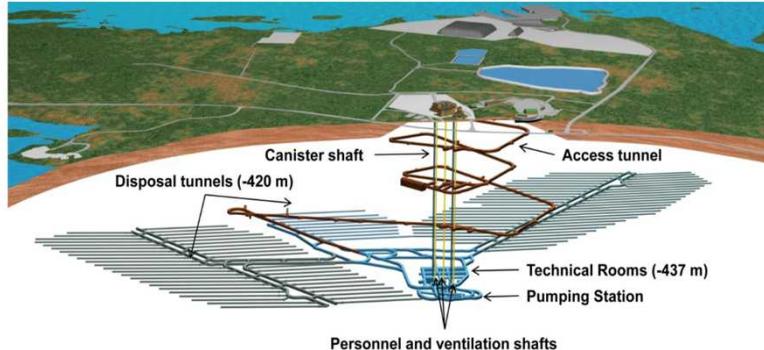


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## Containment and Surveillance as a Primary Approach for Safeguarding Geological Repositories

2016 INMM Annual Meeting  
Atlanta, Georgia  
July 25, 2016

George Baldwin, Risa Haddal, Robert Finch  
*Sandia National Laboratories*



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# Outline

1. Repository Containment
2. Repository End State
3. Material Disposition Area (MDA)
4. Transition MBA
5. End State Safeguards
6. Safeguards Accountancy Information
7. Summary

# REPOSITORY CONTAINMENT

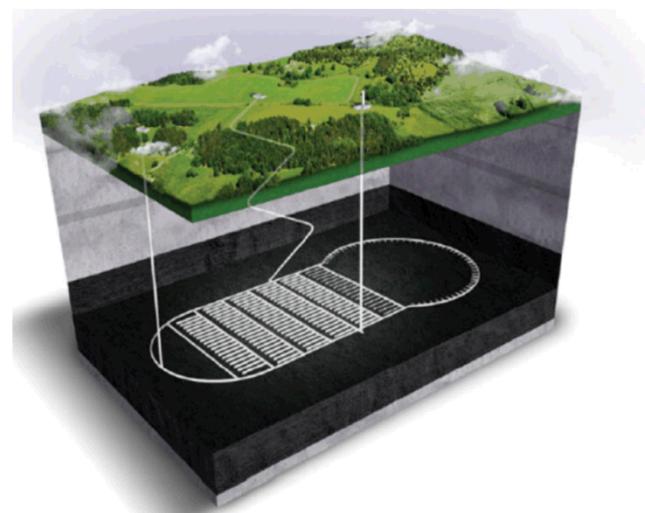
- Restricted Zone
  - Defined by the State
    - Undisturbed-rock zone
    - Surrounds repository
- Access
  - Open
    - *Pre-operational & Operational*
    - Portal monitoring
    - Design Information Verification (DIV)
  - Closed
    - *Post-closure*
    - Long-term monitoring

## CONTAINMENT:

“Structural features ... used to establish the physical integrity of an area or items and can be used to maintain the continuity of knowledge (CoK) of the area or items by preventing undetected access to or movement of material, or interference with the items.”

-- *IAEA Safeguards Glossary (2001)*

} End  
State



# REPOSITORY END STATE

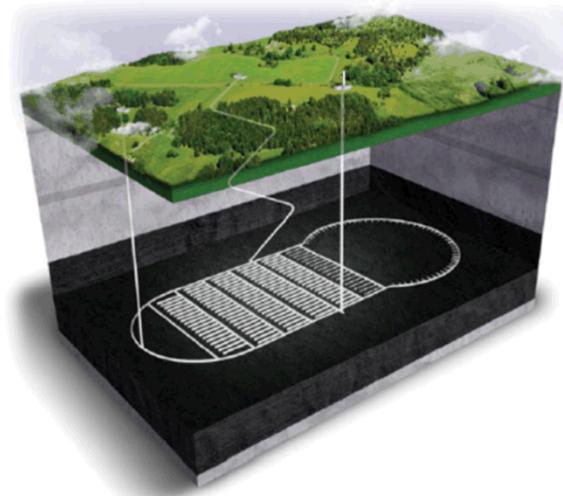
- Post-closure phase
- Arbitrarily far into the future
  - Operations have ceased
  - Penetrations have been closed and backfilled
    - tunnels, ventilation shafts, etc.
  - Access to underground closed off
  - All underground safeguards devices have been removed, or disabled and abandoned
- Long-term safeguards
  - Minimal resource requirements
  - Site visits
    - Infrequent and random
  - Satellite/overhead imagery
  - Long-term seismic/acoustic monitoring
- Verify no underground access
  - Safeguards conclusion augmented by Additional Protocol

*Long-term safeguards measures do not apply to individual disposal canisters or to the spent fuel they contain*

C/S measures are *not* maintaining CoK for NMA

# MATERIAL DISPOSAL AREA (MDA)

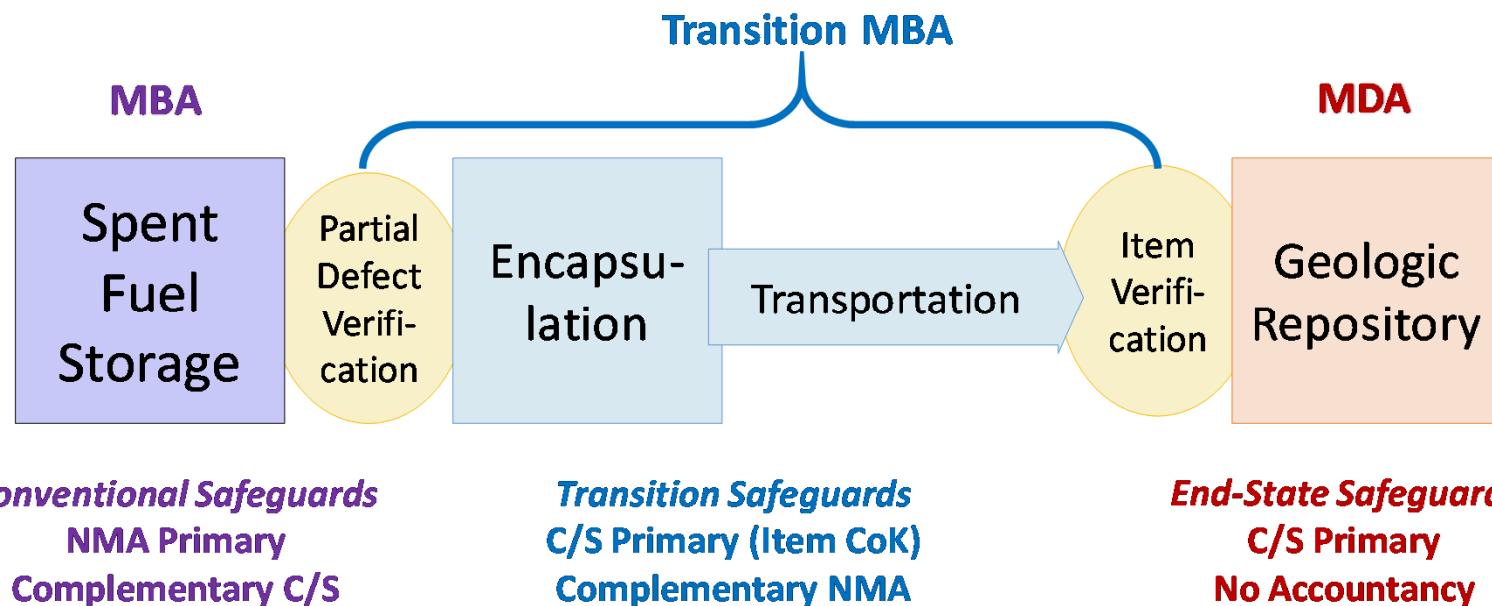
- New Safeguards Designation
  - Formalizes a satisfactory safeguards paradigm for disposal
  - Safeguards effort appropriate for disposed nuclear materials
- No material balance for MDA
  - Repository is inherently different from active fuel cycle
  - No physical inventory verification (PIV) is possible
- Repository restricted zone
  - “Black box”
    - No concern about material locations underground
    - All access portals are monitored
- No ongoing need to retain NMA information for the MDA
- *Release* nuclear materials for disposal
  - Consent by safeguards inspectorate(s)
  - Materials exit accountancy ... but not safeguards.
- Establish a *Transition MBA*



# TRANSITION MBA

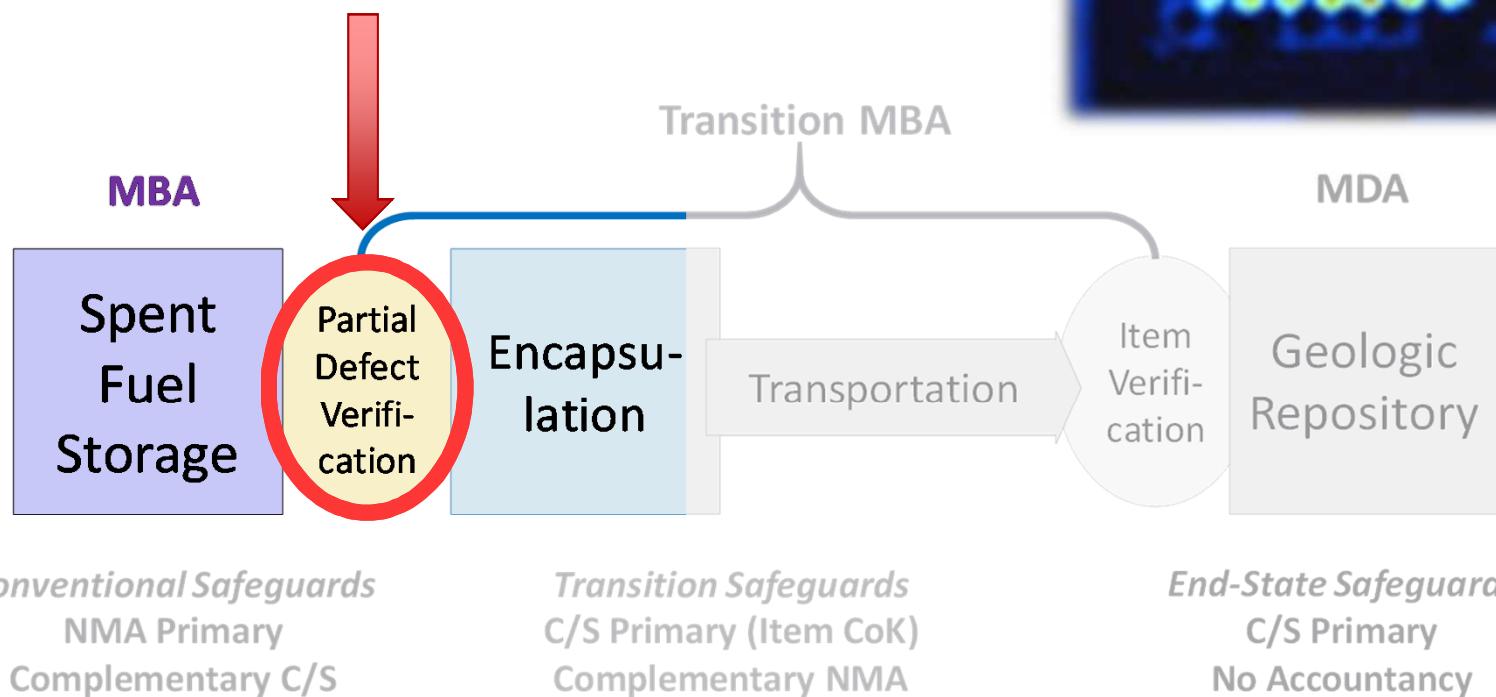


- Partial defect verification
  - Accountancy Exit Portal → Transition MBA
- Transition MBA
  - Encapsulation
  - Transportation
- Item Verification
  - MDA Entrance Portal



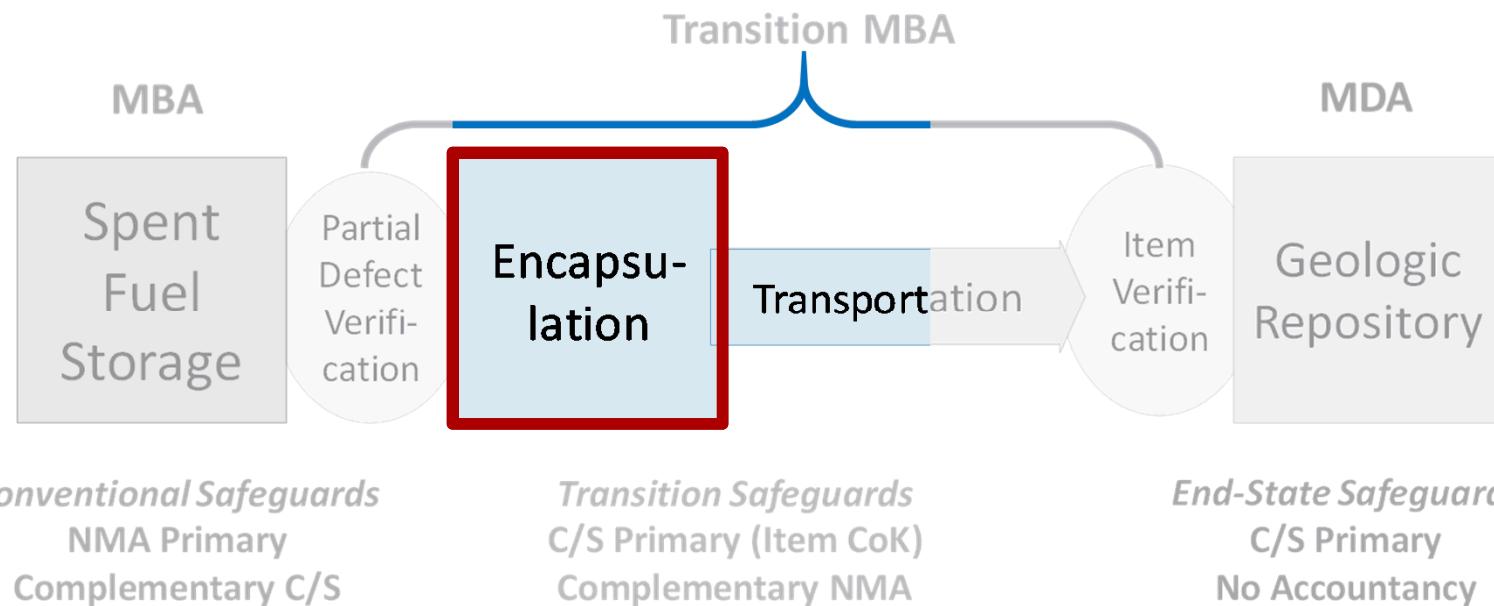
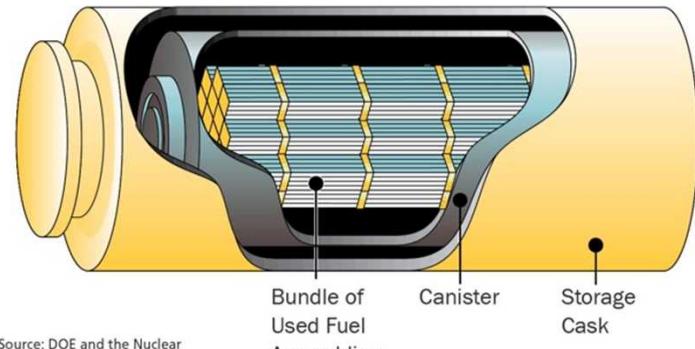
# Accountancy Exit Portal

- Partial defect verification
  - Final Safeguards measurement
    - before encapsulation



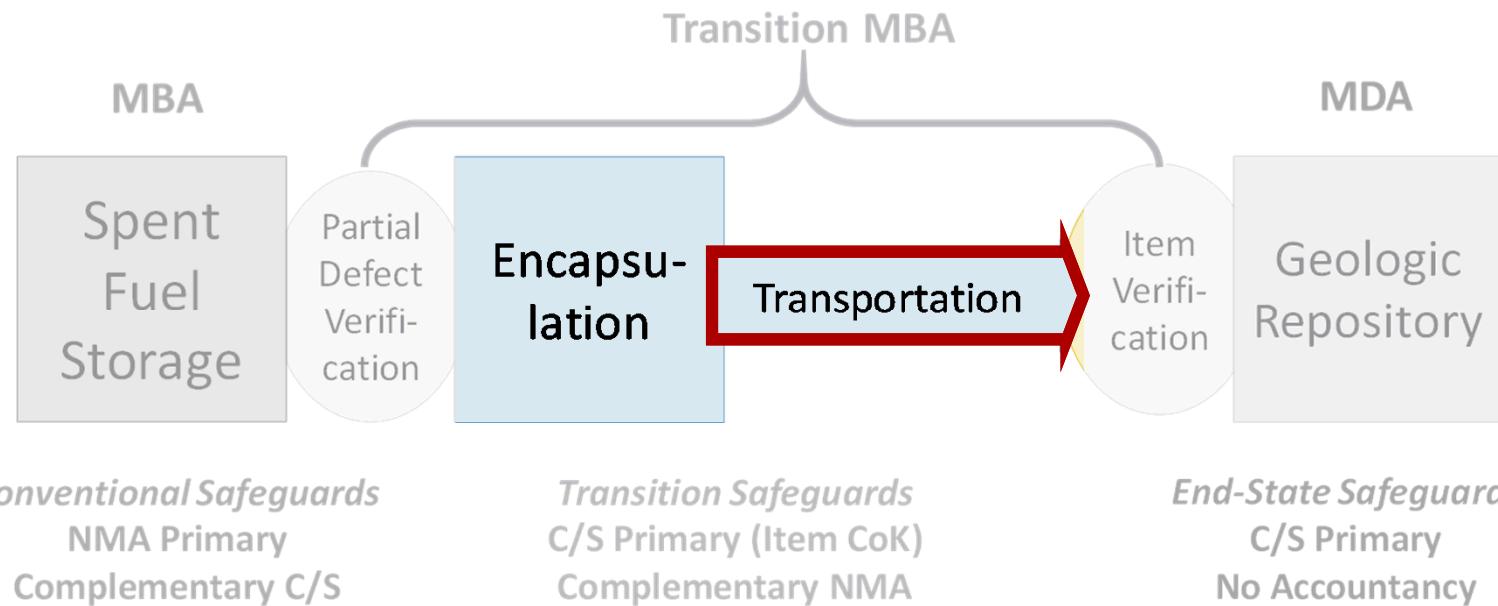
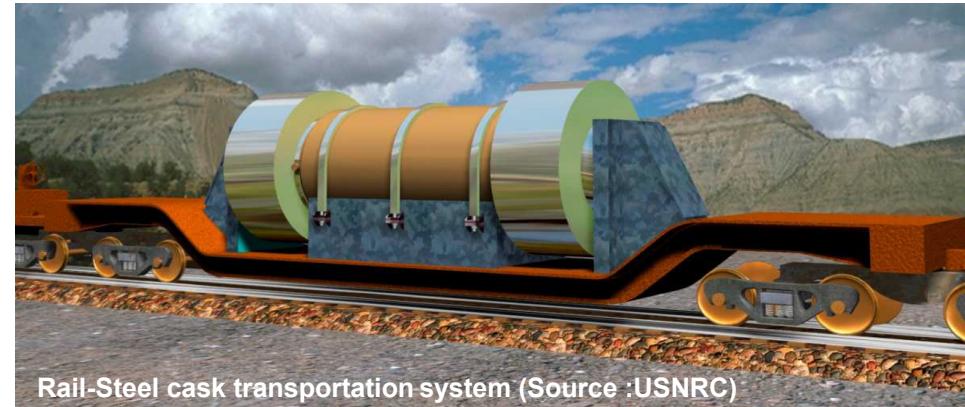
# Encapsulation

- All nuclear materials as items
  - Assemblies → Disposal Canisters



# Transportation

- CoK of transport casks
  - Dual C/S
  - Maintain CoK
    - Verify @ Destination

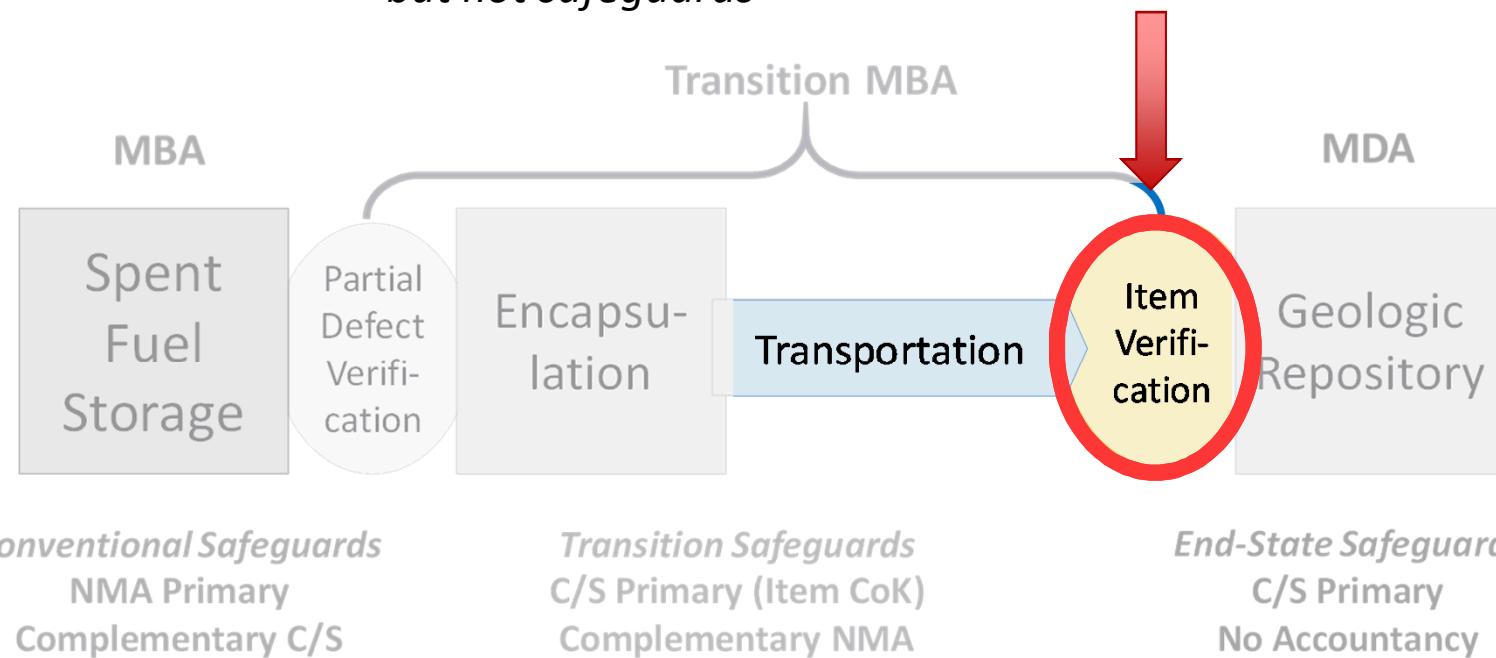


# MDA entrance portal

- Item Verification
  - Assure CoK has been maintained
- Release nuclear materials for disposal
  - Consent by safeguards inspectorate(s)
  - Items (canisters) exit accountancy ...  
*but not safeguards*

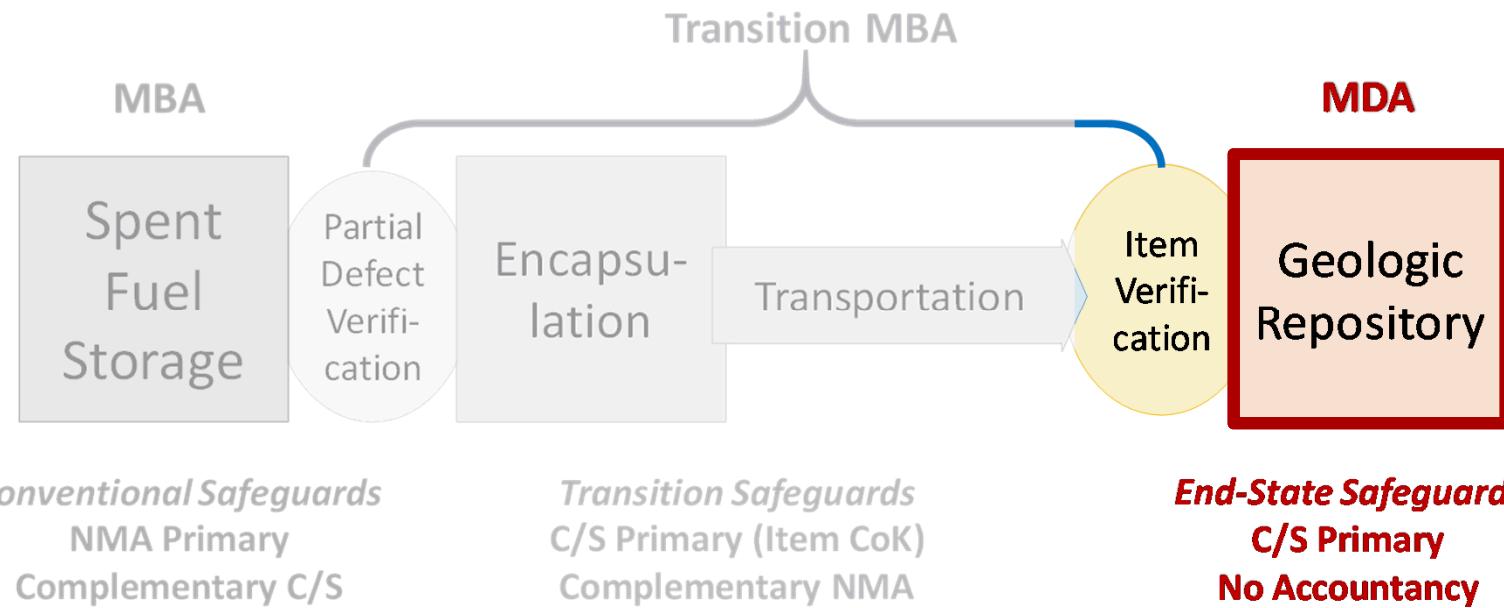


Entrance and exit portals . Source: KINAC



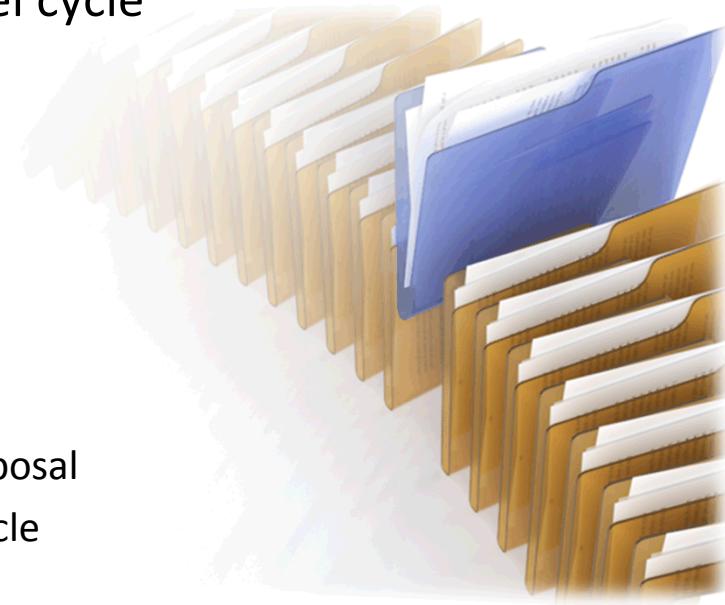
# MDA: Geologic Repository

- End-State Safeguards
  - Repository safeguards will be a purely C/S approach
  - Geological containment supplemented with surveillance & AP
  - C/S measures for the MDA are *not* maintaining CoK for NMA



# Safeguards Accountancy Information

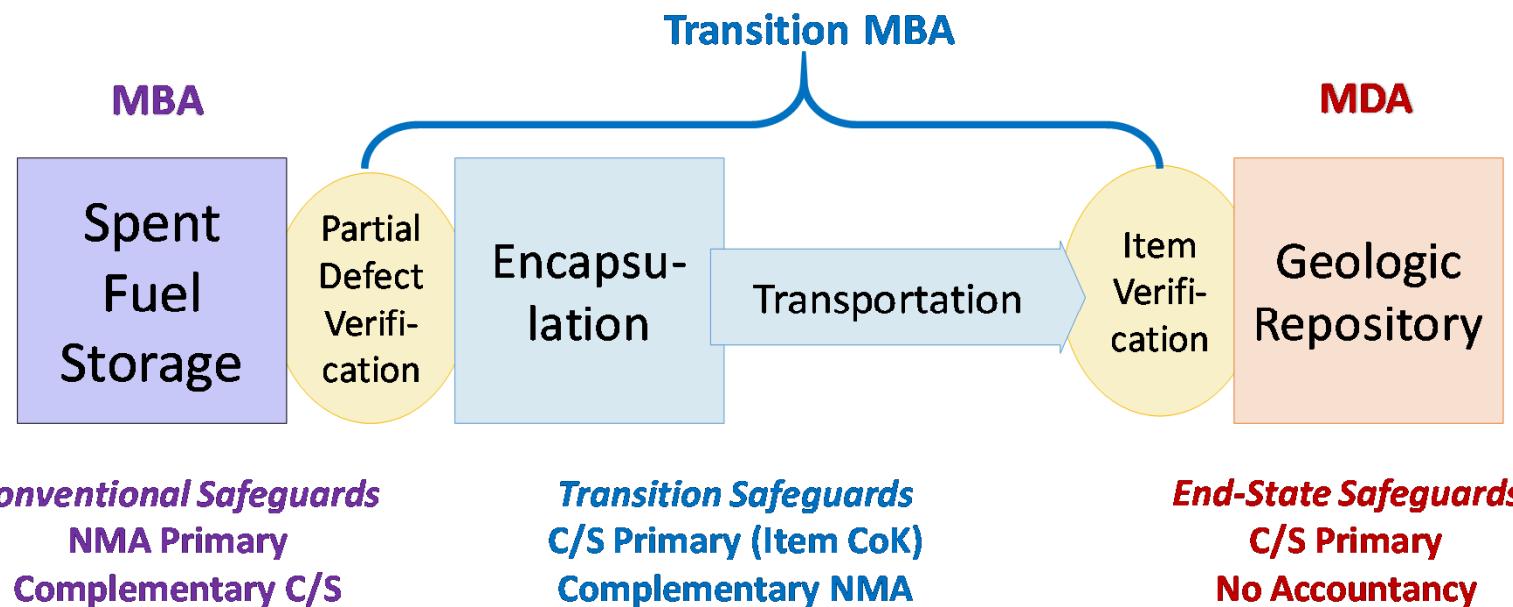
- Disposed materials will never re-enter the fuel cycle
  - NMA information should never again be needed
- NMA records
  - Maintained while materials are in Transition MBA
    - complementary to C/S
    - Until final item accountancy
- NMA no longer needed for MDA safeguards
  - NMA records have served their purpose before disposal
  - Validating material removed from the active fuel cycle



Once verified, each item (canister) exits the Transition MBA and enters the Repository MDA

# SUMMARY

- Transition MBA
  - Maintain CoK on *items*
- Material Disposition Area – MDA
  - C/S measures for the MDA are *not* maintaining CoK for NMA
- Repository End-State safeguards are a purely C/S approach



# THANK YOU