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United States Nuclear Regulatory Commission

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# NRC Welcome and Overview

## Public Meeting on Potential Revisions to Branch Technical Position on Concentration Averaging and Encapsulation

Larry Camper, Director
Division of Waste Management and Environmental Protection

February 24, 2011

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# Welcome

- Purpose
  - To gather information on key issues related to concentration averaging of LLW
- Scope
  - Potential revisions to CA BTP
  - Averaging of discrete items of hardware, mixtures of LLW in a package, and sealed sources
  - Blending of waste, consistent with direction from Commission to risk-inform
- Collaborative discussion

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# BTP - Why Are We Here?

- LLWSA 2007
  - Update BTP high priority
- Risk-informed performance-based
- Update/Revise BTP – user friendly
  - Sandia National Labs
- Blending of LLW – put BTP update on hold
- SRM – SECY-10-0043

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# Expectations on BTP Revision

- Rewrite to improve clarity
- Make risk-informed, performance-based
- Respond to Commission's direction

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# BTP

- 8 Components
  - Mixing of homogeneous waste types or streams
  - Solidified and absorbed liquids
  - Mixing of activated materials or metals
  - Contaminated materials
  - Mixing of cartridge filters
  - Waste in high-integrity containers (HICs)
  - Encapsulation of solid material
  - Mixing of dissimilar waste streams
- Risk-informed Performance-Based

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# Risk-Informed, Performance-Based Regulation

- Risk-Informed:
  - Decisionmaking approach that uses risk insights, engineering judgment, safety limits, and other factors.
  - For establishing requirements that focus on issues commensurate with their importance to public health and safety
- Performance-based regulation:
  - Performance and results as the primary bases for decisionmaking
  - Performance-based regulations have these attributes, among others:
    - (1) measurable, calculable or objectively observable parameters exist or can be developed to monitor performance;
    - (2) objective criteria exist or can be developed to assess performance;
    - (3) licensees have flexibility to determine how to meet the established performance criteria in ways that will encourage and reward improved outcomes;

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# Panelists

- David James
- John Cochran
- Lisa Edwards
- Earl Fordham
- Dr. Christianne Ridge
- Diane D'Arrigo
- James Kennedy
- Graham Johnson
- John LePere
- Marty Letourneau
- Abigail Cuthbertson
- Mark Lewis

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# Agenda

- Regulatory infrastructure
  - Maurice Heath, LLWB, NRC
- Technical overview of Current BTP positions
  - John Cochran, Sandia National Labs
- Overview of Federal Register Questions
  - Dr. Christianne Ridge, PAB, NRC
- Discussion with panel members and public
  - Led by Patricia Adelstein and Bret Leslie, NRC

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# Maximizing Stakeholder Input

| Milestone | Date |
|---|---|
| Conduct public workshop on CA BTP (Rockville, MD) | Feb. 24, 2011 |
| DOE/NRC workshop on Part 61 (Phoenix, AZ) | March 4, 2011 |
| Issue blending Interim Guidance | March 31, 2011 |
| Close comment period on CA BTP | April 15, 2011 |
| Brief ACRS on CA BTP (Rockville, MD) | August 2011 |
| Complete Commission paper on VRPS | August 2011 |
| Complete Commission paper on UWS proposed rule | October 2011 |
| Issue draft VRPS for public comment | October 2011 |
| Issue draft CA BTP for public comment | October 2011 |
| Conduct public workshop on CA BTP (Albuquerque, New Mexico) | October 2011 |
| Issue Commission paper with proposed final VRPS | December 2011 |
| Issue Final CA BTP | June 2012 |
| Issue Commission paper with proposed final UWS rule | October 2012 |
| Commission paper on Part 61 revisions | December 2012 |

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# Regulatory Infrastructure

## Public Meeting on Potential Revisions to Branch Technical Position on Concentration Averaging and Encapsulation

**Maurice Heath, Project Manager**
**Low-Level Waste Branch**
**Environmental Protection and Performance Assessment Directorate**
**Division of Waste Management and Environmental Protection**
**February 24, 2011**

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# Purpose

- Identify and describe regulations and guidance related to concentration averaging and encapsulation
- Commission direction from SRM –SECY-10-0043

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# Commission Direction

- Revise BTP addressing blending
- Obtain review by Advisory Committee on Reactor Safeguards (ACRS)
- Do not include waste at Greater-Than-Class-C (GTCC) concentrations
- Determine standard for homogeneity

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# SECY-10-0043 Option 2

- Blending position risk-informed performance-based
  - BTP on Concentration Averaging
    - Define Homogeneity and sampling
    - Eliminate the “factor of 10”
  - Site-specific intruder
  - Volume Reduction Policy Statement
  - Interim Guidance Agreement States

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# Regulations in 10 CFR

- § 61.42, "Protection of individuals from inadvertent intrusion."
- § 61.55, "Waste classification."
  - Tables 1 and 2 – define Class A, B, and C waste
  - § 61.55(a)(8)
    - Allows concentration averaging
- 10 CFR Part 20, Appendix G

# Waste Classification Table 2
# 10 CFR 61.55

| Radionuclide | Concentration, Ci/m$^3$ | | |
|---|---|---|---|
| | Col. 1 (Class A limit) | Col. 2 (Class B limit) | Col. 3 (Class C limit) |
| Total of all radionuclides with < 5 yr half-life | 700 | n/a | n/a |
| H-3 | 40 | n/a | n/a |
| Co-60 | 700 | n/a | n/a |
| Ni-63 | 3.5 | 70 | 700 |
| Ni-63 in activated metal | 35 | 700 | 7000 |
| Sr-90 | 0.04 | 150 | 7000 |
| Cs-137 | 1 | 44 | 4600 |

If concentration does not exceed column 1, waste is Class A. If concentration is > col. 1 and < col. 2, waste is Class B. If concentration is > col. 2 and < col. 3, waste is Class C. If > col. 3, waste is not acceptable for near-surface disposal

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# Concentration Averaging Guidance

- 1995 Concentration Averaging Branch Technical Position
- Mixing (blending) of homogeneous waste addressed (one of 8 categories in BTP)
- Factor of 10 rule
- Operational efficiency or occupational dose reduction considerations
- Other factors

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# Summary

- Waste classification related to disposal
- Concentration averaging authorized regulations
- BTP Implementation guidance
- Emerging issue blending
- Role of waste classification table

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# Technical Overview of Current BTP for Concentration Averaging and Encapsulation

## Public Meeting on Potential Revisions to Concentration Averaging and Encapsulation Branch Technical Position

John R. Cochran
Sandia National Laboratories
February 24, 2011

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# Why Was BTP Issued?

- Ensure protection of inadvertent human intruder:
  - Requiring radiological uniformity in each waste package, to ensure actual disposal consistent with Part 61 EIS intruder scenarios, which assumed homogeneous source terms
  - Setting boundaries for encapsulated sealed radioactive sources & other LLRW, boundaries derived from gamma-source intruder handling scenarios presented in BTP

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# Broad Categories Guidance in BTP

- homogeneous waste types
- Solidified & absorbed liquids
- Discrete wastes & mixtures of discrete wastes: activated metals, contaminated materials & cartridge filters
- Waste in high-integrity containers (HICs)
- Encapsulation of sealed sources & other LLRW
- Mixing of different waste types in single container
- Alternative Provisions

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# BTP Guidance Not Addressed Here

- Table C - basis for calculating volume
- QA program
- Microcurie sources (<37 MBq  (1 mCi)) mixed with other wastes are exempted

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# Key Terms Used In BTP

- "Waste Types"
  - Wastes with similar physical properties
  - Examples: homogeneous wastes, activated metals, contaminated materials & cartridge filters
- Similar Waste Types
  - Container wastes of same waste type (drum containing pieces activated metal)

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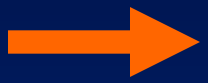
# Road Map



- Homogeneous waste types
- Solidified & absorbed liquids
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# Homogeneous Waste Types

- Homogeneous Waste Type – waste in which *radionuclide concentrations* approach uniformity in context of Part 61 EIS intruder scenarios
- Automatic classification as homogeneous waste types:
  - Spent ion-exchange resins, filter media, solidified liquid, evaporator bottom concentrates
  - Trash & contaminated soil when packaged ≥90% fill
- Homogeneous waste types can be averaged (curies/ volume or weight)

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# Homogeneous Waste Types

- "Similar homogeneous waste types" may be mixed, if:
  - Classification of mixture based on classification of contributor with highest classification, or
  - Classification based on average of final mixture, if classification of each contributor is within factor 10 of average of mixture

- Some mixtures exempt from blending guidance: Systems designed collection homogeneous waste types, multiple sources within facility, for operational efficiency or occupational dose reduction

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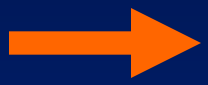
# Road Map



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# Solidified & Absorbed Liquids

- Solidified liquids – average over volume or weight of final waste form
- Absorbed liquids - average over original volume or weight of liquid before being absorbed

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# Discrete Wastes & Mixtures of Discrete Wastes

- BTP guidance equal for: *activated metals, contaminated materials & cartridge filters*, therefore, single overview guidance that applies to all three:
  - Classify mixture using class. piece w/ highest class.

*Or classify based on average of mixture, if:*

1. Pieces < 0.01 $ft^3$ and > Table A gamma emitters
2. Factor 1.5 rule for pieces gamma emitters
3. Pieces > Table B for non-gamma pieces, any size
4. Factor 10 rule for non-gamma pieces

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# Discrete Wastes & Mixtures of Discrete Wastes

- Definitions in BTP
- Primary gamma emitters: Co-60, Nb-94, and Cs-137/Ba-137m
- Non-gammas emitters: H-3, C-14, Ni-59, Ni-63, and alpha-emitting TRU half-life > 5 years (except Pu-241 and Cm-242)

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# Discrete Wastes & Mixtures of Discrete Wastes

- Classify mixture based on classification of piece with highest classification

  OR classify, average of mixture, if

- Meet up to 4 criteria to ensure relative radiological uniformity

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# Discrete Wastes & Mixtures of Discrete Wastes

## 1. Pieces < 0.01 $ft^3$ and > Table A gamma emitters

- Individual pieces < 0.01 $ft^3$ and > Table A values must be managed separately
- Ensures sealed-source-like pieces are managed appropriately

| Nuclide | For Waste Classified as Class A or B | For Waste Classified as Class C |
|---|---|---|
| Co-60 | >26 TBq (700 Ci) | N.A. |
| Nb-94 | >37 MBq (1 mCi) | >37 MBq (1 mCi) |
| Cs-137/Ba-137m | >111 MBq (3 mCi) | >1.1 TBq (30 Ci) |

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# Discrete Wastes & Mixtures of Discrete Wastes

## 2. Factor 1.5 for pieces gamma emitters

- If primary gamma-emitters control classification and concentration of any item of mixture > 1.5 times overall average, that item should be removed & managed separately
- No factor 1.5, if all items < 37 MBq (1 mCi)
- Ensures radiological uniformity of pieces in container

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# Discrete Wastes & Mixtures of Discrete Wastes

## 3. Pieces > Table B for non-gamma, any size

- Any item in mixture > Table B, item removed & managed separately
- Prevents averaging non-gammas over > 200 liter drum and ensures radiological uniformity of pieces in container

| Nuclide* | For Waste Classified as Class A or B | For Waste Classified as Class C |
|---|---|---|
| H-3 | >0.3 TBq (8 Ci) | N.A. |
| C-14 | >0.04 TBq (1 Ci) | >0.4 TBq (10 Ci) |
| Ni-59 | >0.15 TBq (4 Ci) | >1.5 TBq (40 Ci) |
| Ni-63 | >0.26 TBq (7 Ci) | >55 TBq (1500 Ci) |
| Alpha emitting TRU with half-life greater than 5 years (excl. Pu-241 and Cm-242) | >111 MBq (3 mCi) | >1110 MBq (30 mCi) |

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# Discrete Wastes & Mixtures of Discrete Wastes

## 4. Factor 10 rule for non-gamma pieces

- Non-gamma activity of any item of mixture > 10 times overall average, that item should be removed & managed separately
- Factor 10 applies to all “classification-controlling” non-gamma nuclides: non-gamma emitters > 0.01 of appropriate Table 1 or 2 values
- Ensures radiological uniformity of pieces in container

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# Road Map

- Homogeneous waste types
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# High-Integrity Containers

- Wastes disposed in high-integrity containers (HICs) - classification based on displaced volume or weight of the waste itself

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# Encapsulation of Sealed Sources and Other LLRW

- Maximum encapsulating volume or mass for single source is 0.2 $m^3$ or 500 kg
- Maximum gamma dose < 0.02 mrem/hr on surface after 500 years
- Maximum Cs-137/Ba-137m is 30 Ci at time disposal
- Maximum non-gammas: Class C limit when averaged across encapsulated package
- Credit must be limited to prevent extreme measures of encapsulation solely for dilution

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# Encapsulation of Sealed Sources and Other LLRW

- 30 Ci limit Cs-137 derived from two Gamma Sealed Source Handling Scenarios in BTP
- Source handling scenarios ensure intruder dose from exposure to discrete gamma source is within “envelope of safety” defined in Part 61 EIS for homogeneous waste

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# Mixing Different Waste Types in Single Container

- Example, single container pieces activated metal and contaminated soil
- OK - if classification of mixture based on classification of contributor with highest classification -- otherwise mixture must be classified under Alternative Provisions

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# Alternative Provisions

- Under 10 CFR 61.58, Commission may authorize other classification based on site/waste specific basis

The BTP also states that:

- Classification alternatives, other than in BTP, may be considered acceptable
- For example, physical form justifies intruder exposure scenarios other than those in Part 61 EIS; must comply Subpart C of 61
- Example - a large intact activated component filled with cement

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# Next Steps

- Reviewed 8 elements of guidance in BPT + Alternative Provisions
- NRC has received several suggestions on how the guidance in the BTP might be updated
- Many of those suggestions were used to create a set of questions, intended to facilitate discussions on how the BTP might be updated
- Dr. Ridge will review those questions in the next presentation

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# Thank You

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# Overview of Federal Register Notice Questions

## Public Meeting on Potential Revisions to Branch Technical Position on Concentration Averaging and Encapsulation

**Dr. Christianne Ridge, Sr. System Performance Analyst**
**Performance Assessment Branch**
**Division of Waste Management and Environmental Protection**
**February 24, 2011**

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## Averaging Provisions

- Q9 Intruder protection and concentration averaging in other programs
- Q3 Need for Concentration Averaging BTP given site-specific intruder analyses

## Intruder Analyses

- Q1 NUREG-1854 methods
- Q8 Interpretation of intruder dose given waste heterogeneity

## Limits to Averaging

- Q4 Averaging volumes for waste classification
- Q5 Factors of 10 and 1.5 for non-homogeneous waste
- Q2 Cs-137 30 Ci/0.2 $m^3$ limit in BTP

## Limits to Blending

- Q6 Sealed sources and cartridge filters
- Q7 Greater than Class C (GTCC) waste

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# Averaging Provisions

9. 10 CFR 61.55(a)(8), allows for averaging of waste concentrations in determining the classification of waste. Such averaging should continue to protect an inadvertent intruder in a waste disposal facility, one of the four performance objectives in 10 CFR Part 61.
   - How do other programs for managing and disposing of waste treat protection of an inadvertent intruder?
   - Do they allow for averaging, and if so, what are the constraints?
   - Could or should NRC harmonize its approach with these other programs? If so, would changes need to be made to NRC regulations, or could they be made in guidance?

3. The rulemaking for unique waste streams (see SECY–08–0147 and the SRM–SECY–08–0147) will protect the inadvertent human intruder by requiring a site- and waste-specific assessment. The current CA BTP defines acceptable practices for applying the 61.55 tables, to ensure that an inadvertent human intruder is protected (as intended in the draft and final Environmental Impact Statement for Part 61). Given the NRC's move towards site- and waste-specific analyses to demonstrate protection of the intruder— is the CA BTP necessary, or could it be eliminated?

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# Intruder Analyses

1. NUREG–1854, ‘‘NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations—Draft Final Report for Interim Use,’’ issued August 2007,’’ contains extensive guidance for site-specific evaluations of intruder protection. The approach in the NUREG was endorsed by NRC’s Advisory Committee on Nuclear Waste and Materials, which also recommended that the staff evaluate a broader application of the new concentration averaging methodology to wastes other than ‘‘waste incidental to reprocessing.’’ How could approaches in that guidance be used in revising the CA BTP?

8. How should NRC consider heterogeneity in waste concentrations in the site-specific intruder analysis? Does there need to be guidance on how to interpret intruder analysis results with respect to waste heterogeneity?

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# Limits to Averaging

4. The volume over which waste concentrations are averaged has a significant effect on waste classification. The current CA BTP addresses averaging over a waste package. Others have suggested that averaging occur over the volume of waste that an inadvertent intruder would be exposed to, or the volume of a disposal trench. What are the pros and cons of these approaches?

5. For blending homogeneous waste types, the NRC will be requiring a site and waste-specific intruder analysis, so as to be risk informed and performance based. In requiring a site- and waste-specific analysis for homogeneous waste types, the NRC is moving away from the CA BTP's ‘‘factor of 10 rule’’ for individual contributors to a mixture of homogeneous waste types. Should NRC also move away from the ‘‘factor of 10 rule’’ for non-primary gamma emitters and away from the ‘‘factor of 1.5 rule’’ for primary gamma emitters?

2. Part 61 limits the disposal of Cs-137 to 4,600 Ci/$m^3$, yet the CA BTP guidance for disposal of discrete Cs-137 sources recommends a limit of 30 Ci in 0.2 $m^3$ (150 Ci/$m^3$). Given the large disparity between the CA BTP guidance and Part 61, and given the need to dispose of large Cs-137 sources, should NRC consider revising the 30 Ci in 0.2 $m^3$ recommendation found in the CA BTP?

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# Limits to Blending

6. What limits on the types of LLW that can be blended should be specified in the CA BTP? Specifically, should blending of cartridge filters and sealed sources to form homogeneous mixtures be addressed in the CA BTP?

7. In the Commission's October 13, 2010, decision on LLRW blending, it stated that ". . . [Greater than Class C (GTCC)] waste is a Federal responsibility and . . . should not be made into a State responsibility, even if the waste has been blended into a lower classification." What unique guidance will GTCC waste require in the BTP, given this direction? For example, when should waste be classified? (Waste is currently not required to be classified until it is shipped for disposal).

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# Summary

- Provide comments
  - www.regulations.gov
    - Docket ID NRC-2011-0022
- Mail Comments
  - Cindy Bladey
    Division of Administrative Services
    U.S. Nuclear Regulatory Commission
    Mail Stop: TWB-05-B01M
    Washington, DC 20555
- Questions
  - Maurice Heath, Project Manager
    - 301-415-3137 or maurice.heath@nrc.gov

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# Maximizing Stakeholder Input

| Milestone | Date |
|---|---|
| Conduct public workshop on CA BTP (Rockville, MD) | Feb. 24, 2011 |
| DOE/NRC workshop on Part 61 (Phoenix, AZ) | March 4, 2011 |
| Issue blending Interim Guidance | March 31, 2011 |
| Close comment period on CA BTP | April 15, 2011 |
| Brief ACRS on CA BTP (Rockville, MD) | August 2011 |
| Complete Commission paper on VRPS | August 2011 |
| Complete Commission paper on UWS proposed rule | October 2011 |
| Issue draft VRPS for public comment | October 2011 |
| Issue draft CA BTP for public comment | October 2011 |
| Conduct public workshop on CA BTP (Albuquerque, New Mexico) | October 2011 |
| Issue Commission paper with proposed final VRPS | December 2011 |
| Issue Final CA BTP | June 2012 |
| Issue Commission paper with proposed final UWS rule | October 2012 |
| Commission paper on Part 61 revisions | December 2012 |