E-07	E	1.18E-05	81.2
Crow Butte	1.5	WSW	3.08E-07	N	1.34E-05	43.4
Christensen / Irigaray	3.5	SE	1.80E-07	ENE	1.02E-05	57.0
Alta Mesa	2.5	NNW	1.28E-06	NW	2.38E-05	18.5
Kingsville Dome	2.5	NNW	1.28E-06	NW	2.38E-05	18.5
Eastern Generic	1.5	NNE	3.76E-06	NE	3.35E-05	8.9
Western Generic	3.5	NW	2.11E-07	SE	4.52E-05	70.5

For each of the 10 uranium sites analyzed in this report, Table 56 presents the CAP88-calculated RMEI and population dose and risk, normalized to the radon release. To estimate the annual dose or risk for a site, simply multiply the normalized dose or risk from Table 56 by the site's annual radon release. For example, if the radon release at the Sweetwater site was 2,075 Ci/yr, then the annual RMEI dose at Sweetwater would be 2,075 Ci/yr × 5.6E-04 mrem/Ci = 1.16 mrem/yr.

Table 56: Calculated RMEI and Population Dose and Risk Normalized to the Radon Release

Uranium Site	Dose (Ci^{-1})		LCF Risk (Ci^{-1})	
	Population (person-rem)	RMEI (mrem)	Population	RMEI
Sweetwater	2.3E-04	5.6E-04	1.4E-09	2.9E-10
White Mesa	2.5E-03	5.8E-03	1.6E-08	3.1E-09
Cañon City	2.4E-02	5.0E-03	1.5E-07	2.6E-09
Smith Ranch - Highlands	1.8E-03	7.2E-04	1.1E-08	3.7E-10
Crow Butte	1.3E-03	1.6E-03	8.4E-09	8.4E-10
Christensen / Irigaray	1.8E-03	9.1E-04	1.2E-08	4.8E-10
Alta Mesa	1.0E-02	5.6E-03	6.3E-08	3.0E-09
Kingsville Dome	2.8E-02	5.5E-03	1.8E-07	2.9E-09
Eastern Generic	9.7E-02	1.4E-02	6.6E-07	7.6E-09
Western Generic	2.5E-03	2.9E-03	1.3E-07	3.7E-09

Presenting the normalized doses and risks allows analysis of the effect that siting has on dose and risk without the complications posed by the different mining and/or milling operations. From Table 56, it can be seen that the RMEI dose/risk can vary by up to about a factor of 50,

depending on the site where the radon release occurs, while the population dose/risk can vary by up to a factor of 450, depending on the site. This population factor is consistent with the factor of 200 difference in the 80 km cumulative population difference identified in Table 54, plus another factor to account for meteorological differences between the sites and the actual location of the population (e.g., if a large fraction of the population is located in a predominant wind direction at one site, that site will have a larger population dose/risk than a similar population located in a minor wind direction at another site).

Table 57 presents the RMEI and population doses and risks due to the maximum radon releases estimated in Section 2.0, for each uranium site. The maximum radon releases were used to calculate the doses in order to be able to compare the results to regulatory criteria. For example, 10CFR § 20.1301 "Dose Limits for Individual Members of the Public" restricts the total effective dose equivalent (TEDE) to individual members of the public from the licensed operation to less than 100 mrem per year.

Table 57: Calculated Maximum Total Annual RMEI, Population Dose and Risk

Uranium Site	Maximum Radon Release (Ci/yr)	Annual Dose		LCF Risk[(a)] (yr^{-1})	
		Population (person-rem)	RMEI (mrem)	Population	RMEI
Sweetwater	2,075	0.5	1.2	2.9E-06	6.0E-07
White Mesa	1,750	5.2	12.0	3.4E-05	6.4E-06
Cañon City	269	49.2	10.3	3.1E-04	5.4E-06
Smith Ranch - Highlands	36,500	3.7	1.5	2.3E-05	7.7E-07
Crow Butte	8,885	2.7	3.3	1.7E-05	1.7E-06
Christensen / Irigaray	1,600	3.8	1.9	2.4E-05	9.9E-07
Alta Mesa	740	21.6	11.5	1.3E-04	6.1E-06
Kingsville Dome	6,958	58.0	11.3	3.8E-04	6.1E-06
Eastern Generic	1,750	200.3	28.2	1.4E-03	1.6E-05
Western Generic	1,750	5.1	6.0	2.7E-04	7.7E-06

[(a)]Latent Cancer Fatalities

Table 58 presents the RMEI and population doses and risks due to the average radon releases estimated in Section 2.0 for each uranium site. The risks were based on average radon releases in order to make it easier to convert these annual risk values into lifetime risk values, by simply multiplying the Table 58 values by the number of years that the facility operates for the population risk or by the length of time that the individual lives next to the facility for the RMEI risk.

Table 58: Calculated Average Total Annual RMEI, Population Dose and Risk

Uranium Site	Average Radon Release (Ci/yr)	Annual Dose		LCF[(a)] Risk (yr^{-1})	
		Population (person-mrem)	RMEI (rem)	Population	RMEI
Sweetwater	1,204	0.3	0.7	1.7E-06	3.5E-07
White Mesa	1,388	3.0	7.0	2.0E-05	3.7E-06
Cañon City	146	28.6	6.0	1.8E-04	3.1E-06
Smith Ranch - Highlands	21,100	2.2	0.9	1.3E-05	4.5E-07
Crow Butte	4,467	1.6	1.9	1.0E-05	1.0E-06
Christensen / Irigaray	1,040	2.2	1.1	1.4E-05	5.7E-07
Alta Mesa	472	12.5	6.7	7.6E-05	3.6E-06
Kingsville Dome	1,291	33.6	6.6	2.2E-04	3.5E-06
Eastern Generic	1,388	116.3	16.4	7.9E-04	9.2E-06
Western Generic	1,388	3.0	3.5	1.6E-04	4.4E-06

[(a)]Latent Cancer Fatalities

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Thornton, Marisa

From: Rosnick, Reid
Sent: Tuesday, September 02, 2014 3:59 PM
To: Thornton, Marisa
Subject: FW: Is this reference in the Subpart W Docket?

From: Nesky, Anthony
Sent: Tuesday, July 01, 2014 11:11 AM
To: Miller, Beth
Subject: Is this reference in the Subpart W Docket?

Dear Beth:

Is this reference below in the Subpart W Docket? If so, could I get an electronic copy of it?

SC&A (S. Cohen and Associates) 2011. "Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings, Task 4 – Detailed Risk Estimates,"

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

Stahle, Susan

From: Nesky, Anthony
Sent: Wednesday, July 23, 2014 10:51 AM
To: Stahle, Susan
Subject: RE: Review of text about hearings
Attachments: TEXT FROM THE REGISTRATION WEBSITE.docx

Importance: High

Dear Sue:

The text from the registration website is in the attached Word file. Thanks for your edits and feedback—I greatly appreciate your help!

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

From: Stahle, Susan
Sent: Wednesday, July 23, 2014 9:13 AM
To: Nesky, Anthony
Cc: Rosnick, Reid
Subject: RE: Review of text about hearings

Edits below on #1 and #2.

For #3 – can you send me a way to edit the text? I see some changes I'd like to suggest on the registration website. For example, please strike this text from the sidebar:

"No one method for submission of comments is "better" than another. EPA will review and respond to all substantive comments in the rulemaking docket, whether they were submitted in writing or verbally during this hearing."

Also – let's call it a "public hearing" as opposed to a "hearing" since the two words/phrases have different meanings. Thanks.

Susan Stahle
Attorney-Advisor
Air and Radiation Law Office
Office of General Counsel
U.S. Environmental Protection Agency
202-564-1272 (ph)
202-564-5603 (fax)
stahle.susan@epa.gov

From: Nesky, Anthony
Sent: Tuesday, July 22, 2014 2:48 PM
To: Stahle, Susan

Cc: Rosnick, Reid
Subject: Review of text about hearings
Importance: High

Dear Sue:

Thanks for your offer to review the text announcing the public hearings. Here's the text we were planning to put on the website:

1. ON THE SUBPART W PAGE:

PUBLIC HEARING, SEPTEMBER 3 and 4, 2014, DENVER, COLORADO. EPA will hold a public hearing to allow the public to make oral presentations of data, views or arguments ~~present verbal comments~~ on the proposed revisions to Subpart W. The public hearing will be held September 3 and 4, 2014, at the EPA Region 8 Office, 1595 Wynkoop Street, Denver, CO 80202-1129. Sessions will be held both days from 9:00 am to 12:00 pm and from 1:00 pm to 5:00 pm. ~~The purpose of the public hearing is to allow members of the public to have their verbal comments entered into the official record. EPA will not respond to remarks during the hearing, but will respond to all substantive comments after the comment period closes on October 29, 2014.~~

~~Please sign-up if you wish to attend.~~ Those wishing to ~~speak~~ make a presentation at the public hearing must register ~~are strongly encouraged to sign-up~~ by August 22, 2014. CLICK TO ~~SIGN-UP~~ REGISTER FOR THE PUBLIC HEARING.

Note: Participation or attendance at the public hearing is not necessary to comment on this proposed rulemaking. EPA also welcomes written comments.

Requests for a Public Hearing

- Memo to Docket on Telephone Request for Public Hearing (PDF) (1 pp, 196 KB About PDF)
- Letter from Uranium Watch (PDF) (1 pp, 42.9 KB About PDF)

2, On the RPD Home Page:

Notice of Proposed Rulemaking. National Emission Standards for Hazardous Air Pollutants (NESHAPs)-Radon from Operating Uranium Mill Tailings EPA has released a Notice of Proposed Rulemaking that would revise "National Emission Standards for Radon Emissions from Operating Mill Tailings," Subpart W of 40 CFR Part 61.

- **Comment period extended to October 29, 2014**. The public is invited to submit comments on the proposed rulemaking for NESHAP Subpart W. Comments are due October 29, 2014.
- **Public Hearing, September 3 and 4, 2014, Denver, Colorado.** EPA will hold a public hearing at its Region 8 offices in Denver to allow the public to make oral presentations of data, views or arguments~~give verbal comments~~ on the proposed revisions to Subpart W.

3. ON THE REGISTRATION SITE ITSELF

You should probably take a look at the registration page. Please note the sidebar: About Hearings and Comments, and the Registration Information. To view all the text, please go ahead and test register as a speaker.

Website:
https://www.eventbrite.com/e/subpart-w-hearings-registration-1408042493

Password: SRA (Note: password will be removed when the site goes live.)

I'm working from home because of the office move. You can reach me at 703-403-7014.

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

Stahle, Susan

From: Thornton, Marisa
Sent: Tuesday, July 22, 2014 10:01 AM
To: Nesky, Anthony
Cc: Rosnick, Reid;Stahle, Susan;Herrenbruck, Glenna;Romero, Carmen
Subject: RE: updating Subpart W website for extension of public comment period

Tony,

You may now view your changes on the live server –
- http://www.epa.gov/radiation/
- http://www.epa.gov/radiation/neshaps/subpartw/rulemaking-activity.html

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From: Stahle, Susan
Sent: Monday, July 21, 2014 4:37 PM
To: Rosnick, Reid
Cc: Thornton, Marisa; Nesky, Anthony
Subject: updating Subpart W website for extension of public comment period

Hi –

I noticed the FR Notice was published today to extend the public comment period (see attached). Please update the "Comment Period" section of the Subpart W website and make sure this is posted to Subpart W website.

Thanks.

Susan Stahle
Attorney-Advisor
Air and Radiation Law Office
Office of General Counsel
U.S. Environmental Protection Agency
202-564-1272 (ph)
202-564-5603 (fax)
stahle.susan@epa.gov

Stahle, Susan

From: Nesky, Anthony
Sent: Tuesday, July 22, 2014 2:48 PM
To: Stahle, Susan
Cc: Rosnick, Reid
Subject: Review of text about hearings

Importance: High

Dear Sue:

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Please sign-up if you wish to attend. Those wishing to speak are strongly encouraged to sign-up by August 22, 2014.
CLICK TO SIGN-UP FOR THE HEARING.

Note: Attendance at the hearing is not necessary to comment on this proposed rulemaking. EPA also welcomes written comments.

Requests for a Public Hearing

- Memo to Docket on Telephone Request for Public Hearing (PDF) (1 pp, 196 KB About PDF)
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2, On the RPD Home Page:

Notice of Proposed Rulemaking. National Emission Standards for Hazardous Air Pollutants (NESHAPs)-Radon from Operating Uranium Mill Tailings EPA has released a Notice of Proposed Rulemaking that would revise "National Emission Standards for Radon Emissions from Operating Mill Tailings," Subpart W of 40 CFR Part 61.

- **Comment period extended to October 29, 2014**. The public is invited to submit comments on the proposed rulemaking for NESHAP Subpart W. Comments are due October 29, 2014.
- **Public Hearing, Sep. 3 and 4, 2014, Denver, Colo.** EPA will hold a public hearing at its Region 8 offices in Denver to allow the public to give verbal comments on the proposed revisions to Subpart W.

3. ON THE REGISTRATION SITE ITSELF

You should probably take a look at the registration page. Please note the sidebar: About Hearings and Comments, and the Registration Information. To view all the text, please go ahead and test register as a speaker.

Website:
https://www.eventbrite.com/e/subpart-w-hearings-registration-1408042493

Password: SRA (Note: password will be removed when the site goes live.)

I'm working from home because of the office move. You can reach me at 703-403-7014.

Tony Nesky
Center for Radiation Information and Outreach
Tel: 202-343-9597
nesky.tony@epa.gov

Stahle, Susan

From: Blake, Wendy
Sent: Monday, July 21, 2014 4:25 PM
To: Stahle, Susan
Subject: FW: FR notice extending public comment period
Attachments: FR Notice extending comment period 072114.pdf

Sue – Please ensure that the attached is uploaded to the Subpart W website. Thanks, Wendy

Wendy L. Blake
Assistant General Counsel
Air and Radiation Law Office
Office of General Counsel
U.S. Environmental Protection Agency
phone: (202) 564-1821
fax: (202) 564-5603

From: Blake, Wendy
Sent: Monday, July 21, 2014 4:25 PM
To: 'Travis Stills'
Subject: FW: FR notice extending public comment period

Travis –

Attached is the Federal Register notice extending the comment period on the Subpart W rule. The attached notice extends the comment period by 90 days. The comment period now closes on October 29, 2014.

Wendy

Wendy L. Blake
Assistant General Counsel
Air and Radiation Law Office
Office of General Counsel
U.S. Environmental Protection Agency
phone: (202) 564-1821
fax: (202) 564-5603

Thornton, Marisa

From: Blake, Wendy
Sent: Wednesday, September 17, 2014 9:55 AM
To: Thornton, Marisa
Subject: FW: when is the hearing in the Subpart W matter?

From: Perrin, Alan
Sent: Wednesday, July 16, 2014 4:21 PM
To: Blake, Wendy
Subject: RE: when is the hearing in the Subpart W matter?

We are planning for September 3 and 4 in Denver. This has not been announced yet.

~~~~~~~~~~~~~~~

Alan Perrin, Deputy Director
Radiation Protection Division, USEPA
office (202) 343-9775 | bb (202) 279-0376

From: Blake, Wendy
Sent: Wednesday, July 16, 2014 4:14 PM
To: Perrin, Alan
Subject: when is the hearing in the Subpart W matter?

Wendy L. Blake
Assistant General Counsel
Air and Radiation Law Office
Office of General Counsel
U.S. Environmental Protection Agency
phone: (202) 564-1821
fax: (202) 564-5603
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