YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

EAST-WEST DRIFT SYSTEM SAFETY ANALYSIS

REVISION 02

June 8, 1999

Document Identifier: BAB000000-01717-0200-00004 Rev 02

Prepared for:

U. S. Department of Energy
Yucca Mountain Site Characterization Project Office
P.O. Box 98608
Las Vegas, Nevada 89193-8608

Prepared by:

TRW Environmental Safety Systems, Inc.
1180 Town Center Drive
Las Vegas, Nevada 89134

YMP-229-R1
09/08/98

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
SSA REVISION RECORD

1.
QA: N/A
Page 2 of

2. SSA TITLE:
Yucca Mountain Site Characterization Project East-West Drift System Safety Analysis

3. DOCUMENT IDENTIFIER:
BAB000000-01717-0200-00004 Rev 02

4. PREVIOUS REV. NO.
01

5. CURRENT REV. NO.	6. PAGES ADDED	7. PAGES DELETED	8. DESCRIPTION OF REVISION
02*	Cover Page	Cover Page	New SSA Cover Page for Revision 02
02*	ii-vi	ii-vi	Update SSA Revision Record & Table of Contents to Reflect SSA Changes.
02*	1-12	1-9	Update Introduction to Reflect SSA Changes.
02*	Appendix A	Appendix A	No Change
02*	5088-5105.3	A-1 - A-288	Added new Scenarios and Updated Previous for Continuing East-West
			Drift Design Activities. Appendix A Scenario Page Numbers Changed
			to Reflect Database Identification Numbering System.
			* NOTE: Revision 02 of the East-West Drift SSA Completely Replaces
			Revision 01 of the East-West Drift SSA.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

WARNING

ALTHOUGH EVERY EFFORT HAS GENERALLY BEEN MADE TO INCORPORATE SAFETY FEATURES INTO DESIGN, IT IS OFTEN NECESSARY TO RELY ON PROCEDURES AND TRAINING TO MITIGATE SITUATIONS THAT CAN PRODUCE HAZARDS. THEREFORE, SAFETY IS HEAVILY DEPENDENT ON ADEQUATE TRAINING AND ADHERANCE TO APPROVED PROCEDURES. INADEQUATE TRAINING OR FAILURE TO STRICTLY ADHERE TO TRAINING AND FOLLOW APPROVED PROCEDURES CAN LEAD TO SEVERE INJURIES OR DEATH.

1. PURPOSE

The purpose of this analysis is to systematically identify and evaluate hazards related to the design of the Yucca Mountain Project Exploratory Studies Facility (ESF) East-West Cross Drift. This analysis builds upon prior ESF System Safety Analyses and incorporates TS Main Drift scenarios, where applicable, into the East-West Drift scenarios. This System Safety Analysis (SSA) focuses on the personnel safety and health hazards associated with the engineered design of the East-West Drift. The analysis also evaluates other aspects of the East-West Drift, including purchased equipment (e.g., scientific mapping platform) or Systems/Structures/Components (SSCs) and out-of-tolerance conditions. In addition to recommending design mitigation features, the analysis identifies the potential need for procedures, training, or Job Safety Analyses (JSAs). The inclusion of this information in the SSA is intended to assist the organization(s) (e.g., constructor, Safety and Health, design) responsible for these aspects of the East-West Drift in evaluating personnel hazards and augment the information developed by these organizations.

The SSA is an integral part of the systems engineering process, whereby safety is considered during planning, design, testing, and construction. A largely qualitative approach is used which incorporates operating experiences and recommendations from vendors, the constructor and the operating contractor. The risk assessment in this analysis characterizes the scenarios associated with East-West Drift SSCs in terms of relative risk and includes recommendations for mitigating all identified hazards. The priority for recommending and implementing mitigation control features is:

1) Incorporate measures to reduce risks and hazards into SSC designs.
2) Add safety features and capabilities to existing designs.
3) Develop procedures and conduct training to increase worker awareness of potential hazards, reduce exposure to hazards, and inform personnel of the actions required to avoid accidents or correct hazardous conditions.

This analysis does not consider temporary construction items and, therefore, does not consider hazards associated with temporary construction items. This analysis will be reviewed and updated to reflect new East-West Drift design changes, construction modifications, and "as built" documentation of the East-West Drift when completed.

A major difference between this analysis and previous ESF SSAs is the inclusion of hazards that arise as a result of non-accident events, (e.g., "off-normal" operations, adverse environmental conditions, or "out-of-tolerance" conditions). Non-accident events, that were not included in previous ESF SSAs, include environmental and/or toxic hazards such as leaking gases/fluids, off-gassing reactions, and excessive dust, particulates, exhaust fumes, noise, temperature, etc. which could have an adverse health effect on personnel.

2. QUALITY ASSURANCE

A QAP-2-0 evaluation was performed to determine whether System Safety Analyses are subject to QARD requirements. The results of this evaluation are presented in a QAP-2-0 Activity Evaluation for Specialty Engineering, dated August 7, 1997.

Based on the results of the QAP-2-0 evaluation, this analysis is not subject to requirements of the QARD.

3. METHOD

The System Safety Analysis process used in this analysis is described in YAP-30.48 (Reference 4.9) and is based on the methodology of MIL-STD-882C (Reference 4.5). The System Safety Analysis process is a systematic approach used to identify and mitigate system design-related hazards that could potentially have an adverse effect on personnel safety or health. The system safety analysis process includes four distinct steps: (1) hazard description (scenario development); (2) risk assignment (an initial risk rating) which is made prior to development of mitigations or controls; (3) development of hazard mitigations or controls; (4) risk designation (final risk rating) which considers that mitigations or controls are fully implemented.

Hazard description is the process of developing scenarios based upon the applicable hazards identified in a Preliminary Hazards Analysis (PHA). A Preliminary Hazards List (PHL), which is a result of the PHA, is generated by applying a generic checklist of potential internal and external events and phenomena to each SSC under consideration. The PHL is used as a direct input to the scenario development activity.

Risk assignment is an initial risk assessment that is performed before development of hazard mitigations or controls. It involves a qualitative frequency and consequence rating to determine a risk level for each scenario. The frequency rating is based on the estimated likelihood of a scenario occurring during the anticipated useful life of the affected SSC (useful life may vary for each SSC, depending on its intended function in the East-West Drift). The consequence rating is an estimate of the impact magnitude if the postulated scenario occurs. A qualitative level of risk (high, medium, low, extremely low) is determined for each scenario based on the frequency and consequence combinations using the Risk Rating Matrix found in the System Safety Analysis Procedure, YAP-30.48.

Hazard mitigation and control is the process by which specific measures are identified to prevent or mitigate potential hazards. Hazard mitigation and control can be applied prior to an event occurring or a condition/situation reaching a critical stage (i.e., "preventive") or after an event has occurred or a condition has exceeded acceptable limits (i.e., "post-occurrence"). In the first case (preventive), the mitigation and control features have a direct

impact on the frequency; i.e., by reducing the probability of an event occurring or an acceptable limit being exceeded, the frequency rating can be lowered. In the second case (post occurrence), the mitigation and control features have a direct impact on the consequence; i.e., the event has occurred or the acceptable limit has been exceeded but the impact on personnel safety can be reduced or eliminated by implementing the mitigation and control features. Hazard mitigation is achieved through design selection, safety design features or devices, detection and warning devices, and/or the use of procedures and training.

Risk designation is a final risk rating that assumes that the mitigations or controls developed in the preceding activity have been fully implemented. The frequency and consequence ratings are reevaluated considering the mitigations and controls in order to determine a resulting level of risk (high, medium, low, extremely low). The Risk Rating Matrix from the System Safety Analysis procedure referenced above is utilized. The resulting or final risk designation level is scenario specific including the specific set of mitigation(s) developed in the analysis. The risk designation is not applicable to systems, processes or activities that are not controlled/designed per referenced codes and specifications, or which have mitigation features that are substantially different from those contained in the analysis.

The following SSCs were considered in this analysis:

- East-West Drift Excavation and Layout Design
- Linings and Ground Support
- Ventilation System
- 480V Power Line/Cables
- Compressed Air Line
- Electrical Switchgear
- Rail
- Rail Cars/Locomotives (e.g., man trains, muck transporters)
- Subsurface Vehicles (e.g., Alpine Miner, front-end loader, drill jumbo)
- Supply/Waste Water Line
- Subsurface Fire Protection System
- Engineering/Scientific Mapping Floor

The SSCs listed above were evaluated based upon current best-available design/functional information relative to the Starter Tunnel and East-West Drift. This analysis provided conservative estimates of the potential design safety hazards in cases where design/historical information was limited or unavailable.

4. CODES, STANDARDS, AND REFERENCES

4.1 DOE 1989. *General Design Criteria.* DOE Order 6430.1A. April 6, 1989. ACC: NNA.19900403.0021. TIC Catalog Number 219982.

4.2 CRWMS M&O 1995. *Topopah Springs Main Drift System Safety Analysis.* BAB000000-01717-0200-00149, REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960312.0256, MOL.19960513.00.

4.3 DOE 1992. *Preliminary Safety Analysis Report for the Yucca Mountain Project Exploratory Studies Facility and Site Characterization Program.* YMP/91-37, Rev. 0. DOE: OCRWM. ACC: NNA.19920831.0019, NNA.19920831.0020.

4.4 CRWMS M&O 1997. *Activity Evaluation: Specialty Engineering (1.2.1.8).* Las Vegas, Nevada. August 7, 1997. CRWMS M&O. ACC: MOL.19971215.0018.

4.5 DOD 1993. *Military Standard System Safety Program Requirements.* MIL-STD-882C. January 19, 1993. TIC Catalog Number 209468.

4.6 DOE 1986. *Safety Analysis and Review System.* DOE Order 5481.1B. September 23, 1986. TIC Catalog Number 221740.

4.7 System Safety Society 1997. *System Safety Analysis Handbook – A source book for safety practitioners. Second Edition.* Albuquerque, New Mexico. System Safety Society. TIC Catalog Number 236411.

4.8 DOE 1995. *System Safety Plan.* YMP/94-13, Rev. 0. Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.19960130.0047.

4.9 DOE 1995. *System Safety Analysis Procedure.* YAP-30.48, Rev. 1, ICN 0. September 8, 1998. Las Vegas, Nevada. Yucca Mountain Site Characterization Office. ACC: MOL.19990125.0080.

4.10 CRWMS M&O 1997. *Enhanced Characterization of the Repository Block Requirements Document (TBV-227).* BAB000000-01717-5705-00013 REV 0. June 13, 1997. Las Vegas, Nevada: CRWMS M&O ACC: MOL.19971103.0527.

4.11 OSHA 1990. *Safety and Health Regulations for Construction.* 29 CFR 1926. July 1, 1990. ACC: NNA.19910123.0044. TIC Catalog Number 238502.

5. ASSUMPTIONS

- A number of scenarios and SSCs (e.g., ventilation) in this analysis have counterparts in the Topopah Springs (TS) Main Drift System Safety Analysis. Because of the scarcity of detailed design information and the assumed similarity between the SSCs, SSC features, characteristics, and limitations identified for the TS Main Drift SSA were also applied for the conduct of the East-West Drift SSA.

- Standard SSCs common to the subsurface ESF (e.g., power/water/compressed air lines, electrical equipment) will be present in the East-West Drift.

- The Construction Management Organization (CMO) will verify that the mitigation features approved in this SSA are effectively implemented and provide implementation status to M&O System Safety.

- The conclusions of this SSA pertain only to the scenarios identified herein.

- Future design changes will need to be evaluated to determine the impact on personnel safety and health.

- All procedures, training, manuals, and other documentation identified as mitigation features are complete, comprehensive, and accurate.

6. RESULTS

Due to the similarities of the designed systems in the TS Main Drift and the East-West Drift, the TS Main Drift scenarios were used as a basis for developing the East-West Drift scenarios. The TS Main Drift SSA and the design documentation for the East-West Drift were reviewed in detail. Specifically, this analysis focused on personnel safety and health hazards associated with the engineered design of the East-West Drift. The analysis also evaluated other aspects of the East-West Drift, including purchased equipment or SSCs and out-of-tolerance conditions.

The List of Scenarios Evaluated (Table 1) contains a brief description of each scenario in this analysis and a final frequency, consequence and risk rating that assumes all of the mitigations and controls recommended have been fully implemented. Forty-six (46) scenarios are listed. The detailed scenario analysis summaries are contained in Appendix A.

Each scenario was assigned a final risk level based upon the frequency and consequence of the potential hazards identified. In this analysis, there were zero (0) scenarios with a ***high*** risk designation, zero (0) scenarios with a ***medium*** risk designation, twenty-four (24) scenarios with a ***low*** risk designation, and twenty-two (22) scenarios with an ***extremely low***

risk designation. The Hazard Risk Matrix (Figure 1) illustrates the distribution of the scenarios risk ratings with in the matrix.

The risk designation serves two purposes:

1) It is a qualitative indicator that can be used by management to determine whether the level of risk is acceptable or if additional safety mitigation features must be implemented to lower the risk to an acceptable level.
2) It is a management tool that can be used to determine the order for addressing hazards and implementing the associated mitigation features.

7. CONCLUSIONS

The East-West Drift System Safety Analysis identified hazards related to the design and design/testing related construction of the ESF East-West Drift. The consequences of the hazards were analyzed, mitigation measures to control the hazards by design and/or administrative controls were identified, and an assessment of the risk(s) was performed. Information concerning the design of the East-West Drift was obtained from the M&O ESF Design organization; discussions with the designers; and the exchange of information between DOE, M&O and Kiewit personnel during the SSA development and review process. The final risk assessments were the subject of formal detailed reviews by a System Safety Working Group and recognized as credible hazard scenarios for the East-West Drift.

Table 1 - List of Scenarios Evaluated

Scenario ID Number	Risk Level	Frequency	Consequence	Scenario Description
UE5088 5 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	Personnel injury/equipment damage caused by failure of ground support due to earthquake.
UI5010 7 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).
UI5011 8 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	Subsurface vehicle (e.g., Alpine Miner, front-end loader, drill jumbo) accident.
UI5017 12 Mitigation Sheets	Extremely Low	E - Improbable	III - Marginal	Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).
UI5025 4 Mitigation Sheets	Extremely Low	E - Improbable	III - Marginal	Compressed air line rupture results in personnel injury.
UI5028 10 Mitigation Sheets	Extremely Low	E - Improbable	III - Marginal	Fire involving subsurface vehicle (e.g., Alpine Miner, front-end loader, drill jumbo) or temporarily stored materials.
UI5030 8 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).
UI5042 6 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).
UI5046 1 Mitigation Sheet	Low	B - Probable	IV - Negligible	Train/locomotive derailment at turnout (intersection of East-West Starter Tunnel and TS Main Drift).
UI5047 6 Mitigation Sheets	Low	A - Frequent	IV - Negligible	General slips and trips resulting in minor personnel injury (see also UI5069).
UI5048 5 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Personnel injury due to tools, equipment, or debris dropping or falling from an elevated platform.
UI5050 8 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader, drill jumbo) on slope.
UI5054 8 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Personnel injury due to failure of ground support (e.g., rock fall).

Table 1 - List of Scenarios Evaluated

Scenario ID Number	Risk Level	Frequency	Consequence	Scenario Description
UI5057 12 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.
UI5058 5 Mitigation Sheets	Low	E - Improbable	II - Critical	Electrical shock resulting in personnel injury.
UI5060 6 Mitigation Sheets	Low	B - Probable	IV - Negligible	Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).
UI5061 5 Mitigation Sheets	Extremely Low	C - Occasional	IV - Negligible	Excessive noise due to Alpine Miner, rock bolt drills, ventilation fans, drilling/blasting, or other potential sources of noise.
UI5062 5 Mitigation Sheets	Low	E - Improbable	II - Critical	Worker injury due to fall from an elevated platform.
UI5067 6 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Subsurface vehicle (e.g., Alpine Miner, front-end loader, drill jumbo) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).
UI5069 6 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	General slips and trips resulting in severe personnel injury (see also UI5047).
UI5070 5 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Air Quality - Excessive diesel soot and/or smoke particulates results in a personnel health hazard (see also UI5042).
UI5072 4 Mitigation Sheets	Low	E - Improbable	II - Critical	Ventilation fan structural failure.
UI5073 6 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Personnel injury/equipment damage due to muck falling off the conveyor system.
UI5075 4 Mitigation Sheets	Low	E - Improbable	II - Critical	Personnel injury resulting from misuse of rail cars for personnel transit.
UI5077 4 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	Personnel injury/equipment damage due to falling or partially detached hanging installed equipment (e.g., ventilation ducts, conveyor support framing, power lines, service lines).
UI5078 2 Mitigation Sheets	Low	B - Probable	IV - Negligible	Ventilation fan failure (foreign object(s) in system).
UI5080 4 Mitigation Sheets	Low	E - Improbable	II - Critical	Fire hazards: Conveyor system.

Table 1 - List of Scenarios Evaluated

Scenario ID Number	Risk Level	Frequency	Consequence	Scenario Description
UI5081 5 Mitigation Sheets	Extremely Low	E - Improbable	IV - Negligible	Fire hazards: Ventilation system.
UI5082 2 Mitigation Sheets	Low	B - Probable	IV - Negligible	Ventilation system shutdown due to main power failure.
UI5083 4 Mitigation Sheets	Extremely Low	E - Improbable	IV - Negligible	Lighting system failure for an extended period of time.
UI5084 3 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Diesel fuel hazard: Leak in engine compartment provides fuel source for possible fire.
UI5085 10 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	Vehicle hits personnel on foot in the East-West Drift.
UI5086 5 Mitigation Sheets	Low	E - Improbable	II - Critical	Vehicle diesel fire hazard: Diesel leak(s) from fuel tank or fuel lines or spills during refueling.
UI5087 8 Mitigation Sheets	Low	E - Improbable	I - Catastrophic	Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.
UI5089 6 Mitigation Sheets	Low	E - Improbable	II - Critical	Personnel working on the mapping floor come into contact with operating much conveyor system mechanical parts.
UI5091 3 Mitigation Sheets	Extremely Low	C - Occasional	IV - Negligible	Mapping floor door(s) fall into path of the train or against moving train or cars.
UI5092 6 Mitigation Sheets	Extremely Low	D - Remote	IV - Negligible	Train strikes equipment or mapping floor doors while transiting the mapping floor.
UI5093 8 Mitigation Sheets	Low	E - Improbable	II - Critical	Train strikes personnel while transiting the mapping floor.
UI5094 6 Mitigation Sheets	Low	B - Probable	IV - Negligible	Minor personnel injuries due to falls/trips/slips on the mapping floor.
UI5096 1 Mitigation Sheet	Low	E - Improbable	I - Catastrophic	Personnel injury due to crawling or becoming stuck under the transition ramp and/or mapping floor to retrieve items.
UI5097 2 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Personnel injury (pinch, amputation, crush) from opening/closing mapping floor doors or the access panels to the pressurized air system valves (located in the rail decks)
UI5098 1 Mitigation Sheet	Extremely Low	D - Remote	III - Marginal	If the air winches (tuggers) are ever used to move the mapping floor along the tracks to a new location and a cable fails or slips resulting in personnel injury.

Table 1 - List of Scenarios Evaluated

Scenario ID Number	Risk Level	Frequency	Consequence	Scenario Description
UI5099 3 Mitigation Sheets	Low	E - Improbable	II - Critical	Tow cable slips or breaks and the train operator loses positive control of the raised/moving mapping floor.
UI5100 1 Mitigation Sheet	Extremely Low	D - Remote	III - Marginal	Personnel are injured while riding on the elevated mapping cars during movement.
UI5103 3 Mitigation Sheets	Extremely Low	E - Improbable	III - Marginal	Personnel receive electrical shock(s) from defective electrical equipment that shorts/burns out or from severed connectors.
UI5105 3 Mitigation Sheets	Extremely Low	D - Remote	III - Marginal	Installed electrical outlets/access panels/electrical connectors/cables are damaged when the mapping floor is moved.

HAZARD RISK MATRIX

FREQUENCY LEVELS

	I	II	III	IV
A	**High**	**High**	**High**	**Low** UI5047
B	**High**	**High**	**Medium**	**Low** UI5046 UI5060 UI5078 UI5082 UI5094
C	**High**	**Medium**	**Medium**	**Extremely Low** UI5061 UI5091
D	**Medium**	**Medium**	**Extremely Low** UI5030 UI5042 UI5048 UI5054 UI5057 UI5067 UI5070 UI5073 UI5084 UI5097 UI5098 UI5100 UI5105	**Extremely Low** UI5092
E	**Low** UE5088 UI5010 UI5011 UI5050 UI5069 UI5077 UI5085 UI5087 UI5096	**Low** UI5058 UI5062 UI5072 UI5075 UI5080 UI5086 UI5089 UI5093 UI5099	**Extremely Low** UI5017 UI5025 UI5028 UI5103	**Extremely Low** UI5081 UI5083

CONSEQUENCE LEVELS

Figure 1. Scenarios Distributed Over Risk Matrix

Frequency Levels
A - Frequent
B - Probable
C - Occasional
D - Remote
E - Improbable

Consequence Levels
I - Catastrophic
II - Critical
III - Marginal
IV - Negligible

8. INDEX TO APPENDIX A

Scenario Analysis Summaries and Mitigations

APPENDIX A

Scenario Description and Analysis

Approved

Scenario Number: UE5088
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift
Location: East-West Drift

Scenario: Personnel injury/equipment damage caused by failure of ground support due to earthquake.

Cause, Failure, or Hazardous Event: Earthquake induced failure of ground support system components (steel sets, rockbolts).

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	Medium
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UE0361, UE0362

Prevention Mitigation Documentation:
Test, Inspection and Material Dedication Analysis: Shotcrete, Rockbolt and Accessories, BABEE0000-01717-0200-00006 Rev. 00B
ESF Ground Support Design Analysis, BABEE0000-01717-0200-00002 Rev. 00C
OSHA - 29 CFR 1926
Emergency evacuation plan and procedures.
Training and safety manuals.

Mitigation Feature

Scenario Number: UE5088

Mitigation Number: 1

Scenario: Personnel injury/equipment damage caused by failure of ground support due to earthquake.

Mitigation Feature: Install steel sets, lagging, rockbolts, wire mesh and shotcrete based on analysis of ground type and proximity to faults.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98__Ground Support is installed as warranted) wp. A&E ground support walkdowns are providing analysis and recommendations and remedial ground support. Per Bob Law 5/5/99, JR

Mitigation Feature

Scenario Number: UE5088

Mitigation Number: 2

Scenario: Personnel injury/equipment damage caused by failure of ground support due to earthquake.

Mitigation Feature: Establish installation inspection/acceptance procedures for steel sets, rockbolts, wire mesh and shotcrete.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UE5088

Mitigation Number: 3

Scenario: Personnel injury/equipment damage caused by failure of ground support due to earthquake.

Mitigation Feature: Visually inspect the ground support system on a weekly basis and prior to reoccupation following any earthquake event.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Weekly inspections by A/E and supervisors.) wp.

Mitigation Feature

Scenario Number: UE5088

Mitigation Number: 4

Scenario: Personnel injury/equipment damage caused by failure of ground support due to earthquake.

Mitigation Feature: Develop procedures for cessation of work and evacuation of personnel following earthquake event.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Evacuation procedure is in place.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UE5088

Mitigation Number: 5

Scenario: Personnel injury/equipment damage caused by failure of ground support due to earthquake.

Mitigation Feature: Safety training in evacuation procedures.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__ GUT training covers evacuation procedure) wp.

Scenario Description and Analysis

Approved

Scenario Number:	UI5010	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Cause, Failure, or Hazardous Event: Brake failure; load shifting; lack of proper equipment/material restraints/guards; failure to adhere to safety and operating procedures.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0021, UI0022, UI0025

Prevention Mitigation Documentation: 29 CFR 1926.800; training manuals; safety manuals; JSAs.

Mitigation Feature

Scenario Number: UI5010

Mitigation Number: 1

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Mitigation Feature: Don't transport personnel in the same car as materials, equipment and supplies.

Documentation: 29 CFR 1926.800; training manuals; safety manuals; JSAs.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Materials, supplies and equipment are transported separately) wp.

Mitigation Feature

Scenario Number: UI5010

Mitigation Number: 2

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Mitigation Feature: Design/select cars with adequate geometry and capacity to handle load weights and shifting of load.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5010

Mitigation Number: 3

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Mitigation Feature: Restrain equipment and material (e.g., drill steel, loading poles, etc.) so that it cannot change position and protrude outside the transportation window.

Documentation: Training manuals; safety manuals; JSAs.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Materials are secured on flatcars) wp.

Mitigation Feature

Scenario Number: UI5010

Mitigation Number: 4

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Mitigation Feature: Select equipment/materials/supplies that do not exceed the carrying capacity of cars or the transportation envelope dimensions.

Documentation: 29 CFR 1926.800; training manuals; safety manuals; JSAs.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5010

Mitigation Number: 5

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Mitigation Feature: Design adequate clearance for the transportation envelope.

Documentation:

Remarks: Rev.01, Mit# 8

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98__Track has been previously changed to accommodate envelope) wp.

Mitigation Feature

Scenario Number: UI5010

Mitigation Number: 6

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Mitigation Feature: Explosives will only be transported in "day boxes" which are mounted securely to the vehicle.

Documentation: 29 CFR 1926.800; training manuals; safety manuals; JSAs.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5010

Mitigation Number: 7

Scenario: Accident due to load shifting or equipment/materials protruding from a subsurface transport vehicle (e.g., mantrip, flat car, utility car).

Mitigation Feature: JSA will address proper loading and securing of materials, equipment and supplies on transport vehicles.

Documentation: 29 CFR 1926.800; training manuals; safety manuals; JSAs.

Remarks: Rev.01, Mit# 9

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Covered in JSA and tool box training.) wp.

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5011
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: East-West Drift

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Cause, Failure, or Hazardous Event: Component failure (e.g., brakes, steering); operator error; pedestrian error; improper storage of equipment or materials.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	**High**
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0043

Prevention Mitigation Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 1

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Establish maximum safe speed limits for all vehicles.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Speed limit of 15 mph for locomotive traffic set by CMO and constructor.) wp

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 2

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Establish maintenance and inspection schedule for all vehicles.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__All equipment is inspected during pre-shift inspection prior to operating and undergo periodic preventive maintenance.) wp

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 3

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Install onboard fire suppression systems on locomotives and front-end loaders.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Auto fire suppression installed on locomotives and front end loaders) wp.

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 4

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Provide safety training for vehicle operators and personnel working around vehicles.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Covered in GUT training) wp.

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 5

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Provide headlights on vehicles.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 6

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Equip vehicles with automatic "back-up" alarms as appropriate.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ● Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 7

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Require personnel to stop work and clear the vehicle travel envelop to permit vehicle passage.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per Bob Law, 5May99) jr.

Mitigation Feature

Scenario Number: UI5011

Mitigation Number: 8

Scenario: Subsurface vehicle (e.g., front-end loader) accident.

Mitigation Feature: Storage areas and containers will be located as far outside the travel envelope as possible to reduce the likelihood of damage/explosion/fire in the event of an accident.

Documentation: Vehicle specifications; OSHA - 29 CFR 1926 Subparts O & S; training manuals; operators manuals; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5017
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	East-West Drift

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Cause, Failure, or Hazardous Event: Fan failures; exhaust duct system breaks, blockage or rupture; electrical power failure; failure to properly secure equipment or supplies for travel or they exceed travel envelope.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0013, UI0106, UI5060, UI5042

Prevention Mitigation Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification; ESF Ventilation Duct and Fittings Procurement Specification; ventilation fan service manual; operational procedures; JSAs; evacuation procedures; safety manuals; inspection and maintenance records; training manuals & records.

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 1

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Ventilation fan procurement specifications shall meet mining industry standards with proven performance in the mining operations.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification; ESF Ventilation Duct and Fittings Procurement Specification.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98__Fans purchased with required specs) wp.

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 2

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Provide ventilation system capacity to maintain adequate air circulation in the event of several fan failures.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification; ESF Ventilation Duct and Fittings Procurement Specification.

Remarks: Rev.01, Mit# 15

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 3

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Design ventilation system such that individual fans can be shut down without having to shut down operations in the tunnel.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification; ESF Ventilation Duct and Fittings Procurement Specification; System Design/Fan drawings.

Remarks: Rev.01, Mit# 14

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 4

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Perform scheduled preventive maintenance in accordance with manufacturer's recommendations and maintain records.

Documentation: Ventilation fan service manual; operational procedures; JSAs.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 5

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Monitor ventilation system for out-of-tolerance or out-of-specified range conditions. When out of tolerance/range, perform immediate system/equipment repairs or adjustments. Immediate use of respirators by all personnel may be required. Cease work and evacuate.

Documentation: Ventilation fan service manual; operational procedures; JSAs; evacuation procedures.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Monitoring system is in place) wp.

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 6

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Provide personnel safety training regarding evacuation procedures and respirator use. Execute emergency evacuation plan as necessary.

Documentation: Evacuation procedures; safety training manuals.

Remarks: Rev.01, Mit# 16

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per Bob Law, 5 May 99) jr

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 7

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Provide reinforcement along ducting ribs and joints to minimize leaks and damage if struck by foreign objects.

Documentation: ESF Ventilation Duct and Fittings Procurement Specification; operational procedures; JSAs.

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 8

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Provide enhanced joint seal (i.e., rubber band plus metal duct band) on ventilation ducts.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Neoprene band placed on East-West drift duct.) wp.

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 9

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Prevent movement of equipment or supplies that exceed travel envelope. JSA will address preparation of equipment or supplies for travel.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification; ESF Ventilation Duct and Fittings Procurement Specification; ventilation fan service manual; operational procedures; JSAs; evacuation procedures; safety manuals; inspection and maintenance

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Maintenance procedures for locomotive.) wp.

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 10

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Design exhaust ducts to easily repair or replace a section/component.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification; ESF Ventilation Duct and Fittings Procurement Specification.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 11

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Install airflow monitors to detect ventilation failure and periodically inspect monitors to ensure proper functioning.

Documentation: Inspection procedures.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ● Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Monitors installed in main tunnel and on the TBM.) wp

Mitigation Feature

Scenario Number: UI5017

Mitigation Number: 12

Scenario: Ventilation system failure or out-of-tolerance condition results in personnel health hazard (see also UI5060 and UI5042).

Mitigation Feature: Perform periodic inspection of the exhaust ducting system.

Documentation: Inspection and maintenance procedures.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5025
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	East-West Drift

Scenario: Compressed air line rupture results in personnel injury.

Cause, Failure, or Hazardous Event: Pipe rupture (e.g., due to over-pressure or impact on piping); pipe fitting failure

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0020

Prevention Mitigation Documentation: System specifications; inspection/maintenance/test records; Design drawing: BABFAG000-01717-2100-45302, Subsurface Compressed Air System Flow Diagram.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5025

Mitigation Number: 1

Scenario: Compressed air line rupture results in personnel injury.

Mitigation Feature: Design and install air lines and pressure relief valves to applicable codes & standards.

Documentation: System specifications; Design drawing: BABFAG000-01717-2100-45302.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5025

Mitigation Number: 2

Scenario: Compressed air line rupture results in personnel injury.

Mitigation Feature: Position piping out of vehicle, equipment and material travel envelope and path.

Documentation: Design drawing: BABFAG000-01717-2100-45302, Subsurface Compressed Air System Flow Diagram.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5025

Mitigation Number: 3

Scenario: Compressed air line rupture results in personnel injury.

Mitigation Feature: Provide safety training for personnel regarding high pressure fitting leak hazards and locations of shut off valves.

Documentation: Safety manuals; maintenance manuals; training manuals; Design drawing: BABFAG000-01717-2100-45302, Subsurface Compressed Air System Flow Diagram

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5025

Mitigation Number: 4

Scenario: Compressed air line rupture results in personnel injury.

Mitigation Feature: Establish inspection and maintenance schedules (for valves, pipes, etc.).

Documentation: Maintenance manuals; training manuals; system specifications; inspection/maintenance/test records; Design drawing: BABFAG000-01717-2100-45302, Subsurface Compressed Air System Flow Diagram.

Remarks: Rev.02, Mit# 5

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments: Pending Maximo implementation. (per Bob Law, 5 May 99) JLR

Scenario Description and Analysis

Approved

Scenario Number:	UI5028	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Cause, Failure, or Hazardous Event: Unsafe vehicles (e.g., improper maintenance); Fuel source (diesel fuel) exposed to ignition source (e.g., spark, flame); Use of unauthorized vehicle underground; Poor housekeeping; Lack of storage space/facilities; Failure to adhere to safety procedures.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0055

Prevention Mitigation Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 1

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Implement procedures for handling/working around combustible materials (e.g., disposal, proper storage, no smoking).

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__No smoking provisions are in place during combustible operations and handling) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 2

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Use fire-resistant materials (e.g., belts, hoses, seat covers, etc.) whenever practical.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 3

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Provide approved fuel storage containers.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Flammables are stored in appoved containers) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 4

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Limit diesel fuel storage volume to no more than 24-hour supply.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 5

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Provide safety training (e.g., rules and regulations concerning the employee's safety and the safety of others, parking of vehicles).

Documentation: OSHA 29 CFR 1926, JSAs

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 6

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Install portable extinguishers and hose bibs in the ECRB.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 7

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Provide onboard fire suppression systems (e.g., installed or portable fire extinguishers) on locomotives and front-end loaders.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 8

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Establish vehicle inspection and maintenance schedules.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 9

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Evacuate in accordance with Emergency Evacuation Plan. Use self rescuer as required.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Mitigation Feature

Scenario Number: UI5028

Mitigation Number: 10

Scenario: Fire involving subsurface vehicle (e.g., front-end loader) or temporarily stored materials.

Mitigation Feature: Ventilation system exhausts smoke and confines dispersion. Also provides fresh air source up wind of a fire.

Documentation: OSHA 29 CFR 1926.800; NFPA Fire Protection Rules and Regulations; maintenance manuals and safety manual; inspection and maintenance records

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number:	UI5030
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	East-West Drift

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Cause, Failure, or Hazardous Event: Bad winding insulation; short circuit inside electrical panel/box; insulation failure (e.g., cracked, frayed); cable breach; electrical overload, impact damage to electrical devices.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0037, UI0040

Prevention Mitigation Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 1

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Design electrical systems/components to applicable codes & standards.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 2

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Conduct inspections during electrical equipment installation and connection.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 3

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Incorporate protective devices (e.g., fuses, circuit breakers, temperature relays) where appropriate.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 4

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Field test according to applicable specifications.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 5

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Provide portable extinguishers and hose bibs in the ECRB.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 6

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Establish inspection and maintenance schedule.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments: Pending Maximo implementation (per Bob Law, 5 May 99) jr

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 7

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Ensure cable meets applicable codes and standards.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5030

Mitigation Number: 8

Scenario: Fire due to failure/short/arc/overload of electrical switchgear or other electrical equipment (e.g., transformer, electrical panel/box, electrical wire or cable).

Mitigation Feature: Provide fire safety training.

Documentation: ANSI/IEEE C2-93, OSHA 29 CFR 1926; National Electrical Safety Code; National Electrical Code; NEMA and UL standards; system specifications; maintenance manuals; safety manuals; inspection and maintenance records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Scenario Description and Analysis

Approved

Scenario Number:	UI5042	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).

Cause, Failure, or Hazardous Event: Diesel vehicle exhaust system failure or out-of-tolerance condition; ventilation system failure or out-of-tolerance condition.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI5070

Prevention Mitigation Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); Training records.

Mitigation Feature

Scenario Number: UI5042

Mitigation Number: 1

Scenario: Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).

Mitigation Feature: JSAs, procedures and/or training will address hazards associated with operational activities.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); training records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5042

Mitigation Number: 2

Scenario: Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).

Mitigation Feature: Ventilation system removes exhaust fumes and confines dispersion. Also provides fresh air source up wind of the diesel equipment.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); training records

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T. Rotert, aug98__Vent system installed and monitored) wp.

Mitigation Feature

Scenario Number: UI5042

Mitigation Number: 3

Scenario: Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).

Mitigation Feature: Monitor ventilation system for out-of-tolerance or out-of-specified range conditions. When out of tolerance/range, perform immediate system/equipment repairs or adjustments. Immediate use of respirators by all personnel may be required. Cease work and evacuate if fumes rise to life threatening levels.

Documentation: OSHA workplace exposure limits; JSA(s)

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Maintenance procedures for locomotive.) wp.

Mitigation Feature

Scenario Number: UI5042

Mitigation Number: 4

Scenario: Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).

Mitigation Feature: Minimize idling of diesel engines.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); training records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5042

Mitigation Number: 5

Scenario: Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).

Mitigation Feature: Install scrubbers (catalytic converters) on subsurface diesel equipment/vehicles.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); training records

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5042

Mitigation Number: 6

Scenario: Air Quality - Toxic fumes (e.g., carbon monoxide, carbon dioxide, nitrogen dioxide, NOx) from diesel exhaust results in a personnel health hazard (see also UI5070).

Mitigation Feature: Establish vehicle inspection & maintenance schedule.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); training records

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Maintenance and inspection every 500 hrs or when unit is malfunctioning.) wp.

Scenario Description and Analysis

Approved

Scenario Number: UI5046
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Starter Tunnel

Scenario: Train/locomotive derailment at turnout (intersection of East-West Starter Tunnel and TS Main Drift).

Cause, Failure, or Hazardous Event: Rail failure, switch malfunction, operator error, failure to adhere to safety procedures and rules.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0206

Prevention Mitigation Documentation: Inspection and maintenance records; training manuals; operators manuals; maintenance manuals; safety manuals; operator training records.

Mitigation Feature

Scenario Number: UI5046

Mitigation Number: 1

Scenario: Train/locomotive derailment at turnout (intersection of East-West Starter Tunnel and TS Main Drift).

Mitigation Feature: JSAs, procedures and/or training will address hazards associated with train operations.

Documentation: Inspection and maintenance records; training manuals; operators manuals; maintenance manuals; safety manuals; operator training records.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number:	UI5047
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	East-West Drift

Scenario: General slips and trips resulting in minor personnel injury (see also UI5069).

Cause, Failure, or Hazardous Event: Failure of emergency backup lighting; material spills; human error; lack of adequate illumination; debris (e.g., oil, water, tools) on surfaces; slippery surfaces; lack of non-skid surfaces; failure to adhere to safety procedures and rules.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
● A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
● A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0265, UI0266, UI5069 (severe trips & slips)

Prevention Mitigation Documentation: Inspection, maintenance and cleanup records; maintenance manuals; safety manuals

Mitigation Feature

Scenario Number: UI5047

Mitigation Number: 1

Scenario: General slips and trips resulting in minor personnel injury (see also UI5069).

Mitigation Feature: Provide adequate and proper illumination in the ECRB for the expected population and activities.

Documentation: Inspection, maintenance and cleanup records; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5047

Mitigation Number: 2

Scenario: General slips and trips resulting in minor personnel injury (see also UI5069).

Mitigation Feature: Provide non-skid surfaces on platforms and walkways.

Documentation: Inspection, maintenance and cleanup records; design drawings; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98__Non-skid surfaces on mapping floor, walkway and TBM.) wp

Mitigation Feature

Scenario Number: UI5047

Mitigation Number: 3

Scenario: General slips and trips resulting in minor personnel injury (see also UI5069).

Mitigation Feature: Provide safety training and caution all personnel regarding uneven surfaces on platforms and tunnel flooring.

Documentation: Inspection, maintenance and cleanup records; design drawings; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Covered in GUT training.) wp

Mitigation Feature

Scenario Number: UI5047

Mitigation Number: 4

Scenario: General slips and trips resulting in minor personnel injury (see also UI5069).

Mitigation Feature: Establish inspection, maintenance and good housekeeping rules.

Documentation: Inspection, maintenance and cleanup records; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5047

Mitigation Number: 5

Scenario: General slips and trips resulting in minor personnel injury (see also UI5069).

Mitigation Feature: Provide first-aid kits on the TBM and at the entrance to the ECRB.

Documentation: Inspection, maintenance and cleanup records; design drawings; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5047

Mitigation Number: 6

Scenario: General slips and trips resulting in minor personnel injury (see also UI5069).

Mitigation Feature: Use personal lighting (i.e., cap lamps) in unlighted or poorly illuminated areas.

Documentation: Inspection, maintenance and cleanup records; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Scenario Description and Analysis

Approved

Scenario Number:	UI5048
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	East-West Drift

Scenario: Personnel injury due to tools, equipment, or debris dropping or falling from an elevated platform.

Cause, Failure, or Hazardous Event: Human error; dropped tools or equipment; material spills; loss of balance; failure to adhere to JSA, safety procedures and rules.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0109

Prevention Mitigation Documentation: Safety manual; JSA, OHSA - 29 CFR 1926 Subpart E; maintenance manuals

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5048

Mitigation Number: 1

Scenario: Personnel injury due to tools, equipment, or debris dropping or falling from an elevated platform.

Mitigation Feature: Control personnel and any ongoing work activities below an elevated platform in the ECRB.

Documentation: Safety manual; JSA; OHSA - 29 CFR 1926 Subpart E; maintenance manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Portal guard established and A/B/C badge system established) wp.

Mitigation Feature

Scenario Number: UI5048

Mitigation Number: 2

Scenario: Personnel injury due to tools, equipment, or debris dropping or falling from an elevated platform.

Mitigation Feature: Screen enclosure with toe plate around work platforms.

Documentation: Safety manual; JSA; OHSA - 29 CFR 1926 Subpart E; maintenance manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Toe/kick plates are used on all elevated platforms. Screens are not used. Bob Law 05/19/99 JLR.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5048

Mitigation Number: 3

Scenario: Personnel injury due to tools, equipment, or debris dropping or falling from an elevated platform.

Mitigation Feature: Provide safety training.

Documentation: Safety manual; JSA; OHSA - 29 CFR 1926 Subpart E; maintenance manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Covered in GUT training.) wp

Mitigation Feature

Scenario Number: UI5048

Mitigation Number: 4

Scenario: Personnel injury due to tools, equipment, or debris dropping or falling from an elevated platform.

Mitigation Feature: Hardhats, safety glasses, and steel-toe shoes are required underground.

Documentation: Safety manual; JSA; OHSA - 29 CFR 1926 Subpart E; maintenance manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5048

Mitigation Number: 5

Scenario: Personnel injury due to tools, equipment, or debris dropping or falling from an elevated platform.

Mitigation Feature: Tools/equipment will be tethered to an individual or the platform, as appropriate.

Documentation: Safety manual; JSA; OHSA - 29 CFR 1926 Subpart E; maintenance manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Scenario Description and Analysis

Approved

Scenario Number:	UI5050
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	East-West Drift

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Cause, Failure, or Hazardous Event: Controls failure, human error, failure to adhere to safety procedures and rules.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0041, UI5046, UI5067

Prevention Mitigation Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 1

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: Provide restraints (e.g., chocks or blocks) on parked vehicles to prevent rolling down sloped grade.

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance schedules.

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Loci carry stops and attachments are lowered on the drill and loader.) wp

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 2

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: Provide safety chains or cables between locomotive and cars and between cars.

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Remarks: Rev.01, Mit#9

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Cables vice chains provided) wp.

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 3

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: Provide safety training for vehicle operators (e.g., vehicle operators cannot leave a vehicle until it is properly secured).

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 4

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: Establish operation, inspection and maintenance schedule for vehicles.

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 5

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: Personnel will set derail devices and/or bumper blocks in their work areas in the ECRB.

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 6

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: For trains, provide couplers with locks which prevent cars and locomotive from being accidentally uncoupled.

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Safety cables between cars provided) wp.

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 7

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: Provide redundant braking systems on locomotives.

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98__Air and mechanical systems.) wp

Mitigation Feature

Scenario Number: UI5050

Mitigation Number: 8

Scenario: Personnel injury/equipment damage due to runaway vehicle (e.g., train, locomotive, front-end loader).

Mitigation Feature: Design locomotive operator console to include "deadman" controls and indicators for braking system status and brake setting.

Documentation: Safety Manuals; inspection and maintenance records; vehicle inspections; OSHA - 29CFR 1926.600; operating procedures & manuals; maintenance manuals.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98__Deadman is in place, operator is accompanied by the swamper.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5054	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Cause, Failure, or Hazardous Event: Failure of ground support system; failure to adhere to safety procedures and rules (e.g., hard hat or eye protection); vehicle collision with tunnel wall/steel sets; earthquake.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0271, UI0360

Prevention Mitigation Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 1

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Implement JSAs for drill & blast and/or mechanical excavation.

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 2

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Test and inspect rockbolts and shotcrete. ...

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert,aug98__Tested prior to use.) wp

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 3

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Provide personnel safety training.

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert,aug98__Covered in GUT training.) wp

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 4

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Use PPE (e.g., hard hat, safety glasses, steel-toe shoes) where appropriate.

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 5

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Provide adequate lighting in the ECRB.

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 6

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Steel sets, lagging, rock bolts, wire mesh and shotcrete are installed based on analysis of ground type and condition and location of faults.

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 7

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Implement emergency evacuation plan.

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Mitigation Feature

Scenario Number: UI5054

Mitigation Number: 8

Scenario: Personnel injury due to failure of ground support (e.g., rock fall).

Mitigation Feature: Establish vehicle safety inspection and maintenance procedures and schedule.

Documentation: Training manuals; safety manuals; emergency evacuation plan/procedure; test/inspection/maintenance records; OSHA - 29 CFR 1926 Subpart S; ECRB Starter Tunnel and Starter Tunnel/North Ramp Intersection Stability Analysis, BABEE0000-01717-0200-00016 Rev 00

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5057	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Cause, Failure, or Hazardous Event: Electrical cables, connections (splices), outlets sparking in the presence of hydraulic fluid, lubricating oil, diesel fuel, cleaning solvents, disposable cleanup materials, or catalytic reactions involving the above materials; lack of storage space/facilities.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0056, UI0053

Prevention Mitigation Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 1

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Implement JSAs/procedures for handling or working with combustible materials.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Storage of combustibles according to OSHA in JSA procedures.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 2

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Minimize use of combustible materials underground.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 3

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: "Weld, cut and burn" procedures in effect for all underground areas.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 4

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Use fire-resistant materials whenever practical.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 5

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Provide approved storage containers.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 6

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Provide safety training (e.g., identification of fire hazards, corrective actions).

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Covered in GUT training.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 7

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Install portable extinguishers and hose bibs in the ECRB.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 8

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Limit diesel fuel storage volume to no more than 24-hour supply.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 9

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Implement good "house keeping" in the subsurface.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Sanitation procedures implemented.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 10

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Use self rescuer as required.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 11

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Ventilation system.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments:

Mitigation Feature

Scenario Number: UI5057

Mitigation Number: 12

Scenario: General underground fire due to ignition of trash, solvents, chemicals, or other combustible product.

Mitigation Feature: Implement emergency evacuation plan.

Documentation: Safety Manuals; OSHA - 29 CFR 1926 Subpart S; NFPA Fire Protection Rules and Regulations

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number: UI5058
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: East-West Drift

Scenario: Electrical shock resulting in personnel injury.

Cause, Failure, or Hazardous Event: Personnel exposure to energized conductors, high voltage cables or static charges; electrical panel/transformer short circuit; defective electrical outlet; malfunctioning fuses/breakers; insulation failure; cable break; electrical overload

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0274

Prevention Mitigation Documentation: Procedures, system specifications, Title II design drawings, maintenance manuals, training manuals, safety manual, electrician's certifications on file

Mitigation Feature

Scenario Number: UI5058

Mitigation Number: 1

Scenario: Electrical shock resulting in personnel injury.

Mitigation Feature: Design electrical systems/components to applicable codes & standards.

Documentation: Procedures, system specifications, Title II design drawings, maintenance manuals, training manuals, safety manual

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5058

Mitigation Number: 2

Scenario: Electrical shock resulting in personnel injury.

Mitigation Feature: Conduct inspections during installation and connection.

Documentation: Procedures, system specifications, Title II design drawings, maintenance manuals, training manuals, safety manual

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Inspections conducted by A/E and QA.) wp

Mitigation Feature

Scenario Number: UI5058

Mitigation Number: 3

Scenario: Electrical shock resulting in personnel injury.

Mitigation Feature: Incorporate protective electrical devices where practical (e.g., fuses, circuit breakers).

Documentation: Procedures, system specifications, Title II design drawings, maintenance manuals, training manuals, safety manual

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5058

Mitigation Number: 4

Scenario: Electrical shock resulting in personnel injury.

Mitigation Feature: Field test according to applicable testing specifications.

Documentation: Procedures, system specifications, Title II design drawings, maintenance manuals, training manuals, safety manual

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5058

Mitigation Number: 5

Scenario: Electrical shock resulting in personnel injury.

Mitigation Feature: Safety training for personnel working around electrical equipment.

Documentation: Procedures, system specifications, Title II design drawings, maintenance manuals, training manuals, safety manual

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Covered in GUT training.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5060
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift
Location: East-West Drift

Scenario: Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).

Cause, Failure, or Hazardous Event: Ventilation system failure or out-of-tolerance condition, ventilation duct leak, loss of off-site power

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios: UI5017, UI5070

Prevention Mitigation Documentation: Procedures, JSA(s), safety manuals

Mitigation Feature

Scenario Number: UI5060

Mitigation Number: 1

Scenario: Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).

Mitigation Feature: Ventilation system.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments:

Mitigation Feature

Scenario Number: UI5060

Mitigation Number: 2

Scenario: Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).

Mitigation Feature: Monitor for out-of-tolerance or out-of-specified range conditions; when out of tolerance/range, work ceases until mitigation is accomplished by respirator use and/or system/equipment repair or adjustments.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5060

Mitigation Number: 3

Scenario: Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).

Mitigation Feature: Respirator use as dictated by Industrial Hygienist.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5060

Mitigation Number: 4

Scenario: Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).

Mitigation Feature: Use water sprays or other dust suppression materials to wet down excavated walls and muck pile.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5060

Mitigation Number: 5

Scenario: Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).

Mitigation Feature: Provide enhanced joint seal (i.e., rubber band plus metal duct band) on ventilation ducts.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5060

Mitigation Number: 6

Scenario: Air Quality - Excessive dust results in a personnel health hazard (see also UI5017 and UI5070).

Mitigation Feature: JSAs, procedures and/or training will address hazards associated with operational activities.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number: UI5061
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift
Location: East-West Drift

Scenario: Excessive noise due to vehicles, rock bolt drills, ventilation fans, drilling/blasting, or other potential sources of noise.

Cause, Failure, or Hazardous Event: Normal drill & blast/excavation activities, transport systems, and ground support installation activities.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	**Extremely Low**
○ D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Procedures, JSA(s), safety manuals

Mitigation Feature

Scenario Number: UI5061

Mitigation Number: 1

Scenario: Excessive noise due to vehicles, rock bolt drills, ventilation fans, drilling/blasting, or other potential sources of noise.

Mitigation Feature: Implement the Hearing Conservation Program (PRO-SH-004) and Medical Surveillance Program (NAP-SH-007) to minimize exposure to excessive noise levels.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Mitigation Feature

Scenario Number: UI5061

Mitigation Number: 2

Scenario: Excessive noise due to vehicles, rock bolt drills, ventilation fans, drilling/blasting, or other potential sources of noise.

Mitigation Feature: Periodically measure for out-of-tolerance or out-of-specified range conditions; when out of tolerance/range, provide ear protection for immediate mitigation.

Documentation: Procedures, JSA(s), safety manuals

Remarks: Rev.01, Mit #6

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5061

Mitigation Number: 3

Scenario: Excessive noise due to vehicles, rock bolt drills, ventilation fans, drilling/blasting, or other potential sources of noise.

Mitigation Feature: Clear area prior to blasting.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5061

Mitigation Number: 4

Scenario: Excessive noise due to vehicles, rock bolt drills, ventilation fans, drilling/blasting, or other potential sources of noise.

Mitigation Feature: Ventilation fans purchased/installed shall meet ACGIH standard for noise.

Documentation: Purchase specification, ACGIH standard.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98__Purchase specs require noise levels below ACGIH standard.) wp

Mitigation Feature

Scenario Number: UI5061

Mitigation Number: 5

Scenario: Excessive noise due to vehicles, rock bolt drills, ventilation fans, drilling/blasting, or other potential sources of noise.

Mitigation Feature: JSAs, procedures and/or training will address hazards associated with operational activities.

Documentation: Procedures, JSA(s), safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5062
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift
Location: East-West Drift

Scenario: Worker injury due to fall from an elevated platform.

Cause, Failure, or Hazardous Event: Personnel negligence, slippery surface, material spills, failure to adhere to safety procedures and rules.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0108

Prevention Mitigation Documentation: Safety manual; OSHA - 29 CFR 1926 Subparts E, M, X; procedures and operators manuals; maintenance manuals; personnel training records.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5062

Mitigation Number: 1

Scenario: Worker injury due to fall from an elevated platform.

Mitigation Feature: Handrail and toe plate around all landings, platforms and stairs per OSHA standards.

Documentation: OSHA - 29 CFR 1926 Subparts E, M, X; maintenance manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5062

Mitigation Number: 2

Scenario: Worker injury due to fall from an elevated platform.

Mitigation Feature: Establish JSA procedures for elevated platform operations and maintenance.

Documentation: Safety manual; OSHA - 29 CFR 1926 Subparts E, M, X; procedures and operators manuals; maintenance manuals; personnel training records.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5062

Mitigation Number: 3

Scenario: Worker injury due to fall from an elevated platform.

Mitigation Feature: Provide gate or chain across openings, where appropriate.

Documentation: Safety manual; OSHA - 29 CFR 1926 Subparts E, M, X; procedures and operators manuals; maintenance manuals; personnel training records.

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5062

Mitigation Number: 4

Scenario: Worker injury due to fall from an elevated platform.

Mitigation Feature: Implement OSHA requirements for usage of safety belts during work in unprotected areas.

Documentation: Safety manual; OSHA - 29 CFR 1926 Subparts E, M, X; procedures and operators manuals; maintenance manuals; personnel training records.

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5062

Mitigation Number: 5

Scenario: Worker injury due to fall from an elevated platform.

Mitigation Feature: Provide safety training using JSA procedures as a guide for work on elevated platforms.

Documentation: Safety manual; OSHA - 29 CFR 1926 Subparts E, M, X; procedures and operators manuals; maintenance manuals; personnel training records.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5067	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Subsurface vehicle (e.g., front-end loader) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).

Cause, Failure, or Hazardous Event: Failure to install utilities clear of travel envelope; failure to provide protective barriers which protect utilities in the event of a collision; failure to properly prepare equipment for travel (e.g., set brakes) and/or restrain equipment so that it is not ejected from the vehicle in the event of a collision; loss of control over vehicle.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0051

Prevention Mitigation Documentation: Title II Design Drawings; vehicle specifications; training manuals; operator manuals; safety manual; JSAs.

Mitigation Feature

Scenario Number: UI5067

Mitigation Number: 1

Scenario: Subsurface vehicle (e.g., front-end loader) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).

Mitigation Feature: Design drifts and alcoves large enough to provide adequate space for utilities, taking into account all of the equipment that will be used in these confined spaces.

Documentation: Title II Design Drawings; vehicle specifications; training manuals; operator manuals; safety manual; JSAs.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5067

Mitigation Number: 2

Scenario: Subsurface vehicle (e.g., front-end loader) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).

Mitigation Feature: Select equipment/materials/supplies that are compatible with the transportation envelope.

Documentation: Title II Design Drawings; vehicle specifications; training manuals; operator manuals; safety manual; JSAs.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5067

Mitigation Number: 3

Scenario: Subsurface vehicle (e.g., front-end loader) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).

Mitigation Feature: Develop operating procedures that prohibit equipment travel without having extendible appendages retracted and/or properly restrained.

Documentation: Title II Design Drawings; vehicle specifications; training manuals; operator manuals; safety manual; JSAs.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5067

Mitigation Number: 4

Scenario: Subsurface vehicle (e.g., front-end loader) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).

Mitigation Feature: Design ground fault protection into electrical systems where appropriate.

Documentation: Title II Design Drawings; vehicle specifications; training manuals; operator manuals; safety manual; JSAs.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5067

Mitigation Number: 5

Scenario: Subsurface vehicle (e.g., front-end loader) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).

Mitigation Feature: Design adequate clearance for the transportation envelope.

Documentation: Title II Design Drawings; vehicle specifications; training manuals; operator manuals; safety manual; JSAs.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5067

Mitigation Number: 6

Scenario: Subsurface vehicle (e.g., front-end loader) or machinery collision with utility cable, conduit or pipe (e.g., ventilation, water supply, subsurface waste water, compressed air, electrical line, communications line, data line).

Mitigation Feature: Provide safety training for vehicle operators and personnel working around vehicles.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number:	UI5069	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: General slips and trips resulting in severe personnel injury (see also UI5047).

Cause, Failure, or Hazardous Event: Loss of off-site power; failure of emergency backup lighting; material spills; human error; lack of adequate illumination; debris (e.g., oil, water, tools) on surfaces; slippery surfaces; lack of non-skid surfaces; failure to adhere to safety procedures and rules.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI5047 (minor slips and trips)

Prevention Mitigation Documentation: Inspection, maintenance and cleanup records; design drawings; maintenance manuals; safety manuals

Mitigation Feature

Scenario Number: UI5069

Mitigation Number: 1

Scenario: General slips and trips resulting in severe personnel injury (see also UI5047).

Mitigation Feature: Provide adequate and proper illumination in the ECRB for the expected population and work activities.

Documentation: Inspection, maintenance and cleanup records; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments:

Mitigation Feature

Scenario Number: UI5069

Mitigation Number: 2

Scenario: General slips and trips resulting in severe personnel injury (see also UI5047).

Mitigation Feature: Provide emergency lighting for use during a power failure or lighting system failure.

Documentation: Inspection, maintenance and cleanup records; design drawings; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- (●) Not Implemented
- ( ) Implemented

Comments:

Mitigation Feature

Scenario Number: UI5069

Mitigation Number: 3

Scenario: General slips and trips resulting in severe personnel injury (see also UI5047).

Mitigation Feature: Use personal lighting (I.e., cap lamps) in unlighted or poorly illuminated areas.

Documentation: Inspection, maintenance and cleanup records; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Mitigation Feature

Scenario Number: UI5069

Mitigation Number: 4

Scenario: General slips and trips resulting in severe personnel injury (see also UI5047).

Mitigation Feature: Establish inspection, maintenance and good housekeeping rules.

Documentation: Inspection, maintenance and cleanup records; design drawings; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Mitigation Feature

Scenario Number: UI5069

Mitigation Number: 5

Scenario: General slips and trips resulting in severe personnel injury (see also UI5047).

Mitigation Feature: Provide first-aid kits on the TBM and at the entrance to the ECRB.

Documentation: Inspection, maintenance and cleanup records; maintenance manuals; safety manuals

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5069

Mitigation Number: 6

Scenario: General slips and trips resulting in severe personnel injury (see also UI5047).

Mitigation Feature: Provide safety training and caution all personnel regarding uneven surfaces on platforms and tunnel flooring.

Documentation: Inspection, maintenance and cleanup records; design drawings; maintenance manuals; safety manuals

Remarks: Rev.01, Mit #7

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5070
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	East-West Drift

Scenario: Air Quality - Excessive diesel soot and/or smoke particulate results in a personnel health hazard (see also UI5042).

Cause, Failure, or Hazardous Event: Diesel vehicle exhaust system failure or out-of-tolerance condition; ventilation system failure or out-of-tolerance condition; failure to adhere to proper procedures (e.g., use wrong fuel or oil in vehicles)

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI5042

Prevention Mitigation Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); Title II design drawings; training records; safety manual

Mitigation Feature

Scenario Number: UI5070

Mitigation Number: 1

Scenario: Air Quality - Excessive diesel soot and/or smoke particulate results in a personnel health hazard (see also UI5042).

Mitigation Feature: JSAs, procedures and/or training will address hazards associated with operational activities.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; MSHA 30 CFR Part 7; JSA(s); training records; safety manual

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Mitigation Feature

Scenario Number: UI5070

Mitigation Number: 2

Scenario: Air Quality - Excessive diesel soot and/or smoke particulate results in a personnel health hazard (see also UI5042).

Mitigation Feature: Ventilation System removes exhaust smoke and suspended particulates. Also provides fresh air up wind of the diesel equipment.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); Title II design drawings; training records; safety manual

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments:

Mitigation Feature

Scenario Number: UI5070

Mitigation Number: 3

Scenario: Air Quality - Excessive diesel soot and/or smoke particulate results in a personnel health hazard (see also UI5042).

Mitigation Feature: Establish vehicle inspection & maintenance schedule.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); Title II design drawings; training records; safety manual

Remarks: Rev.01, Mit #6

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5070

Mitigation Number: 4

Scenario: Air Quality - Excessive diesel soot and/or smoke particulate results in a personnel health hazard (see also UI5042).

Mitigation Feature: Minimize idling of diesel engines.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); Title II design drawings; training records; safety manual

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5070

Mitigation Number: 5

Scenario: Air Quality - Excessive diesel soot and/or smoke particulate results in a personnel health hazard (see also UI5042).

Mitigation Feature: Install scrubbers (catalytic converters) on subsurface diesel vehicles.

Documentation: Vehicle operating and maintenance procedures, manuals and records; OSHA workplace exposure limits; JSA(s); Title II design drawings; training records; safety manual

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5072	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Ventilation fan structural failure.

Cause, Failure, or Hazardous Event: Equipment/component failure of bearing, blades, impeller assembly, nose cone or guide vanes.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0012, UI0101, UI0102, UI0103

Prevention Mitigation Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification and ESF Ventilation Duct and Fittings Procurement Specification. Ventilation fan service manual, operational procedures, safety manuals, maintenance manuals, training manuals.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5072

Mitigation Number: 1

Scenario: Ventilation fan structural failure.

Mitigation Feature: Ventilation fan components are of high quality materials with proven performance record.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification and ESF Ventilation Duct and Fittings Procurement Specification. Ventilation fan service manual, operational procedures, safety manuals, maintenance manuals, training manuals.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5072

Mitigation Number: 2

Scenario: Ventilation fan structural failure.

Mitigation Feature: The fan is inside a metal housing and connected to ventilation ducts. Provides missile protection.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification and ESF Ventilation Duct and Fittings Procurement Specification. Ventilation fan service manual, operational procedures, safety manuals, maintenance manuals, training manuals.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5072

Mitigation Number: 3

Scenario: Ventilation fan structural failure.

Mitigation Feature: Provide for vibration and bearings temperature inspections.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification and ESF Ventilation Duct and Fittings Procurement Specification. Ventilation fan service manual, operational procedures, safety manuals, maintenance manuals, training manuals.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- (●) Not Implemented
- ( ) Implemented

Comments:

Mitigation Feature

Scenario Number: UI5072

Mitigation Number: 4

Scenario: Ventilation fan structural failure.

Mitigation Feature: Perform scheduled maintenance according to manufacturers recommendation. Maintain maintenance records.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification and ESF Ventilation Duct and Fittings Procurement Specification. Ventilation fan service manual, operational procedures, safety manuals, maintenance manuals, training manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number:	UI5073	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Personnel injury/equipment damage due to muck falling off the conveyor system.

Cause, Failure, or Hazardous Event: Conveyor component failure (e.g., conveyor belt, support rollers, etc.). Failure to follow safety procedures or operating/maintenance procedures (e.g., walking/crawling under a running conveyor belt, attempting maintenance when the system is not shut off

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0023

Prevention Mitigation Documentation: System specifications and design drawings. Maintenance and safety manuals.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5073

Mitigation Number: 1

Scenario: Personnel injury/equipment damage due to muck falling off the conveyor system.

Mitigation Feature: Provide guards at transfer points to prevent muck from falling off the conveyor belt or between the conveyor belt and support structure.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5073

Mitigation Number: 2

Scenario: Personnel injury/equipment damage due to muck falling off the conveyor system.

Mitigation Feature: Provide lockout/tagouts. Prevents system start up while in maintenance or inoperable status

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5073

Mitigation Number: 3

Scenario: Personnel injury/equipment damage due to muck falling off the conveyor system.

Mitigation Feature: Personnel must keep hands and arms inside the train car while transiting the tunnel in order to avoid the conveyor structure.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Mancar openings are towards the utilities.) wp

Mitigation Feature

Scenario Number: UI5073

Mitigation Number: 4

Scenario: Personnel injury/equipment damage due to muck falling off the conveyor system.

Mitigation Feature: Require personnel to wear personal protective equipment (e.g., hard hats, eye protection, hard toed shoes)

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5073

Mitigation Number: 5

Scenario: Personnel injury/equipment damage due to muck falling off the conveyor system.

Mitigation Feature: Establish inspection and maintenance procedures (e.g., alignment connections, guide wear) and schedule. Maintain inspection and maintenance records.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments: To be implemented with the Maximo system. [Bob Law 05/19/99]

Mitigation Feature

Scenario Number: UI5073

Mitigation Number: 6

Scenario: Personnel injury/equipment damage due to muck falling off the conveyor system.

Mitigation Feature: Provide safety training (e.g., rules and regulations pertaining to personnel safety, personnel exclusion area, etc.).

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Covered in GUT training.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5075	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Personnel injury resulting from misuse of rail cars for personnel transit.

Cause, Failure, or Hazardous Event: Action(s) by an individual cause exposure of the body (e.g., head, arms) beyond the upper and side limits of the rail transit window.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: 29 CFR 1926.800. Vehicle and equipment specifications. Operation and maintenance manuals. Training and safety manuals.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5075

Mitigation Number: 1

Scenario: Personnel injury resulting from misuse of rail cars for personnel transit.

Mitigation Feature: Personnel must ride within authorized personnel compartments. Prohibit personnel from riding on or outside (hanging on) vehicles, or material cars. Train operators will not move the train until all personnel are properly seated.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5075

Mitigation Number: 2

Scenario: Personnel injury resulting from misuse of rail cars for personnel transit.

Mitigation Feature: Prohibit mixed loads on rail cars. Personnel and materials must be transported separately. Prohibit personnel from riding on, or holding materials and/or equipment in place.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5075

Mitigation Number: 3

Scenario: Personnel injury resulting from misuse of rail cars for personnel transit.

Mitigation Feature: Design/modify personnel cars with high sides to prevent head, hands and arms from extending beyond the train.

Documentation: 29 CFR 1926.800. Vehicle and equipment specifications. Operation and maintenance manuals. Training and safety manuals.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5075

Mitigation Number: 4

Scenario: Personnel injury resulting from misuse of rail cars for personnel transit.

Mitigation Feature: Operators will not move the train until all personnel are properly seated.

Documentation: 29 CFR 1926.800. Vehicle and equipment specifications. Operation and maintenance manuals. Training and safety manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5077
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: East-West Drift

Scenario: Personnel injury/equipment damage due to falling or partially detached hanging installed equipment (e.g., ventilation ducts, conveyor support framing, power lines, service lines)

Cause, Failure, or Hazardous Event: Broken support bracket(s), bolts, support stand(s), fasteners. Improper fastening or attaching. Fastener capacity exceeded.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0034

Prevention Mitigation Documentation:

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5077

Mitigation Number: 1

Scenario: Personnel injury/equipment damage due to falling or partially detached hanging installed equipment (e.g., ventilation ducts, conveyor support framing, power lines, service lines)

Mitigation Feature: Design and install brackets, bolts, support framework with adequate safety factors for anticipated loads.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5077

Mitigation Number: 2

Scenario: Personnel injury/equipment damage due to falling or partially detached hanging installed equipment (e.g., ventilation ducts, conveyor support framing, power lines, service lines)

Mitigation Feature: Minimize access to essential personnel during initial equipment installation and when equipment changes, or repair and maintenance activities are being conducted.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5077

Mitigation Number: 3

Scenario: Personnel injury/equipment damage due to falling or partially detached hanging installed equipment (e.g., ventilation ducts, conveyor support framing, power lines, service lines)

Mitigation Feature: Shut down any damaged equipment that is still running. Limit access to qualified, trained, and necessary personnel to perform repairs.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5077

Mitigation Number: 4

Scenario: Personnel injury/equipment damage due to falling or partially detached hanging installed equipment (e.g., ventilation ducts, conveyor support framing, power lines, service lines)

Mitigation Feature: Provide safety training (e.g., personnel exclusion areas, personnel protective equipment)

Documentation: JSAs document.

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number: UI5078
Revision Number: 02
Revision Date: 12/17/98

SSA: East- West Drift

Location: East-West Drift

Scenario: Ventilation Fan Failure (Foreign Object(s) in System).

Cause, Failure, or Hazardous Event: Foreign object(s) ingested into the system.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0105

Prevention Mitigation Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification. Ventilation fan service manual, maintenance manuals and safety manuals.

Mitigation Feature

Scenario Number: UI5078

Mitigation Number: 1

Scenario: Ventilation Fan Failure (Foreign Object(s) in System).

Mitigation Feature: Install screens upstream of each fan to protect against foreign object damage. The ducting design should provide access panels adjacent to screen sites for cleaning.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5078

Mitigation Number: 2

Scenario: Ventilation Fan Failure (Foreign Object(s) in System).

Mitigation Feature: Perform maintenance in accordance with manufacturer's recommendation to remove foreign objects from screen filters.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Scenario Description and Analysis

Approved

Scenario Number:	UI5080	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Fire Hazards: Conveyor System

Cause, Failure, or Hazardous Event: Conveyor belt fire due to friction on bearing, idlers frozen.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	Medium
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0067

Prevention Mitigation Documentation: OSHA - 29 CFR 1926 Subparts S & F. NFPA Fire Protection Rules and Regulations. System specifications, maintenance and safety manuals.

Mitigation Feature

Scenario Number: UI5080

Mitigation Number: 1

Scenario: Fire Hazards: Conveyor System

Mitigation Feature: Install automatic fire suppression systems at all transfer points.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5080

Mitigation Number: 2

Scenario: Fire Hazards: Conveyor System

Mitigation Feature: Install fire resistant belts.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5080

Mitigation Number: 3

Scenario: Fire Hazards: Conveyor System

Mitigation Feature: Provide wall mounted fire extinguishers at each electric panel site and every 200-300 feet on the tunnel wall.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Extinguishers are in place per FHA.) wp.

Mitigation Feature

Scenario Number: UI5080

Mitigation Number: 4

Scenario: Fire Hazards: Conveyor System

Mitigation Feature: Establish inspection, maintenance procedures and schedule for conveyor components. Maintain inspection and maintenance records.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98__Inspected on shift basis per manufacturers instruction during operations and annual suppression system inspections.) wp. Will be formally documented in the Maximo system. [Bob Law 05/19/99] JLR

Scenario Description and Analysis

Approved

Scenario Number:	UI5081	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Fire Hazards: Ventilation System

Cause, Failure, or Hazardous Event: Fire in a fan motor. Friction heat in bearing, electrical short.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Extremely Low**
○ D - Remote	● IV - Negligible	
● E - Improbable		

Related Scenarios: UI0104

Prevention Mitigation Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification. Ventilation fan service manual, operational procedures, maintenance manuals and safety manuals.

Mitigation Feature

Scenario Number: UI5081

Mitigation Number: 1

Scenario: Fire Hazards: Ventilation System

Mitigation Feature: Metal housing contains fire.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5081

Mitigation Number: 2

Scenario: Fire Hazards: Ventilation System

Mitigation Feature: Electrical components are UL-Listed or UL-List recognized equivalent for intended purpose. Fan electrical meets requirements of NFPA 70.

Documentation: ESF Subsurface Vaneaxial Ventilation Fans Procurement Specification. Ventilation fan service manual, operational procedures, maintenance manuals and safety manuals.

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5081

Mitigation Number: 3

Scenario: Fire Hazards: Ventilation System

Mitigation Feature: The temperature of each fan's bearings can be inspected for overheating condition.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- (●) Not Implemented
- ( ) Implemented

Comments:

Mitigation Feature

Scenario Number: UI5081

Mitigation Number: 4

Scenario: Fire Hazards: Ventilation System

Mitigation Feature: Individual fans can be electrically isolated (e.g., shutoff switch)

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5081

Mitigation Number: 5

Scenario: Fire Hazards: Ventilation System

Mitigation Feature: Combustible materials available are extremely limited.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number: UI5082
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift
Location: East-West Drift

Scenario: Ventilation System Shutdown Due to Main Power Failure

Cause, Failure, or Hazardous Event: Power grid interruption (e.g., utility power source, site transformers, circuit breakers, switches)

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0110

Prevention Mitigation Documentation: Emergency evacuation plan. Evacuation training and safety manuals.

Mitigation Feature

Scenario Number: UI5082

Mitigation Number: 1

Scenario: Ventilation System Shutdown Due to Main Power Failure

Mitigation Feature: Develop procedures for cessation of work and evacuation of personnel when ventilation system fails.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5082

Mitigation Number: 2

Scenario: Ventilation System Shutdown Due to Main Power Failure

Mitigation Feature: Safety Training in Evacuation Procedures.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5083
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift
Location: East-West Drift

Scenario: Inadequate Lighting Hazard

Cause, Failure, or Hazardous Event: Failure of support lighting system.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Extremely Low**
○ D - Remote	● IV - Negligible	
● E - Improbable		

Related Scenarios: UI0242

Prevention Mitigation Documentation: OSHA 29 CFR 1926.800(1). System specifications and design drawings. Maintenance and safety manuals.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5083

Mitigation Number: 1

Scenario: Inadequate Lighting Hazard

Mitigation Feature: Provide emergency lighting with battery backup at all telephone stations.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5083

Mitigation Number: 2

Scenario: Inadequate Lighting Hazard

Mitigation Feature: Provide individual power pack lights/flashlights for emergency use.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Cap lamps or flashlights are provided.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5083

Mitigation Number: 3

Scenario: Inadequate Lighting Hazard

Mitigation Feature: Inspect, maintain and test the emergency lighting system according to manufacturer's recommendation. Maintain inspection and maintenance records.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments: Will be implemented with the Maximo system. [Bob Law 05/19/99] JLR

Mitigation Feature

Scenario Number: UI5083

Mitigation Number: 4

Scenario: Inadequate Lighting Hazard

Mitigation Feature: Provide lighted Exit Signs with battery backup at all intersections.

Documentation: OSHA 29 CFR 1926.800(1). System specifications and design drawings. Maintenance and safety manuals.

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Installed at the ECRB main drift intersection [Bob Law 05/19/99] JLR

Scenario Description and Analysis

Approved

Scenario Number: UI5084
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: East-West Drift

Scenario: Diesel Fuel Hazard: Leak in Engine compartment

Cause, Failure, or Hazardous Event: Internal fuel line leak from mechanical failure (joints, intrusive rupture)

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios: UI0354

Prevention Mitigation Documentation:

NFPA 124, Diesel Fuel and Diesel Equipment in Underground Mines.
NFPA 122, Standard for Storage of Flammable and Combustible Liquids within Underground Metal and Non-Metal Mines.
OSHA - 29 CFR 1926 Subpart S.
Subsurface Fire Hazard Analysis, BABFAH000-01717-0200-00121 Rev. 0
Subsurface Fire Protection Design Analysis, BABFAH000-01717-0200-00114 Rev. 0
Subsurface Fire Protection, BABFAH000-01717-6300-15300 Rev. 0
Fire Alarm and Smoke Detector System, BABFAH000-01717-6300-16721 Rev. 0
Emergency evacuation plan and procedures.
Maintenance, operations and housekeeping procedures.
Inspection and maintenance records.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5084

Mitigation Number: 1

Scenario: Diesel Fuel Hazard: Leak in Engine compartment

Mitigation Feature: Provide an automatic or manual fire suppression system in all mobile diesel equipment.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98__All underground mobile diesel equipment is equipped with automatic fire suppression.) wp

Mitigation Feature

Scenario Number: UI5084

Mitigation Number: 2

Scenario: Diesel Fuel Hazard: Leak in Engine compartment

Mitigation Feature: Engine compartment is an enclosed space.

Documentation:

Remarks: [Note: When written, this mitigation was intended for the locomotive. wprather]

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98__Locomotive is enclosed, not possible on some other equipment.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5084

Mitigation Number: 3

Scenario: Diesel Fuel Hazard: Leak in Engine compartment

Mitigation Feature: Shut down diesel engine at first sign of any leak or spill condition. Clean or repair on site.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number:	UI5085	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Cause, Failure, or Hazardous Event: Vehicle operating in the East-West Drift runs into personnel working/walking in the Drift (walkway/tracks occupy same transit window as vehicle).

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0207

Prevention Mitigation Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 1

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Install warning devices (flashing lights/sounding horn) on vehicles to warn personnel of vehicle approach.

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ● Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Locomotives are equiped.) wp

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 2

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Provide personnel working/walking between the ECRB entrance and the TBM complex (e.g., TBM, support cars/structures, support equipment) with reflective vests, reflective tape on hard hats and lights (e.g., cap lamps, flashlights) to signal vehicle operator of their presence.

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 3

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Provide flat jump seat areas mounted on top of the top utility pipe spaced to allow quick access when a train is approaching (e.g., co-located with the fire extinguishers). The seat must allow for complete relief from the train travel area.

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 4

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Restrict walking access to the drift to essential personnel required for maintenance and supervisory walk downs.

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 5

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Train traffic will be suspended during special walk downs/inspections (e.g., DIE, Safety, or other special purpose walk downs).

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 6

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Derailers with warning lights will be utilized during major maintenance tasks requiring extended periods in the train travel area.

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 7

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Loci operators will be trained to bring the trains to a stop until personnel on foot in the tunnel are safely seated on a jump seat (Mitigation 3) before proceeding.

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 8

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Train personnel to proceed to the nearest jump seat when a train is approaching.

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 9

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Restrict general access to the drift to authorized personnel only (e.g., require special badges to enter the drift).

Documentation: It is the constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5085

Mitigation Number: 10

Scenario: Vehicle hits personnel on foot in the East-West Drift.

Mitigation Feature: Whenever a train or other vehicle encounters personnel working or walking in the ECRB, the operator shall bring the train to a complete stop before proceeding. This stop will be accomplished even if on foot personnel are already prepared for vehicle passage and are well clear of the vehicle path.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number: UI5086
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: East-West Drift

Scenario: Vehicle Diesel Fire Hazard: Diesel leak(s) from fuel tank or fuel lines or spills during refueling.

Cause, Failure, or Hazardous Event: Mechanical failure(s) of container, fuel lines/joints. Human error during refueling activities (dropping container, inattention to refueling process).

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0361

Prevention Mitigation Documentation:

NFPA 124, Diesel Fuel and Diesel Equipment in Underground Mines.
NFPA 122, Standard for Storage of Flammable and Combustible Liquids within Underground Metal and Non-Metal Mines.
OSHA - 29 CFR 1926 Subpart S.
Subsurface Fire Hazard Analysis, BABFAH000-01717-0200-00121 Rev. 0
Subsurface Fire Protection Design Analysis, BABFAH000-01717-0200-00114 Rev. 0
Subsurface Fire Protection, BABFAH000-01717-6300-15300 Rev. 0
Fire Alarm and Smoke Detector System, BABFAH000-01717-6300-16721 Rev. 0
Emergency evacuation plan and procedures.
Maintenance, operations and housekeeping procedures.
Inspection and maintenance records.

Mitigation Feature

Scenario Number: UI5086

Mitigation Number: 1

Scenario: Vehicle Diesel Fire Hazard: Diesel leak(s) from fuel tank or fuel lines or spills during refueling.

Mitigation Feature: Install automatic fire suppression on the refueling vehicle.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5086

Mitigation Number: 2

Scenario: Vehicle Diesel Fire Hazard: Diesel leak(s) from fuel tank or fuel lines or spills during refueling.

Mitigation Feature: Daily inspection of diesel engine compartment and fuel lines to detect any small leaks.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Part of the pre-shift inspection.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5086

Mitigation Number: 3

Scenario: Vehicle Diesel Fire Hazard: Diesel leak(s) from fuel tank or fuel lines or spills during refueling.

Mitigation Feature: All diesel refueling activities shall be a two man operation. One refuels and the other mans the fire extinguisher and diesel fuel cutoff valve.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T. Rotert, aug98) wp.

Mitigation Feature

Scenario Number: UI5086

Mitigation Number: 4

Scenario: Vehicle Diesel Fire Hazard: Diesel leak(s) from fuel tank or fuel lines or spills during refueling.

Mitigation Feature: Provide an automatic and/or manual fire suppression system in vehicle engine compartment.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- ( ) Not Implemented
- (●) Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5086

Mitigation Number: 5

Scenario: Vehicle Diesel Fire Hazard: Diesel leak(s) from fuel tank or fuel lines or spills during refueling.

Mitigation Feature: Operator training on proper methods of handling diesel fuel and refueling procedures.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Scenario Description and Analysis

Approved

Scenario Number:	UI5087	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	East-West Drift

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Cause, Failure, or Hazardous Event: Track failure (e.g., track damage, debris on track). Component failure (e.g., brakes, runaway locomotive). Operator error (e.g., excessive speed, misjudgment or failure to stop causing collision with other equipment). Operator incapacitated.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios: UI0201, UI0202

Prevention Mitigation Documentation:
Title II Design Drawings, Vehicle and Equipment Specifications.
OSHA - 29 CFR 1926.800
Operators and maintenance manuals.
Training and safety manuals.

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 1

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Incorporated "deadman" controls and an emergency stop switch in locomotive.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Deadman in place.) wp

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 2

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Install a speedometer on the locomotive.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 3

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Install derail devices and/or bumper blocks behind the mapping floor and TBM work areas.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 4

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Test the function of the braking system daily.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Part of the pre-shift inspection.) wp

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 5

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Daily inspection of track to detect any damage and to ensure that their no equipment/structure and or support system(s) intruding into the transit envelop.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 6

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Operating contractor will establish and enforce a safe maximum speed limit for the locomotive in the tunnel.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98__Speed limit of 15 mph for locomotive traffic set by CMO and constructor.) wp

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 7

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Locomotive operator training. Contractor will insure that all locomotive operators are properly trained and qualified.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

Mitigation Feature

Scenario Number: UI5087

Mitigation Number: 8

Scenario: Train/locomotive derailment and/or impacting the TBM causing personnel injury and/or major equipment damage.

Mitigation Feature: Accomplish daily equipment inspections and remove from service ("red tag") any equipment that does not conform with safety requirements.

Documentation:
Title II Design Drawings, Vehicle and Equipment Specifications.
OSHA - 29 CFR 1926.800
Operators and maintenance manuals.
Training and safety manuals.

Remarks:

Mitigation type:
- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:
- ○ Not Implemented
- ● Implemented

Comments: Implemented (per T.Rotert, aug98.) wp

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5089
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Mapping Floor

Scenario: Personnel working on the mapping floor come into contact with operating muck conveyor system mechanical parts (e.g., conveyor belts, idlers, etc.)

Cause, Failure, or Hazardous Event: Personnel inadvertently walk into or back into the running conveyor system. Personnel reach into or bend forward into the conveyor envelope to survey the tunnel walls or retrieve tools/materials from conveyor side of the mapping floor. Personnel fall into the conveyor system from mobile or raised stands (e.g., ladders, stools, etc.) on the mapping floor.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	High
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground mapping of the ECRB JSA, 19jun98,page1.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5089

Mitigation Number: 1

Scenario: Personnel working on the mapping floor come into contact with operating muck conveyor system mechanical parts (e.g., conveyor belts, idlers, etc.)

Mitigation Feature: Stowage of tools and materials on the deck of the conveyor side of the mapping floor will be prohibited. The conveyor side of the three mapping floor cars and the two transition ramps will be kept clear of materials at all times.

Documentation: Underground mapping of the ECRB JSA, 19jun98,page1.

Remarks: JSA developed. Part of mapping floor training.
Stowage compartments are provided below the floor decks.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5089

Mitigation Number: 2

Scenario: Personnel working on the mapping floor come into contact with operating muck conveyor system mechanical parts (e.g., conveyor belts, idlers, etc.)

Mitigation Feature: Install handrails equipped with small-opening mesh on the conveyor side of the mapping floor cars to prevent personnel from inadvertently entering/reaching into the conveyor area.

Documentation:

Remarks: Tortoise fencing is in place over handrails with holes in fencing to allow access to the E-stops.

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5089

Mitigation Number: 3

Scenario: Personnel working on the mapping floor come into contact with operating muck conveyor system mechanical parts (e.g., conveyor belts, idlers, etc.)

Mitigation Feature: The conveyor system shall be tagged out/locked out to prevent conveyor operation whenever mapping survey or scientific evaluation of the tunnel walls above or below the conveyor would expose personnel to the moving mechanical parts of the conveyor system. Mitigation requires coordination with TBM operations.

Documentation: Underground mapping of the ECRB JSA, 19jun98,page1.

Remarks: JSA developed. Part of mapping floor training. Work on the conveyor side is limited to painting of rock fractures above the conveyor.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5089

Mitigation Number: 4

Scenario: Personnel working on the mapping floor come into contact with operating muck conveyor system mechanical parts (e.g., conveyor belts, idlers, etc.)

Mitigation Feature: Personnel working on the mapping floor shall be trained to never enter the two foot wide section of the floor that is under the conveyor system unless the conveyor is locked/tagged out. A lock/tag shall be applied by the mapping crew supervisor in addition to any others.

Documentation: Underground mapping of the ECRB JSA, 19jun98,page1.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5089

Mitigation Number: 6

Scenario: Personnel working on the mapping floor come into contact with operating muck conveyor system mechanical parts (e.g., conveyor belts, idlers, etc.)

Mitigation Feature: The emergency stop cord for the conveyor system will be placed so it is accessible from both the upper mapping floor and the rail deck floor without exposing personnel to moving conveyor parts.

Documentation:

Remarks: There are holes in the mesh fencing that allow access to the E-stop cords.

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ○ Not Implemented
- ● Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number: UI5091
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Mapping Floor

Scenario: Mapping floor door(s) fall into path of train or against moving train or cars.

Cause, Failure, or Hazardous Event: Doors positioned to provide clearance for train passage fall into path of the train due to vibration of the mapping floor or inadvertent personnel acts that dislodge doors from vertical position.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	○ III - Marginal	**Extremely Low**
○ D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground Mapping of the ECRB JSA, 19jun98, page1.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5091

Mitigation Number: 1

Scenario: Mapping floor door(s) fall into path of train or against moving train or cars.

Mitigation Feature: Install automatic latches to hold each door in the open vertical position.

Documentation:

Remarks: Pins installed.

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5091

Mitigation Number: 2

Scenario: Mapping floor door(s) fall into path of train or against moving train or cars.

Mitigation Feature: Equipment and/or materials will not be leaned or braced against the raised vertical mapping floor doors.

Documentation: Underground mapping of the ECRB JSA, 19jun98,page1.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5091

Mitigation Number: 3

Scenario: Mapping floor door(s) fall into path of train or against moving train or cars.

Mitigation Feature: Personnel will not brace themselves or lean against the raised vertical mapping floor doors.

Documentation: Underground mapping of the ECRB JSA, 19jun98,page1.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number: UI5092
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Mapping Floor

Scenario: Train strikes equipment or mapping floor doors while transiting the mapping floor.

Cause, Failure, or Hazardous Event: Mapping floor equipment protrudes into the train envelope. Mapping floor doors are left in horizontal position and are not positioned vertically for train transit. Train operator fails to see horizontal floor panel obstructions.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Extremely Low**
● D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground Mapping of the ECRB, 19jun98, page2.

Mitigation Feature

Scenario Number: UI5092

Mitigation Number: 1

Scenario: Train strikes equipment or mapping floor doors while transiting the mapping floor.

Mitigation Feature: The train operator shall always stop the train before entering the mapping floor. The train brakeman shall walk ahead of the train across the mapping floor to determine that the track is clear. He will signal the train to stop is any obstacles (e.g., equipment, hoses or cables) are found in the train path.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5092

Mitigation Number: 2

Scenario: Train strikes equipment or mapping floor doors while transiting the mapping floor.

Mitigation Feature: Install high-visibility reflective materials (e.g., tape or paint) on both the heading and portal edges of all the mapping floor door support frames so that the train operator can clearly see any doors that are left in the down position.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ● Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5092

Mitigation Number: 3

Scenario: Train strikes equipment or mapping floor doors while transiting the mapping floor.

Mitigation Feature: The mapping floor doors shall be raised and locked in a vertical position prior to train passage.

Documentation:

Remarks: JSA developed. Covered in mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5092

Mitigation Number: 4

Scenario: Train strikes equipment or mapping floor doors while transiting the mapping floor.

Mitigation Feature: The mapping floor work supervisor will insure that all doors are properly secured and no equipment protrudes or overhangs into the transit space. He will then signal (e.g., hand and arm) the train operator that the mapping floor is prepared for passage of the train.

Documentation: Underground Mapping of the ECRB, 19jun98, page 2.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5092

Mitigation Number: 5

Scenario: Train strikes equipment or mapping floor doors while transiting the mapping floor.

Mitigation Feature: The train operator shall limit the speed of the train across the mapping floor to a very slow speed.

Documentation: Underground Mapping of the ECRB, 19jun98, page 2.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5092

Mitigation Number: 6

Scenario: Train strikes equipment or mapping floor doors while transiting the mapping floor.

Mitigation Feature: Derailers will be installed approximately 60 feet in front and behind the mapping floor to insure that the train can not reach the mapping floor until the area is prepared for train passage and the derailers have been removed.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5093
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Mapping Floor

Scenario: Train strikes personnel while transiting the mapping floor.

Cause, Failure, or Hazardous Event: Personnel inadvertently enter the train envelope or fall against moving train/cars in transit of the floor.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground Mapping of the ECRB, 19jun98, page2.

Mitigation Feature

Scenario Number: UI5093

Mitigation Number: 1

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: The train operator shall always stop the train before entering the mapping floor. The brakeman will precede the train and ensure that the train envelop is clear of personnel prior to the train entering the floor.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5093

Mitigation Number: 2

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: All personnel working on the mapping floor shall wear high-visibility reflective material/tape on hard hats and clothing (e.g., vests, etc.) so that their location(s) are clearly visible to the train operator.

Documentation: Underground Mapping in the ECRB, 19jun98, page 2.

Remarks: JSA developed. Part of mapping floor training. (The high-visibility reflective material/tape requirement applies to all personnel in the ECRB).

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ● Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5093

Mitigation Number: 3

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: Mapping floor personnel shall cease scientific evaluation and survey work during preparation and passage of the train over the mapping floor. Personnel shall stand in place on the two foot wide utility side of the mapping floor. Personnel will not move about on the mapping floor during train passage.

Documentation: Underground Mapping of the ECRB, 19jun98, page 2.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5093

Mitigation Number: 4

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: The mapping floor supervisor or designee shall signal (e.g., hand and arm) the train operator/brakeman when all personnel are prepared for passage of the train. Any personnel may signal the train operator to stop if danger or a potential problem is perceived while the train is transiting the floor.

Documentation: Underground Mapping of the ECRB, 19jun98, page 2.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5093 Mitigation Number: 5

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: The train operator shall blow the horn prior to entering the mapping floor and limit the speed of the train across the mapping floor to a very slow speed.

Documentation: Underground Mapping in the ECRB, 19jun98, page 2.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:
- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:
- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5093

Mitigation Number: 6

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: All personnel (e.g., scientific, engineering, maintenance, etc.) who will work on the mapping floor will receive a safety briefing to emphasize the personnel hazards of working on the mapping floor and detailed instructions regarding procedures for passage of the train across the mapping floor.

Documentation:

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5093

Mitigation Number: 7

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: Personnel shall be trained to never attempt to enter a moving train while it is transiting the mapping floor. Same rule applies to personnel on a moving train not to attempt exiting onto the mapping floor.

Documentation: Underground Mapping of the ECRB, 19jun98, page 2.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5093

Mitigation Number: 8

Scenario: Train strikes personnel while transiting the mapping floor.

Mitigation Feature: The train brakeman precedes the train across the mapping floor to determine that the track is clear. He will signal the train to proceed only after all obstacles (e.g., equipment, hoses or cables) and personnel are clear of the train path.

Documentation: Underground Mapping of the ECRB, 19jun98, page 2.

Remarks: JSA developed. Part of train operator and brakeman training

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number:	UI5094
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	Mapping Floor

Scenario: Minor personnel injuries due to fall/trip/slip on the mapping floor.

Cause, Failure, or Hazardous Event: On the mapping floor car with doors there are uneven floor surface(s), open gaps (approx. 1.5 inches) between closed doors. There is an 16-inch drop from the center mapping floor to the rail deck well on adjoining mapping cars. Debris on all mapping floor cars (e.g., loose tools, electrical cables, personal items (e.g., jackets, lunch boxes, etc.).

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
● B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	● IV - Negligible	
○ E - Improbable		

Related Scenarios: UI5047, UI5069

Prevention Mitigation Documentation: Underground Mapping of the ECRB, 19jun98, page3.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5094

Mitigation Number: 1

Scenario: Minor personnel injuries due to fall/trip/slip on the mapping floor.

Mitigation Feature: To prevent falls/trips/slips, small items to the extent practical shall be tethered to prevent their cluttering the mapping floor.

Documentation: Underground Mapping of the ECRB, 19jun98, page 3.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5094

Mitigation Number: 2

Scenario: Minor personnel injuries due to fall/trip/slip on the mapping floor.

Mitigation Feature: Electrical cables not in use will be stored in the mapping floor storage compartments and not left on the mapping floor surface or rail deck.

Documentation: Underground Mapping of the ECRB, 19jun98, page 3

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5094

Mitigation Number: 3

Scenario: Minor personnel injuries due to fall/trip/slip on the mapping floor.

Mitigation Feature: Temporary task lighting on stands or pedestals shall be provided to illuminate all mapping floor work areas where tunnel lighting is inadequate for scientific/survey tasks.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5094

Mitigation Number: 4

Scenario: Minor personnel injuries due to fall/trip/slip on the mapping floor.

Mitigation Feature: Personnel working on the mapping floor will be provided with a designated storage location for personnel items (e.g., jackets, lunch boxes, etc.) so they do not clutter the mapping floor.

Documentation:

Remarks: Storage areas have been added on the conveyor side with access from the side wall of the rail deck floor.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5094

Mitigation Number: 5

Scenario: Minor personnel injuries due to fall/trip/slip on the mapping floor.

Mitigation Feature: Provide safety training and orientation to personnel working on the mapping floor with information regarding the floor conditions (e.g., uneven areas, gaps, 16 inch drop between the floor and the rail deck, etc.)

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ○ Procedure
- ● Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5094

Mitigation Number: 6

Scenario: Minor personnel injuries due to fall/trip/slip on the mapping floor.

Mitigation Feature: Frequently perform "housekeeping" tasks to keep the working floor area clear. Specifically accomplish the housekeeping chores prior to opening the doors for train passage.

Documentation: Underground Mapping of the ECRB, 19jun98, page3.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number:	UI5096
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	Mapping Floor

Scenario: Personnel injury due to crawling or becoming stuck under the Transition Ramp and/or Mapping Floor (either raised or lowered) to retrieve items.

Cause, Failure, or Hazardous Event: Personnel attempt to recover dropped items from beneath the Transition Ramp or Mapping Floor.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	Medium
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	● I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground Mapping of the ECRB, 19jun98, page3.

Mitigation Feature

Scenario Number: UI5096

Mitigation Number: 1

Scenario: Personnel injury due to crawling or becoming stuck under the Transition Ramp and/or Mapping Floor (either raised or lowered) to retrieve items.

Mitigation Feature: Personnel shall be prohibited from crawling under any of the mapping floor cars for any reason. Dropped items shall be retrieved when the mapping floor is moved.

Documentation: Underground Mapping of the ECRB, 19jun98, page3.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number:	UI5097	SSA:	East-West Drift
Revision Number:	02		
Revision Date:	12/17/98	Location:	Mapping Floor

Scenario: Personnel injury (e.g., pinch, amputation, crush) from opening/closing the mapping floor doors or the access panels to the pressurized air system valves (located in the rail decks) of the transition ramp/mapping floor cars.

Cause, Failure, or Hazardous Event: Personnel hands/fingers extend into mapping floor pinch points while opening/closing the doors. Personnel lowering access panels catch fingers between the panel and the floor well supports.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground Mapping of the ECRB, 19jun98, page4.

Mitigation Feature

Scenario Number: UI5097

Mitigation Number: 1

Scenario: Personnel injury (e.g., pinch, amputation, crush) from opening/closing the mapping floor doors or the access panels to the pressurized air system valves (located in the rail decks) of the transition ramp/mapping floor cars.

Mitigation Feature: Personnel will open/close the mapping floor doors holding the door sides only while standing in the rail deck well. Personnel will keep hands and fingers clear of the hinge edge and center edges where doors join.

Documentation: Underground Mapping of the ECRB, 19jun98, page4.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5097

Mitigation Number: 2

Scenario: Personnel injury (e.g., pinch, amputation, crush) from opening/closing the mapping floor doors or the access panels to the pressurized air system valves (located in the rail decks) of the transition ramp/mapping floor cars.

Mitigation Feature: Install fold down handles on the access panels or move the hand holes 2 to 3 inches away from the floor supports.

Documentation:

Remarks:

Mitigation type:

- (●) Design Feature
- ( ) Safety Device
- ( ) Warning Device
- ( ) Procedure
- ( ) Training

Mitigation Tracking

Mitigation Implementation Status:

- (●) Not Implemented
- ( ) Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number: UI5098
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Mapping Floor

Scenario: If the air winches (tuggers) are ever used to move the mapping floor (in raised configuration) along the tracks to a new location and a cable fails or slips resulting in personnel injury.

Cause, Failure, or Hazardous Event: Cable fails or slips under high tension.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation:

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5098

Mitigation Number: 1

Scenario: If the air winches (tuggers) are ever used to move the mapping floor (in raised configuration) along the tracks to a new location and a cable fails or slips resulting in personnel injury.

Mitigation Feature: Install guards on the air winches at both ends of the mapping floor to protect the operator(s) from cable failures or slips.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Scenario Description and Analysis

Approved

Scenario Number: UI5099
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Mapping Floor

Scenario: Tow cable slips or breaks and the train operator loses positive control of the raised/moving mapping floor.

Cause, Failure, or Hazardous Event: Tow cable slips or breaks while the mapping cars are elevated/moving and control of the mapping floor is lost.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	Medium
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
○ C - Occasional	○ III - Marginal	**Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation:

Mitigation Feature

Scenario Number: UI5099

Mitigation Number: 1

Scenario: Tow cable slips or breaks and the train operator loses positive control of the raised/moving mapping floor.

Mitigation Feature: During movement of the mapping floor, a mapping floor air system operator will ride on the transition ramp above the air system controls (e.g., used to elevate the mapping floor) and if necessary will depressurize the air system in order to stop any uncontrolled movement of the mapping floor

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5099

Mitigation Number: 2

Scenario: Tow cable slips or breaks and the train operator loses positive control of the raised/moving mapping floor.

Mitigation Feature: The speed of the locomotive shall be very slow when towing the mapping floor

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5099

Mitigation Number: 3

Scenario: Tow cable slips or breaks and the train operator loses positive control of the raised/moving mapping floor.

Mitigation Feature: The locomotive will always tow the mapping floor. The locomotive will never push the mapping floor.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number: UI5100
Revision Number: 02
Revision Date: 12/17/98

SSA: East-West Drift

Location: Mapping Floor

Scenario: Personnel are injured while riding on the elevated mapping cars during movement.

Cause, Failure, or Hazardous Event: Personnel fall on mapping floor cars or are caught by passing conveyor or utility surfaces.

Risk Assignment **Before** Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation **After** Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground Mapping of the ECRB, 19jun98, page4.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5100

Mitigation Number: 1

Scenario: Personnel are injured while riding on the elevated mapping cars during movement.

Mitigation Feature: During movement of the mapping floor all scientific/engineering personnel will be seated on the utilities side of one of the mapping floor cars without doors with feet and legs extending into the rail deck well. Personnel will not sit adjacent to the 3-inch gaps between cars.

Documentation: Underground Mapping of the ECRB, 19jun98, page4.

Remarks: JSA developed. Covered in mapping floor JSA training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Impiemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number:	UI5103
Revision Number:	02
Revision Date:	12/17/98
SSA:	East-West Drift
Location:	Mapping Floor

Scenario: Personnel receive electrical shock(s) from defective electrical equipment that shorts/burns out or from severed electrical wire/connectors.

Cause, Failure, or Hazardous Event: Electrical equipment shorts or burns out while in use on the mapping floor.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	● II - Critical	
● C - Occasional	○ III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
○ D - Remote	○ IV - Negligible	
● E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation: Underground Mapping of the ECRB, 19jun98, page4.

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5103

Mitigation Number: 1

Scenario: Personnel receive electrical shock(s) from defective electrical equipment that shorts/burns out or from severed electrical wire/connectors.

Mitigation Feature: All electrical equipment used on the mapping floor shall be connected through a GFCI receptacle.

Documentation: Underground Mapping of the ECRB, 19jun98, page4.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5103

Mitigation Number: 2

Scenario: Personnel receive electrical shock(s) from defective electrical equipment that shorts/burns out or from severed electrical wire/connectors.

Mitigation Feature: Electrical power boxes, equipment and power lines will only be activated when the mapping floor is seated on the tunnel rails (creates an extensive metal to metal grounding to the tunnel rail system).

Documentation: Underground Mapping of the ECRB, 19jun98, page4.

Remarks: JSA developed. Part of mapping floor training.

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5103

Mitigation Number: 3

Scenario: Personnel receive electrical shock(s) from defective electrical equipment that shorts/burns out or from severed electrical wire/connectors.

Mitigation Feature: The mapping floor shall be grounded to the tunnel ground system (e.g., positively bonded by a ground cable and clamp to the tunnel grid wire.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ● Safety Device
- ○ Warning Device
- ○ Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

DI: BAB000000-01717-0200-0004, Rev 02

Scenario Description and Analysis

Approved

Scenario Number:	UI5105
Revision Number:	02
Revision Date:	12/ 7/98
SSA:	East-West Drift
Location:	Mapping Floor

Scenario: Installed electrical outlets/access panels in the tunnel and/or electrical connectors/cables are damaged when the mapping floor is moved.

Cause, Failure, or Hazardous Event: Electrical cables are left connected to tunnel utility outlets or panels when the mapping floor is moved.

Risk Assignment Before Considering Mitigations:

Frequency Rating:	Consequence Rating:	*Risk Before:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
● C - Occasional	● III - Marginal	Medium
○ D - Remote	○ IV - Negligible	
○ E - Improbable		

Risk Designation After Applying Mitigations:

Frequency Rating:	Consequence Rating:	Risk After:
○ A - Frequent	○ I - Catastrophic	
○ B - Probable	○ II - Critical	
○ C - Occasional	● III - Marginal	**Extremely Low**
● D - Remote	○ IV - Negligible	
○ E - Improbable		

Related Scenarios:

Prevention Mitigation Documentation:

DI: BAB000000-01717-0200-0004, Rev 02

Mitigation Feature

Scenario Number: UI5105

Mitigation Number: 1

Scenario: Installed electrical outlets/access panels in the tunnel and/or electrical connectors/cables are damaged when the mapping floor is moved.

Mitigation Feature: Electrical power cables to the mapping floor will be disconnected and the cables stored prior to raising the mapping floor.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5105

Mitigation Number: 2

Scenario: Installed electrical outlets/access panels in the tunnel and/or electrical connectors/cables are damaged when the mapping floor is moved.

Mitigation Feature: Upon cessation of scientific/survey work on the mapping floor in preparation for floor movement, the mapping floor supervisor will verify that the electrical cables are disconnected and stored.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments:

Mitigation Feature

Scenario Number: UI5105

Mitigation Number: 3

Scenario: Installed electrical outlets/access panels in the tunnel and/or electrical connectors/cables are damaged when the mapping floor is moved.

Mitigation Feature: Prior to movement, the train operator and/or brakeman will physically inspect the mapping floor to verify that no utility (e.g., electrical, compressed air hoses) connections have been left attached to tunnel resources and that no equipment protrudes into utility or conveyor spaces that could damage those systems, the mapping floor or personnel.

Documentation:

Remarks:

Mitigation type:

- ○ Design Feature
- ○ Safety Device
- ○ Warning Device
- ● Procedure
- ○ Training

Mitigation Tracking

Mitigation Implementation Status:

- ● Not Implemented
- ○ Implemented

Comments: