BSC

Calculation/Analysis Change Notice

Complete only applicable items.

3. Document Identifier:	4. Rev.:	5. CACN:
000-PSA-MGR0-00400-000-00A	00A	002

6. Title:
Subsurface Operations Event Sequence Development Analysis

7. Reason for Change:
Correct errors in response to Condition Reports (CRs) 11989, 12105, and 12121.

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 006 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 and other security threats were considered in a separate safeguards and security analysis performed by others. Although CR 11989 specifically addressed the need for this change in *Subsurface Reliability and Event Sequence Categorization Analysis* (000-PSA-MGR0-00500-000-00A), this change is also being made to *Subsurface Operations Event Sequence Development Analysis* (PSA-MGR0-00400-000-00A) to maintain the consistency between these two documents.

2. To resolve action 014 for CR 12105, blank cells in the following tables were filled: Page 62, Table 7: filled in blank cells with dashes; Page 81, Table 11: filled in blank cell with a dash; Page E-8, Table E-2: filled in blank cells with dashes; Page E-9, Table E-3: filled in blank cells with dashes; Page E-10, Table E-42: filled in blank cells with dashes; Page E-11 and E-12, Table E-5: filled in blank cells with dashes.

3. To resolve action 010 of CR 12121, updated Table E-2 on page E-8 to add MLD identifier SSO-901 to Node Item 1.6. Updated Table E-3 on Page E-9 to add MLD identifier SSO-203 to Node Item 2.4. Updated Table E-5 on Page E-11 to add MLD identifier SSO-504 to Node Item 4.11 and add MLD identifier SSO-502 to Node Items 4.15 and 4.16.

11. REVIEWS AND APPROVAL

Printed Name	Signature	Date
11a. Originator: R.J. Garrett		8/4/08
11b. Checker: P.T. Le		8/6/08
11c. EGS: M.V. Frank		8/6/08
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- Intentional malevolent acts, such as sabotage and other security threats, were considered in a separate safeguards and security analysis performed by others.

Scope

The scope of the present Subsurface Operations analysis includes the identification of internal events spanning the operations of the lifting of a waste package within a waste handling facility by the TEV, the movement of a waste package along surface and subsurface rail lines by the TEV, eventually moving the waste package into an emplacement drift, together with any other operations or occurrences in the emplacement drift that can pose a hazard during the post-emplacement period, including drip shield emplacement, which occurs just prior to repository closure.

The results of this analysis includes: a process flow diagram (PFD), a master logic diagram (MLD), a hazard and operability (HAZOP) evaluation, event sequence diagrams (ESDs), and event trees. Initiating events considered in this analysis include internal events (i.e., events that are initiated during defined Subsurface Operations) as well as external events (i.e., events that are initiated outside Subsurface Operations, such as weather and seismicity). However, event sequences for external events (including seismic events) are not developed in this analysis. External events and associated event sequences are evaluated and documented separately. In addition, event sequences for construction-related subsurface activities are also evaluated and documented separately.

Table 7. Example Hazard and Operability Evaluation for Exposure during Emplacement in Emplacement Drift (Partial Analysis)

Facility/Operation: Subsurface					**Process:** Waste Package Emplacement Operations		
Node 4: Emplace Waste Package in drift					**Process/Equipment:** TEV, Waste Package, Rail		
Guidewords: No, More, Less, Reverse, Other Than, As Well as					**Consequence Categories:** Radioactive Release, Lack of Shielding, Criticality		
Node Item Number	**Parameter**	**Deviation Considered**	**Postulated Cause**	**Hypothetical Consequence**	**Potential Prevention/Mitigation Design of Operational Feature**	**Note**	**Related MLD Identifier**
4.1	Shielding	(Less or No) Damage of TEV shield enclosure	Rockfall	Direct exposure	1 - Design TEV 2 - Ground support system	Verify PEFA. Ground support system prevents rock movement.	EX-201
4.2	Emplacement access door open	(Less or No) Door not completely opened	Human failure or mechanical failure	Potential release of radioactive material due to collision	1 - TEV design 2 - Emplacement access door design 3 - Procedures and training	Emplacement access door independently controlled by operator.	EX-204
4.3	Movement (into drift)	(Other Than) Derailment	Obstructions on rail or mechanical failure	Potential radioactive release direct exposure	1 - Training and procedures 2 - TEV design 3 - Rail design	Validate with PEFA. TEV shielding can potentially be deformed due to roll over.	EX-205
4.4	Movement (into drift)	(No) TEV stuck in doorway	Mechanical failure	No safety consequence	—	Increase exposure time to emplacement access door close.	N/A
4.5	Emplacement access door close	(Other Than) Inadvertent closure of emplacement access door while TEV in doorway	Human failure or mechanical failure	Potential release of radioactive material due to collision	1 - Procedures and training 2 - TEV design	Validate with PEFA.	EX-201
4.6	Position calibration	(Other Than) Miscalibrates position	Mechanical failure	Potential release of radioactive material due to collision	1 -Procedures and training 2 - TEV design	TEV carries diverse positional sensors and cameras. Result is collision with a WP.	EX-204
4.7	Shielding (door open)	(Less or No) Door not completely opened	Mechanical failure	Potential release of radioactive material due to collision of door with WP in drift	1 - TEV design	—	EX-204
4.8	Extend (base-plate)	(No or Less) Does not extend	Mechanical failure	No safety consequence	—	—	N/A
4.9	Movement (to emplacement point)	(More) TEV moves too far	Mechanical failure	Potential release of radioactive material due to collision of TEV door with WP in drift or drift itself	1 - TEV design 2 - WP design 3 - Procedures and training	Operator observing emplacement and stop TEV if necessary.	EX-204
4.10	Movement (to emplacement point)	(Less) TEV moves too little	Mechanical failure	No safety consequence	—	—	N/A
4.11	Speed	(More) TEV moves too fast	Mechanical failure	No safety consequence	—	Precursor to damaging collision with WP.	N/A
4.12	Direction	(Reverse) TEV goes backwards instead of forwards	Mechanical failure	Potential release of radioactive material due to collision with emplace access door	1 - TEV design 2 - WP design 3 - Procedures and training	—	EX-204
4.13	Lower (WP)	(Other Than) Asymmetrical lowering	Screw jack failure	No safety consequence	—	—	N/A
4.14	Lower (WP)	(Other Than) Drop	Mechanical failure	Potential radioactive release	1 - Design of TEV and WP	Verify maximum drop of 1ft	EX-202
4.15	Lower (WP)	(Less or No) Not lowered enough - WP partially unloaded	Mechanical failure	No safety consequence	—	Precursor to potential WP damage due to dragging while backing TEV out.	EX-202
4.16	Lower (WP)	(Less or No) Not lowered enough - WP not unloaded	Mechanical failure	No safety consequence	—	Precursor to bringing WP back out, however the TEV is inspected on the way out.	N/A

Source: Original

To facilitate ESD development, a unique identification number ("MLD Identifier") has been assigned to each initiating event as shown in Attachment D. The identifier consists of "SSO-" to identify the event as part of subsurface operations, 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.

Table 11. List of Internal Initiating Events

MLD Identifier	General Event Description	MLD Figure No.	HAZOP Evaluation Table No.	ESD Figure No.
SSO-201	Impact from heavy load onto TEV	D-2	---	SSO-ESD-01
SSO-202	TEV drops WP during loading	D-2	E-2	SSO-ESD-01
SSO-203	WP impact due to collision with facility structure or equipment	D-2	E-2	SSO-ESD-01
SSO-204	WP impact due to TEV shield doors closing on WP	D-2	---	SSO-ESD-01
SSO-205	WP impact due to facility shield door closing or failure	D-2	E-2	SSO-ESD-01
SSO-301	Impact from heavy load onto TEV	D-3	---	SSO-ESD-02
SSO-302	TEV drops WP during transit	D-3	---	SSO-ESD-02
SSO-303	Impact on TEV during transit	D-3	---	SSO-ESD-02
SSO-304	Thermal impact due to loss of TEV movement	D-3	E-3	SSO-ESD-04
SSO-305	Impact due to TEV derailment or collision with object	D-3	E-3	SSO-ESD-02
SSO-401	Impact from heavy load onto TEV	D-4	E-4	SSO-ESD-02
SSO-402	TEV drops WP during transit	D-4	---	SSO-ESD-02
SSO-403	Thermal impact due to loss of TEV movement	D-4	E-4	SSO-ESD-04
SSO-404	Impact due to TEV derailment or collision with object	D-4	E-4	SSO-ESD-02
SSO-501	Impact from heavy load onto TEV	D-5	E-5	SSO-ESD-03
SSO-502	TEV drops/drags WP during emplacement	D-5	E-5	SSO-ESD-03
SSO-503	WP impact due to TEV doors closing on WP	D-5	E-5	SSO-ESD-03
SSO-504	Impact to WP due to collision during emplacement	D-5	E-5	SSO-ESD-03
SSO-505	TEV derails or impacts object, causing WP impact	D-5	E-5	SSO-ESD-03
SSO-601	Impact from heavy load onto WP	D-6	---	SSO-ESD-03
SSO-701	Impact from heavy load onto WP	D-7	---	SSO-ESD-03

Table E-2. Subsurface HAZOP Evaluation Results - Node 1

Facility/Operation: Subsurface	**Process**: Waste Package Loadout
Node 1: Load TEV with Waste Package and TEV exits facility	**Process/Equipment**: TEV, Waste Package
Guidewords: No, More, Less, Reverse, Other Than, As Well As, Part Of	**Consequence Categories**: Radioactive Release, Lack of Shielding, Criticality

Node Item Number	Parameter	Deviation Considered	Postulated Cause	Consequence	Potential Prevention/Mitigation Design of Operational Feature	Note	MLD Identifier
1.1	Lift (WP)	(More) Lifted load too heavy	No cause identified	No safety consequence	---	Starting point: TEV lowered, doors open with WP positioned within the TEV envelope	---
1.2	Lift (WP)	(Less) Load is less than it's supposed to be	No cause identified	No safety consequence	---	---	---
1.3	Lift (WP)	(Other Than) Asymmetrical lift	Screw jack failure	No safety consequence	---	---	---
1.4	Lift (WP)	(Other Than) Drop	Mechanical failure	Potential radioactive release	Design of TEV, pallet and WP	Verify maximum drop of 1ft	SSO-202
1.5	Lift (WP)	(Less) Not lifted high enough	Mechanical failure	No safety consequence	---	Track not aligned for base plate movement	---
1.6	Retract (Base Plate)	(No) Does not retract	Mechanical failure	No safety consequence	PLC interlock: if base plate does not retract then TEV should not move. PLC interlock also does not allow TEV to move unless both front and rear shield doors are closed	Precursor to potential direct exposure if system continues in motion Shine from rear shield door open and lack of base plate	SSO-901
1.7	Shielding (Shield Door Closed)	(Less or No) Door not completely closed	Mechanical failure	No safety consequence	PLC interlock also does not allow TEV to move unless both front and rear shield doors are closed	Precursor to potential direct exposure if system continues in motion Shine from rear shield door open	SSO-901
1.8	Facility Door Open	(Less or No) Door not completely opened	Human failure or mechanical failure	Potential release of radioactive material due to collision	1 - TEV design 2 - Facility design 3 - Procedures and training	Facility door independently controlled by operator [a]	SSO-203
1.9	Facility Door Open	(Other Than) Facility door improperly opened (see Retract and TEV Shield door precursors)	Human failure	Potential direct exposure	Procedures and training	Verify radiation detectors inform operators that door should not be opened	Not part of Subsurface Operations
1.10	Facility Door Close	(Other Than) Inadvertent closure of facility door while TEV in doorway	Human failure or mechanical failure	Potential release of radioactive material due to collision	Procedures and training TEV design	Validate with PEFA	SSO-205
1.11	Movement	(Other Than) Derailment	Obstructions on rail or mechanical failure	Potential radioactive release direct exposure	1 - Training and procedures 2 - TEV design 3 - Rail design	Validate with PEFA TEV shielding can potentially be deformed due to roll over	SSO-203
1.12	Movement	(No) TEV stuck in doorway	Mechanical failure	No safety consequence	---	Increase exposure time to Facility door close	---

NOTE: [a] Facility door may collapse upon TEV due to impact.

Guidewords not used in this node: Reverse, As Well As, and Part Of.

ft = feet; PEFA = passive equipment failure analysis; PLC = programmable logic controller; TEV = transport and emplacement vehicle; WP = waste package.

Source: Original

Table E-3. Subsurface HAZOP Evaluation Results - Node 2

Facility/Operation: Subsurface	**Process**: TEV on Surface Rail
Node 2: TEV travels from Facility to North Portal	**Process/Equipment**: TEV, Waste Package, Rail
Guidewords: No, More, Less, Reverse, Other Than, As Well As, Part Of	**Consequence Categories**: Radioactive Release, Lack of Shielding, Criticality

Node Item Number	Parameter	Deviation Considered	Postulated Cause	Consequence	Potential Prevention/Mitigation Design of Operational Feature	Note	MLD Identifier
2.1	Movement	(Other Than) Concurrent movement of two or more TEVs	Human failure	Potential collision leading to radioactive release	1 - Procedures and training 2 - Rail power source design 3 - TEV design	Current operational design precludes this type of movement	SSO-305
2.2	Movement	(Other Than) TEV crossings not closed	Human failure	Potential collision leading to radioactive release	1 - Procedures and training	Verify with PEFA An operational criterion precludes movement of other vehicles, personnel or equipment in path of TEV	SSO-305
2.3	Movement	(Other Than) Personnel in close proximity to TEV	Human failure	Direct exposure	1 - Procedures and training	Verify barriers/indicators preventing personnel from approaching TEV	SSO-903
2.4	Speed	(More) TEV moves at greater than 1.7 mph	Mechanical failure	No safety consequence	1 - Motor burn-up at about 2 mph	Precursor to derailment	SSO-203
2.5	Speed	(Less) TEV moves slower than 1.7 mph	Mechanical failure	No safety consequence	---	---	---
2.6	Speed	(No) TEV does not move	Human failure, mechanical failure or loss of power	Potential overheating leading to radioactive release	1 - Procedures and training 2 - Design of TEV	Verify thermal effects of insolation coupled with heat of waste (determine duration to overheat) In case of loss of power, no active cooling	SSO-304
2.7	Direction	(Reverse) Back up instead of going forward	Mechanical failure	Potential collision or derailment leading to radioactive release	1 - Design of TEV 2 - Procedures and training	In order for a collision or derailment to happen, the TEV has to go through closed switch	SSO-305
2.8	Direction	(Other Than) Derailment	Mechanical failure of rail or obstruction of rail	Potential collision or rollover leading to radioactive release	1 - Design of TEV 2 - Procedure and training	Procedures include track inspection and visual confirmation of clear track	SSO-305
2.9	Vision	(Less or No)	Loss of light, loss of camera, environmental conditions	No safety consequence	1 - Procedures and training	If operator cannot see, they should stop the TEV	---
2.10	Rail Switch	(Reverse) Close instead of open	Human failure	Potential collision or rollover leading to radioactive release	1 - Design of TEV 2 - Procedures and training	Considered as cause for derailment	SSO-305
2.11	Shielding	(Less or No) Door open while in transit	Mechanical failure or abrupt stop and WP shift	Direct exposure	1 - Design of door	PLC initiates inappropriate door opening or mechanical failure of door	SSO-901

NOTE: Guidewords not used in this node: As Well As and Part Of.

PEFA = passive equipment failure analysis; PLC = programmable logic controller; TEV = transport and emplacement vehicle; WP = waste package.

Source: Original

Table E-4. Subsurface HAZOP Evaluation Results - Node 3

Facility/Operation: Subsurface	**Process**: Subsurface Transit
Node 3: Travel from North Portal to the door of assigned emplacement drift	**Process/Equipment**: TEV, Waste Package, Drift, Rail
Guidewords: No, More, Less, Reverse, Other Than, As Well As, Part Of	**Consequence Categories**: Radioactive Release, Lack of Shielding, Criticality

Node Item Number	Parameter	Deviation Considered	Postulated Cause	Consequence	Potential Prevention/Mitigation Design of Operational Feature	Note	MLD Identifier
3.1	Movement	(Other Than) Concurrent movement of two or more TEVs	Human failure	Potential collision leading to radioactive release	1 - Procedures and training 2 - Rail power source design 3 - TEV design	---	SSO-404
3.2	Movement	(Other Than) TEV crossings not closed	Human failure	Potential collision leading to radioactive release	1 - Procedures and training	Verify with PEFA An operational criterion precludes movement of other vehicles, personnel or equipment in path of TEV	SSO-404
3.3	Movement	(Other Than) Personnel in close proximity to TEV	Human failure	Direct exposure	1 - Procedures and training	Verify barriers/indicators preventing personnel from approaching TEV	SSO-903
3.4	Speed	(More) TEV moves at greater than 1.7 mph	Mechanical failure	No safety consequence	1 - Motor burn up at about 2 mph	Precursor to derailment Uncontrolled descent down the ramp precluded by motor design unless all eight motors fail simultaneously	SSO-404
3.5	Speed	(More) TEV moves at greater than 1.7 mph	Loss of friction	Potential derailment or collision leading to radioactive release	1 - Procedures and training 2 - Design of TEV and rail	---	SSO-404
3.6	Speed	(Less) TEV moves slower than 1.7 mph	Mechanical failure	No safety consequence	---	---	---
3.7	Speed	(No) TEV does not move	Human failure, mechanical failure or loss of power	Potential overheating leading to radioactive release	1 - Procedures and training 2 - Design of TEV	Verify thermal effects of heat of waste (determine duration to overheating) In case of loss of power, no active cooling	SSO-403
3.8	Direction	(Reverse) Back up instead of going forward	Mechanical failure	Potential collision or derailment leading to radioactive release	1 - Design of TEV 2 - Procedures and training	In order for a collision or derailment to happen, the TEV has to go through closed switch	SSO-404
3.9	Direction	(Other Than) Derailment	Mechanical failure of rail or obstruction of rail (including rockfall)	Potential collision or rollover leading to radioactive release	1 - Design of TEV. 2 - Procedure and training	Procedures include track inspection and visual confirmation of clear track	SSO-404
3.10	Vision	(Less or No)	Loss of light, loss of camera, environmental conditions (dust)	No Safety Consequence	1 - Procedures and training	If operator cannot see, they should stop the TEV	---
3.11	Rail Switch	(Reverse) Close instead of open	Human failure	Potential collision or rollover leading to radioactive release	1 - Design of TEV 2 - Procedures and training	Closed switch will derail TEV	SSO-404
3.12	Shielding	(Less or No) Door open while in transit	Mechanical failure or abrupt stop and WP shift	Direct exposure	1 - Design of door	PLC initiates inappropriate door opening or mechanical failure of door	SSO-902
3.13	Shielding	(Less or No) Damage of TEV shielded enclosure	Rockfall	Direct exposure	1 - Design of TEV 2 - Ground support system	Verify PEFA Ground support system prevents rock movement	SSO-401

NOTE: Guidewords not used in this node: As Well As and Part Of.

PEFA = passive equipment failure analysis; PLC = programmable logic controller; TEV = transport and emplacement vehicle; WP = waste package.

Source: Original

Table E-5. Subsurface HAZOP Evaluation Results - Node 4

Facility/Operation: Subsurface	**Process**: Waste Package Emplacement Operations
Node 4: Emplace Waste Package in drift	**Process/Equipment**: TEV, Waste Package, Rail
Guidewords: No, More, Less, Reverse, Other Than, As Well As, Part Of	**Consequence Categories**: Radioactive Release, Lack of Shielding, Criticality

Node Item Number	Parameter	Deviation Considered	Postulated Cause	Consequence	Potential Prevention/Mitigation Design of Operational Feature	Note	MLD Identifier
4.1	Shielding	(Less or No) Damage of TEV shielded enclosure	Rockfall	Direct exposure	1 - Design TEV 2 - Ground support system	Verify PEFA Ground support system prevents rock movement	SSO-501
4.2	Emplacement Access Door Open	(Less or No) Door not completely opened	Human failure or mechanical failure	Potential release of radioactive material due to collision	1 - TEV design 2 - Emplacement access door design 3 - Procedures and training	Emplacement access door independently controlled by operator	SSO-505
4.3	Movement (Into Drift)	(Other Than) Derailment	Obstructions on rail or mechanical failure	Potential radioactive release direct exposure	1 - Training and procedures 2 - TEV design 3 - Rail design	Validate with PEFA TEV shielding can potentially be deformed due to roll over	SSO-505
4.4	Movement (Into Drift)	(No) TEV stuck in doorway	Mechanical failure	No safety consequence	---	Increase exposure time to emplacement access door close	---
4.5	Emplacement Access Door Close	(Other Than) Inadvertent closure of emplacement access door while TEV in doorway	Human failure or mechanical failure	Potential release of radioactive material due to collision	1 - Procedures and training 2 - TEV design	Validate with PEFA	SSO-501
4.6	Position Calibration	(Other Than) Miscalibrates position	Mechanical failure	Potential release of radioactive material due to collision	1 -Procedures and training 2 - TEV design	TEV carries diverse positional sensors and cameras Result is collision with a WP	SSO-504
4.7	Shielding (Door Open)	(Less or No) Door not completely opened	Mechanical failure	Potential release of radioactive material due to collision of door with WP in drift	1 - TEV design	---	SSO-503
4.8	Extend (Bsae plate)	(No or Less) Does not extend	Mechanical failure	No safety consequence	---	---	---
4.9	Movement (to Emplacement Point)	(More) TEV moves too far	Mechanical failure	Potential release of radioactive material due to collision of TEV door with WP in drift or drift itself	1 - TEV design 2 - WP design 3 - Procedures and training	Operator observing emplacement and stop TEV if necessary	SSO-504
4.10	Movement (To Emplacement Point)	(Less) TEV moves too little	Mechanical failure	No safety consequence	---	---	---
4.11	Speed	(More) TEV moves too fast	Mechanical failure	No safety consequence	---	Precursor to damaging collision with WP	SSO-504
4.12	Direction	(Reverse) TEV goes backwards instead of forwards	Mechanical failure	Potential release of radioactive material due to collision with emplace access door	1 - TEV design 2 - WP design 3 - Procedures and training	---	SSO-504
4.13	Lower (WP)	(Other Than) Asymmetrical lowering	Screw jack failure	No safety consequence	---	---	---
4.14	Lower (WP)	(Other Than) Drop	Mechanical failure	Potential radioactive release	1 - Design of TEV and WP	Verify maximum drop of 1ft	SSO-502
4.15	Lower (WP)	(Less or No) Not lowered enough - WP partially unloaded	Mechanical failure	No safety consequence	---	Precursor to potential WP damage due to dragging while backing TEV out	SSO-502
4.16	Lower (WP)	(Less or No) Not lowered enough - WP not unloaded	Mechanical failure	No safety consequence	---	Precursor to bringing WP back out, however the TEV is inspected on the way out	SSO-502

Table E-5. Subsurface HAZOP Results – Node 4 (Continued)

Facility/Operation: Subsurface					**Process**: Waste Package Emplacement Operations		
Node 4: Emplace Waste Package in drift					**Process/Equipment**: TEV, Waste Package, Rail		
Guidewords: No, More, Less, Reverse, Other Than, As Well As, Part Of					**Consequence Categories**: Radioactive Release, Lack of Shielding, Criticality		
Node Item Number	**Parameter**	**Deviation Considered**	**Postulated Cause**	**Consequence**	**Potential Prevention/Mitigation Design of Operational Feature**	**Note**	**MLD Identifier**
4.17	Movement (to clear WP)	(Other Than) TEV drags WP, see precursor above.	Mechanical failure	Potential release of radioactive material	1 - TEV design 2 - WP design 3 - Procedures and training	---	SSO-502
4.18	Movement (to clear WP)	(More) TEV moves too far	Mechanical failure	No safety consequence	---	---	---
4.19	Movement (to clear WP)	(Less) TEV does not clear WP	Mechanical failure	Potential release of radioactive material due TEV door close on WP	1 - WP design 2 - Procedures and training	---	SSO-503
4.20	Speed (to clear WP)	(More) TEV moves too fast	Mechanical failure	No safety consequence	---	---	---
4.21	Direction (movement to clear WP)	(Reverse) TEV goes forwards instead of backwards	Mechanical failure	Potential release of radioactive material due to collision of TEV with WP	1 - TEV design 2 - WP design 3 - Procedures and training	Back shield door of TEV will push into emplaced WP, and push WP off the pallet	SSO-504
4.22	All (prepare to leave drift)	(Anything)	---	No safety consequence	---	No WP (TEV is empty)	---
4.23	Open emplacement access door	(Less or No) Emplacement Door does not completely open	Mechanical failure	No safety consequence	---	---	---
4.24	Direction (leaving drift)	(Reverse) TEV goes forwards instead of backwards	Mechanical failure	Potential release of radioactive material due to collision of TEV with WP	1 - TEV design 2 - WP design 3 - Procedures and training	---	SSO-504

NOTE: ft = feet; PEFA = passive equipment failure analysis; TEV = transport and emplacement vehicle; WP = waste package.

Source: Original