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# Preliminary Dose Comparisons for the MRS Systems Study

P. J. Pelto
J. C. Lavender

April 1989

Prepared for the U.S. Department of Energy
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Pacific Northwest Laboratory
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# PRELIMINARY DOSE COMPARISONS FOR THE MRS SYSTEMS STUDY

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## ABSTRACT

This report provides preliminary information on the radiological doses to the public and the workers for alternative system configurations proposed in the MRS Systems Study. Information published in the MRS Environmental Assessment (DOE 1986) was used as a basis for this analysis. The risk differences between alternative configurations were found to be small and should not be viewed as a major factor in selecting alternative configurations.

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## DISCUSSION

The MRS Systems Study has proposed alternative system configurations for the federal waste management system. This report provides preliminary risk information for these alternative system configurations using information published in the MRS Environmental Assessment (DOE 1986). For the purposes of this report, risk is broadly defined to include the radiological doses to the public and the workers as a result of routine activities and potential accidents. Five alternative system configurations are examined:

- System Configuration 1
  - No MRS
  - Repository consolidates and containerizes spent fuel
- System Configuration 2
  - No MRS
  - Repository containerizes intact fuel
- System Configuration 3
  - Storage-only MRS
  - Repository consolidates and containerizes spent fuel
- System Configuration 4
  - Storage-only MRS
  - Repository containerizes intact fuel
- System Configuration 5
  - MRS consolidates and canisters
  - Repository containerizes

A system handling 3000 MTU/year of spent fuel is assumed for each of these configurations. For options with an MRS, 2700 MTU/year of spent fuel is assumed shipped to and from the MRS and 300 MTU/year is assumed shipped from western reactors directly to the repository. The radiological doses are given in units of person-rem/1000 MTU.

System Configuration 5 is essentially the original MRS proposal outlined in the MRS Environmental Assessment (DOE 1986). This option is discussed first and the other four options are then compared with System Configuration 5.

## SYSTEM CONFIGURATION 5

In this configuration, spent fuel from eastern reactors is shipped by truck and rail (30%/70%) to the proposed MRS facility where it is unloaded. The reference truck cask has the capacity to carry 2 intact PWR and 5 intact BWR assemblies. The reference rail cask has the capacity to carry 14 intact PWR and 36 intact BWR assemblies. These values are slightly smaller than those used in the MRS Systems Study (317 PWR/BWR truck and 21/48 PWR/BWR rail). These differences will not significantly affect the risk comparisons for the alternative configurations. The spent fuel and nonfuel-bearing components (NFBC) are consolidated and placed into canisters. The consolidated spent fuel and NFBC are stored if necessary. The consolidated spent fuel and NFBC are loaded into 100-ton rail casks and shipped to the repository by five-car, dedicated train. Consolidation is assumed to increase the cask capacity for spent fuel by a factor of 2. The cask is unloaded at the repository and the consolidated spent fuel and NFBC are placed into their respective disposal containers. These containers are then loaded into a transfer cask. Spent fuel from western reactors is shipped by truck and rail (30%/70%) directly to the repository. The intact spent fuel is unloaded and placed into disposal containers. These containers are then loaded into a transfer cask.

The MRS Environmental Assessment presents preliminary information on radiological doses from each of these operations. Occupational doses and doses to the public from routine operations are shown to be larger than the doses resulting from potential accidents. Table 1 presents a summary of this information for System Configuration 5. The values given in the MRS EA are adjusted to account for the fraction of fuel shipped directly to the repository from western reactors. As indicated above, this fraction is assumed to be 10%.

TABLE 1. System Configuration 5 - Dose Results

| Activity | Dose in Person-rem/1000 MTU[a] Public | Worker | Total |
|---|---|---|---|
| Transportation - Eastern Reactors to MRS | 64 | 14 | 78 |
| Transportation - Western Reactors to Repository | 16 | 3 | 19 |
| MRS Cask Receipt | (b) | 52 | 52 |
| MRS Storage Operations | (b) | 20 | 20 |
| MRS Consolidation/Canister | (b) | 5 | 5 |
| MRS Cask Loadout | (b) | 8 | 8 |
| MRS Routine Release | 5 | N/A | 5 |
| Transportation - MRS to Repository | 3 | 1 | 4 |
| Repository Cask Receipt from MRS | (b) | 14 | 14 |
| Repository Cask Receipt from Western Reactors | (b) | 6 | 6 |
| Repository Containerization - MRS Shipments | (b) | 1 | 1 |
| Repository Containerization - Western Reactors | (b) | .2 | .2 |
| Repository Routine Release | <.1 | N/A | <.1 |
| Total | 88 | 124 | 212 |

(a) Per 1000 MTU throughput for the reference system.
(b) Estimates for these operations are included in the routine release estimates.

SYSTEM CONFIGURATION 1

In this configuration, spent fuel from all reactors is shipped by truck and rail (30%/70%) to the repository where it is unloaded. The spent fuel and NFBC are consolidated and placed into disposal containers. These containers are then loaded into a transfer cask. Table 2 presents a summary of the dose results for System Configuration 1.

TABLE 2. System Configuration 1 - Dose Results

| Activity | Dose in Person-rem/1000 MTU[a] Public | Worker | Total |
|---|---|---|---|
| Transportation - Reactors to Repository | 164 | 34 | 198 |
| Repository Cask Receipt | (b) | 58 | 58 |
| Repository Consolidation and Containerization | (b) | 5 | 5 |
| Repository Routine Release | 6 | N/A | 6 |
| Total | 170 | 97 | 267 |

(a) Per 1000 MTU throughput for the reference system.
(b) Estimates for these operations are included in the routine release estimates.

System Configuration 1 has a lower worker dose from the spent fuel handling and processing operations than System Configuration 5. This decrease in dose from the handling and processing activities is offset by an increase in the public and worker dose from the transportation operations.

SYSTEM CONFIGURATION 2

In this configuration, spent fuel from all reactors is shipped to the repository by truck and rail. The intact fuel is unloaded and placed into disposal containers. These containers are then loaded into a transfer cask. Table 3 presents a summary of the dose results for System Configuration 2.

This system configuration has a lower public and worker dose from the spent fuel handling and processing operations than System Configuration 5. This decrease in dose from the handling and processing activities is offset by an increase in the public and worker dose from the transportation operations. This configuration results in a slight decrease in public and worker dose from that of System Configuration 1 due to the elimination of consolidation operations. This decrease is partially offset by an increased

TABLE 3. System Configuration 2 - Dose Results

| Activity | Dose in Person-rem/1000 MTU[a] Public | Worker | Total |
|---|---|---|---|
| Transportation - Reactors to Repository | 164 | 34 | 198 |
| Repository Cask Receipt | (b) | 58 | 58 |
| Repository Containerization | (b) | 2 | 2 |
| Repository Routine Release | <.1 | N/A | <.1 |
| Total | 164 | 94 | 258 |

(a) Per 1000 MTU throughput for the reference system.
(b) Estimates for these operations are included in the routine release estimates.

worker dose from additional containerization operations for the intact fuel. The doses from transportation operations are identical to those of System Configuration 1.

SYSTEM CONFIGURATION 3

In this configuration, spent fuel from eastern reactors is shipped by truck and rail to the MRS where it is unloaded. The intact spent fuel is stored if necessary. The intact spent fuel is loaded into 100-ton rail casks and shipped to the repository by five-car, dedicated train. The cask is unloaded at the repository and the spent fuel and NFBC are consolidated and placed into disposal containers. These containers are then loaded into a transfer cask. Spent fuel from western reactors is shipped directly to the repository by truck and rail where it is consolidated and placed into disposal containers. These containers are then loaded into a transfer cask. Table 4 presents a summary of the dose results for System Configuration 3.

System Configuration 3 has a higher public and worker dose for both the spent fuel handling and processing operations and the transportation operations than System Configuration 5. This increase is due to the additional handling at the MRS and the additional transportation shipments from the MRS required as a result of not consolidating spent fuel at the MRS.

TABLE 4. System Configuration 3 - Dose Results

| Activity | Dose in Person-rem/1000 MTU[a] Public | Worker | Total |
|---|---|---|---|
| Transportation - Eastern Reactors to MRS | 64 | 14 | 78 |
| Transportation - Western Reactors to Repository | 16 | 3 | 19 |
| MRS Cask Receipt | (b) | 52 | 52 |
| MRS Storage Operations | (b) | 40 | 40 |
| MRS Cask Loadout | (b) | 16 | 16 |
| MRS Routine Release | <.1 | N/A | <.1 |
| Transportation - MRS to Repository | 6 | 2 | 8 |
| Repository Cask Receipt from MRS | (b) | 28 | 28 |
| Repository Cask Receipt from Western Reactors | (b) | 6 | 6 |
| Repository Consolidation and Containerization | (b) | 5 | 5 |
| Repository Routine Release | 6 | N/A | 6 |
| Total | 92 | 166 | 258 |

(a) Per 1000 MTU throughput for the reference system.
(b) Estimates for these operations are included in the routine release estimates.

SYSTEM CONFIGURATION 4

In this configuration, spent fuel from eastern reactors is shipped by truck and rail to the MRS where it is unloaded. The intact spent fuel is stored if necessary. The intact spent fuel is loaded into 100-ton rail casks and shipped to the repository by five-car, dedicated train. The intact spent fuel is unloaded and placed into disposal containers. These containers are then loaded into a transfer cask. Spent fuel from western reactors is shipped directly to the repository by truck and rail where it is unloaded and

placed into disposal containers. These containers are then loaded into a transfer cask. Table 5 presents a summary of the dose results for System Configuration 4.

TABLE 5. System Configuration 4 - Dose Results

| Activity | Dose in Person-rem/1000 MTU[a] | | |
|---|---|---|---|
| | Public | Worker | Total |
| Transportation - Eastern Reactors to MRS | 64 | 14 | 78 |
| Transportation - Western Reactors to Repository | 16 | 3 | 19 |
| MRS Cask Receipt | (b) | 52 | 52 |
| MRS Storage Operations | (b) | 40 | 40 |
| MRS Cask Loadout | (b) | 16 | 16 |
| MRS Routine Release | <.1 | N/A | <.1 |
| Transportation - MRS to Repository | 6 | 2 | 8 |
| Repository Cask Receipt from MRS | (b) | 28 | 28 |
| Repository Cask Receipt from Western Reactors | (b) | 6 | 6 |
| Repository Containerization | (b) | 2 | 2 |
| Repository Routine Release | <.1 | N/A | <.1 |
| Total | 86 | 163 | 249 |

(a) Per 1000 MTU throughput for the reference system.
(b) Estimates for these operations are included in the routine release estimates.

System Configuration 4 has a higher public and worker dose for both the spent fuel handling and processing operations and the transportation operations than System Configuration 5. This increase is due to the additional handling at the MRS and the additional transportation shipments from the MRS required as a result of not consolidating spent fuel at the MRS. This configuration results in a slight decrease in public and worker dose from that

of System Configuration 3 due to the elimination of consolidation operations at the repository. This decrease is partially offset by an increased worker dose from additional containerization operations for intact fuel. The doses from transportation operations are identical to those of System Configuration 3.

## CONCLUSIONS

The above results indicate that information in the MRS EA can be used to provide preliminary estimates of the dose from these alternative system configurations. These estimates are based on conceptual systems using conservative assumptions. As shown by the analysis, the dose differences between configurations are small and are dominated by the transportation operations. Due to the preliminary nature of the system design and the potential uncertainties in the dose estimates, the system configurations examined should be viewed as having essentially similar small risks, and any risk differences should not be a major factor in selecting alternative configurations.

## REFERENCE

U.S. Department of Energy (DOE). February 1986. Environmental Assessment for a Monitored Retrievable Storage Facility. Monitored Retrievable Storage Submission to Congress, DOE/RW-0035/1 Vol. II, U.S. DOE, Office of Civilian Radioactive Waste Management, Washington, D.C.

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