POSTING OF SOIL CONTAMINATION AREAS

Purpose

This Meteorology and Air Quality Group (MAQ) procedure describes how to decide if an area should be posted as a Soil Contamination Area.

Scope

This procedure applies to Soil Contamination Areas.

In this procedure

This procedure addresses the following major topics:

Hazard Control Plan

The hazard evaluation associated with this work is documented in HCP-MAQ-Office Work.

Signatures

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Work authorized by: Jean Dewart, MAQ Group Leader	Date: 12/2/2002

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General information about this procedure

Attachments

This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Soil Contamination Guidelines for 15 mrem/y	2
2	Scenario-specific Parameters	2

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	12/10/02	New document.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- Personnel assigned to do dose assessment.

Annual retraining is required and will be by self-study ("reading") training.

Training method

The training method for this procedure is "**self-study**" (reading) and is documented in accordance with the procedure for training (MAQ-024).

General information, continued

Definitions specific to this procedure

None

References

The following documents are referenced in this procedure:

- MAQ-024, "Personnel Training"
- LIR 402-700-01.2, "Occupational Radiation Protection Requirements"
- LIG 402-700-01.0, "Occupational Radiation Protection Guidance"
- 10 CFR 835 "Occupational Radiation Protection"
- 10 CFR 835 Implementation Guide Sec. IV.G.6 http://tis.eh.doe.gov/docs/ig/100181.html
- DOE/EH-0256T "Environmental Reg. Guide"
- DOE-STD-1098-99, "Radiological Control Standard"
- DOE Order 5400.5, "Radiation Protection of the Public and the Environment," changed January 7, 1993
- NCRP Report No. 49, "Structural Shielding Design and Evaluation"
- NCRP Report No. 129, "Recommended Screening Limits for Contaminated Surface Soil"
- LA-UR-00-4084, "Standard Human Health Risk Scenarios", R. Mirenda and L. Soholt, Sept. 1, 2000
- LA-UR-00-1903 (Steven Reneau et al., April 27, 2000)
- RESRAD documents at http://web.ead.anl.gov/resrad/home2/

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

Background and guidance

LANL Requirement

The LANL requirement for soil posting is in LIR 402-700-01.2 Chapter 7, Section 727, which states "Areas with soil contamination that have a reasonable potential to cause more than 15 mrem/yr off-site or more than 30 mrem/yr on-site, as predicted by RESRAD or an equivalent model, shall be posted as Soil Contamination Areas."

The present procedure describes how to determine if the criterion is met at a particular location.

Other authorities

In general, radiological posting at LANL is driven by 10 CFR 835 Sub-part G, but soil contamination is not mentioned in 10 CFR 835. Instead, the LANL requirement for Soil Contamination Area posting was originally driven by Table 2-4 of the DOE Radiological Control Manual (DOE/EH-0256T), which was superceded in 1999 by the DOE Radiological Control Standard (DOE-STD-1098-99). Section 238 of this standard states: "for areas with contaminated soil that is not releasable in accordance with DOE's environmental protection standards, a soil contamination area should be established."

Guidance from DOE 5400.5
(continued on next page)

DOE Order 5400.5 Chapter IV discusses soil contamination without mentioning "Soil Contamination Area" posting. Nevertheless, the Order contains useful guidance, as follows.

DOE Order 5400.5 Chapter IV is directed toward measurements of surface contamination. The table in Chapter IV Section 5 is similar to Table 14-1 in LANL LIR 402-700-01.2. In Table 14-1, the criteria for *removable* surface contamination define a "Contamination Area". The criteria for *fixed* surface contamination defined the "Fixed Contamination Area" posting until this was discontinued in 1999. In the present procedure, these criteria are used as guidance to help define the extent of the area to be posted as a Soil Contamination Area.

DOE 5400.5 Chapter IV Section 4c discusses a criterion for external gamma exposure: 20 microR/h above background. Although this is not a requirement for soil contamination, it is useful guidance. When combined with appropriate occupancy factors (e.g., see page 65 of NCRP Report No. 49) this criterion is comparable with the LANL criteria. Therefore, this criterion is also useful to help define the extent of the area to be posted.

Background and guidance, continued

Guidance from DOE 5400.5, *continued*

Thus, when a location meets the dose-based criteria of LIR 402-700-01, a hand-held radiological instrument may be used to help determine the boundaries of the area using the criteria discussed in the previous two paragraphs. In the case of beta emitters such as strontium-90, the count-rate criterion should be used: 1,000 dpm/100 cm^2 above background. In the case of gamma emitters such as cesium-137, the exposure-rate criterion should be used: 20 microR/h above background.

Guidance on averaging

DOE Order 5400.5 Chapter IV Section 4a includes guidance for averaging over areas that contain hot spots. Section 4a(2) suggests applying the standard criteria to the first 15 cm below the surface, while allowing the concentrations to be a factor of 3 greater at depths more than 15 cm below the surface.

Tables of soil concentrations

Attachment 1, "Soil contamination guidelines for 15 mrem/year," lists the soil concentrations (pCi/g) that correspond to 15 mrem/year, as calculated by RESRAD. The scenarios are defined in Attachment 2 and further described in LA-UR-00-4084 (R. Mirenda and L. Soholt, September 1, 2000) and in LA-UR-00-1903 (Steven Reneau et al., April 27, 2000). These attachments are for initial screening as described in Step 1 below and should be supplemented by RESRAD runs as described in Step 3. RESRAD is a standard computer code developed at Argonne National Laboratory and may be obtained from http://web.ead.anl.gov/resrad/home2/ .

DU shrapnel

LIG 402-700-01 Chapter 7, Section 716.3 states "A Soil Contamination Area sign should not be used for areas of soil with only depleted uranium shrapnel present." Instead, such areas should be posted as RCAs for DU shrapnel (see LIR 402-700-01.2 Chapter 7, Section 722).

On-site or off-site

"On-site" means property owned by the DOE. Rental property within the townsite is considered "off-site".

Determining if soil contamination area

Scenarios

A residential scenario (such as in attachment 2) is appropriate for off-site areas that could reasonably be used for a residence in the foreseeable future. A recreational scenario (such as in attachment 2) is appropriate for a canyon such as Acid Canyon that is not suitable for residential development. (**Note**: The recreational scenario considered reasonable-maximum exposures for 3 users: a jogger, a hiker, and a child playing within the canyon reaches, aka "extended backyard". The extended backyard scenario was limiting.)

An industrial scenario may be appropriate at some on-site locations; it should be based on the industrial scenarios in the RESRAD folder of the RRES-MAQ Projects Drive, with reduced occupancy if appropriate.

Other scenarios may be developed or chosen, e.g., from NCRP Report No. 129. You should consult RRES management and staff to discover what scenarios have previously been used. Consult the original authors and their supervisors, to the extent possible, and document changes from previous scenarios.

General posting provisions

General posting guidance is in LIG 402-700-01 Chapter 7, Section 711. The "Soil Contamination Area" sign has been approved by the Sign Standards Committee and is listed in the Sign Catalog; see LIR 402-100-01.1 and LIG 402-100-01. Further general provisions are in LIR 402-700-01 Appendix 8A and Section 923; and also in the 10 CFR 835 Implementation Guide Section IV.G.6 http://tis.eh.doe.gov/docs/ig/100181.html .

Steps to determine if an area is a Soil Contamination Area

To determine if an area is a Soil Contamination Area, perform the following steps.

Step	Action
1	Obtain the best-available soil-concentration data for the area (the best source of data is RRES-R) and compare with the values listed in Attachment 1. If all the soil concentrations are below the values for all scenarios, it is not a Soil Contamination Area and you are done. Otherwise, proceed to step 2.
2	Choose an appropriate scenario as described above.
3	Run RESRAD to calculate the dose. If the dose is greater than 15 mrem off-site or 30 mrem on-site, it is a Soil Contamination Area. You may also propose posting for other reasons. If no posting is proposed, you are done.

Steps continued on next page.

Determining if soil contamination area, continued

Step	Action
4	Inform all RRES line managers and resolve any issues before proceeding.
5	Use the guidance from DOE 5400.5 (discussed above) to define the boundary of the area.
6	Write a memo to define the Soil Contamination Area, through the RRES-EP manager, to the facility manager or the appropriate stakeholder such as the county management, with copies to the RRES line managers, the HSR-1 and HSR-12 group leaders, and the Radiation Protection Program Manager.

Records resulting from this procedure

Records

The following records generated as a result of this procedure are to be filed with the Records Coordinator:

- memo described in step 6.
- references to sources of data and RESRAD calculations.

Click here to record “self-study” training to this procedure.

ATTACHMENT 1

SOIL CONTAMINATION GUIDELINES FOR 15 mREM/YEAR

Nuclide	Residential pCi/g	Recreational pCi/g
Ac-227	4.200E+00	5.046E+01
Ag-108m	3.030E+00	7.294E+01
Ag-110m	2.698E+00	6.479E+01
Al-26	1.691E+00	4.019E+01
Am-241	4.364E+00	2.678E+02
Am-243	1.912E+01	2.015E+02
Au-195	2.421E+02	6.063E+03
Ba-133	1.525E+01	3.625E+02
Bi-207	3.151E+00	7.535E+01
C-14	3.624E+01	1.150E+06
Ca-41	4.051E+02	8.271E+05
Cd-109	8.217E+01	3.798E+04
Ce-144	1.357E+02	3.145E+03
Cf-252	1.782E+02	1.032E+03
Cl-36	4.247E+00	1.588E+05
Cm-243	2.907E+01	2.998E+02
Cm-244	8.576E+01	4.999E+02
Cm-245	2.051E+01	1.469E+02
Cm-246	4.596E+01	2.679E+02
Cm-247	1.132E+01	1.522E+02
Cm-248	1.251E+01	7.291E+01
Co-57	8.701E+01	2.109E+03
Co-60	1.908E+00	4.601E+01
Cs-134	3.549E+00	8.694E+01
Cs-135	9.022E+02	1.474E+05
Cs-137	8.214E+00	2.065E+02
Eu-152	4.312E+00	1.025E+02
Eu-154	3.978E+00	9.453E+01
Eu-155	1.684E+02	3.992E+03
Fe-55	3.241E+05	1.959E+06
Gd-153	1.875E+02	4.450E+03
Ge-68	7.814E+00	1.878E+02
H-3	1.124E+03	1.567E+06
I-129	4.497E+01	3.545E+03
K-40	1.752E+01	6.644E+02
Mn-54	8.183E+00	1.981E+02
Na-22	2.447E+00	5.841E+01
Nb-93m	4.162E+04	1.537E+06

ATTACHMENT 1 (CONTINUED):

SOIL CONTAMINATION GUIDELINES FOR 15 mREM/YEAR

Nuclide	Residential pCi/g	Recreational pCi/g
Nb-94	3.054E+00	7.260E+01
Ni-59	2.436E+04	4.973E+06
Ni-63	8.899E+03	1.818E+06
Np-237	2.572E+00	1.649E+02
Pm-147	8.598E+04	1.043E+06
Pu-238	5.334E+01	3.109E+02
Pu-239	4.803E+01	2.801E+02
Pu-240	4.804E+01	2.801E+02
Pu-241	1.436E+03	8.803E+03
Pu-242	5.060E+01	2.949E+02
Pu-244	3.533E+00	6.668E+01
Ra-226	5.000E+00	5.000E+00
Ra-228	5.000E+00	5.000E+00
Ru-106	2.950E+01	7.423E+02
Sb-125	1.355E+01	3.222E+02
Se-79	2.951E+02	1.204E+05
Sm-147	4.657E+02	4.736E+03
Sm-151	2.322E+05	2.602E+06
Sr-90	5.641E+00	5.512E+03
Tc-99	3.527E+01	6.346E+05
Th-228	3.229E+00	7.668E+01
Th-229	1.249E+01	1.398E+02
Th-230	5.000E+00	5.000E+00
Th-232	5.000E+00	5.000E+00
Tl-204	3.973E+02	1.198E+05
U-232	2.873E+00	6.420E+01
U-233	8.257E+01	6.912E+02
U-234	7.945E+01	2.655E+03
U-235	2.324E+01	4.898E+02
U-236	3.165E+02	3.174E+03
U-238	1.281E+02	1.969E+03
Zn-65	1.085E+01	3.030E+02
Zr-93	3.028E+04	4.187E+05

ATTACHMENT 2

SCENARIO-SPECIFIC PARAMETERS

Parameter	Residential Adult[1]	Residential Child[2]	Recreational User[3]
Dose Conversion Factors	RESRAD Defaults	RESRAD Defaults	RESRAD Defaults
Area of Contaminated Zone (m^2)	10000	10000	10000
Thickness of Contaminated Zone (m)	2	2	2
Basic Radiation Dose Limit (mrem/year)	15	15	15
Time since Placement of Material (years)	0	0	0
Cover Depth (m)	0	0	0
Density of Contaminated Zone (g/cm^3)	1.5	1.5	1.5
Physical Parameters of Contaminated Zone	RESRAD Defaults	RESRAD Defaults	N/A
Evapotranspiration Coefficient	0.999	0.999	0.999
Precipitation (m/year)	0.35	0.35	0.35
Shielding Factors	RESRAD Default	RESRAD Default	N/A
Outside Occupancy	0.08	0.08	0.0228
Indoor Occupancy	0.66	0.66	0
Soil Ingestion Rate (g/year)	23.6	35	626
Inhalation Rate (m^3/year)	5320	2940	10500
Dust Loading (g/m^3)	1E-04	1E-04	2E-04
Plant Ingestion Rate (kg/year)	Veg: 68.6 Fruit: 63.1	Veg: 30.3 Fruit: 84	N/A
Fraction of Plants Grown Onsite	0.4	0.4	N/A

Footnotes:

1. Residential Adult Pathways: external gamma exposure, dust inhalation, soil ingestion, plant ingestion, radon.
2. Residential Child Pathways: external gamma exposure, dust inhalation, soil ingestion, plant ingestion, radon.
3. Recreational User Pathways: external gamma exposure, dust inhalation, soil ingestion.