U. S. Department of Energy
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Alternative Cask and Canister Concepts for Storage, Transportation, and/or Emplacement

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Alternative Cask and Canister Concepts

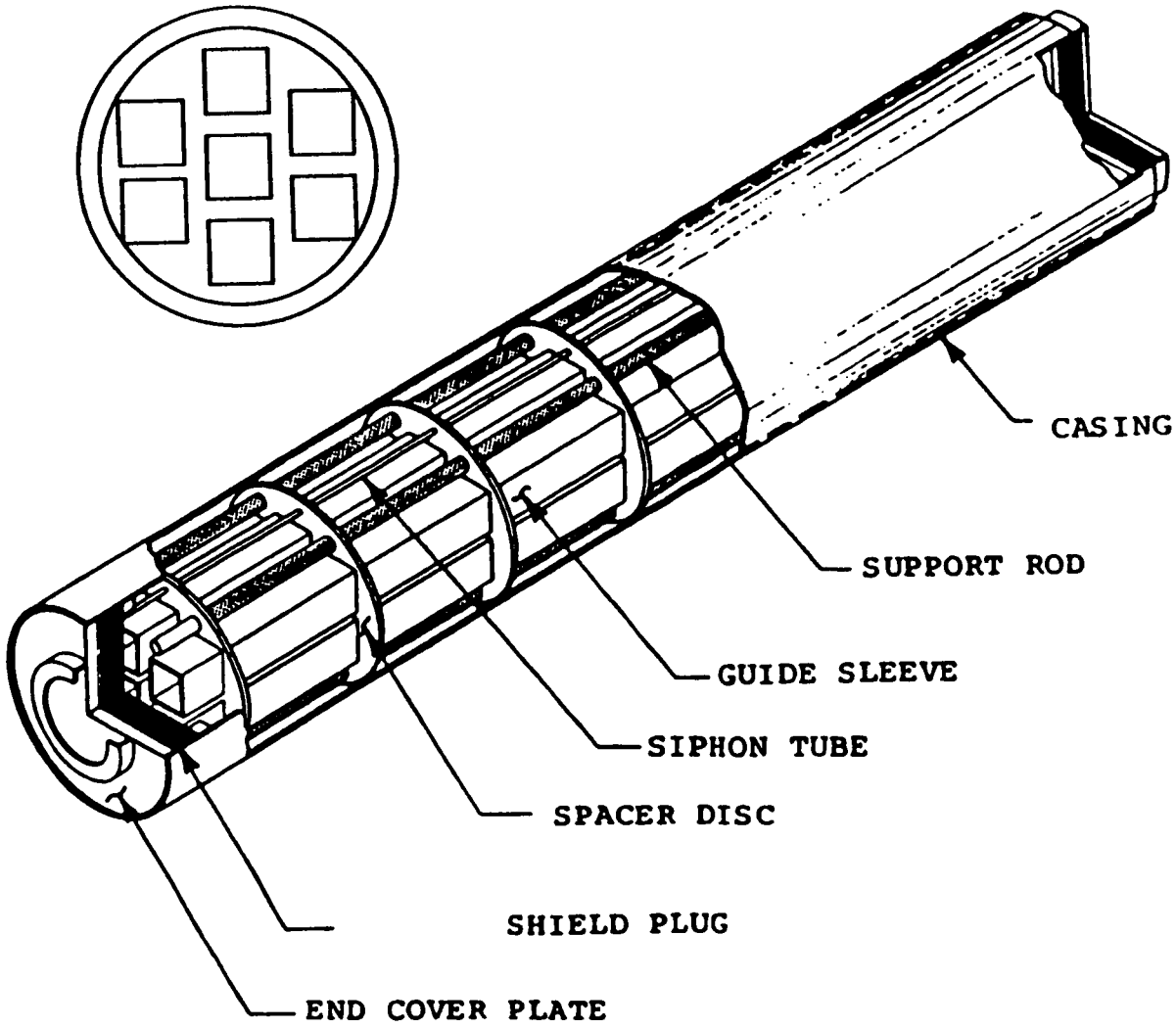
- Approach:
  - Perform system studies on alternative cask and canister concepts including
    - -- Universal Casks
    - -- Dual Purpose Casks
    - -- Universal Canisters
    - -- MESCs
- System studies identified and underway
  - Assessment of Multiple Element Sealed Canisters (MESCs) for transportation and storage of spent fuel at the MRS
    - -- Motivated by issues raised by potential MRS hosts
    - -- Assessment of a limited MESC scenario
    - -- Work completed; report issued (May 1992)
  - Cask and Canister Concepts Assessment
    - -- An assessment encompassing all alternative cask and canister concepts to provide a basis for program direction and decision making
    - -- Work underway

Assessment of Multiple Element Sealed Canisters (MESCs) for Transportation and Storage of Spent Fuel at the MRS

MESC Assessment

- **Background:**
  - -- **MESCs are sealed metal canisters containing one or more spent fuel assemblies (Multiple Element Sealed Canisters)**
  - -- **Issue of using MESC technology for transportation to and storage at the MRS raised by potential MRS hosts**
  - -- **System study required to determine the range of possible impacts on the CRWMS of using MESCs for transportation and storage at the MRS**

MESC



A Multiple Element Sealed Canister (MESC)

MESC Assessment

- Motivation
  - -- A MESC-based system could avoid the routine handling of individual, uncanistered spent fuel elements at the MRS
- Objective
  - -- Perform a system study to assess the positive and negative impacts that a MESC-based system would have on the overall CRWMS and on each element of the system
  - -- Evaluate a system where MESCs are loaded and sealed at the reactor sites and only MESCs are accepted and stored at the MRS (without being opened)
- Status
  - -- Work completed; report issued (May 1992)

Methodology

- Identify ground rules
- Define MESC-based CRWMS scenarios
- Develop input data for MESC and cask capacities
- Identify and evaluate Measures of Effectiveness (MOEs)
- Perform systematic evaluation of impacts on each system element:
  - -- waste generators/waste acceptance
  - -- transportation
  - -- MRS
  - -- repository
- Identify potential critical issues that could impede the implementation of a MESC-based system

Ground Rules

- Use existing MESC technology
- MESCs loaded and sealed at reactor/pool sites
- System must accommodate all reactor/pool sites
- Only MESCs accepted and stored at MRS
- MESCs not opened at MRS
- Recovery cell still required at MRS
- Waste generators have option to ship uncanistered fuel directly to the repository (when open); for analysis, only first 10,000 MTU (until 2010) sealed in MESCs and stored at MRS
- At repository, MESCs either overpacked and integrated into the Engineered Barrier System or cut open and unloaded; both options considered

Scenarios Considered

- Scenario 1 - Use of currently available MESCs
  - -- 7-PWR and 24-PWR fuel element MESCs compatible with rail casks
- Scenario 2 - Use of MESCs for LWT and rail casks
- Scenario 3 - Use of MESCs for OWT and rail casks
- Scenario 4 - Use of MESCs for LWT casks only
- Reference scenario - no use of MESCs
  - -- No-MESC system using transport-only casks with uncanistered spent fuel elements and dry cask storage at the MRS

LWT = Legal Weight Truck cask
OWT = Overweight Truck cask

Quantitative MOEs

Scenario*	Number of Transport. Casks	Number of MESCs	Number of Shipments	Number of Cask-Miles	Number of Shipment-Miles	Number of Handlings
Reference Scenario	86	0	36,600	44,000,000	27,200,000	627,000
Scenario 2, MESCs for LWT and Rail Casks	152	14,500	41,800	74,500,000	65,600,000	482,000
Scenario 3, MESCs for OWT and Rail Casks	134	6,290	33,500	67,700,000	58,800,000	457,000
Scenario 4, MESCs for LWT Casks Only	158	19,500	46,700	78,200,000	69,700,000	497,000

*Scenario 1, the use of currently available MESCs, was not analyzed due to its inability to accommodate all reactor/pool sites.

Qualitative MOEs

Scenario*	Occ. Rad. Exposure Waste Gen.	Occ. Rad. Exposure Transport.	Occ. Rad. Exposure MRS	Occ. Rad. Exposure Repository	Public Radiation Exposure
Reference Scenario	1	1	4	**	1
Scenario 2, MESCs for LWT and Rail Casks	3	3	2	**	3
Scenario 3, MESCs for OWT and Rail Casks	2	2	1	**	2
Scenario 4, MESCs for LWT Casks Only	4	4	3	**	4

Note: 1 = Best, 4 = Worst

*Scenario 1, the use of currently available MESCs, was not analyzed due to its inability to accommodate all reactor/pool sites.

**Occupational Exposure not quantified due to uncertainty in operations required.

Advantages, Disadvantages, and Critical Issues

- Primary Advantages
  - -- No routine handling of uncanistered spent fuel at the MRS
  - -- Reduced number of waste handlings in system
  - -- Decreased occupational radiation exposure at the MRS
  - -- Potential to integrate MESC into the Engineered Barrier System (EBS)
- Primary Disadvantages
  - -- Burden on waste generators to load and seal MESCs
  - -- Increased number of casks, cask-miles, and shipment-miles
  - -- Increased occupational radiation exposure at the waste generators and during transportation; increased public radiation exposure
  - -- Need to cut open and unload MESCs if not integrated into EBS
  - -- Restricted flexibility to support repository thermal loading
- Critical Issues
  - -- Licensing of MESCs
  - -- Ability to meet schedule milestones
  - -- Renegotiation of utility contracts
  - -- Radiological risk partitioning (between operating venues and between occupational and public exposure)

Conclusions

- A MESC-based CRWMS is feasible, but its merits depend on the relative weighting of positive and negative system impacts
- Adopting this MESC-based CRWMS to avoid the routine handling of spent fuel elements at the MRS results in accruing positive effects at the MRS but incurring negative effects at the other system elements of the CRWMS (waste acceptance, transportation, and repository).

- This study represents a limited MESC scenario, other MESC scenarios will be considered in the future

Cask and Canister Concepts Assessment

Cask and Canister Concepts

- Objective:
  - -- Perform a systematic assessment encompassing all alternative cask and canister concepts
  - -- Provide a basis for program direction and decision making

- Cask/Canister Concepts Considered:
  - -- Universal Casks
  - -- Dual Purpose Casks
  - -- Universal Canisters
  - -- MESCs

Cask and Canister Concepts (continued)

- Methodology:
  - Determine and describe alternative cask and canister concepts
  - Define a base scenario and alternative scenarios within each concept -
  - Perform a comparative assessment of the concepts relative to a reference system
  - Determine positive and negative impacts of each concept on the overall CRWMS and each of the system elements-
  - Provide findings on the primary issues related to each concept
  - Make recommendations for continued investigation on specific alternatives

- Status:
  - Work underway

Minimizing Waste Handlings in the CRWMS

Minimizing Waste Handlings

- Approach:
  - Perform a three-part system study on minimizing waste handlings

- Three-part system study:

1) Technologies and operating strategies for minimizing waste handlings
   - Address potential technologies and operating strategies
   - Draft report issued for comment (May 1992)

2) Potential limitations on adopting technologies for minimizing waste handlings
   - Address potential limitations on adopting technologies
   - Currently being addressed in cask and canister concepts work

3) Assessment of trade-offs in implementing strategies for minimizing waste handlings
   - Address risk and cost trade-offs embedded in strategies for minimizing waste handlings
   - Future work

Technologies and Operating Strategies for Minimizing Waste Handlings

Objective

- Objective
  - To identify technologies and operating strategies for minimizing the number of waste handlings

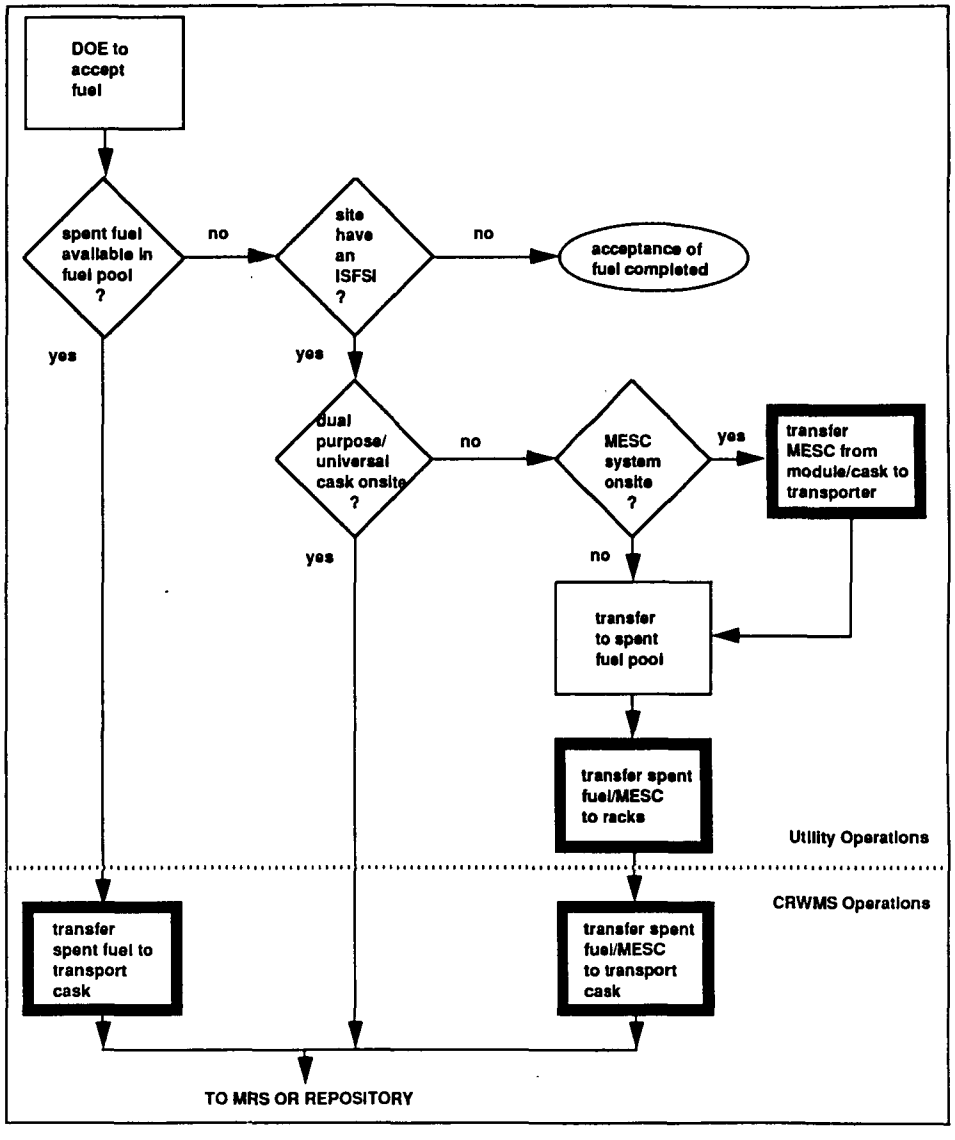
- Definition of waste handling
  - Waste handling is the transfer of a waste type, where a waste type is defined as:
    - An individual, uncanistered fuel assembly
    - An unshielded canister containing one or more fuel assemblies
  - Only spent fuel considered

  - Waste handlings can occur at
    - The reactor/pool sites
    - The MRS
    - The repository

Reference Case for Comparison

- Reference case assumptions (for this study):
  - 63,000 MTU spent nuclear fuel (SNF) accepted and emplaced in repository (219,250 assemblies)
  - Individual fuel assembly handling
  - All SNF goes through MRS storage
  - No consolidation in the system
  - Lag storage handlings not counted
- Each assembly is handled four times

Methodology - Handlings at Reactor



Operating Strategies

- Pass-through
  - -- Assemblies arriving at the MRS in from-reactor casks transferred directly into from-MRS casks for shipment to the repository
- Flow-through
  - -- From-reactor rail casks arriving at the MRS are connected directly to a from-MRS train headed for the repository
- Western Strategy
  - -- Western reactors ship directly to repository after repository begins operations

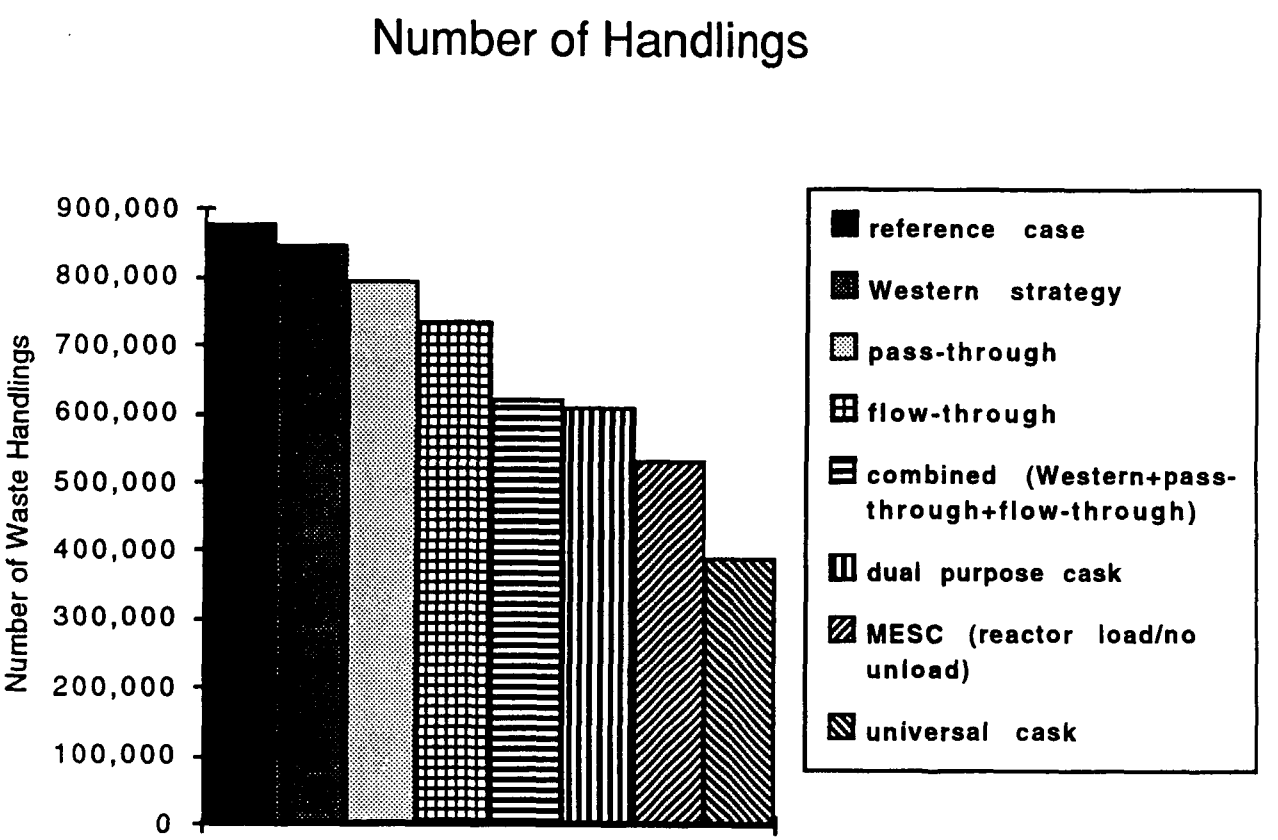
Technologies

- Dual Purpose Casks
  - Cask used for both storage and transportation
  - Reduces handlings at the MRS

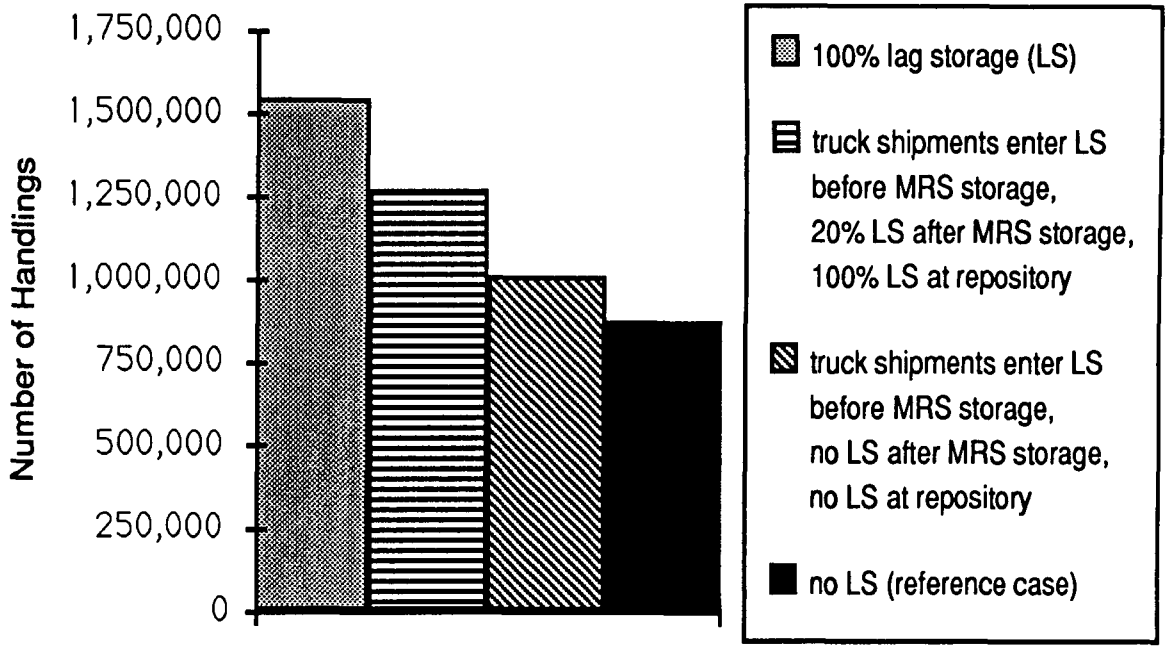
- Universal Canisters/Multiple Element Sealed Canisters (MESCs)
  - Sealed canister containing one or more spent fuel assemblies
  - Canister used for storage, transportation, and/or emplacement
  - Reduction in handlings dependent on where canisters are loaded and where/if unloaded

- Universal Casks
  - Cask used for storage, transportation, and emplacement
  - Reduces handlings at the MRS and the repository

Results of Strategies



Handlings With Lag Storage at MRS and Repository



Observations

- A combination of operational strategies:
  - Western Strategy
  - Pass-through
  - Flow-through

  can reduce the number of handlings by about 30%, relative to the reference case

- Selection of physical system design:
  - Dual purpose Casks
  - Universal Canisters/MESCs
  - Universal Casks

  can reduce the number of handlings by 30% - 75%, relative to the reference case

- Planned and efficient use of lag storage can minimize incremental waste handlings

- Largest reduction in waste handlings would occur with the use of Universal Casks

Observations (continued)

- All waste handlings are not equal
  - MESCs versus uncanistered fuel assemblies
  - Fuel assembly handling versus cask handling
- Shielded cask handlings not counted in current study
- Implementing technologies and strategies to minimize waste handlings may impact other system parameters, including
  - Cask shipments and shipment-miles
  - Operational flexibility
  - Radiation exposure
  - Program schedule
  - Cost
- Risk and cost trade-offs of adopting technologies and strategies must be evaluated