YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

CONVEYOR SYSTEM SAFETY ANALYSIS

REVISION 00

June 1995

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Conveyor System Safety Analysis

Revision 00

June 1995

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11. REMARKS

Design Analysis Revision Record

Complete only applicable items.

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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. SAFETY IS, THEREFORE, HEAVILY DEPENDENT ON ADEQUATE TRAINING AND PROCEDURES. INADEQUATE TRAINING OR PROCEDURES OR FAILURE TO STRICTLY ADHERE TO TRAINING AND PROCEDURES CAN LEAD TO SEVERE INJURIES OR DEATH.

1. PURPOSE

The purpose and objective of this analysis is to systematically identify and evaluate hazards related to the Yucca Mountain Project Exploratory Studies Facility (ESF) surface and subsurface conveyor system (for a list of conveyor subsystems see section 3). This process is an integral part of the systems engineering process; whereby safety is considered during planning, design, testing, and construction. A largely qualitative approach was used since a radiological System Safety Analysis is not required. The risk assessment in this analysis characterizes the accident scenarios associated with the conveyor structures/systems/components in terms of relative risk and includes recommendations for mitigating all identified risks. The priority for recommending and implementing mitigation control features is: 1) Incorporate measures to reduce risks and hazards into the structure/system/component (S/S/C) design, 2) add safety devices and capabilities to the designs that reduce risk, 3) provide devices that detect and warn personnel of hazardous conditions, and 4) develop procedures and conduct training to increase worker awareness of potential hazards, on methods to reduce exposure to hazards, and on the actions required to avoid accidents or correct hazardous conditions.

The scope of this analysis is limited to the hazards related to the design of conveyor structures/systems/components (S/S/Cs) that occur during normal operation. Hazards occurring during assembly, test and maintenance or "off normal" operations have not been included in this analysis. Construction related work activities are specifically excluded per DOE Order 5481.1B section 4. c.

2. QUALITY ASSURANCE

A QAP-2-0 evaluation was performed to determine if the Conveyor System Safety Analysis is subject to QARD requirements. The results of the evaluation are presented in a "Quality Activity Evaluation Engineering Specialty", Revision 0, dated June 20, 1994.

Based on the results of the QAP-2-0 evaluation, this analysis is not considered to be important to radiological safety or waste isolation. Therefore, this analysis is not quality affecting.

The format of this report is in compliance with the Yucca Mountain Project System Safety Plan YMP/ 94-13.

3. METHOD

The safety/risk assessment methodology used in this analysis is shown in Figure 1. The result of the analysis is a "risk evaluation" of the scenarios identified in this analysis in accordance with MIL-STD-882C. Three steps are required to complete the risk evaluation. The steps are hazard/scenario identification, consequence assessment, and frequency assessment. The word

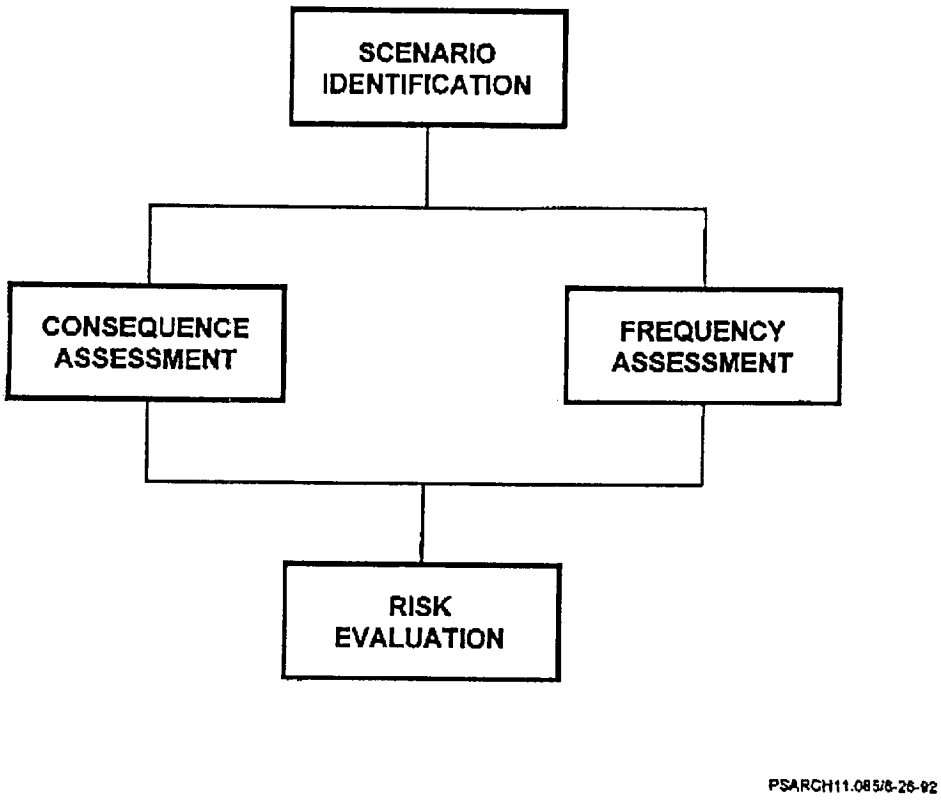


Figure 1. Risk Methodology Conceptual Overview

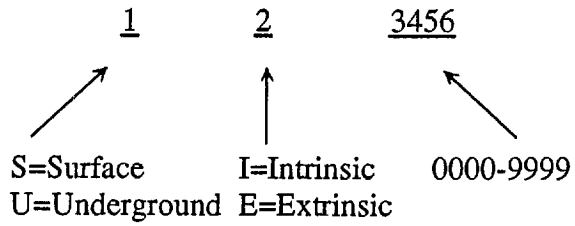
"accident" as used in this analysis refers to events, breakdowns, incidents, or any other occurrence that may have a negative effect on personnel safety.

In addition to the guidance provided in DOE Orders, traditional methods of the System Safety Analysis were reviewed and adopted for this analysis, including those sources listed in sections 4 and 5.

The conveyor system includes S/S/Cs required to support the Tunnel Boring Machine (TBM) operations. Specific S/S/C design items included in this safety analysis are:

- Subsurface conveyor
- Surface conveyor
- Surface support towers
- Surface elevated walkway
- Radial stacker

The Conveyor System Safety Analysis considered accidents caused by both intrinsic (e.g., human error, equipment failure) and extrinsic (e.g., act of nature, earthquake, high winds) occurrences. Each of the scenarios contained in Attachment A of this System Safety Analysis has a scenario number which uniquely identifies the scenario. The scenario number not only uniquely identifies the scenario, it also provides information concerning the type of scenario, i.e., surface or subsurface, extrinsic or intrinsic. The format of the scenario number is:



where 1 = S or U and 2 = I or E.

3.1 Scenario Identification

The first step involves the identification of possible accident scenarios that can have negative consequences for the ESF personnel or facilities. It is important to provide assurance that potentially significant scenarios have been considered and the consequences are appropriately mitigated through design selection, safety design features or devices, detection and warning devices, and/or use of procedures and training. To identify the scenarios, the Conveyor System documentation was reviewed, i.e., design specifications, drawings, Determination of Importance Evaluations and the BFD.

A systematic procedure has been used to identify the relevant scenarios. The identification of scenarios is a relatively complex task. Analogous scenarios were grouped together to determine if there were any significant differences among them. For example, a number of the accident scenarios address ventilation fan failure. Failure may be caused by a failure of a fan component (e.g., blades, bearings) or some external source (e.g., being struck by an object, fire). Each of these scenarios could be included in the System Safety Analysis as a separate scenario, a subset

of the group of scenarios could be included in the analysis, or a single representative sample scenario could be included in the System Safety Analysis. The decision of whether to include one or more scenarios from a group of potential scenarios in the System Safety Analysis was based largely on qualitative factors such as the probability that the scenarios will result in a significantly different risk designation, the accident can be associated with a particular situation or piece of equipment, and the probability that the accident cause(s) or result(s) will impact the frequency or consequence rating.

The scenarios are contained in Attachment A. Refer to the "System Safety Analysis Handbook," Scenario Analysis, page 3-241, for a description of scenario analysis, page 3-77 for Energy Analysis, and page 3-151 for Human Factors Analysis, all of which were used in this analysis.

3.2 Frequency Assessment

Bounding frequency estimates were developed for the accident scenarios and system failures. The frequency rating scale contains five levels of estimated frequency. The frequency levels are shown in Table 1.

Table 1. Frequency Rating Scale

Frequency		Description
A	Frequent	Likely to occur frequently
B	Probable	Will occur several times in the life of an SSC*
C	Occasional	Likely to occur some time in the life of an SSC*
D	Remote	Unlikely but possible to occur in the life of an SSC*
E	Improbable	So unlikely, it can be assumed occurrence may not be experienced

* SSC = system/structure/component

On September 6-8, 1994, a System Safety Working Group met to review the TBM System Safety Analysis and the Design Package 2C (subsurface lighting) System Safety Analysis. During this review the working group also defined a set of frequency and consequence scales. A major objective was to define the scales so that they could be applied to other system safety analyses

with little or no modifications. Also during the review, DOE stated that the following new project phases and schedule were being established:

- Technical Site Suitability
- Environmental Impact Statement
- License Application.

DOE further said that the Technical Site Suitability phase is synonymous with the ESF; and they directed System Safety to use a life expectancy of four (4) years for the Design Package 2C System Safety Analysis.

Based on the System Safety Working Group definitions and the life expectancy of the ESF, the frequency rating scale definitions used for this analysis are the same as the frequency rating scale definitions used for the TBM and Design Packages 1C, 1D, 2B, and 2C system safety analyses. The definitions are:

Frequent - Greater than 4.5 occurrences during the life of Conveyor System or more than one occurrence per year.

Probable - Greater than 2.25 but not more than 4.5 occurrences during the life of Conveyor System or one or less occurrence per year.

Occasional - Greater than 1.0 but not more than 2.25 occurrences during the life of Conveyor System (e.g. one or two occurrences during the life of the Conveyor System).

Remote - Greater than .25 but not more than 1.0 occurrences during the life of Conveyor System (e.g. the occurrence may happen once).

Improbable - From 0 to .25 occurrences during the life of Conveyor System or very unlikely, probably no occurrence.

3.3 Consequence Assessment

The potential range of consequences, from minor health effects to injury and/or fatality, was determined by using a consequence rating scale. The rating scale and definitions are presented in Table 2. The consequence rating scale also addresses potential impacts to site characterization data ranging from no loss of data to an irretrievable loss of license application data. The determination of consequence for each scenario, like the frequency estimate, was based on engineering experience and judgment and historical operating data.

Table 2. Consequence Rating and Definition

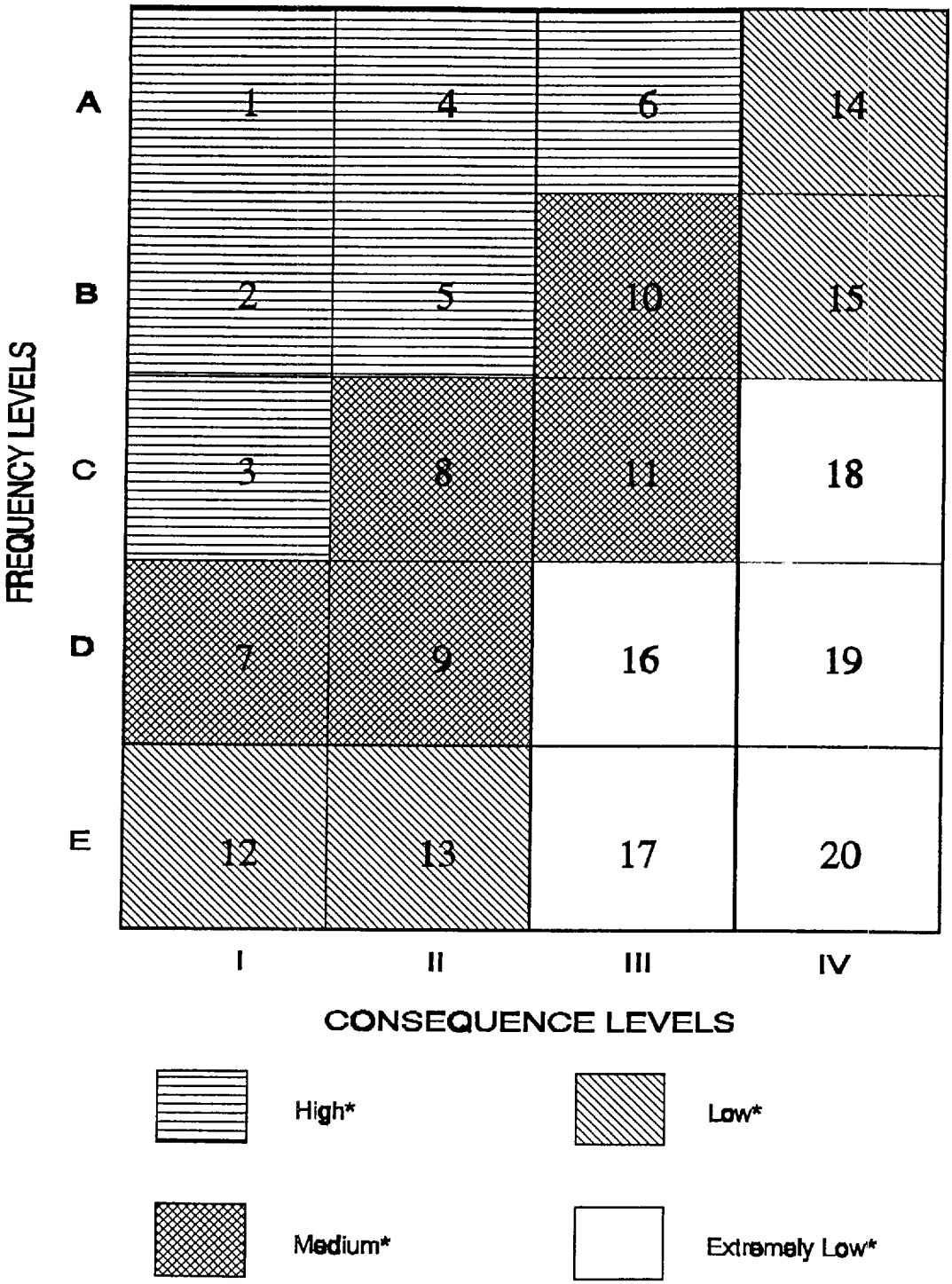
Consequence Level		Maximum Consequence
I	Catastrophic	Death, system/equipment loss, or severe environmental impact
II	Critical	Severe injury or illness, major system/equipment or environmental impact
III	Marginal	Minor injury or illness, minor system/equipment damage, minor delay of data collection or loss of data
IV	Negligible	Less than minor injury, occupational illness, or system damage

The definitions for the consequence ratings are the same as the definitions established by the System Safety Working Group for the TBM and Design Package 2C system safety analyses. They are:

Catastrophic - Death
Critical - Permanent partial or complete disability. Injury does not allow worker to return to same job (e.g., loss of limb or eye).
Marginal - Nonpermanent, recoverable injury that would not preclude performing the same job (e.g., broken bones).
Negligible - First aid injury with no loss of work time.

3.4 Risk Assessment

Risk is a function of frequency and consequence. The level of risk is determined by assigning a qualitative rating - high, medium, low, extremely low - to each of the frequency and consequence combinations. By determining each scenario's frequency of occurrence and level of consequence, the scenario's risk classification is determined by using the risk matrix in Figure 2. Within each risk category there is a precedence, based on consequence and frequency. For example, a scenario with a frequency = A and a consequence = I has a higher risk than a scenario with a frequency = A and a consequence = II.



* DOE is responsible for defining the criteria for risk acceptability

Figure 2. Risk Rating Matrix

Since the levels of risk are largely subjective, the risk designations must be viewed as relative. Relative risks are useful for determining the order in which risks are addressed; they are not absolute measures. Absolute risk is used when sufficient historical operating data is available on the same design as is currently being utilized and under the same operating conditions.

None-the-less, relative risk can be used as a management tool, especially when mitigation features have not been established and/or verified.

3.5 Exclusions

The following systems, structures, and components; processes; activities; and functions were not considered in this analysis:

- Interface of the TBM conveyor system and the tunnel conveyor system;
- Mucking by rail car;
- Maintenance procedures;
- Industrial hygiene exposure (noise, dust, biological contaminants, etc.); and
- Emergency response/contingencies and off-normal operations.

In addition, this system safety analysis does not include determining hazards associated with construction, maintenance, maintenance facilities, training, testing, and support operations.

4. CODES AND STANDARDS

4.1 MIL-STD-882C, System Safety Program Requirements, 19 January 1993

4.2 DOE Order 5481.1B, Safety Analysis and Review System, 23 September 1986

4.3 DOE Order 6430.1A, General Design Criteria, 6 April 1989

4.4 Applicable NFPA and OSHA sections (see individual scenarios)

4.5 System Safety Analysis Handbook, System Safety Society, July 1993

4.6 Uniform Building Code UBC-91

4.7 Cal Tunnel, 8 CCR 8410 & 8459

5. CRITERIA

5.1 YMP/CM-0019, Exploratory Studies Facility Design Requirements, Rev.1, ICN 1 & 2

6. ASSUMPTIONS

6.1 It is the designer's, i.e., M&O's, responsibility to implement the design based mitigation features, and it is the constructor's and operator's responsibility to verify and document that the hazards identified in this report have been mitigated.

6.2 The information, i.e., Analysis and Conclusions, contained in this System Safety Analysis is limited to only the scenarios identified.

6.3 Future design changes will need to be evaluated for risk to personnel.

6.4 It is the constructor's and operator's responsibility to ensure that all procedures, training, manuals, and other documentation identified as mitigation features are complete, comprehensive, and accurate.

7. REFERENCES

7.1 Specification BABFC0000-01717-6300-14553 Rev. 01, Installation of Belt Conveyors

7.2 Specification BABFCA000-01717-6300-14554 Rev. 04, Radial Stacker

7.3 Specification BABFCA000-01717-6300-14555 Rev. 04, Surface Belt Conveyors for Overland Muck Handling,

7.4 Specification BABFCA000-01717-6300-14556 Rev. 03, Weigh Scales for Surface Belt Conveyors

7.5 Specification BABFC0000-01717-6300-14557 Rev. 03, Conveyor Chutes, Hoppers and Bins

7.6 Specification BABFCB000-01717-6300-14558 Rev. 04, Subsurface Belt Conveyor System

7.7 YMP/91-37, Preliminary Safety Analysis Report for the Yucca Mountain Project Exploratory Studis cility and Site Characterization Program

7.8 Title II Material Handling Drawings BABFC0000-01717-2100-45030 & 45031 General Arrangement Drwgs. BABFCA000-01717-2100-45032, 3, 4, &5 General Arrangement Drwgs. BABFCB000-01717-2100-45036 thru 49

Other appropriate specifications and drawings are referenced on applicable Accident Analysis Summary Sheets.

8. COMPUTER PROGRAMS

Computer programs were not used in conjunction with this analysis.

9. RESULTS

Based on the results of the analysis, existing Preliminary Safety Analysis Report scenarios were modified and the need for new scenarios was identified. Table 3 identifies the scenarios contained in Attachment A. Each scenario was assigned a risk category based on the consequence and the frequency of occurrence, and the scenario identification number was plotted on the risk rating matrix shown in Figure 3. Table 4 lists the scenarios in rank order from high to low risk levels. Detailed scenario descriptions for the Conveyor System are contained in Attachment A.

Based on the frequency and consequence ratings, there were no scenarios with a high risk designation, eleven (11) scenarios with a medium risk designation, twenty-seven (27) scenarios with a low risk designation, and thirteen (13) scenarios with an extremely low risk designation.

10. CONCLUSIONS

The Conveyor System Safety Analysis has identified hazards related to the Conveyor System and mitigation measures to eliminate or control hazards by design or operational controls. The consequences of the hazards have been analyzes and an assessment of the risk(s) has been performed. Information concerning the design was obtained from the Conveyor System procurement documentation, i.e., specifications and drawings.

Table 3. List of Scenarios Retained for Evaluation (page 1 of 5)

Scenario ID Number	Description
SE0105	Personnel injury from muck being ejected from the conveyor due to high winds
SE0106	Personnel injury/death caused by collapse of conveyor system due to earthquake/high winds
SI0122	Personnel injury/death due to fall off elevated conveyor walkway, stairs, or ladder
SI0123	Personnel injury/equipment damage due to tools or equipment being dropped onto or off the conveyor
SI0124	Personnel injury/death/equipment damage due to tools, equipment, or debris falling off elevated conveyor walkway/platforms
SI0125	Personnel injury/equipment damage due to muck being ejected from the conveyor or personnel falling onto the conveyor
SI0126	Personnel injury/equipment damage (e.g., personnel climbing on conveyor, equipment resting on conveyor) when starting/stopping the conveyor
SI0127	Personnel injury/death/equipment damage due to fire on the conveyor system
SI0128	Personnel injury/equipment damage because personnel cannot locate/access conveyor emergency stop controls
SI0129	Personnel injury/death due to fall from ladder/stairway
SI0130	Personnel injury/death due to fall from elevated walkway

Table 3. List of Scenarios Retained for Evaluation (page 2 of 5)

Scenario ID Number	Description
SI0131	Personnel take wrong action based on inability to observe/read displays/labels, misinterpretation of displayed information, or lack of information
SI0132	Personnel injury/equipment damage because display fails without operator knowledge
SI0133	Personnel injury due to extremities/clothing/tools getting caught in conveyor moving parts
SI0134	Personnel injury due to accidental start of conveyor
SI0135	Personnel injury/equipment damage caused by fire due to conveyor electric cables in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.
SI0136	Personnel injury/equipment damage caused by fire due to conveyor motors in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.
SI0137	Personnel injury/equipment damage caused by fire due to conveyor motor control centers in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.
SI0138	Personnel injury due to conveyor belt break.
SI0139	Injury due to Electrical Shock from conveyor electric cables; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water

Table 3. List of Scenarios Retained for Evaluation (page 3 of 5)

Scenario ID Number	Description
SI0140	Injury due to Electrical Shock from transformer; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water
SI0141	Injury due to Electrical Shock from conveyor motor; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
SI0142	Injury due to Electrical Shock from conveyor motor control center; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
UE0101	Personnel injury/death caused by collapse of conveyor system due to earthquake
UI0030	Muck falling from conveyor causing personal injury/equipment damage
UI0327	Personnel injury/equipment damage due to tools being dropped onto or off the conveyor
UI0328	Personnel injury/equipment damage due to muck being ejected from the conveyor
UI0329	Personnel injury/equipment damage (e.g., personnel climbing on conveyor, equipment resting on conveyor) when starting/stopping the conveyor
UI0330	Personnel injury/death/equipment damage due to belt fire on the conveyor system
UI0331	Personnel injury/equipment damage because personnel cannot locate/access conveyor emergency stop controls

Table 3. List of Scenarios Retained for Evaluation (page 4 of 5)

Scenario ID Number	Description
UI0332	Personnel injury/death due to fall from ladder/stairway
UI0333	Personnel take wrong action based on inability to observe/read displays/labels, misinterpretation of displayed information, or lack of information
UI0334	Personnel injury/equipment damage because display fails without operator knowledge
UI0335	Personnel injury due to extremities/clothing/tools getting caught in conveyor moving parts
UI0336	Personnel injury due to accidental start of conveyor
UI0337	Personnel injury/equipment damage caused by fire due to conveyor electric cables in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs, chemical reactions, hot surfaces, small flames, catalytic reactions, etc.
UI0338	Personnel injury/equipment damage caused by fire due to conveyor motor in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs, ... etc.
UI0339	Personnel injury/equipment damage caused by fire due to conveyor motor control center in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs, chemical reactions, hot surfaces, small flames, catalytic reactions, etc.
UI0340	Personnel injury due to conveyor belt break.
UI0341	Injury due to Electrical Shock from conveyor electric cables; causes include exposed conductors, arcs, high voltage, shorts to ground static charges, or the presence of water

Table 3. List of Scenarios Retained for Evaluation (page 5 of 5)

Scenario ID Number	Description
UI0342	Injury due to Electrical Shock from transformer; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water
UI0343	Injury due to Electrical Shock from conveyor motor; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
UI0344	Injury due to Electrical Shock from conveyor motor control center; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
UI0345	Injury due to improper storage of tramp iron
UI0347	Muck falling from conveyor causing personal injury/equipment damage
UI0348	Muck falling from conveyor causing personal injury/equipment damage
UI0349	Muck falling from conveyor causing personal injury/equipment damage
UI0350	Muck falling from conveyor causing personal injury/equipment damage
UI0351	Muck falling from conveyor causing personal injury/equipment damage
UI0352	Tramp iron magnet swings/falls causing personal injury/equipment damage
UI0353	Conveyor collapse causing personal injury/equipment damage

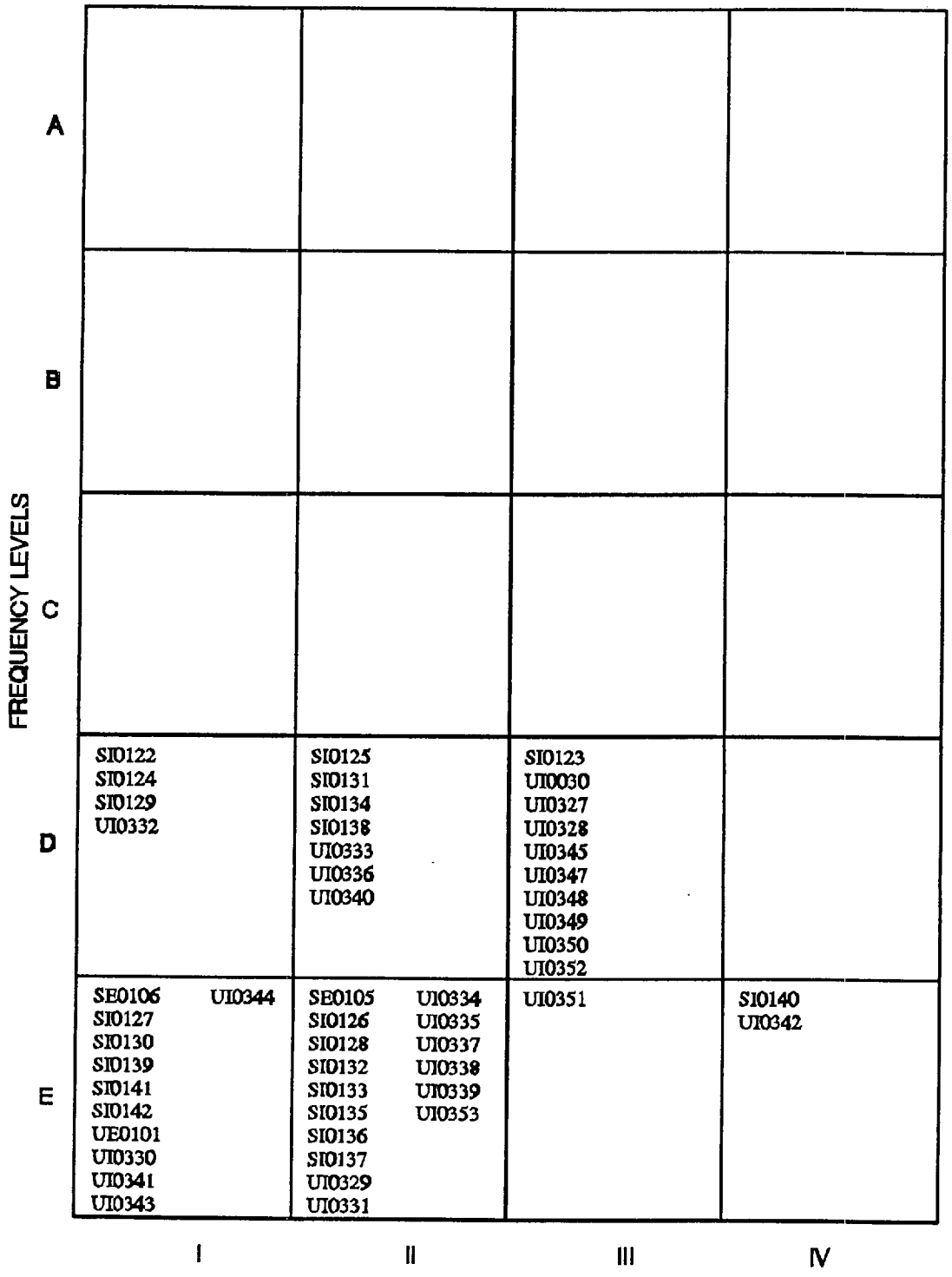


Figure 3. Scenarios Distributed Over Risk Matrix

Table 4. Highest Risk Contributors (page 1 of 7)

Risk Level	Frequency, Consequence	Scenario ID Number	Scenario Description
Medium	D,I	SI0122	Personnel injury/death due to fall off elevated conveyor walkway, stairs, or ladder
Medium	D,I	SI0124	Personnel injury/death/equipment damage due to tools, equipment, or debris falling off elevated conveyor walkway/platforms
Medium	D,I	SI0129	Personnel injury/death due to fall from ladder/stairway
Medium	D,I	UI0332	Personnel injury/death due to fall from ladder/stairway
Medium	D,II	SI0125	Personnel injury/equipment damage due to muck being ejected from the conveyor or personnel falling onto the conveyor
Medium	D,II	SI0131	Personnel take wrong action based on inability to observe/read displays/labels, misinterpretation of displayed information, or lack of information
Medium	D,II	SI0134	Personnel injury due to accidental start of conveyor
Medium	D,II	SI0138	Personnel injury due to conveyor belt break
Medium	D,II	UI0333	Personnel take wrong action based on inability to observe/read displays/labels, misinterpretation of displayed information, or lack of information
Medium	D,II	UI0336	Personnel injury due to accidental start of conveyor

Table 4. Highest Risk Contributors (page 2 of 7)

Risk Level	Frequency, Consequence	Scenario ID Number	Scenario Description
Medium	D,II	UI0340	Personnel injury due to conveyor belt break
Low	E,I	SE0106	Personnel injury/death caused by collapse of conveyor system due to earthquake/high winds
Low	E,I	SI0127	Personnel injury/death/equipment damage due to fire on the conveyor system
Low	E,I	SI0130	Personnel injury/death due to fall from elevated walkway
Low	E,I	SI0139	Injury due to Electrical Shock from conveyor electric cables; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water
Low	E,I	SI0141	Injury due to Electrical Shock from conveyor motor; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
Low	E,I	SI0142	Injury due to Electrical Shock from conveyor motor control center; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
Low	E,I	UE0101	Personnel injury/death caused by collapse of conveyor system due to earthquake
Low	E,I	UI0330	Personnel injury/death/equipment damage due to belt fire on the conveyor system

Table 4. Highest Risk Contributors (page 3 of 7)

Risk Level	Frequency, Consequence	Scenario ID Number	Scenario Description
Low	E,I	UI0341	Injury due to Electrical Shock from conveyor electric cables; causes include exposed conductors, arcs, high voltage, shorts to ground static charges, or the presence of water
Low	E,I	UI0343	Injury due to Electrical Shock from conveyor motor; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
Low	E,I	UI0344	Injury due to Electrical Shock from conveyor motor control center; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor
Low	E,II	SE0105	Personnel injury from muck being ejected from the conveyor due to high winds
Low	E,II	SI0126	Personnel injury/equipment damage (e.g., personnel climbing on conveyor, equipment resting on conveyor) when starting/stopping the conveyor
Low	E,II	SI0128	Personnel injury/equipment damage because personnel cannot locate/access conveyor emergency stop controls
Low	E,II	SI0132	Personnel injury/equipment damage because display fails without operator knowledge
Low	E,II	SI0133	Personnel injury due to extremities/clothing/tools getting caught in conveyor moving parts

Table 4. Highest Risk Contributors (page 4 of 7)

Risk Level	Frequency, Consequence	Scenario ID Number	Scenario Description
Low	E,II	SI0135	Personnel injury/equipment damage caused by fire due to conveyor electric cables in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.
Low	E,II	SI0136	Personnel injury/equipment damage caused by fire due to conveyor motors in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.
Low	E,II	SI0137	Personnel injury/equipment damage caused by fire due to conveyor motor control centers in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.
Low	E,II	UI0329	Personnel injury/equipment damage (e.g., personnel climbing on conveyor, equipment resting on conveyor) when starting/stopping the conveyor
Low	E,II	UI0331	Personnel injury/equipment damage because personnel cannot locate/access conveyor emergency stop controls
Low	E,II	UI0334	Personnel injury/equipment damage because display fails without operator knowledge
Low	E,II	UI0335	Personnel injury due to extremities/clothing/tools getting caught in conveyor moving parts

Table 4. Highest Risk Contributors (page 5 of 7)

Risk Level	Frequency, Consequence	Scenario ID Number	Scenario Description
Low	E,II	UI0337	Personnel injury/equipment damage caused by fire due to conveyor electric cables in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs....etc.
Low	E,II	UI0338	Personnel injury/equipment damage caused by fire due to conveyor motors in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs....etc.
Low	E,II	UI0339	Personnel injury/equipment damage caused by fire due to conveyor motor control centers in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs....etc.
Low	E,II	UI0353	Conveyor collapse causing personal injury/equipment damage
Extremely Low	D,III	SI0123	Personnel injury/equipment damage due to tools or equipment being dropped onto or off the conveyor
Extremely Low	D,III	UI0030	Muck falling from conveyor causing personal injury/equipment damage
Extremely Low	D,III	UI0327	Personnel injury/equipment damage due to tools being dropped onto or off the conveyor
Extremely Low	D,III	UI0328	Personnel injury/equipment damage due to muck being ejected from the conveyor

Table 4. Highest Risk Contributors (page 6 of 7)

Risk Level	Frequency, Consequence	Scenario ID Number	Scenario Description
Extremely Low	D,III	UI0345	Storage of tramp iron collected by magnet stored improperly causing injury to personnel
Extremely Low	D,III	UI0347	Muck falling from conveyor causing personal injury/equipment damage
Extremely Low	D,III	UI0348	Muck falling from conveyor causing personal injury/equipment damage
Extremely Low	D,III	UI0349	Muck falling from conveyor causing personal injury/equipment damage
Extremely Low	D,III	UI0350	Muck falling from conveyor causing personal injury/equipment damage
Extremely Low	D,III	UI0352	Tramp iron magnet swings/falls causing personal injury/equipment damage
Extremely Low	E,III	UI0351	Muck falling from conveyor causing personal injury/equipment damage
Extremely Low	E,IV	SI0140	Injury due to Electrical Shock from transformer; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water

Table 4. Highest Risk Contributors (page 7 of 7)

Risk Level	Frequency, Consequence	Scenario ID Number	Scenario Description
Extremely Low	E,IV	UI0342	Injury due to Electrical Shock from transformer; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water

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Attachment A

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SE0105 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury from muck being ejected from the conveyor due to high winds.

SYSTEM/COMPONENT FAILURE:

- Missing conveyor guards/covers
- Debris falling through gaps in the conveyor belt and the conveyor belt frame
- Failure to adhere to safety procedures and rules (e.g., being on or under conveyor during high winds)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Conveyor system designed to withstand 80 mile per hour winds (UBC requirement).
- Provide guards/covers which prevent objects from being ejected from the conveyor, chutes, and transfer points.
- Angle sides of conveyor belt so that sides of belt extend beyond height of muck to the extent possible by design.
- Conveyor designed to carry 972 tons per hour (projected load per hour is 572 tons).
- Provide flashing for the conveyor belt frame which prevents muck from being ejected from the sides or from underneath the conveyor.
- Design conveyor to prevent belt from twisting in high winds.
- Provide safety training for all personnel working on and around the conveyor (e.g., working in high wind conditions). For example establish procedures that require:

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1. No work when gusts reach 30 mph.
2. No inspection when gusts reach 35 mph.
3. Shutdown radial stacker when gusts reach 40 mph.

Note: The above wind speeds are examples only. The exact numbers depend on such things as NTS regulations or requirements.

- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.

MITIGATION DOCUMENTATION:

- See Section 7. References

  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling

- Title II Drawings*

  - BABFCA000-01717-2100-45034, Cnvr W-S01 Head End General Arrangement Detail, Elev & Sections
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

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SCENARIO NUMBER: SE0105

- Maintenance Manuals*
- General Safety Manuals and Training*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SE0106 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/death caused by collapse of conveyor system due to earthquake/high winds.

SYSTEM/COMPONENT FAILURE:

- Failure of tower(s)
- Failure to adhere to safety procedures and rules as they apply to earthquakes or high winds

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: I - Catastrophic

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Conveyor system designed to withstand UBC Zone 3 seismic requirements (e.g., trusses, supports, rebar).
- Conveyor system designed to withstand 80 mile per hour winds.
- Provide safety training for all personnel working on and around the conveyor (e.g., working in earthquake/high wind conditions).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: SE0106

MITIGATION DOCUMENTATION:

- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14556, Weigh Scales for Surface Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Drawings*

  - BABFCA000-01717-2100-45034, Cnvr W-S01 Head End General Arrangement Detail, Elev & Sections
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

- Maintenance Manuals*
- General Safety Manuals and Training*
- Uniform Building Code

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0122 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/death due to fall off elevated conveyor walkway, stairs, or ladder.

SYSTEM/COMPONENT FAILURE:

- Missing/failure of guardrails/handrails
- Lack of adequate illumination/lighting malfunction
- Debris (e.g., oil, water, tools) on walkway, stairs, landings, or ladder
- Missing non-skid surface on walkway, stairs, landings, or ladder
- Failure to adhere to safety procedures and rules

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: I - Catastrophic

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Provide guardrail(s)/handrail(s) and toe plate on all surfaces including walkway, landings, and stairs/ladders.
- Provide safety cages around ladders
- Provide lighting to support access and personnel activities.
- Provide non-skid surface on all surfaces including walkway, landings, and stairs/ladders.
- Provide stairs/ladders
- Post safety/warning signs.
- Require safety belts during work in unprotected areas
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: SI0122

MITIGATION DOCUMENTATION:

- 29 CFR 1910.23, .24 and 29 CFR 1926.500, .1052
- See Section 7. References

  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14558, Subsurface Belt Conveyor

  Title II Drawings*

  - BABFCA000-01717-2100-45034, Cnvr W-S01 Head End General Arrangement Detail, Elev & Sections
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

- Maintenance Manuals*
- General Safety Manuals and Training*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0123 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/equipment damage due to tools or equipment being dropped onto or off the conveyor.

SYSTEM/COMPONENT FAILURE:

- Missing guards/covers on the conveyor
- Failure to adhere to safety procedures and rules (e.g., resting tools on the conveyor belt or on edge of the conveyor)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: III - Marginal

Risk Designation: Extremely Low

MITIGATION/CONTROL FEATURES:

- Provide guards/covers which prevent objects from being dropped onto the conveyor.
- Provide access points/covers for retrieving objects and clearing the conveyor, e.g., at transfer points.
- Provide sensors and limit switches for belt speed, overload, slippage and side travel
- Provide accessible emergency shut down controls.
- Provide safety training for all personnel working on, under or around the conveyor (e.g., shut off conveyor when performing maintenance or retrieving objects from personnel exclusion areas).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: SI0123

MITIGATION DOCUMENTATION:

- See Section 7. References

  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling

  Title II Drawings*

  - BABFCA000-01717-2100-45034, Cnvr W-S01 Head End General Arrangement Detail, Elev & Sections
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

- Maintenance Manuals*
- General Safety Manuals and Training*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0138 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Personnel injury/equipment damage due to conveyor belt break.

SYSTEM/COMPONENT FAILURE:

- Idler/roller sticking or misalignment
- Conveyor frames not aligned properly
- Belt splices not square
- Improper loading
- Improper tension and slippage causing excessive wear

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: II - Critical

Risk Designation: 9 - Medium

MITIGATION/CONTROL FEATURES:

- Provide guards/covers/adjustable feed openings which prevent muck from extending beyond the conveyor; muck being ejected from the conveyor, chutes, and transfer points; and personnel from reaching into the conveyor.
- Use proper installation/construction procedures per design specs/mfg. instructions.
- Use proper inspection/preventive maintenance techniques.
- Conveyor designed to carry 972 tons per hour (projected load per hour is 572 tons).
- Detection capability for incipient belt break conditions (torn belt detection)

SCENARIO NUMBER: SI0138

- Post safety/warning signs along all exposed areas of the conveyor and adjacent to the conveyor controls.
- Provide safety training for all personnel working on and around the conveyor (e.g., personnel exclusion areas - under conveyor).
- Provide flashing around conveyor belt frame.
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.

MITIGATION DOCUMENTATION:

- Training Manuals*
- Maintenance Manuals*
- Safety Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0124 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/death/equipment damage due to tools, equipment, or debris falling off elevated conveyor walkway/platforms.

SYSTEM/COMPONENT FAILURE:

- Human error (e.g., worker drops tools or piece of equipment)
- Missing toe kicks or other devices to prevent personnel from kicking a tool off the walkway/platform(s)
- Failure to adhere to safety procedures and rules (e.g., not wearing protective equipment such as hardhat and eye protection)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: I - Catastrophic

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Install toe kicks on walkways/platforms.
- Provide safety training (e.g., personnel exclusion areas - under elevated walkway).
- Require personnel to wear personal protective equipment (e.g., hard hat, eye protection, and hardtoe shoes).
- Establish inspection, maintenance, and housekeeping procedures (inspect for debris and fluids, loose/missing guardrail(s)/handrail(s), etc.) and schedule. Maintain inspection, maintenance, and housekeeping records.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: SI0124

MITIGATION DOCUMENTATION:

- See Section 7. References
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
- Title II Design Drawings*
  - BABFCA000-01717-2100-45034, Cnvr W-S01 Head End General Arrangement Detail, Elev & Sections
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
- General Safety Manuals and Training*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0125 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/equipment damage due to muck being ejected from the conveyor or personnel falling onto the conveyor (also see SE0105).

SYSTEM/COMPONENT FAILURE:

- Failure to provide guards/covers on conveyor
- Breakage of conveyor belt
- Failure to adhere to safety procedures and rules (e.g., wearing loose clothing, resting tools on the edge of the conveyor)
- Debris falling through gaps in the conveyor belt and the conveyor belt frame

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: II - Critical

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Provide guards/covers/adjustible feed openings which prevent muck from extending beyond the conveyor; muck being ejected from the conveyor, chutes, and transfer points; and personnel from reaching into the conveyor.
- Angle sides of conveyor belt so that sides of belt extend beyond height of muck.
- Conveyor designed to carry 972 tons per hour (projected load per hour is 572 tons).
- Provide accessible emergency shut down controls.

SCENARIO NUMBER: SI0125

- Require personnel to dress appropriately (e.g., no loose clothing, jewelry) and wear personal protective equipment (e.g., hard hat, eye protection and hardtoe shoes).
- Post safety/warning signs along all exposed areas of the conveyor and adjacent to the conveyor controls.
- Provide safety training for all personnel working on and around the conveyor
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.

MITIGATION DOCUMENTATION:

- See Section 7. References

  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling

- Title II Design Drawings*

  - BABFCA000-01717-2100-45034, Cnvr W-S01 Head End General Arrangement Detail, Elev & Sections
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

SCENARIO NUMBER: SI0125

- Maintenance Manuals*
- General Safety Manuals and Training*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0126 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/equipment damage (e.g., personnel climbing under/on conveyor, equipment resting on conveyor) when starting/stopping the conveyor.

SYSTEM/COMPONENT FAILURE:

- Lack of lockout(s) to prevent conveyor activation/deactivation
- Lack of ability to establish primary/secondary control (i.e., master-slave control relationship)
- Operator error (e.g., starting conveyor from remote master station without knowing what activities, such as maintenance or debris removal, are being performed on the conveyor)
- Failure to adhere to safety procedures and rules (e.g., starting conveyor without checking for personnel working on conveyor)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide accessible controls, indicators, legend lights, and labels which are consistent and meaningful.
- Provide redundant indicators (e.g., dual filament, dual lamps).
- Provide monitoring test capability.

SCENARIO NUMBER: SI0126

- Provide local/remote switches for each conveyor drive (the local/remote switch will allow users to select whether control is through the controls physically located at the conveyor or through the remote master station).
- Provide accessible shut down controls (such as stop pull cords)
- Provide safety belts during work in unprotected areas
- Provide capability to display conveyor system status information and control conveyor system from remote master station.
- Provide alarm (audible/visual) which is activated prior to the start of the conveyor.
- Provide emergency/override control(s) for the conveyor.
- Provide procedure prohibiting personnel on conveyor unless it is locked out.
- Provide lockout(s)/tagout(s) which prevent accidental activation of conveyor.
- Post safety/warning signs along the conveyor.
- Provide safety training for all personnel working on and around the conveyor.
- Guard moving parts/pinch points (e.g., drives, pulleys, counterweights).
- Provide communications capability (radio, PA, etc.)

MITIGATION DOCUMENTATION:

- 10CFR 1926.555
- 29 CFR 1926.104 & .500
- 29 CFR 1910.212 and 29 CFR 1926.300
- Cal Tunnel; 8 CCR 8410 & 8459
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling

- DOE Construction Order 5480.9A
- Title II Design Drawings*

  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections (control locations not shown)
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans (control locations not shown)
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections (control locations not shown)
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation (control locations not shown)

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- BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation (control locations not shown)
- BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
- BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation (control locations not shown)
- BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation (control locations not shown)

- Training Manuals*
- Safety Manuals*

*It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0127 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/death/equipment damage due to fire on the conveyor system.

SYSTEM/COMPONENT FAILURE:

- Missing/failure of fire detection/suppression system
- Failure to adhere to safety procedures and rules (e.g., fighting fire beyond incipient stage)
- Ignition of belt due to friction of seized idlers, belt or drive pulley mis-alignment

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: I - Catastrophic

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide fire detection and suppression system (e.g., fire extinguishers, and automatic dry chemical extinguishing systems at the conveyor drive sections).
- Use belts which are fire resistant.
- Provide lightning protection system.
- Provide safety training for all personnel working on and around the conveyor (e.g., evacuation, rules for fighting fires, location of fire fighting equipment).
- Establish test, inspection, and maintenance procedures and schedule. Maintain test, inspection, and maintenance records.
- Provide safety/warning signs

SCENARIO NUMBER: SI0127

MITIGATION DOCUMENTATION:

- 29 CFR 1910.145 and 29CFR 1926.200
- NFPA 70-93
- NFPA 780-92
- 30 CFR 18.65 and 30 CFR 57
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14556, Weigh Scales for Surface Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Design Drawings*

  - BABFC0000-01717-2100-45031, Surface and Subsurface Material Handling Flow Diagram, (Identifies location of automatic dry chemical fire suppression systems)
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

- Training Manuals*
- Safety Manuals*

*It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0128 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/equipment damage because personnel cannot locate/access conveyor emergency stop controls.

SYSTEM/COMPONENT FAILURE:

- Missing conveyor emergency stops
- Conveyor emergency stop control locations

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Locate emergency controls so they are easily accessible
  - No higher than 70 inches above the standing surface
  - Operation is not obstructed by other conveyor system or ESF components
- Where the conveyor is elevated provide emergency controls on the walkway side(s) of the conveyor.
- Where the conveyor is accessible from both sides provide emergency controls on both sides of the conveyor.
- Provide emergency stop controls at locations other than the conveyor where personnel may be working (e.g., transfer tower, head end access platform).
- Color code controls so they are easily distinguishable/visible from the surface on which they are mounted.

SCENARIO NUMBER: SI0128

- Label controls so they are easily identifiable.
- Maintain walkways so they are clear of obstructions.
- Provide safety training.
- Post safety/warning signs.

MITIGATION DOCUMENTATION:

- 29 CFR 1926.555
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Design Drawings*

  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections (access platform emergency stop not shown)
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans (emergency stops not shown)
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45046, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

SCENARIO NUMBER: SI0128

- Safety Manuals*
- Training Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0129 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/death due to fall from ladder/stairway.

SYSTEM/COMPONENT FAILURE:

- Debris (e.g., oil, water, tools) on steps or landing
- Lack of adequate illumination/lighting malfunction
- Missing non-skid surface on steps or landing
- Missing/failure of guardrail(s)/handrail(s)/cage(s) on ladders/stairways or landings
- Failure to adhere to safety procedures and rules

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: I - Catastrophic

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Provide handrails/guardrails/cages
- Provide safety training (e.g., restriction on climbing with equipment).
- Provide non-skid surface on all ladders/stairways and landings.
- Provide adequate lighting for the tasks/activities to be performed.
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.
- Install jib cranes for tools and equipment.
- Provide tools at preferred locations for each conveyor segment.
- Provide safety/warning signs

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: SI0129

MITIGATION DOCUMENTATION:

- 29 CFR 1910.145 and 29CFR 1926.200
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Design Drawings*

  - BABFCA000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans
  - BABFCA000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

- Maintenance Manuals*
- Safety Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0130 REVISION: 01 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/death due to fall from elevated walkway.

SYSTEM/COMPONENT FAILURE:

- Missing/failure of guardrails/restraints/guards
- Spacing/opening between guardrails
- Debris (e.g., oil, water, tools) on walkway
- Missing non-skid surface on walkway
- Lack of adequate illumination/lighting malfunction
- Failure to adhere to safety procedures and rules (e.g., climbing on guardrails, being on walkway in high winds)

ACCIDENT CLASSIFICATION:

Frequency Rating: E - Improbable

Consequence Rating: I - Catastrophic

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide guardrails on walkway.

  NOTE: It is recommended that permanent, i.e., non-removable, guardrails be installed.

- Provide non-skid surface on walkway.
- Provide adequate lighting for the tasks/activities to be performed.

SCENARIO NUMBER: SI0130

- Space guardrails so that an individual cannot pass through the opening(s) between guardrails.
- Provide safety training (e.g., personnel not allowed on walkway during high wind conditions).
- Establish inspection, maintenance, and housekeeping procedures (inspect for debris and fluids, loose/missing guardrail(s)/handrail(s), lighting, etc.) and schedule. Maintain inspection, maintenance, and housekeeping records.

MITIGATION DOCUMENTATION:

- 29 CFR 1926.555
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14556, Weigh Scales for Surface Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Design Drawings*

  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45036, Transfer Tower No 1 General Arrangement Plans
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation

SCENARIO NUMBER: SI0130

- Maintenance Manuals*
- General Safety Manuals and Training*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0131 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel take wrong action resulting in injuries to personnel from conveyor operation based on inability to observe/read displays/labels, misinterpretation of displayed information, or lack of information.

SYSTEM/COMPONENT FAILURE:

- Missing status displays/indicators
- Missing control/display labeling
- Location of controls/displays (e.g., obstructions)
- Improper labelling (e.g., control/display mislabelled, improper spatial orientation, labelling not readable from viewing distance)
- Inconsistent coding of displays (e.g., color - red for danger, warning, stop)
- Master Control System human-computer interface software (e.g., command structure, information display)
- Train all personnel to recognize labels and displays

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: II - Critical

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Permanently label all controls and displays.
- Provide displays/indicators for all system functions.
- Provide communications (radio or PA)

SCENARIO NUMBER: SI0131

- Label all controls/displays to identify the function/equipment that is being controlled/monitored.
- Locate and group displays, controls, and labels so that relationships are easily identifiable.
- Locate controls, displays, and labels so they are clearly visible under all expected viewing positions and conditions.
- Arrange functionally related displays, controls, and labels so that they are located in proximity to one another.
- Provide labeling in the same spatial orientation as the items being labeled.
- Arrange displays, controls, and labels logically (e.g., left to right, top to bottom).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide software which meets operational requirements (e.g., automatic display of warning messages, consistent use of terminology/coding between hardware controls/displays and information displayed at workstations, simplified command structure).
- Provide alarm (audible/visual) which is activated prior to the start of the conveyor.
- Provide operator training.

MITIGATION DOCUMENTATION:

- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14556, Weigh Scales for Surface Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Operators Manuals*
- Training Manuals*
- Maintenance Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0132 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury/equipment damage because display fails without operator knowledge.

SYSTEM/COMPONENT FAILURE:

- Display failure (e.g., power on/off, status)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Monitor PLC.
- Provide monitoring test capability.
- Provide panel meters which fail to off-scale.
- Provide digital displays which flash if no other failure indicator is present. Digital display can go blank if there is another failure indicator.
- Provide safety training (e.g., test lamps at each shift change, before conveyor startup, after routine maintenance per manufacturers recommendations).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records

SCENARIO NUMBER: SI0132

MITIGATION DOCUMENTATION:

- See Section 7. References
  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14558, Subsurface Belt Conveyor System

- Safety Manuals*
- Training Manuals*
- Maintenance Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0133 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury due to extremities/clothing/tools getting caught in conveyor moving parts.

SYSTEM/COMPONENT FAILURE:

- Missing/failure of covers/guards
- Failure to adhere to safety procedures and rules (e.g., wearing loose clothing, resting tools near moving parts of the conveyor)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide covers/guards for all pulleys, sheaves, shafts, couplings, counterweights, and other moving parts/pinch points.
- Provide accessible emergency shut down controls.
- Provide access points/covers for maintenance, retrieving objects, and clearing the conveyor, e.g., at transfer towers.
- Protect exposed edges/surfaces/protrusions (e.g., rounding, rubber grommet).
- Post safety/warning signs along the conveyor.
- Require personnel to dress appropriately (e.g., no loose clothing, jewelry) and wear personal protective equipment (e.g., hard hat, eye protection and hardtoe shoes).
- Provide safety training for all personnel working on and around the conveyor (e.g., only authorized personnel on conveyor).
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: SI0133

MITIGATION DOCUMENTATION:

- 29 CFR 1910.212
- 29 CFR 1926
- Cal Tunnel; 8 CCR 8410 & 8459
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Drawings*

  - BABFCA000-01717-2100-45034, Cnvr W-S01 Head End General Arrangement Detail, Elev & Sections
  - BABFCA000-01717-2100-45035, Cnvr W-S01 Head End General Arrangement Plan and Sections
  - BABFCB000-01717-2100-45037, Transfer Tower No 1 General Arrangement Sections
  - BABFCB000-01717-2100-45041, Cnvr W-T03 Head End General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45046, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45047, Subsurface Cnvr W-T03 General Arrangement Sections
  - BABFCB000-01717-2100-45048, Subsurface Conveyor W-T03 Booster Drive Arrangement Plan, Elev & Section
  - BABFCB000-01717-2100-45049, Subsurface Conveyor W-T03 Load Section Arrangement Plan, Elev & Section

SCENARIO NUMBER: SI0133

- Safety Manuals*
- Training Manuals*
- Maintenance Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0134 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad, Muck Pile

SCENARIO:

Personnel injury due to accidental start of conveyor.

SYSTEM/COMPONENT FAILURE:

- Equipment failure (e.g., conveyor start control, PLC)
- Operator error (e.g., starting conveyor from remote master station without knowing what activities, such as maintenance or debris removal, are being performed on the conveyor)
- Failure to adhere to safety procedures and rules (e.g., starting conveyor without checking for personnel working on conveyor)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: II - Critical

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Provide maintained-contact type switches for conveyor emergency stop switches.
- Provide lockout(s)/tagout(s) which prevent accidental activation of conveyor.
- Provide a startup delay incorporated with audible and visible startup alarms along entire conveyor length
- Provide operator training (e.g., starting the conveyor system from the remote Master Control System workstation).
- Provide control software which prevents accidental activation of conveyor system.
- Provide safety training for all personnel working on and around the conveyor (e.g., only authorized personnel on conveyor).

SCENARIO NUMBER: SI0134

MITIGATION DOCUMENTATION:

- 29 CFR 1910.212
- 29 CFR 1926
- Cal Tunnel; 8 CCR 8410 & 8459
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14554, Radial Stacker
  - Specification Section 14555, Surface Belt Conveyors for Overland Muck Handling
  - Specification Section 14556, Weigh Scales for Surface Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Safety Manuals*
- Training Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0135 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Personnel injury/equipment damage caused by fire due to conveyor electrical cables, connections (splices) outlets sparking in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.

SYSTEM/COMPONENT FAILURE:

- Conveyor electrical cables, connections (splices) outlets sparking in the presence of hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable (requires at least two events)

Consequence Rating: II-critical

Risk Designation: 13 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Control sparking: (use appropriate codes and regulations):
- Control fuel sources: (hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials).
- Damage control:

1. Fire suppression equipment including highest level of conveyor.
2. Emergency evacuation procedures from elevated structures.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: SI0135

MITIGATION DOCUMENTATION:

- Surface Belt Conveyor System Specification BABFCA000-01717-6300-14555 Rev. 04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the surface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- Safety training and procedures must be provided.

- Verify that appropriate fire fighting equipment is available. - BABFC0000-01717-2100-45031, Surface and Subsurface Material Handling Flow Diagram, (Identifies location of automatic dry chemical fire suppression systems)

- Observe proper operating and maintenance practices/emergency tower evacuation procedures.

- Observe maintenance, opreations and housekeeping procedures.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0136 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Personnel injury/equipment damage caused by fire due to conveyor motors sparking in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.

SYSTEM/COMPONENT FAILURE:

- Conveyor motors sparking in the presence of hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable (requires at least two events)

Consequence Rating: II-Critical

Risk Designation: 13 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Control sparking: (use appropriate codes and regulations):
- Control fuel sources: (hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials).
- Damage control:

1. Fire suppression equipment including highest level of conveyor.
2. Emergency evacuation procedures from elevated structures.

SCENARIO NUMBER: SI0136

MITIGATION DOCUMENTATION:

- Surface Belt Conveyor System Specification BABFCA000-01717-6300-14555 Rev.04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the surface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- Safety training and procedures must be provided.

- Verify that appropriate fire fighting equipment is available. - BABFC0000-01717-2100-45031, Surface and Subsurface Material Handling Flow Diagram, (Identifies location of automatic dry chemical fire suppression systems)

- Observe proper operating and maintenance practices/emergency tower evacuation procedures.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0137 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Personnel injury/equipment damage caused by fire due to conveyor motor control centers sparking in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs.

SYSTEM/COMPONENT FAILURE:

- Conveyor motor control centers sparking in the presence of hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable (requires at least two events)

Consequence Rating: II-critical

Risk Designation: 13 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Control sparking: (design to codes and regulations using sealed motors or TEFC motors where appropriate):
- Control fuel sources: [hydraulic fluid (controlled per TBM specs.), lubricating oil (leak resistant seals in common use), diesel fuel (controlled per TBM specs.), flammable cleaning solvents (prohibit use of solvents that by NFPA definitions can be classified as flammable), disposable clean up materials (controlled by inspection and housekeeping procedures]. If combustible gasses are projected to be above 10% of lower flamable limit at any time during operation use combustible gas sensors.
- Damage control:
  1. Follow emergency fire procedures beyond incipient conditions.
  2. Emergency evacuation procedures from elevated structures.

SCENARIO NUMBER: SI0137

MITIGATION DOCUMENTATION:

- Surface Belt Conveyor System Specification BABFCA000-01717-6300-14555 Rev.04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the surface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- Safety training and procedures must be provided.

- Verify that appropriate fire fighting equipment is available. - BABFC0000-01717-2100-45031, Surface and Subsurface Material Handling Flow Diagram, (Identifies location of automatic dry chemical fire suppression systems)

- Observe proper operating and maintenance practices/emergency tower evacuation procedures.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0139 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Injury due to Electrical Shock from conveyor electric cables; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor cables, connections (splices), outlets or malfunction of fuses/breakers injuring personnel from exposed wiring or through water as a conductor.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable

Consequence Rating: I-catastrophic

Risk Designation: 12 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Fluid leak control
- Compliance with electrical codes and standards

SCENARIO NUMBER: SI0139

MITIGATION DOCUMENTATION:

- Surface Belt Conveyor System Specification BABFCA000-01717-6300-14555 Rev.04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the surface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- Safety training and procedures must be provided.

- Verify that appropriate fire fighting equipment is available.

- Observe proper operating and maintenance practices/emergency tower evacuation procedures.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0140 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Injury due to Electrical Shock from transformer; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor transformer causing personnel injury from exposed wiring or through water, from dust suppression, system as a conductor.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	E-improbable
Consequence Rating:	IV-negligible (personnel cannot be present during normal operation-transformers are enclosed)
Risk Designation:	20 Extremely low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Fluid leak control
- Compliance with electrical codes and standards

SCENARIO NUMBER: SI0140

MITIGATION DOCUMENTATION:

- Surface Belt Conveyor System Specification BABFCA000-01717-6300-14555 Rev.04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the surface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- Safety training and procedures must be provided.

- Verify that appropriate fire fighting equipment is available.

- Observe proper operating and maintenance practices.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0141 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Injury due to Electrical Shock from conveyor motor; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor motor or conveyor control system causing injury to personnel through water (from dust suppression system for example) as a conductor.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	E-improbable
Consequence Rating:	I-catastrophic
Risk Designation:	12 low

MITIGATION/CONTROL FEATURES:

1. Operator/personnel training
2. Fluid leak control.
3. Compliance with electrical codes and standards.

SCENARIO NUMBER: SI0141

MITIGATION DOCUMENTATION:

- Surface Belt Conveyor System Specification BABFCA000-01717-6300-14555 Rev.04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the surface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- Safety training and procedures must be provided.

- Verify that appropriate fire fighting equipment is available.

- Observe proper operating and maintenance practices.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: SI0142 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

North Portal Pad

SCENARIO:

Injury due to Electrical Shock from conveyor motor control center; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor motor control center causing injury to personnel.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable

Consequence Rating: I-catastrophic

Risk Designation: 12-low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Fluid leak control
- Compliance with electrical codes and standards.
- Provide lockouts

SCENARIO NUMBER: SI0142

MITIGATION DOCUMENTATION:

- Surface Belt Conveyor System Specification BABFCA000-01717-6300-14555 Rev.04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the surface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- Safety training and procedures must be provided.

- Observe proper fire emergency procedures

- Observe proper operating and maintenance practices.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER:UE0101 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/death caused by collapse of conveyor system due to earthquake.

SYSTEM/COMPONENT FAILURE:

- Failure of supports
- Failure to adhere to safety procedures and rules as they apply to earthquake or high wind conditions.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:E - Improbable

Consequence Rating:I - Catastrophic

Risk Designation:Low

MITIGATION/CONTROL FEATURES:

- Conveyor system designed to withstand UBC Zone 3 seismic requirements.
- Provide safety training for all personnel working in the tunnel (e.g., tunnel access and egress, evacuating tunnel after earthquake).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER:UE0101

MITIGATION DOCUMENTATION:

- See Section 7. References

  -Specification Section 14553, Installation of Belt Conveyors
  -Specification Section 14558, Subsurface Belt Conveyor System

- Title II Drawings*

  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45046, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45047, Subsurface Cnvr W-T03 General Arrangement Sections
  - BFCB000-01717-2100-45048, Subsurface Conveyor W-T03 Booster Drive Arrangement Plan, Elev & Section
  - BABFCB000-01717-2100-45049, Subsurface Conveyor W-T03 Load Section Arrangement Plan, Elev & Section

- Maintenance Manuals*
- General Safety Manuals and Training*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0030 REVISION: 01 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Muck falling from conveyor causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Conveyor belt failure
- Impact idler/slider failure
- Booster drive failure
- Constant tension winch failure
- Belt storage and take-up unit failure

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	D - Remote
Consequence Rating:	III - Marginal
Risk Designation:	16 - Extremely Low

MITIGATION/CONTROL FEATURES:

- Provide sensors and alarms for belt rip, overload, slippage, misalignment, and low speed.
- Provide status signals and indication for drive faults, belt side travel, damaged belt, belt speed and belt speed shutdown, belt take-up overtravel, belt storage unit empty, creep drive operation, hydraulic power unit low pressure, motor running status, bearing temperature and overload relay status, and emergency stop.
- Restrict muck loading and angle conveyor sides so that belt extends above muck height.

SCENARIO NUMBER: UI0030

- Provide full enclosure chutework at all material transfer points.
- Provide operator training and start-up support.
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide lower deck plates on advancing tail section for personnel protection while installing carrying idlers.
- Provide continuous visual indication (eg. yellow lights) that conveyor is operating.
- Post safety/warning signs.
- Require personnel walking through tunnel to walk along tunnel wall side opposite the conveyor.

MITIGATION DOCUMENTATION:

- Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1. Section 2.14A specifies minimum requirements for sensors and alarms including audible and visible start-up alarms.
2. Section 2.12F specifies minimum requirements for status signals to the master control system.
3. Section 2.13A & B specifies conveyor and transfer point enclosure requirements for dust control and muck retention.
4. Section 2.06A specifies the use of a lower deck plate on the advancing tail section.
5. Section 3.01 specifies that 40 hours of operator training and that additional start-up support will be provided by the conveyor supplier.
6. Section 2.12I specifies the operations and maintenance manuals, diagrams, and drawings to be provided by conveyor supplier
7. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0327 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage due to tools being dropped onto or off the conveyor.

SYSTEM/COMPONENT FAILURE:

- Human error (e.g., worker drops tools or piece of equipment)
- Missing of guards/covers on the conveyor
- Failure to adhere to safety procedures and rules (e.g., resting tools on the conveyor belt or on edge of the conveyor, not wearing protective equipment such as hardhat and eye protection)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: III - Marginal

Risk Designation: Extremely Low

MITIGATION/CONTROL FEATURES:

- Provide guards/covers at transfer points which prevent objects from being dropped into the conveyor.
- Provide emergency shut down control.
- Post safety/warning signs.
- Provide safety training for all personnel working on and around the conveyor (e.g., shut off conveyor when performing maintenance or retrieving objects, personnel exclusion areas - under conveyor).

SCENARIO NUMBER: UI0327

- Require personnel to wear personal protective equipment (e.g., hard hat, eye protection, and hardtoe shoes).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.

MITIGATION DOCUMENTATION:

- See Section 7. References
- Training Manuals*
- Maintenance Manuals*
- Safety Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0328 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage due to muck being ejected from the conveyor.

SYSTEM/COMPONENT FAILURE:

- Failure to provide guards/covers on conveyor
- Breakage of conveyor belt
- Failure to adhere to safety procedures and rules (e.g., not wearing personnel protective equipment)
- Debris falling through gaps in the conveyor belt and the conveyor belt frame
- Debris falling through gaps at transfer points

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: III - Marginal

Risk Designation: Extremely Low

MITIGATION/CONTROL FEATURES:

- Provide guards/covers/adjustable feed openings which prevent muck from extending beyond the conveyor; muck being ejected from the conveyor, chutes, and transfer points; and personnel from reaching into the conveyor.
- Provide dust suppression system (e.g., water).
- Angle sides of conveyor belt so that sides of belt extend beyond height of muck.
- Conveyor designed to carry 972 tons per hour (projected current load per hour is 572 tons).
- Provide accessible emergency shut down controls (such as emergency pull cords).

SCENARIO NUMBER: UI0328

- Post safety/warning signs along all exposed areas of the conveyor and adjacent to the conveyor controls.
- Provide safety training for all personnel working on and around the conveyor (e.g., personnel exclusion areas - under conveyor).
- Provide flashing around conveyor belt frame.
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.

MITIGATION DOCUMENTATION:

- Training Manuals*
- Maintenance Manuals*
- Safety Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0329 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage (e.g., personnel climbing on conveyor, equipment resting on conveyor) when starting/stopping the conveyor.

SYSTEM/COMPONENT FAILURE:

- Lack of lockout(s) to prevent conveyor activation/deactivation
- Lack of ability to establish primary/secondary control
- Operator error (e.g., starting conveyor from remote master station without knowing what activities, such as maintenance or debris removal, are being performed on the conveyor)
- Failure to adhere to safety procedures and rules (e.g., starting conveyor without checking for personnel working on conveyor)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide redundant indicators (e.g., dual filament, dual lamps).
- Provide monitoring test capability.
- Provide accessible controls, indicators, legend lights, and labels which are consistent and meaningful.

SCENARIO NUMBER: UI0329

- Provide local/remote switches for each conveyor drive (the local/remote switch will allow users to select whether control is through the controls physically located at the conveyor or through the remote master station).
- Provide capability to display conveyor system status information and control conveyor system from remote master station.
- Provide alarm (audible/visual) which is activated prior to the start of the conveyor.
- Provide emergency/override control(s) for the conveyor.
- Provide lockout(s)/tagout(s) which prevent accidental activation of conveyor.
- Post safety/warning signs along the conveyor.
- Provide safety training for all personnel working on and around the conveyor (e.g., only authorized personnel on conveyor).
- Guard moving parts/pinch points (e.g., drives, pulleys, counterweights).
- Provide communications (radio or PA)

MITIGATION DOCUMENTATION:

- 29 CFR 1910.212
- 29 CFR 1926
- Cal Tunnel; 8 CCR 8410 & 8459
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Design Drawings*

  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation (control locations not shown)
  - BABFCB000-01717-2100-45046, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation (control locations not shown)
  - BABFCB000-01717-2100-45047, Subsurface Cnvr W-T03 General Arrangement Sections (control locations not shown)
  - BABFCB000-01717-2100-45048, Subsurface Conveyor W-T03 Booster Drive Arrangement Plan, Elev & Section (control locations not shown)
  - BABFCB000-01717-2100-45049, Subsurface Conveyor W-T03 Load Section Arrangement Plan, Elev & Section (control locations not shown)

SCENARIO NUMBER: UI0329

- Training Manuals*
- Safety Manuals*
- Safety training*

*It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0330 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/death/equipment damage due to belt fire on the conveyor system.

SYSTEM/COMPONENT FAILURE:

- Missing/failure of fire detection/suppression system
- Failure to adhere to safety procedures and rules (e.g., evacuation procedures, fighting fire beyond incipient stage)
- Ignition of belt due to friction of seized idlers, belt or drive pulley mis-alignment

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: I - Catastrophic

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide fire detection and suppression system (e.g., fire extinguishers, and automatic dry chemical extinguishing systems at the conveyor drive sections).
- Use belts which are fire resistant.
- Provide safety training for all personnel working on and around the conveyor (e.g., evacuation, rules for fighting fires, location of fire fighting equipment).
- Establish test, inspection, and maintenance procedures and schedule. Maintain test, inspection, and maintenance records.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: UI0330

MITIGATION DOCUMENTATION:

- 30 CFR 18.65 and 30 CFR 57
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Design Drawings*

  - BABFC0000-01717-2100-45031, Surface and Subsurface Material Handling Flow Diagram, (Identifies location of automatic dry chemical fire suppression systems)
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45046, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45047, Subsurface Cnvr W-T03 General Arrangement Sections
  - BABFCB000-01717-2100-45048, Subsurface Conveyor W-T03 Booster Drive Arrangement Plan, Elev & Section
  - BABFCB000-01717-2100-45049, Subsurface Conveyor W-T03 Load Section Arrangement Plan, Elev & Section

- Training Manuals*
- Safety Manuals*

*It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0331 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage because personnel cannot locate/access conveyor emergency stop controls.

SYSTEM/COMPONENT FAILURE:

- Missing conveyor emergency stops
- Conveyor emergency stop control locations

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Locate emergency controls so they are easily accessible
  - No higher than 70 inches above the standing surface

    NOTE: For the subsurface conveyor system the emergency stop controls must be located so that they are within reach of personnel standing on the invert segments. Placement must consider not only height but also forward reach when determining the proper location of the emergency stop controls.

  - Operation is not obstructed by other conveyor system or ESF components

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: UI0331

- Provide emergency controls on the maintenance walkway side of the conveyor.
- Color code controls so they are easily distinguishable/visible from the surface on which they are mounted.
- Label controls so they are easily identifiable.
- Provide safety training.
- Post safety/warning signs.

MITIGATION DOCUMENTATION:

- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Design Drawings*

  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45046, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45047, Subsurface Cnvr W-T03 General Arrangement Sections
  - BABFCB000-01717-2100-45048, Subsurface Conveyor W-T03 Booster Drive Arrangement Plan, Elev & Section
  - BABFCB000-01717-2100-45049, Subsurface Conveyor W-T03 Load Section Arrangement Plan, Elev & Section

- Safety Manuals*
- Training Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0332 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/death due to fall from ladder/stairway.

SYSTEM/COMPONENT FAILURE:

- Debris (e.g., oil, water, tools) on steps or landing
- Lack of adequate illumination/lighting malfunction
- Missing non-skid surface on steps or landing
- Missing/failure of guardrail(s)/handrail(s)/cage(s) on ladders/stairways or landings
- Failure to adhere to safety procedures and rules

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: I - Catastrophic

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Provide handrails/guardrails/cages per OSHA.
- Provide safety training (e.g., restriction on climbing with equipment).
- Provide non-skid surface on all ladders/stairways and landings.
- Provide adequate lighting for the tasks/activities to be performed.
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.
- Provide safety/warning signs

SCENARIO NUMBER: UI0332

MITIGATION DOCUMENTATION:

- 29 CFR 1910.145 and 29 CFR 1926.200
- See Section 7. References
  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System
- Title II Design Drawings*
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
- Maintenance Manuals*
- Safety Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0333 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel take wrong action based on inability to observe/read displays/labels, misinterpretation of displayed information, or lack of information resulting in injury due to equipment failure or unexpected operation.

SYSTEM/COMPONENT FAILURE:

- Missing status displays/indicators
- Missing control/display labeling
- Location of controls/displays (e.g., obstructions)
- Improper labelling (e.g., control/display mislabelled, improper spatial orientation, labelling not readable from viewing distance)
- Inconsistent coding of displays (e.g., color - red for danger, warning, stop)
- Master Control System human-computer interface software (e.g., command structure, information display)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: II - Critical

Risk Designation: Medium

MITIGATION/CONTROL FEATURES:

- Permanently label all controls and displays.
- Provide displays/indicators for all system functions.
- Label all controls/displays to identify the function/equipment that is being controlled/monitored.

SCENARIO NUMBER: UI0333

- Locate and group displays, controls, and labels so that relationships are easily identifiable.
- Locate controls, displays, and labels so they are clearly visible under all expected viewing positions and conditions.
- Arrange functionally related displays, controls, and labels so that they are located in proximity to one another.
- Provide labeling in the same spatial orientation as the items being labeled.
- Arrange displays, controls, and labels logically (e.g., left to right, top to bottom).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide software which meets operational requirements (e.g., automatic display of warning messages, consistent use of terminology/coding between hardware controls/displays and information displayed at workstations, simplified command structure).
- Provide operator training.
- Provide communications (radio or PA).

MITIGATION DOCUMENTATION:

- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Operators Manuals*
- Training Manuals*
- Maintenance Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0334 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage because any display (critical to safety) fails without operator knowledge.

SYSTEM/COMPONENT FAILURE:

- Display failure

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide redundant indicators (PLC computer CRT) for all lamps.
- Provide monitoring test capability.
- Provide panel meters which fail to off-scale.
- Provide digital displays which flash if no other failure indicator is present. Digital display can go blank if there is another failure indicator.
- Provide safety training (e.g., test lamps at each shift change, before conveyor startup, after maintenance).
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records

SCENARIO NUMBER: UI0334

MITIGATION DOCUMENTATION:

- See Section 7. References
  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System
- Safety Manuals*
- Training Manuals*
- Maintenance Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0335 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury due to extremities/clothing/tools getting caught in conveyor moving parts.

SYSTEM/COMPONENT FAILURE:

- Missing/failure of covers/guards
- Failure to adhere to safety procedures and rules (e.g., wearing loose clothing, resting tools near moving parts of the conveyor)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E - Improbable

Consequence Rating: II - Critical

Risk Designation: Low

MITIGATION/CONTROL FEATURES:

- Provide covers/guards for all pulleys, sheaves, shafts, couplings, counterweights, and other moving parts/pinch points.
- Provide accessible emergency shut down controls.
- Provide access points/covers for maintenance, retrieving objects, and clearing the conveyor, e.g., at transfer towers.
- Protect exposed edges/surfaces/protrusions (e.g., rounding, rubber grommet).
- Provide lockout(s)/tagout(s) which prevent accidental activation of conveyor.
- Post safety/warning signs along the conveyor.
- Require personnel to dress appropriately (e.g., no loose clothing, jewelry) and wear personal protective equipment (e.g., hard hat, eye protection and hardtoe shoes).

SCENARIO NUMBER: UI0335

- Provide safety training for all personnel working on and around the conveyor (e.g., only authorized personnel on conveyor).
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records

MITIGATION DOCUMENTATION:

- 29 CFR 1910.212
- 29 CFR 1926
- Cal Tunnel; 8 CCR 8410 & 8459
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Title II Drawings*

  - BABFCB000-01717-2100-45042, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45043, Subsurface Conveyor W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45044, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45045, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45046, Subsurface Cnvr W-T03 General Arrangement Plan and Elevation
  - BABFCB000-01717-2100-45047, Subsurface Cnvr W-T03 General Arrangement Sections
  - BABFCB000-01717-2100-45048, Subsurface Conveyor W-T03 Booster Drive Arrangement Plan, Elev & Section
  - BABFCB000-01717-2100-45049, Subsurface Conveyor W-T03 Load Section Arrangement Plan, Elev & Section

SCENARIO NUMBER: UI0335

- Safety Manuals*
- Training Manuals*
- Maintenance Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0336 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury due to accidental start of conveyor.

SYSTEM/COMPONENT FAILURE:

- Equipment failure (e.g., conveyor start control, PLC)
- Operator error (e.g., starting conveyor from remote master station without knowing what activities, such as maintenance or debris removal, are being performed on the conveyor)
- Failure to adhere to safety procedures and rules (e.g., starting conveyor without checking for personnel working on conveyor)

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	D - Remote
Consequence Rating:	II - Critical
Risk Designation:	Medium

MITIGATION/CONTROL FEATURES:

- Provide maintained-contact type switches for conveyor emergency stop switches.
- Provide lockout(s)/tagout(s) which prevent accidental activation of conveyor.
- Provide a startup delay incorporated with audible and visible startup alarms along entire conveyor length
- Provide operator training (e.g., starting the conveyor system from the remote Master Control System workstation).
- Provide control software which prevents accidental activation of conveyor system.

SCENARIO NUMBER: UI0336

- Provide safety training for all personnel working on and around the conveyor (e.g., only authorized personnel on conveyor).

MITIGATION DOCUMENTATION:

- 29 CFR 1910.212
- 29 CFR 1926
- Cal Tunnel; 8 CCR 8410 & 8459
- See Section 7. References

  - Specification Section 14553, Installation of Belt Conveyors
  - Specification Section 14558, Subsurface Belt Conveyor System

- Safety Manuals*
- Training Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0337 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage caused by fire due to conveyor electrical cables in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs, chemical reactions, hot surfaces, small flames, catalytic reactions, etc.

SYSTEM/COMPONENT FAILURE:

- Conveyor electrical cables
- Connections (splices) outlets sparking in the presence of hydrogen, methane, hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable

Consequence Rating: II-critical

Risk Designation: 13-low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Control sparking: (design to codes and regulations using sealed motors or TEFC motors where appropriate):
- Control fuel sources: [hydraulic fluid (controlled per TBM specs.), lubricating oil (leak resistant seals in common use), diesel fuel (controlled per TBM specs.), flammable cleaning solvents (prohibit use of solvents that by NFPA definitions can be classified as flammable), disposable clean up materials (controlled by inspection and housekeeping procedures]. If combustible gasses are projected to be above 10% at any time during operation use combustible gas sensors.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: UI0337

- Damage control:

  1. Follow emergency fire procedures beyond incipient conditions.
  2. Emergency evacuation procedures

- Damage control:

  1. Fire suppression system.
  2. Emergency evacuation procedures.

MITIGATION DOCUMENTATION:

- Subsurface Belt Conveyor System Specification BABFCB000-01717-6300-14558 Rev. 04

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the subsurface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

  Section 2.10 A. " Conveyor belting shall be MSHA - approved, fire resistant."

  Section 2.20 A. "Pre-engineered, automatically activated, multipurpose dry chemical (monoammonium phosphate) fire suppression systems in accordance with NFPA 17 shall be installed..."

- YMP-025-1-SP05 rev.3 (Nov. 92) Sec. 11910 Part 1-1.02 "Control of Fluids". This specification places emphasis on the control of TBM operating fluids and minimizing the potential for leakage and spillage of those fluids; 2.18 B. Fire suppression-dry chemical per NFPA-17.

- Observe proper operating and maintenance practices/emergency evacuation procedures.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0338 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage caused by fire due to conveyor motors sparking in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs, chemical reactions, hot surfaces, small flames, catalytic reactions, etc.

SYSTEM/COMPONENT FAILURE:

- Conveyor motors sparking in the presence of hydrogen, methane, hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable (requires at least two events)

Consequence Rating: II-Critical

Risk Designation: 13 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Control sparking: (design to codes and regulations using sealed motors or TEFC motors where appropriate):
- Control fuel sources: [hydraulic fluid (controlled per TBM specs.), lubricating oil (leak resistant seals in common use), diesel fuel (controlled per TBM specs.), flammable cleaning solvents (prohibit use of solvents that by NFPA definitions can be classified as flammable), disposable clean up materials (controlled by inspection and housekeeping procedures]. If combustible gasses are projected to be above 10% at any time during operation use combustible gas sensors.

SCENARIO NUMBER: UI0338

- Damage control:

  1. Follow emergency fire procedures beyond incipient conditions.
  2. Emergency evacuation procedures
  3. Proper ventilation

- Damage control:

  1. Fire suppression system.
  2. Emergency evacuation procedures.

MITIGATION DOCUMENTATION:

- Subsurface Belt Conveyor System Specification BABFCB000-01717-6300-14558 Rev. 04.

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the subsurface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- YMP-025-1-SP05 rev.3 (Nov. 92) Sec. 11910 Part 1-1.02 "Control of Fluids" This specification places emphasis on the control of TBM operating fluids and minimizing the potential for leakage and spillage of those fluids; 2.18 B.Fire suppression-dry chemical per NFPA-17.

- Observe proper operating and maintenance practices/emergency evacuation procedures.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0339 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage caused by fire due to Conveyor motor control centers sparking in combination with fuel and oxidizer sources; causes include electrical faults/shorts, arcs, chemical reactions, hot surfaces, small flames, catalytic reactions, etc.

SYSTEM/COMPONENT FAILURE:

- Conveyor motor control centers sparking in the presence of hydrogen, methane, hydraulic fluid, lubricating oil, diesel fuel, flammable cleaning solvents, disposable clean up materials.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable

Consequence Rating: II-critical

Risk Designation: 13 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Control sparking: (design to codes and regulations using sealed motors or TEFC motors where appropriate):
- Control fuel sources: [hydraulic fluid (controlled per TBM specs.), lubricating oil (leak resistant seals in common use), diesel fuel (controlled per TBM specs.), flammable cleaning solvents (prohibit use of solvents that by NFPA definitions can be classified as flammable), disposable clean up materials (controlled by inspection and housekeeping procedures)]. If combustible gasses are projected to be above 10% at any time during operation use combustible gas sensors (use pressurized motor control centers if ventilation is inadequate).

SCENARIO NUMBER: UI0339

- Damage control:

  1. Follow emergency fire procedures beyond incipient conditions.
  2. Emergency evacuation procedures
  3. Proper ventilation

MITIGATION DOCUMENTATION:

- Subsurface Belt Conveyor System Specification BABFCB000-01717-6300-14558 Rev. 04.

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the subsurface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- YMP-025-1-SP05 rev.3 (Nov. 92) Sec. 11910 Part 1-1.02 "Control of Fluids". This specification places emphasis on the control of TBM operating fluids and minimizing the potential for leakage and spillage of those fluids; 2.18 B. Fire suppression-dry chemical per NFPA-17.

- Observe proper operating and maintenance practices/emergency evacuation procedures.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

Analysis: BAB000000-01717-0200-00147 REV. 00

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0340 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Personnel injury/equipment damage due to conveyor belt break.

SYSTEM/COMPONENT FAILURE:

- Idler/roller sticking or misalignment
- Conveyor frames not aligned properly
- Belt splices not square
- Improper loading
- Improper tension and slippage causing excessive wear

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D - Remote

Consequence Rating: II - Critical

Risk Designation: 9 - Medium

MITIGATION/CONTROL FEATURES:

- Provide guards/covers/adjustable feed openings which prevent muck from extending beyond the conveyor; muck being ejected from the conveyor, chutes, and transfer points; and personnel from reaching into the conveyor.
- Use proper installation/construction procedures per design specs/mfg. instructions.
- Use proper inspection/preventive maintenance techniques.
- Conveyor designed to carry 972 tons per hour (projected load per hour is 572 tons).
- Detection capability for incipient belt break conditions (belt tare detection)

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- Post safety/warning signs along all exposed areas of the conveyor and adjacent to the conveyor controls.
- Provide safety training for all personnel working on and around the conveyor (e.g., personnel exclusion areas - under conveyor).
- Provide flashing around conveyor belt frame.
- Establish inspection, maintenance, and housekeeping procedures and schedule. Maintain inspection, maintenance, and housekeeping records.

MITIGATION DOCUMENTATION:

- Training Manuals*
- Maintenance Manuals*
- Safety Manuals*

* It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0341 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Injury due to electrical Shock from conveyor electric cables; causes include exposed conductors, arcs, high voltage, shorts to ground static charges, or the presence of water.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor cables, connections (slices), outlets
- Malfunction of fuses/breakers injuring personnel from exposed wiring or through water as a conductor

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable

Consequence Rating: I-catastrophic

Risk Designation: 12 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Fluid leak control
- Compliance with electrical codes and standards

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SCENARIO NUMBER: UI0341

MITIGATION DOCUMENTATION:

- Subsurface Belt Conveyor System Specification BABFCB000-01717-6300-14558 Rev. 04.

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the subsurface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- MP-025-1-SP05 rev.3 (Nov. 92) Sec. 11910 Part 1-1.02 "Control of Fluids". This specification places emphasis on the control of TBM operating fluids and minimizing the potential for leakage and spillage of those fluids.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0342 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Injury due to Electrical Shock from transformer; causes include exposed conductors, arcs, high voltage, shorts to ground, static charges, or the presence of water.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor transformer causing personnel injury from exposed wiring or through water, from dust suppression system as a conductor.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	E-improbable
Consequence Rating:	IV-negligible (personnel cannot be present during normal operation-transformers are enclosed)
Risk Designation:	20 Extremely low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Fluid leak control
- Compliance with electrical codes and standards
- Enclose transformers to prevent contact by personnel during normal operation also use interlocks.
- Provide ground fault protection per specification.

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SCENARIO NUMBER: UI0342

MITIGATION DOCUMENTATION:

- Subsurface Belt Conveyor System Specification BABFCB000-01717-6300-14558 Rev. 04.

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the subsurface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- YMP-025-1-SP05 rev.3 (Nov. 92) Sec. 11910 Part 1-1.02 "Control of Fluids". This specification places emphasis on the control of TBM operating fluids and minimizing the potential for leakage and spillage of those fluids

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0343 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Injury due to Electrical Shock from conveyor motor; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor motor or conveyor control system causing injury to personnel through water (from dust suppression system for example) as a conductor.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable

Consequence Rating: I-catastrophic

Risk Designation: 12 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Fluid leak control.
- Compliance with electrical codes and standards.

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SCENARIO NUMBER: UI0343

MITIGATION DOCUMENTATION:

- Subsurface Belt Conveyor System Specification BABFCB000-01717-6300-14558 Rev. 04.

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the subsurface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- YMP-025-1-SP05 rev.3 (Nov. 92) Sec. 11910 Part 1-1.02 "Control of Fluids". This specification places emphasis on the control of TBM operating fluids and minimizing the potential for leakage and spillage of those fluids.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0344 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Injury due to Electrical Shock from conveyor motor control center; causes include exposed conductors, arcs, high voltage, shorts to ground, and static charges or through water as a conductor.

SYSTEM/COMPONENT FAILURE:

- Electrical shock from conveyor motor control center causing injury to personnel.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: E-improbable

Consequence Rating: I-catastrophic

Risk Designation: 12 low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training
- Fluid leak control
- Compliance with electrical codes and standards.

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SCENARIO NUMBER: UI0344

MITIGATION DOCUMENTATION:

- Subsurface Belt Conveyor System Specification BABFCB000-01717-6300-14558 Rev. 04.

  Section 1.04E. "Supplier shall incorporate in design and manufacture of the subsurface conveyor system all reasonable methods for precluding and mitigating the leakage and spillage of fluids including full containment of fluids where applicable"

- YMP-025-1-SP05 rev.3 (Nov. 92) Sec. 11910 Part 1-1.02 "Control of Fluids". This specification places emphasis on the control of TBM operating fluids and minimizing the potential for leakage and spillage of those fluids.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0345 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Storage of tramp iron collected by magnet stored improperly causing injury to personnel

SYSTEM/COMPONENT FAILURE:

- Improperly located or controlled storage for tramp iron.

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating: D-remote

Consequence Rating: III-marginal

Risk Designation: 16 - extremely low

MITIGATION/CONTROL FEATURES:

- Operator/personnel training.
- Remotely locate tramp iron.
- Provide barriers around tramp iron.
- Post safety/warning signs.

MITIGATION DOCUMENTATION:

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0347 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Muck falling from conveyor causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Excessive vibration due to worn bearings
- Misalignment of transfer/loading hopper

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	D - Remote
Consequence Rating:	III - Marginal
Risk Designation:	16 - Extremely Low

MITIGATION/CONTROL FEATURES:

- Restrict muck loading and angle conveyor sides so that belt extends above muck height.
- Provide full enclosure chutework at all material transfer points.
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide long life high quality idler and roller assemblies.
- Provide shutdown and indication for high/low belt speed, belt overload and misalignment.
- Provide operator training and start-up support.
- Provide continuous visual indication (eg. yellow lights) that conveyor is operating.
- Post safety/warning signs.
- Require personnel walking through tunnel to walk along tunnel wall side opposite the conveyor.

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SCENARIO NUMBER: UI0347

MITIGATION DOCUMENTATION:

Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1. Section 2.14A specifies minimum requirements for sensors and alarms including audible and visible start-up alarms.
2. Section 2.12F specifies minimum requirements for status signals to the master control system.
3. Section 2.13A & B specifies conveyor and transfer point enclosure requirements for dust control and muck retention.
4. Section 3.01 specifies that 40 hours of operator training and that additional start-up support will be provided by the conveyor supplier.
5. Section 2.12I specifies the operations and maintenance manuals, diagrams, and drawings to be provided by conveyor supplier
6. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

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ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0348 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Muck falling from conveyor causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Equipment collision with conveyor
- Rail tie / tools falling on conveyor

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	D - Remote
Consequence Rating:	III - Marginal
Risk Designation:	16 - Extremely Low

MITIGATION/CONTROL FEATURES:

- Restrict muck loading and angle conveyor sides.
- Provide full enclosure chutework at all material transfer points.
- Provide metal guarding for all drive equipment.
- Restrict area underneath/by conveyor.
- Post safety/warning signs.

Analysis: BAB000000-01717-0200-00147 REV. 00

SCENARIO NUMBER: UI0348

MITIGATION DOCUMENTATION:

Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1. Section 2.14A specifies minimum requirements for sensors and alarms including audible and visible start-up alarms.
2. Section 2.13A & B specifies conveyor and transfer point enclosure requirements for dust control and muck retention.
3. Section 2.04 & 2.14 requires metal guarding on conveyor terminals and support structure platforms, handrails and ladders
4. Section 3.01 specifies that 40 hours of operator training and additional start-up support will be provided by the conveyor supplier.
5. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0349 REVISION:00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Muck falling from conveyor causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Failure to stop due to muck back-up at hopper or chute
- Failure to stop when belt looses alignment
- Failure to stop due to electrical component or sensor failure

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	D - Remote
Consequence Rating:	III - Marginal
Risk Designation:	16 - Extremely Low

MITIGATION/CONTROL FEATURES:

- Restrict muck loading and angle conveyor sides.
- Provide full enclosure chutework at all material transfer points.
- Provide plugged chute indication and alarm to master control system.
- Provide secure dust free electrical enclosures and approved electrical protection features.
- Provide emergency stop pull cord along entire length of accessible sections of conveyor.
- Provide operator training and start-up support.
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.

SCENARIO NUMBER: UI0349

- Provide continuous visual indication (eg. yellow lights) that conveyor is operating.
- Post safety/warning signs.
- Require personnel walking through tunnel to walk along tunnel wall side opposite the conveyor.

MITIGATION DOCUMENTATION:

Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1 Section 2.13A & B specifies conveyor and transfer point enclosure requirements for dust control and muck retention.
2. Section 2.14A specifies minimum requirements for sensors and alarms including audible and visible start-up alarms and the safety pull cord system installation requirements.
3. Section 2.12F specifies minimum requirements for status signals to the master control system including plugged chute indication.
4. Section 2.18 specifies electrical enclosure and protection requirements.
5. Section 2.20C specifies the control module electrical enclosure requirements.
6. Section 2.12I specifies the operations and maintenance manuals, diagrams, and drawings to be provided by conveyor supplier
7. Section 3.01 specifies that 40 hours of operator training and additional start-up support will be provided by the conveyor supplier.
8. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0350 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Muck falling from conveyor causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Sudden stop due to misalignment or loading conditions
- Sudden stop due to electrical component or sensor failure
- Sudden stop due to severed electrical cable

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	D - Remote
Consequence Rating:	III - Marginal
Risk Designation:	16 - Extremely Low

MITIGATION/CONTROL FEATURES:

- Restrict muck loading and angle conveyor sides.
- Provide full enclosure chutework at all material transfer points.
- Provide secure dust free electrical enclosures and approved electrical protection features.
- Require all wiring to be routed out of the way of moving equipment.
- Provide operator training and start-up support.
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide communications (radio or PA).

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SCENARIO NUMBER: UI0350

- Provide continuous visual indication (eg. yellow lights) that conveyor is operating.
- Post safety/warning signs.
- Require personnel walking through tunnel to walk along tunnel wall side opposite the conveyor.

MITIGATION DOCUMENTATION:

Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1. Section 2.13A & B specifies conveyor and transfer point enclosure requirements for dust control and muck retention.
2. Section 2.18 specifies electrical enclosure, wiring and electrical protection requirements
3. Section 2.20C specifies the control module electrical enclosure requirements.
4. Section 3.01 specifies that 40 hours of operator training and additional start-up support will be provided by the conveyor supplier.
5. Section 2.12I specifies the operations and maintenance manuals, diagrams, and drawings to be provided by conveyor supplier
6. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

Analysis: BAB000000-01717-0200-00147 REV. 00

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0351 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Muck falling from conveyor causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Unanticipated start due to electrical component or control panel failure
- Unanticipated start due to programmable logic controller (PLC) failure
- Unanticipated start due to electrical short circuit
- Unanticipated start due to remote reset/restart
- Unanticipated start due to operator error

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	E - Improbable
Consequence Rating:	III - Marginal
Risk Designation:	17 - Extremely Low

MITIGATION/CONTROL FEATURES:

- Restrict muck loading and angle conveyor sides.
- Provide full enclosure chutework at all material transfer points.
- Provide secure dust free electrical enclosures and approved electrical protection features.
- Require all wiring to be routed out of the way of moving equipment.

SCENARIO NUMBER: UI0351

- Provide operator training and start-up support.
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide emergency stop pull cord along entire length of accessible sections of conveyor.
- Provide a startup delay incorporated with audible and visible startup alarms along entire conveyor length
- Provide restart interlocks between remote and master control stations
- Provide drive motors with soft starting characteristics
- Post safety/warning signs.
- Require personnel walking through tunnel to walk along tunnel wall side opposite the conveyor.
- Provide communications (radio or PA).

MITIGATION DOCUMENTATION:

Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1. Section 2.13A & B specifies conveyor and transfer point enclosure requirements for dust control and muck retention.
2, Section 2.12I specifies the manuals, diagrams, and drawings to be provided.
3. Section 2.18 specifies electrical enclosure, wiring and electrical protection requirements
4. Section 2.20C specifies the control module electrical enclosure requirements, the replacement battery power supply, and the startup / reset delay features.
5. Section 2.14A specifies required sensors and alarms including audible and visible start-up alarms and the safety pull cord system installation requirements.
6. Section 2.03 specifies that direct connected drive motors will be soft starting
7. Section 2.12I specifies the operations and maintenance manuals, diagrams, and drawings to be provided by conveyor supplier
8. Section 3.01 specifies that 40 hours of operator training and additional start-up support will be provided by the conveyor supplier.
9. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0352 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Tramp iron magnet swings/falls causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Tramp iron magnet suspension cable failure
- Swinging magnet impacts personnel
- Falling, tripping, while handling magnet

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	D - Remote
Consequence Rating:	III - Marginal
Risk Designation:	16 - Extremely Low

MITIGATION/CONTROL FEATURES:

- Provide metal guarding for all drive equipment.
- Provide handrails, access platforms and ladders for equipment operation and maintenance.
- Provide non-skid surface on all landings, platforms, stairs and ladders
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide operator training and start-up support.
- Post safety/warning signs.

SCENARIO NUMBER: UI0352

- Require personnel walking through tunnel to walk along tunnel wall side opposite the conveyor.

MITIGATION DOCUMENTATION:

Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1. Section 2.04 & 2.14 requires metal guarding on conveyor terminals and support structure platforms, handrails and ladders
2. Section 2.14A specifies audible and visible start-up alarms and the safety pull cord system installation requirements.
3. Section 2.12I specifies the operation and maintenance manuals, diagrams, and drawings to be provided with conveyor
4. Section 3.01 specifies that 40 hours of operator training and additional start-up support will be provided by the conveyor supplier.
5. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.

ACCIDENT ANALYSIS SUMMARY

SCENARIO NUMBER: UI0353 REVISION: 00 REVISION DATE: 6/15/95

LOCATION:

Main Drift

SCENARIO:

Conveyor collapse causing personal injury/equipment damage.

SYSTEM/COMPONENT FAILURE:

- Conveyor collapse/support failure due to overload
- Conveyor collapse/support failure due to improper installation
- Conveyor collapse due to collision with equipment

ACCIDENT CLASSIFICATION AFTER MITIGATION:

Frequency Rating:	E - Improbable
Consequence Rating:	II - Critical
Risk Designation:	13 - Low

MITIGATION/CONTROL FEATURES:

- Provide sensors and alarms for belt rip, overload, slippage and low speed.
- Provide handrails, access platforms and ladders for equipment operation and maintenance.
- Establish inspection and maintenance procedures and schedule. Maintain inspection and maintenance records.
- Provide operator training and start-up support.
- Post safety/warning signs.
- Require personnel walking through tunnel to walk along tunnel wall side opposite the conveyor.

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SCENARIO NUMBER: UI0353

MITIGATION DOCUMENTATION:

Subsurface Conveyor Purchase Specification BABFCB000-01717-6300-14558 Rev 04

1. Section 2.04 & 2.14 requires metal guarding on conveyor terminals and support structure platforms, handrails and ladders
2. Section 2.14A specifies requirements for sensors and alarms and the safety pull cord system installation requirements.
3. Section 2.12I specifies the operation and maintenance manuals, diagrams, and drawings to be provided with conveyor
4. Section 3.01 specifies that the conveyor supplier will provide on site assistance during installation, 40 hours of operator training and additional start-up training
5. Personnel are required to have general site safety and underground training and are required to wear protective clothing.

It is the designer's and constructor's and operator's responsibility to assure that the hazard(s) associated with this scenario have been mitigated through proper documentation.