APPENDIX - C
HAZOP SESSION SUMMARY TABLE

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRANSPORTER

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
1) Transporter at Front Gate	Exceeds Acceptance Criteria (WAC)	Technician or instrumentation error Shift of internal shielding Shipment sent by Generator above WAC limits for dose rate	Potential inability to perform radiation survey and security checks Potential inability to bring transporter on site Potential to block primary vehicle access into site Potential to delay unloading transporter Potential for personnel radiation exposure Potential to expose dosimeters located in the security building Potential for sabotage of facility Potential to remove TRUPACT-II or transporter from service Potential for notification to DOE, DOT and the State of violation of the shipping requirements Potential for DOE\DOT investigation into the violation	Generator processes provide for shipping in accordance with the WAC requirements Radiation survey upon arrival provides early detection Instruments are periodically calibrated Training and qualification of health physics personnel conducting surveys Instrument calibration programs are periodically audited Health physics qualification programs are periodically audited WIPP conducts periodic audits on the Generator processes TRUPACT-II certified as a DOT Type B shipping container	0,3	2, 3
1) Transporter at Front Gate	No Notice of Arrival	Generator fails to notify facility of shipment	Potential inability to perform radiation survey and security checks Potential inability to bring transporter on site Potential to block primary vehicle access into site Potential to delay unloading transporter Potential for personnel radiation exposure Potential to expose dosimeters located in the security building Potential for sabotage of facility	Notification from TRANSCOM Physical fence partitions transporter from personnel Physical manifest for transporter received prior to transporter arrival at site Physical data on waste form and dose rate on TRUPACT-II contents Procedure of receipt of transporter at the gate Radiation survey of transporter and TRUPACT-II Procedures in place for reading dosimeters on a periodic basis Administrative control for inspection of transporter enroute and before leaving Generator DOT physical inspection of transporter to manifest at state lines WAC shipping requirements		2, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRANSPORTER

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
1) Transporter at Front Gate	Shipping Papers Do Not Correlate	Generator's personnel error in matching manifest papers to shipment Transporter driver connects to incorrect trailer at Generator site	Potential to delay unloading transporter Potential to notify Generator that paperwork is incorrect for shipment received	Periodic paperwork checks by DOT as transporter crosses state lines during transit WIPP performs audits of Generator's shipping procedures on a periodic basis		1, 3
1) Transporter at Front Gate	TRUPACT-II Damage	Vehicle accident Road debris Sabotage Rifle fire	Potential to delay unloading transporter Potential for personnel radiation exposure Potential to expose dosimeters located in the security building Potential inability to perform normal operations Potential to lose continuing usage of a TRUPACT-II container Potential to contaminate surface Potential need to decontaminate area or contain contamination Potential economic loss	TRUPACT-II certification as a DOT Class B shipping container Radiation surveys are performed on incoming shipments Hourly inspections enroute are performed by the drivers Driver training and qualification Procedures in place for placing TRUPACT-II in a safe condition WAC shipping requirements		3, 1
1) Transporter at Front Gate	Transporter Breakdown	Mechanical or electrical failure Operator error No fuel	Potential for delay in positioning and unloading the trailer	Alternate means available to position the trailer		1, 3
1) Transporter at Front Gate	Transporter Fire	Diesel fuel line breaks spraying diesel fuel on hot manifold Electrical fire Brake defect Collision with another vehicle	Potential to delay unloading transporter Potential to lose use of the access gate Potential to lose guard house in a fire Potential to rupture fuel tank Potential for explosion Potential for personnel injury or fatality Potential to lose security vehicles in a fire Potential to release combustion products to the environment Potential to contaminate water used to control fire Potential environmental concern Potential for smoke entering the mine Potential economic loss	Transporter driver required qualification Fire extinguisher available on transporter Frequent inspection of transporter Site fire fighting personnel available to minimize loss Provisions in place for alternate site access Procedures in place to shutdown ventilation preventing smoke from entering the mine Procedures in place to monitor fire water run-off Emplacement dikes surround perimeter of site to capture fire water TRUPACT-II design	0,2	4, 2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRANSPORTER

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
1) Transporter at Front Gate	Waste Ignites	Lightning strikes the TRUPACT II		The TRUPACT II is approved by DOE, therefore, its safety is already justified by the TRUPACT SAR		
1) Transporter at Front Gate	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRANSPORTER

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
2)Transfer Trailer from Gate to Unloading Position	Damage To Trailer Jockey During Hook Up	Mechanical/electrical failure of trailer jockey Operator error in adjusting the 5th wheel plate elevation on the trailer jockey	Potential to delay unloading trailer Potential to damage trailer Potential to drop the trailer Potential for TRUPACT-II to slip from trailer Potential to disrupt facility operations	Operator certification provides for proper use of the trailer jockey Preventative maintenance of the trailer jockey Outside trucking services available to position the trailer Tie-downs prevent TRUPACT-II from slipping from trailer		1, 3
2)Transfer Trailer from Gate to Unloading Position	Jockey and Trailer Low Speed Accident	Mechanical or electrical failure Operator error	Potential to damage the waste handling building, trailer and/or jockey Potential to lose the negative pressure in the waste handling building Potential to lose the negative pressure boundary of the air lock Potential to slow down or stop unloading operations Potential for collision with another trailer Potential for fire Potential for personnel injury Potential to release combustion products to the environment Potential to slip TRUPACT-II from trailer Potential for collision with another vehicle	Operator training and qualifications provide for proper operation of equipment Vehicle preventative maintenance provides for proper equipment operation Tie-downs prevent TRUPACT-II from slipping from trailer Trailer jockey has fire suppression equipment installed TRUPACT-II design Low speed during equipment operation TRUPACT-II handling area is restricted to people and equipment Emergency Response Team available	0,4	2, 4
2)Transfer Trailer from Gate to Unloading Position	Trailer Jack Failure During Unhooking	Mechanical failure of the trailer jack stand Operator error during unhooking operation Inclement weather	Potential to delay unloading trailer Potential to drop trailer Potential to damage tractor Potential to damage trailer Potential for TRUPACT-II to disengage from the trailer Potential to disrupt facility operations	Transporter driver required qualification Trailer maintenance and inspection programs provide assurance for proper operation of the jacks TRUPACT-II tie-downs are designed to restrain the TRUPACT-II to the trailer TRUPACT-II design	0,3	2, 3
2)Transfer Trailer from Gate to Unloading Position	Transporter Breakdown	Mechanical or electrical failure Empty fuel tank	Potential slight delay in positioning trailer	Alternate means available to move trailer		1, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRANSPORTER

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
2)Transfer Trailer from Gate to Unloading Position	Transporter Crashes Through Gate	Transporter brake system fails Driver error	Potential to damage the access gates Potential to damage sections of the facility Potential for personnel injury or fatality Potential economic loss	Drivers are trained, and qualified for proper transporter operation Transporter is equipped with emergency brakes Transporter maintenance provides for proper equipment operation Access road has a 90 degree turn immediately prior to approaching the main access gate, minimum speeds achieved Access roads are level	0,1	4, 1
2)Transfer Trailer from Gate to Unloading Position	Transporter/ Trailer Low Speed Accident	Operator error Mechanical or electrical failure Pedestrian inadvertently in roadway Restricted access path	Potential to delay unloading trailer Potential for personnel injury Potential to upset trailer Potential to damage trailer Potential to damage fire protection post indicator valves Potential to reduce fire protection capacity to some buildings Potential to slip load from trailer Potential to damage TRUPACT-II Potential for collision with another vehicle Potential economic loss	TRUPACT-II certification as a DOT Type B shipping container Driver training and qualification Trailer designed to withstand low speed impacts Site limits vehicle speed through facility Barricades around post indicator valves Dual fire protection loop	0,4	2, 4
2) Transfer Trailer from Gate to Unloading Position	Waste Ignites	Lightning strikes the TRUPACT II		The TRUPACT II is approved by DOE, therefore, its safety is already justified by the TRUPACT SAR		
2)Transfer Trailer from Gate to Unloading Position	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRAILER

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
3) Unloading of the Trailer	Failure to Properly Disconnect Trailer	Operator error in disconnecting trailer jockey from trailer	Potential to damage trailer Potential to lose continuing usage of trailer Potential for maintenance on trailer Potential to delay unloading trailer	Operators are trained and qualified to operate the equipment safely Preventative maintenance is performed on the trailer and the trailer jockey to provide reliable equipment operation Operator follows procedure during the unhooking operation		1, 3
3) Unloading of the Trailer	Loose surface contamination detected	Shipment sent by generator above WAC limits TRUPACT-II failure	Delay in waste handling operations Spread of loose surface contamination Decontamination required	Generator processes provide for shipping in accordance with the WAC requirements Radiation survey upon arrival provides early detection Instruments are periodically calibrated Training and qualification of health physics personnel conducting surveys Instrument calibration programs are periodically audited Health physics qualification programs are periodically audited WIPP conducts periodic audits on the Generator processes TRUPACT-II certified as a DOT Type B shipping container		1,3
3) Unloading of the Trailer	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
4) Transfer TRUPACT-II from Trailer to TRUDOCK	Failure to Remove TRUPACT From Trailer	Operator error Mechanical or electrical failure of fork lift Failure to remove tie-downs	Potential to delay unloading trailer Potential to damage TRUPACT-II Potential to damage trailer	Operator training and qualification Procedures are in place to perform operation Preoperational check list used during operation		1, 2
4) Transfer TRUPACT-II from Trailer to TRUDOCK	Failure to Remove Tie-downs	Operator error Mechanical Failure	Potential to stretch and break tie-downs	Operator training and qualification Operating procedures are in place to perform this operation		1, 3
4) Transfer TRUPACT-II from Trailer to TRUDOCK	Improper Stabilization of Trailer	Operator error	Potential for trailer to roll Potential for personnel injury Potential to damage trailer jockey Potential to damage fence, building or other trailers Potential to damage fire water post indicator valve Potential to lose fire protection water in the trailer staging area Potential economic loss	Traffic barricades stationed around post indicator valves Operator training and qualification Procedures in place to perform operation Trailer brake has fail safe mode of operation Trailer staging area is level prohibiting trailer from rolling	0,3	2, 3
4) Transfer TRUPACT-II from Trailer to TRUDOCK	Improper Transit to TRUDOCK	Operator error Mechanical/electrical failure of fork lift Collision with another vehicle, a pedestrian, building, or air lock door Air lock door interlock failure Air lock door(s) fail to fully open TRUDOCK doors fail to fully open	Potential to slightly damage TRUPACT-II Potential to damage fork lift Potential to damage Waste Handling Building Potential to damage air lock Potential for personnel injury Potential to damage TRUDOCK Potential to lose ventilation in the air lock Potential to damage air lock duct work Potential to activate the fire protection system in the air lock	Operator training and qualification TRUPACT-II design and certification as a DOT Class B container Spotter used during transit Low battery indicator on the fork lift Equipment preventative maintenance program provides for reliable equipment operation Backup fork lift available Alternate air locks are available Procedures are in place to perform operation Air lock duct work may be isolated Air lock fire protection may be isolated Fire watches may be used to supplement fire protection loss	0,3	2, 3

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NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
4) Transfer TRUPACT-II from Trailer to TRUDOCK	Misalignment of Fork Lift to TRUPACT-II	Operator error Failure to remove TRUPACT-II fork lift access covers Fork lift mechanical or electrical failure	Potential to knock TRUPACT-II off trailer Potential for personnel injury or fatality Potential to damage TRUPACT-II Potential to damage trailer Potential to damage fork lift	Operator training and qualification Second person used during the operation to spot the fork lift properly Procedures are in place to perform operation TRUPACT-II design mitigates damage Preoperational checks of equipment prior to use Work practices minimize unnecessary personnel from the work area Area is a radiological controlled area during the handling of waste Forklift is equipped with two television cameras and monitors to aid in positioning	0,2	4, 2
4) Transfer TRUPACT II from Trailer to TRUDOCK	Waste Ignites	Lightning strikes the TRUPACT II		The TRUPACT II is approved by NRC, therefore, its safety is already justified by the TRUPACT SAR		
4) Transfer TRUPACT-II from Trailer to TRUDOCK	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
5) Removal of Outer Containment Vessel (OCV) Lid	Failure to Lift OCV Lid	Locking ring fails to rotate OCV lid binds Crane mechanical or electrical failure Crane lift wire rope fails	Potential to delay unloading operations Potential to damage TRUPACT-II	Operator training and qualification Preoperational checks are used prior to starting the process Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with indicating light when engaged in pallet Crane over designed with a by factor of 5 Duplicate lifting fixtures are available Preventative maintenance checks on crane, wire rope, ACGLF, and hook are performed monthly Generator ships in accordance with the WAC shipping limitations Radiological surveys identify radiation levels and contamination levels as found WIPP lifting practices comply with DOE hoisting and rigging regulations		1, 3
5) Removal of Outer Containment Vessel (OCV) Lid	Failure to Move OCV Lid to Lid Stand	Radioactive contamination found inside the TRUPACT-II Crane mechanical or electrical failure Crane lift wire rope fails	Potential to lose use of TRUDOCK Potential to reclose TRUPACT-II and send shipment back to generator Potential for spot decontamination Potential to drop OCV lid Potential to damage OCV lid Potential for personnel injury or fatality Potential to damage TRUDOCK	Operator and health physics technician training and qualification Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with position indicating light Crane over designed by factor of 5 Duplicate lifting fixtures are available Preventative maintenance checks on crane, cables, ACGLF, and hook are performed monthly Generator ships in accordance with the WAC shipping limitations Radiological surveys identify radiation levels and contamination levels above WAC WIPP lifting practices comply with DOE hoisting and rigging regulations Generator checks shipment prior to departure WIPP Waste Information System (WWIS) data received from the Generator Second TRUDOCK available Preoperational checks	0,2	4, 2

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NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
5) Removal of Outer Containment Vessel (OCV) Lid	Failure to Prep OCV Lid For Removal	Operator error Jammed access plug	Potential to delay unloading operation Potential to perform maintenance on access port	Operator training and qualification Maintenance procedures for rework of the access plug		1, 3
5) Removal of Outer Containment Vessel (OCV) Lid	Failure to Pull Vacuum on OCV Lid	Mechanical/electrical failure of the vacuum system Operator error Failure to remove access plug Leak in TRUPACT-II Loss of HVAC system	Potential inability to remove the OCV lid Potential to delay unloading operations	TRUPACT-II certification as a DOT Class B container TRUPACT-II container integrity is checked during annual maintenance by WIPP personnel Operator training and qualification Redundant HVAC system available to support operations Backup vacuum pumps are available		1, 3
5) Removal of Outer Containment Vessel (OCV) Lid	Failure to Verify System Conditions	Operator error	Potential to violate administrative controls/operating procedures Potential to lose negative pressure in the Waste Handling Building Potential to delay waste handling operations	Operator training and qualification Procedures are in place to check and verify system conditions Conduct of Operations provides guidelines for activities Local audible and visual alarm when inadequate negative pressure exists in the Waste Handling Building	0,3	2, 3
5) Removal of Outer Containment Vessel (OCV) Lid	Missing Security Seals	Generator fails to install seals Seal(s) lost in transit	Potential to delay unloading operations	DOT checks presence of seals during inspections at the state lines Design of the security seal minimizes inadvertent loss Procedures require checking for the seals		1, 3

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NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
5) Removal of Outer Containment Vessel Lid (OCV)	Crane load swing while moving OCV Lid to OCV Lid Stand	Improper balance of load Operator error Equipment malfunction	Potential for personnel injury or fatality Potential to delay operations Potential to damage WHB	ACGLF provided with position indicating light Preventative maintenance checks on ACGLF WIPP lifting practices comply with DOE hoisting and rigging regulations Operator training and qualifications Procedures are in place to perform operations QA Pre-operational checks of equipment prior to use	0,2	4,2
5) Removal of Outer Containment Vessel (OCV) Lid	All Other Deviations		NAHI			

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NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
6) Removal of Inner Containment Vessel (ICV) Lid	Failure to Establish Vent Hood Operation	Loss of HVAC in the CH bay Loss of ventilation at the TRUDOCK Damper out of position Valve fails	Potential to delay unloading operations	Verification of vent flow is required Valve positions are verified Operator training and qualification Periodic preventative maintenance performed on equipment Periodic equipment checks during the process Procedures are in place to perform process Redundant trains available in the CH HVAC system	0,4	1, 4
6) Removal of Inner Containment Vessel (ICV) Lid	Failure to Lift the ICV Lid	Locking ring fails to rotate Lid binds Crane mechanical or electrical failure Crane lift wire rope fails	Potential to delay unloading operations Potential to damage TRUPACT-II	Operator training and qualification Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with indicating light when engaged in pallet Crane over designed by factor of 5 Duplicate lifting fixtures are available Preventative maintenance checks on crane, cables, ACGLF, and hook are performed monthly Generator ships in accordance with the WAC shipping limitations Radiological surveys identify radiation levels and contamination levels as found WIPP lifting practices comply with DOE hoisting and rigging regulations Emergency Response/Recovery Plan Preoperational checks		1, 3

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NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
6) Removal of Inner Containment Vessel (ICV) Lid	Failure to Move ICV Lid to ICV Lid Stand	Radioactive contamination found inside the TRUPACT-II Crane mechanical or electrical failure Crane lift wire rope fails Airborne contamination found	Potential to lose use of TRUDOCK Potential to reclose the TRUPACT-II and send shipment back to generator Potential for spot decontamination Potential to drop ICV lid Potential to damage ICV lid Potential for personnel injury or fatality Potential to damage TRUDOCK Potential to contaminate the area Potential need to decontaminate area Potential to sound alarms on the continuous air monitors (CAM) Potential need to issue Report of Occurrence on activation of CAM alarms Potential personnel radiation exposure Potential environmental concern Potential economic loss	Operator and Health Physics technician training and qualification Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with position indicating light Crane over designed by factor of 5 Duplicate lifting fixtures are available Monthly preventative maintenance checks on crane, cables, ACGLF, and hook Generator ships in accordance with the WAC shipping requirements WIPP lifting practices comply with DOE hoisting and rigging regulations WIPP WWIS data received from generator Radiological surveys identify radiation levels and contamination levels above WAC Generator checks shipment prior to departure Abnormal operation procedures available for guidance Vent hood design and use Radiological instrumentation alarms Emergency Response/Recovery Plan Preoperational checks	0,2	4, 2
6) Removal of Inner Containment Vessel (ICV) Lid	Failure to Prep ICV Lid For Removal	Operator error	Potential to delay unloading operations	Operator training and qualification Procedures are in place to perform operation		1, 3
6) Removal of Inner Containment Vessel (ICV) Lid	Failure to Pull Vacuum on ICV Lid	Mechanical or electrical failure of the vacuum system Operator error Leak in TRUPACT-II Loss of HVAC system	Potential inability to remove the ICV lid Potential to delay unloading operations	TRUPACT-II certification as a DOT Class B container TRUPACT-II container integrity is checked during annual maintenance by WIPP personnel Operator training and qualification Redundant HVAC system available to support operations Backup vacuum pumps are available		1, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
6) Removal of Inner Containment Vessel (ICV) Lid	Radiological Assessment > Background	Possible airborne contamination	Potential to delay unloading of the TRUPACT-II Potential to reclose the TRUPACT-II, spot decon or send shipment back to generator Potential to replace tool and filter due to internal contamination	Health Physics survey confirms contamination levels Health Physics personnel training and qualification Simplistic design of filter and sample rig Procedures are in place to perform process Generator conforms to shipping per WAC regulations Ventilation system prefilter and HEPA filter available for removing radioactive material from exhaust stream WAC shipping limits	0,4	2, 4
6) Removal of Inner Containment Vessel Lid (ICV)	Crane load swing while moving ICV Lid to ICV Lid Stand	Improper balance of load Operator error Equipment malfunction	Potential for personnel injury or fatality Potential to delay operations Potential to damage WHB	ACGLF provided with position indicating light Preventative maintenance checks on ACGLF WIPP lifting practices comply with DOE hoisting and rigging regulations Operator training and qualifications Procedures are in place to perform operations QA Pre-operational checks of equipment prior to use		1,3
6) Removal of Inner Containment Vessel (ICV) Lid	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
7) TRUPACT-II Internal Condition	Fire in TRUPACT-II	Spontaneous ignition in a waste container due to corrosion, chemical breakdown or anaerobic decomposition or pyrophoric interaction	Potential to shut down operations Potential to damage TRUPACT-II Potential to damage overhead crane Potential to rupture waste container Potential to spread contamination Potential need to decontaminate area Potential to damage TRUDOCK Potential for explosion Potential for personnel injury or fatality Potential to damage WHB Potential to lose containment Potential to release radioactive material Potential for personnel radiation exposure Potential to release combustion products to the environment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention Potential to shutdown site operations Potential for site evacuation Potential economic loss	Generator ships waste in accordance to WAC shipping criteria Waste containers are characterized Fissile loading is known Minimum liquids contained in Waste containers Waste containers are vented thru carbon filters Waste containers, due to storage prior to shipment, are more stable and lessens the likelihood of fire Waste container integrity is tested TRUPACT-II integrity On-site emergency responders available Building has fire suppression capability Waste containers are designed and certified as DOT Class A containers Building ventilation is filtered through prefilters and HEPA filters ICV lid can be reinstalled to aid in controlling fire in TRUPACT-II Smoke may be visible through hoses on vacuum systems Portable fire fighting equipment available Fire hose station available Limited combustibles in the area Building design is noncombustible Building design has two hour fire rating Emergency response team available Fire suppression system Vent hood system in place	3,3	4, 3
7) TRUPACT-II Internal Condition	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
8) Transfer of Payload from TRUDOCK to Facility Pallet	Failure To Place Load On Facility Pallet	Operator error Equipment failure Loss of power	Potential to misposition waste container on facility pallet Potential to delay operations	Operator training and qualification Maintenance procedures available Spotters used during transit of payload Preventative maintenance program in place Procedures used to perform operation Preoperational checks of equipment prior to use Adequate lighting in area Backup power available		1, 3
8) Transfer of Payload from TRUDOCK to Facility Pallet	Failure of Lifting Equipment	Mechanical or electrical failure of lifting equipment Operator error	Potential to drop the load Potential to damage CAMS Potential to damage TRUDOCK Potential to rupture waste container Potential for personnel injury or fatality Potential to release radioactive material Potential to contaminate surface Potential need to decontaminate area Potential for personnel radiation exposure Potential to delay operations Potential for fire Potential for explosion Potential to shutdown operations Potential to release combustion products to the environment Potential to damage Waste Handling Building Potential to lose containment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention Potential for site evacuation Potential economic loss	Generator ships waste in accordance to WAC Operator training and qualification Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with position indicating light Crane over designed by factor of 5 Duplicate lifting fixtures are available Monthly preventative maintenance checks on crane, wire rope, ACGLF, and hook Waste containers are designed and certified as DOT Class A containers Seven packs are wrapped restricting free motion Ventilation is designed to contain rad releases through use of HEPA filters WHB has fire suppression systems and portable fire extinguishers and hose station available Emergency response team on site WIPP lifting practices comply with DOE Hoisting and Rigging regulations Limited combustibles in area Building design is noncombustible	2,3	4, 3

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NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
8) Transfer of Payload from TRUDOCK to Facility Pallet	Failure to Secure Load	Operator error Damaged securing devices	Potential to lose load during transit Potential to drop the load Potential to damage CAMS Potential to damage TRUDOCK Potential to rupture waste container Potential for personnel injury or fatality Potential to release radioactive material Potential to contaminate surface Potential need to decontaminate area Potential for personnel radiation exposure Potential to delay operations Potential for fire Potential for explosion Potential to shutdown operations Potential to release combustion products to the environment Potential to damage Waste Handling Building Potential to lose containment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention Potential for site evacuation Potential economic loss	Generator ships waste in accordance to WAC Operator training and qualification Preventative maintenance Preoperational checks of equipment prior to use Equipment is designed as fail safe Waste containers are certified as DOT Class A containers Seven packs are wrapped restricting free motion Ventilation is designed to contain rad releases through use of HEPA filters WHB has fire suppression systems, fire extinguishers and hose station Emergency response team on site WIPP lifting practices comply with DOE Hoisting and Rigging regulations Limited combustibles in area Building design is noncombustible Waste Handling Building is a controlled area, thus minimizing worker exposure to contamination	2,3	4, 3
8) Transfer of Payload from TRUDOCK to Facility Pallet	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
9) Transfer Facility Pallet to Conveyance Car	Fork Lift Improper Engagement of Load	Operator error Fork lift mechanical or electrical failure	Potential to puncture waste container Potential to lose load Potential to damage TRUDOCK Potential to rupture waste container Potential to release radioactive material Potential need to decontaminate area Potential for fire Potential for explosion Potential for personnel injury or fatality Potential to shutdown operations Potential to damage fork lift Potential to damage Waste Handling Building Potential to release combustion products to the environment Potential to lose containment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential adverse media attention Potential site evacuation Potential economic loss Potential loss of remote alarms	Generator ships waste in accordance to WAC Operator training and qualification Maintenance procedures available Spotters used during engagement and transit of payload Preventative maintenance program in place Procedures used to perform operation Preoperational checks of equipment prior to use Adequate lighting in area Backup power available Fire suppression systems Emergency response team available Building construction Waste containers are DOT Type A HEPA filtration in place Tine design prevents puncture Stretchwrap and tie-downs Emergency Response/Recovery Plan	2,3	4, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
9) Transfer Facility Pallet to Conveyance Car	Mislocation On the Conveyance Car	Operator error Fork lift mechanical or electrical failure Air lock door failure	Potential to puncture waste container Potential to lose load Potential to rupture waste container Potential to release radioactive material Potential need to decontaminate area Potential for fire Potential for explosion Potential for personnel injury or fatality Potential to damage fork lift Potential to damage building Potential to release combustion products to environment Potential to notify proper authorities of release Potential vehicle collision Potential building collision Potential to damage the CMS monitor Potential to lose remote alarms Potential to lose air lock door interlock Potential to damage conveyance car Potential to damage conveyance room door seal Potential to lose secondary egress from underground Potential for adverse media attention Potential environmental concern Potential economic loss	Generator ships waste in accordance to WAC Waste containers are certified as DOT Class A containers Seven packs are wrapped restricting free motion Ventilation designed to contain rad releases through HEPA filters Operator training and qualification Fire suppression, fire extinguishers, hose station available Spotters are used during load movements Restricted access to qualified personnel Local alarms on CAM's and ventilation system Air intake and salt shafts are available for egress from underground Reinforced shield door and thick concrete containment walls Air lock doors are interlocked Tie-down straps and lateral straps Emergency Response/Recovery Plan	2,3	4, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
9) Transfer Facility Pallet to Conveyance Car	Moving Accident	Operator error Fork lift mechanical or electrical failure	Potential to puncture waste container Potential to lose load Potential to rupture waste container (on facility pallet, waste container in temporary waste handling building storage, site generated waste container) Potential to release radioactive material Potential need to decontaminate area Potential for fire Potential for explosion Potential for personnel injury or fatality Potential to damage fork lift Potential to damage building Potential to damage TRUDOCK Potential to release combustion products to the environment Potential to notify DOE, EPA, and State of environmental violation Potential vehicle collision Potential building collision Potential for adverse media attention Potential for site evacuation Potential economic loss Potential to damage the CMS monitor Potential loss of remote alarms	Generator ships waste in accordance to WAC Operator training and qualification Spotters are used during load movements Preventative maintenance on equipment Waste containers are designed and certified as DOT Class A containers Seven packs are wrapped restricting free motion Ventilation is designed to contain rad releases through use of HEPA filters WHB has fire suppression systems, fire extinguishers and hose station Emergency response team on site Limited combustibles in area Building design is noncombustible Tie-down straps and lateral straps Emergency Response/Recovery Plan Forklift tine design prevents puncture	2,3	4, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
9) Transfer Facility Pallet to Conveyance Car	Fork Lift Improper Engagement of Load	Operator Error	Possible Ignition of Drum if the Waste Container is Punctured	Generator ships waste in accordance to WAC Operator training and qualification Maintenance procedures available Spotters used during engagement and transit of payload Preventative maintenance program in place Procedures used to perform operation Fire suppression systems Emergency response team available Building construction Waste containers are DOT Type A HEPA filtration in place Tine design prevents puncture Stretchwrap and tie-downs Emergency Response/Recovery Plan	2,3	4,3
9) Transfer Facility Pallet to Conveyance Car	Mislocation on the Conveyance Car	Operator Error	Possible Ignition of Drum if the Waste Container is Punctured	Generator ships waste in accordance to WAC Waste containers are certified as DOT Class A containers Seven packs are wrapped restricting free motion Ventilation designed to contain rad releases through HEPA filters Operator training and qualification Fire suppression, fire extinguishers, hose station available Spotters are used during load movements Restricted access to qualified personnel Local alarms on CAM's and ventilation system Air intake and salt shafts are available for egress from underground Reinforced shield door and thick concrete containment walls Tie-down straps and lateral straps Emergency Response/Recovery Plan	2,3	4,3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
9) Transfer Facility Pallet to Conveyance Car	Moving Accident	Operator Error	Possible Ignition of Drum if the Waste Container is Punctured	Generator ships waste in accordance to WAC Operator training and qualification Spotters are used during load movements Preventative maintenance on equipment Waste containers are designed and certified as DOT Class A containers Seven packs are wrapped restricting free motion Ventilation is designed to contain rad releases through use of HEPA filters WHB has fire suppression systems, fire extinguishers and hose station Emergency response team on site Limited combustibles in area Building design is noncombustible Tie-down straps and lateral straps Emergency Response/Recovery Plan Forklift tine design prevents puncture	2,2	4,2
9) Transfer Facility Pallet to Conveyance Car	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
10) Transfer Conveyance Car Load onto the Waste Cage	Driving Conveyance Car Into Empty Shaft	Operator error Equipment malfunction	Potential loss of operations Potential to damage equipment Potential to rupture waste container Potential to have a fire in waste shaft Potential to drop load down shaft Potential to contaminate the underground Potential need to decontaminate area Potential to fill underground with smoke Potential for explosion Potential for personnel injury or fatality Potential to release combustion products to the environment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential to evacuate the underground Potential economic loss Potential for adverse media attention	Generator ships waste in accordance to WAC Operator training and qualification Position sensors on conveyance car automatically stop car prompting operator to use bypass Shaft tender in attendance Rail extensions engage cage rails to the floor to enable transferring the car Procedures are in place to perform operation Front wheels dropping off the track will high center the car stopping car movement Waste containers are designed and certified as DOT Class A containers Emergency Response/Recovery Plan	3,1	4, 1
10) Transfer Conveyance Car Load onto the Waste Cage	Failure of Conveyance Car	Mechanical or electrical failure	Potential to delay operations Potential to lose conveyance car Potential loss of operations	Maintenance programs Preventative maintenance program Preoperational checks Car can be manually removed from waste cage Operator training and qualification Durability of conveyance car		1, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II PAYLOAD

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
10) Transfer Conveyance Car Load onto the Waste Cage	Moving Accident	Failure to raise car lift table Failure to lower pins on the waste car chairs Alignment of waste cage with the tracks Operator error Mechanical or electrical failure	Potential to lose load Potential to rupture waste container Potential to release radioactive material Potential need to decontaminate area Potential for fire Potential for explosion Potential for personnel injury or fatality Potential to release combustion products to environment Potential to notify DOE, EPA, and State of environmental violation Potential environmental concern Potential for adverse media attention Potential for waste hoist cage collision Potential to damage the chairs Potential to damage the facility pallet Potential to delay operations Potential economic loss	Operator training and qualification Procedures available to perform operation Preoperational checks prior to use Maintenance programs Preventative maintenance programs in place Car speed very slow Waste containers are stretch wrapped Load is strapped down Positive engagement of pallet to chairs Engineering design Restricted access Shaft tender, spotter and operator in attendance Table height interlock design Alignment system Fire suppression system WAC Emergency Response/Recovery Plan	2,3	4, 3
10) Transfer Conveyance Car Load onto the Waste Cage	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: WASTE HOIST

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
11) Waste Hoist	Waste Hoist Failure	Wire rope failure Power loss Overtravel-up or -down	Potential loss of facilities Potential to lose waste emplacement capabilities Potential for personnel injury or fatality Potential to release radioactive material Potential to contaminate underground Potential unfiltered release Potential to release combustion products to the environment Potential to drop car into shaft Potential for fire Potential for explosion Potential to loss all electrical power in mine Potential to lose plant air line and air services Potential to lose underground air locks and lighting Potential to evacuate underground personnel Potential need to decontaminate the underground Potential to notify DOE, EPA, and State of environmental violation Potential environmental concern Potential for adverse media attention Potential economic loss	Waste hoist is held by six wire ropes, each capable of holding load Catch gear in head frame to hold load Redundant brake systems available Four independent valve failures required to fail brakes Waste hoist design fails towards the "cage up" condition Controls are redundant Control system has elevation check mechanisms Maintenance procedures Maintenance program Weekly inspections Qualified personnel to operate NDT on ropes and bolts Acoustics emissions to check for fatigued parts Independent verification on shaft inspections by MSHA Vendor inspects annually Visual inspection of structural steel assemblies Preoperational checks before handling any loads including upper and lower limits and dump valves and backups are functioning Full power used to check the brakes 130 foot sump at bottom of shaft below mine level Other shafts available for egress Personnel underground trained in use of safety equipment Alternate source of power to the mine Exhaust filtration available Ventilation can be secured Gate and barriers established during hoist movement Plate out and depletion in mine Portable fire fighting equipment underground Transporter has built in fire suppression Rescue tools and equipment available Self rescuers available Underground has limited combustibles Brake system tested at full power Emergency Response/Recovery Plan	3,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: WASTE HOIST

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
11) Waste Hoist	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: TRUPACT-II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
14) Shielded Holding Room	Failure to Transfer Waste Containers	Mechanical or electrical failure Operator error	Potential to drop the load Potential to rupture waste container Potential for personnel injury or fatality Potential to release radioactive material Potential to spread contamination Potential need to decontaminate area Potential for personnel radiation exposure Potential to delay operations Potential for fire Potential for explosion Potential for off site release Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention Potential to release combustion products to the environment Potential environmental concern Potential economic loss	Generator ships waste in accordance to WAC Procedures available to perform operations Operator training and qualification Preventative maintenance on equipment Equipment is designed as fail safe Design of waste container as DOT Class A container Seven packs are wrapped restricting free motion (containerized) preventing loss of waste containers Ventilation is designed to contain rad releases WHB has fire suppression systems, portable fire extinguishers and hose station available Emergency response team is on site WIPP lifting practices comply with DOE Hoisting and Rigging regulations Stretchwrap	1,3	4, 3
14) Shielded Holding Room	Fire in Waste Container	Spontaneous combustion	Potential to spread fire and smoke through ventilation Potential to damage ventilation duct work Potential to lose negative pressure in Shielded Holding Room Potential to release radioactive material Potential for personnel radiation exposure Potential need to decontaminate area Potential for smoke to be released to the environment Potential for smoke to enter mine Potential for underground evacuation	Generator ships waste in accordance to WAC Room not occupied Fire detection system available Ventilation system continually vents air through HEPA filtration devices Fire suppression system available Construction of room has a 3 hr fire rating Alarm in CMS HEPA filtration designed not to ignite Double HEPA filtration (room and main exhaust filters) Procedures for compensatory fire protection measures Weekly inspection performed in room Periodic check of sprinklers and detectors Site emergency response team	3,3	2, 1
14) Shielded Holding Room	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: NATURAL EVENTS

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
15) Natural Events	Range Fire	Range fire	Potential to stop site operations Potential for smoke to enter the mine shaft Potential for underground evacuation Potential for smoke to enter facility buildings	CMS shuts down mine ventilation systems Interior buildings available for relocation of personnel Fire break installed Mutual aid agreements with the local communities for fire fighting assistance Emergency response team Memorandum of Understanding with Department of Interior for fire fighting assistance	0,4	2, 4
15) Natural Events	Seismic Event (Design Basis Event)	Earthquake	Potential to stop operations Potential to lose site utilities Potential to drop waste container Potential to rupture waste container Potential to release radioactive material Potential to release combustion products to the environment Potential for personnel radiation exposure Potential for fire Potential for explosion Potential for personnel injury or fatality Potential to breach electrical switchgear or circuits Potential to notify DOE, EPA, and State of environmental violation Potential environmental concern Potential economic loss Potential for adverse media attention Possible Ignition of Drum if the Waste Container is Punctured	Low probability of earthquake Building is designed for DBE Procedures in place to shutdown equipment Waste container, and TRUPACT-II integrity Generator ships waste in accordance to WAC CH bay overhead crane is seismically qualified Waste containers certified as Type A containers Fire suppression system Emergency response/Recovery Plan	2,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: NATURAL EVENTS

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
15) Natural Events	Tornado (Design Basis Event)	Tornado	Potential to stop operation Potential to lose site utilities Potential for personnel injury or fatality Potential for tornado driven missile through the WHB, impacting TRUPACT-II or waste container causing a breach Potential for fire Potential for explosion Potential to release radioactive material Potential to release combustion products to the environment Potential for radiation exposure Potential need to decontaminate area Potential to notify DOE, EPA, and State of environmental violation Potential environmental concern Potential for adverse media exposure Potential economic loss	Waste Handling Building designed to withstand tornados Procedures in place to warn personnel to stay inside permanent buildings TRUPACT-II and waste containers confine material Procedures require shutdown of operations CMR operator monitors weather channel Generator ships waste in accordance to WAC Waste containers certified as Type A containers Fire suppression system Emergency response/Recovery Plan	2,2	4, 2
15) Natural Events	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: EXTERNAL EVENTS

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
16) External Events	Aircraft Crashes Into WHB	Personnel error Equipment failure	Potential to lose Waste Handling Building Potential to breech TRUPACT-II Potential for fire Potential for personnel injury or fatality Potential to release radioactive material Potential for personnel radiation exposure Potential need to decontaminate area Potential to release combustion products to the environment Potential to notify DOE, EPA, and State of environmental violation Potential environmental concern Potential for adverse media attention Potential economic loss Possible Ignition of Drum if the Waste Container is Punctured	Physical location of site is remote Air space above facility is not part of normal flight patterns Restricted flight pattern within a 500 foot radius of site Generator ships waste in accordance to WAC Waste containers certified as Type A containers Emergency Response/Recovery Plan	3,1	4, 1
16) External Events	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: ABNORMAL OPERATION

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
17) Abnormal Operation (Accident Status)	Cold Weather Natural Ventilation Pressure	Cold weather caused Natural Ventilation Pressure (NVP)	Potential to stop waste handling operations Potential to, in the event of an accident, spread airborne contamination to the environs Potential to cause deterioration of braking and electronic systems for the waste shaft hoist during prolonged exposure to salt Potential for waste shaft hoist to fail	Operator training and qualification Engineering designs Procedures Test and balance Shaft pressures are monitored at the CMR Alarms for pressure problems WIPP ventilation simulator used for guidance Underground ventilation remote monitoring control system (monitors air flows and d/p's and enable CMR operator to adjust dampers to control flow) Mine weather stations to monitor natural ventilation pressure(temp, relative humidity and barometric pressure) Isolation of mine splits Backup power available to operate fans for flow through the panel area		3, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: ABNORMAL OPERATION

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
17) Abnormal Operation (Accident Status)	Hot Weather Natural Ventilation Pressure	Hot weather caused Natural Ventilation Pressure (NVP)	Potential to leak radiation outside radiological controlled area Potential for personnel radiation exposure Potential to release radioactive material Potential need to decontaminate area Potential to notify DOE, EPA, and State of environmental violation Potential environmental concern Potential for adverse media attention Potential to stop waste handling operations Potential to, in the event of an accident, spread airborne contamination to the environs Potential to cause deterioration of braking and electronic systems for the waste shaft hoist during prolonged exposure to salt Potential for waste shaft hoist to fail	Operator training and qualification Engineering design waste shaft hoist systems Preventative maintenance procedures Test and balance Monitoring at bulkhead 309 Bulkhead 309 redesign (recent) to pressurize the chamber between the walls of the 309 bulkhead using fans Procedures to maintain differential pressures in the mine WIPP ventilation simulator used for guidance Underground ventilation remote monitoring control system (monitors air flows and d/p's and enable CMR operator to adjust dampers to control flow) Mine weather stations to monitor natural ventilation pressure(temp, relative humidity and barometric pressure) Isolation of mine splits Backup power available to operate fans for flow through the panel area Alarms for pressure problems		3, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: ABNORMAL OPERATION

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
17) Abnormal Operation (Accident Status)	Loss of Fire Protection	Loss of power Loss of 180,000 gallon fire water storage tanks DBE tornado	Potential inability to fight fires Potential excessive loss of facility Potential for personnel injury or fatality Potential to release radioactive material Potential need to decontaminate area Potential to release combustion products to environment Potential to notify DOE, EPA, and State of environmental violation Potential environmental concern Potential for adverse media attention Potential economic loss	Design and construction of fire suppression Two on site fire water storage tanks containing 180,000 gallons (One storage tank capacity sufficient for DBF) Two fire pumps, one electrical and one diesel, available Limited amount of combustibles on site and in Waste Handling Building WHB fire design and compartmentalized fire areas WHB segregated from other structures Emergency response fire fighting capability Fire truck and fire fighting equipment Assistance from surrounding communities All fire related systems, training, inspection, and testing are in accordance to NFPA and NEC regulations On-site fire trucks Procedures available for control of hot work Inspections and functional tests of system performed on a periodic basis Independent assessments by customer Fire detection systems available 24 hour battery backup for fire detection system available in Waste Handling Building	0,2	4, 2
17) Abnormal Operation (Accident Status)	Loss of HVAC systems	Loss of compressed air Loss of electrical power Operator error	Potential to stop operations Potential to release radioactive material Potential for personnel radiation exposure Potential for underground evacuation Potential need to decontaminate the facility	Redundant compressors available Backup diesel generator (2) power available for selected loads Operator training and qualification Maintenance programs in place Preventative maintenance programs Adequate separation exists between alternate compressors	0,2	3, 2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: ABNORMAL OPERATION

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
17) Abnormal Operation (Accident Status)	Loss of On-Site Communication	Excavation work Loss of site power loss of UPS Equipment malfunction RF interference Loss of telephone system causes loss of paging system	Potential to lose TRANSCOM Potential to lose control of an accident Potential to delay evacuation Potential inability to communicate for off site assistance Potential to lose meteorological data Potential to lose off site notification capability Potential inability to notify headquarters of an event	Preventative maintenance system checks Redundant and multiple means to communicate UPS systems available with backup battery power Microwave/ground line for off site communication Procedures in place for notification of casualties Emergency and security vehicles equipped for broadcast	0,1	4, 1
17) Abnormal Operation (Accident Status)	Loss of Power (localized) On Site	Operator error Equipment failure Excavation work External causes	Potential to release radioactive materials to environment Potential to contaminate mine Potential to shutdown operations Potential inability to control underground ventilation Potential for underground evacuation Potential need to decontaminate Potential to lose fire water Potential to lose lighting Potential to lose CMS indication	Multiple paths of routing power Operator training and qualification Maintenance programs in place Preventative maintenance programs Thermography availability Backup Diesel generators (2) Uninterrupted Power Supplies (UPS) available with backup battery for important loads Waste Handling Equipment designed to be fail-safe in the event of power loss Operators trained to reconfigure power distribution to plant Diesel fire pump available Alternate means to remove personnel (secondary egress) from mine Emergency Response/Recovery Plan	0,2	3, 2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: ABNORMAL OPERATION

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
17) Abnormal Operation (Accident Status)	Loss of Utility Power	Interruption of electrical service	Potential to shutdown operations Potential inability to control underground ventilation Potential to release radioactive material Potential for underground evacuation Potential need to decontaminate surface and underground areas Potential to lose fire water Potential to lose lighting Potential to lose CMS indication	Backup diesel generator (2) power system available UPS available with backup battery for important loads Diesel fire pump available Operators trained to reconfigure power distribution to plant Alternate means to remove personnel (secondary egress) from mine Waste Handling Equipment designed to be fail-safe in the event of power loss Emergency Response/Recovery Plan	0,2	3, 2
17) Abnormal Operation (Accident Status)	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
18) Waste Transfer Cage to Transporter	Transporter Failure	Transporter mechanical or electrical defect	Potential inability to start transporter Potential inability to unload cage Potential to tie up the shaft Potential to slow down operations	A backup transporter is available Preoperational checks Monthly preventative maintenance schedules	0,4	1, 4
18) Waste Transfer Cage to Transporter	Transporter Fire	Injector line breaks spraying diesel fuel onto exhaust Hydraulic system failure Brakes overheating	Potential for diesel engine fire on transporter Potential to slow down operations Potential to shutdown operations Potential for underground evacuation Potential for personnel injury or fatality Potential for heat damage to slip sheets Potential to melt bands holding waste containers onto pallet Potential for recovery operation Potential environmental concern Potential to damage waste container Potential to release Transuranic (TRU) waste material from waste container to environment Potential for airborne contamination Potential for personnel radiation exposure Potential for surface contamination Potential need to decontaminate surface and underground areas Potential for heat radiation into waste container and increased VOC emissions Potential for adverse media attention Potential to weaken the drifts ceiling Potential to release combustion products to the environment Potential economic loss	Fire suppression system with linear thermal detection capability available on transporter Dry chemical system to auto dump when activated from heat sensor Auto-manual operation of fire suppression system Inspection monthly by Emergency Service Tech (EST) Vendors check fire suppression equipment on periodic basis Operator training for fire scenarios Qualification of operators Limited quantity of diesel fuel contained in transporter Portable fire extinguishers available Braided hydraulic lines (steel jacketed) Preoperational checks Quarterly inspections Fire resistant hydraulic fluid Minimal amount of combustibles in area Low sulphur fuel used Isolated ventilation path Periodic exhaust temperature checks Few sources of ignition Emergency response teams available Assembly areas with safety equipment WAC criteria Manual shift to HEPA filtered exhaust Waste containers certified as Type A containers	2,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
18) Waste Transfer Cage to Transporter	Transporter Mishaps	Operator inattentive in operating transporter Transporter mechanical defect	Potential to damage cage Potential to damage transporter Potential to push pallets through back of cage Potential to knock waste containers from facility pallet Potential to rupture waste containers Potential to release Transuranic (TRU) waste material from waste container to environment Potential for airborne contamination Potential for personnel radiation exposure Potential for underground evacuation Potential for surface contamination Potential for recovery operation Potential inability to transport waste Potential for personnel injury or fatality Potential for shutdown of operations Potential environmental concern Potential for spontaneous ignition Potential for explosion Potential for adverse media attention Potential to weaken the drifts ceiling Potential to release combustion products to the environment Potential economic loss	Qualified operators Preoperational procedures Whole operation proceduralized Spotter for operator Lock pins on opposite sides of facility pallets Transporter has a speed governor Distance to travel to cage is too short for transporter to pick up much speed Waste containers are secured to facility pallet Waste is above transporter to prevent ramming with transporter Cannot drive off cage with transporter WAC criteria Isolated ventilation path Fire suppression system with linear thermal detection system available on transporter Dry chemical system to auto dump when activated from sensing system Auto-manual operation of fire suppression system Vendor checks fire suppression equipment on a periodic basis Operator training for fire scenarios Portable fire extinguishers available Manual shift to HEPA filtered exhaust Assembly areas with safety equipment Waste containers certified as Type A containers Emergency Response/Recovery Plan	2,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
18) Waste Transfer Cage to Transporter	Transporter Screw System Failure	Leak in transporter hydraulic screw system Metal fatigue	Potential to lose hydraulic fluid from the screw drive system Potential inability to operate screw drive system Potential inability to pull waste pallet onto transporter Potential to tie-up waste transfer cage Potential to slow down operations Potential to shutdown operations Potential need to readjust pallet on platform or transporter Potential to recover pallet	Preventative maintenance Preoperational checks Operator training Backup transporter available		1, 3
18) Waste Transfer Cage to Transporter	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
19) Transport of Waste from Transfer Cage to Disposal Room	Air Lock Failure (415 and 416)	Loss of air lock control	Potential for damper to fail open or closed Potential for ventilation deficiencies Potential for lower differential pressure in mine Potential to shutdown operations	Preventative maintenance performed on a periodic basis Preoperational checks before handling waste Ventilation fan line up Surveillance Bulkhead design is fail-as-is	0,4	1, 4
19) Transport of Waste from Transfer Cage to Disposal Room	Waste Container Hold-down Failure	Mechanical failure Operator error Uneven loading Tie-down failure for 7 pack Z clamp failure for SWB	Potential to damage waste containers Potential for fire Potential to release Transuranic (TRU) waste materials from waste containers to the environment Potential to release combustion products to the environment Potential for personnel radiation exposure Potential for surface contamination Potential for recovery operation Potential for underground evacuation Potential environmental concern Potential to shutdown operations Potential for adverse media attention Potential for personnel injury or fatality Potential economic loss	Per procedure, operators are trained to inspect tie downs prior to transporting waste pallets Slow travel speed Emergency response teams available Safety training Assembly areas with safety equipment WAC criteria CMR operator initiated shift to HEPA filtered exhaust Waste containers certified as Type A containers Stretchwrap and tie-downs	2,1	4, 1
19) Transport of Waste from Transfer Cage to Disposal Room	Loss of Electrical Power	Loss of site commercial power	Potential to lose ventilation fans Potential to lose ventilation Potential to shutdown operations Potential to evacuate underground personnel	Diesel generators (2) available for standby power UPS backup on all CAMs that initiate mine filtration to ensure radiation monitoring capabilities Isolated ventilation path	0,4	1, 4
19) Transport of Waste from Transfer Cage to Disposal Room	Loss of Plant Air	Plant air compressor mechanical or electrical defect	Potential inability to supply plant air to bulkhead pneumatic cylinders Potential inability to automatically operate bulkhead doors Potential to slow down operations	Doors can be manually operated Preventative maintenance Facility operations surveillance Preoperational checks Backup compressor available Ability to isolate and use portable compressors		1, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
19) Transport of Waste from Transfer Cage to Disposal Room	Loss of Ventilation Fans	Mechanical or electrical failure	Potential to lose ventilation Potential to lose containment Potential disruption of operations Potential for underground work stoppage Potential for underground evacuation	Preventative maintenance performed on a periodic basis Backup ventilation fans available Dampers set to fail in a safe operational mode Selective configuration control to pull air where needed Periodic inspections of fans Vibration monitors available on the two larger sized ventilation fans and alarmed to CMR	0,4	1, 4
19) Transport of Waste from Transfer Cage to Disposal Room	Vehicular Collision	Operator inattentive in operating transporter Transporter mechanical defect	Potential for collision with another vehicle, bulkhead, personnel, or high voltage equipment Potential to damage vehicle Potential to spill battery acid/oil Potential to shutdown operations Potential for fire Potential for personnel injury or fatality Potential damage to waste containers Potential to release Transuranic (TRU) waste material from waste containers to environment Potential for personnel radiation exposure Potential for surface contamination Potential for recovery operation Potential to damage bulkhead Potential to weaken drifts ceiling Potential to shutdown diesel activities Potential to release combustion products to the environment Potential for underground evacuation Potential to upset differential pressure Potential environmental concern Potential for adverse media attention Potential for credibility damage Potential economic loss Possible ignition of drum if the waste container is punctured	Qualification of operators in vehicles use Pallets securely fixed to transporter Conduct of operations Safety procedures in place Major intersections have stop signs Limited access to bulkheads in planned path of transporters Access to area is restricted during waste handling operations Lighted intersections Mine operations are closely supervised WAC criteria Portable fire extinguishers available Minimal amount of combustibles in area Isolated ventilation path CMR operator initiated shift to HEPA filtered exhaust Waste containers certified as Type A containers Stretchwrap and tie-downs Transporter equipped with low speed governor By procedure, no other vehicles other than transporter will be in motion along waste disposal route. Emergency Response/Recovery Plan	3,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
19) Transport of Waste from Transfer Cage to Disposal Room	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
20) Disposal Room Waste Handling Operations	Diesel Fire in Unloading Area	Injector line breaks spraying diesel fuel onto exhaust	Potential for diesel engine fire on transporter or forklift Potential to slow down operations Potential to shutdown operations Potential for underground evacuation Potential for personnel injury or fatality Potential for heat damage to slip sheets Potential to melt bands holding waste containers on pallet Potential to rupture waste containers Potential to release Transuranic (TRU) waste material from waste containers to the environment Potential for airborne contamination Potential for personnel radiation exposure Potential for recovery operation Potential to release combustion products to the environment Potential environmental concern Potential for heat concentration due to ventilation Potential to weaken the drifts ceiling Potential for adverse media attention Potential economic loss	Fire suppression system with linear thermal detection capability available on transporter Dry chemical system to auto dump when activated from heat sensor Auto-manual operation of fire suppression system Inspection monthly by Emergency Service Tech (EST) Vendors check fire suppression equipment on periodic basis Operator training for fire scenarios Qualification of operators Limited quantity of diesel fuel contained in transporter Portable fire extinguishers available Braided hydraulic lines (steel jacketed) Preoperational checks Quarterly inspections Fire resistant hydraulic fluid Minimal amount of combustibles in the area Low sulphur fuel used Isolated ventilation path Periodic exhaust temperature checks Few sources of ignition Emergency response teams available Safety training Assembly areas with safety equipment Manual shift to HEPA filtered exhaust WAC criteria	2,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
20) Disposal Room Waste Handling Operations	Fork Lift Accident	Operator inattentive in fork lift operation Fork lift mechanical failure	Potential to ram fork lift into stacked waste containers Potential to puncture waste containers with BRUDI lift fixture Potential to dislodge waste containers from facility pallet Potential to exceed waste container safe drop height Potential to release Transuranic (TRU) waste material from waste containers to environment Potential for airborne contamination Potential for personnel radiation exposure Potential for underground evacuation Potential for surface contamination Potential for recovery operation Potential inability to transport waste Potential for shutdown of operations Potential environmental concern Potential for personnel injury or fatality Potential for fire Potential for explosion Potential for adverse media attention Potential to weaken the drifts ceiling Potential to release combustion products to the environment Potential economic loss Possible ignition of drum if the waste container is punctured	Qualification of operators in operation of fork lifts Operator training Procedures in place Preventative maintenance performed on periodic basis on fork lift Spotter available during operations Preoperational checks prior to handling waste containers Emergency assembly areas available with safety equipment CMR operator initiated shift of HEPA exhaust filtration available Design of the BRUDI Design of the SWB handling fixture Electric fork lift limits speed Area lighting available during placement Health Physics available during placement Established ventilation flows during placement Boundaries established for radioactive materials Fire suppression system with linear thermal detection available Dry chemical system available Auto-manual operation of fire suppression system available Vendors check fire suppression system periodically Operator training for fire scenarios Portable fire extinguishers available Emergency response teams available Safety training Waste containers certified as Type A containers Stretchwrap	3,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
20)Disposal Room Waste Handling Operations	Fork Lift Failure	Fork lift electrical or mechanical defect Hydraulic leak in lifting mechanism	Potential inability to start fork lift Potential to lose hydraulic fluid Potential to lose lifting capability Potential inability to unload transporter and stack waste containers Potential to lose hydraulic power when placing waste containers on stack Potential for waste containers to be hung up partially between fork lift and stack Potential to recover partially stacked waste containers Potential to slow down operations	Fork lift capable of controlled manual lowering Backup fork lift available Preventative maintenance Preoperational checks per shift Hydraulic controls return-to-neutral when released		1, 3
20) Disposal Room Waste Handling Operations	Transporter Mishap	Operator error Transporter mechanical failure	Potential to drive transporter into stacked waste containers Potential to knock waste containers off of stack Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to the environment Potential for airborne contamination Potential for personnel radiation exposure Potential for underground evacuation Potential for surface contamination Potential for recovery operation Potential inability to transport waste Potential to shutdown operations Potential environmental concern Potential to reduce ventilation Potential to shift ventilation filtration modes Possible ignition of drum if the waste container is punctured	Operator training and qualification Procedures in place Transporter keeps its distance to previously stacked waste containers Spotter used when backing transporter Preventative maintenance WAC criteria Preoperational checks Manual shift to HEPA filtered exhaust Waste containers certified as Type A containers Stretchwrap Emergency Response/Recovery Plan	3,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
20) Disposal Room Waste Handling Operations	Backfill Operation Mishap	Operator error in backfill operation Lifting mechanism mechanical failure	Release of Magnesium Oxide to work area Slowdown of operations Potential to knock waste containers off of stack during backfill emplacement Potential to damage waste containers with lift mechanism or other backfill equipment Potential to release Transuranic (TRU) waste material from waste containers to the environment from breached waste container Potential for airborne contamination Potential for personnel radiation exposure Potential for recovery operation Potential to shift ventilation filtration modes Potential for Worker Injury/Fatality Possible ignition of drum if the waste container is punctured	Backfill equipment design Operator training and qualification Procedures in place Spotter used when backfilling Preventative maintenance WAC criteria Preoperational checks Manual shift to HEPA filtered exhaust M_gO not a hazardous material Emergency Response/Recovery Plan	3 ,3	4,3
20) Disposal Room Waste Handling Operations	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
21) Refueling Activities	Refueling Vehicle Mishap	Tank leakage or spill Hose break during refueling Isolation valve inadvertently opened or leaking	Potential to release diesel fuel to environment Potential for fire Potential for personnel injury or fatality Potential for underground evacuation Potential to shutdown operations Potential environmental concern Potential for adverse media attention Potential to weaken the drifts ceiling Potential to release combustion products to the environment Potential economic loss	Fuel dispensing is controlled by procedures All fuel tanks have bladders Fire suppression systems on all waste handling equipment Portable fire extinguishers on all vehicles Service vehicles have spill mitigation apparatus Training of personnel to dispense fuel Emergency response teams available Safety training Assembly areas with safety equipment WAC criteria Waste containers certified as Type A containers	0,1	4, 1
21) Refueling Activities	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
22)Disposal Room	Failure and Fallout of Roof Bolt	Bolt strength exceeded	Potential for personnel injury or fatality Potential to shutdown operations Potential to damage equipment Potential for adverse media attention	Low frequency of occurrence Daily inspections Protective equipment worn by underground personnel includes hard hats Area covered by mesh	0,3	4, 3
22) Disposal Room	Floor Distortion	Floor failure due to heaves and buckles Normal traffic	Potential to slow down operations Potential to reconstitute floor Potential to stick fork lift in floor drop area especially along edges Potential need to pull fork lift free Potential to drop load Potential to damage waste container Potential to rupture waste container Potential to release Transuranic (TRU) waste from waste containers to the environment Potential for airborne contamination Potential for personnel radiation exposure Potential for surface contamination Potential for recovery operation Potential inability to transfer waste Potential environmental concern	Floor surveyed and prepared before filling room Waste handling supervisor performs periodic inspections of storage room Procedure exists for performing room inspections MSHA inspections WAC criteria CMR operator initiated shift to HEPA filtered exhaust Established ventilation flows during waste emplacement Waste containers certified as Type A containers Stretchwrap and tie-downs Emergency Response/Recovery Plan	2,1	4, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
22) Disposal Room	Roof Collapse During Emplacement	Deterioration of roof	Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to environment Potential for airborne contamination Potential for personnel radiation exposure Potential for underground evacuation Potential for recovery operation Potential for shutdown of operations Potential environmental concern Potential to lose storage room or panel Potential for personnel injury or fatality Potential to damage equipment Potential for radiological release Potential to lose project credibility Potential to release combustion products to the environment Potential for adverse media attention Potential economic loss	Predictive monitoring program Per procedure, rooms are checked before any waste containers are received and immediately prior to waste container disposal Instrumented and monitored extensively per DOE and external organization assessments and regulations Support systems specifically designed to handle conditions expected and may be instrumented and tied into monitoring and analysis Mine Safety and Health (MSHA) require shiftly work place inspections Bimonthly visual and instrument inspections and assessments Annual ground control plan and long term 5 year ground control plan All inspection plans are rolled over Inspections performed on a shift by shift basis Room closure on a room-by-room basis CMR operator initiated shift to HEPA filtered exhaust Waste containers certified as Type A containers Stretchwrap and slipsheets Emergency Response/Recovery Plan	2,3	4, 3
22) Disposal Room	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

SYSTEM/VESSEL: CH TRU Waste System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
23) Life of Facility Area	Failure and Fallout of Roof Bolt	Bolt strength exceeded	Potential for personnel injury or fatality Potential to shutdown operations Potential to damage equipment Potential for adverse media attention	Low frequency of occurrence Daily inspections Protective equipment worn by underground personnel include hard hats Area covered by mesh	0,3	2, 3
23) Life of Facility Area	Floor Distortion	Floor failure due to heaves and buckles Normal traffic	Potential to slow down operations Potential to reconstitute floor Potential to stick fork lift in floor drop area especially along edges Potential need to pull fork lift free Potential to damage waste container Potential to rupture waste container Potential to release Transuranic (TRU) waste from waste container to the environment Potential for airborne contamination Potential for personnel radiation exposure Potential for surface contamination Potential for recovery operation Potential inability to transfer waste Potential environmental concern	Floor surveyed periodically Drift inspections are performed periodically MSHA inspections WAC criteria Established ventilation flows during waste emplacement CMR operator initiated shift to HEPA filtered exhaust Waste containers certified as Type A containers Stretchwrap and tie-downs Emergency Response/Recovery Plan	2,3	2, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
23) Life of Facility Area	Roof Collapse Life of Facility	Deterioration of roof outside the disposal area	Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to environment Potential for airborne contamination Potential for personnel radiation exposure Potential for underground evacuation Potential for recovery operation Potential for shutdown of operations Potential environmental concern Potential to lose facility areas Potential to lose egress Potential for personnel injury or fatality Potential to damage equipment Potential for radiological release Potential to lose project credibility Potential for adverse media attention Potential economic loss	Instrumented and monitored extensively per DOE and external organization assessments and regulations Support systems specifically designed to handle conditions expected and will be instrumented and tied into monitoring and analysis (MSHA) require weekly inspections Bimonthly visual and instrument inspections and assessments Annual ground control plan and long term 5 year ground control plan All inspection plans are rolled over Inspections performed on a shift by shift basis Accessibility for maintenance CMR operator initiated shift to HEPA filtered exhaust WAC criteria Emergency response teams available Assembly areas with safety equipment Waste containers certified as Type A containers Stretchwrap and tie-downs	2,2	4, 2
23) Life of Facility Area	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
24) Waste Criteria	Excessive H2 Emissions	Generation of Hydrogen gas from Transuranic (TRU) waste material exceeds expected values	Potential to exceed VOC emission thresholds per RCRA/NMD Potential environmental concern Potential to violate permit Potential to receive fines and criminal penalties for violating permit Potential to lose permit Potential for fire Potential for explosion Potential to release radioactive material Potential to release combustion products to the environment Potential for personnel injury or fatality Potential for recovery operation Potential for underground evacuation Potential for adverse media attention	Ventilation available MSHA regulations followed WAC limits Operator safety training Qualification of operators Portable fire extinguishers available Separate ventilation exhaust path Emergency response teams available Assembly areas with safety equipment CMR operator initiated shift to HEPA filtered exhaust	2,1	4, 1
24) Waste Criteria	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
25) Natural Events Underground	Earthquake	Earthquake occurrence	Potential to lose electrical power Potential to lose ventilation fans Potential for sensitive instrumentation to fail Potential for underground evacuation Potential to shutdown operations Potential ground fall Potential for personnel injury or fatality Potential to flood mine Potential to rupture waste containers Potential for fire Potential for explosion Potential release of radioactive material Potential for personnel radiation exposure Potential for recovery operation Potential for surface contamination Potential for airborne contamination Potential for adverse media attention Potential to release combustion products to the environment Potential economic loss	Site was selected because of low seismic conditions Regional seismic activities monitored Diesel generators available for standby power UPS systems available for radiation monitoring Shaft collars are sealed Drift ceilings support system Miner training and evacuation training Facility designed for DBE	2,1	4, 1
25) Natural Events Underground	Natural Disaster - Tornado	Tornado occurrence	Potential to lose site power Potential to lose ventilation fans Potential to lose ventilation Potential for underground evacuation Potential to shutdown operations Potential for adverse media attention	Diesel generators (2) available for standby power UPS system available for radiation monitoring Multiple ventilation fans available CMR monitors weather conditions Diesel powered hoist and bullet for personnel egress from the mine Mutual agreement with other mines for assistance WHB designed for DBT Multiple egress paths available from the mine	0,2	3, 2
25) Natural Events Underground	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
26) UPS System, Electric Carts	UPS & Electric Cart Charging Mishaps	Overcharge of electrical battery Electrical contact sparking	Potential to buildup hydrogen in battery Potential to release H2 from battery to the environment Potential for explosion Potential for personnel injury or fatality Potential for fire Potential for release of combustion products to the environment Potential for recovery operation Potential for underground evacuation Potential for adverse media attention Potential economic loss	Preventative Maintenance Procedures UPS batteries are factory sealed and contain pressure reliefs Ventilation system dilutes hydrogen concentration UPS are enclosed units Cart operator training Portable fire extinguishers on all carts	0,2	4, 2
26) UPS System, Electric Carts	_All Other Deviations		NAHI			
27) Waste Container Fire	Waste Container Fire	Spontaneous ignition in a waste container due to corrosion, chemical breakdown, anaerobic decomposition or pyrophoric interaction	Potential for fire in waste shaft station Potential to lose waste shaft station Potential for fire in disposal room Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to the environment Potential to release combustion products to the environment Potential to shutdown operations Potential for personnel radiation exposure Potential for surface contamination Potential ingestion of radioactive material Potential for underground evacuation Potential for recovery operation Potential for explosion Potential for adverse media attention Potential environmental concern Potential economic loss	Waste Acceptance Criteria No propagation expected Environment is stable	3,3	4, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
27) Waste Container Fire	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
28) Disposal Room Completion	Changes to Lighting & Air Services	Operator inattentive while disconnecting temporary lighting Operator inattentive while working with ladder Temporary lighting or ladder equipment failure	Potential for personnel injury or fatality Potential to damage equipment Potential to slow down or stop operations Potential for adverse media attention	Maintenance operations proceduralized or controlled Equipment inspections Equipment design Operator and electrician training Electricians disconnect temporary lighting	0,2	4, 2
28) Disposal Room Completion	All Other Deviations		NAHI			
29) Room Finalization (Closure) Proceed to the Next Room	Industrial Accident	Maintaining or closing (emplacing ventilation barriers or barricades) one room while emplacing waste in an adjoining room	Potential to generate dust Potential to damage cams Potential to increase maintenance Potential to slow down operations Potential to setoff false alarms Potential for personnel injury or fatality Potential for adverse media attention	Established procedures for ground control Operator training and qualification Ventilation system design Ventilation system operating procedures	0,2	4, 2
29) Room Finalization (Closure) Proceed to the Next Room	All Other Deviations		NAHI			
30) External Events	External Events		No Hazards Identified			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
31) Closed Room	Waste Container Internal Fire in closed room	Spontaneous ignition in a waste container due to corrosion, chemical breakdown, anaerobic decomposition or pyrophoric interaction	Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to the environment Potential to release combustion products to the environment Potential to shutdown operations Potential for personnel radiation exposure Potential for surface contamination Potential ingestion of radioactive material Potential for underground evacuation Potential for recovery operation Potential for explosion Potential for adverse media attention Potential environmental concern Potential economic loss	Room barricade systems Ventilation cut off to closed room Waste Acceptance Criteria No propagation expected Environment is stable Shift to HEPA filtration Backfill	2, 1	2, 1
31) Closed Room	Excessive Buildup of Explosive Gasses in closed room	Generation of Methane, or Hydrogen gas from Transuranic (TRU) waste material exceeds expected values	Potential to exceed VOC emission thresholds per RCRA/NMD Potential environmental concern Potential to violate permit Potential to receive fines and criminal penalties for violating permit Potential to lose permit Potential for fire Potential for explosion Potential to release radioactive material Potential to release combustion products to the environment Potential for personnel injury or fatality Potential for recovery operation Potential for underground evacuation Potential for adverse media attention	Room barricade systems Ventilation cut off to closed room Waste Acceptance Criteria MSHA regulations followed Shift to HEPA filtration Backfill	2, 1	2, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
31) Closed Room	Roof Fall in closed room	Deterioration of roof	Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to environment Potential for airborne contamination Potential for personnel radiation exposure Potential for underground evacuation Potential for recovery operation Potential for shutdown of operations Potential environmental concern Potential to lose disposal room or panel Potential for personnel injury or fatality Potential to damage equipment Potential for radiological release Potential to lose project credibility Potential to release combustion products to the environment Potential for adverse media attention Potential economic loss	Room barricade systems Backfill Ventilation cut off to closed room Room closure on a room-by-room basis CMR operator initiated shift to HEPA filtered exhaust	2, 1	2, 1
32) Panel Closure Operations	Industrial Accident	Equipment or human error	Potential to generate dust Potential to damage cams Potential to increase maintenance Potential to slow down operations Potential to setoff false alarms Potential for personnel injury or fatality Potential for adverse media attention	Established procedures for ground control Operator training and qualifications Ventilation system design Ventilation system operating procedures	0, 2	4, 2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
32) Panel Closure	Waste Container Internal Fire in closed panel	Spontaneous ignition in a waste container due to corrosion, chemical breakdown, anaerobic decomposition or pyrophoric interaction	Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to the environment Potential to release combustion products to the environment Potential to shutdown operations Potential for personnel radiation exposure Potential for surface contamination Potential ingestion of radioactive material Potential for underground evacuation Potential for recovery operation Potential for explosion Potential for adverse media attention Potential environmental concern Potential economic loss	Panel Closure systems Backfill Ventilation cut off to closed panel Waste Acceptance Criteria No propagation expected Environment is stable Shift to HEPA filtration	1, 1	1, 1
32) Panel Closure	Excessive Buildup of Explosive Gasses in closed panel	Generation of Methane, or Hydrogen gas from Transuranic (TRU) waste material exceeds expected values	Potential to exceed VOC emission thresholds per RCRA/NMD Potential environmental concern Potential to violate permit Potential to receive fines and criminal penalties for violating permit Potential to lose permit Potential for fire Potential for explosion Potential to release radioactive material Potential to release combustion products to the environment Potential for personnel injury or fatality Potential for recovery operation Potential for underground evacuation Potential for adverse media attention	Panel Closure systems Backfill Ventilation cut off to closed panel Waste Acceptance Criteria No propagation expected Environment is stable Shift to HEPA filtration	1 ,1	1, 1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Waste Handling System

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
32) Panel Closure	Roof Fall in closed panel	Deterioration of roof	Potential to damage waste containers Potential to release Transuranic (TRU) waste material from waste containers to environment Potential for airborne contamination Potential for personnel radiation exposure Potential for underground evacuation Potential for recovery operation Potential for shutdown of operations Potential environmental concern Potential to lose disposal room or panel Potential for personnel injury or fatality Potential to damage equipment Potential for radiological release Potential to lose project credibility Potential to release combustion products to the environment Potential for adverse media attention Potential economic loss	Panel Closure systems Backfill Ventilation cut off to closed panel Waste Acceptance Criteria No propagation expected Environment is stable Shift to HEPA filtration	1, 2	1, 2
32) Panel Closure	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Site-Derived Waste

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
33) Preliminary Actions	Use of faulty container, filters, or plugs	Operator error Defective material	Potential to release radioactive material Potential to release hazardous material Potential for explosion Potential for personnel exposure to radiation	QA Operator training and qualification Receiving inspection Procedures WAC criteria	1,2	2,2
	Inadequate WHO staff available	Medical event	N/A	Procedures	1,1	1,1
	Waste contains prohibited materials	Operator error Unauthorized addition of waste	Potential for fire Potential for explosion Potential for toxicological exposure Potential for radiological exposure	Procedures Operator training and qualification WAC criteria Personnel access controls Radiological controls	1,1	3,1
34) Liquid Waste Collection	Liquids mix with solids to form sludge	Design of sump is a confined space	Confined space	Procedures Operator training and qualification	1,1	2,1
	Loss of power to wet vacuum	Power outage Equipment failure	N/A		1,1	1,1
35) Solidification of liquid waste	Personnel and Container Radiation Limits Exceeded	Equipment failure Human error	Potential for personnel exposure to radiation	Procedures Operator training and qualification Warning equipment Preventative maintenance program	1,1	1,1
36) Local Solid Waste Collection	Personnel and Container Radiation Limits Exceeded	Equipment failure Human error	Potential for personnel exposure to radiation	Procedures Operator training and qualification Warning equipment Preventative maintenance	1,1	1,1
	Failure to lift drum	Power failure Equipment failure Operator error	Potential to delay operations	Operator training and qualification Preventative maintenance program Redundant power Procedures Pre-Op check QA	0,2	0,2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Site-Derived Waste

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
36) Local Solid Waste Collection	Lifting Equipment Failure, including Rigging	Operator error Equipment failure Power failure Improper attachment of rigging	Potential for delay of operations Potential to release radioactive material Potential to release hazardous material Potential to drop the load Potential to rupture waste container Potential for personnel injury Potential for personnel radiation exposure	Type A container Operator training and qualification Preventative maintenance program Spotters WAC criteria Procedures Pre-Op check QA Waste container integrity WHB exhaust HEPA filter Shift to HEPA filtration Emergency response plan and team	2,2	2,2
	Failure to Secure Load	Operator error Damaged securing devices	Potential to lose load during transit Potential to drop the load Potential to rupture waste container Potential for personnel injury Potential to release radioactive material Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention. Potential economic loss	Type A container Operator training and qualification Fail safe equipment design Preventative maintenance program Spotters Stretch wrapping Tie-down strapping WAC criteria Procedures Pre-op checks QA Waste Container integrity WHB fire suppression system Building Exhaust HEPA Filtered Emergency Response Plan and Teams	2,2	3,2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Site-Derived Waste

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
36) Local Solid Waste Collection	Vehicular Collision	Operator inattentive in operating forklift Forklift mechanical defect	Potential for collision with another vehicle, bulkhead, personnel, or high voltage equipment Potential to damage vehicle Potential to spill battery acid/oil Potential to shutdown operations Potential for personnel injury Potential damage to waste containers Potential to release Transuranic (TRU) waste material from waste containers to the environment Potential for personnel radiation exposure Potential for surface contamination Potential to damage bulkhead Potential to weaken drifts in ceiling Potential to shutdown diesel activities Potential for underground evacuation Potential to upset differential pressure Potential environmental concern	Qualification of operators in vehicles use Conduct of operations Safety procedures in place Major intersections have stop signs Limited access to bulkheads in planned path of transporters Access to area is restricted during waste handling operations Lighted intersections Mine operations are closely supervised WAC criteria Portable fire extinguishers available Isolated ventilation path CMR operator initiated shift to HEPA filtered exhaust Waste containers certified as Type A containers Stretchwrap Emergency Response/Recovery Plan	2,1	3,1
37) Site-Derived Waste Storage Area Operations	Prohibited Items are in container	Operator error Unauthorized addition of waste	Potential for fire Potential for explosion Potential for toxicological exposure Potential for radiological exposure	Procedures Operator training and qualification WAC criteria Personnel access controls Radiological controls	1,1	3,1
	Container, bag, etc. Damaged	Operator error Defective material	Potential to release radioactive material Potential to release hazardous material Potential pressure buildup	QA Operator training and qualification Receiving inspection Procedures WAC criteria	1,1	2,1
	Overloaded bag	Operator error	Potential to release radioactive material Potential to release hazardous material	QA Operator training and qualification Procedures	1,2	1,2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: CH TRU Site-Derived Waste

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
	Exceeds any part of the criteria for WAC	Operator error Unauthorized addition of waste	Potential for fire Potential for explosion Potential for chemical exposure Potential for radiological exposure	Procedures Operator training and qualification WAC criteria Personnel access controls Radiological controls	1,1	3,1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
38) Removal of Outer Containment Vessel (OCV) Lid	Failure to Lift OCV Lid	Locking ring fails to rotate OCV lid binds Crane mechanical or electrical failure Crane lift wire rope fails	Potential to delay unloading operations Potential to damage TRUPACT-II	Operator training and qualification Pre-operational checks are used prior to starting the process Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with indicating light when engaged in pallet Crane over designed with a by factor of 5 Duplicate lifting fixtures are available Preventative maintenance checks on crane, wire rope, ACGLF, and hook are performed monthly Generator ships in accordance with the WAC shipping limitations Radiological surveys identify radiation levels and contamination levels as found WIPP lifting practices comply with DOE hoisting and rigging regulations		1, 3
	Failure to Move OCV Lid to Lid Stand	Radioactive contamination found inside the TRUPACT-II Crane mechanical or electrical failure Crane lift wire rope fails	Potential to lose use of TRUDOCK Potential to reclose TRUPACT-II and send shipment back to generator Potential for spot decontamination Potential to drop OCV lid Potential to damage OCV lid Potential for personnel injury or fatality Potential to damage TRUDOCK	Operator and health physics technician training and qualification Preoperational checks Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with position indicating light Crane over designed by factor of 5 Duplicate lifting fixtures are available Preventative maintenance checks on crane, wire rope, ACGLF, and hook are performed monthly Generator ships in accordance with the WAC shipping limitations Radiological surveys identify radiation levels and contamination levels above WAC WIPP lifting practices comply with DOE hoisting and rigging regulations Generator checks shipment prior to departure WIPP Waste Information System (WWIS) data received from the Generator Second TRUDOCK available	0,2	4, 2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
38) Removal of Outer Containment Vessel (OCV) Lid	Failure to Prep OCV Lid For Removal	Operator error Jammed access plug	Potential to delay unloading operation Potential to perform maintenance on access port	Operator training and qualification Maintenance procedures for rework of the access plug		1, 3
	Failure to Pull Vacuum on OCV Lid	Mechanical/electrical failure of the vacuum system Operator error Failure to remove access plug Leak in TRUPACT-II Loss of HVAC system	Potential inability to remove the OCV lid Potential to delay unloading operations	TRUPACT-II certification as a DOT Class B container TRUPACT-II container integrity is checked during annual maintenance by WIPP personnel Operator training and qualification Redundant HVAC system available to support operations Backup vacuum pumps are available		1, 3
	Failure to Verify System Conditions	Operator error	Potential to violate administrative controls/operating procedures Potential to lose negative pressure in the Waste Handling Building Potential to delay waste handling operations	Operator training and qualification Procedures are in place to check and verify system conditions Conduct of Operations provides guidelines for activities Local audible and visual alarm when inadequate negative pressure exists in the Waste Handling Building	0,3	2, 3
	Missing Security Seals	Generator fails to install seals Seal(s) lost in transit	Potential to delay unloading operations	DOT checks presence of seals during inspections at the state lines Design of the security seal minimizes inadvertent loss Procedures require checking for the seals		1, 3
38) Removal of Outer Containment Vessel (OCV) Lid	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
39) Removal of Inner Containment Vessel (ICV) Lid	Failure to Establish Vent Hood Operation	Loss of HVAC in the CH bay Loss of ventilation at the TRUDOCK Damper out of position Valve fails	Potential to delay unloading operations	Verification of vent flow is required Valve positions are verified Operator training and qualification Periodic preventative maintenance performed on equipment Periodic equipment checks during the process Procedures are in place to perform process Redundant trains available in the CH HVAC system	0,4	1, 4
	Failure to Lift the ICV Lid	Locking ring fails to rotate Lid binds Crane mechanical or electrical failure Crane lift wire rope fails	Potential to delay unloading operations Potential to damage TRUPACT-II	Operator training and qualification Preoperational checks Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with indicating light when engaged in pallet Crane over designed by factor of 5 Duplicate lifting fixtures are available Preventative maintenance checks on crane, wire rope, ACGLF, and hook are performed monthly Generator ships in accordance with the WAC shipping limitations Radiological surveys identify radiation levels and contamination levels as found WIPP lifting practices comply with DOE hoisting and rigging regulations Emergency Response/Recovery Plan		1, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
39) Removal of Inner Containment Vessel (ICV) Lid	Failure to Move ICV Lid to ICV Lid Stand	Radioactive contamination found inside the TRUPACT-II Crane mechanical or electrical failure Crane lift wire rope fails Airborne contamination found	Potential to lose use of TRUDOCK Potential to reclose the TRUPACT-II and send shipment back to generator Potential for spot decontamination Potential to drop ICV lid Potential to damage ICV lid Potential for personnel injury or fatality Potential to damage TRUDOCK Potential to contaminate the area Potential need to decontaminate area Potential to sound alarms on the continuous air monitors (CAM) Potential need to issue Report of Occurrence on activation of CAM alarms Potential personnel radiation exposure Potential environmental concern Potential economic loss	Operator and Health Physics technician training and qualification Preoperational checks Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with position indicating light Crane over designed by factor of 5 Duplicate lifting fixtures are available Monthly preventative maintenance checks on crane, cables, ACGLF, and hook Generator ships in accordance with the WAC shipping requirements WIPP lifting practices comply with DOE hoisting and rigging regulations WIPP WWIS data received from generator Radiological surveys identify radiation levels and contamination levels above WAC Generator checks shipment prior to departure Abnormal operation procedures available for guidance Vent hood design and use Radiological instrumentation alarms Emergency Response/Recovery Plan	0,2	4, 2
	Failure to Prep ICV Lid For Removal	Operator error	Potential to delay unloading operations	Operator training and qualification Procedures are in place to perform operation		1, 3
	Failure to Pull Vacuum on ICV Lid	Mechanical or electrical failure of the vacuum system Operator error Leak in TRUPACT-II Loss of HVAC system	Potential inability to remove the ICV lid Potential to delay unloading operations	TRUPACT-II certification as a DOT Class B container TRUPACT-II container integrity is checked during annual maintenance by WIPP personnel Operator training and qualification Redundant HVAC system available to support operations Backup vacuum pumps are available		1, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
39) Removal of Inner Containment Vessel (ICV) Lid	Radiological Assessment > Background	Possible airborne contamination	Potential to delay unloading of the TRUPACT-II Potential to reclose the TRUPACT-II, spot decon or send shipment back to generator Potential to replace tool and filter due to internal contamination	Health Physics survey confirms contamination levels Health Physics personnel training and qualification Simplistic design of filter and sample rig Procedures are in place to perform process Generator conforms to shipping per WAC regulations Ventilation system prefilter and HEPA filter available for removing radioactive material from exhaust stream WAC shipping limits	0,4	2, 4
39) Removal of Inner Containment Vessel (ICV) Lid	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
40) TRUPACT-II Internal Condition	Fire in TRUPACT-II	Spontaneous ignition in a waste container due to corrosion, chemical breakdown or anaerobic decomposition or pyrophoric interaction	Potential to shut down operations Potential to damage TRUPACT-II Potential to damage overhead crane Potential to rupture TDOP Potential to spread contamination Potential need to decontaminate area Potential to damage TRUDOCK Potential for explosion Potential for personnel injury or fatality Potential to damage WHB Potential to lose containment Potential to release radioactive material Potential for personnel radiation exposure Potential to release combustion products to the environment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention Potential to shutdown site operations Potential for site evacuation Potential economic loss	Generator ships waste in accordance to WAC shipping criteria Waste containers are characterized Fissile loading is known Minimum liquids contained in Waste containers Waste containers are vented thru carbon filters Waste containers, due to storage prior to shipment, are more stable and lessens the likelihood of fire Waste container integrity is tested TRUPACT-II integrity On-site emergency responders available Building has fire suppression capability TDOP's are designed and certified as DOT Class 7A containers Building ventilation is filtered through prefilters and HEPA filters ICV lid can be reinstalled to aid in controlling fire in TRUPACT-II Smoke may be visible through hoses on vacuum systems Portable fire fighting equipment available Fire hose station available Limited combustibles in the area Building design is noncombustible Building design has two hour fire rating Emergency response team available Fire suppression system Vent hood system in place	3,3	4, 3
40) TRUPACT-II Internal Condition	All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
41) Transfer of Payload from TRUDOCK to Facility Pallet	Failure To Place Load On Facility Pallet	Operator error Equipment failure Loss of power	Potential to misposition waste container on facility pallet Potential to delay operations	Operator training and qualification Maintenance procedures available Spotters used during transit of payload Preventative maintenance program in place Procedures used to perform operation Preoperational checks of equipment prior to use Adequate lighting in area Backup power available		1, 3
	Failure of Lifting Equipment	Mechanical or electrical failure of lifting equipment Operator error	Potential to drop the TDOP Potential to damage CAMS Potential to damage TRUDOCK Potential to rupture TDOP Potential for personnel injury or fatality Potential to release radioactive material Potential to contaminate surface Potential need to decontaminate area Potential for personnel radiation exposure Potential to delay operations Potential for fire Potential for explosion Potential to shutdown operations Potential to release combustion products to the environment Potential to damage Waste Handling Building Potential to lose containment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention Potential for site evacuation Potential economic loss	Generator ships waste in accordance to WAC Operator training and qualification Procedures are in place to perform operation Overhead crane fails as is on loss of power ACGLF provided with position indicating light Crane over designed by factor of 5 Duplicate lifting fixtures are available Monthly preventative maintenance checks on crane, wire rope, ACGLF, and hook TDOP's are designed and certified as DOT Class 7A containers Ventilation is designed to contain rad releases through use of HEPA filters WHB has fire suppression systems and portable fire extinguishers and hose station available Emergency response team on site WIPP lifting practices comply with DOE Hoisting and Rigging regulations Limited combustibles in area Building design is noncombustible	2,3	4, 3

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Removal of a TDOP from a TRUPACT II

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
41) Transfer of Payload from TRUDOCK to Facility Pallet	Failure to Secure Load	Operator error Damaged securing devices	Potential to lose TDOP during transit Potential to drop the load Potential to damage CAMS Potential to damage TRUDOCK Potential to rupture TDOP Potential for personnel injury or fatality Potential to release radioactive material Potential to contaminate surface Potential need to decontaminate area Potential for personnel radiation exposure Potential to delay operations Potential for fire Potential for explosion Potential to shutdown operations Potential to release combustion products to the environment Potential to damage Waste Handling Building Potential to lose containment Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention Potential for site evacuation Potential economic loss	Generator ships waste in accordance to WAC Operator training and qualification Preventative maintenance program Pre-operational checks of equipment prior to use Equipment is designed as fail safe TDOP's are certified as DOT Class 7A containers Ventilation is designed to contain rad releases through use of HEPA filters WHB has fire suppression systems, fire extinguishers and hose station Emergency response team on site WIPP lifting practices comply with DOE Hoisting and Rigging regulations Limited combustibles in area Building design is noncombustible Waste Handling Building is a controlled area, thus minimizing worker exposure to contamination	2,3	4, 3
41) Transfer of Payload from TRUDOCK to Facility Pallet	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
42) Preparation of overpacking	Use of faulty overpacking, plugs or filters	Operator error Defective material	Potential for gas buildup Potential for pressure buildup Potential to release radioactive material Potential to release hazardous material Potential to rupture waste container Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations	Operator training and qualification QA Receiving inspection WAC criteria Procedures Building Exhaust HEPA Filtered Emergency Response Plan and Teams	2,1	2,1
	Failure to correctly insert plugs and filters	Operator error Defective material	Potential to release radioactive material Potential to release hazardous material Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations	Operator training and qualification Receiving inspection WAC criteria Procedures QA Building Exhaust HEPA Filtered Emergency Response Plan and Teams	2,1	2,1
42) Preparation of overpacking	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
43) Loading drum into the overpack	Failure to lift drum	Power failure Equipment failure Operator error	Potential for delay of operations	Operator training and qualification Preventative maintenance program Procedures Pre-op checks QA Redundant power	0,2	0,2
43) Loading drum into the overpack	Lifting Equipment failure including Rigging	Operator error Power failure Equipment failure Improper attachment of rigging	Potential for personnel injury Potential to drop the load Potential to release radioactive material Potential to release hazardous material Potential to rupture waste container Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations	Type A container Operator training and qualification Preventative maintenance program Spotters WAC criteria Procedures Pre-op checks QA Drum integrity Waste Container integrity WHB Exhaust HEPA Filtered Shift to HEPA Filtration in the U/G Emergency Response Plan and Teams	2,2	2,2
43) Loading drum into the overpack	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
44) Loading the SWB into TDOP	Load SWB and attach TDOP lid with at least one bolt	Operator error Equipment malfunction	Forklift collision with Upender Falls during insertion of SWB Bumping or Overloading the Upender by forklift Dropping SWB while transferring to TDOP Loaded TDOP and Upender tips over	Operator training Require the use of ladders or personnel lifts if necessary to install SWB Require drive train , support wheels, and cradle alignment inspection if Upender has been bumped hard or if the weight of the forks/forklift has been placed on the Upender or TDOP Provide safe method of handling a SWB in the orientation needed to load a TDOP Installation of Upender on Facility Pallet and leaving the pallet forklift inserted into the pallet	2,2	2,2
44) Loading the SWB into TDOP	Rotate to safe 45 degree transport position and install safety pin	Operator error Equipment malfunction	Failure to adequately secure and align TDOP Pinch points around chain drive and support wheels	Approved operating procedure Vee support on cradle hold down straps Safety guards over drive chain and support wheel pinch points Remote location of chain drive pinch point Warnings posted on safety guards	2,1	2,1
	Bolt TDOP lid. Release hold down straps and remove TDOP from Upender with forklift	Operator error Equipment malfunction	Falls during bolting lid and removing lid lifting eye Forklift collision with Upender Falls during removal of hold down straps Bumping or Overloading the Upender by forklift	Provide approved and tested TDOP lid handling fixtures Modify WIPP TDOP=s to be used for overpacking with lifting lugs welded on the lids Require drive train , support wheels, and cradle alignment inspection if Upender has been bumped hard or if the weight of the forks/forklift has been placed on the Upender or TDOP Require the use of ladders or personnel lifts Prohibit climbing on the Upender Operator training and fall prevention	2,2	2,2

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
44) Loading the SWB into TDOP	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
45) Seals	Faulty seals on the overpack	Operator error Defective material	Potential to release hazardous waste Potential to release radioactive material Potential to contaminate surface Potential need to decontaminate area Potential for personnel radiation exposure Potential to delay operations	Type A container Operator training and qualification Receiving inspection WAC criteria Procedures Pre-op checks QA WHB Exhaust HEPA Filtered Shift to HEPA Filtration in the U/G Emergency Response Plan and Teams	2,1	2,1
	Failure to seal liner/bag properly	Operator error Defective material	Potential to release radioactive material Potential to release hazardous material Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations	Type A container Operator training and qualification WAC criteria Procedures QA Building Exhaust HEPA Filtered Emergency Response Plan and Teams	2,1	2,1
45) Seals	Failure to secure lid to overpack properly	Operator error Defective material Equipment Failure	Potential to release radioactive material Potential to release hazardous material Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations	Type A container Operator training and qualification WAC criteria Procedures QA Building Exhaust HEPA Filtered Emergency Response Plan and Teams	2,1	2,1
45) Seals	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
46) Radiation Check	Excess external radiation	Technician or instrumentation error Shift of internal shielding Shipment sent by Generator above WAC limits for dose rate	Potential for notification to DOE Potential for DOE investigation into the violation Potential to delay operations Potential for personnel radiation exposure	Radiation survey upon arrival provides early detection Instruments are periodically calibrated Training and qualification of health physics personnel conducting surveys Instrument calibration programs are periodically audited Health physics qualification programs are periodically audited	1,3	1,3
46) Radiation Check	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
47) Transfer in the WHB of the overpack to the facility pallet	Failure to place load on facility pallet	Operator error Equipment failure Loss of power	Potential to misposition waste container on facility pallet Potential to delay operations	Operator training and qualification Preventative maintenance program Spotters Procedures Pre-op checks Adequate lighting in area Backup power available	0,3	1,3
	Failure of Lifting Equipment	Mechanical or electrical failure of lifting equipment Operator error	Potential to drop the load Potential to rupture waste container Potential for personnel injury Potential to release radioactive material Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention. Potential economic loss	Generator ships waste in accordance to WAC Operator training and qualification Procedures are in place to perform operation Forklift fails as is on loss of power Duplicate lifting fixtures are available Preventative maintenance checks on forklift Waste containers are designed and certified as DOT Class A containers Ventilation is designed to contain radiological releases through use of HEPA filters Emergency response team on site WIPP lifting practices comply with DOE	2,1	3,1

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
47) Transfer in the WHB of the overpack to the facility pallet	Failure to Secure Load	Operator error Damaged securing devices	Potential to lose load during transit Potential to drop the load Potential to rupture waste container Potential for personnel injury Potential to release radioactive material Potential to contaminate surface Potential for personnel radiation exposure Potential to delay operations Potential environmental concern Potential to notify DOE, EPA, and State of environmental violation Potential for adverse media attention. Potential economic loss	Type A container Operator training and qualification Fail safe equipment design Preventative maintenance program Spotters Stretch wrapping Tie-down strapping WAC criteria Procedures Pre-op checks QA Drum integrity Waste Container integrity WHB fire suppression system Building Exhaust HEPA Filtered Emergency Response Plan and Teams	2,1	3,1
47) Transfer in the WHB of the overpack to the facility pallet	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

HAZOP SESSION SUMMARY TABLE

SYSTEM/VESSEL: Overpacking Procedure - 55-gallon drum into a 85-gallon overpack, TDOP, or SWB into a TDOP

Node or Line #	Deviation/ Guide Word	Possible Cause (Scenario)	Potential Hazard or Operability Consequences	Existing Safeguards	* Hazard Rank	* Total Rank
48) Transfer in the U/G from the overpack site to the disposal room	Vehicular Collision	Operator inattentive in operating forklift Forklift mechanical defect	Potential for collision with another vehicle, bulkhead, personnel, or high voltage equipment Potential to damage vehicle Potential to spill battery acid/oil Potential to shutdown operations Potential for personnel injury Potential damage to waste containers Potential to release Transuranic (TRU) waste material from waste containers to the environment Potential for personnel radiation exposure Potential for surface contamination Potential to damage bulkhead Potential to weaken drifts in ceiling Potential to shutdown diesel activities Potential for underground evacuation Potential to upset differential pressure Potential environmental concern	Qualification of operators in vehicles use Conduct of operations Safety procedures in place Major intersections have stop signs Limited access to bulkheads in planned path of transporters Access to area is restricted during waste handling operations Lighted intersections Mine operations are closely supervised WAC criteria Portable fire extinguishers available Isolated ventilation path CMR operator initiated shift to HEPA filtered exhaust Waste containers certified as Type A containers Stretchwrap Emergency Response/Recovery Plan	2,1	3,1
48) Transfer in the U/G from the overpack site to the disposal room	_All Other Deviations		NAHI			

* The first number indicates consequence, and the second indicates the relative probability.

NAHI - No Additional Hazards Identified

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