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9. Checker	J. Pullen		11/12/99
10. Lead/Supervisor	F. Bierich		11-17-99
11. Responsible Manager	D.G. McKenzie		11/19/99

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ACRONYMS AND ABBREVIATIONS

BDBE	Beyond design basis event
DBE	Design basis event
TBD	to be determined
TBV	to be verified
WES	Waste Emplacement System
WP	waste package
WRS	Waste Retrieval System

1. PURPOSE

The purpose of this analysis is to evaluate impacts to the retrieval concept presented in the Design Analysis *Retrieval Equipment and Strategy* (Reference 6), from abnormal events based on Design Basis Events (DBE) and Beyond Design Basis Events (BDBE) as defined in two recent analyses:

- *DBE/Scenario Analysis for Preclosure Repository Subsurface Facilities* (Reference 4)
- *Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository* (Reference 5)

The objective of this task is to determine what impacts the DBEs and BDBEs have on the equipment developed for retrieval. The analysis lists potential impacts and recommends changes to be analyzed in subsequent design analyses for developed equipment, or recommend where additional equipment may be needed, to allow retrieval to be performed in all DBE or BDBE situations. This analysis supports License Application design and therefore complies with the requirements of Systems Description Document input criteria comparison as presented in Section 7, Conclusions.

In addition, the analysis discusses the impacts associated with not using concrete invert in the emplacement drifts. The *Retrieval Equipment and Strategy* analysis was based on a concrete invert configuration in the emplacement drift.

The scope of the analysis, as presented in *Development Plan for Retrieval Events Evaluation* (Reference 3) includes evaluation and criteria of the following:

- Impacts to retrieval from the emplacement drift based on DBE/BDBEs, and changes to the invert configuration for the preclosure period.
- Impacts to retrieval from the main drifts based on DBE/BDBEs for the preclosure period.

2. QUALITY ASSURANCE

This document was prepared in accordance with AP-3.10Q, *Analysis and Models* (Reference 11) and AP-3.15Q, *Managing Technical Products Inputs* (Reference 12).

The quality assurance classification of repository structures, systems, and components has been performed in accordance with QAP-2-3, *Classification of Permanent Items* (Reference 7). The waste package retrieval system has been classified as a Q-list item by *Classification of the Preliminary MGDS Repository Design* (Reference 8).

This design activity has been evaluated in accordance with QAP-2-0, *Conduct of Activities* (Reference 9), and has been determined to be quality-affecting and therefore is subject to the requirements of the *Quality Assurance Requirements and Description* (Reference 10).

The input data used in this analysis require verification; therefore, the outputs are unqualified. The outputs from this document cannot be used for procurement, fabrication, or construction. The formal process that will be used to capture, track, and status technical product inputs, TBVs (to be verified), and TBDs (to be determined) is described in AP-3.15Q (Reference 12)

3. COMPUTER SOFTWARE AND MODEL USAGE

No engineering or scientific design computer software programs were used in the preparation of this analysis.

4. INPUTS

The design criteria and assumptions used in this analysis are identified in this section.

4.1 PARAMETERS

Not used.

4.2 CRITERIA

The criteria applicable to the retrieval system are listed in the *Retrieval Equipment and Strategy* (Reference 6, Section 4.2). Of the criteria listed in that analysis, the following three apply directly to this evaluation of impacts from DBE/BDBEs. The following design criteria correspond to the referenced requirements contained in the *Waste Retrieval System Description Document* (Reference 1).

- 4.2.1 The system shall have an operational life of 134 years following the start of emplacement (Reference 1, Section 1.2.1.1) (used in Section 6.3).

Operation life is considered to be 34 years emplacement phase and 100 years of extended operation.

- 4.2.2 The system shall be capable of transporting retrieved waste packages to the Waste Handling Building and to a storage area located less than 2.5 miles directly north of the Waste Handling Building (TBV-336) (Reference 1, Section 1.2.1.5) (used in Section 6.3.1).

- 4.2.3 The system shall be designed to perform retrieval with the subsurface emplacement transportation system intact (Reference 1, Section 1.2.1.6). There are no restrictions to the emplacement cycle or to the emplacement equipment design that preclude waste package retrieval under normal conditions. Equipment used for emplacement will be designed for use in normal retrieval (Reference 2, Section 7.9) (used in Section 6.2.2).

4.3 CODES AND STANDARDS

Codes and standards that apply to the retrieval system are listed in the *Retrieval Equipment and Strategy* (Reference 6, Section 4.4). Only one code is directly applicable to this evaluation of

DBE/BDBE impacts, and it is being revised and replaced with the proposed rule, 10 CFR 63 (Reference 13) (used in Section 6.2.1).

5. ASSUMPTIONS

Assumptions applicable to the Waste Retrieval System (WRS) are listed in the *Retrieval Equipment and Strategy* analysis (Reference 6). However, based on additional guidance contained in "Direction to Transition to Enhanced Design Alternate II" (Reference 14), the only applicable assumption is:

- 5.1 The ground support in the repository will be carbon steel (steel sets and/or rock bolts and mesh) with granular ballast in the invert. Cementitious grout will be used to anchor the rock bolts. The amount of grout should be kept to a minimum while affording satisfactory performance of the rock bolts. The ground support shall be maintained during the preclosure period (Reference 14, Section A 5.0).

6. ANALYSIS

6.1 GENERAL

The purpose of this section of the analysis is twofold. First, it evaluates whether the DBE/BDBEs identified in *DBE/Scenario Analysis for Preclosure Repository Subsurface Facilities* (Reference 4) and *Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository* (Reference 5) were adequately addressed in the retrieval concept presented in the *Retrieval Equipment and Strategy* (Reference 6). If it was determined that the DBE/BDBE were not adequately addressed, this is identified. If additional equipment may be required to accommodate the DBE/BDBEs during the retrieval process, this is also identified.

It is not within the scope of this analysis to provide solutions to DBE/BDBE impacts on the retrieval concept. DBE/BDBE impacts are defined as those occurrences that can not be mitigated by normal retrieval methods. It was the intent of this analysis to identify conditions that have not been addressed and to recommend future, detailed evaluations and analyses.

The following steps were followed to determine if additional analyses may be required to address specific DBE/BDBEs.

- The DBE/BDBEs were evaluated to determine which ones interrelate with the retrieval concept defined in the *Retrieval Equipment and Strategy* analysis (Reference 6) as listed in Table 1.
- The potential impacts on the retrieval system defined in the *Retrieval Equipment and Strategy* analysis (Reference 6) were reviewed. A determination was based on whether the DBE/BDBE was adequately addressed.
- If the impact on the WRS by the DBE/BDBEs required future analysis, this was indicated in Table 2.

- Should additional equipment beyond that specified in *Retrieval Equipment and Strategy* (Reference 6) be required, this was noted.

The second function of this analysis is to discuss impacts associated with the use of steel sets and/or rock bolts and mesh with granular ballast instead of concrete for invert in the emplacement drifts.

6.2 DEFINITIONS

Definitions of the terms used in this analysis are presented in the following subsection.

6.2.1 Design Basis Events (DBE/BDBEs)

The current 10 CFR Part 63 (Reference 13, 10 CFR 63.2 *Definitions*) defines two categories of Design Basis Events as follows:

DBE Category	Category Definition
1	Those natural events and human-induced event sequences that are expected to occur one or more times before permanent closure of the geologic repository operations area
2	Other human-induced event sequences that have at least one chance in 10,000 of occurring before permanent closure of the geologic repository, and (b) appropriate consideration of natural events (phenomena) that have been historically reported for the site and the geologic setting.

Event sequences that are estimated to have a frequency less than 1E-6/yr, with a significant margin relative to the uncertainty in the frequency estimate, are deemed incredible or BDBEs.

Because different dose limits apply to each category, and each category is defined as above, it is important to distinguish between the categories by identifying quantitative frequency thresholds between them. It has been established that the lower frequency limit for screening of DBEs should be 1.0E-6/yr (Reference 4, Section 7.2.2.1). Based on a repository preclosure phase of 100 years and the definitions above, the DBE categories used in this analysis are based on the following frequency ranges:

DBE 1	Event Frequency $\geq 1.0\text{E-}2$ per year
DBE 2	$1.0\text{E-}6 \leq \text{Event Frequency} < 1.0\text{E-}2$ per year
BDBE	Event Frequency $< 1.0\text{E-}6$ per year

6.2.2 Retrieval

“Retrieval” is used to indicate removal of groups of WPs or the entire inventory of WPs from the subsurface. “Recovery” is used to indicate selective removal of a small set of WPs from the underground, *Waste Retrieval System Description Document* (Reference 1, Section 1.0). The Waste Retrieval System (WRS) shall be designed to perform WP retrieval with the subsurface emplacement transportation system intact (Reference 1, Section 1.2.1.6). Equipment used for

emplacement will be designed for use in normal retrieval (Reference 2, Section 7.9). The WRS shall provide additional equipment and strategy for the recovery of WPs from abnormal and/or DBE events (Reference 6).

6.3 DBE/BDBE EVALUATION

This section evaluates whether additional analysis may be required to address specific DBE/BDBE impacts on the WRS. During the emplacement phase, the Waste Emplacement System (WES) equipment will be used to retrieve WPs. Normal retrieval is essentially the same as the emplacement, but with the steps in reverse order (Reference 2, Section 7.9). The WRS shall be in place during the 34-year emplacement phase as well as an operational period of 100 years after the emplacement phase is completed (Reference 1, Section 1.2.1.1). Impact analysis for DBE/BDBE must include the 134-year operation period. Retrieval of WPs under abnormal conditions such as a DBE/BDBE event may require additional retrieval equipment (beyond the waste emplacement system), such as the emplacement drift gantry carrier and the multipurpose hauler discussed in Section 6.4.2.

6.3.1 DBE/BDBE Interactions on Waste Retrieval System

This section presents the DBE/BDBEs identified in the following analyses:

- *DBE/Scenario Analysis for Preclosure Repository Subsurface Facilities* (Reference 4)
- *Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository* (Reference 5)

Because these analyses address DBE/BDBEs for the entire waste storage process, some of the DBE/BDBEs are not associated with the retrieval concept. Table 1 presents the list of the DBE/BDBEs, it states whether the event is a DBE or a BDBE, and identifies whether the DBE/BDBE could interrelate with the retrieval operation. Because the retrieval process includes both subsurface operations and surface elements, including delivery of the retrieved waste package (WP) to the Waste Handling Building and to a storage area less than 2.5 miles directly north of the Waste Handling Building (Reference 1, Section 1.2.16), Table 1 also identifies if the potential DBE/BDBE interaction would be a surface or subsurface activity.

Table 1. DBE/BDBE Interactions with Retrieval Equipment and Strategy

DBE/BDBE		Interrelates with <i>Retrieval Equipment and Strategy</i>		Interrelationship/Comment
Event Description	Type	Yes or No	Surface or Subsurface	
DBE/Scenario Analysis for Preclosure Repository Subsurface Facility ^a				
Transporter Derailment in Ramp or Main Drift	DBE	Yes	Subsurface	Potential derailment with roll-over during the retrieval process.
Emplacement Gantry Derailment – Normal Speed	BDBE	Yes	Subsurface	Potential derailment during the retrieval process.

Table 1. DBE/BDBE Interactions with Retrieval Equipment and Strategy (continued)

DBE/BDBE		Interrelates with <i>Retrieval Equipment and Strategy</i>		Interrelationship/Comment
Event Description	Type	Yes or No	Surface or Subsurface	
Emplacement Gantry Derailment – Gantry Runaway	BDBE	Yes	Subsurface	Potential derailment during the retrieval process.
Waste Package reusable car is ejected out of Transporter	BDBE	Yes	Subsurface	Potential drop of WP during retrieval onto tracks, impacts similar to derailment.
Runaway Transporter (with WP)	DBE	Yes	Subsurface	Potential derailment, crash into wall. Crash into ground support and potentially initiate rockfall or other event.
Runaway Transporter (without WP)	DBE	Yes	Subsurface	Potential to roll back and collide with another transporter train during retrieval.
Emplacement Gantry WP lifting mechanism fails	DBE	Yes	Subsurface	Potential inability to complete retrieval operation, stuck WP. Potential to drop WP onto pedestal.
Rockfall/Ground support fall onto transporter	BDBE	Yes	Subsurface	Potential to impact/breach transporter car and WP during retrieval.
Rockfall/Ground support fall onto locomotive	BDBE	Yes	Subsurface	Potential to halt train, disrupt electrical supply, initiate electrical discharge and/or fire during retrieval.
Rockfall and/or Ground Support collapse onto waste package – static rockfall	DBE	Yes	Subsurface	Potential for rockfall and/or ground support collapse from static forces during the retrieval operation.
Rockfall and/or Ground Support collapse onto waste package – seismic induced, beyond DBE earthquake	BDBE	Yes	Subsurface	Potential for rockfall and/or ground support collapse from seismic forces greater than DBE criteria during the retrieval operation.
Fire/Explosion	Defer to future analysis	Yes	Subsurface	Potential damage to equipment and WP. DBE determination deferred to future analyses.
Thermal cycling of waste package	Not in scope of subsurface design	No	Surface and Subsurface	Potential to induce crack growth in WP.
Thermal cycling of emplacement drift ground support	Defer to future analysis	No	Subsurface	Potential deterioration of ground support strength leading to rockfall and or lining fall. Covered in other events. DBE determination deferred to future analyses
Aircraft Crash	Ongoing Analysis	Yes	Surface	Ongoing analysis to determine if DBE or BDBE. Potential interrelationship during period that the WP is transported from the portal to the waste handling building or storage area.
Debris Avalanche	BDBE	Yes	Surface	Potential debris falling on transporter/WP at the North Portal.
Dissolution	DBE	No	Subsurface	Dissolution is the process of chemical weathering of rock. This is covered in the other rockfall events.

Table 1. DBE/BDBE Interactions with Retrieval Equipment and Strategy (continued)

DBE/BDBE		Interrelates with <i>Retrieval Equipment and Strategy</i>		Interrelationship/Comment
Event Description	Type	Yes or No	Surface or Subsurface	
Extreme Wind	DBE	Yes	Surface	From the portal to the waste treatment building or storage area, wind loading on the side of the transport car could cause a derailment or rollover.
Extreme Weather Fluctuations	DBE	Yes	Surface	Weather conditions including fog, frost, hail, high and low temperature, ice cover, snow, etc., might lead to derailments.
Fire (range)	Ongoing analysis	Yes	Surface	Ongoing analysis to determine if DBE or BDBE. The transporter car and locomotives may be subject to fire damage and heat intensity sufficient to be a threat to WP integrity.
Flooding (storm, river, diversion)	DBE	Yes	Surface	Surface operations could be affected including slippery tracks in the ramp contributing to a runaway transporter.
Inadvertent Future Intrusions (man-made)	BDBE	No	Surface	No interrelationship for the preclosure phase because the safeguards and Security Plan will provide necessary physical and administrative controls.
Industrial-Activity-Induced Accident	Ongoing analysis	Yes	Surface and subsurface	Ongoing analysis to determine events that may fall in this category and if these events are DBE or BDBE
Intentional Future Intrusion (man-made)	BDBE	No	Surface and subsurface	No interrelationship for the preclosure phase because the safeguards and Security Plan will provide necessary physical and administrative controls.
Landslide	BDBE	--	--	See Debris Avalanche
Lightning/Direct Strike to WP Transporter Car	BDBE	Yes	Surface	Potential exists from portal to waste handling building.
Loss of Offsite/ Onsite Power	DBE	Yes	Surface and Subsurface	Many parts of the retrieval system require electrical power.
Military Activity-Induced Accident	Ongoing analysis	Yes	Surface and subsurface	Ongoing analysis to determine potential events and if DBE or BDBE
Rainstorm	DBE	Yes	Surface	Included in flooding.
Sandstorm	DBE	Yes	Surface	Track conditions and sand on the tracks might lead to derailments.
Seismic Activity including, earthquake, Surface Fault Displacement, Subsurface Fault Displacement	Ongoing analysis	Yes	Surface and Subsurface	Seismic events are considered credible and are part of the principal design and characterization studies for the repository. Consequences will be evaluated in future work. DBE/BDBE status has not been finalized.
Static Fracturing	--	--	--	Included in Static Rockfall below
Tornado	Ongoing analysis	Yes	Surface	Potential for transporter derailment and wind-driven missiles. Ongoing analysis to determine if DBE or BDBE
Volcanism, Ash Fall	BDBE	Yes	Surface	Potential weight loading and potential cause of derailing.
Events in Repository Development Sector (explosions, fires, other)	Ongoing analysis	Yes	Subsurface	Potential events in this category are yet to be determined.

Table 1. DBE/BDBE Interactions with Retrieval Equipment and Strategy (continued)

DBE/BDBE		Interrelates with <i>Retrieval Equipment and Strategy</i>		Interrelationship/Comment
Event Description	Type	Yes or No	Surface or Subsurface	
Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository ^b				
Rockfall onto WP (21-PWR & 44- BWR)	DBE	Yes	Subsurface	Covered in rockfall and/or ground support collapse on WP (static and/or seismic induced).
Transporter Runaway (21-PWR & 44-BWR)	DBE	Yes	Subsurface	Covered in runaway transporter with WP.

Sources:

^a Reference 4, Table 8-1 and 8-2, pages 194, 195, 199.

^b Reference 5, Table 6.5-1, page. 39.

6.3.2 Additional Analysis Requirements

For those DBE/BDBEs identified in Table 1 as having potential interactions with the retrieval process, this section identifies if the *Retrieval Equipment and Strategy* (Reference 6) considers and addresses the DBE/BDBE. Any additional design analysis that may be required are also recommended.

Table 2 shows the DBE/BDBEs that interrelate with the WRS and assesses whether additional analysis is required. DBE/BDBEs that do not interrelate with the WRS are not shown on this table. In addition, potential equipment types have been identified if planning for the DBE/BDBEs indicates that additional or different equipment would be required.

Table 2. DBE/BDBE Interactions and Additional Analysis Requirements

DBE/BDBE Event Description	Addressed in <i>Retrieval Equipment and Strategy</i> Analysis ^a	Needs to be Addressed in Future Analysis	Comment	Potential Equipment that May Require Future Analysis
DBE/Scenario Analysis for Preclosure Repository Subsurface Facility ^b				
Transporter Derailment in Ramp or Main Drift	Yes	No	Adequately addressed	No
Emplacement Gantry Derailment – Normal Speed	Yes	No	Adequately addressed	No
Emplacement Gantry Derailment – Gantry Runaway	Yes	No	Adequately addressed	No
Waste Package reusable car is ejected out of Transporter	Yes	No	Adequately addressed	No

Table 2. DBE/BDBE Interactions and Additional Analysis Requirements (continued)

DBE/BDBE Event Description	Addressed in <i>Retrieval Equipment and Strategy Analysis</i> ^a	Needs to be Addressed in Future Analysis	Comment	Potential Equipment that May Require Future Analysis
Runaway Transporter (with WP)	Yes	No	Adequately addressed	No
Runaway Transporter (without WP)	Yes	No	Adequately addressed	No
Emplacement Gantry WP lifting mechanism fails	Yes	No	Adequately addressed	No
Rockfall/Ground support fall onto transporter	Yes	No	Adequately addressed	No
Rockfall/Ground support fall onto locomotive	Yes	No	Adequately addressed	No
Rockfall and/or Ground support collapse onto waste package – static rockfall	Yes	No	Adequately addressed	No
Rockfall and/or ground support collapse onto waste package – seismic induced, beyond DBE earthquake	Yes	No	Adequately addressed	No
Fire/Explosion	No	Yes	DBE determination deferred to future analyses. Possible analysis depending on findings of this DBE determination.	Possible additional equipment or modifications.
Aircraft Crash	No	Yes	Ongoing analysis to determine if DBE or BDBE. Depending on the results of this ongoing analysis, decision as to need for additional study should be made.	No
Debris Avalanching	Yes	No	Design of the portal facility should fully address this potential event to the specified level of protection	No
Extreme Wind	No	Yes	Because of the potential for interrelations between the retrieval process and several weather events at the surface, analysis of a covered/enclosed travel way from the portal to the storage area may be appropriate.	Cover/enclosure of travel way from the portal to the waste handling building or storage area.
Extreme Weather Fluctuations	No	Yes	See Extreme Wind event above.	Cover/enclosure of travel way from the portal to the waste handling building.
Fire (range)	No	Yes	Ongoing analysis to determine if DBE or BDBE. Depending on the results of this ongoing analysis, decision as to need for additional study should be made.	No

Table 2. DBE/BDBE Interactions and Additional Analysis Requirements (continued)

DBE/BDBE Event Description	Addressed in <i>Retrieval Equipment and Strategy Analysis</i> ^a	Needs to be Addressed in Future Analysis	Comment	Potential Equipment that May Require Future Analysis
Flooding (storm, river, diversion)	No	Yes	Potential cover and adequate surface runoff control should be reviewed.	Cover/enclosure of travel way from the portal to the waste handling building.
Industrial-Activity-Induced Accident	No	Yes	Ongoing analysis to determine events that may fall in this category and if these events are DBE or BDBE	Potentially, depending on results of other analyses.
Lightning/Direct Strike to WP Transporter Car	No	Yes	Potential exists from portal to 2.5 miles beyond waste handling building	Specific protection from lightning.
Loss of Offsite/Onsite Power	Yes	Yes	While the need for electrical power, including backup, was discussed, an analysis of backup systems should be conducted.	Backup electrical equipment (batteries, generators, etc.) should be analyzed.
Military-Activity-Induced Accident	No	Yes	Ongoing analysis to determine potential events and if DBE or BDBE	Potentially, depending on results of other analyses.
Sandstorm	No	No	Administration procedures should address such events.	No
Seismic Activity including, earthquake, Surface Fault Displacement, Subsurface Fault Displacement	Yes	Yes	Seismic events are considered credible and are part of the principal design and characterization studies for the repository. Consequences should be evaluated in future work. DBE/BDBE status has not been finalized.	To be included in potential equipment design.
Tornado	No	Yes	Potential for transporter detachment and wind-driven missiles. Ongoing analyses to determine if DBE or BDBE.	See Extreme Wind above.
Volcanism, Ash Fall	No	No	Administrative procedures and controls should accommodate this event.	No
Events in Repository Development Sector (explosions, fires, other)	No	Yes	Potential events in this category are yet to be determined. Events that are identified should be analyzed.	Potentially, depending on results of other analyses.
Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository ^c				
Rockfall onto WP (21-PWR & 44-BWR)	Yes	No	Adequately addressed	No
Transporter Runaway (21-PWR & 44-BWR)	Yes	No	Adequately addressed	No

Source:

^a Reference 6, Sections 7.2.4 and 7.2.5, pp. 41-61.^b Reference 4, Table 8-1 and 8-2, pages 194, 195, 199.^c Reference 5, Table 6.5-1, page. 39.

6.4 INVERT MODIFICATION EVALUATION

6.4.1 Emplacement Drift Invert Modifications

The *Retrieval Equipment and Strategy* (Reference 6) developed a strategy for recovering WPs under abnormal conditions. The strategy was based on retrieval equipment that could operate on the concrete inverts that were being designed for the emplacement drifts. Subsequent to that analysis, it was determined that ground support in the repository would be carbon steel (steel sets and/or rock bolts and mesh) with granular ballast (Reference 15, Section A 5.0). This final concept has not been completed at this time, but the fact that the concrete inverts will not be used impacts the conclusions of the *Retrieval Equipment and Strategy*.

6.4.2 Retrieval Equipment Impacted

Two pieces of retrieval equipment that were developed in the *Retrieval Equipment and Strategy* (Reference 6) and were based on the use of the concrete inverts in the emplacement drifts are:

- Emplacement Drift Gantry Carrier, shown in Figure 1 (Reference 6, Section 7.2.5.10)
- Multipurpose Hauler, shown in Figure 2 (Reference 6, Section 7.2.5.12)

These two pieces of equipment were conceptually developed to operate on rollers directly on the concrete invert between the gantry rails. This concept lowered the total height of the equipment, because use of rubber tires or tracks made the equipment too tall to operate effectively within the emplacement drift. The use of rollers also allowed the equipment to operate within the emplacement drift even if the gantry rails were damaged. Table 3 lists the DBE/BDBEs for which the previously developed recovery strategy will be impacted because the emplacement drift gantry carrier and the multipurpose hauler will not be able to operate as conceptually developed.

Table 3. DBE/BDBE Potentially Impacted

Emplacement gantry derailment – normal speed
Emplacement gantry derailment – gantry runaway
Emplacement gantry waste package lifting mechanism fails
Rockfall and/or ground support collapse onto waste package – static rockfall
Rockfall and/or ground support onto waste package – seismic induced, beyond DBE earthquake

6.4.3 Recommendations for Evaluation of Impact Resolution

The effects of the DBE/BDBEs that are listed in Table 3 on the retrieval equipment described in Section 6.4.2 should be evaluated following finalization of the emplacement drift invert concept. The resolution of the impacts could take one of two forms:

Figure 1. Emplacement Drift Gantry Carrier

NOTES: Removable enclosure over DC with HEPA filters slides onto deck on rails/slots. Roll-down door drops to seal. Deck would be equipped with slots and other openings for attaching guides, equipment, fasteners, rails. Roller locations are interchangeable, depending on intended loads and rail configuration.

Figure 2. Multipurpose Hauler

- The equipment concept could be revised to use rubber tires or tracks that could operate within the gantry rails over the selected invert concept. This may require the equipment be customized to reduce the overall height in the equipment structure, rather than in the equipment mobility system.
- It may be necessary to revise the final emplacement drift invert design to accommodate the WRS equipment. For example, the invert surface could be retrofitted with a surface material that would allow the equipment to operate with rollers as conceptually developed.

7. CONCLUSIONS

7.1 DBE/BDBES REQUIRING ADDITIONAL ANALYSIS

As detailed in Table 2, it is recommended that the WRS should be analyzed for the effects of the following DBE/BDBEs.

- Fire/Explosion
- Aircraft Crash
- Extreme Wind (includes tornado winds/missiles)
- Extreme Weather Fluctuations
- Fire (range)
- Flooding (storm, river, diversion)
- Industrial Activity Induced Accident
- Lightning Direct Strike to WP Transporter Car
- Loss of Offsite/Onsite Power
- Military Activity Induced Accident
- Seismic Activity (earthquake, surface fault displacement, subsurface fault displacement)
- Events in Repository Development Sector (explosions, fires, other)

Six of the DBE/BDBEs are surface related (aircraft crash, extreme wind and weather, range fire, flooding, and lighting). One DBE/BDBE is strictly subsurface related (events in the repository development sector), and the remaining five DBE/BDBEs are related to both surface and subsurface (fire/explosion, loss of power, seismic activity, industrial activity-induced accident, and military activity induced accident). It is also acknowledged there are on-going analyses for several of the preceding DBE/BDBEs.

The requirement that the WRS transport WPs to the Waste Handling Building and waste storage area less than 2.5 miles directly north of the Waste Handling Building (Criterion 4.2.2, TBV 336) impacts the conclusion of this analysis. Resolution of TBV 336 will be a determining factor of the bounding conditions that will apply to the analyses for the eleven surface-related DBE/BDBEs identified above. It may be possible that a future screening of these DBE/BDBEs after the bounding conditions have been established will determine that some of the eleven surface-related events may not need to be addressed.

This analysis concludes that all of the other DBE/BDBEs listed in Table 1 are adequately addressed in the *Retrieval Equipment and Strategy* (Reference 6).

7.2 IMPACTS OF NOT USING CONCRETE INVERTS

The retrieval strategy plan for the DBE/BDBEs listed in Table 3 will be affected by the change from concrete invert to steel sets and/or rock bolts and mesh with granular ballast in the emplacement drifts. The emplacement drift gantry carrier and the multipurpose hauler will not operate as conceptually developed (Section 6.4). To evaluate the effect created by the change in the invert design, it will be necessary to revisit the *Retrieval Equipment and Strategy* analysis (Reference 6). There are other subsurface systems that could be impacted by this emplacement drift invert design change. They are not part of the scope of this analysis and, therefore, have not been evaluated in this analysis.

7.3 CRITERIA COMPARISON

This section compares the criteria derived from the *Waste Retrieval System Description Document* (Reference 1) and the results of this analysis to show what criteria have been met and to identify criteria that need further proof. Only the criteria listed in Section 4.2 of this analysis have been evaluated.

- 7.3.1 Criterion 4.2.1 (SDD 1.2.1.1) Retrieval system operational life of 134 years was used when specific DBE/BDBEs were examined.
- 7.3.2 Criterion 4.2.2 (SDD 1.2.1.5) DBE/BDBEs events that are associated with the WRS surface transportation requirements were identified and included in the recommended list for further analysis of the WRS.
- 7.3.3 Criterion 4.2.3 (SDD 1.2.1.6) Waste retrieval is defined as the transportation of WPs when the Subsurface Transportation System is intact.

ATTACHMENTS

Attachment	Title
I	Document Input Reference Sheets

ATTACHMENT I

DOCUMENT INPUT REFERENCE SHEETS

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT DOCUMENT INPUT REFERENCE SHEET									
1. Document Identifier No./Rev.: ANL-WRS-ME-000001 Rev. 00		Change: None		Title: Retrieval Events Evaluations					
Input Document		3. Section	4. Input Status	5. Section Used in	6. Input Description	7. TBV/TBD Priority	8. TBV Due To		
2. Technical Product Input Source Title and Identifier(s) with Version							Unqual.	From Uncontrolled Source	Un-confirmed
2a	CRWMS M&O (Civilian Radioactive Waste Management System Management and Operating Contractor) 1998. <i>Waste Retrieval System Description Document</i> . BCA000000-01717-1705-00018 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980903.0869.	1.2.1.5	TBV-336	4.2.2, 7.1	The system shall be capable of transporting retrieved WPs to the Waste Handling building and to a storage area less than 2.5 miles north of the Waste Handling Building	2	X	---	---
1									
1		1.2.1.5	TBV-336	6.3.1	The retrieval system shall be capable of transporting the WP up to 2.5 miles north of the Waste Handling Building	2	X	---	---
1		1.2.1.1	N/A	4.2.1, 6.3	The system shall have an operational life of 134 years following the start of emplacement.	N/A	N/A	N/A	N/A
1		1.2.1.6	N/A	4.2.3, 6.2.2	The system shall be designed to perform retrieval with the subsurface emplacement transportation system intact.	N/A	N/A	N/A	N/A
1		Section 1	N/A	6.2.2	Definition of "retrieval" and "recovery"	N/A	N/A	N/A	N/A

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT DOCUMENT INPUT REFERENCE SHEET									
1. Document Identifier No./Rev.: ANL-WRS-ME-000001 Rev. 00		Change: None		Title: Retrieval Events Evaluations					
Input Document			4. Input Status	5. Section Used in	6. Input Description	7. TBV/TBD Priority	8. TBV Due To		
2. Technical Product Input Source Title and Identifier(s) with Version		3. Section					Unqual.	From Uncontrolled Source	Un-confirmed
2a	CRWMS M&O 1997. <i>DBE/Scenario Analysis for Preclosure Repository Subsurface Facilities</i> . BCA000000-01717-0200-00017 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980218.0237.	Table 8.1	N/A	6.3.1 & 6.3.2	Table 8.1 Summary Grouping and Screening of External Events for Transportation and Emplacement Operations Event Category list.	N/A	N/A	N/A	N/A
4									
4		Table 8.2	N/A	6.3.1 & 6.3.2	Table 8.2 Summary of Screening Analysis of Internal Events for Subsurface Facilities Events Description list	N/A	N/A	N/A	N/A
4		7.2.2.1	N/A	6.2.1	Definition of DBE event frequency	N/A	N/A	N/A	N/A

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT DOCUMENT INPUT REFERENCE SHEET									
1. Document Identifier No./Rev.: ANL-WRS-ME-000001 Rev. 00		Change: None		Title: Retrieval Events Evaluations					
Input Document		3. Section	4. Input Status	5. Section Used in	6. Input Description	7. TBV/TBD Priority	8. TBV Due To		
2. Technical Product Input Source Title and Identifier(s) with Version							Unqual.	From Uncontrolled Source	Un-confirmed
2a	CRWMS M&O 1998. <i>Retrieval Equipment and Strategy</i> . BCAF00000-01717-0200-00008 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990414.0212.	7.2.4 & 7.2.5	N/A	Table 2, 6.2.2, 7.2	Provide input to table from 7.2.4 Mitigation for Abnormal Conditions from Retrieval System Design Events 7.2.5 Mitigation/Retrieval Equipment	N/A	N/A	N/A	N/A
6									
6		7.2.5.10	N/A	6.4.2	7.2.5.10 Equipment description of Drift Gantry Carrier	N/A	N/A	N/A	N/A
6		7.2.5.12	N/A	6.4.2	7.2.5.12 Equipment description of Multipurpose Hauler	N/A	N/A	N/A	N/A
6		Section 4.4	N/A	4.3	4.4 Codes & Standards	N/A	N/A	N/A	N/A
6		Global	N/A	6.1, 7.1		N/A	N/A	N/A	N/A

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