BSC

Calculation/Analysis Change Notice

Complete only applicable items.

1. QA: ~~NA (draft)~~ QA 8/8/08

3. Document Identifier:	4. Rev.:	5. CACN:
000-PSA-MGR0-00800-000-00A	00A	002

6. Title:
Intra-Site Operations and BOP Event Sequence Development Analysis

7. Reason for Change:
Correct errors in response to Condition Reports (CRs) 11989 and 12105.

8. Supersedes Change Notice: ☐ Yes If, Yes, CACN No.: _____ ☒ No

9. Change Impact:

Inputs Changed:	☐ Yes	☒ No	Results Impacted:	☐ Yes	☒ No
Assumptions Changed:	☐ Yes	☒ No	Design Impacted:	☐ Yes	☒ No

10. Description of Change:

1. Page 13; Section 1: To resolve action 005 for CR 11989, the text in the bullet at the top of the page was rewritten to state that intentional malevolent acts such as sabotage were considered in a separate safeguards and security analysis performed by others. Although CR 11989 specifically addressed the need for this change in *Intra-Site Operations and BOP Reliability and Event Sequence Categorization Analysis* (000-PSA-MGR0-00900-000-00A), this change is also being made to *Intra-Site Operations and BOP Event Sequence Development Analysis* (000-PSA-MGR0-00800-000-00A) to maintain the consistency between these two documents.
2. To resolve action 013 for CR 12105, blank cells in Tables 6 and 10 were populated with 'N/A.'

11. REVIEWS AND APPROVAL

Printed Name	Signature	Date
11a. Originator: L.A. Plumb		8/5/08
11b. Checker: P.T. Le		8/5/08
11c. EGS: M.V. Frank		8/6/08
11d. DEM: M.V. Frank		8/6/08
11e. Design Authority: B.E. Rusinko	B Rusinko	8/7/08

strength) are not within the scope of the PCSA. Such potential precursors are subject to deterministic regulations (e.g., 10 CFR 50, 71 and 72) and associated quality assurance (QA) programs. As a result of compliance to such regulations, the SSCs are deemed to pose no undue risk to health and safety. Although the analyses do not address quantitative probabilities, it is clear that very conservative design criteria and QA result in very unlikely exposures to radiation.

A risk informed approach to event sequence identification is followed. SSC and personnel activities that are associated with the direct handling of high-level radioactive waste (HLW) and low-level radioactive waste (LLW) are included in the event sequence analysis because these activities are much more safety significant than the non-waste-handling activities (e.g., movement of empty aging overpacks). However, earthquake induced interactions of SSCs not involved in waste handling activities with those that are involved with waste handling activities are quantitatively analyzed elsewhere in a separate seismic event sequence analysis, and are not included herein. Other such interactions are analyzed qualitatively and are documented in a separate analysis, also not included herein.

Other boundary conditions used in the PCSA include:

- Plant operational state. Initial state of the facility is normal with each system operating within its vendor prescribed operating conditions.

- No other simultaneous initiating events. It is standard practice to not consider the occurrence of other initiating events (human-induced or naturally occurring) during the time span of an event sequence because: (a) the probability of two simultaneous initiating events within the time window is small and, (b) each initiating event will cease operations of the waste handling facility, which further reduces the conditional probability of the occurrence of a second initiating event, given the first has occurred.

- Component failure modes. The failure mode of a structure, system, or component (SSC) corresponds to that required to make the initiating or pivotal event occur.

- Fundamental to the basis for the use of industry-wide reliability parameters within the PCSA, such as failure rates, is the use of SSCs within the GROA that conform to NRC accepted consensus codes and standards, and other regulatory guidance.

- Intentional malevolent acts, such as sabotage and other security threats, were considered in a separate safeguards and security analysis performed by others

The scope of the present analysis includes the following activities:

- Site transportation activities
  - Security and radiological inspections
  - Movement of transportation casks from the GROA boundary to buffer areas and to waste handling facilities

Table 6. Example HAZOP for Intra-Site Operations (with Emphasis on Initiating Event Branch Relevant to Site Transportation Activities)

Facility/Operation: Intra-Site Operations					Process: Rail TC Transit		
Node 3: TC (TAD Canister, DPC, DC) Movement from Cask Receipt Security Station to Railcar Buffer Area					Process/Equipment: SPM/Railcar		
Guide Words: No, More, Less, Reverse, Other Than, As Well As, Part Of					Consequence Categories: Radioactive Release, Direct Exposure, Criticality		
Node Item Number	**Parameter**	**Deviation Considered**	**Postulated Cause**	**Consequence(s)**	**Potential Prevention/Mitigation Design of Operational Feature**	**Notes**	**MLD Index Number**
3.1	Speed	(More) SPM moves at faster than desired speed	Driver drives SPM faster than desired speed	Potential loss of control or collision leading to radioactive release	1 – TC in 10 CFR Part 71 configuration [a] 2 – Speed control feature on SPM engine 3 – Procedures and training	Safe speed of 5 mph or less expected	EX-501
3.2	Speed	(More) SPM moves at faster than desired speed	Mechanical failure of SPM	Potential loss of control or collision leading to radioactive release	1 – TC in 10 CFR Part 71 configuration 2 – Procedures and training	Safe speed of 5 mph or less expected	EX-501
3.3	Speed	(Less) SPM moves at slower than desired speed	Mechanical failure of SPM	No safety consequences	N/A	N/A	N/A
3.4	Speed	(No) SPM does not move	1 – Human failure 2 – Mechanical failure of SPM	No safety consequences	N/A	N/A	N/A
3.5	Direction	(Reverse) SPM moves backward instead of going forward	1 – Human failure (chock, set brake) 2 – Failure of brake	Potential collision leading to radioactive release	1 – TC in 10 CFR Part 71 configuration 2 – Procedures and training 3 – Brake design	N/A	EX-501
3.6	Direction	(Other Than) Derailment of railcar	1 – Human failure 2 – Mechanical failure of railcar	Potential collision leading to radioactive release	1 – TC in 10 CFR Part 71 configuration 2 – Procedures and training 3 – Brake design	N/A	EX-503
3.7	Direction	(Other Than) Derailment of railcar	Rail distortion due to structural failure	Potential drop leading to radioactive release	1 – TC in 10 CFR Part 71 configuration 2 – Procedures and training 3 – Rail design	N/A	EX-503
3.8	Temperature	(More) Temperature exceeds TC design basis	Fire caused by or involving SPM	1 – Potential radioactive release 2 – Potential criticality	1 – Procedures and training 2 – Combustible materials control	10 CFR Part 71 temperature design basis	EX-F403 [b]
3.9	Temperature	(Less) Temperature does not exceed design basis	Normal condition	No safety consequences	TC in 10 CFR Part 71 configuration	10 CFR Part 71 temperature design basis	N/A
3.10	Shielding	(Less) Displacement of TC shielding	Impact or fire	Potential direct exposure	1 – TC in 10 CFR Part 71 configuration 2 – Procedures and training 3 – Combustible materials control	N/A	EX-F403 and EX-502 [b]
3.11	Shielding	(No) Total displacement of TC shielding	No cause identified	N/A	N/A	N/A	N/A

NOTE: [a] 10 CFR Part 71 (Ref. 2.3.2).
[b] MLD index numbers EX-F403 and EX-502 are included in the table for completeness. They are not used further in the Intra-Site Operations example.
Guidewords not used in this node: As Well As and Part Of.
DC = disposable canister; DPC = dual-purpose canister; EX = example; MLD = master logic diagram; SPM = site prime mover; TAD = transportation, aging, and disposal; TC = transportation cask.

Source: Original

To facilitate ESD development, a unique identification number has been assigned to each initiating event. The numbers consist of "ISO-" to identify the facility, followed by a three- or four-digit number. The last two digits of the identification numbers uniquely identify events on each page of the MLD. The first one or two digits specify the MLD page number. For example, "ISO-503" means "initiating event 03 on the page 5 of the MLD" and "ISO-1001" means "initiating event 01 on page 10 of the MLD." A slightly different convention has been used for external events: a prefix "E" has been inserted before the page number. Thus, "ISO-E202" means "external initiating event 02 on page 2 of the MLD." For internal events relating to fire, an "I" has been inserted before the page number. Thus, "ISO-I402" means "internal fire initiating event 02 and page 4 of the MLD."

A comprehensive list of initiating events identified by the MLD and HAZOP evaluation is provided in Table 9 for external events and Table 10 for internal events.

Table 9. List of External Initiating Events

Initiating Event Identifier	Initiating Event Description
ISO-E201	Exposure due to seismic events
ISO-E202	Non-seismic geologic activity (including landslides, avalanches)
ISO-E203	Volcanic activity
ISO-E204	Extreme winds/tornadoes (including wind effects from hurricanes)
ISO-E205	External floods
ISO-E206	Lightning
ISO-E207	Loss of power events
ISO-E208	Loss of cooling capability events (non-power cause, including biological events)
ISO-E209	Aircraft crash
ISO-E210	Nearby industrial/military facility events (including transportation events)
ISO-E211	Onsite hazardous materials release
ISO-E212	External fires (including forest fires, grass fires)
ISO-E213	Extraterrestrial activity (including meteorites, falling satellites)

Source: Original

Table 10. List of Internal Initiating Events

Identifier	General Event Description	MLD Figure #	HAZOP Table #	ESD Figure #
ISO-I401	Fire at Aging Facility	D-4	N/A	F-9
ISO-I402	Fire affects TC during movement between GROA boundary and either buffer area or handling facility	D-4	E-3, E-4, E-5, E-6, E-7	F-9
ISO-I403	Fire affects TC during staging in buffer area	D-4	N/A	F-9
ISO-I404	Fire affects AO, HTC, or HSTC during movement among facilities or to/from Aging Facility	D-4	E-8, E-9, E-11	F-9
ISO-501	RC collision leads to TC impact	D-5	E-3, E-4, E-5, E-6	F-1

Table 10. List of Internal Initiating Events (Continued)

Identifier	General Event Description	MLD Figure #	HAZOP Table #	ESD Figure #
ISO-502	TT collision leads to TC impact	D-5	E-3, E-7	F-1
ISO-503	RC derailment leads to TC rollover	D-5	E-4, E-5, E-6	F-1
ISO-504	Drop of object onto TC	D-5	E-2	F-1
ISO-601	Impact to HTC or HSTC during movement via cask tractor and CT trailer	D-6	E-11	F-3
ISO-602	Cast tractor/CT trailer drops an HTC or HSTC	D-6	E-11	F-3
ISO-701	ST collision causes impact to AO	D-7	E-8, E-9, E-10	F-2
ISO-702	ST drops AO	D-7	E-8, E-9, E-10	F-2
ISO-801	Collision during loading/unloading operations of LLW container	D-8	N/A	F-8
ISO-802	Drop during loading/unloading operations of LLW container	D-8	N/A	F-8
ISO-803	Collision during loading/unloading operations of LLW container or transfer pipe/equipment	D-8	N/A	F-8
ISO-804	Failure of transfer equipment during loading/unloading of LLW	D-8	N/A	F-8
ISO-805	Collision during transport of LLW container	D-8	N/A	F-8
ISO-806	Drop during transport of LLW container	D-8	N/A	F-8
ISO-807	Collision during transport of LLW container	D-8	N/A	F-8
ISO-808	Failure of equipment during transport of LLW	D-8	N/A	F-8
ISO-809	Loss of containment boundary	D-8	N/A	F-8
ISO-901	Impact to cask (HTC or HSTC) or canister or HAM during insertion and retrieval activities at HAM	D-9	N/A	F-4
ISO-1001	Impact to HAM involving auxiliary equipment	D-10	N/A	F-4
ISO-1002	Impact with HTC or HSTC involving auxiliary equipment at HAM location	D-10	N/A	F-3
ISO-1101	Impact to a single LLW container at the LLWF	D-11	N/A	F-5
ISO-1102	Non-fire event involving all LLW containers	D-11	N/A	F-6
ISO-1103	Fire event involving all combustible LLW in the LLWF	D-11	N/A	F-7

NOTE: [a] Screened from consideration. Refer to *Intra-Site Operations and BOP Reliability and Event Sequence Categorization Analysis* (Ref. 2.4.1, Section 6.0).

AO = aging overpack; CT = cask transfer; ESD = event sequence diagram; HAM = horizontal aging module; HSTC = horizontal shielded transfer cask; ISO = Intra-Site Operations; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; MLD = master logic diagram; RC = railcar; SPM = site prime mover; ST = site transporter; TC = transportation cask; TT = truck trailer; WHF = Wet Handling Facility.

Source: Original