Training for the Concentration Averaging and Encapsulation Branch Technical Position, Revision 1

Division of Decommissioning, Uranium Recovery and Waste Programs

U.S. Nuclear Regulatory Commission

March 2016

Topics

Part I

- Purpose, scope, and use of guidance
- Background on Part 61 and need for concentration averaging guidance
- History of development
- Highlights of major changes

Part II

- Detailed description of 2015 positions, examples and discussion
- Wrap up

Objectives of Training

- Explain origin of concentration averaging guidance and its evolution
- Discuss major changes from 1995 to 2015
- Provide inspectors with sufficient understanding to assess whether guidance has been appropriately implemented by licensees
- Facilitate common understanding among NRC and Agreement State regulators

Purpose of CA BTP

- **Under Part 61, NRC regulations require that individuals inadvertently intruding into a closed and unrecognized LLW landfill be protected**
- **Part 61 was developed assuming all LLW is soil-like and radiologically homogenous**
- **CA BTP supplements Part 61, by providing guidance to help ensure protection of an inadvertent intruder from durable hot spots (e.g., sealed sources)**
- **CA BTP guidance has no effect on vast majority of LLW, which is not expected to contain durable hot spots (e.g., contaminated trash)**

Scope of the CA BTP

- Covers only averaging of radionuclide concentrations in waste for the purpose of classifying it as A, B, or C, in accordance with 10 CFR Part 61
- Provides averaging positions, but does not prescribe inspection considerations
- Meeting the averaging positions in BTP does not affect the applicability of other LLW guidance
- Other NRC guidance documents cover related topics:
  - Radiological characterization
  - Waste form stability
  - Attribution of waste
  - Transportation

Examples of Other NRC LLW Guidance

- 1983 BTP on waste classification
- "Technical Position on Waste Form, Revision 1," 1991, ADAMS Accession No. ML033630746
- NUREG/BR-0204 instructions for completing uniform waste manifest
- RIS 2015-02 guidance on reporting activity of "Phantom 4" on uniform waste manifest
- Information Notice 84-72, "Clarification of Conditions for Waste Shipments Subject to Hydrogen Gas Generation," September 10, 1984, ADAMS Accession No. ML082970390

Use of CA BTP

- Generators and processors shipping LLW for disposal at licensed sites must certify on the uniform waste manifest that waste has been properly classified as A, B, or C as defined in 10 CFR Part 61
- Three of four licensed disposal facility licenses reference the CA BTP in its entirety. Barnwell license/WAC refers to it in part
- Thousands of shipments each year to disposal facilities
- Licensee staff and NRC and Agreement State staff use the CA BTP
- However, NRC regulations to not require generators shipping LLW to processors to classify waste as Class A, B or C

Backfit Considerations

- **Revised CA BTP Position:**
  - **Either the 1995 or 2015 version may be used by licensees – as both versions are protective; and**
  - **If both versions are used, licensees can "mix and match"**
- **Agreement States may use a different approach**
- **Licensees should document the basis for their averaging positions**

Inspection Considerations

- CA BTP expected to affect reactor licensees more than materials licensees
- Generators and processors should have documentation that justifies averaging positions used. NRC regulations do not require that the documentation travels with the manifest
- BTP averaging positions are linked to waste types
  - Uniform manifest will specify waste types in each container
  - Discrete item waste types require greatest attention
- Disposal facility licensees may conduct independent surveys of activity and concentrations of radionuclides and point of origin inspections/audits

Future NRC HQ Assistance

- NRC Management Directive 5.7, "Technical Assistance to Agreement States":
  - Provides guidance to NRC and Agreement State management on the submission and review of requests for NRC technical assistance
  - Establishes guidance in determining when and if NRC should provide routine, special, or programmatic technical assistance to Agreement States
  - Establishes a process for determining the extent and conduct of this assistance
- NRC Regional staff can follow existing procedures and practices for requesting HQ assistance
- Staff will document any necessary clarifications of revised guidance in Regulatory Information Summaries or NRC CA BTP web page

Topics

Part I

- Purpose, scope, and use of guidance
- Background on Part 61 and need for concentration averaging guidance
- History of development
- Highlights of major changes

Part II

- Detailed description of 2015 positions, examples and discussion
- Wrap up

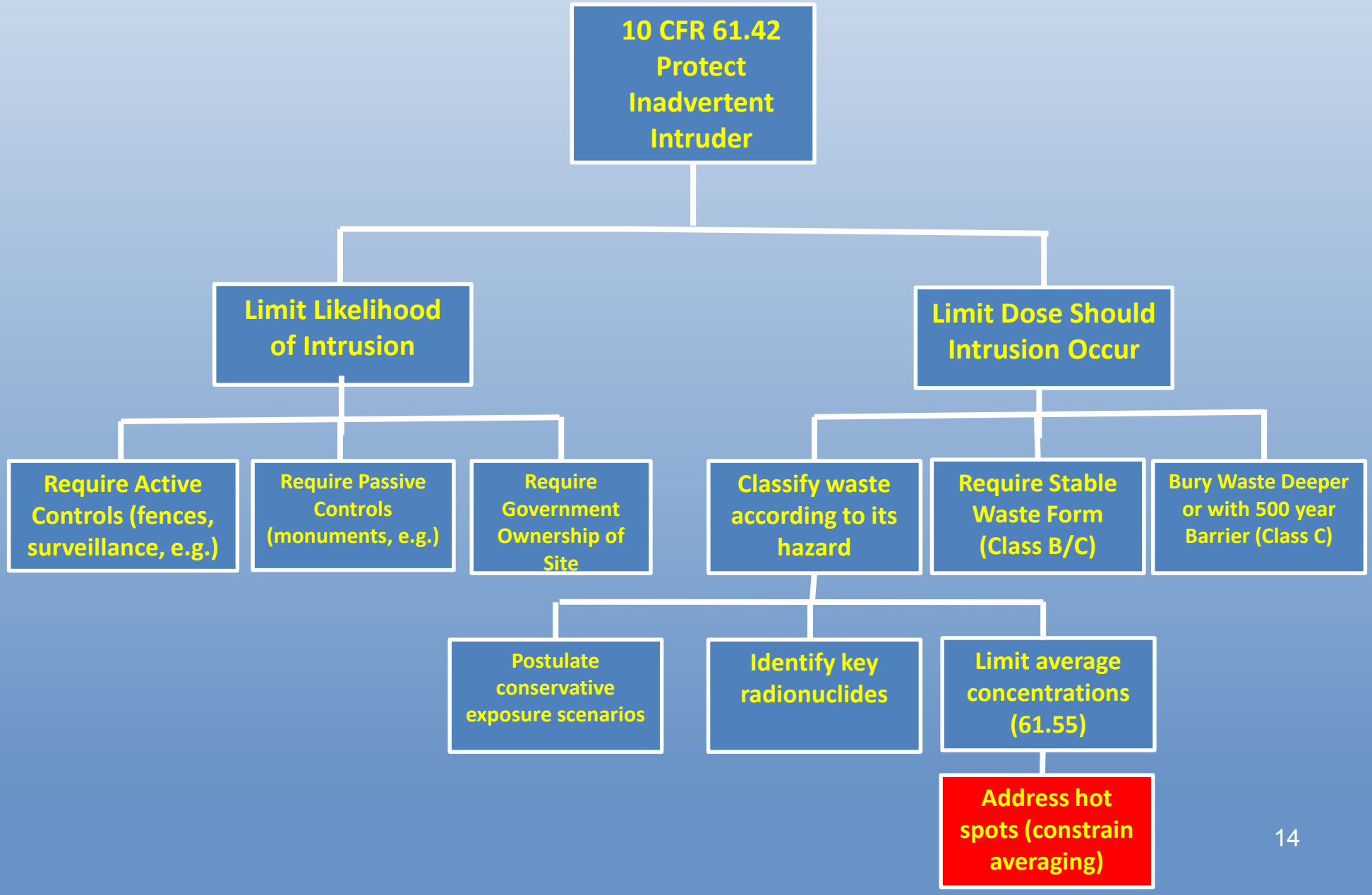
10 CFR 61 Subpart C Performance Objectives

- Protection of the general population from releases of radioactivity
- Protection of individuals from inadvertent intrusion
- Protection of individuals during operations
- Stability of the disposal site after closure

Protection of individuals from inadvertent intrusion

“Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed.” § 61.42

10 CFR Part 61 employs multiple measures to address inadvertent intruder protection



Section 61.55 – Waste Classification Table 2

Radionuclide	Concentration, curies per cubic meter		
	Col. 1 [Class A]	Col. 2 [Class B]	Col. 3 [Class C]
Total of all nuclides with less than 5 year half-life	700	([1])	([1])
H-3	40	([1])	([1])
Co-60	700	([1])	([1])
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

[1] There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table 2 determine the waste to the Class C independent of these nuclides.

10 CFR 61.55(a)(8)

"The concentration of a radionuclide [for the purpose of classifying waste] may be averaged over the volume of the waste, or weight of the waste if the units are expressed in nanocuries per gram."

Hot Spot

A portion of the overall waste volume whose radionuclide concentrations are above the class limit for the entire container.

Why Guidance is Needed

- **Provide guidance not included in Part 61 and supporting documents**

- **Reduce need for case-by-case determinations. Radioactivity concentrations in waste are not always uniform (e.g., control rod blade)**

- **Constrain averaging to address potentially unsafe practices (e.g., activated metal averaged over contaminated trash)**

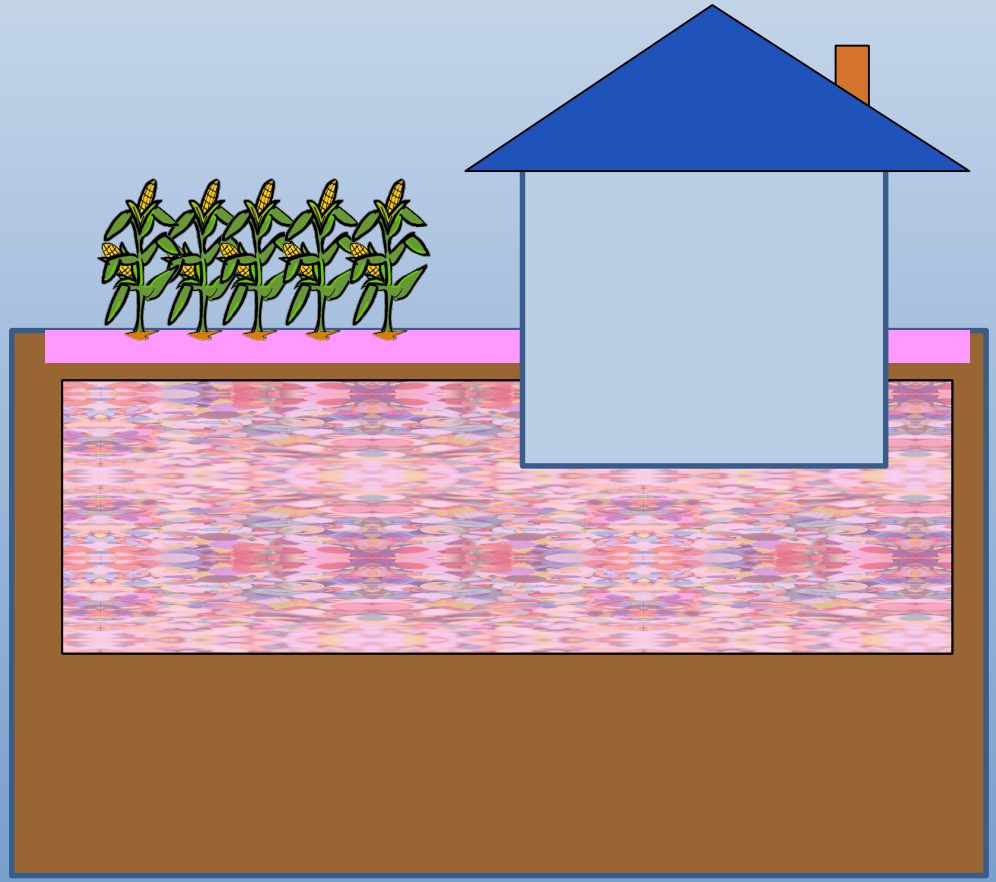
Why Guidance is Needed– NPP Cartridge Filter

- **Assume**
  - **Classification dominated by 0.65 Ci Ni-63**
  - **Filter medium volume of 0.092 m^3**
  - **"Envelope" volume of 0.14 m^3**

Cartridge Filter

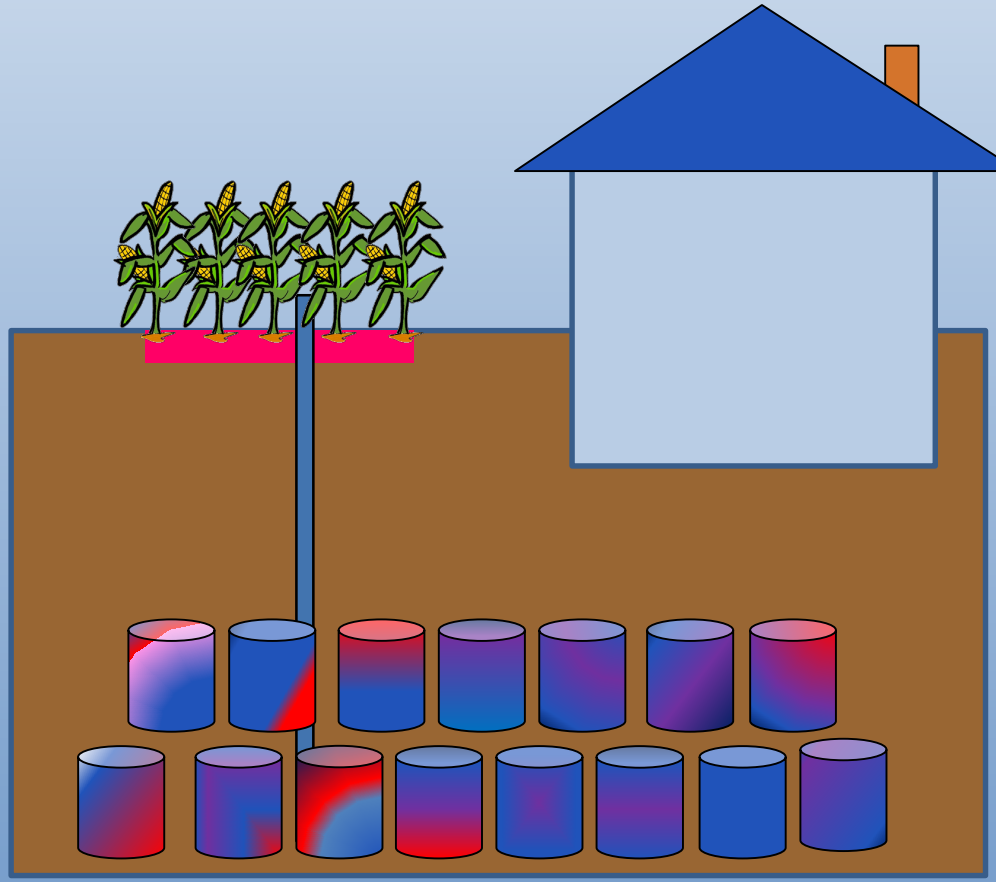
- **Average over filter medium only → Class C**
- **Average according to 1995 BTP → Class B**
- **Average according to 2015 BTP → Default position is Class B. Could be Class A if averaged over lower-activity waste, with documented justification that addresses BTP criteria**
- **Three interpretations of rule → three different classifications**
- **Guidance needed to interpret the rule**

Why Guidance is Needed – Blendable Waste



Part 61

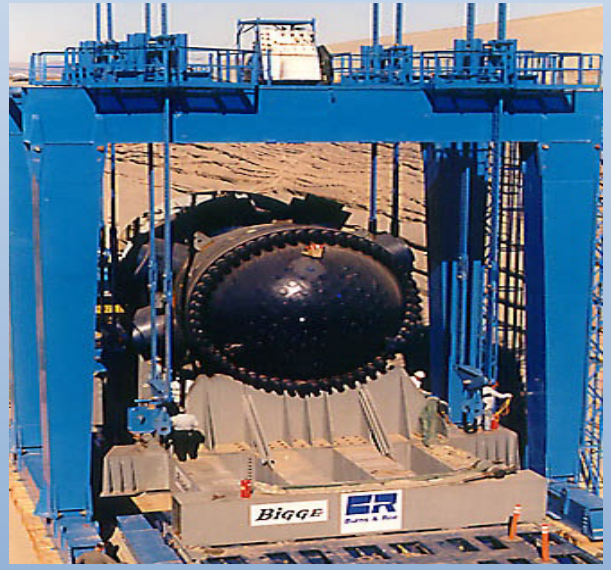
waste is assumed to be homogeneous

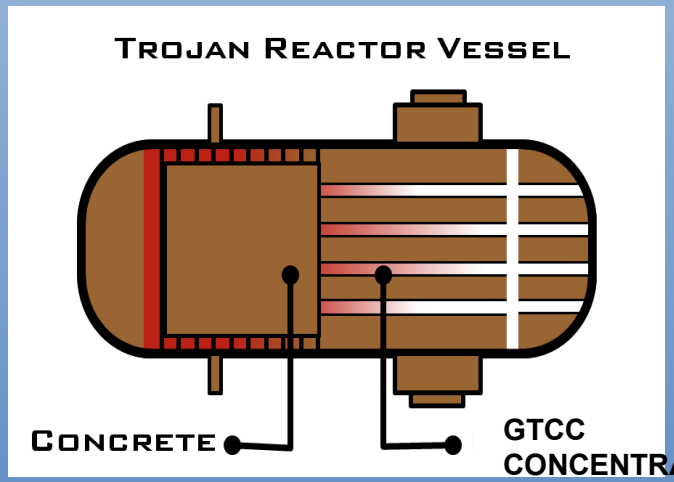


Revised BTP

hot spots are considered

Disposal of the Trojan NPP Reactor Vessel





Topics

Part I

- Purpose, scope, and use of guidance
- Background on Part 61 and need for concentration averaging guidance
- History of development
- Highlights of major changes

Part II

- Detailed description of 2015 positions, examples and discussion
- Wrap up

1995 CA BTP

- 1995 BTP supersedes section C3 of 1983 Guidance
- Detailed guidance for averaging different types of waste –21 pages long vs. 1 page in 1983 CA BTP
- Purpose was to achieve consistency among regulators
- Agreement States have mostly adopted the 1995 CA BTP. Widely used by generators and processors in U.S.

Drivers for Revision to 1995 Guidance

- Make positions more risk-informed, performance based
- Make basis for positions easier to understand
- Reduce worker exposures by eliminating unnecessary waste surveying and sampling
- Update guidance to be consistent with Commission decision on blending of LLW in 2010
- Re-evaluate constraints on sealed source disposal
  - Commission Policy Statement:
    - "... waste disposal is still considered the safest and most secure long-term LLRW management approach."
    - "... Commission continues to favor disposal of LLW over storage..."

Topics

Part I

- Purpose, scope, and use of guidance
- Background on Part 61 and need for concentration averaging guidance
- History of development
- Highlights of major changes

Part II

- Detailed description of 2015 positions, examples and discussion
- Wrap up

Highlights of Major Changes

A summary of major changes is provided in Vol. 1 Appendix B

- Added guidance for alternative approaches
- Added criterion for adequate blending with threshold volumes below which no demonstration of blending is recommended
- Revised Factors of 1.5 (now 2) and 10 including option to use either Factors or activity limits in CA BTP Tables 2 and 3
- Added provision for treating cartridge filters as blendable waste
- Revised sealed source limits
- Expanded provisions for encapsulation

Alternative Approaches

- Like 1995 BTP, the 2015 revision identifies uniform “look up” guidance that is applicable to all disposal sites and waste types
- New Alternative Approaches provides Licensees / Agreement States with specific NRC guidance on factors to consider in submitting/reviewing alternative approaches
- Allows for site- and waste-specific considerations
- CA BTP strongly urges licensees to submit proposals for alternative approaches to the disposal facility regulator

Blendable Waste vs. Discrete Items

- *Blendable Waste*
  - Majority of LLW (by volume) is blendable and concentrations can be averaged without constraint *
  - Examples: soils, ash, ion exchange resins, contaminated trash

- *Discrete Items*
  - Subject to more complex averaging constraints
  - Durable and often have high activities or concentrations
  - Examples: sealed sources, activated metals

* "average without constraint" means using a sum of fractions of the total inventory in the package divided the by total volume or mass, as appropriate

Blendable Waste vs. Discrete Items (cont'd)

- **Blendable waste & discrete items are defined by waste type (not by test) to reduce the need to survey items and to minimize worker dose**

- **In general, discrete items may present more of an intruder hazard because radioactivity is more likely to remain concentrated. Therefore, discrete items have more averaging constraints than blendable waste.**

Revised Blending Guidance

- **In the 2015 BTP, single blendable waste streams can still be averaged without constraint (similar to 1995 position)**
- **Generators may combine multiple blendable waste streams of the same waste type for the purposes of operational efficiency, occupational safety, or occupational dose reduction and average without constraint (similar to 1995 position)**
- **For other types of blending, the revised BTP addresses the o*utputs* of the blending process**
  - **Threshold averaging volumes below which no demonstration of blending is recommended**
  - **Criterion for demonstrating waste is adequately blended**

What are Discrete Items?

- **Discrete Items are items of one of these waste types:**
  - **activated metals**
  - **sealed sources**
  - **contaminated materials**
  - **components incorporating radioactivity into design, and**
  - **cartridge filters (Cartridge filters may be treated as blendable waste in some cases, see Section 3.3.3)**

- **Items of these waste types are considered discrete because they typically have these two characteristics:**
  - **Items are durable (expected to be intact at time of intrusion), and**
  - **Items have high amounts or concentrations of radioactivity**

Big Picture – Averaging a Mixture of Discrete Items

- For classifying a mixture of discrete items in single container
- Criteria designed to identify hot spots
- If all criteria for identifying hot spots are met, average without constraint
- If an item does not meet the criteria for a mixture of discrete items, remove the item and average the remaining mixture of discrete items
- Either activity limits (CA BTP Tables 2 and 3) or concentration limits (Factors of 2 and 10) may be used, as explained later in this presentation

"Radionuclides of Concern"

- New term for what had been called "classification-controlling" radionuclides in 1995 CA BTP
- The term "classification-controlling" has a more common-sense definition in the 2015 CA BTP
- Radionuclides of Concern are defined as: Any nuclide(s) in the waste in concentrations greater than either
  - 1 percent of the concentration of that nuclide listed in Table 1 in 10 CFR Part 61 or
  - 1 percent of the applicable class-dependent concentration of that nuclide in Column 2 or 3 of Table 2 in 10 CFR Part 61

Concentration Limits
(Factors of 2 and 10)

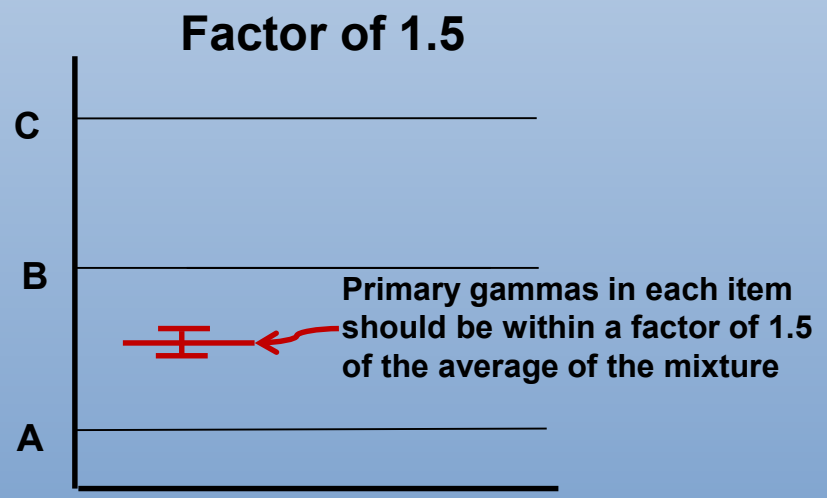
- **Factor of 2 – the concentration of each primary gamma-emitting nuclide* in each item should be less than 2 times the classification limit for that nuclide**

- **Factor of 10 – the concentration of each radionuclide of concern in each item should be less than 10 times the classification limit for that radionuclide**

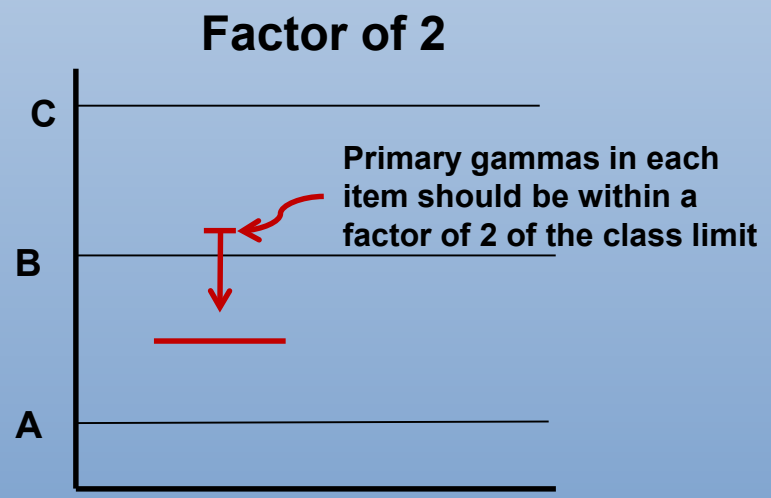
*** Factor of 10 applies to primary gamma-emitting nuclides when they do not control the waste classification**

More Risk-Informed Averaging Constraint for Discrete Items

Example: average concentration in each package is the same and meets the Class B limit



1995 Guidance

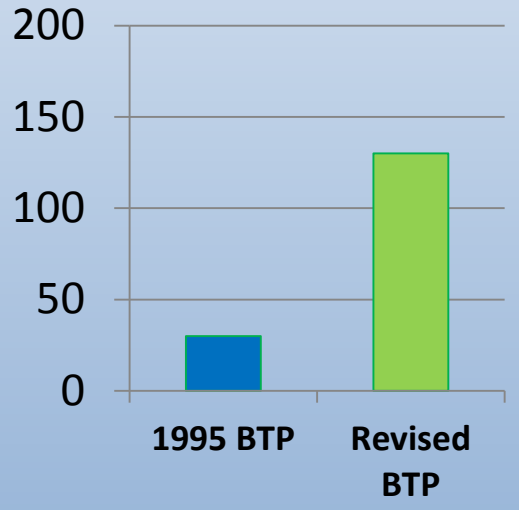


Revised Guidance

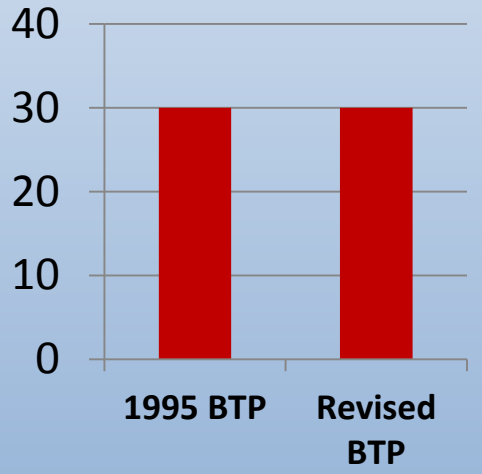
Sealed Sources

Sealed sources are concentrated and durable

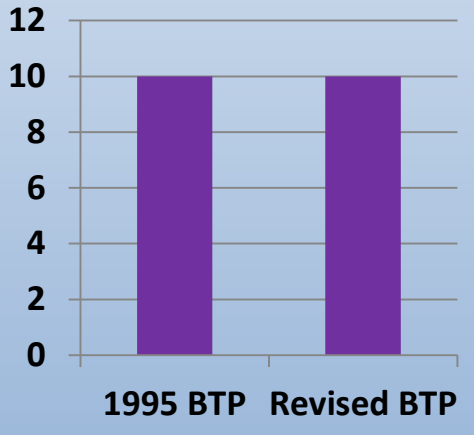
Revised Sealed Source Limits Are Higher, Lower and the Same as the 1995 CA BTP



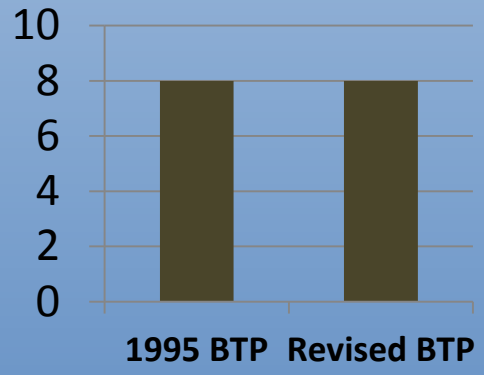
Cs-137 Limit, Class C, Ci



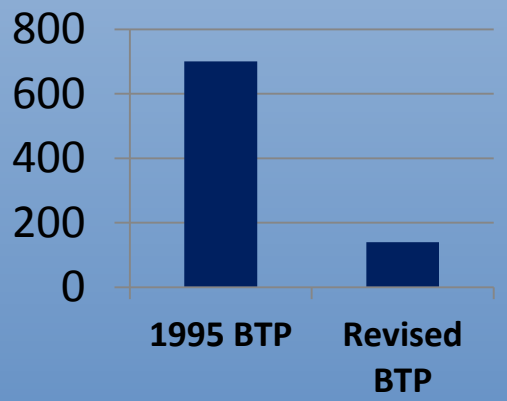
Am-241, Cm-244, Pu-238, Pu-239 Limits, Class C, mCi



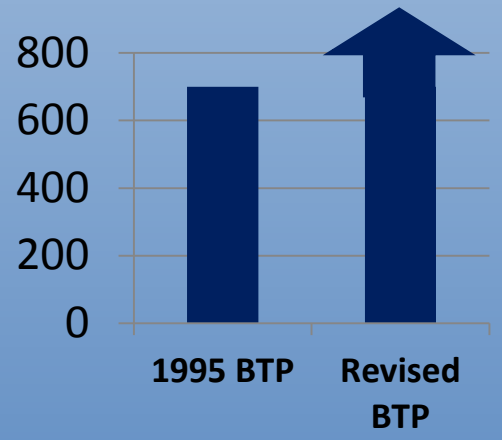
C-14 Activity Limits, Class C, Ci



H-3 Activity Limits, Class A and B (no limit for Class C) (Ci)

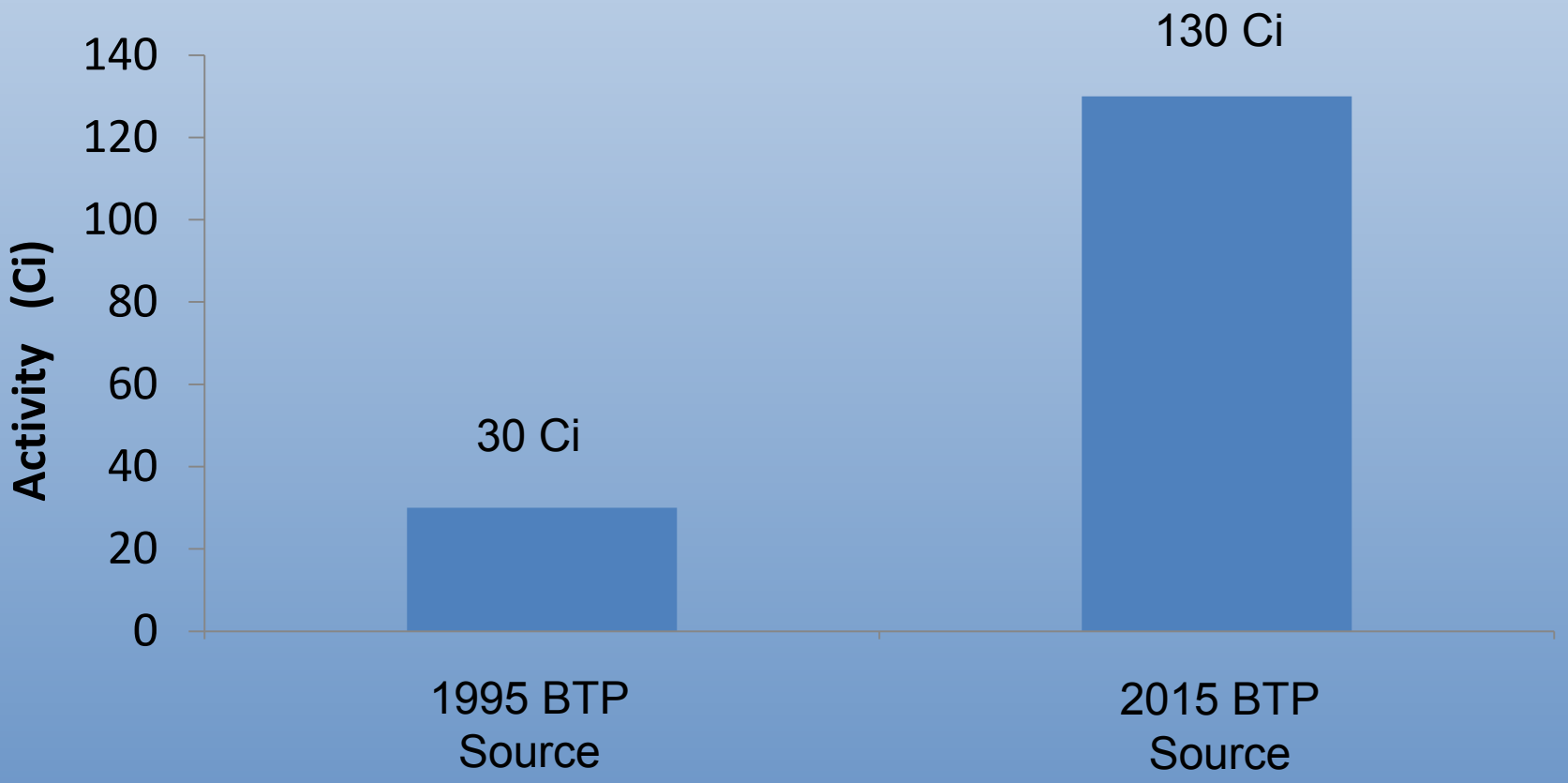


Co-60 Activity Limit, Class A, Ci

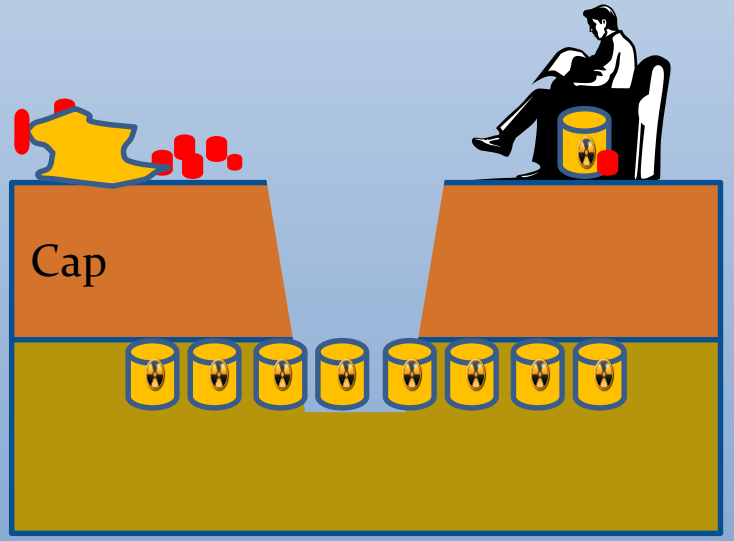


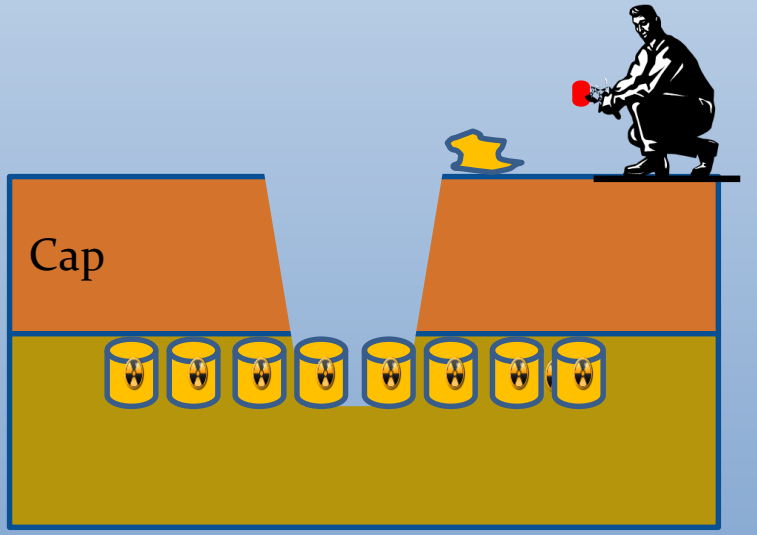
Co-60 Activity Limit, Class B, Ci

Class C Cs-137 Sealed Source Activity Increased



1995 BTP vs Revised CA BTP Exposure Scenario for Cs-137 Sealed Source





1995 BTP

50* mrem from sealed source
Encapsulation intact
2360 hours
Contact dose

Revised BTP

500 mrem from sealed source
No encapsulation
4 hours in pocket
720 hours at 2 m

* 450 mem exposure from other waste

Overview of Encapsulation of Discrete Items

- **Encapsulation is the process of surrounding a radioactive sealed source, a collection of such sources, or other materials in a binding matrix within a container, where the activity remains within the dimensions of the original source(s) or other materials**
- **When CA BTP conditions are met, credit can be taken for volume or mass of the binding matrix**
  - **1995 CA BTP provision preserved – any size item can be averaged over the volume of a 55 gallon drum (0.2 m^3). Activity limits for items changed in some cases**
  - **2015 CA BTP allows for volumes up to 9.5 m^3 (331 ft^3) with 14% minimum waste loading**
- **Application of concentration and activity limits are the same as for mixtures of discrete items**

Next Steps

- Continue training with Agreement States and Regional inspectors
- Continue dialogue with and respond to questions from inspection staff
- Continue stakeholder outreach (licensees, EPRI, etc.)
- Provide formal clarifications as necessary

Summary—Part I

- **2015 CA BTP is an extensive revision of 1995 version to make it more risk-informed, performance-based, and transparent**
- **Part II presents the details of the 2015 version**
- **NRC staff committed to helping to ensure smooth transition to revised CA BTP**

Part II

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Waste Type

- **A Waste Type has relatively uniform physical characteristics – but not necessarily the same radiological characteristics**

- **As defined in 10 CFR Part 20, "Standards for Protection against Radiation," a waste type is waste having a unique physical description (i.e., a specific waste descriptor code). For example:**
  - **Spent ion exchange resins and contaminated soils are different waste types**
  - **Primary and secondary spent ion exchange resins are the same waste type**

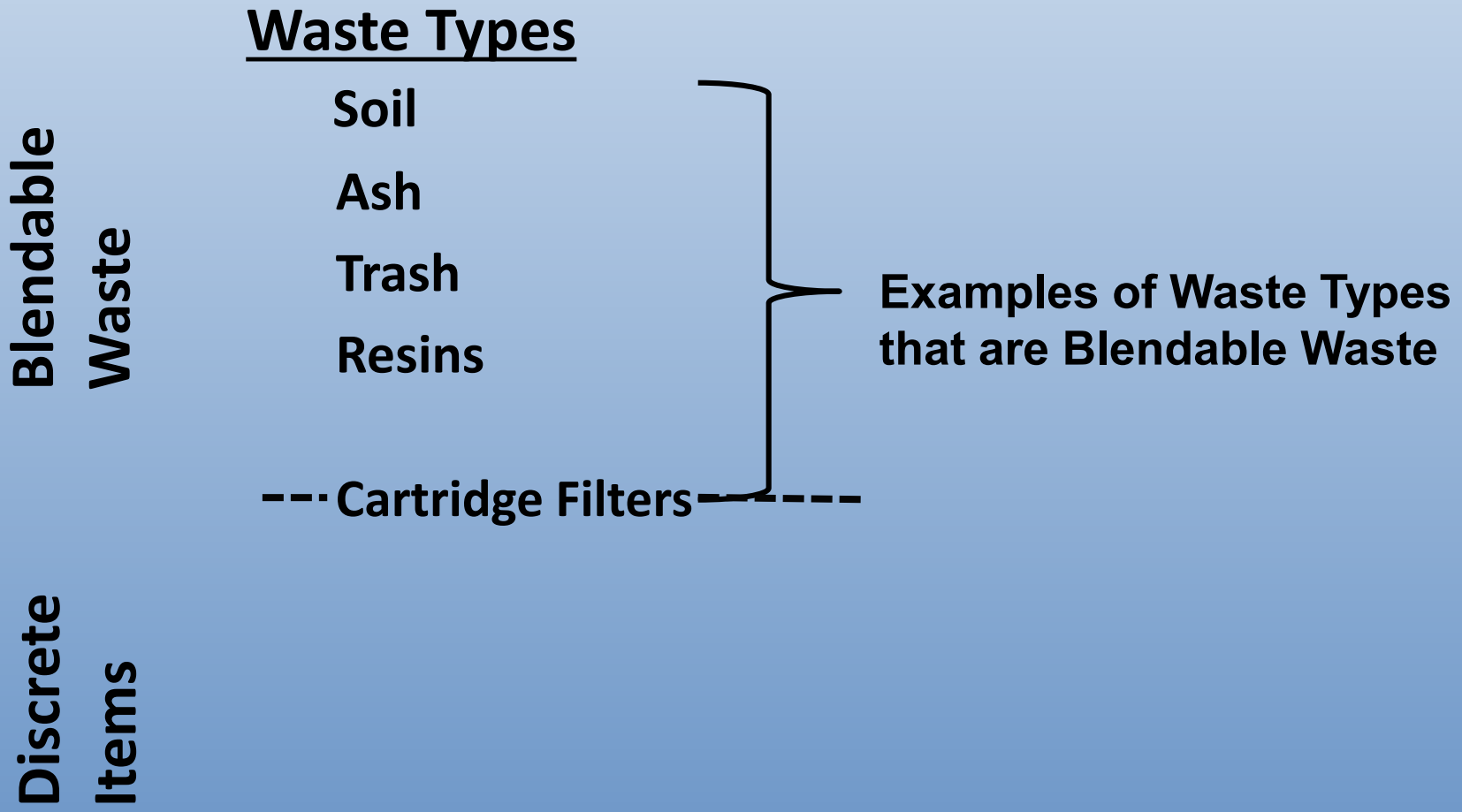
Waste Stream

- **A Waste Stream has relatively uniform physical and radiological characteristics**

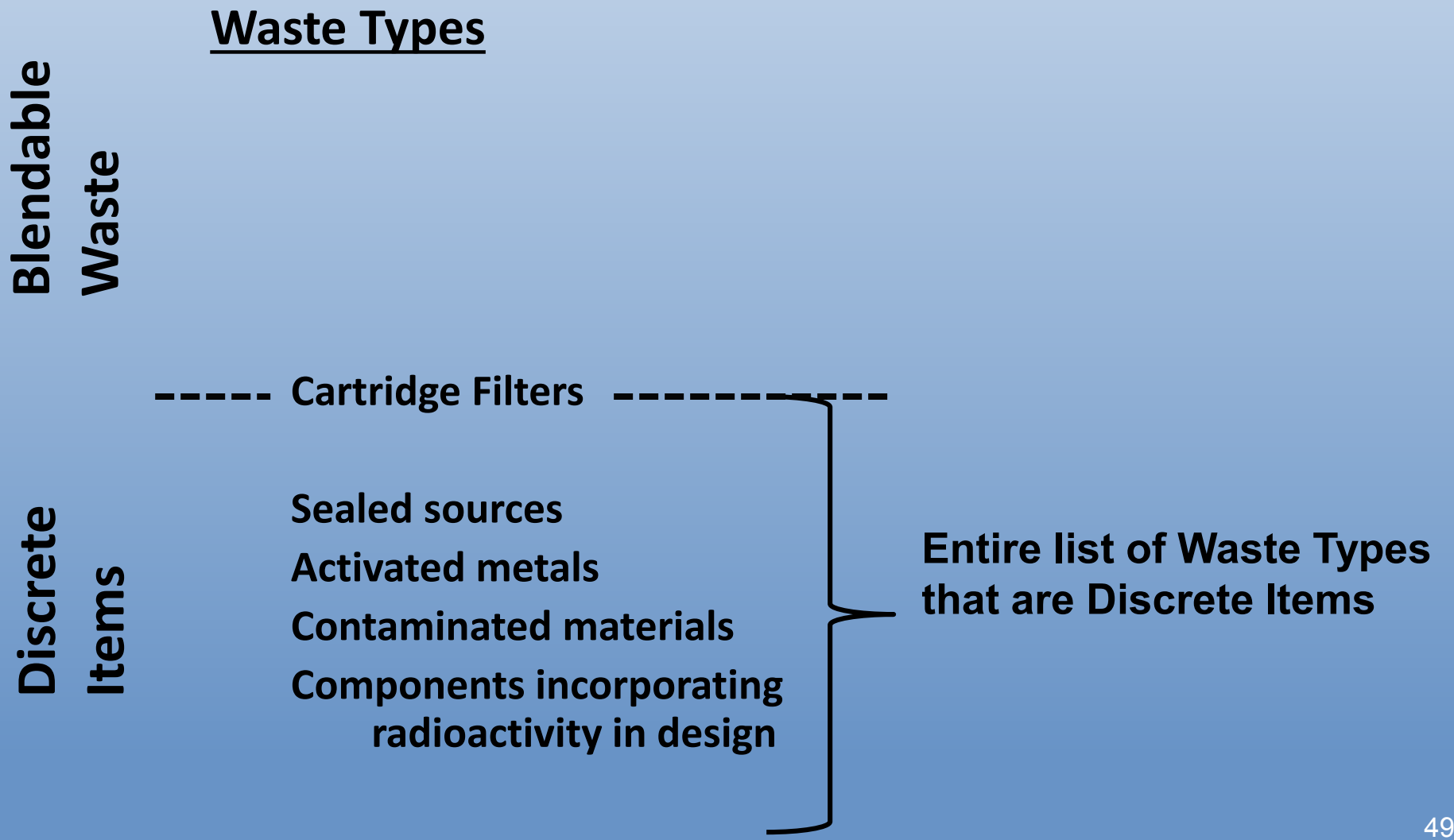
- **Often, a waste stream results from a single process. For example:**
  - **Primary spent ion exchange resins from a single NPP are a single waste stream**
  - **Secondary spent ion exchange resins from the same NPP are a separate waste stream**
  - **Primary spent ion exchange resins from a different NPP are a separate waste stream**

The relationship between Waste Types, Waste Streams, Blendable Wastes, and Discrete Item Wastes

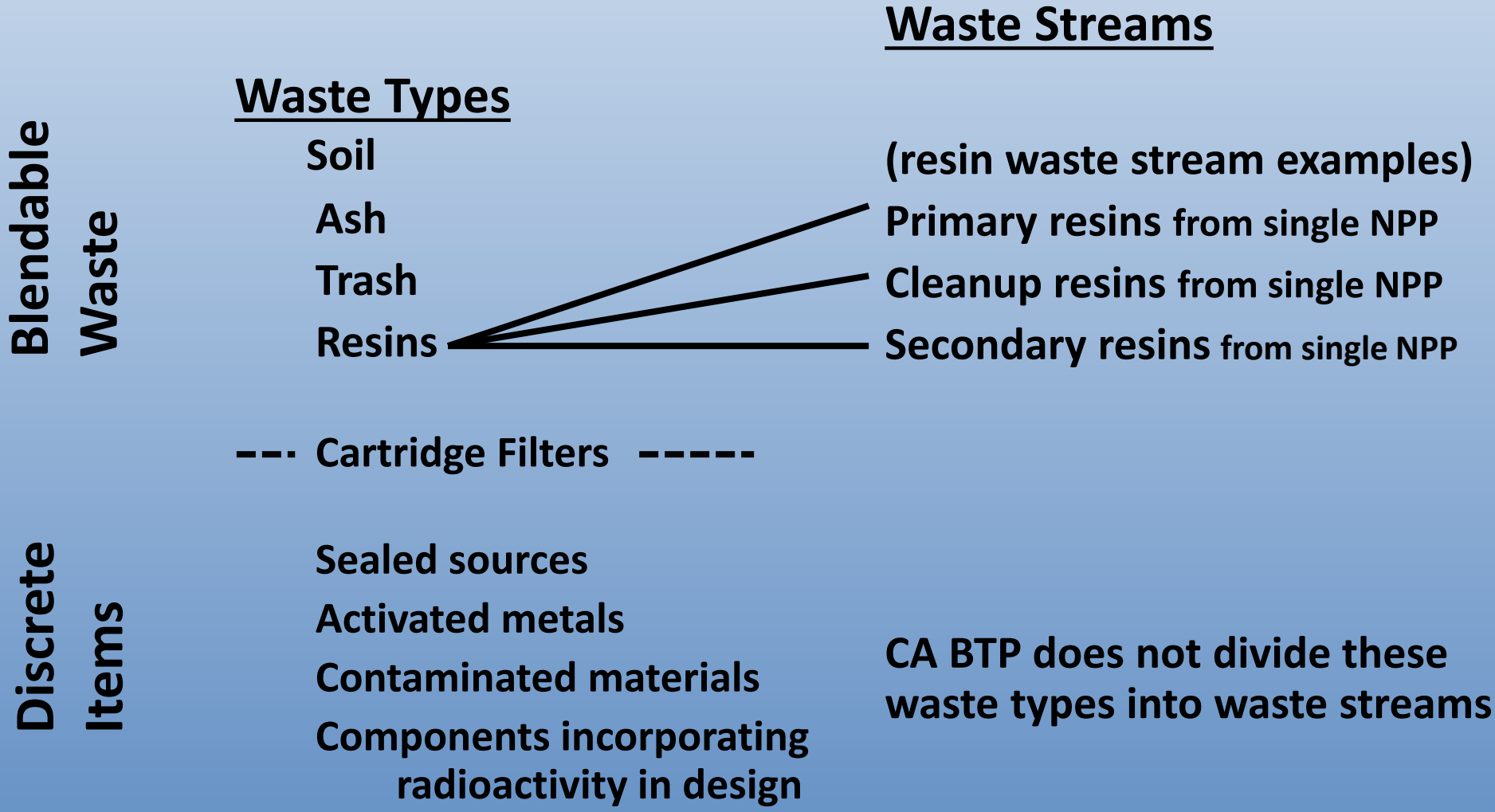
Waste Types and Blendable Wastes



Waste Types and Discrete Items



Waste Types & Streams



Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Overview of BTP Guidance

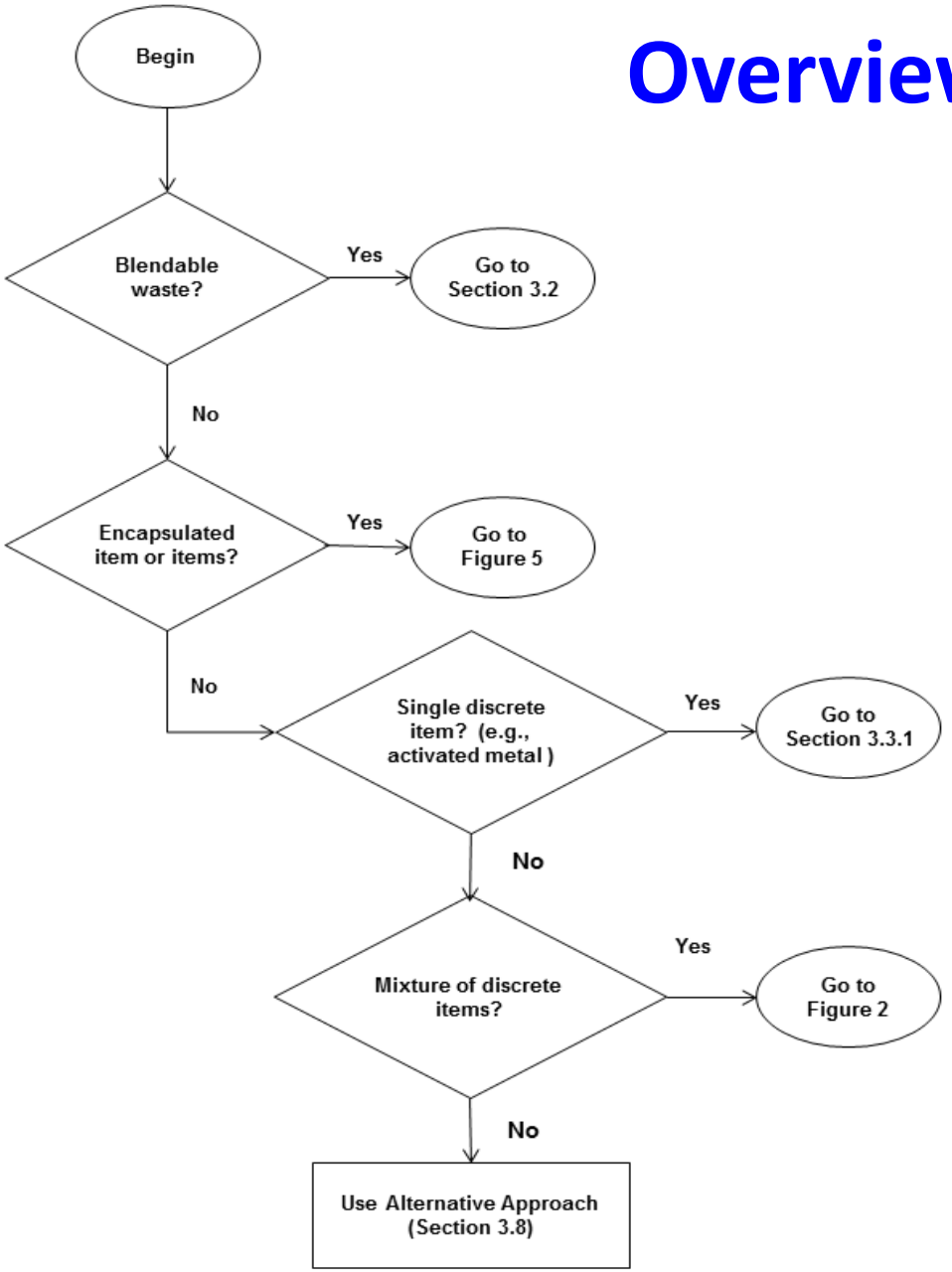


Figure 1. CA BTP Guidance Overview

Overview of BTP Guidance

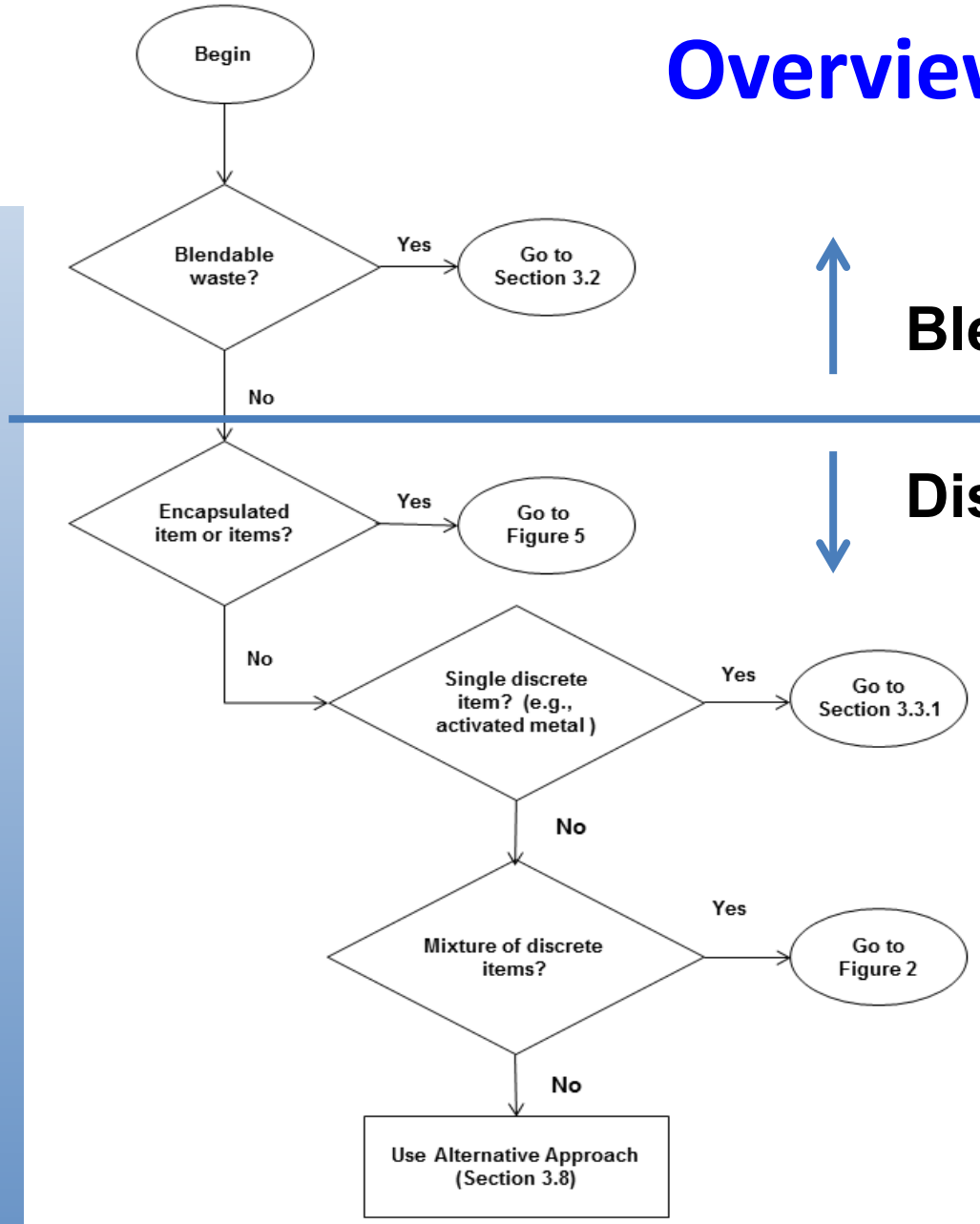


Figure 1. CA BTP Guidance Overview

Blendable Waste

Discrete Items

Guidance for Blendable Waste

3.2 Blendable Waste

3.2.1 Concentration Averaging for a Single Blendable Waste Stream

3.2.2 Concentration Averaging for Multiple Blendable Waste Streams

3.2.3 Classification of Solidified Waste

"Homogeneous Waste" vs. "Blendable Waste"

- **Blendable Waste (2015 BTP) is similar to homogeneous waste in the 1995 BTP**
- **In the 1995 BTP**
  - **homogeneous waste types were assumed to be radiologically homogenous**
  - ***Inputs* to blending were limited to within a Factor of 10 of the product**
- **In SRM-SECY-10-0043, the Commission directed the staff to revise this position to be more risk-informed and performance-based**

Blendable Waste

- **Revised BTP provides guidance for blending *outputs***
  - **Criterion to demonstrate adequate blending**
  - **Table 1 volume thresholds below which no demonstration is recommended**

- **Blendable Waste has one of two characteristics:**
  a. **Can be physically mixed to create relatively uniform radionuclide concentrations (e.g., soils, ash, resins)**

     or

  b. **Is not expected to contain durable items with significant activity (e.g., contaminated trash)**

- **Most LLW (by volume) is blendable**

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Single Blendable Waste Streams

Average without constraint – i.e., average based on the sum of fractions using the total inventory divided by total volume (or mass, as appropriate)

Topics

Part II Detailed description of 2015 positions

- Waste Streams and Waste Types
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Mixing Multiple Blendable Waste Streams

- ***Generator Facilities*** **may mix multiple blendable waste streams of the same waste type for the purposes of operational efficiency, occupational safety, or occupational dose reduction (similar to 1995 position) and average without constraint**
- **In other cases, *Generator Facilities* mixing multiple blendable waste streams of the same type should ensure either:**
  - **Table 1 volume and concentration thresholds are met; or**
  - **The blended product meets the criterion for adequate blending**

Mixing Multiple Blendable Waste Streams (cont'd)

- ***Waste Processors*** **mixing multiple blendable waste streams of the same type should ensure either:**
  - **Table 1 volume and concentration thresholds are met; or**
  - **The blended product meets the criterion for adequate blending**

- **Blending criterion: the sum of fractions of any volume of the blended waste larger than 0.2 m^3 (7 cubic ft^3) should not exceed 10**

- **Criterion may be applied to a process or to individual containers. CA BTP emphasizes use of process knowledge instead of direct measurements to limit worker dose.**

Table 1 from BTP

Characteristics of Most Concentrated Influent Waste Stream‡	Volume of Mixture in m^3 (ft^3)		
	Class A Mixture	Class B Mixture	Class C Mixture
Sum of fractions less than 10	No limit	No limit	No limit
Sum of fractions between 10 & 20	No limit	No limit	50 (1800)
Sum of fractions between 20 & 30	60 (2100)	No limit	20 (700)
Sum of fractions between 30 & 50	20 (700)	No limit	6 (210)
Sum of fractions between 50 & 100	6 (210)	40 (1400)	2 (70)

‡ Sum of fractions is based on the class of the blended product

Table 1. Thresholds for Demonstrating Adequate Blending

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Solidified & Absorbed Wastes

- **Solidified waste should be adequately mixed to produce a physically uniform product in accordance with existing NRC guidance and industrial standards**
  - **For example: NRC's "Technical Position on Waste Form, Revision 1," 1991, ADAMS ML033630746 and American Nuclear Society (ANS) 55.1**
- ***Nonradioactive materials used in solidification should have a purpose other than lowering the waste classification***
- **For solidified waste – classification based on average radionuclide concentrations in *final solidified volume or mass* as appropriate**
- **For absorbed liquids - Average radionuclide concentrations in solidified waste shall be based on the *volume or mass of original liquid***

Sample Problems

For determining the waste classification for disposal, the BTP divides wastes into two broad categories, discrete items and blendable wastes. Which of these broad categories is not expected to contain durable hot spots?

i. Discrete items
ii. Blendable waste

Can waste from a single blendable waste stream be concentration averaged (i.e., based on the sum of fractions using the total inventory, divided by total volume) without consideration of hot spots and special averaging constraints?

i. Yes
ii. No

Sample Problems

For determining the waste classification for disposal, the BTP divides wastes into two broad categories, discrete items and blendable wastes. Which of these broad categories is not expected to contain durable hot spots?

i. Discrete items
ii. Blendable waste

Can waste from a single blendable waste stream be concentration averaged (i.e., based on the sum of fractions using the total inventory, divided by total volume) without consideration of hot spots and special averaging constraints?

i. Yes
ii. No

Sample Problems

Is contaminated trash a blendable waste?

i. Yes

ii. No

Are pieces of activated metal a blendable waste?

i. Yes

ii. No

Are spent ion exchange resins a blendable waste?

i. Yes

ii. No

Sample Problems

Is contaminated trash a blendable waste?

i. Yes

ii. No

Are pieces of activated metal a blendable waste?

i. Yes

ii. No

Are spent ion exchange resins a blendable waste?

i. Yes

ii. No

Sample Problems

A waste processor has combined primary and secondary spent ion exchange resins (two blendable wastes) in a single container with a volume of 7 m^3 (247 ft^3). Based on the sum of fractions using the total inventory divided by total volume, the container will be classified as Class A. The sum of fractions for the most concentrated influent resin is 60 times the Class A limit. Will the waste processor need to demonstrate adequate blending of the primary and secondary spent ion exchange resins?

i. Yes

ii. No

Sample Problems

A waste processor has combined primary and secondary spent ion exchange resins (two blendable wastes) in a single container with a volume of 7 m^3 (247 ft^3). Based on the sum of fractions using the total inventory divided by total volume, the container will be classified as Class A. The sum of fractions for the most concentrated influent resin is 60 times the Class A limit. Will the waste processor need to demonstrate adequate blending of the primary and secondary spent ion exchange resins?

i. Yes

ii. No

Table 1 from BTP

Characteristics of Most Concentrated Influent Waste Stream‡	Volume† of Mixture in m^3 (ft^3)		
	Class A Mixture	Class B Mixture	Class C Mixture
Sum of fractions less than 10	No limit	No limit	No limit
Sum of fractions between 10 & 20	No limit	No limit	50 (1800)
Sum of fractions between 20 & 30	60 (2100)	No limit*	20 (700)
Sum of fractions between 30 & 50	20 (700)	No limit*	6 (210)
Sum of fractions between 50 & 100	6 (210)	40 (1400)*	2 (70)

Table 1. Thresholds for Demonstrating Adequate Blending

Sample Problems

The operator of a nuclear power plant, for operational efficiency, has combined primary and secondary spent ion exchange resins (two blendable wastes) in a single container with a volume of 7 m^3 (247 ft^3). Based on the sum of fractions using the total inventory divided by total volume, the container will be classified as Class A. The sum of fractions for the most concentrated influent resin is 60 times the Class A limit. Will the operator need to demonstrate adequate blending of the primary and secondary spent ion exchange resins?

i. Yes

ii. No

Sample Problems

The operator of a nuclear power plant, for operational efficiency, has combined primary and secondary spent ion exchange resins (two blendable wastes) in a single container with a volume of 7 m^3 (247 ft^3). Based on the sum of fractions using the total inventory divided by total volume, the container will be classified as Class A. The sum of fractions for the most concentrated influent resin is 60 times the Class A limit. Will the operator need to demonstrate adequate blending of the primary and secondary spent ion exchange resins?

i. Yes

ii. No

Sample Problems

One fundamental purpose of the BTP is to provide guidance on acceptable methods for concentration averaging of hot spots for the purpose of determining the waste classification for disposal. A hot spot is:

i. A site that offers internet access over a wireless local area network

ii. An unshielded radioactive source

iii. A portion of the overall waste volume whose radionuclide concentrations are above the class limit for the entire container.

Sample Problems

One fundamental purpose of the BTP is to provide guidance on acceptable methods for concentration averaging of hot spots for the purpose of determining the waste classification for disposal. A hot spot is:

i. A site that offers internet access over a wireless local area network

ii. An unshielded radioactive source

iii. A portion of the overall waste volume whose radionuclide concentrations are above the class limit for the entire container.

Sample Problems

Discrete items are divided into 5 waste types. Three of the five waste types are: contaminated materials, cartridge filters, and components incorporating radioactivity into their design. The other two waste types are:

i. Depleted uranium and NORM

ii. Sealed sources and spent ion exchange resins

iii. Deactivated metals and open sources

iv. Activated metals and sealed sources

Sample Problems

Discrete items are divided into 5 waste types. Three of the five waste types are: contaminated materials, cartridge filters, and components incorporating radioactivity into their design. The other two waste types are:

i. Depleted uranium and NORM

ii. Sealed sources and spent ion exchange resins

iii. Deactivated metals and open sources

iv. Activated metals and sealed sources

Sample Problems

The BTP uses the terms Waste Stream and Waste Type. These two terms sound similar, but they have different meanings. Which of these two is expected to *have relatively uniform physical characteristics and radiological characteristics?*

i. Waste Stream

ii. Waste Type

Sample Problems

The BTP uses the terms Waste Stream and Waste Type. These two terms sound similar, but they have different meanings. Which of these two is expected to *have relatively uniform physical characteristics and radiological characteristics?*

i. Waste Stream

ii. Waste Type

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

What are Discrete Items?

- **Discrete Items are items of one of these waste types:**
  - **activated metals**
  - **sealed sources**
  - **contaminated materials**
  - **components incorporating radioactivity into design, and**
  - **cartridge filters (Cartridge filters may be treated as blendable waste in some cases, see Section 3.3.3)**
- **These waste types typically**
  - **Contain durable items (expected to be intact at time of intrusion), and**
  - **Have high amounts or concentrations of radioactivity**

Guidance on Discrete Items

3.3 Discrete Items

3.3.1 Averaging and Classification of Single Discrete Items

3.3.2 Averaging and Classification of Mixtures of Discrete Items

3.3.2.3 Sectioning Components

3.3.3 Alternative Treatment of Certain Cartridge Filters

3.3.4 Encapsulation of Discrete Items

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Requirements and Approaches
- Wrap up

Single Discrete Item

- **Average based on the sum of fractions of the total inventory, divided by the volume or mass, as appropriate**
- **See Table 4 for guidance on volume**
  - **Cartridge Filters – *Use envelope volume* or mass of filters. The envelope volume is the volume obtained using the outer dimensions of the filter (interstitial volume is included in the envelope volume)**
  - **Activated components, components containing radioactivity in their design, or contaminated materials – *Use displaced volume* (major void volumes subtracted from envelope volume) or mass of components**

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Mixture of Discrete Items

- **For classifying a mixture of discrete items in a single container**
- ***May be the most complex of all averaging positions in the revised CA BTP***
- **However, there are two simple screening options**
- **Mixtures that meet one of the simple screening criteria do not have to use the more complex criteria to identify hot spots**

Mixture of Discrete Items Simple Screening Options

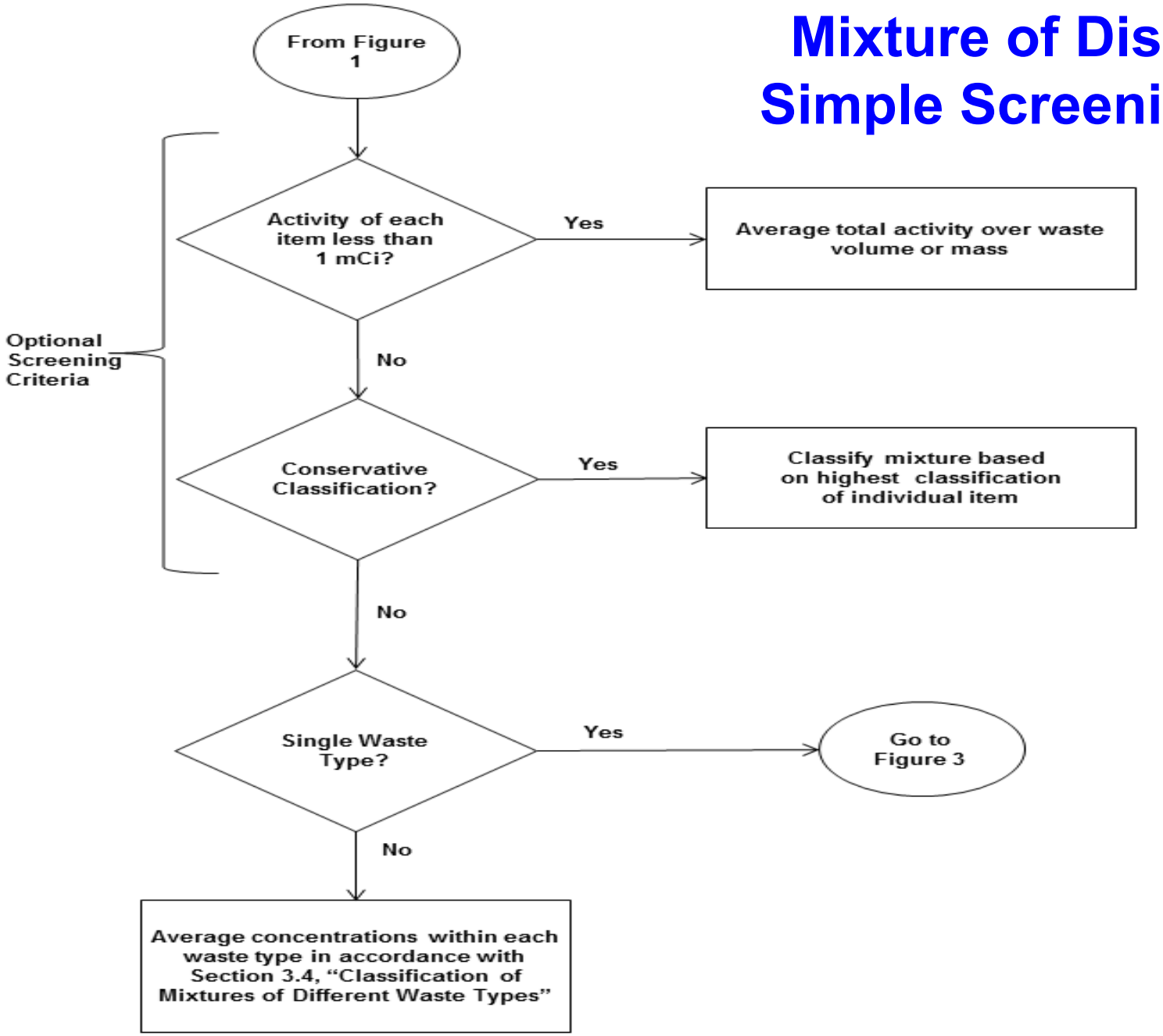


Figure 2. Overview of Classification of Mixtures of Discrete Items (Sections 3.3.2.1 and 3.3.2.2)

Mixture of Discrete Items

- If one of the screening options is not used, then more rigorous criteria are used to identify hot spots

- If all criteria for identifying hot spots are met, then use simple averaging to classify mixture (i.e., average based on the sum of fractions using the total inventory in all of the items in the mixture, divided by the total volume or mass, as appropriate)

- If an item fails, remove the piece that failed the test and reevaluate remaining pieces

Mixture of Discrete Items (cont'd)

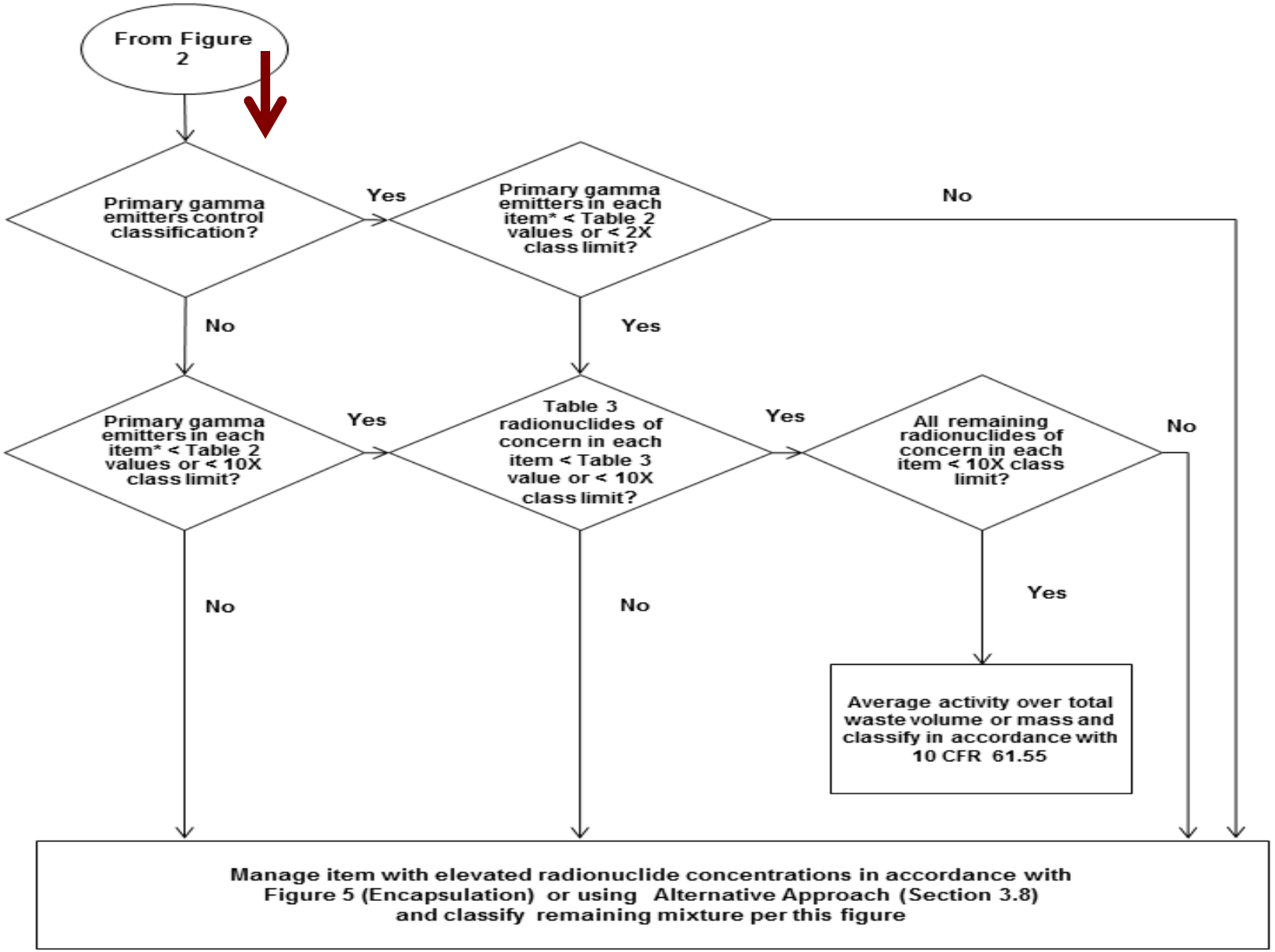
- Criteria used to identify hot spots depend on whether or not "primary gammas" control classification of mixture
- Primary gammas are: Co-60, Cs-137, and Nb-94
- Determining whether or not the primary gammas control the classification is addressed in detail later in the presentation

Mixture of Discrete Items

- "Radionuclides of Concern" other than primary gammas should meet either the Factor of 10 concentrations OR Table 3 activities
- For primary gammas
  - If they control the classification, they should meet either the Factor of 2 or Table 2
  - If they do not control classification, they should meet either the Factor of 10 or Table 2
- Table 2 is applied with a sum of fractions, Table 3 and the Factors of 2 and 10 are not
- Items smaller than 280 cc (0.01 ft^3) are grouped for comparison to Table 2 activities, other tests are applied to individual items

"Radionuclides of Concern"

- New term for what had been called "classification-controlling" radionuclides in 1995 CA BTP
- The term "classification-controlling" has a more common-sense definition in the 2015 CA BTP
- Radionuclides of Concern are defined as: Any nuclide(s) in the waste in concentrations greater than either
  - 1 percent of the concentration of that nuclide listed in Table 1 in 10 CFR Part 61 or
  - 1 percent of the applicable class-dependent concentration of that nuclide in Column 2 or 3 of Table 2 in 10 CFR Part 61.

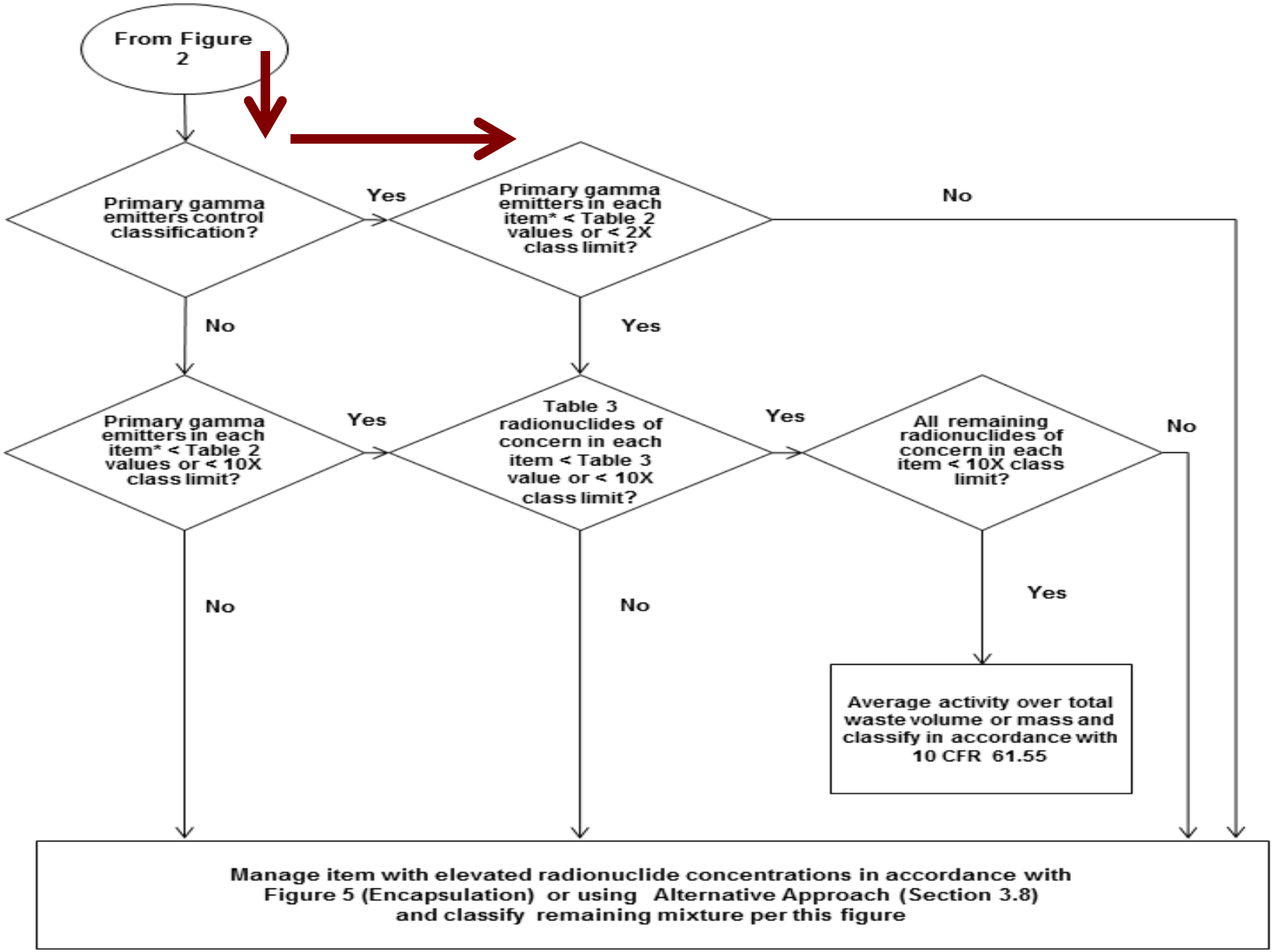


* For comparison to Table 2 values, items larger than 280 cc (0.01 ft³) may be treated individually. Items smaller than 280 cc (0.01 ft³) should be grouped together (see Section 3.3.2.2).

Figure 3. Classification of Mixtures of Discrete Items Within a Single Waste Type (from Section 3.3.2.2)

Do Primary Gammas Control?

- Use the total volume of the items and determine the sum of fractions (SOF) for the total inventory, using 10 CFR 61.55 Tables 1 and 2
- Use the 61.55 Table that gives higher classification
- If Tables 1 and 2 give same classification, use Table with greater SOF
- Determine fractional contribution the primary gamma emitters make to that SOF
- If the primary gamma emitters contribute more than 50% of the SOF, then primary gamma emitters are "classification controlling"



* For comparison to Table 2 values, items larger than 280 cc (0.01 ft³) may be treated individually. Items smaller than 280 cc (0.01 ft³) should be grouped together (see Section 3.3.2.2).

Figure 3. Classification of Mixtures of Discrete Items Within a Single Waste Type (from Section 3.3.2.2)

Table 2 or Factor of 2?

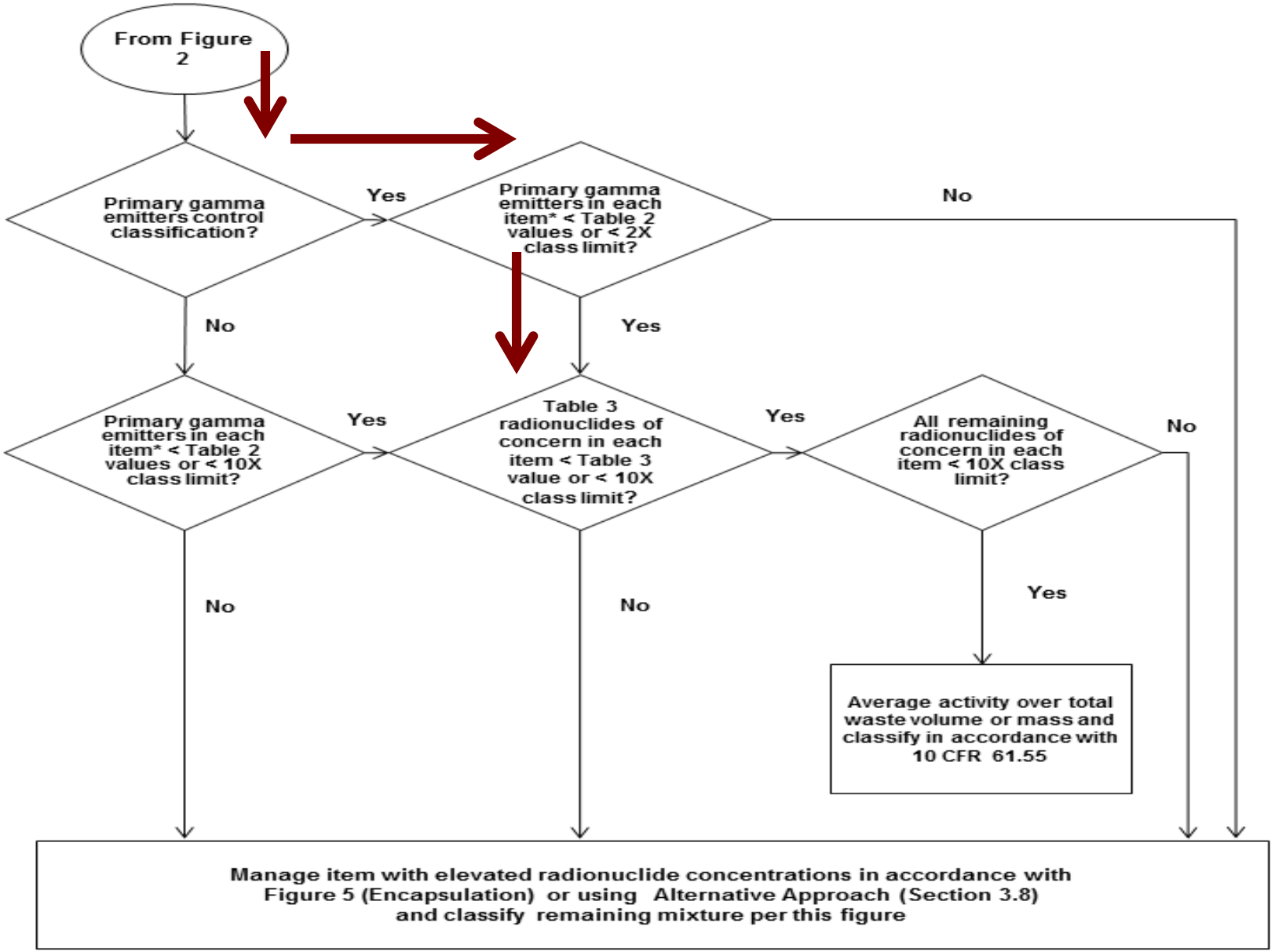
- **If primary gammas control classification of the mixture, then the licensee can use the *least restrictive* of:**
  - **Factor of 2 for each item in the mixture OR**
  - **Table 2 activity limits**
    - **For items > 0.01 ft^3, evaluate items individually**
    - **For items < 0.01 ft^3, evaluate items collectively**
  - **It is acceptable to use Factor of 2 for some items and Table 2 for others, as long as all items < 0.01 ft^3 in package are grouped for comparison to Table 2 (i.e., a comparison to Table 2 cannot include some items < 0.01 ft^3 but exclude others)**

- **Factor of 2 means that that the concentration of each primary gamma-emitting nuclide in each item should be less than 2 times the classification limit for that nuclide, based on the waste class of the mixture**

Table 2 of the Revised CA BTP

Nuclide	Waste Classified as Class A	Waste Classified as Class B	Waste Classified as Class C
^{60}Co	5.2 TBq (140 Ci)	No limit	No limit
^{94}Nb	37 MBq (1 mCi)	37 MBq (1 mCi)	37 MBq (1 mCi)
^{137}Cs	266 MBq (7.2 mCi)	27 GBq (0.72 Ci)	4.8 TBq (130 Ci)

Table 2. Recommended Activity Limits of Primary Gamma Emitters Potentially Requiring Piecemeal Consideration in Classification Determinations



* For comparison to Table 2 values, items larger than 280 cc (0.01 ft³) may be treated individually. Items smaller than 280 cc (0.01 ft³) should be grouped together (see Section 3.3.2.2).

Figure 3. Classification of Mixtures of Discrete Items Within a Single Waste Type (from Section 3.3.2.2)

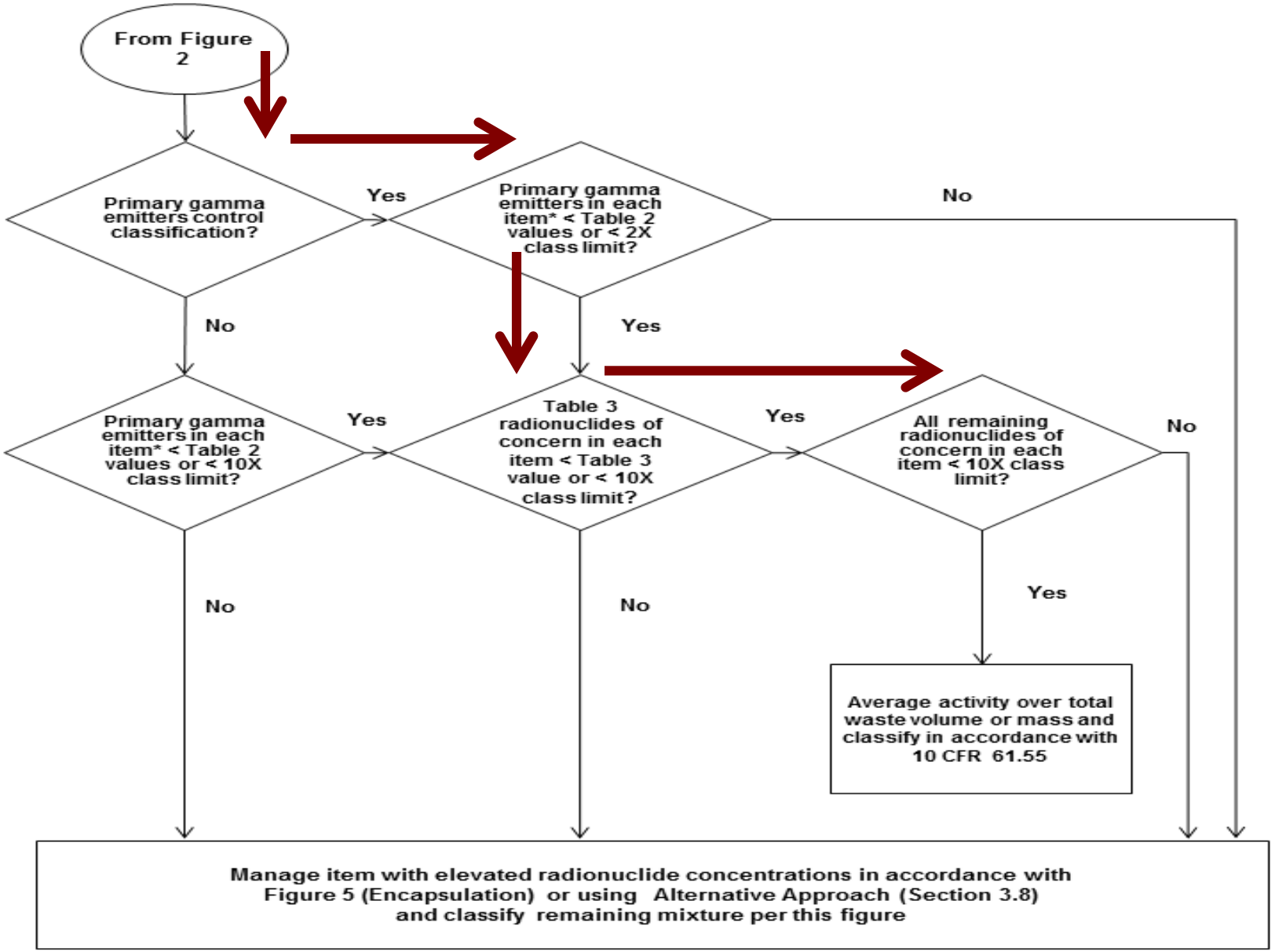
Factor of 10 or Table 3?

- **For Table 3 nuclides in *each item* in the mixture**
- **Licensee can use *least restrictive*:**
  - **Factor of 10 or**
  - **Table 3**
  - **OK to mix-and-match (use Factor of 10 for some and Table 3 for others)**
- **Factor of 10 - the concentration of each Table 3 nuclide, in each item, should be less than 10 times the classification limit for that nuclide, using the classification of the mixture**

Table 3 of BTP

Nuclide*	For Waste Classified as Class A or B	For Waste Classified as Class C
^{3}H	0.3 TBq (8 Ci)	No limit
^{14}C	0.04 TBq (1 Ci)	0.4 TBq (10 Ci)
^{59}Ni	0.15 TBq (4 Ci)	1.5 TBq (40 Ci)
^{63}Ni	0.26 TBq (7 Ci)	55 TBq (1500 Ci)
Alpha-emitting transuranic (TRU) waste with half-life greater than 5 years (excluding ^{241}Pu and ^{242}Cm)	111 MBq (3 mCi)	1.1 GBq (30 mCi)

Table 3 Recommended Activity Limits of Radionuclides Other Than Primary Gamma Emitters Potentially Requiring Piecemeal Consideration in Classification Determinations

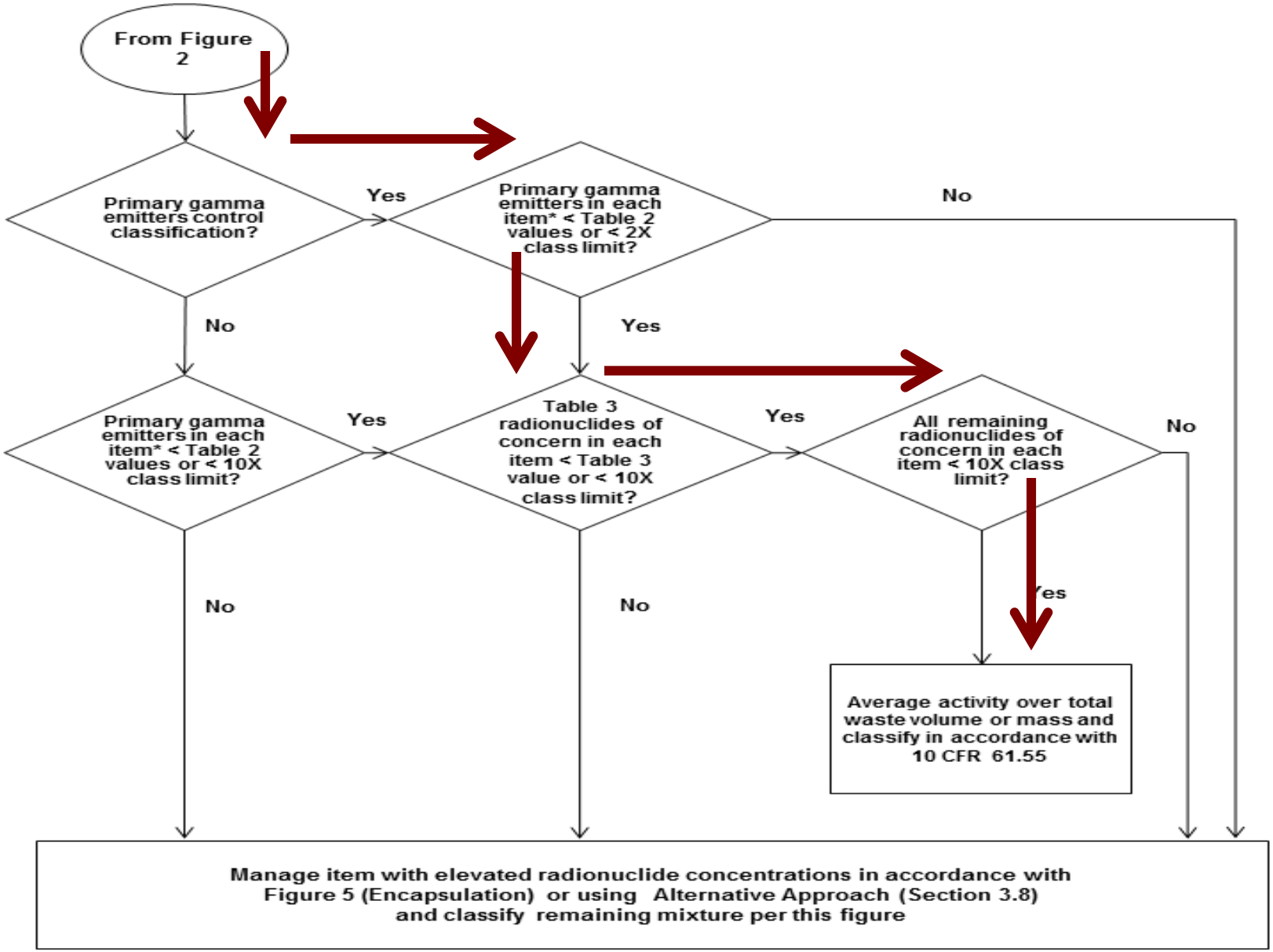


* For comparison to Table 2 values, items larger than 280 cc (0.01 ft³) may be treated individually. Items smaller than 280 cc (0.01 ft³) should be grouped together (see Section 3.3.2.2).

Figure 3. Classification of Mixtures of Discrete Items Within a Single Waste Type (from Section 3.3.2.2)

All remaining nuclides less than Factor of 10?

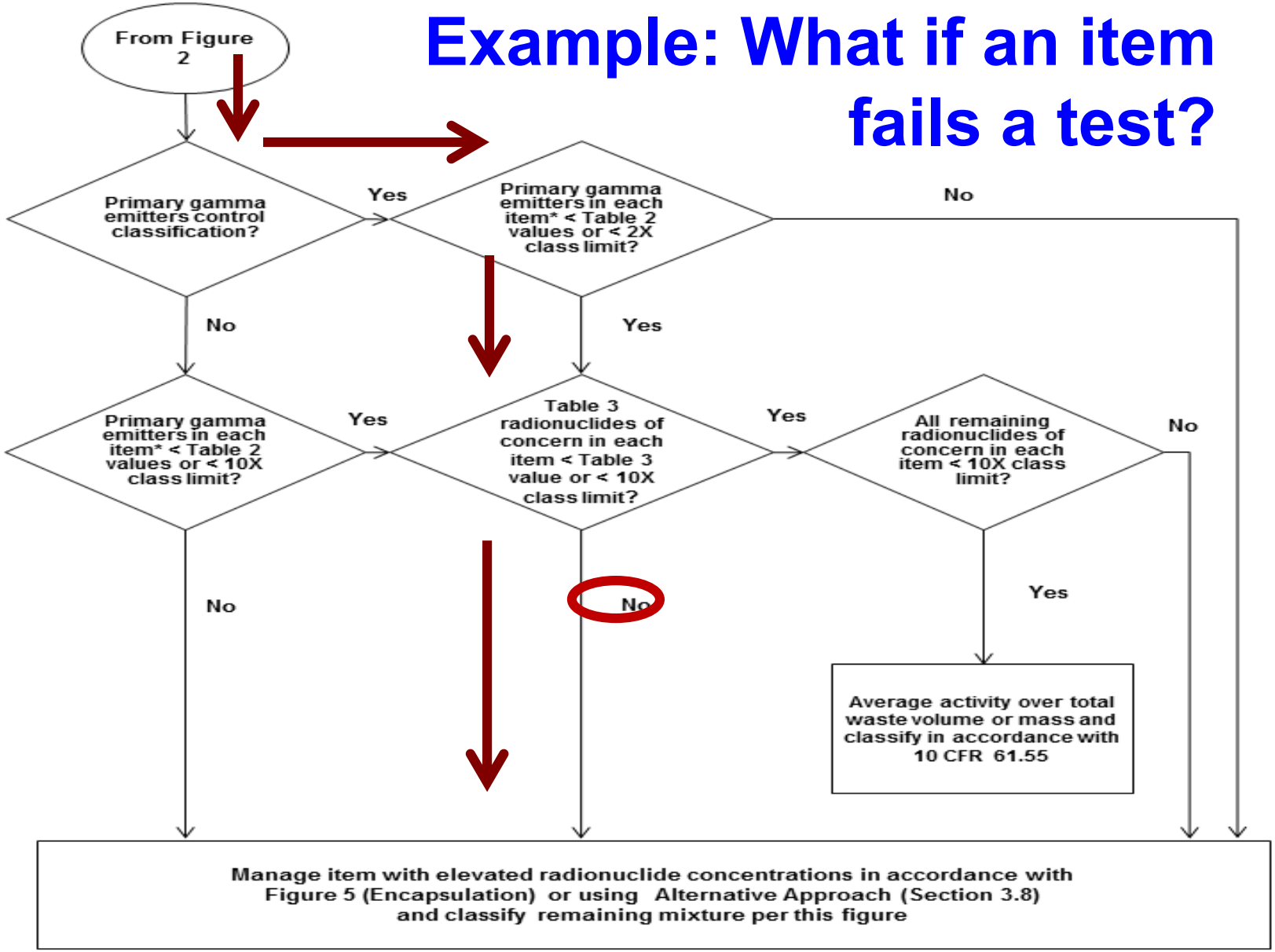
- **Determine nuclides in mixture that are in Tables 1 and 2 of Part 61, but which *are not* in Table 2 and Table 3 of BTP**
- **For all those remaining nuclides, *in each piece*, each must be less than Factor of 10 of the classification limit for the mixture**
- **If the classification of the mixture is Class B, and there are Table 1 long-lived nuclides, then apply Factor of 10 to Table 1 Class A limits, not Class C limits**



* For comparison to Table 2 values, items larger than 280 cc (0.01 ft³) may be treated individually. Items smaller than 280 cc (0.01 ft³) should be grouped together (see Section 3.3.2.2).

Figure 3. Classification of Mixtures of Discrete Items Within a Single Waste Type (from Section 3.3.2.2)

Example: What if an item fails a test?



* For comparison to Table 2 values, items larger than 280 cc (0.01 ft^3) may be treated individually. Items smaller than 280 cc (0.01 ft^3) should be grouped together (see Section 3.3.2.2).

Figure 3. Classification of Mixtures of Discrete Items Within a Single Waste Type (from Section 3.3.2.2)

Summary for Mixture of Discrete Items

- Applies to durable items that often have relatively high activities or concentrations (e.g., pieces of activated metal)
- Averaging positions for mixtures of discrete items are designed to allow flexibility (e.g., operator can chose the least restrictive of Table 2 or Factor of 2)
- However, this position may be the most complex of all averaging positions in BTP (unless one of the two simple screening options is used)
- Use the flowchart and BTP text and proceed one step at a time

Sample Problems

Ten pieces of activated metal are in a container. The contents will be classified as Class A , based on the sum of fractions using the total inventory, divided by total volume. The primary gammas control classification. One item exceeds the BTP's Table 2 limit for Co-60, but is less than 2X the Class A limit for Co-60 in that piece. All other primary gamma emitters in all other pieces are less than 2x the Class A limit. All remaining nuclides of concern, in each piece, are less than 10X the Class A limit. Is this a Class A waste?

i. **Yes**
ii. **No**

Sample Problems

Ten pieces of activated metal are in a container. The contents will be classified as Class A , based on the sum of fractions using the total inventory, divided by total volume. The primary gammas control classification. One item exceeds the BTP's Table 2 limit for Co-60, but is less than 2X the Class A limit for Co-60 in that piece. All other primary gamma emitters in all other pieces are less than 2x the Class A limit. All remaining nuclides of concern, in each piece, are less than 10X the Class A limit. Is this a Class A waste?

i. Yes
ii. No

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Alternative Treatment of Cartridge Filters

- Cartridge filters that do not contain significant amounts or concentrations of primary gamma emitters may be treated as blendable waste – with justification
- Such justification might include:
  - A history showing primary gamma emitters are less than Table 2 of BTP (activity limits for primary gamma emitters)
  - Concentrations of non-primary gamma emitters are not greater than Class C, and
  - The physical characteristics of the filter do not justify treating it as a discrete waste:
    - Filter is designed so radioactivity will not remain concentrated inside the filter during human intrusion
    - Filter medium is not metal and is expected to degrade before intrusion
- This justification should be available for inspection

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Sectioning

- Policy unchanged from 1995 BTP
- A component may be sectioned for operational considerations (e.g., packaging for transportation)
- Activities of the pieces may be averaged over the volume (or mass, as appropriate) of the original larger component, provided that:
  - The individual pieces are all in the same container, and
  - The activities of radionuclides are less than the Table 3 values and
  - The activities of all pieces smaller than 0.01 ft^3 are less than Table 2 values.

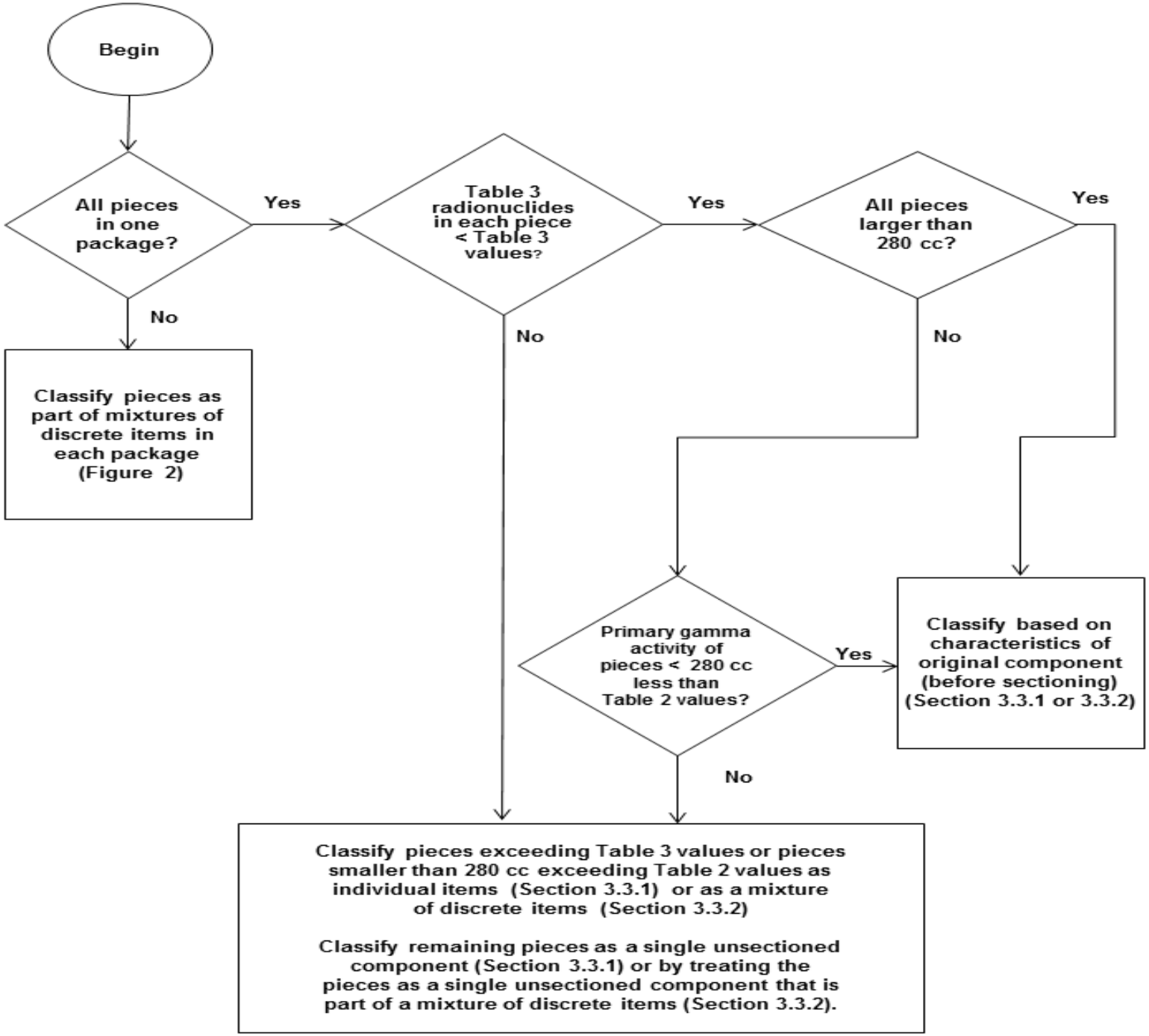


Figure 4. Classification of Sectioned Components (from Section 3.3.2.3)

Sectioning and Classifying Mixture of Discrete Items

- A sectioned item may be combined with other items in a single container
- For concentration averaging, the sectioned item is to be treated as if the item had not been sectioned
- For example:
  - A piece of activated metal is sectioned into 4 pieces, and all 4 pieces meet the Sectioning Criteria (so the item can be classified as if it had not been sectioned)
  - The sectioned 4 pieces are added to a liner, along with 8 other pieces of activated metal
  - When the "Mixture of Discrete Items" criteria are applied, the sectioned pieces is treated as one item (i.e., 9 items are evaluated, not 12 items)

Sample Problems

A 4-m long control rod blade is cut into four 1-m long sections to facilitate packaging for transportation for disposal. No piece is smaller than 0.01 ft^3. When the total activity of each nuclide in the four pieces is averaged over the total volume of the four pieces, the SOF meets the Class C limit. All items are to be shipped and disposed in the same waste container, and no item has an activity that exceeds BTP's Table 3 criteria. Is this acceptable?

i. Yes

ii. No

Sample Problems

A 4-m long control rod blade is cut into four 1-m long sections to facilitate packaging for transportation for disposal. No piece is smaller than 0.01 ft^3. When the total activity of each nuclide in the four pieces is averaged over the total volume of the four pieces, the SOF meets the Class C limit. All items are to be shipped and disposed in the same waste container, and no item has an activity that exceeds BTP's Table 3 criteria. Is this acceptable?

i. Yes

ii. No

Sample Problems

For the problem above (a 4-m long control rod blade cut into four 1-m long sections), the operator also wants to place eight additional pieces of activated metal into the container. When the total activity of each radionuclide in all 12 pieces is averaged over the total volume of the 12 pieces, using the SOF, the contents of the container meets the Class C limit. No item has an activity that exceeds BTP's Table 3 criteria. Is this acceptable?

i. **Yes, because the average meets Class C, all items are less than the BTP's Table 3, and all items are in the same container**

ii. **Possibly, but must demonstrate criteria for averaging a "Mixture of Discrete Items" is met**

iii. **No, individual pieces should not be mixed with an item that has been sectioned.**

Sample Problems

For the problem above (a 4-m long control rod blade cut into four 1-m long sections), the operator also wants to place eight additional pieces of activated metal into the container. When the total activity of each radionuclide in all 12 pieces is averaged over the total volume of the 12 pieces, using the SOF, the contents of the container meets the Class C limit. No item has an activity that exceeds BTP's Table 3 criteria. Is this acceptable?

i. **Yes, because the average meets Class C, all items are less than the BTP's Table 3, and all items are in the same container**

ii. **Possibly, but must demonstrate criteria for averaging a "Mixture of Discrete Items" is met**

iii. **No, individual pieces should not be mixed with an item that has been sectioned.**

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Encapsulation of Discrete Items

- The process of surrounding a radioactive sealed source, a collection of such sources, or other materials in a binding matrix within a container, where the activity remains within the dimensions of the original source(s) or other materials.
- Encapsulation may help meet stability criteria, provides shielding, limits migration
- When conditions defined in the CA BTP are met, credit can be taken for volume or mass of the binding matrix, when determining concentration of the final waste form
- CA BTP constraints are designed to limit the amount of non-radioactive material used in concentration averaging

Overview of Encapsulation of Discrete Items

- **Volumetric constraints are specific to encapsulation**
  - **1995 CA BTP provision preserved – any size item can be averaged over the volume of a 55 gallon drum (0.2 m^3). Activity limits for items changed in some cases in revised BTP (e.g., Cs-137)**
  - **2015 CA BTP also allows for larger volumes up to 9.5 m^3 (331 ft^3), if there is a 14% minimum waste loading**

- **Application of Tables 2 and 3 and the Factors of 2 and 10 are the same as for mixtures of discrete items**

Encapsulation of Discrete Items
Waste Loading Boundary

- **"Waste Loading" – (volume of waste / final volume) x 100**

- **14% waste loading boundary**
  - **< 14% waste loading – maximum volume *for averaging** is 0.2 m^3 or 500 kg (~ 55 gallons or 1,100 pounds)**
  - **> 14% waste loading – maximum volume 9.5 m^3 (331 ft^3)**

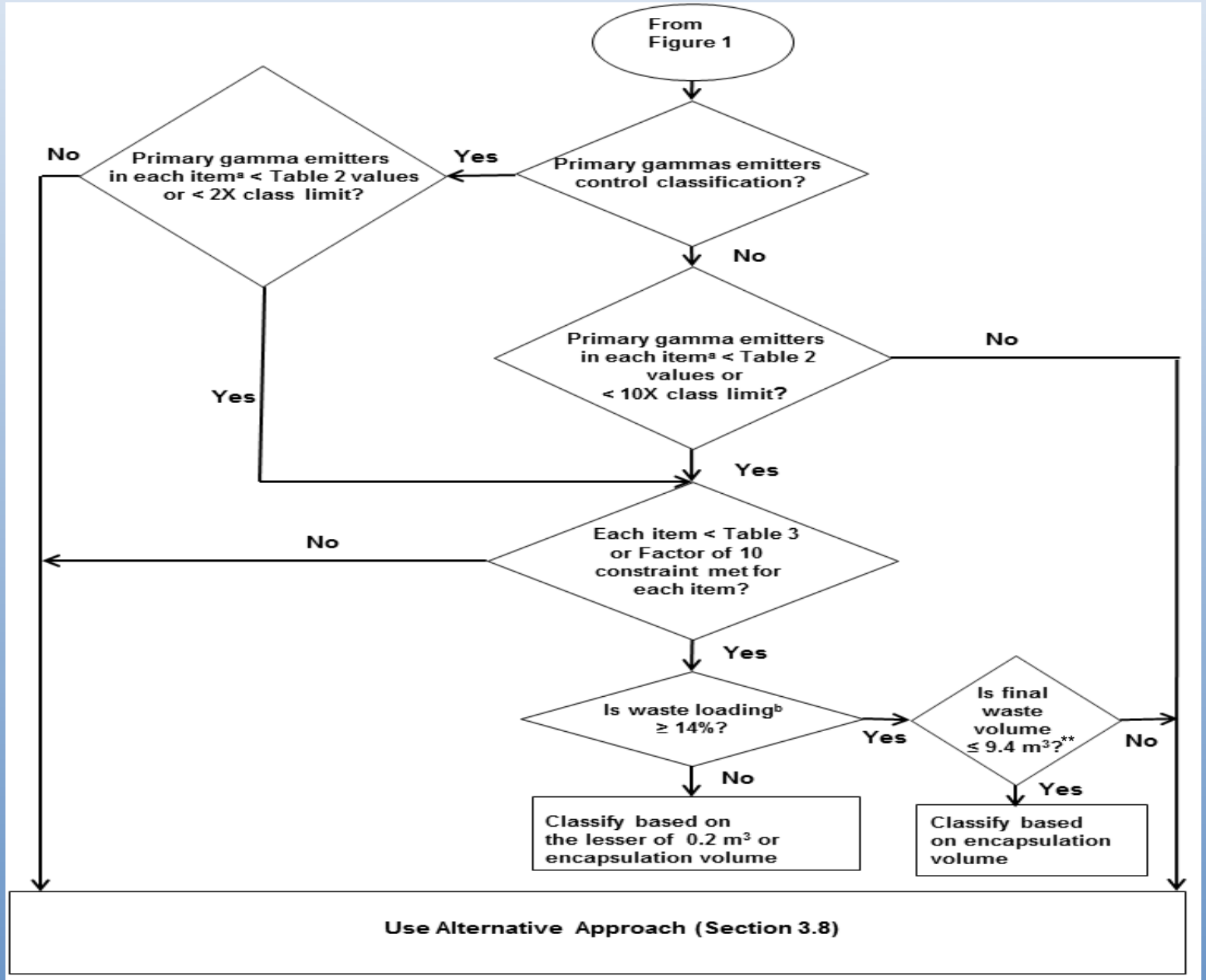
*** Larger encapsulation volumes can be used, but maximum credit is for 0.2 m^3**

Encapsulation of Discrete Items Additional Considerations

- **Multiple items may be encapsulated together, so long as the final encapsulated package meets the CA BTP criteria**

- **Total activity divided by final volume* (or mass) of encapsulated waste form cannot exceed the appropriate class limit (e.g., Class C)**

*** when waste loading is < 14%, maximum averaging volume is limited to 0.2 m^3, even if final waste form is larger**



[a] For comparison to Table 2 values, items larger than 280 cc (0.01 ft³) may be treated individually. Items smaller than 280 cc (0.01 ft³) should be grouped together (see Section 3.3.4)

[b] Waste loading = (vol waste / total vol) x 100

Fig. 5. Classification of Encapsulated Items

** This figure is reproduced from Figure 5 of the revised CA BTP, which incorrectly uses 9.4 m^3. The correct value is 9.5 m^3.

Sample Problems

Five Cesium-137 sealed sources are to be encapsulated by a stabilizing agent in a 200 L (55 gallon) drum* and disposed as Class C waste. The Cs-137 sources have activities of 13, 19, 28, 33, and 47 curies, and each source has a volume much smaller than 0.01 ft^3. The waste loading is < 14%. The activity of each source is well below the BTP's Table 2 limits for Cs-137 for Class C, and when the total curies are averaged over 200 L (55 gallons), the final waste form meets 61.55 Class C concentration limits. Is the final waste form acceptable for disposal as Class C waste?

i. Yes

ii. No

*activity on surface of drum could exceed 200 mrem/hr surface dose shipping criteria

Sample Problems

Five Cesium-137 sealed sources are to be encapsulated by a stabilizing agent in a 200 L (55 gallon) drum* and disposed as Class C waste. The Cs-137 sources have activities of 13, 19, 28, 33, and 47 curies, and each source has a volume much smaller than 0.01 ft^3. The waste loading is < 14%. The activity of each source is well below the BTP's Table 2 limits for Cs-137 for Class C, and when the total curies are averaged over 200 L (55 gallons), the final waste form meets 61.55 Class C concentration limits. Is the final waste form acceptable for disposal as Class C waste?

i. Yes

ii. No

*activity on surface of drum could exceed 200 mrem/hr surface dose shipping criteria

Sample Problems

Ten pieces of activated metal are in a 1 m^3 (35 ft^3) waste container. The total curies in the 10 pieces, divided by the summed volume of the 10 pieces, on a SOF basis, exceeds the Class C limit by 20%. There are no pieces < 0.01 ft^3, the classification is *not* controlled by the primary gamma emitters, and no item has nuclide concentrations that exceed the Factor of 10. Therefore, the waste processor would like to center the pieces and add a stabilizing agent to the container, encapsulating the pieces of metal and bringing the specific activity of the waste container below the Class C limits for disposal. The operator understands that the revised BTP allows averaging over encapsulated volumes of up to 331 ft^3 – if the waste loading is > 14% and in this case, the waste loading (volume of waste / final waste volume) is > 14%. Is this acceptable?

i. **Yes**
ii. **No**

Sample Problems

Ten pieces of activated metal are in a 1 m^3 (35 ft^3) waste container. The total curies in the 10 pieces, divided by the summed volume of the 10 pieces, on a SOF basis, exceeds the Class C limit by 20%. There are no pieces < 0.01 ft^3, the classification is *not* controlled by the primary gamma emitters, and no item has nuclide concentrations that exceed the Factor of 10. Therefore, the waste processor would like to center the pieces and add a stabilizing agent to the container, encapsulating the pieces of metal and bringing the specific activity of the waste container below the Class C limits for disposal. The operator understands that the revised BTP allows averaging over encapsulated volumes of up to 331 ft^3 – if the waste loading is > 14% and in this case, the waste loading (volume of waste / final waste volume) is > 14%. Is this acceptable?

i. Yes
ii. No

Sample Problems

An experimental irradiator was recovered from a university and it contains a Co-60 sealed source that is a cylinder, 1 cm (0.39 in.) tall and 1 cm (0.39 in.) in diameter (i.e., volume < 0.01 ft^3). The irradiator is old and the strength of the source has decayed to 5 Ci. The 61.55 Class A limit for Co-60 is 700 Ci/m^3. Does this 5 Ci source qualify for disposal as Class A waste?

i. Yes

ii. No, because this 5 Ci source has a specific activity of 5,000,000 Ci/m^3

Sample Problems

An experimental irradiator was recovered from a university and it contains a Co-60 sealed source that is a cylinder, 1 cm (0.39 in.) tall and 1 cm (0.39 in.) in diameter (i.e., volume < 0.01 ft^3). The irradiator is old and the strength of the source has decayed to 5 Ci. The 61.55 Class A limit for Co-60 is 700 Ci/m^3. Does this 5 Ci source qualify for disposal as Class A waste?

i. Yes

ii. No, because this 5 Ci source has a specific activity of 5,000,000 Ci/m^3

Sample Problems

If the Co-60 source described in the previous problem is encapsulated by a stabilizing agent in a 200 L (55 gallon) drum, the waste loading is < 14%. The Co-60 source has a volume < 0.01 ft^3. The activity of the source is below the BTP's Table 2 limits for Co-60 for Class A, and when the total curies are averaged over 200 L (55 gallons), the final waste form meets Class A concentration limits. Is this acceptable for disposal as Class A waste?

i. Yes

ii. No

Sample Problems

If the Co-60 source described in the previous problem is encapsulated by a stabilizing agent in a 200 L (55 gallon) drum, the waste loading is < 14%. The Co-60 source has a volume < 0.01 ft^3. The activity of the source is below the BTP's Table 2 limits for Co-60 for Class A, and when the total curies are averaged over 200 L (55 gallons), the final waste form meets Class A concentration limits. Is this acceptable for disposal as Class A waste?

i. Yes

ii. No

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Mixture of Different Waste Types

- Addressed averaging of blendable wastes
- Addressed averaging of mixture of discrete items
- Now address averaging of different waste types

Mixture of Different Waste Types

- When mixing different blendable waste types (e.g., ion-exchange resins with soils or mixing ion-exchange resins with cartridge filters), the licensee should document the physical and chemical compatibility of the waste types and make the documentation available for inspection

- When mixing discrete items of different waste types (e.g., sealed sources with pieces of activated metal), the classification of the entire mixture of waste types should be the highest classification of any of the individual waste type(s) in the mixture

- If discrete items are mixed with blendable wastes, the averaging constraints in Section 3.3 should be applied to the discrete items, and physical and chemical compatibility must be demonstrated

Sample Problems

A waste container is full and contains spent ion exchange resins (IERs) and a discrete item (a piece of activated metal). When the total curies inside the waste container are divided by the total volume of the waste container, the contents of the container, on a SOF basis, would be Class A. However, the piece of activated metal by itself would be classified as Class C. The spent IERs and the piece of activated metal are chemically compatible. Can this discrete item (the piece of activated metal) be disposed in the same waste container as the blendable waste (the spent IERs)?

i. Yes

ii. No

Sample Problems

A waste container is full and contains spent ion exchange resins (IERs) and a discrete item (a piece of activated metal). When the total curies inside the waste container are divided by the total volume of the waste container, the contents of the container, on a SOF basis, would be Class A. However, the piece of activated metal by itself would be classified as Class C. The spent IERs and the piece of activated metal are chemically compatible. Can this discrete item (the piece of activated metal) be disposed in the same waste container as the blendable waste (the spent IERs)?

i. Yes

ii. No

Sample Problems

A waste container is full and contains spent ion exchange resins and a discrete item (a piece of activated metal). When the total curies inside the waste container are divided by the total volume of the container, the contents of the waste container, on a SOFs basis, would be classified as Class A waste. However, the piece of activated metal by itself will be classified as Class C. How must the waste container be classified for disposal?

i. The spent IERs and the piece of activated metal cannot be disposed in the same container

ii. Class A

iii. Class C

Sample Problems

A waste container is full and contains spent ion exchange resins and a discrete item (a piece of activated metal). When the total curies inside the waste container are divided by the total volume of the container, the contents of the waste container, on a SOFs basis, would be classified as Class A waste. However, the piece of activated metal by itself will be classified as Class C. How must the waste container be classified for disposal?

i. The spent IERs and the piece of activated metal cannot be disposed in the same container

ii. Class A

iii. Class C

Topics

Part II Detailed description of 2015 positions

- Waste Types and Waste Streams
- Blendable waste and discrete items
- Blendable waste
  - Single blendable waste stream
  - Mixture of blendable waste streams of same waste type
  - Solidified Wastes
- Discrete items
  - Single item
  - Mixture of discrete items
  - Alternative treatment of filters
  - Sectioning
  - Encapsulation
- Mixture of different waste types
- Alternative Approaches
- Wrap up

Alternative Approaches

- **Like 1995 BTP, the 2015 revision identifies uniform "look up" guidance that is applicable to all disposal sites and waste types**
- **New Alternative Approaches section provides Licensees / Agreement States with specific NRC guidance on factors to consider in submitting/reviewing site- and waste-specific averaging methods**
- **CA BTP "strongly urges" licensees to submit proposals to regulator**
  - **Note that proposal is to be submitted to *disposal facility* regulator**
  - **CA BTP notes that detailed discussions of proposal would help to ensure that enforcement actions or return of wastes to the shipper will not be necessary**

Alternative Approaches, Section 3.8

- 3.8.1 Site Specific Intruder Assessments
- 3.8.2 Encapsulation of Discrete Items, Including Sealed Sources
- 3.8.3 Likelihood of Intrusion
- 3.8.4 Large Components
- 3.8.5 Time of Intrusion into Blendable Waste
- 3.8.6 Legacy Wastes

Example—Alternative Approach

- **A disposal facility licensee wants to accept an 800 Ci Cs-137 sealed source encapsulated in a 0.2 m^3 (55 gallon) drum for Class C disposal**
  - **When averaged over 0.2 m^3, 800 Ci Cs-137 meets the Class C limit, so no exception from Part 61 is needed**
  - **However, the CA BTP recommends a 130 Ci limit for Cs-137 in 0.2 m^3**
  - **Licensee would propose disposal of larger source to disposal facility regulator, addressing relevant considerations in Section 3.8.2, "Encapsulation of Discrete Items, Including Sealed Sources"**
  - **Primary consideration is whether there is reasonable assurance of compliance with the inadvertent intruder performance objective in 10 CFR 61.42**

Alternative Requirements and Alternative Approaches

- **Revised CA BTP clarifies use of 10 CFR 61.58, "Alternative Requirements for Waste Classification and Characteristics"**
  - **1995 CA BTP stated that licensees must obtain approval under 10 CFR 61.58 to deviate from positions in BTP**
  - **However, 10 CFR 61.58 is designed for deviations from *regulations for waste classification*, not *averaging guidance***
  - **2015 CA BTP discusses use of 10 CFR 61.58 in the context of deviations from disposal regulations**
  - **A new section, "Alternative Approaches for Averaging," discusses deviations from generic averaging positions in CA BTP**

Summary

- CA BTP covers averaging of radionuclide concentrations in waste for the purpose of classifying it in accordance with 10 CFR Part 61
- Guidance has been extensively revised and is expected to be widely used by industry
- Revised positions will affect reactor licensee waste management practices. Materials licensees, with the exception of waste processors, may be less impacted by revised guidance
- The BTP divides wastes into two broad categories, blendable wastes and discrete items
- Some of the averaging constraints for discrete items are complex: Use the flowchart and BTP text and proceed one step at a time
- NMSS staff is conducting training of NRC and Agreement State inspection staff to facilitate implementation

For Additional Information contact:

Maurice Heath

Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission,
Washington, DC 20555–0001
telephone: 301–415–3137
email: *Maurice.Heath@nrc.gov*

CA BTP Volume 1 – ADAMS ML12254B065

CA BTP Volume 2 – ADAMS ML12326A611

More information on the CA BTP can be found at
http://www.nrc.gov/waste/llw-disposal/llw-pa/llw-btp.html

Thank You