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2.0 General Safety

Introduction

Most accidents occur when people fail to recognize a potentially hazardous situation and do not take preventive measures. The goal of the Prospectors & Developers Association of Canada (PDAC) Health and Safety Guidelines is to increase safety awareness for people employed in the mineral exploration industry, especially those who work in a field environment. It is important to recognize situations where the risks and hazards at a project or camp location are higher than normal, which is typical at remote sites when first aid and medical treatment may be unavailable for hours or even days. Two noteworthy circumstances also increase the risk of accidents – working alone, and being a new employee at a site, especially if the worker is male and under the age of 25. Statistics indicate that 50% of all accidents that happen to young workers aged 15-24 (including students) occur during their first six months on a job.

There are numerous measures aimed at diminishing the occurrence and severity of accidents; they include company policies and procedures, safety meetings, and risk assessments and job safety analyses (JSAs). Company policies and procedures should include requirements for safety meetings, risk assessments and JSAs. Safety meetings take many forms. They may be lengthy and detailed with required attendance by all employees, such as pre-program site induction sessions, or meetings may be limited in focus and last only a few minutes, such as when employees perform a daily pre-job check.

At any safety meeting, the information has to be understood by the attendees. Therefore, translation may be an issue in places where companies hire local employees who speak a language other than the language the company normally uses. For instance, a first aid attendant has to be able to communicate with a patient, and employees have to understand safe operating procedures (SOPs), why and how to use personal protective equipment (PPE), and the safety instructions from a charter aircraft pilot when they are transported by air. At some sites the translator may be hired by a contractor. In any situation, critical information should be communicated in the local language when comprehension is necessary. Finally, risk assessments and job safety analyses (JSAs) can help identify risks and hazards so they can be mitigated, which should result in lower accident rates. Trained company personnel, competent contractors, and specialists (sometimes) who are familiar with the work site and the jobs should conduct risk assessments and JSAs.

Acronyms

AHJ – Authority Having Jurisdiction

ATV – All-Terrain Vehicle

ERP – Emergency Response Plan

FMEA – Failure Modes and Effects Analysis

JSA – Job Safety Analysis

MSDS – Material Safety Data Sheet

OHS – Occupational Health and Safety

PAL – Possession and Acquisition License

PFD – Personal Flotation Device

PPE – Personal Protective Equipment

RCA – Root Cause Analysis

RPN – Risk Priority Number

SOP – Safe Operating Procedure

WHMIS – Workplace Hazardous Materials Information System

Definitions

Companies should clearly define the terms they use – "accident", "incident" and "near miss" – so employees are aware of the significance and required response to an event. Below are some suggested definitions.

Accident: An occurrence that results in serious injury requiring medical aid. An accident may also be an unplanned event that causes damage to equipment or property. Some companies avoid the use of the word "accident" as it implies an "act of God", or something beyond human control; there are some in the health and safety field that believe there is no such thing as a negative event in the workplace that is beyond human control.

Event: A general term for accident, incident, near miss, mishap, occurrence, crash, collision

Hazard: Anything (object, situation or condition) that has the potential to cause harm to a person, property, machinery, or the environment. Examples of hazards include terrain (e.g., slippery or steep ground, cliffs, crevasses, dry stream bed), conditions in the work environment (e.g., cold temperatures, high altitude, carrying heavy loads), transportation routes (e.g., rough roads, thin ice) and exposure to potential occupational diseases (e.g., silica dust, radiation, bat droppings).

Incident: An occurrence that results in minor injury requiring first aid treatment only. An incident may also be defined as an unplanned event that does not have serious consequences (e.g., no injury, damage, or property loss).

Near Miss: An unplanned event that does not result in injury, but has the potential to cause harm to personnel and/or damage to property or the environment under slightly different circumstances.

Risk: The likelihood (chance) of injury, loss, damage, or occupational disease resulting from exposure to a hazard.

Risk Assessment: The process of identifying hazards and evaluating them to determine appropriate methods to eliminate or control the risks of injury, loss or damage

Root Cause: A root cause is an underlying reason in a sequence of events leading to an event (accident, incident or near miss). There may be more than one root cause.

Root Cause Analysis (RCA): A process that uses systematic techniques that focus on finding the underlying cause(s) of a problem (accidents, incidents, risks and hazards). Root cause analysis examines physical causes, human causes, and organizational causes in order to detect significant actions or situations that can be changed to prevent repeating an event.

2.1 Preparations to Reduce Risks

A company should make sure that all people present at work sites, including contractor's employees and visitors, follow the same safe work practices, which include all regulations of the authorities having jurisdiction (AHJs), occupational health and safety (OHS) regulations, company policies, and standard operation procedures (SOPs) and guidelines etc. Cooperation between a company and its contractors is required if safety goals and objectives are to be achieved. In addition, employees should develop a strong sense of ownership regarding their personal safety

and that of their co-workers to reduce the risks inherent in exploration work. Employees who traverse should strive to become as self reliant as possible in case they become stranded or injured, especially if they traverse alone. In addition, it is essential that senior management follow safe practices when visiting work sites in order to set a good example that encourages and supports a positive attitude toward safety.

The following important measures will reduce risks while carrying out exploration field work and other project work.

1. All workers should be trained to work safely and to follow site specific safe operating procedures (SOPs). Appropriate training includes but is not limited to:
    - Safety induction training sessions at the start of the season or project and routine safety meetings (see section 2.1.2 Safety Meetings below).
    - Certifications such as first aid, Workplace Hazardous Materials Information System (WHMIS), and Possession and Acquisition License (PAL) in Canada, as appropriate
    - Awareness of terrain and other site specific risks and hazards in the project area (refer to sections 6. Safe Traversing Practices, 9. Weather and Environmental Risks, and 10. Wildlife)
    - Relevant regulations and job skills, including required personal protective equipment (PPE)
2. All visitors should have a safety induction that addresses the site specific risks and hazards.
3. Students and other young workers should receive sufficient training and supervision, as they are statistically more likely to have accidents than older more experienced workers. Unlike a generation ago, students rarely start field work with experience or knowledge about the use of navigation equipment, field tools, firearms, communication equipment, or camping skills. Students and young workers should be trained for the specific jobs they will perform. Employers should be aware of the following generalizations in order to promote a greater awareness of safety among students and young workers:
    - They often believe an accident will not happen to them.
    - They may be afraid to ask questions for fear of appearing “dumb”.
    - They are often unaware of their right to refuse work they feel is unsafe and/or that they may request more training if they are not comfortable doing a job.
    - They are often unaware of their own lack of knowledge i.e., “they don’t know what they don’t know”.
4. Carry out a risk assessment of the project site and area so managers can prioritize which hazards are most important to address and provide relevant training. Performing risk assessments should be an ongoing process throughout the project. Weekly safety meetings provide an opportunity to identify new risks and hazards and educate employees about how to mitigate them. See section 2.1.5 Risk Assessments below.
5. Develop an emergency response plan (ERP) for each project site. Some drill sites may need an independent ERP if the site could become isolated. Refer to section 3. Emergency Response.
    - Train everyone to be sufficiently familiar with the plan and emergency procedures. Employees with assigned emergency duties should be competent.

- Test the plan to be sure it works; test the emergency communication contact numbers and radio frequencies.
- Hold fire drills, evacuation drills, bear sighting drills etc., as appropriate.
- If a company hotline is not available, the people designated to receive calls and relay information during an emergency situation should be trained to do this job properly.

6. Fully equip project sites to address emergencies. Required equipment includes but is not limited to:
    - First aid kits and supplies at the first aid station including a spine board and basket stretcher for transportation, as required. Some jurisdictions dictate a minimum level of equipment and training.
    - Firefighting equipment
    - Survival supplies: Equip project sites, survival caches for employees who work off site, and vehicles or boats that transport employees to and from a work site. Refer to section 8. Survival.
7. Communication equipment should be appropriate for the location and terrain and have adequate reception in the area (refer to section 19. Communications).
    - Everyone should be trained to use the communication equipment.
    - Post operating instructions by the stationary communication equipment and supply instructions to be carried with portable equipment.
8. Provide translation when the employees do not speak the language of company operation. Training regarding company SOPs, ERPs, safety briefings and first aid procedures are among the most important information that requires full understanding by all employees.
9. Provide training regarding transportation safety. Most fatalities in the exploration industry are related to transportation.

2.1.1 Working Alone Versus the “Buddy System”

2.1.1.1 Risks and Hazards

The following list identifies some of the increased risks of working alone:

- Delayed emergency response resulting in increased severity of injury or death.
- Inability to administer essential first aid to oneself in the event of an accident.
- Inability to self-rescue, which results in drowning
- Inability to recognize the signs of hypothermia, frostbite, heat illnesses, dehydration, altitude illness etc. These symptoms are often identified by a co-worker.
- Attack by an animal (or human) that might not attack a group of people.
- When lost or in a survival situation, a person working alone may have a greater tendency to panic or “give up” than when with a co-worker.

2.1.1.2 Jurisdictional Requirements

Working alone or in isolation is defined in some OHS legislation as working in circumstances where emergency assistance might not be easily available should the worker become injured or ill. For exploration companies, examples of working alone include: traversing alone, working at some distance from the camp, project or office without easy access to help, and travelling alone to or from a site via ATV, snowmobile, or four-wheel drive vehicle (4x4) etc. Depending on the jurisdiction and circumstances, OHS regulations usually require special procedures to be in place when employees work alone. Such procedures usually include a job safety analysis (JSA) and communication provisions specific to the job and work site to make certain the worker will be checked at frequent intervals, for example a minimum of every 2.5 hours. Even with excellent communication equipment, an accident or incident may leave the employee unable to communicate with base camp, the project manager or the office when he or she requires assistance.

Working Alone

When a company decides that working alone is necessary, the company should:

- Identify all risks and hazards to the employee and take measures to eliminate or mitigate the hazards to the lowest practical level.
- Provide appropriate training to address any additional and increased risks and hazards that result from working alone.
- Provide written safe operating procedures (SOPs). Set up and implement tracking and check-in procedures. The emergency response plan (ERP) should include required actions to address a missed check-in and appropriate emergency rescue procedures.
- Provide excellent communication equipment in good working order and with adequate local coverage.
- Provide top quality, appropriate safety equipment, such as bear deterrents, emergency shelter, survival caches etc.

Employees should realize that if they are asked to work alone, it is imperative to do the following:

- Realistically evaluate their level of experience and capabilities before making a decision.
- Be informed about and carefully evaluate all the risks and hazards.
- Ask advice from more experienced workers.
- Work with extra caution.
- Confirm that all equipment is in good working order. Verify that communication equipment functions by initiating communication at the onset of the job as soon as they are dropped off or reach the work location.
- Strictly adhere to tracking and check-in procedures and immediately notify the contact person whenever there is a change of plans.
- Remember that they have the right to refuse work that they perceive to be unsafe and/or for which they feel inadequately trained.
- Additional information regarding working alone is available on the following websites: http://employment.alberta.ca/documents/WHS/WHS-PUB_workingalone.pdf

  http://www.ccohs.ca/oshanswers/hsprograms/workingalone.html

The PDAC advocates the "buddy system" and recommends against working alone in the bush.

Working in pairs – the "buddy system" – is safer than working alone.

2.1.2 Safety Meetings

The importance of regular, well planned safety meetings cannot be overemphasized. Safety meetings provide an effective tool for promoting safety awareness, raising concerns about safety at the work site, and communicating safe work procedures to all company and contractor employees. Safety planning should start at office meetings before project work begins in the field. At the project site, formal scheduled safety meetings provide an excellent way for management, supervisors or project leaders to demonstrate leadership and commitment to working safely. Informal safety meetings can provide the opportunity to emphasize safety on the job. For instance, a hands-on demonstration of how to safely perform a particular task can be given. Informal meetings can be in small groups or on a one-to-one basis as necessary. Both types of safety meetings are important in order to implement and continuously improve safety procedures, safety awareness and safety performance.

At all safety meetings employees should be encouraged to discuss safety issues with the aim of developing a sense of proactive involvement and ownership of the idea that safety is everyone's responsibility. By requiring contractor's employees to attend safety meetings, a company emphasizes their commitment to occupational health and safety for all employees and promotes a culture of safety at a work site.

Obviously, the level of formality or informality of safety meetings at work sites will depend on the size of the operation. For example, a larger project with a greater variety of workers, contractors and frequent visitors may require a very formal rigid meeting system. Smaller work sites may rely on very informal systems of meetings. No matter the size and formality of safety meetings, there still needs to be mechanisms for workers to express concerns.

Tips for the person conducting a safety meeting

Whoever is responsible for running a regularly scheduled safety meeting should show his or her personal commitment to the company safety program. Sufficient care should go into planning the meetings. The PDAC Health and Safety Guidelines are a major source of information on many aspects of exploration safety and they are intended to be a resource for agendas at safety meetings.

- Cover topics that directly relate to conditions at the project site.
- Prepare and organize the agenda.
- Employee attendance should be mandatory. Encourage them to discuss their concerns, "near misses" and observed hazards. Ask for suggestions for solutions to safety issues.
- Keep good records of attendance, discussions, hazards and issues that are raised.
- Follow-up: Report topics of concern that require the attention of management to the appropriate management personnel. When issues have been addressed, report back at the next safety meeting with updates on corrections, hazard mitigation and unresolved issues.
- One possible way of engaging site workers is to assign a different person a specific topic to research and present at each meeting, rotating gradually through all workers at the site.

- Set a firm time limit (and agenda) to change the atmosphere if safety meetings become confrontational or are unproductive.

Meeting Minutes

Document all safety meetings with minutes that include the agenda, issues discussed, proceedings and a list of attendees. Forward a copy of the completed minutes to the project supervisor or manager.

- Schedules: Whenever there are 24 hour operations at a project, it will be necessary to hold at least two separate safety meetings covering the same topics to access all employees.
- Minutes: Minutes should be a succinct summary of the important points discussed at the safety meeting. Review minutes of the previous meeting to make sure relevant topics are addressed and follow-up actions are discussed. Maintain a record of the minutes for all safety meetings.
- Record the following:
  1. Date
  2. Location
  3. Attendee list
  4. Agenda items discussed
  5. Specific safety concerns raised by attendees
  6. Decisions reached and follow-up
  7. Persons responsible for follow-up actions and reporting of progress

2.1.2.1 Pre-Program Induction Safety Meetings

An induction safety meeting should be held at the beginning of a project for all employees working at the site. It is recommended that individuals sign off that they have attended and understood the induction information. These records should be maintained by the senior person on site. The induction should be supported by ongoing safety meetings at regularly scheduled intervals.

Frequency

- Every company should require a pre-program safety induction prior to commencing work on any project or at the beginning of the season on a multi-year project.
- Any new employee, contractor, visitor or other individual visiting the site during the project should receive the same induction information as received by employees at the start of the season. The individual should be taken through the induction by an experienced person on site.
- Identify the hazards before visitors are conducted around the site. Depending on the location, it may be acceptable for people who stay less than 24 hours at a site to receive a summary induction if it includes stressing the risks and hazards they will be exposed to during their work or visit. Anyone staying at the site for longer than 24 hour should receive a full induction.

Goals

- Employees should be made aware of all aspects of risks and hazards and SOPs at the site. Aim to reinforce the highest level of safety awareness and make sure all SOPs and safety equipment are in place to accomplish all jobs in a safe manner.
- Site safety inductions should be modified to address relevant issues according to the location and season of the year. Hold an induction for all employees when there are significant seasonal changes, such as summer vs. winter or dry vs. wet season. Any employee who has received a site induction at one time of year (summer) and then returns to work at another time of year (winter) should be required to undergo another site safety induction, as the risks and hazards will have changed.
- Attendance at a pre-program safety induction should be mandatory and include all contractor and company staff.
- Emphasize that safety is a team approach among all people on site (refer to section 1.3 Internal Responsibility System).
- Promote a positive attitude toward safety among the contractor's staff.
- Promote self reliance for employees who traverse.
- Confirm the status of employees' "tickets" such as WHMIS, PAL, and first aid certificates.

Suggested topics include:

- Company principles relating to health and safety
- Site specific rules, SOPs and guidelines
- Coordination of activities of all contractors
- Responsibilities and rights of workers, supervisors and management with respect to health and safety
- Emergency response plan (ERP) and the emergency contact numbers and radio frequencies: Emergency procedures should always be part of the induction agenda and should be thoroughly reviewed. Discuss specific emergency procedures that may be required and make sure that everyone is familiar with them. Refer to section 3. Emergency Response.
- Emergency signals: Develop different signals for different emergencies. For example, workers should not mix up the signal for "fire" when everyone should muster to help, as opposed to the signal for "bear" when people should remain in a shelter unless they have specific duties.
- Site evacuation plans and muster stations
- Fire safety: Location of firefighting equipment, fire stations, posted fire procedures, muster stations, fire drills, safe fire prevention practices
- First aid and medical facilities, procedures to use a spine board and basket stretcher, injuries and illness procedures
- Accident reporting and investigation
- Communication equipment and instruction in the use of the equipment, as appropriate
- Communication procedures and schedules:
    - Required daily communications

  - Emergency communications
  - Between aircraft and camp
  - Between field crew members
  - Between project and head office
  - Refer to section 19. Communications for additional information.
- Policies:
  - Smoking
  - Possession and use of firearms in compliance with AHJs
  - Alcohol and/or illegal non-prescription drugs
  - Fighting and violence
  - Horseplay and pranks
  - Destruction of property, fire alarms or other safety equipment
  - Recreational use of equipment and fishing/hunting activities
  - Use of audio entertainment systems
- Aircraft safety: The pilot should review SOPs and safety regarding the specific aircraft used at the site. Hold a new aircraft safety briefing for employees whenever a new pilot starts work or a new aircraft is brought in.
- Water safety: Required use of PFDs, safety on local water bodies, work related and recreational use of boats, if applicable
- Ground transportation: Vehicles, four-wheel drive vehicles (4x4s), ATVs, utility vehicles, snowmobiles, as appropriate; speed limits, fuelling procedures, specific safety issues including work related and recreational use, if applicable
- Climatic hazards: Hypothermia, frostbite, whiteouts, wind chill, heavy rains, dust or sand storms, dehydration, hyperthermia, heat stroke, as appropriate
- Terrain hazards: High altitude, cliffs, glaciers, avalanches, wet terrain, heavy vegetation, deserts, muskeg, swamps, as appropriate
- Hygiene: Handwashing facilities, kitchen and dining procedures, clothes washing facilities and procedures, waste disposal, including bathroom or privy facilities
- Slips, trips and falls: Location of the greatest risks and hazards, preventions
- Lifting and back safety
- Housekeeping practices
- PPE: Required, what is provided by the company and what is provided by the individual
- Safety regarding fuels, heaters, stoves, generators including the risks of carbon monoxide poisoning
- Safety regarding tools: Chainsaws, rock saws, augers, power tools, hand tools
- Electrical safety
- Confined spaces: Recognition of risks and hazards and entry procedures, as appropriate
- Environmental issues: Site preparation, site cleanup, hazardous materials, spill containment

- Site security
- Working near heavy machinery, if applicable
- Blasting procedures, if applicable
- Wildlife concerns: Feeding wildlife, bears, cougars, snakes, insects etc.
- Inspections
- Documentation: Requirements of the company, contractors and the AHJs
- Available general site services

2.1.2.2 Routine Scheduled Safety Meetings

Following the pre-program induction, safety meetings should be held regularly i.e., monthly, weekly or even more often as conditions dictate. All employees and all contractors' employees should participate. Regularly scheduled formal meetings can be structured to include different types of training (e.g., hands-on training, practice, audiovisual presentations, demonstrations or instructional reading and exercises).

Suggested topics include:

- Safe operating procedures: General and site specific
- Refresher training for safety procedures that are not being followed
- Introduction of new safety procedures
- Importance of and the proper use of PPE
- Follow-up actions: Inform all participants so they understand any decisions or follow-up actions originating from previous recommendations.
- "Near miss" incidents. Safety meetings are a good time to report, discuss and develop preventive actions regarding significant safety incidents that could have resulted in an accident. Follow-up actions, including modification of SOPs, may be required to prevent similar incidents in the future that could have potentially serious consequences.
- Review past accidents experienced by the company and contractors and emphasize the lessons to be learned.
- Housekeeping
- Emergency response procedures for potential emergency situations
- Accident reporting and investigation procedures
- Improvements in current procedures
- Discussing a difficult or rarely performed job

2.1.2.3 Daily or Shift Work Safety Meetings

A short safety meeting should be held at the start of each shift or day's work.

- Highlight the safety issues associated with the task to be performed.

- Check that required written and verbal procedures are completed before daily work commences (e.g., fall protection, lockout, and confined spaces). Use appropriate permits and checklists.
- For some jobs it is advisable to hold the meeting when shifts change so the “off” crew can talk about shift issues with the “on” crew.
- Check that PPE functions correctly.
- Check that communication equipment is functioning and confirm the check-in schedule.
- Traversing crews should check to confirm their location – drop off and pick up points, the placement of any survival caches and the means of transportation (aircraft, boat, or vehicle). Do not leave your transportation unless you can accurately place yourself on your map.

2.1.2.4 Drill Site Safety Meetings

A safety meeting for a drill program should normally be held at the drill rig. It is very important for geoscientists and employees who work in the area of a drill rig to be familiar with the risks and hazards associated with the drill and the sampling and drilling processes. Refer to section 20. Drilling Sites for information about specific risks and hazards associated with drills, drilling methods and drill sites. Include potential environmental issues and emergency response plans at the same time as reviewing safety procedures at the drill.

Suggested topics include:

1. Drilling safety issues for the specific type of drilling equipment used on site:
    - PPE: Requirements should include safety glasses with side shields, steel toed safety boots, hard hat and hearing protection at all times. Possible job specific requirements include gloves and dust masks or respirators.
    - Demonstrate exactly where each hazard is located at the drill rig.
        - Emergency shut-offs: Demonstrate the location and proper operation of every emergency shut-off on each piece of equipment. Everyone must know the location of shut off equipment and how to operate it.
        - Compressed air hazards:
            - Pressure relief valves: Location, direction of discharge, potential blockages and the consequences of being hit by an unexpected discharge
            - Whip checks: Inspection of attachment points and condition
            - Couplings: Inspection procedures
            - Booster compressor: Whip checks, condition of hoses, location of relief valves and emergency shut-offs
        - High pressure air hoses: Position, couplings, support and wear, check quality
        - Hydraulic hoses: Check the quality of hoses. Caution about potential pinhole ruptures, burns from hot oil and fluids, correct methods to determine the location of a leak and the potential for fluid embolism.

- Pinch points: Indicate possible pinch points for fingers, hands, arms, and feet from sprockets, pipes, wrenches, drill rods etc.

- Fall protection system: Demonstrate the difference between a travel restraint, which prevents an employee from approaching hazards, and a fall arrest system, which brings the employee to a complete stop when they fall. Demonstrate the correct use of the harnesses, shock-absorbing lanyards, attachment point and retractable or fixed cable in the fall arrest system.
- Hoisting equipment: Cables, clamps and sheaves
- Hazardous chemicals: Familiarize employees with the characteristics of the chemicals on site and with the use and content of the Material Safety Data Sheets (MSDSs).
- Housekeeping:
  - The general layout should be efficient and as free of hazards as possible.
  - Maintain tools and equipment in good condition and store them in the proper place.
  - Slips, trips and falls: Point out the hazards and the avoidance techniques.
  - Keep the area around the drill clean to avoid slipping hazards (e.g., no lubricants etc., spilled on the ground, ice cleared away).
- Manual handling: Demonstrate proper lifting procedures and techniques. Use lifting equipment whenever possible.
- Fire prevention:
  - Discuss possible fire hazards that may result from fuel or oil leaks, especially those near a source of heat or ignition.
  - Designated “No Smoking” areas
  - Demonstrate the correct use of stoves, tiger torches, propane etc. Refer to sections 18. Camp Set Up and Management and 20. Drilling Sites.
  - Discuss fire hazards that may result from vegetation and debris caught under mufflers and catalytic converters of vehicles, etc., in hot dry regions.

2. Emergency response plan (ERP)
   - Post emergency procedures with contact numbers and radio frequencies. Employees must be able to access the information at a centrally located and accessible place at the drill site. Make sure every person can use the communication equipment required to contact base camp and beyond.
   - Indicate the location of fire extinguishers, first aid kits, eyewash stations, communication equipment, MSDSs etc.
   - Review the potential emergencies that may occur at the drill site, including spills, drill related injuries, fires, slips and falls, bears etc.
   - Some drill sites should have their own emergency evacuation plan in place in case they are isolated from camp when an emergency develops.
   - Make sure the first aid kit at the drill site is equipped to address potential injuries that may occur. Refer to sections 20. Drilling Sites and 18.5 First Aid.

3. General topics:
    - Vehicles: Safe driving rules, daily inspection, loads, local hazards, driver fatigue, parking etc., which apply to ATVs and snowmobiles as well.
    - Review of accidents: Past experiences of company and contractor personnel
    - Environment: Oil or chemical spills including the use of correct cleanup and reporting procedures, use of bulldozers, site access trail building
    - First aid: Training, station locations, kit contents and requirements. Confirm that the contents are replenished, up-to-date, and are not expired, dull or worn out.

2.1.3 Alcohol and Drug Policies

In the past, many mineral exploration companies have not been familiar with the definition of a "mine" according to jurisdictional Mines Safety Acts and Regulations. The definition includes "a place, where the ground is mechanically disturbed or an excavation is made to explore for or to produce minerals…" (Source: Northwest Territories Mines Health & Safety Act). Using this definition, all Mine Health and Safety Regulations apply to an exploration site, including those that address the presence and use of alcohol and drugs on a mine site. Refer to: http://www.justice.gov.nt.ca/PDF/ACTS/Mine_Health_Safety.pdf

A mineral exploration company should have a clear and concise policy to address the presence and use of alcohol and illegal drugs at a project work site or camp. In the past there have been "dry" camps and "wet" camps. The PDAC recommends that a drug and alcohol policy should address the following:

- The distribution, possession, consumption or use of alcohol at work sites
- The distribution, possession, consumption or use of illegal drugs at work sites
- Reporting to work or being at work under the influence of any drug or substance that may or will affect the employee's ability to work safely
- The operation of any vehicle, ATV, snowmobile or boat while the driver is under the influence of alcohol or drugs
- The misuse of prescription or non-prescription drugs while at work
- The option for an employee to successfully complete a rehabilitation program and then be allowed to return to work
- How to handle zero tolerance for alcohol while on a work site near a town where alcohol is available and the town is accessible
- Viable options for "dry" versus "wet" camps
- Workers who take a prescription or non-prescription drug for which there may be an unsafe side effect should report this potential to his or her supervisor. In addition, employees who require medication (e.g., insulin, epinephrine) should keep a sufficient supply (perhaps a three-day supply) with them at all times in case an emergency occurs away from the project or camp where their medication supply is kept. It is understood that many jurisdictions have privacy regulations relating to medical matters. It may be advisable for a company to have a lawyer address how this issue should be handled.
- Two documents with models for alcohol and drug policies are available on the following websites:
  https://www.cagc.ca/_files/practices/pdf/upi.pdf

http://www.mhsa.ab.ca/2005canadianmodel.pdf

2.1.4 Job Safety Analyses

A job safety analysis (JSA) is a procedure where observers carry out a safety evaluation of the required actions to perform a specific job with the aim of improving safety for workers. A JSA differs from a risk assessment (see section 2.1.5 Risk Assessments below). The JSA procedures detect hazardous aspects of the job and then the employer undertakes to remove or mitigate the risks and hazards associated with it. The JSA procedure should be performed by experienced employees and/or specialists who are trained in specific job safety analysis techniques. While JSAs may not always be easy to perform, they are an essential part of an effective health and safety program.

Synopsis of the Job Safety Analysis procedure

1. Select or determine a job and use a standard format for JSAs.
2. Evaluate the job by breaking it down into a sequence of steps; there should be no more than ten steps (tasks) in the process. If there are more than ten, divide the job into two separate JSA procedures. The evaluators should be required to have a good working knowledge of the job being analyzed in order to break the job into appropriate tasks.
3. Analyze each task being performed in the correct sequence of steps. Special methods are employed to identify and evaluate the risks and hazards.
    a. The “Change Analysis” method may be used to establish causes of accidents. “What if?” questions are asked to ascertain how various changes affect the outcome of a sequence of actions used to carry out a job. The questions are asked to determine what actions may result in injury to workers and damage to equipment etc.
    b. The “Energy Barrier” method investigates how uncontrolled forms and various sources of energy impact the outcome of a sequence of tasks that may result in injury to workers and damage to equipment etc.
4. Determine preventive measures to reduce risks and hazards associated with the job. This can be done by:
    a. Eliminating the hazard
    b. Controlling or reducing the risks and hazards to employees
    c. Minimizing the risks and hazards by protecting employees with PPE or machine guards etc.
5. Communicate the preventive measures to the employees who will perform the job that has been analyzed. Train the employees in the safer techniques and seek feedback from them to determine whether new hazards have been introduced by the changes.

Consider which jobs should be the subject of a JSA

- Prioritize jobs according to the rate and severity of the accident, injury or illness. The order should be:
    1. Jobs with a high accident, injury and illness incidence and/or severity
    2. Jobs where there is a high potential for severe injuries or illness

3. Jobs where there are signs of (or the potential for) harmful exposure to substances
4. Modified or new jobs
5. Infrequently performed jobs, especially those with complex actions

- Repeat JSAs when a job is changed or when the equipment or a work process is changed.
- Use JSAs to train employees in the safest way to perform a job.
- JSAs can be used for accident or incident investigation.

Preventive measures

Preventive measures to reduce risks and hazards can be carried out without doing a formal JSA. However, without using the formal methodology to analyze a job, some consequences of implementing preventive measures might not be immediately evident (e.g., they may inadvertently create new hazards). While the ideal ways to reduce risks and hazards are listed below, it is always very important to use and wear PPE. Due to the locations and nature of mineral exploration work, it is often impossible to eliminate risks and hazards.

Recommended ways to reduce risks and hazards include the following measures and examples, which are covered in more detail in the next section (2.1.5 Risk Assessments).

1. Eliminate the hazard.
    - Use a different process or use different equipment for the job.
    - Modify the process or the equipment. Modifications to equipment must meet both the manufacturer's and jurisdictional standards.
    - Lock out the energy source to remove the hazard.
2. Replace the hazard with less hazardous alternatives.
    - This approach is recommended when using hazardous materials.
    - Use up-to-date tools and equipment with better safety features.
3. Minimize the risks, depending on the hazard.
    - Train employees in safer work practices.
    - Reduce exposure to the hazard. Examples include:
        - Improve ventilation; block out noise.
        - Use a safer transportation method (e.g., use snowmobiles in winter rather than ATVs).
4. Use administrative controls.
    - Use job rotation (e.g., share core cutting duties to reduce exposure to silica dust and noise).
    - Designate that two employees should lift very heavy core boxes
5. Provide and require the use of appropriate PPE. For example:
    - Almost every job should require the use of safety glasses.
    - Respirators: Do not rely on dusk masks that are not designed for the job.

- Appropriate gloves: Use the right type for the job.
- Appropriate clothing: High visibility vests, coveralls for certain work
- Fall protection, as required

Additional information about JSAs is available on the following website:
http://www.ccohs.ca/oshanswers/hsprograms/job-haz.html

2.1.5 Risk Assessments

Numerous types of risk assessments (also known as risk analyses) are employed by businesses. With regard to occupational health and safety, a risk assessment is the process of identifying hazards and estimating the likelihood or risk that an event (accident, incident) may occur and the potential consequences or severity of the event. The goals of risk assessments are to identify and then manage risks through the elimination or mitigation of hazards. Risk assessments provide a useful evaluation tool to help determine which preventive actions may result in fewer accidents, injuries and property losses. Risk assessments are a part of a good occupational health and safety program and should be carried out before beginning any substantial field work on a new project or when activities change. The risk assessment process should be ongoing, and a company should evaluate the need for additional risk assessments when there is an accident or a change in work environment (e.g., location, equipment, personnel). It may be advisable for a company to hire specialized expertise in risk management if the company lacks experience in the subject or is starting a project in a completely new area.

2.1.5.1 The Risk Assessment Process

The risk assessment process includes the following steps:

1. Risk Identification: A team of people with appropriate expertise who are familiar with the project area should perform the risk assessments by identifying potential hazards and hazardous situations. The team should include participation by the company Joint Health and Safety Committee or a Health and Safety representative, as appropriate. Hazards may be identified through team observations, inspections, analyzing accident and near miss statistics, checklists, job safety analyses, audits, and the use of special techniques etc. Include the risks to new employees, site visitors and the public in the assessments. There are many options available to help employees determine and analyze risks. Two examples are presented in section 2.1.5.2 Methods to Identify Risk Factors with detailed information about using “Fishbone Diagrams” and “Failure Modes Analysis” techniques to analyze the likelihood and severity of an event. A third method, the “5 Whys” is described in section 2.2 Accident and Incident Investigation and Reporting.
2. Analyse the likelihood that a particular hazard will result in harm or loss. Likelihood may involve a specific timeframe or seasonal element depending on the types of hazards under evaluation. Analyse the hazards and work activities under normal and abnormal situations, including emergencies. Analyze those that are related to terrain, weather and transportation, and those that may occur during the day and/or at night. Analysis should consider the frequency of employee exposure, the percentage of employees exposed to the hazard, the seriousness the potential injury, as well as the probability of occurrence. The following table shows the “likelihood” of an event and a criteria description of the frequency of an event.

Table 1 Likelihood Categories

Likelihood	Criteria Descriptions
Almost Certain	Almost certain to occur within a defined timeframe
Likely	Likely to occur within a defined timeframe
Possible	Possible to occur within a defined timeframe
Unlikely	Unlikely to occur within a defined timeframe
Very Unlikely	Very unlikely to occur within a defined timeframe

3. Determine the level of severity or impact**.** The table below is a typical severity index that can be used for health and safety. Sometimes the severity or consequences are defined using different terminology depending on the site and the types of hazards. The severity categories usually include a monetary value that may reflect jurisdictional or company specifications.

It is important to remember that severity or impact usually emphasises personal injury, and perhaps property damage. However, there are additional factors that may be taken into account – two examples are reputational loss and project delay. Also, when considering potential injury or property loss, assessment should take into account the general public as well as individuals and equipment at the site.

Table 2 Severity Categories

Severity	Criteria Descriptions
Low	No injuries; no property loss
Minor	Minor cuts, abrasions, bruises that may require first aid; minor property damage
Moderate	Injuries requiring medical treatment; moderate property damage
Major	Serious injuries e.g., broken bones, amputation, permanent disability; major and extensive property damage
Critical	Fatality; highest level of property damage

Risk Assessment Classifications: Form a risk matrix with “likelihood” on one axis and “severity” on the second axis. Once a simple matrix is designed, one can assign risk values to individual events, which are the potential accidents due to the identified hazards, hazardous situations, occupational illnesses etc. When risk values are assigned make sure they include all current controls that are in place at the time of evaluation. The resulting risk values will help responsible parties to prioritize the risks and then address and control the most severe ones and the events most likely to occur. It may be advisable to hire risk management specialists to help with this procedure.

Table 3 Risk Assessment Classifications

Likelihood	Consequence Severity				
	Low	**Minor**	**Moderate**	**Major**	**Critical**
Almost Certain	Moderate	Moderately High	High	Very High	Very High
Likely	Moderate	Moderate	Moderately High	High	Very High
Possible	Low	Moderate	Moderately High	High	High
Unlikely	Low	Low	Moderate	Moderately High	Moderately High
Very Unlikely	Low	Low	Low	Moderate	Moderately High

4. Develop an action plan or strategy to manage the risks in order of priority. Risk assessments are useless if no action plan is forthcoming from the exercise. There are three critical elements to an action plan:

    - That a clear action is identified to prevent or mitigate the incident risk being considered
    - That someone is identified as responsible for implementing the action plan
    - That a review or audit is completed to make sure that the action plan has been implemented, and then subsequently that it is effective.

    Identify and analyze options to eliminate, control, or mitigate risks and hazards. Set goals and objectives. Determine what level of risk is acceptable, what level is unacceptable, and what level is acceptable *if* the risks are mitigated through changing the consequences or the likelihood that a consequence will occur. Assign time lines to follow for managing the risks.

    - Events that fall in the **very high risk** category of the matrix should be addressed and/or controlled immediately. If risks cannot be controlled, a company should consider stopping the work or activity until the risks can be addressed.
    - Events that fall in the **high risk** category should be considered urgent and addressed within a short time frame.
    - Events that fall in the **moderate risk** category should require correction within a set number of days.
    - Events that fall in the **low risk** category may be corrected when possible and some toleration may be acceptable if there is ongoing monitoring.
    - What is considered a “tolerable risk” will vary between companies. The cost resulting from an accident may impact the budget of a small company more severely than a large company that has more funds available. An “it won’t happen to us” attitude can be financially disastrous, especially for a small company.

- Reassessing risks: When an event falls into a high and very high risk category and mitigating measures are applied to bring it to a lower ranking, it is important to re-rank the risk after a short time to determine if the new controls are effective. If they are not sufficiently effective, additional controls or mitigation will be required to lower the risk to an acceptable level.

Hazard Controls: General OHS risk management strategies identify the following order as the ideal priority for controlling risks and hazards. This sequential approach is accepted practice in the manufacturing and construction industries, but it is harder to implement in the mineral exploration industry where there are many uncontrolled hazards (e.g., terrain, weather) and when work depends on transportation in remote locations. Exploration companies have a tendency to rely on PPE, which is the last of the preferred approaches. Whenever possible, companies should try to reduce employee exposure to hazards by using approaches one through three – as well as PPE. The ideal order for hazard control is:

a) Eliminate the hazard: Try to remove a hazard or substitute a less hazardous product or system. As mineral exploration is done out-of-doors, physical hazards can rarely be removed although some hazardous systems or procedures can be eliminated. Examples include:
    - Locate a camp close to the work area to eliminate transportation risks (e.g., crossing a water body or driving a hazardous route to the work site).
    - Locate the camp at a lower altitude than the work site. The “work high and sleep low” concept is a good method to reduce the risk of altitude illness.
    - Eliminate the use of hydrofluoric acid by replacing it with a different method of measuring the angle of the hole during drilling (e.g., use single shot or multi-shot cameras, or magnetic and non-magnetic digital downhole survey techniques).
    - Where malaria and dengue fever are a risk, make a determined effort to eliminate the immediate breeding areas for mosquitoes by removing all standing water that accumulates in objects, ditches, tire ruts etc., at the site.
b) Engineering controls may be made to redesign a machine or process if they meet the manufacturer’s or jurisdictional standards. In addition, engineering controls may be applied to isolate machinery with an aim to diminish noise or redirect particulate matter or exhaust. Examples include installing noise barriers and extraction fans to remove airborne dust when cutting rocks. Sometimes the layout of a workshop can be modified by reorganization or placing approved guards to reduce risks to the operator or those who pass through the area.
c) Administrative controls may be developed and implemented to reduce exposure to hazards and risks. Good examples include developing site specific SOPs, shift management to reduce the employee exposure time, training, and working with the “buddy system”.
d) Personal protective equipment: Use appropriately designed and properly fitting PPE to reduce exposure to hazards when other controls are not possible or practical. While it is important to try to use the previous approaches, PPE is a very important barrier between the employee and uncontrollable risks in the field. Examples include wearing a lifejacket when working on water, wearing a helmet, eye protection and appropriate clothing when riding an ATV, and wearing the

correct type or respiratory protection. Refer to section 4. Personal Safety for extensive information regarding PPE.

5. Communications and continuous improvement: Companies should communicate action plans, safety policies, goals, and the results of risk assessments and JSAs to employees as a part of their OHS program. These efforts should be ongoing and supported with safety meetings. In addition, continuous improvement can be accomplished by performing additional risk assessments after tracking and addressing accidents and near miss situations and by adopting new safety procedures based on updated accident statistics.
6. Monitoring and Evaluation
    - Risk assessment should be an ongoing process and new risk assessments should be initiated when there is a change in location, a change in equipment use, a change in personnel, or when there are accidents or near misses that indicate a breakdown in the methods of hazard control.
    - Even though risks fall into a tolerable category, the risks require ongoing management and monitoring to make certain they remain in that category.
    - Monitor employee behaviour, accidents and near misses to see if the corrective and mitigating actions are effective. Determine if new risks arise due to changes in procedures.
    - Keep records of the risk analyses, job hazard analyses and the actions taken to address the risks and hazards.

Additional information regarding terminology, risk assessment and hazard control is available on the following websites:

http://www.ccohs.ca/oshanswers/hsprograms/risk_assessment.html
http://www.ccohs.ca/oshanswers/hsprograms/hazard_risk.html
http://www.ccohs.ca/oshanswers/hsprograms/hazard_control.html
http://www.ccohs.ca/oshanswers/hsprograms/sample_risk.html
http://www.ccohs.ca/oshanswers/prevention/
http://www.tbs-sct.gc.ca/pubs_pol/dcgpubs/riskmanagement/guide10-eng.asp
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/87365/MinInd-Safety-Handbook-part-1.pdf

2.1.5.2 Methods to Identify Risk Factors

Risk factors that may result in incidents may be identified by review of past data. Some sources include the PDAC-AME BC sponsored *Canadian Mineral Exploration Health and Safety Annual Report* surveys, statistics available from local Workers' Compensation Boards, or by consideration of the job at hand. It is very effective to use brain-storming methods with the people involved in the work to identify and assess risk factors. In order for this to be effective, one individual needs to be the facilitator (from either inside or outside the company) for the discussion and assist the group in reaching conclusions. This type of activity should be completed prior to the start of a field program, but may also be utilized during the field program, especially in the event of an incident at a project or a change in type of field activity.

Risk Analysis and Field Safety – Some Tools for the Project Manager

Many tools are available to help identify relevant risks, including those used by specialists. It is not the intention of this section to provide a comprehensive risk analysis methodology but to present two examples of simple tools for field project managers or small teams of individuals to

assess the risks that require addressing prior to the commencement of a field project. In addition, the same tools may be used during a field program to increase team building and to encourage communication within a field program. They can also be used after an incident to address the issues that contributed to an accident or near miss.

Fishbone Diagrams

A useful tool for initial "brainstorming" on health and safety is the Fishbone diagram, also known as the Cause and Effect diagram or an Ishikawa diagram. Brainstorming, which generates a lot of ideas quickly, is a team tool and is effective because many persons' knowledge and ideas are always more effective than those of an individual. The principles of brainstorming are:

- Give everyone a turn to speak.
- At the first stages, listen and respect other's ideas = all ideas are good ideas.
- Focus on the issue at hand.

In cases where there are problems creating an equal opportunity to speak due to hierarchies present in the team, one method that has been successfully applied is to provide all participants with a number of "post-it" notes and let them write anonymously and post their comments onto a board. These are then sorted into topics by the team leader or facilitator.

The fishbone diagram has as its focus – the problem faced – which may be simply incidents at a project, or could be a specific type of incident. Then for the main cause, there is a classification of the types of causes, which may be, for example, "People" "Machines" "Location" etc. Then individual causes are listed on the first branch. It is useful to go into depth on each cause – some experts suggest that the question "why" should be asked a minimum of three times on each cause. For example, under the Main Category "People" there may be a cause "Lack of Training", and the subsequent questions would be:

1. Why is there lack of training? – answer because of insufficient funding.
2. Why is there insufficient funding? – answer because health and safety was not considered in the budget.
3. Why is health and safety not considered in the budget? – answer because management does not have a commitment to health and safety and the company has no health and safety principles.

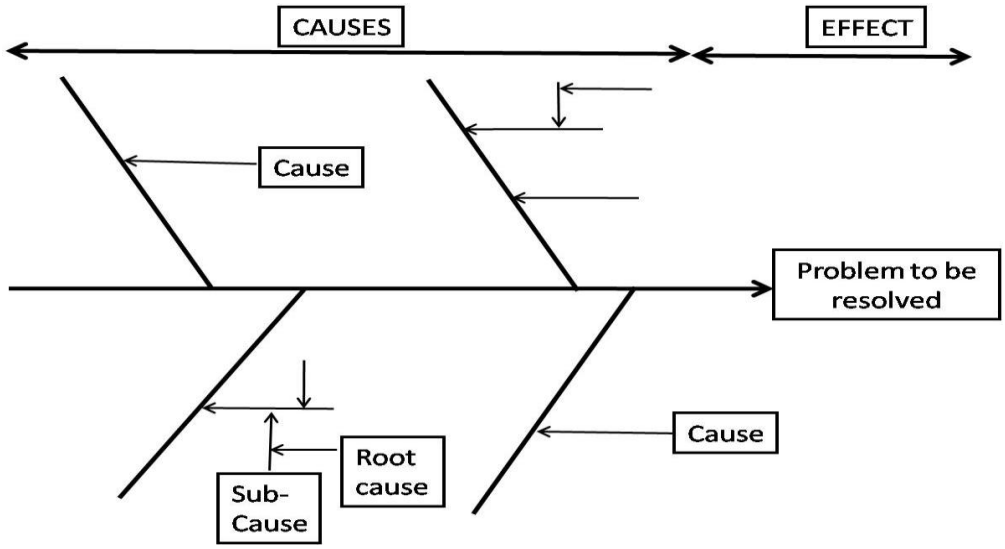

Figure 2.1: Fishbone diagram

When the third question is asked and answered, the team is getting closer to what is considered the root cause of the issue. The program will be more successful if root causes are addressed.

It is useful at this point to then classify the causes as to “controllable” and “uncontrollable”. For example, weather may be considered uncontrollable whereas wearing helmets when riding an ATV is controllable. You cannot change the weather, however you can prepare for it.

When reviewing the results of a fishbone exercise, it is useful to observe when common root causes occur. These can indicate where fundamental changes are needed in practice as the same issue is leading to multiple risks.

Fishbone diagrams are very effective methods of bringing multiple causes of a problem out into the open; however they are not very helpful for ranking risks.

Examples of Fishbone Diagrams for Specific Problems

The following diagram is an example of a fishbone diagram for a particular potential incident, in this case relating to health in a field project.

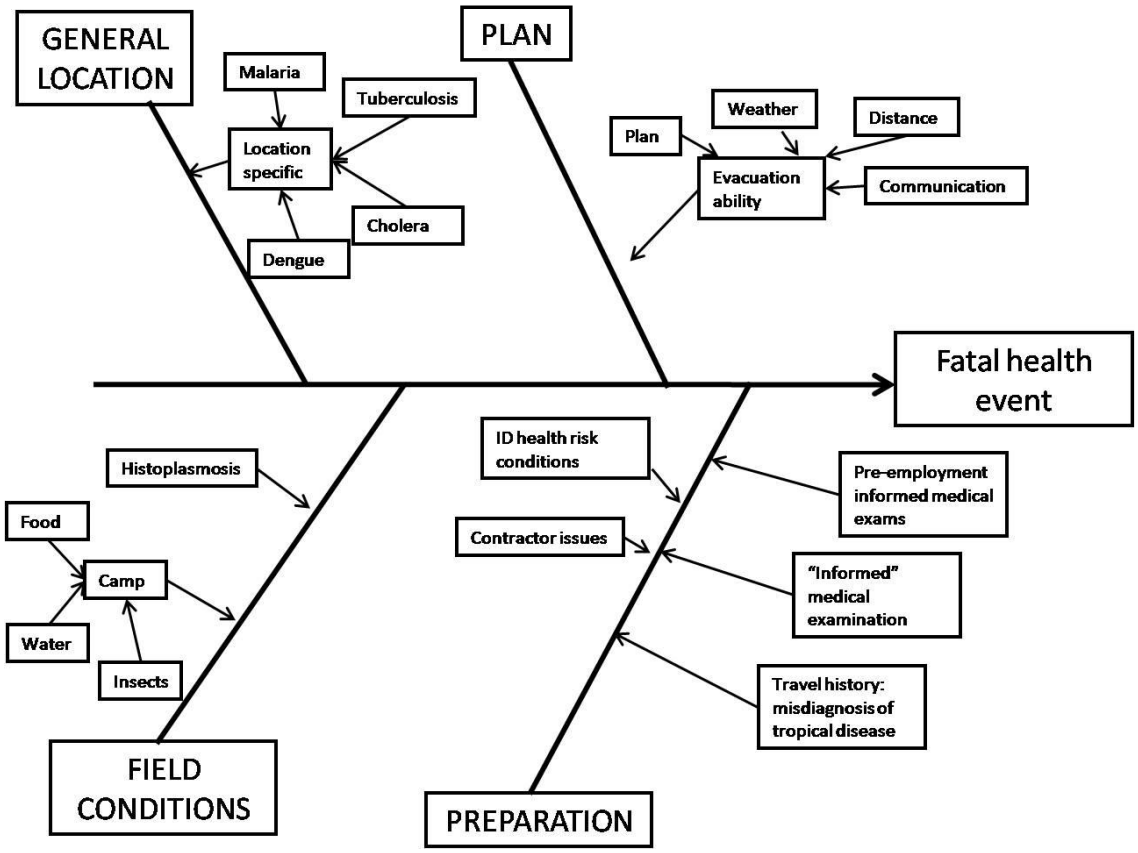

Figure 2.2: Fishbone diagram for specific problems

Another example is given below for risk of a fatal accident while drilling.

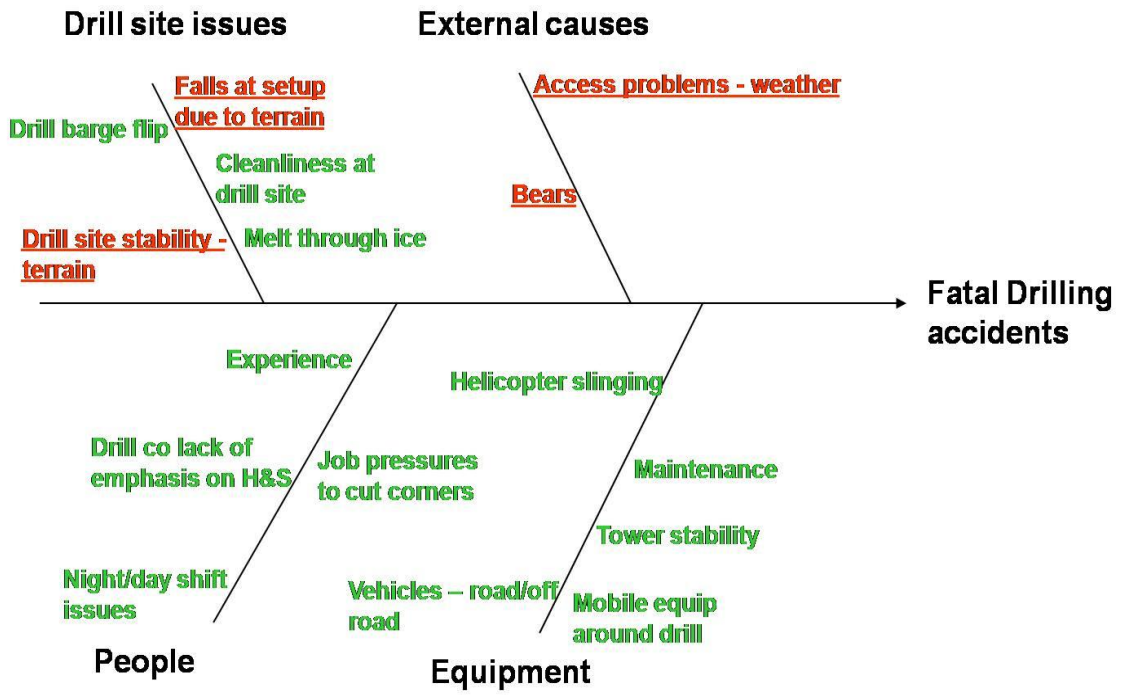

Figure 2.3: Fishbone diagram for risk of a fatal accident while drilling

In this diagram, those causes given in red and underlined were considered uncontrollable in the view of the team which generated the diagram.

These examples should be taken as just that, examples, and teams and field crews should generate their own fishbone diagrams starting from a blank sheet.

All of these brainstorming methods, although fast ways to obtain results, do have pitfalls. First of all, they are based on experience not on facts. Secondly, it is critical to have a diverse team present; otherwise the exercise can be dominated by “group think”.

Procedure for Fishbone Diagram

- Step 1. Define the problem statement – for example, “helicopter slinging incidents at drill site”.
    - The problem statement must be specific defining what, when, where does the problem (effect) occur.
- Step 2. Have the team brainstorm possible causes.
    - Flipchart or whiteboard may be used for this.
- Step 3. Review potential causes and attach to appropriate categories, for example:
    - Location
    - Machine, Materials, Measurement, Method, Man/Woman, Environment

- Weather
- Policies, Procedures, People, Plant, Measurement, Environment
- Or other category that will help people think creatively

- Step 4. During the review of each cause ask, "Why does this happen?"
  - Add as small branches off the main bone.
  - Up to three levels may be used.
  - Attempt to categorize into controllable and uncontrollable causes.
- Step 5. Analyze results, do any causes repeat?
- Step 6. Prioritize the potential causes.
- Step 7. Determine which causes you need to verify with data. Be careful not to overlook causes that should be reviewed with data.

Failure Modes Analysis

As introduced above, when addressing risks and considering whether they are important or not, usually two factors are considered – likelihood and severity. However, more thorough risk analysis would add an additional factor – "Detection" as requiring to be addressed:

1. Severity: What are the consequences of the event? Clearly a fatality is more serious than a minor finger cut. This is a method of ranking possible accidents as to their seriousness.
2. Likelihood or Probability of Occurrence: How likely is the event to happen? Is it likely to happen once every day, or every ten years? This may initially appear difficult to assess but perhaps historic data is available within a company, in the experience of the people involved in the ranking exercise, or in industry surveys, such as the PDAC-AME BC *Canadian Mineral Exploration Health and Safety Annual Report* surveys.
3. Detection: How well can the event be recognised and acted upon before it happens? If the causes are already apparent long before the actual event, then clearly this is a less risky situation than where it is only apparent after the event.

It should be apparent that the worst risks to contemplate are those that can cause a fatality, have a reasonable probability to happen in the field program and are not recognisable ahead of time. In fact, in any scoring exercise, any accident that could cause a fatality or very serious injury should rank very high irrespective of its ranking on probability and prior recognition.

There are many sophisticated brainstorming tools for specialists to use for assessing risk. One tool is presented here that may be useful for team leaders or project managers to utilize in assessing risks. The table below is adapted from more sophisticated Failure Modes and Effects Analysis (FMEA).

Table 4: Example of a Failure Modes Analysis table

Action	What can go wrong?	Potential effect	SEV	Potential cause	PROB	Present controls	DET	OVERALL SCORE (RPN)
What activity is the event associated with	What is the actual event	How bad could the effect of the event be		What is the likely cause. If an event has multiple likely causes then additional lines are used.		What present controls are there to prevent or foresee the incident		
Travel	ATV crash	Serious injury	7	Reckless driving	8	Management supervision	7	392
Travel	Helicopter crash	Multiple fatalities	9	Mechanical failure	3	None (trust in helicopter company)	9	243
Travel	Helicopter crash	Multiple fatalities	9	Poor weather	3	Weather reports from base	3	81

Notes:

SEV = ranking of severity from 1 to 9 where 9 is high.
PROB = ranking of probability of occurrence from 1 to 9 where 9 is high probability of occurrence.
DET = ranking of detection from 1 to 9 where 9 is high probability that the event would be undetected until after it happened.
OVERALL SCORE = SEV*PROB*DET

Such a table may be easily set up in a computer spreadsheet.

The objective would be to list as many possible accidents and causes, not in any particular order and rank them. Then the table would be sorted on the overall score and focus would fall onto those with the highest overall score. A fishbone diagram could then be created for the top few accident categories with the greatest impact. Note that there may be a decision to also address all those where SEV=9 as no number of accidents which may result in fatality will be tolerated.

The column on “Present Controls” refers to what systems are already in place that should either prevent or detect the incident. These could be for example, training courses, protocols, standard operating procedures, audits, or actual mechanical or other devices (“fool proofing”) to prevent the incident. The team then assesses how well the system is likely to detect the event before it happens, enabling prevention, or how well the system can mitigate the effect after the fact if the event is unpreventable.

At the initial stages it is not worthwhile spending excessive time on details of the numerical severity, probability or detection rankings as the objective is to sort out the potential accidents as quickly as possible and eliminate those that are extremely unlikely to occur or that would cause very minor injuries and focus on the top few.

Whether action is required on potential incident categories can be considered two main ways – first of all by reviewing the actual total score, and secondly reviewing where the potential incident individual scores are high. For example, a company or team may decide that all of the following cases require action irrespective of the overall score:

- Any potential incident that may lead to a fatality (SEV = 9 in 9 point scale)
- Any potential incident that has high probability (PROB = 9 or close to 9 in 9 point scale)

Some cases may not require attention such as those that score “1” in all categories.

Procedure for Failure Modes and Effects Analysis (FMEA)

- Step 1. For each activity, determine the ways in which something may go wrong or an incident may happen (these are Failure Modes).
- Step 2. For each Failure Mode associated with the outputs, determine the Effects – what kind of negative impact may occur.
- Step 3. Identify potential Causes for each Failure Mode.
- Step 4. List the Current Controls for each Cause.
- Step 5. Assign Severity, Probability (sometimes referred to as Occurrence or OCC) and Detection ratings to each Cause between 1 and 9 where 1 is lower impact and 9 is higher impact.
- Step 6. Calculate RPN (Risk Priority Number = total score)
- Step 7. Determine Recommended Actions to reduce High RPNs
- Step 8. Take appropriate Actions and Document
- Step 9. Recalculate RPNs after X amount of time where X is an assessment to be made on an appropriate basis

2.2 Accident and Incident Investigation and Reporting

Companies should clearly define the meaning of the words “accident”, “incident” and “near miss”. See the introduction of this section for the definitions of these terms as used in these Guidelines. Risk analysis is a procedure to investigate possible negative events prior to work commencing and before any accidents/incidents happen, whereas accident and incident investigation is an exercise to be conducted after an accident/incident has happened. That said, some of the same tools may be useful in both exercises – for example the Cause and Effect/Fishbone/Ishikawa diagram.

Accident and incident reporting

Depending on jurisdictional regulations, all serious accidents, fatalities, major structural failures, major releases of hazardous substances and any event so required by regulations must be reported to the appropriate jurisdictional authorities within a prescribed time, which is usually 24 hours. All work related accidents, injuries and diseases should be reported to the appropriate supervisor and to the first aid attendant immediately after the occurrence. An investigation should aim to find out the what? when? how? who? why? the accident or incident occurred and then make recommendations to prevent future events of the same type. The results of any accident or incident investigation should be made known to all personnel on the project site.

Investigators should ideally be from all levels within the company (management, supervisory, worker) and if the project site has a joint health and safety committee, investigating accidents is a part of their mandate. Good accident investigation requires training in accident causation and investigating techniques; Workers’ Compensation Boards usually offer instructional classes. Investigators should be careful in their approach and remember the following points.

- Seek all the facts. Witnesses and others will have different perspectives so interviews are important to gain all the facts. Witnesses may remember only what they think is important and some may only remember what they think the investigator wants to hear.

- Do not prejudge the causes of the accident. Gather all the facts before deciding on the causes. Jumping to conclusions can affect the conclusions and influence the questions the investigators ask.
- Recognize that there are usually several causes of an accident. Be open-minded and look for root causes; don't focus on immediate causes or look for a scapegoat.
    - Root Cause Analysis (RCA): Root causes are the fundamental contributing factors that underlie the obvious reason for an accident (or incident). Root cause analysis uses systematic methods that focus on finding the underlying cause(s). Techniques that dig down to root causes include the "5 Whys", Ishikawa (Cause and Effect/Fishbone) diagrams, Failure Modes and Effects Analysis, and other methods. RCA can be used both after an event for investigation and proactively to predict potential events (risk assessments). By addressing the root cause of an accident, it is more likely that the fundamental cause will be identified. When root causes are mitigated, the likelihood or risk of repeating an accident is reduced.
    - The "5 Whys": This problem solving technique is good for trouble shooting and avoiding assumptions during accident investigations. When using the technique, the team should describe the accident and ask "why" it occurred. Then, ask "why" regarding that answer and continue repeating the "why" questioning process to each answer five times (more or less). By using multiple "why" levels of questioning, one is likely to arrive at a root cause of the accident. (Depending on the time available and the seriousness of the issue, it could be the "3 WHYs" or "5 WHYs").
    - Ishikawa/Cause and Effect/Fishbone diagrams and Failure Modes and Effects Analysis are other RCA techniques (see the previous section 2.1.5 Risk Assessments).
- Monitor, investigate and report on accidents and incidents in a manner that encourages continuous learning and promotes improved health and safety performance.
- Accident investigations should begin as soon as possible. Credible accident investigation requires that a sequence of steps is followed.

2.2.1 Securing the Site

Determine if the site is safe to enter. If there are injuries, administer first aid if it is possible to do so without endangering others. The first consideration is to prevent further injuries or damage. Consider restricting access to the site until emergency or rescue crews are finished. To secure the site, consider the following possibilities and be sure the surroundings are safe:

- Mitigate hazards (electrical, mechanical, chemical, fire hazards) to prevent further occurrences (injury and/or damage).
- Keep mobile equipment, vehicles and pedestrians away.
- Preserve evidence by restricting access to the site once victims are removed. If a fatality has occurred, notify appropriate authorities, restrict access and remove the victim according to the jurisdictional regulations.
- Collect names of witnesses and others who have knowledge of the accident or situation.

2.2.2 Observations

Make observations and collect clues to the causes of the accident. There are various strategies to use when looking for information.

- Physical searching for evidence may be done by grid, by zone, or in strips or spiral search patterns.
- Note the location of evidence. Look at what items are in place and what is out of place. Look up as well as at the ground and at work level to note hazards that might have contributed to the event.
- Note indications of movement and/or items out of place. Note marks on or made by vehicles etc., such as skid marks or indications that some things are misplaced. Note tracks or footprints on surfaces. Note the absence of marks indicating removal – dusty outlines, clean or dirty outlines. Look for broken, frayed and snagged items.
- Note if physical evidence is normal or abnormal in appearance, which might indicate reasons the accident occurred.
- Follow logical sequences of events and processes to determine possible causes. Use root cause analysis as described above.

2.2.3 Documentation

- Make clear detailed notes. Record detailed descriptions of the scene, the location of each piece of evidence and what is done with it. If outside authorities are a part of an investigation, share the notes and aid their efforts.
- Photographs: It is preferable to use a camera that requires colour film. Digital photos may not be allowed as evidence in a court of law as they can be “shopped”. It is advisable to keep disposable cameras on a project site to use for documenting accident investigations. Record who takes photos, in what order, the direction the photo is taken and the date and time. Take both close-up and distance shots. Video cameras may be used as well.
- Sketches: Use drawings to indicate locations of major objects, dimensions and views from various angles. Measure the placement of items and evidence accurately. If drawing a map, be sure to indicate which direction is north.

2.2.4 Interviews

Accident investigators should be trained to conduct good interviews and handle witnesses.

- List the people to interview: witnesses, anyone directly or indirectly involved, anyone in the area who could shed light on what happened, and first aid/ambulance attendants, fire or police personnel.
- Keep witnesses separated from each other until after their interviews; they should not compare ideas.
- Conduct interviews as soon after the accident as possible so people do not forget facts.
- The interviewer should be calm and relaxed; ask questions aimed to clarify what happened and cannot be answered with a “yes” or “no” answer.

- Before completing an interview with a witness, the interviewer should summarize the facts to be sure the information in the notes is correct.
- Take careful and thorough notes.

2.2.5 Analysis

- Review the documentation. This includes but is not limited to:
  - Witness reports, photos, sketches and notes
  - Company documents such as permits, SOPs, employee job training records and certifications
  - Inspection and maintenance records
  - Previous or similar accidents and incidents in the same location
- Analyze the information.
- Be certain about the facts and list them in chronological order.
- Evaluate witness testimony.
- Consider the importance of the “lack of information” regarding any aspect of the accident.
- Compare witness accounts with the physical evidence.
- Assess the information in relation to (1) environment, (2) equipment, (3) procedures, (4) supervision, and (5) workers.
- Assess possible contributing factors such as weather, temperature, lighting, noise, housekeeping, footing, and stability of structures.
- Use investigative methods to determine the causes.
- Use root cause analysis (RCA) to look for the root cause of an accident or incident.

2.2.6 Recommendations

Submit written recommendations in the accident or incident investigation report.

- Determine what was learned and what corrective actions (immediate and long term) can be made.
- Eliminate or control hazards that were revealed from the investigation.
- Retrain employees. Train employees in new procedures as needed.
- Evaluate the outcome of the recommendations after a period of time.

2.3 Resources

The Prospectors & Developers Association of Canada (PDAC) thanks the following for granting permission to include material from their publications.

Association for Mineral Exploration British Columbia (AME BC)

Their permission does not imply that they endorse the PDAC Health and Safety Guidelines. The PDAC is solely responsible for the content of these Health and Safety Guidelines.

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