Blending of Low-Level Radioactive Waste

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Presentation to U.S. Nuclear Regulatory Commission
December 15, 2009

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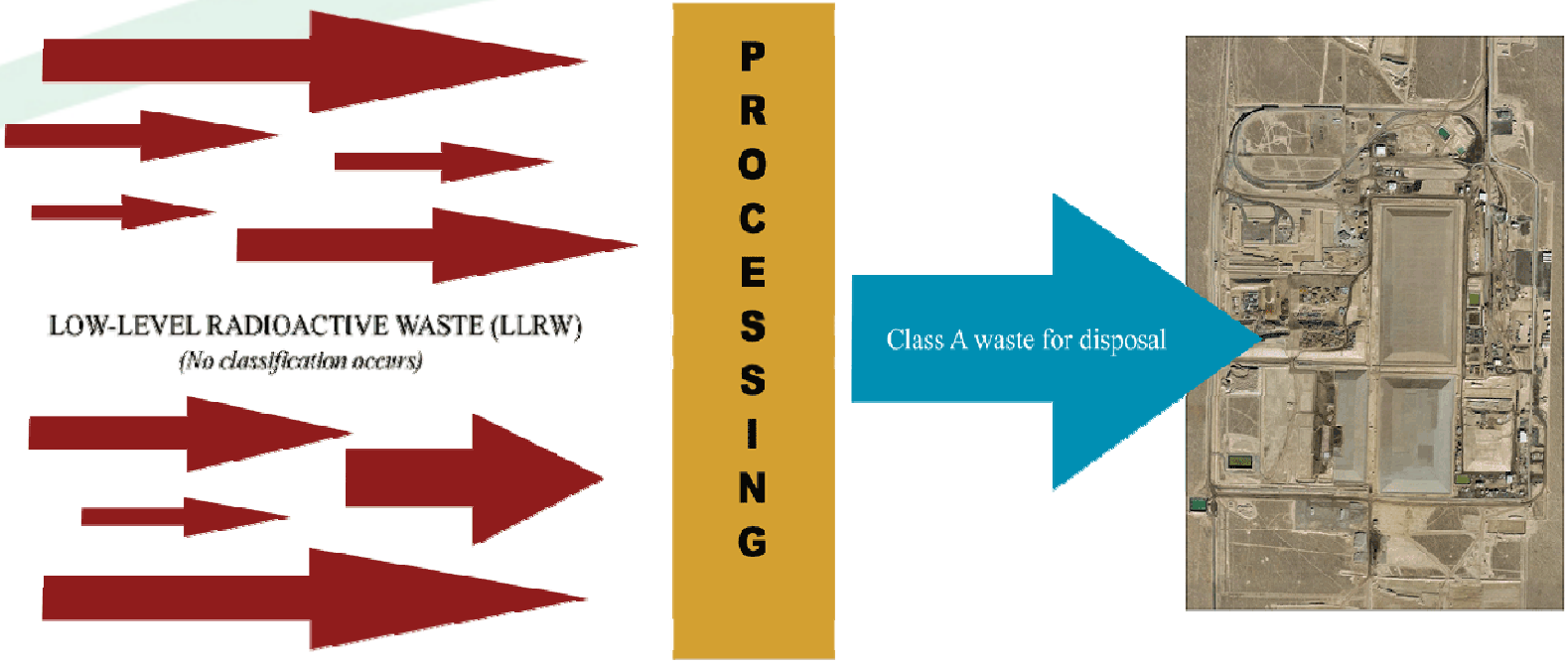
Agenda

- Introduction
- Blending
- *Federal Register* Questions
- Resin*Solutions*
- Q&A

What is important?

- Protecting
  - Public Health & Safety
  - Worker Health & Safety
  - Environment
- Satisfy Performance Objectives of Subpart C
- Evaluating blending in the proper context
- Optimizing management of LLW

Blending

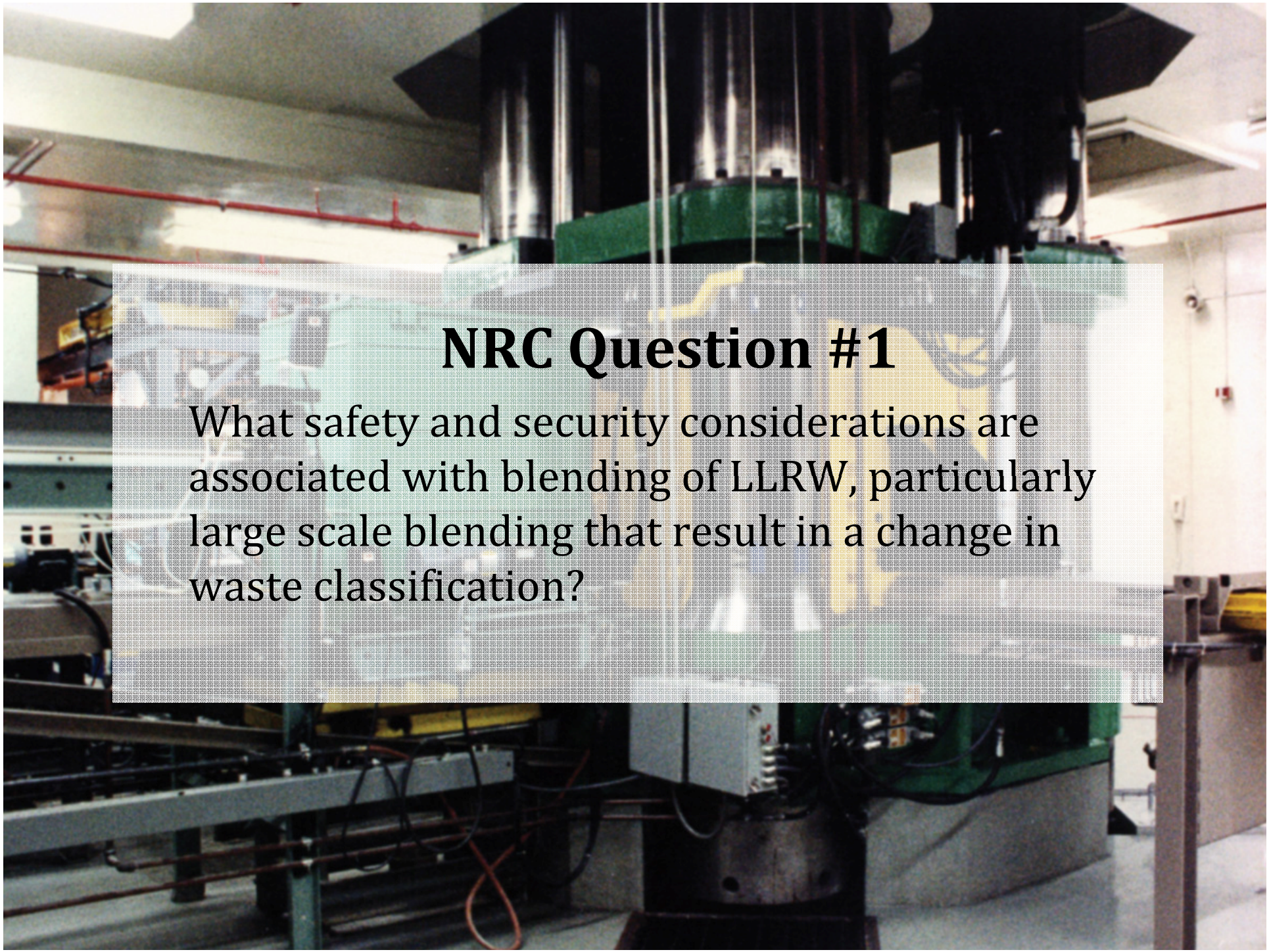

LOW-LEVEL RADIOACTIVE WASTE (LLRW)
(No classification occurs)
PROCESSING
Class A waste for disposal

Why blend?

- Important element of waste management strategy
- Dose reduction (ALARA)
- Improve operational efficiency
- Provide disposal pathway options
- Optimize life cycle cost
- Address lack of disposal for B/C waste
- Reduce interim storage of LLW

Chairman Direction

- Issues related to intentional changes in waste classification
  - Safety
  - Security
  - Policy
- Protection of the public, intruder, environment
- Mathematical concentration averaging
- Homogeneous physical mixing
- Practical considerations in operating a waste treatment or disposal facility
- Recommendations for revisions to current regulations or guidance

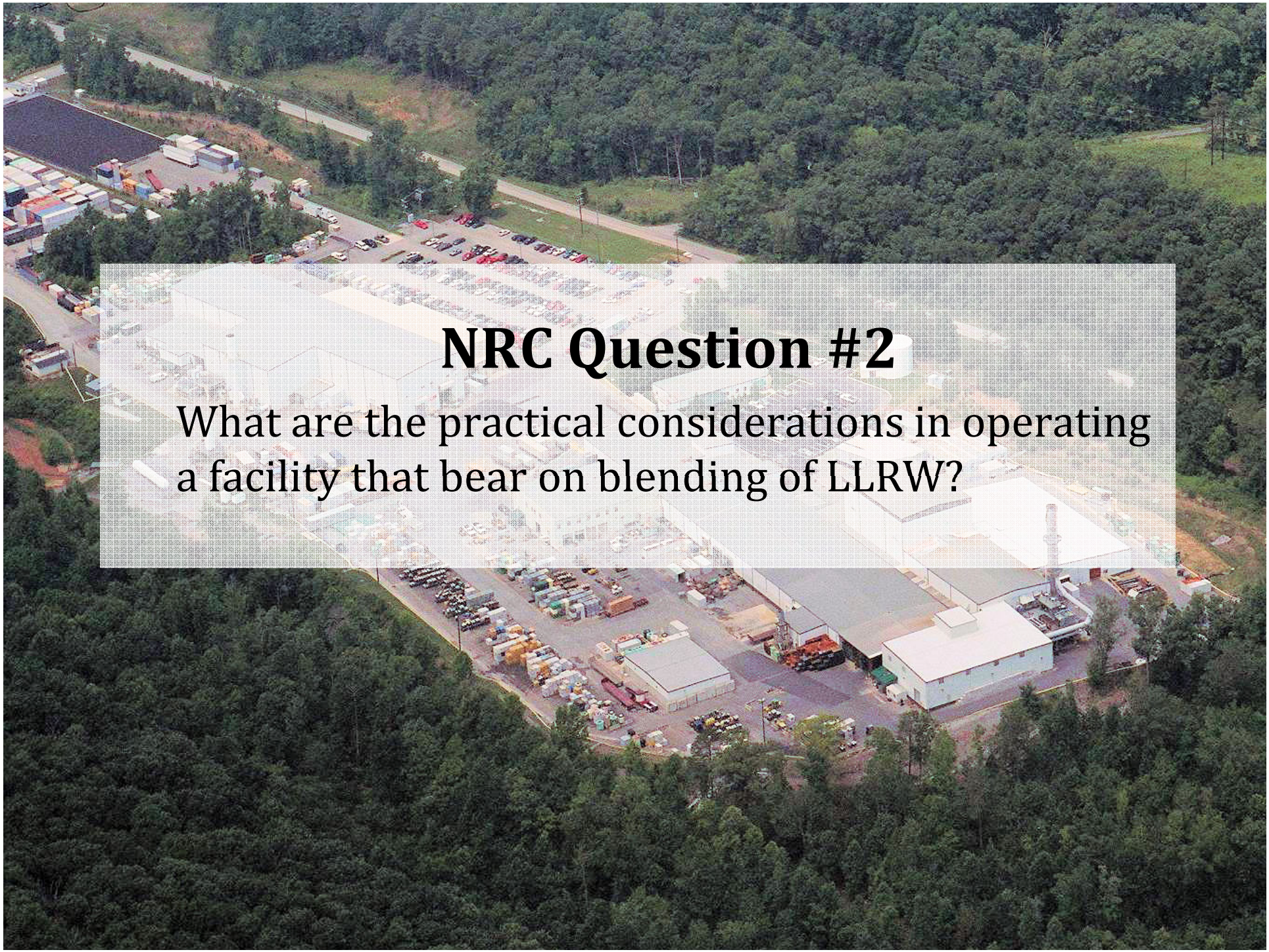


NRC Question #1

What safety and security considerations are associated with blending of LLRW, particularly large scale blending that result in a change in waste classification?

Safety & Security

- Blending does not result in classification change
- Concentration and quantity of waste
  - When generated not relevant
  - Only relevant for disposal
  - Comply with Part 61 performance objectives
- Requires additional controls
  - Occupational exposure
- Enhances safety by reducing onsite storage
  - Reduced exposure
- Ensures prompt disposal and final disposition

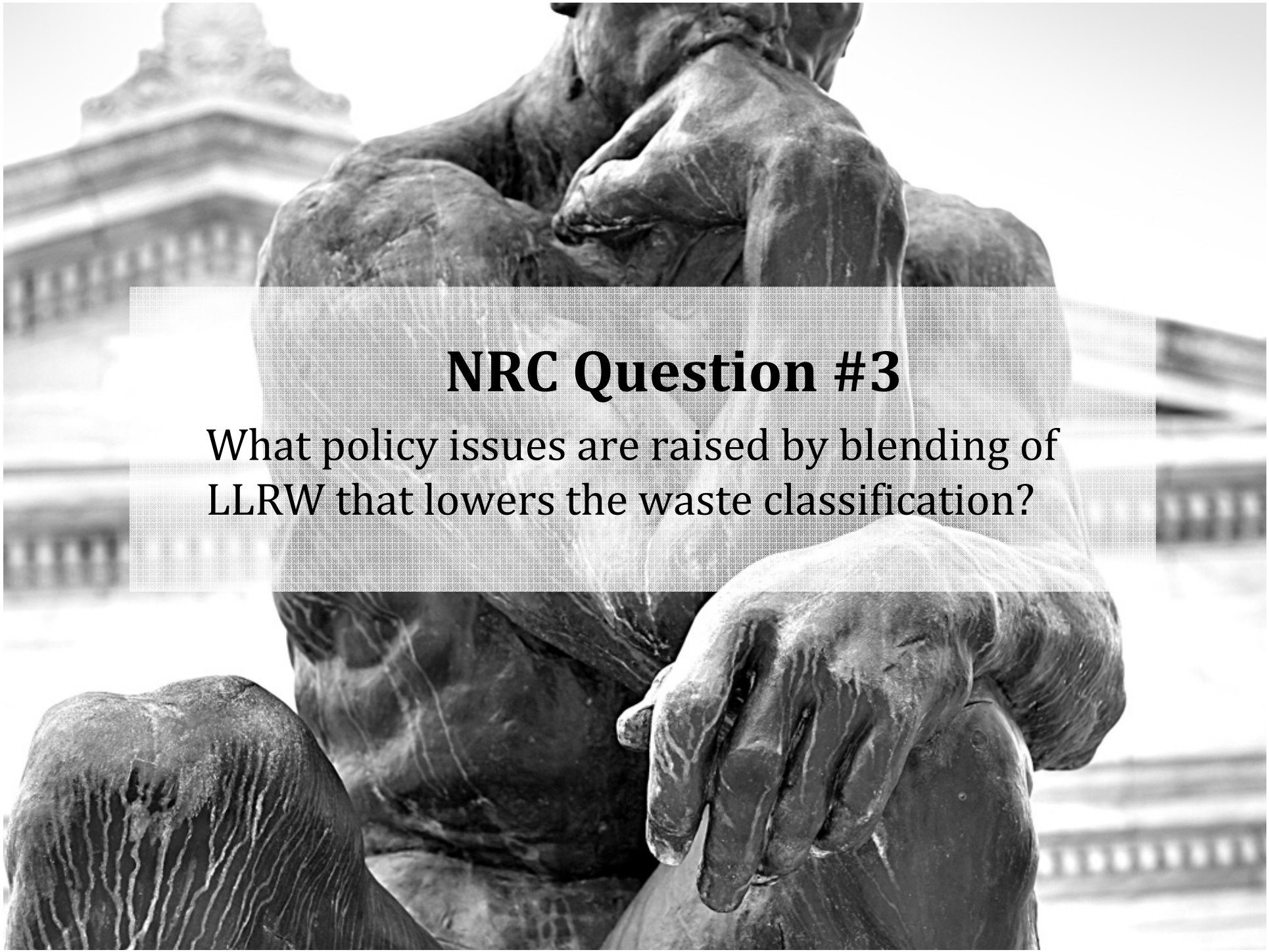


NRC Question #2

What are the practical considerations in operating a facility that bear on blending of LLRW?

Practical Considerations

- Health and Safety
  - Occupational safety
  - Occupational exposure
- Operational
  - Available input stream
  - Processed waste form homogeneity
  - Mixture validation and classification
- Financial
  - Capital Investment
  - Willing customers



NRC Question #3

What policy issues are raised by blending of LLRW that lowers the waste classification?

Contrary to some misperceptions and misrepresentations, blending…

- Is consistent with the 1981 Volume Reduction Policy Statement
- Presents no new disposal capacity problems
- Contributes to solving the B/C disposal problem
- Provides true dose savings and improved plant efficiencies
- Is consistent with the existing waste classification system
- Is *not* dilution, i.e., mixing with clean material
- Does not result in LLRW being diverted to industrial landfills

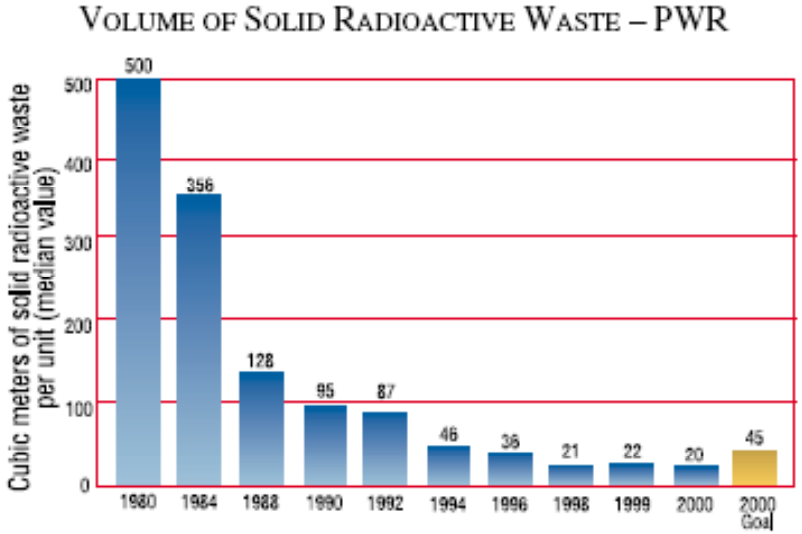
Dose Savings and Efficiencies

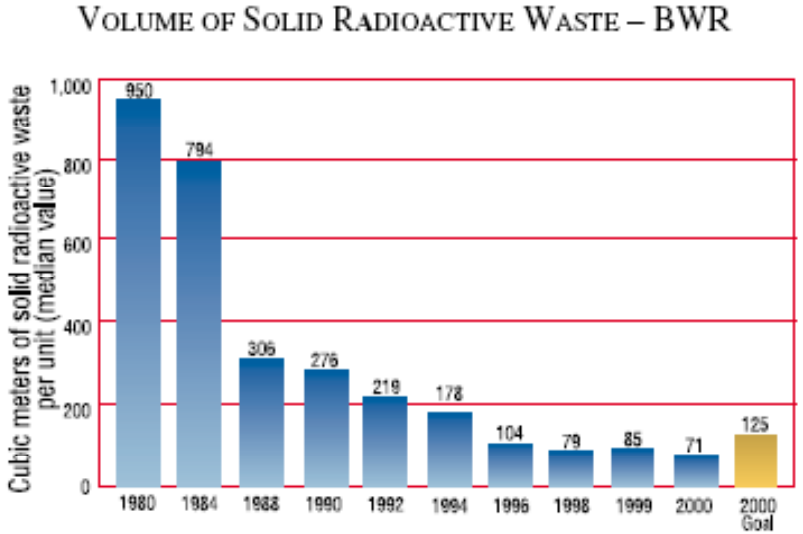
- Indefinite storage results in increased dose
  - Increased routine surveillance surveys and package inspections
- Extended storage requires
  - Detailed container inspection prior to eventual shipment
  - For resins, verification of water content and hydrogen generation following extended storage
- Dose savings less at a plant with remote handling capability
- Shipment to offsite processor provides dose savings over shipment directly to disposal
- Energy*Solutions* processing facilities designed to manage occupational dose
- All of these also result in improved plant efficiencies and cost savings

Blending is not dilution

- Current NRC guidance
  - Dilution is the mixing of waste with clean material
  - Blending is the mixing of waste with waste
- All material blended is destined for disposal
  - No increase in volume disposed
  - Disposing of blended waste results in no decrease in health and safety
  - Provides better protection for unintended intruder
- Maintains maximum regulatory control
  - Disposal only in site licensed for radioactive material

Volume Reduction

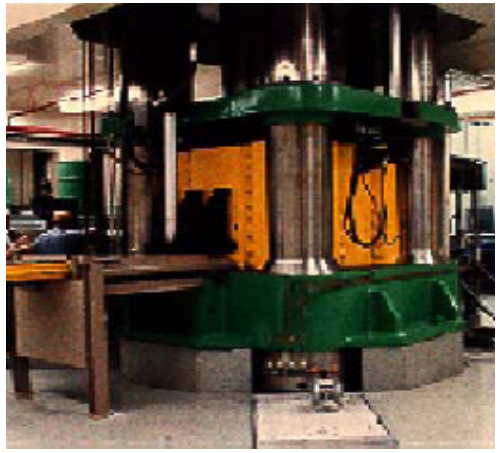




Ref: Statistics show US nuclear plans always improving, *Nuclear News*, May 2001

Volume Reduction

- Bear Creek
  - Leading volume reduction facility in U.S.
    - Incineration
    - Compaction
    - Metal Melt
  - Received Volume – 15,000,000 ft^3
  - Volume after Processing – 2,700,000 ft^3



All data for 6-year period, 2004-2009

VR Historical Averages

- Compaction – 10:1
- Resins/Dewatering – 4:1
- Incineration – 180:1
- Metal Melt – 25:1
  - Metal melt more properly thought of as recycling

All data averaged over 4-year period, 2006-2009

Volume Reduction

- 1981 Policy Statement

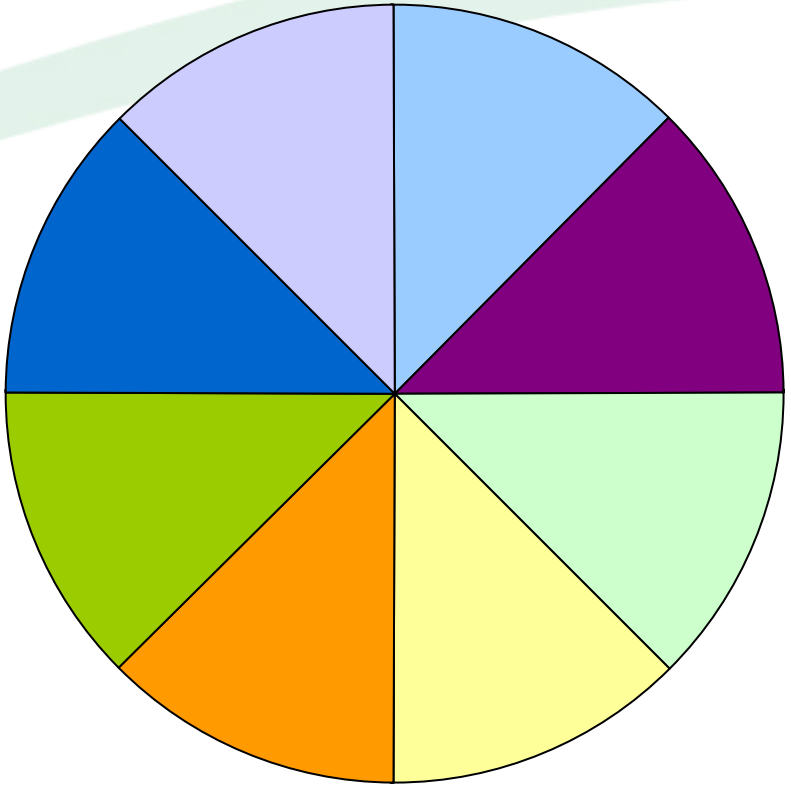
  "The Commission hereby adopts a policy calling on all generators of low-level radioactive waste to reduce the volume of waste for disposal."

  – Policy has worked
  – Improvements in waste reduction have been dramatic
  – Industry has reached point of diminishing returns
- Volume reduction at nuclear power plants
  – Incinerators – None
  – Evaporators – Few plants
  – Fluid bed dryers – None
  – Compactors – None

Volume Reduction

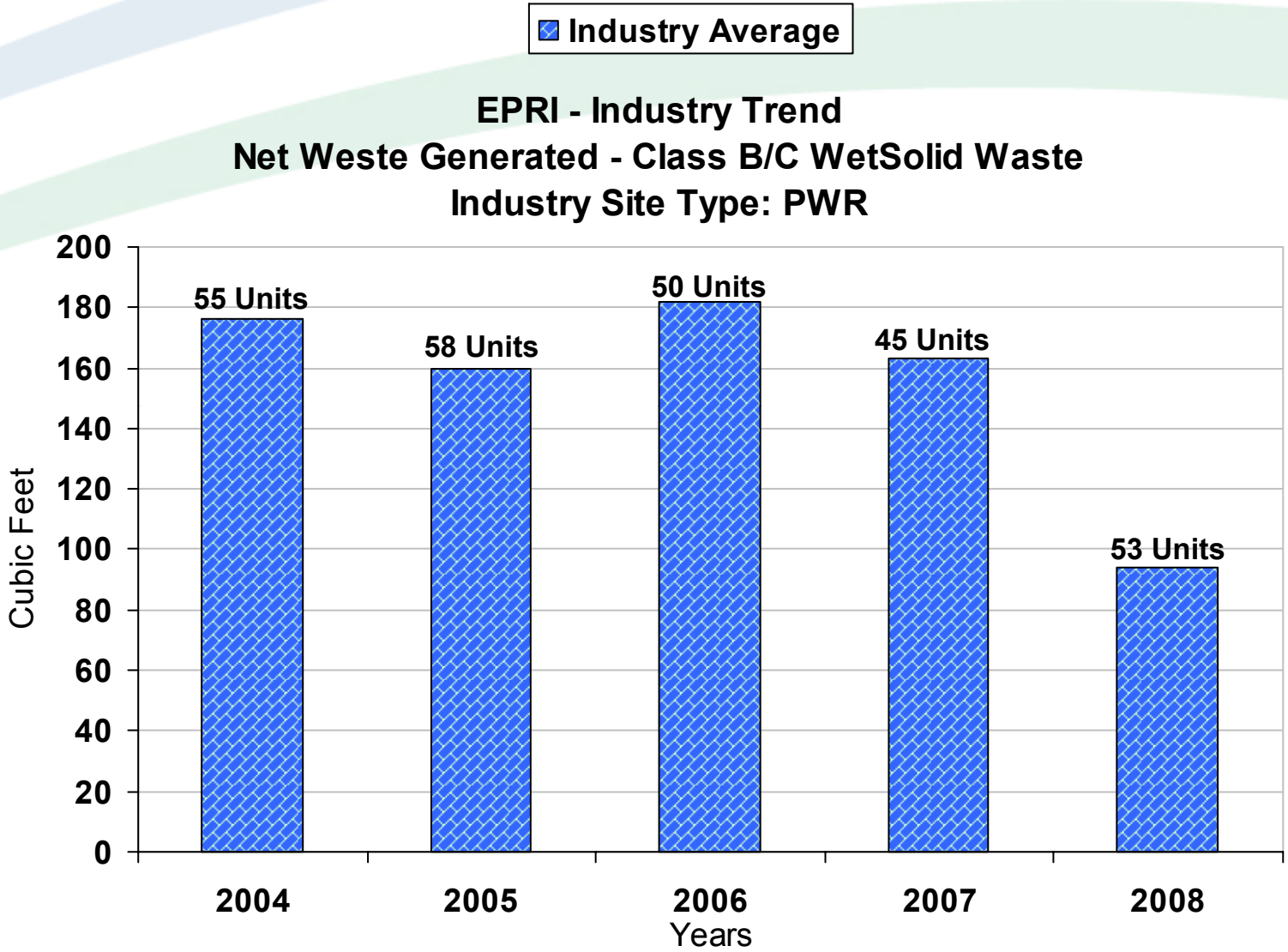
- Volume reduction done by off-site processors
- Blending consistent with Policy Statement
  - Does not increase overall volume of LLW
  - *Decreases* volume of B/C LLW
  - All inputs to process are radioactive waste requiring disposal
- Volume reduction – one element of waste management strategy

Waste Management Strategy



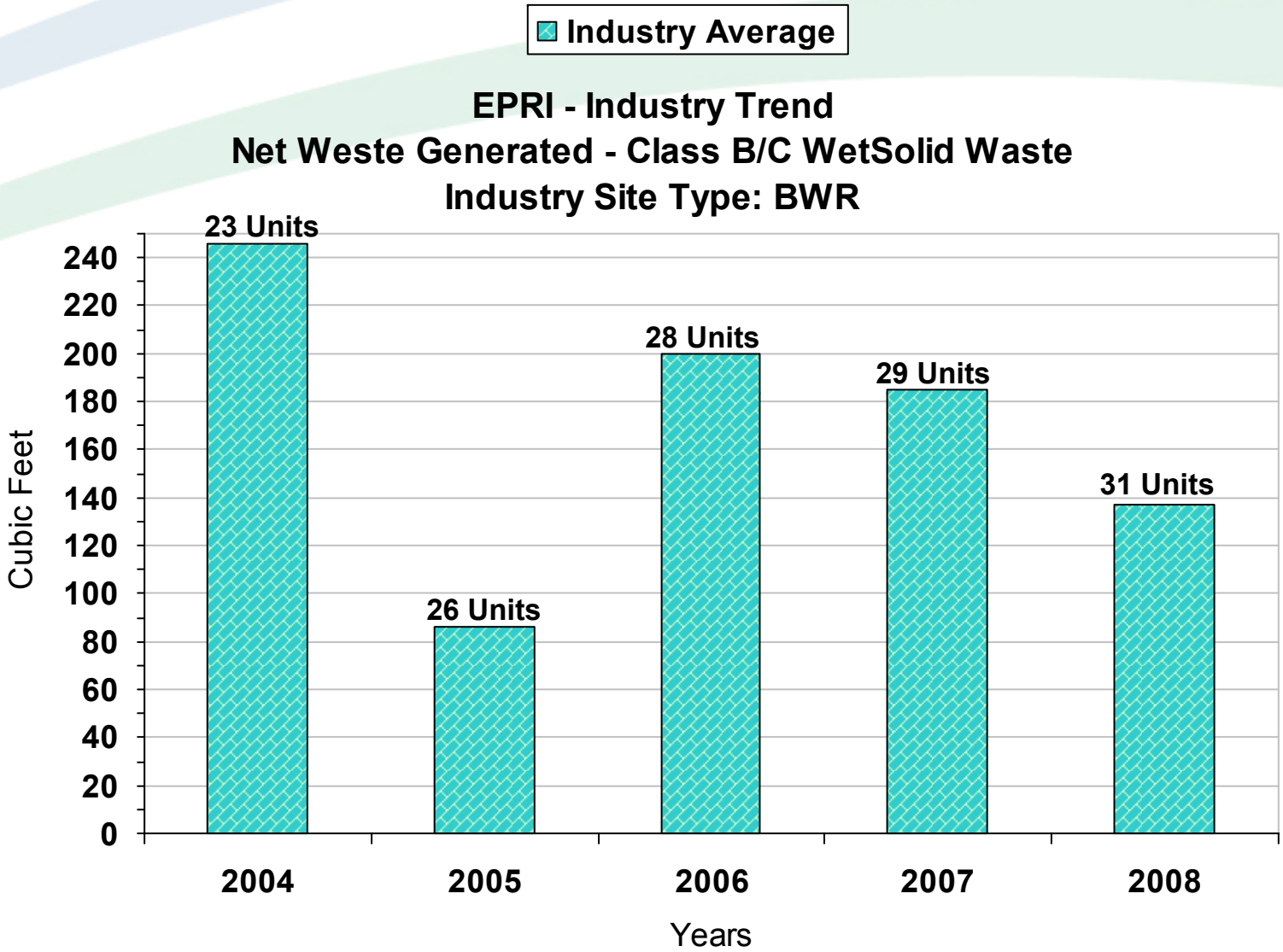
- Volume Reduction
- On-site Storage
- Dose Reduction
- B/C LLW Management
- Cost Reduction
- Waste Minimization
- Long-term Liability
- Processing

Class B/C Waste Generated – PWR



Used with permission, Electric Power Research Institute, September 2009

Class B/C Waste Generated – BWR



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Disposal Capacity

• Clive	484,656,000 ft^3
• Barnwell	1,000,000 ft^3
• U.S. Ecology	37,958,000 ft^3
• WCS	2,310,000 ft^3
• Total	525,924,000 ft^3

• Total power plant LLW – life cycle	107,000,000 ft^3

Waste Volumes – Resin

- Resin waste across the industry
  - Class A resin generated – 65,000 ft^3/yr
  - Class B/C resin generated – 18,000 ft^3/yr
- Resin disposed by Energy*Solutions*
  - Class A resin disposed at Clive – 18,700 ft^3/yr
  - Class A resin disposed at Barnwell – 4,500 ft^3/yr[1]
  - Class B/C resin disposed at Barnwell – <3,000 ft^3/yr[1]
- Additional Class A resin disposed after blending – 8,000 ft^3/yr[2]
- Resin waste projections – blending scenario
  - Class A – 73,000 ft^3/yr
  - Class B/C – 5,000 ft^3/yr[2]

[1]Atlantic Compact only (after closure to out-of-compact waste)

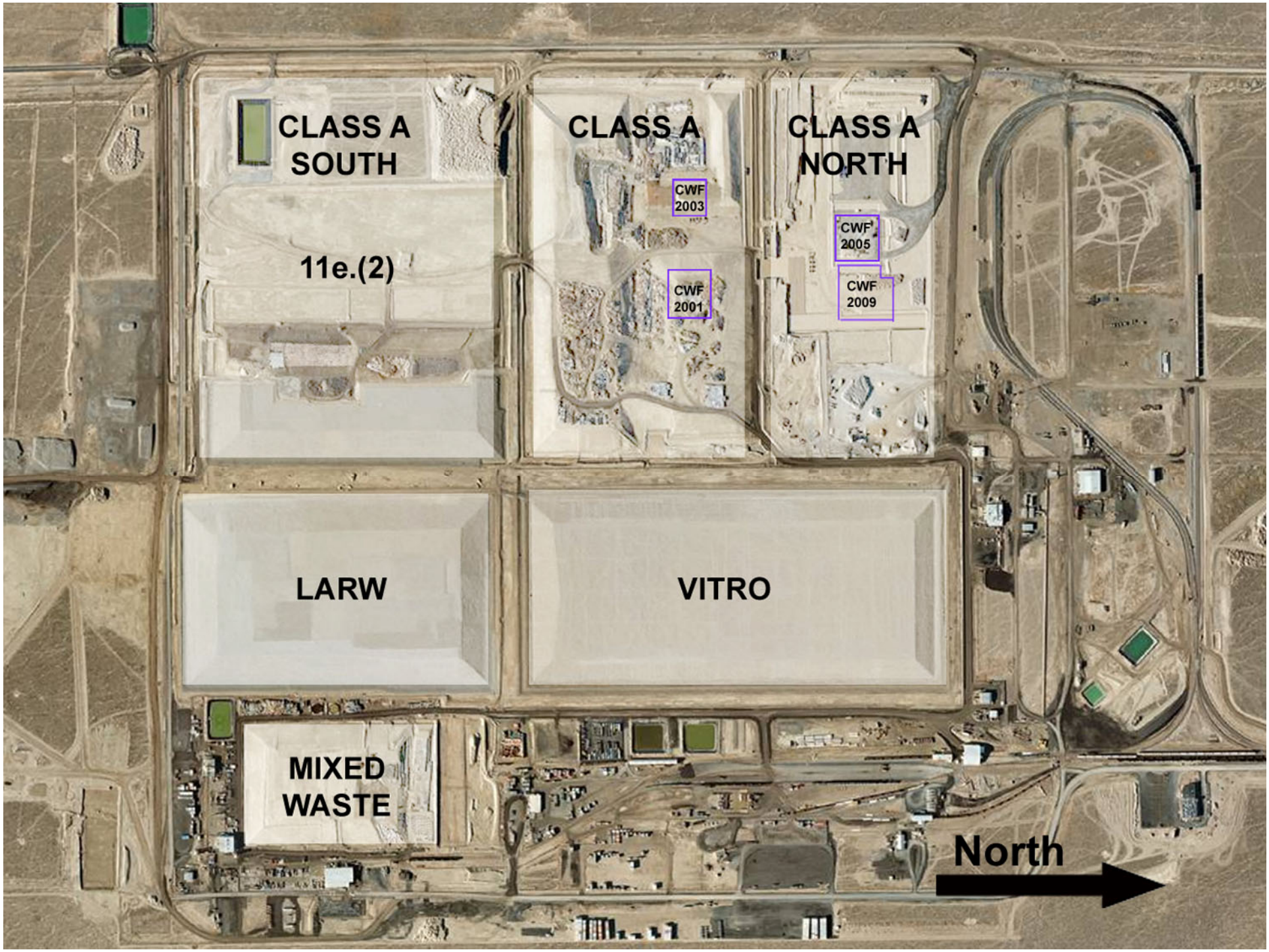
[2]*EPRI takes on Low-Level Waste Disposal Issues*, P. Tran and D. James, Radwaste Solutions, May/June 2008.

Resin Disposal Cases

- Current rate
  - Continue to dispose of Class A resin at historic rate
  - 18,700 ft^3/yr
- All Class A
  - Dispose of all Class A resin produced
  - 65,000 ft^3/yr
- Blended Case 1
  - Dispose of manageable B/C resins (8,000 ft^3/yr)
  - Blend with minimum Class A (38,000 ft^3/yr)
  - 46,000 ft^3/yr
- Blended Case 2
  - Dispose of manageable B/C resins (8,000 ft^3/yr)
  - Blend with all Class A produced (65,000 ft^3/yr)
  - 73,000 ft^3/yr

Resin Disposal Options

- CWF No. 1 – Closed
- CWF No. 2 – Closed
- CWF No. 3 – Currently operating
- CWF No. 4 – Approved November 24, 2009
- Class A North
- Class A South
- Bulk Waste Facility


CLASS A
SOUTH
11e.(2)
CLASS A
CWF
2003
CWF
2001
CLASS A
NORTH
CWF
2005
CWF
2009
LARW
VITRO
MIXED
WASTE
North

Remaining Clive Capacity (yrs)

	Current Rate	All Class A	Blended Case 1	Blended Case 2
CWF #3	**12**	**4**	**5**	**3**
CWF #4	**21**	**6**	**8**	**5**
Class A North	**94**	**27**	**38**	**24**
Class A South	**365**	**105**	**148**	**94**

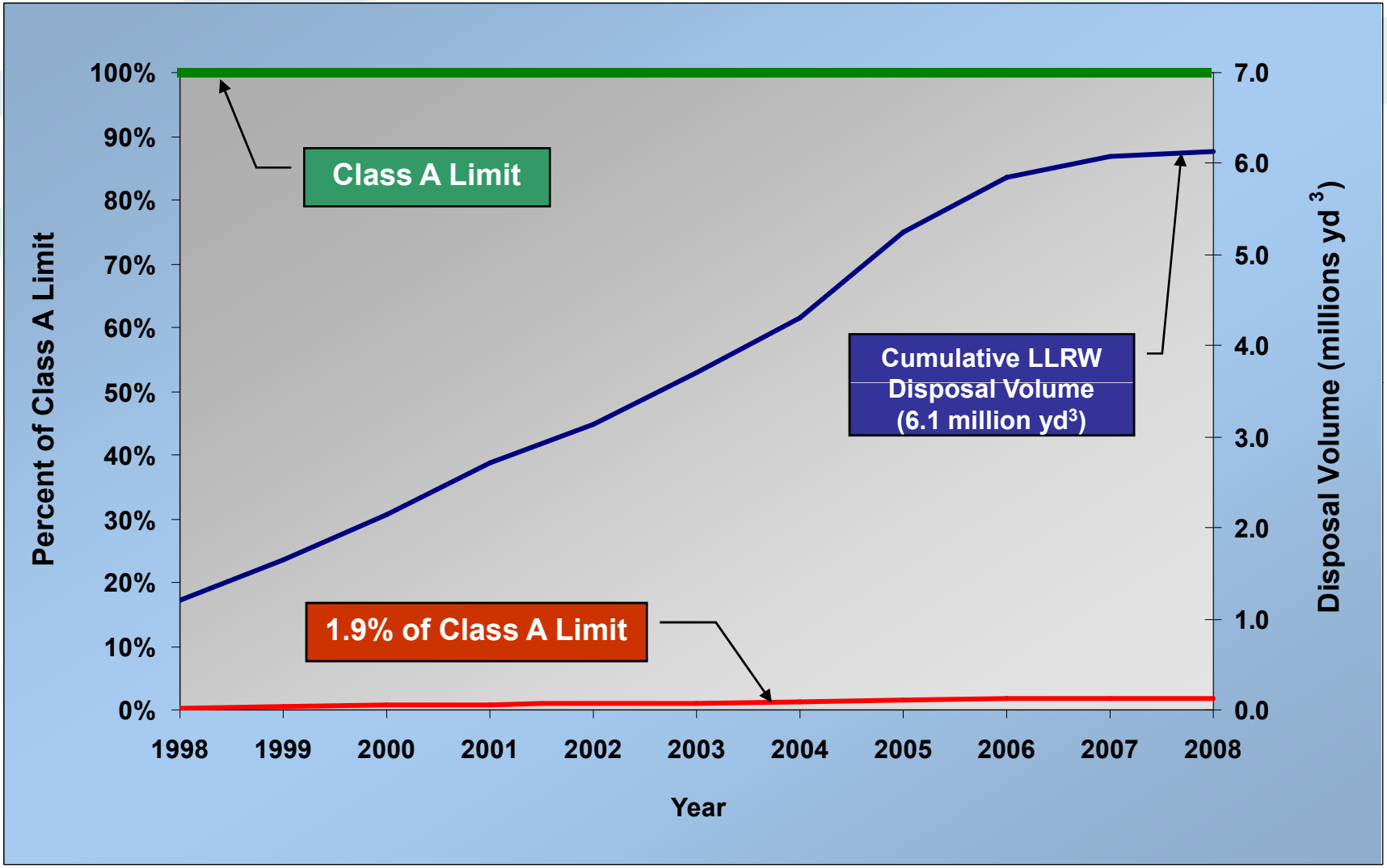
Capacity in years
Current Rate – 18,700 ft^3/yr
All Class A – 65,000 ft^3/yr
Blended Case 1 – 46,000 ft^3/yr
Blended Case 2 – 73,000 ft^3/yr

Remaining Clive Capacity (yrs)

	Current Rate	All Class A	Blended Case 1	Blended Case 2
CWF #3	12	4	5	3
CWF #4	21	6	8	5
Class A North	94	27	38	24
Class A South	365	105	148	94
Optimized Case	**94**	**27**	**38**	**24**

Capacity in years
Current Rate – 18,700 ft^3/yr
All Class A – 65,000 ft^3/yr
Blended Case 1 – 46,000 ft^3/yr
Blended Case 2 – 73,000 ft^3/yr

Clive Activity Loading



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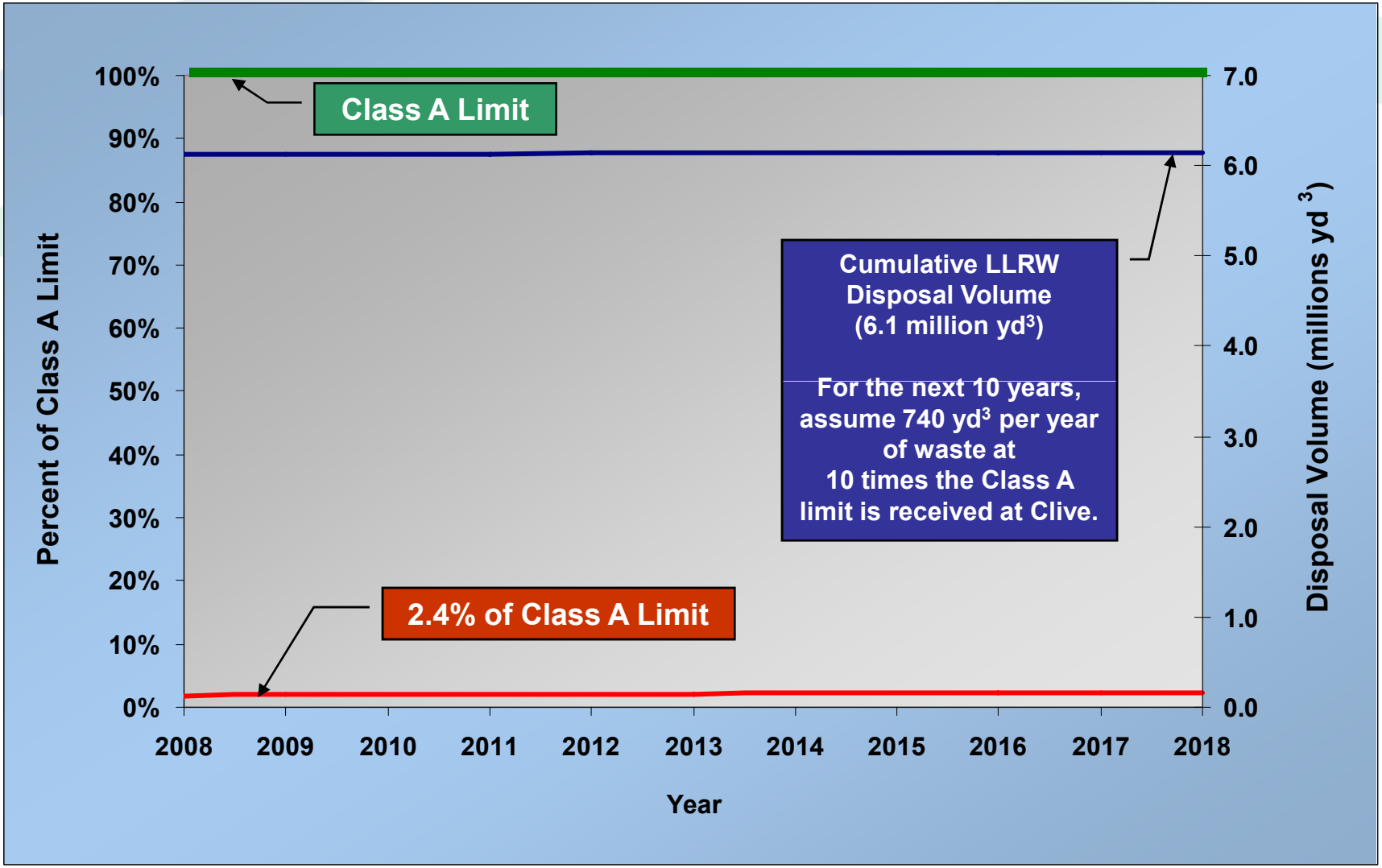


Industry Practices

- Multiple waste streams collected in common tank
  - Typically PWRs
  - No attempt to manage or control classification
- Individual waste streams collected in multiple tanks
  - Typically BWRs
  - Separate by activity level
  - Control ultimate classification
  - Mixing waste from multiple tanks to manage classification
- Remove liners from service early
  - Control ultimate waste classification
  - Generate increased volumes of Class A waste

NRC Question #4

What are the potential blending policies/positions that NRC could take and the advantages and disadvantages of each?

Applicable Regulations

- Part 61
  - Subpart C, particularly 61.42
  - 61.55(a)(8) states concentration may be averaged over the volume or weight of waste
- 10 CFR 20 Appendix G
  - Requires waste be classified for disposal
  - Explicitly exempts classification of waste to be shipped to processor
  - Authorized processor shall certify proper classification of final waste form

Current Guidance

- Current guidance on blending
  - Consciously addressed
  - Clearly allowed
- Blending neither encouraged, discouraged nor prohibited
  - *Branch Technical Position on Concentration Averaging and Encapsulation*, January 17, 1995
  - *Waste Classification Clarification*, Letter, J. Kinneman to J. Harverson, October 16, 2006
  - *Blending of Low-Level Radioactive Waste*, Letter, L. Camper to T. Magette, August 27, 2009
  - Letter, L. Camper to J. DiCamillo, October 30, 2009
  - Letter, L. Camper to S. Kirk, October 30, 2009

Branch Technical Position

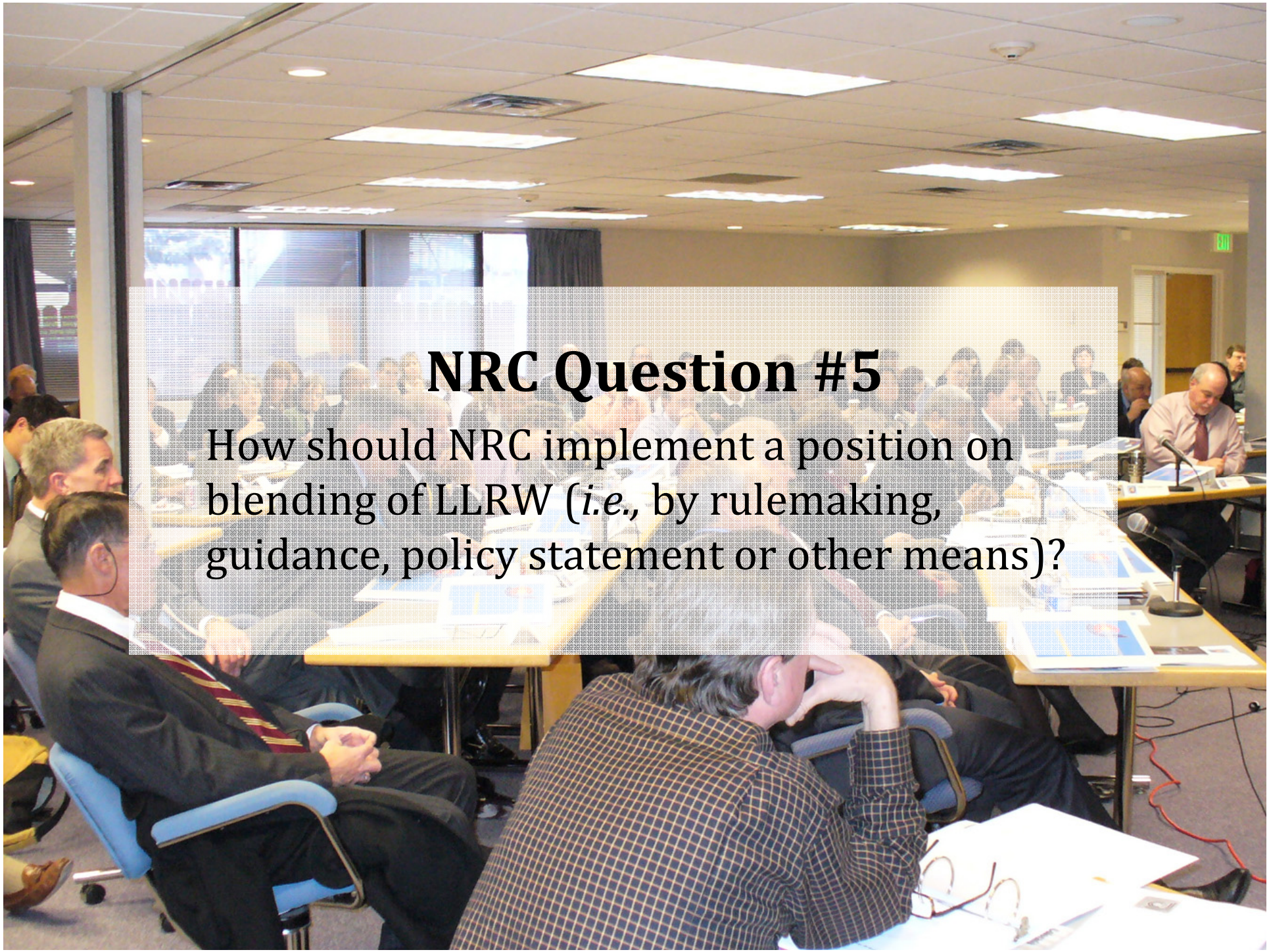
- Homogenous Waste
  - Radionuclide concentrations are likely to approach uniformity in the context of the intruder scenarios
  - Includes, for example, spent ion-exchange resins
  - Mixing of similar homogeneous waste types is permissible
- Classification of a mixture should be based on
  - Highest nuclide concentration in any of the individual waste types contributing to the mixture
  - Volume-averaged or weight-averaged nuclide concentrations of the mixture

Recent Clarification

- Blending
  - Not prohibited nor explicitly addressed in NRC regulations
  - Wastes should not be mixed solely to lower the waste classification
  - Blending that may lower the waste classification may be appropriate under certain circumstances
  - Acceptability of any specific proposal would have to be evaluated by the appropriate regulatory authority
- Classification
  - Waste classification is related to the safety of the disposed waste
  - NRC regulations do not require waste to be classified prior to its shipment for disposal
- NRC Guidance
  - One way for a licensee to demonstrate compliance with the regulations
  - Other approaches may also be found acceptable

Potential NRC Positions

- Formalize and reaffirm current guidance
  - Documented in Camper letters
  - Ensure LLW is safely disposed
  - Provide disposal path for problem waste
  - Reduce onsite storage of LLW
  - No disadvantages
- Revise guidance to allow blending for any purpose if homogenous mixture is produced
  - Maintains focus on health and safety
- Revise guidance to prohibit mixing
  - No advantages
  - Increase storage of LLW
  - Increase waste streams with no or limited disposal options
  - Undermine the existing waste classification system



NRC Question #5

How should NRC implement a position on blending of LLRW (*i.e.*, by rulemaking, guidance, policy statement or other means)?

Implementation

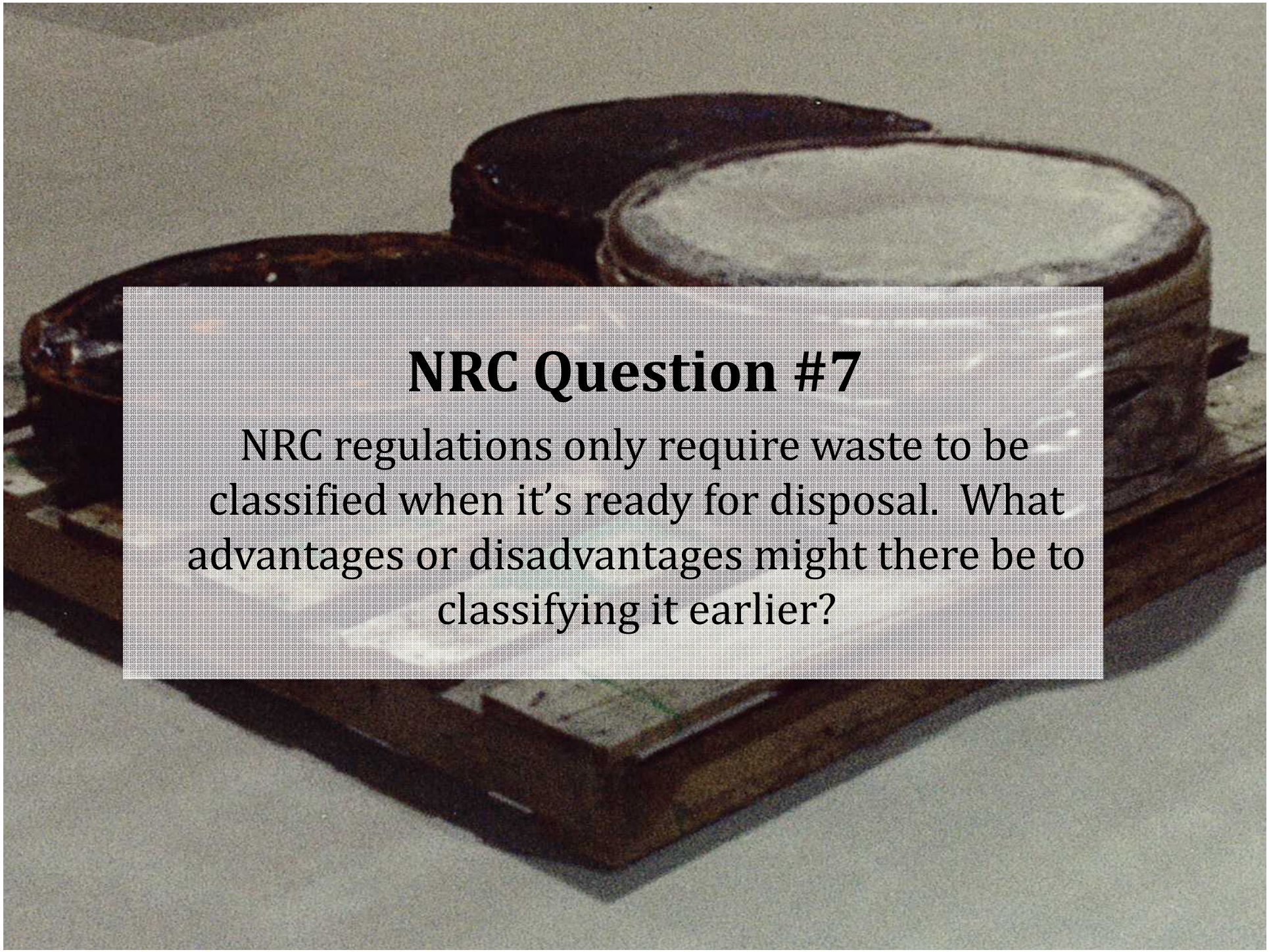
- Blending should be addressed in guidance, not rulemaking
- Regulatory Issue Summary
  - Summarize and formalize guidance from Camper letters
  - Focus on homogenous media
  - Issue as soon as possible
- Update BTP
  - More significant undertaking
  - Address additional technical issues
    - Mathematical averaging
    - Adequacy of mixing
    - Factor of 10
  - Address as part of risk-informing Part 61

NRC Question #6

If a rule were to be promulgated, what compatibility category should it be; *i.e.*, how strictly must Agreement States follow any NRC rule?

Compatibility Category

- Directly relevant to waste classification
- Same as 10 CFR 61.55
- Compatibility Category B
  - Significant transboundary impacts
  - States should be bound to follow NRC direction

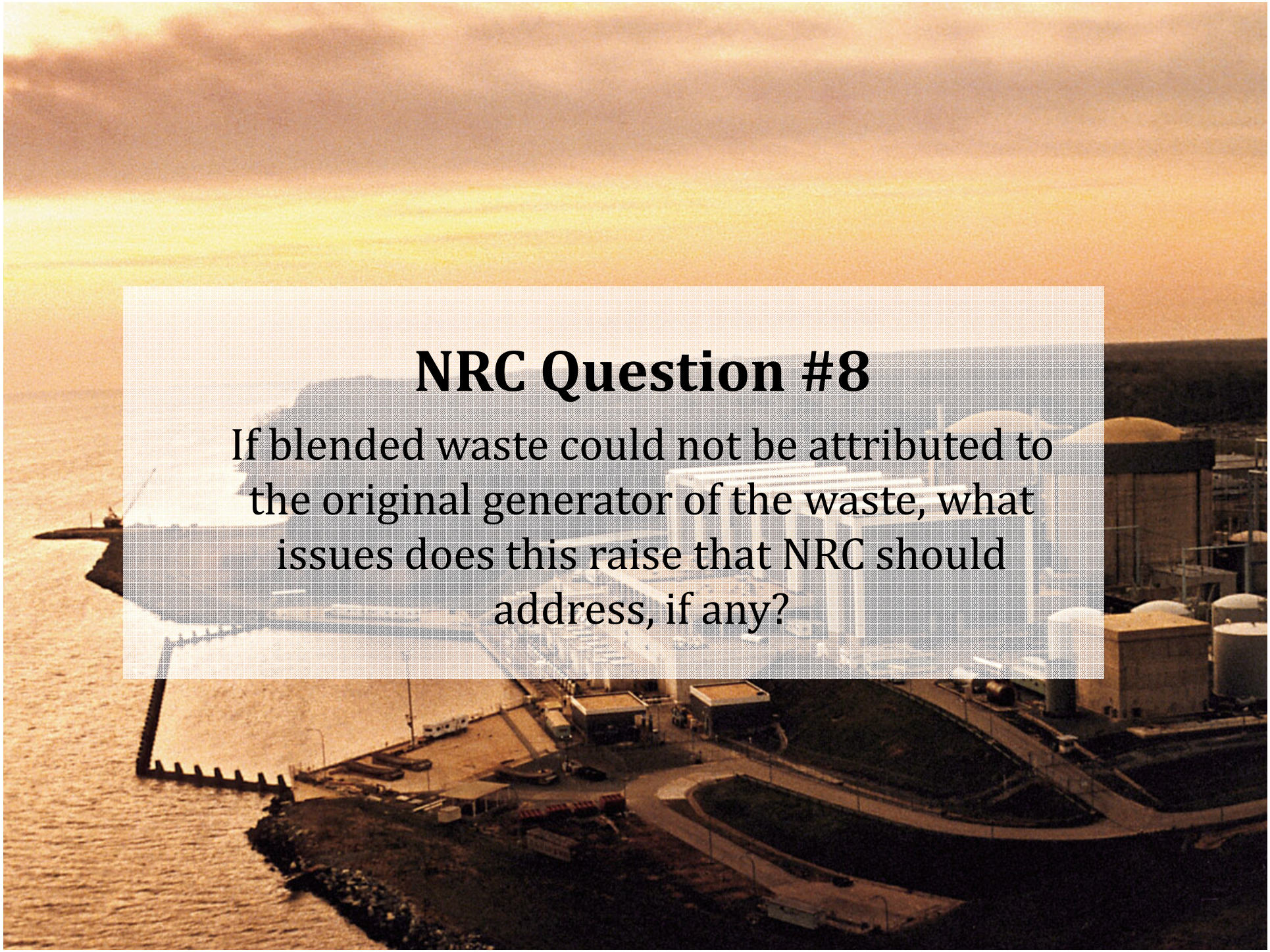


NRC Question #7

NRC regulations only require waste to be classified when it's ready for disposal. What advantages or disadvantages might there be to classifying it earlier?

Waste Classification Issues

- Treatment and preparation for disposal may modify the inbound concentrations
  - **Dewatering** removes mass (water) and drives TRU evaluations higher (limit is mass based)
  - **Compaction** reduces volume and can drive waste class higher
  - **Consolidating** resins from multiple ion exchange vessels in one larger disposal container
  - **Thermal Processing** removes mass and volume and can drive waste class higher
- Waste cannot be classified until the waste is in final form and in the final burial container



NRC Question #8

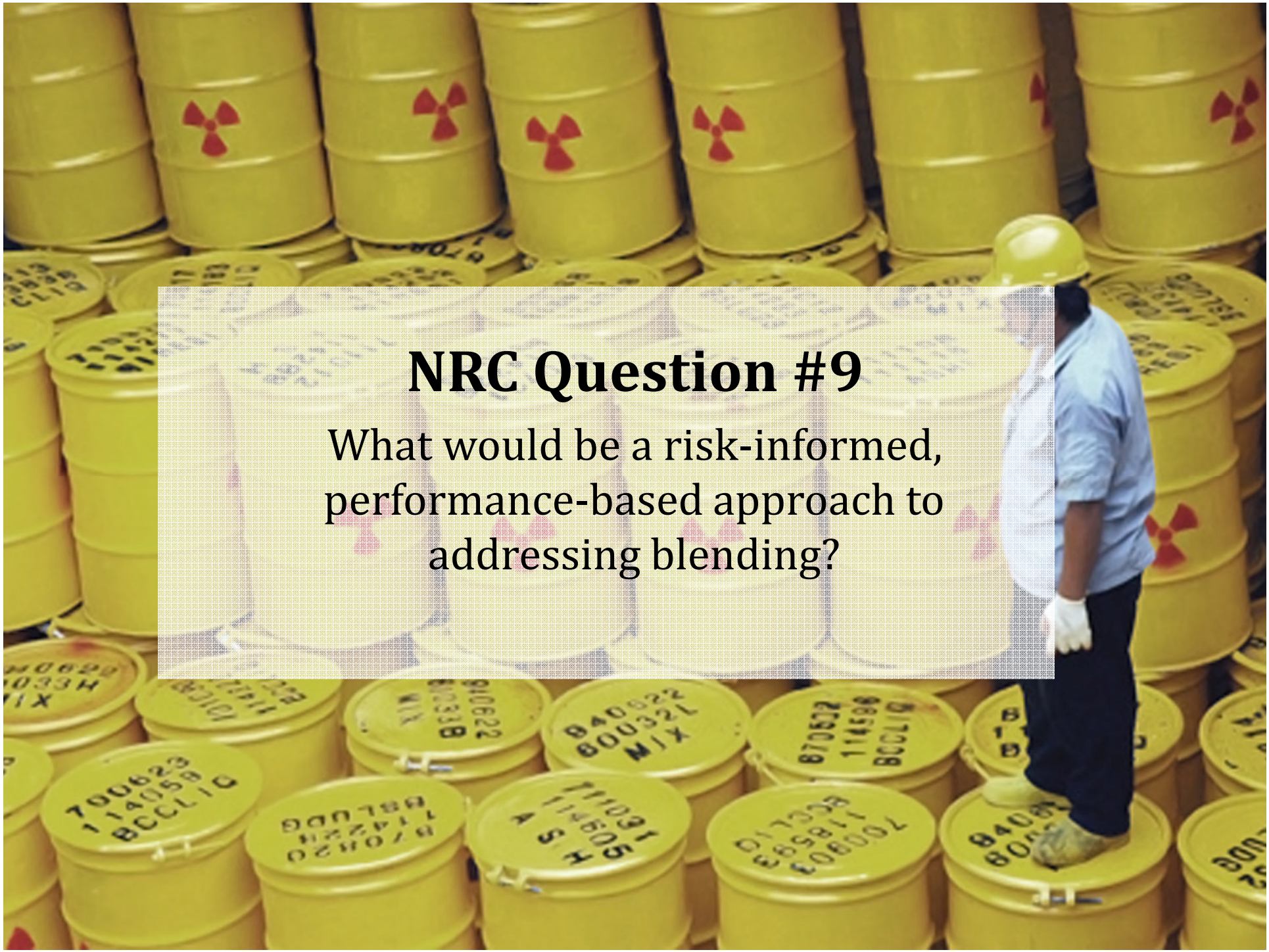
If blended waste could not be attributed to the original generator of the waste, what issues does this raise that NRC should address, if any?

Attribution

- Additional controls are warranted
- Waste disposition and changes in attribution
  - Licensees specifically address in license applications
  - Cognizant licensing authority explicitly address attribution decisions in the licenses
  - Concurrence from the licensee's "home" Compact
  - Additional application requirements should be addressed in NRC guidance (NUREG-1556)
- Residual waste
  - Appendix G definition incomplete
  - Only addresses re-attribution based upon commingling
  - Additional considerations include physical, chemical, and radiological changes

Attribution

- No consistent approach
  - Agreement states
  - Compacts
- NRC guidance needed
- Best addressed in rulemaking



NRC Question #9

What would be a risk-informed, performance-based approach to addressing blending?

Risk-Informed Approach

- Focus on health and safety
  - Does the waste to be disposed meet WAC?
  - Does the waste to be disposed satisfy performance objectives?
- Follow existing guidance as recently interpreted
- Waste pedigree not relevant to health & safety

NRC Question #10

Given that Agreement States are not required to adopt NRC's guidance on blending, how are different States addressing this issue? What are the advantages and disadvantages of these approaches?

State Actions

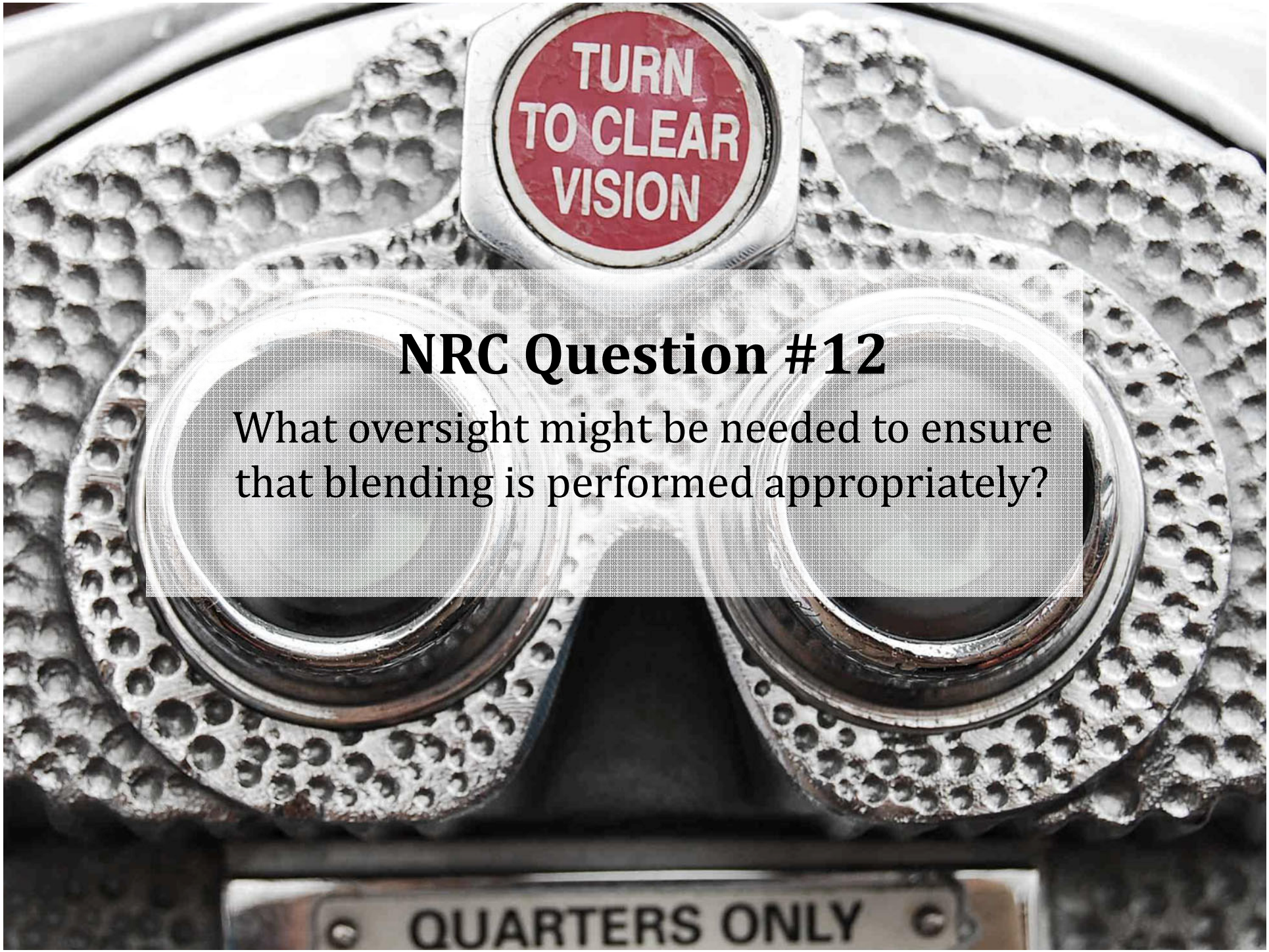
- No state in which Energy*Solutions* operates regulates or objects to blending
- Tennessee
  - Issued testing license for Resin*Solutions*
- Utah
  - BTP is requirement
  - Incorporated into Clive license
- South Carolina
  - BTP is requirement
  - Incorporated into Barnwell license

NRC Question #11

NRC is budgeting resources to initiate a long-term rulemaking to revise the waste classification system. How might alternative waste classification systems to affected by blending?

Risk Informing Part 61

- Primary consideration is health & safety
- Appropriate emphasis
  - Satisfying performance objectives
  - Measured by performance assessment
- Properly account for
  - Radiological loading
  - Characteristics of specific disposal site
- Follow model of DU rulemaking
- How affected by blending? Not at all.

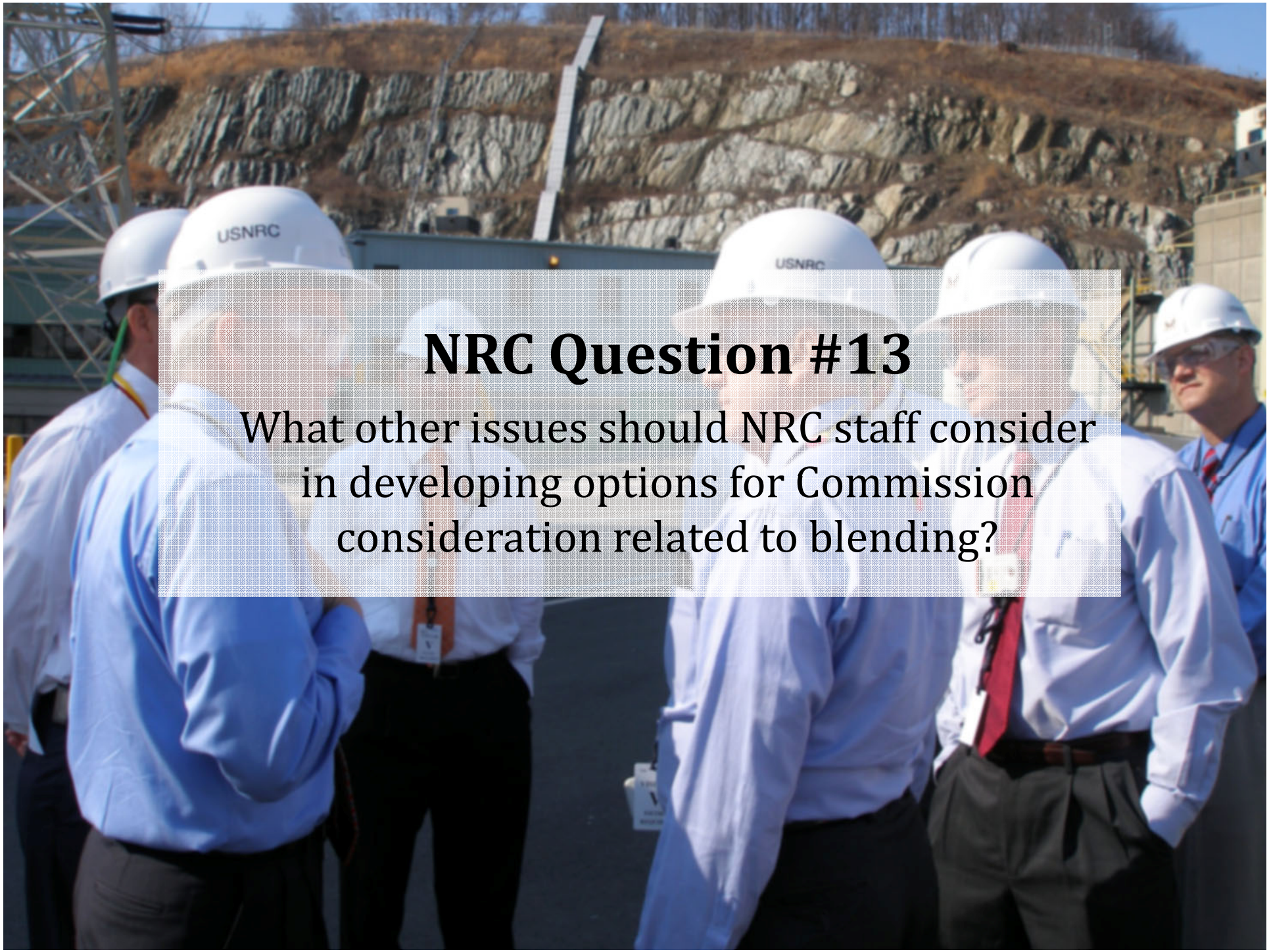


NRC Question #12

What oversight might be needed to ensure that blending is performed appropriately?

Oversight

- Continue existing oversight
- NRC
  - Inspections at power plants
- Agreement States
  - Inspections at processor sites
  - Inspections at disposal sites
  - Verify compliance with WAC at disposal sites
- Customer and industry organizations
  - Audits and assessments at processors and disposal sites



NRC Question #13

What other issues should NRC staff consider in developing options for Commission consideration related to blending?

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Resin*Solutions*

- Receive resin at processing facility without regard to waste classification
- Generate a compliant Class A waste form for disposal at Clive
- No commingling of resins from multiple generators or generation sources under testing license

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Customer Completed Waste Acceptance Form

Container Filled with Resins & Shipped to Oak Ridge, TN

ResinSolutions WOF Process Facility

Process Resins & Ship to Clive, UT

Disposable Container Received & Disposed of at Clive, Utah

Benefits

- Minimal change in plant operations or resin processing equipment
- No change in transport methods
- Single process for all resins generated within WAG

- Eliminates onsite or offsite storage and associated risks and liability
- Provides stable and predictable disposal costs

Benefits

- Only gross liner dewatering is required
- Faster than dewatering for disposal
- Less resin water returned to plant systems
- Saves time, personnel exposure and dollars
- Generates less resin than early bed change-outs

Process

- Liners received and resin is transferred to intermediate bulk containers (IBC)
- IBCs mixed, weighed, void estimated, and activity measured
- Resins processed from numerous containers to maximize waste class fraction
- Final dewatering in steel disposal liners
- Transport to Clive for permanent disposal

Resin*Solutions*

ENERGYSOLUTIONS

- Blending of LLW is entirely consistent with current NRC guidance and policies
  - Clear operational efficiencies
  - Real dose reduction
- Licensed by an agreement state
- Provides a disposal pathway for some B/C waste
- Reduces storage in lieu of permanent disposal

In summary, blending of LLW

- Is entirely consistent with current, well-founded regulations and guidance
- Is an element of LLW management strategy
- Provides a solution for waste with no disposal options
- Reduces storage in lieu of permanent disposal
- Is fully protective of human health & safety and the environment

Questions?