Hse Risk Assessment in Seismic Data Acquisition Activities: Threat and Mitigation*

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ABSTRACT

The purpose of this paper is to emphasize the need for implementing the HSE rules and regulations in seismic operations and assessing the risk and threat to health, safety and environment and its mitigation. The HSE aspects are different for seismic operations in different areas like desert, cultivation and mountains.

The occupational health and safety risk assessment includes identification and classification of the threats like storage, handling, transportation and loading of seismic explosive or bulk storage of fuel or working in hot and environmentally protected areas, along with mitigation procedures and acceptability level.

Safety relates to the conditions at the workplace and applies to the track down of a state where the risk of harm has been eliminated or reduced to an acceptable level. In seismic operations the major safety issue is related to off track transportation in the field.

Health relates to the physical condition of both body and mind, of all people at the workplace and their protection from harm in the form of injury or disease. Major threats in this regard are the hot weather, malaria and drinking water.

Environment can be seen as comprising two types: “The work place environment”, which relates to the general well being of workers at the workplace and the promotion of conditions which help to provide for their need of assigned job, health, comfort, social and personal wellbeing. Second type “The external environment”, which relates to pollution if, or damage to the air, land, water and living creatures outside of the workplace.

Implementation of HSE has benefits for both; the employees from the point of view of work in the safe and hygienic conditions, and the employers from the point of view of creating the proper and normal work environment.

INTRODUCTION

Modern seismic industry has triggered a high demand of manpower for the field and office environments. Working with latest technology on one side increased production whereas on the other side has increased the work load and exposed the worker to different risks and threats to life, health and environment. This gave a realization for the need to educate staff about importance of health, safety and environment at work place.

Human behavior has a direct influence on health, Safety and Environment in many aspects of life – at work, in the home, on the road, in the air and at

sea. Research has confirmed that most accidents are attributable to human failure (unsafe acts). Even when a process is automated, people are still needed to design, control, and maintain the system. The term human factors is used to cover a range of issues. They include the perceptual, mental and physical capabilities of people and the interactions of individuals with their job and working environments.

An immense amount(or quantity) of literature has been published on various aspects of health and safety, and this paper benefited from some of such works, for [1], [2] & [3]. The common HSE definitions used during risk assessments of seismic data acquisition operations are

- Health concerns a *state of well being*, so involves aspects of the work activity that have direct effects upon employees, and concerns the absence of illness or disease.
- Safety concerns the *absence of danger from physical harm*, so involves aspects of the work activity concerned with preventing accidental injury or death.
- Environmental Protection concerns *measures designed to prevent harm* to the environment around us, and is aimed at reducing pollution and protecting the environment from work activities.
- Welfare concerns *facilities for workplace comfort* and involves issues that impact upon the basic well-being of the employee.
- Workplace risk assessment can be done through JSA (*job safety analysis*) and TRA (*task risk assessment*)
- An accident is defined as an unplanned, uncontrolled event which has, or could have in slightly different circumstances, led to injury, damage or some other loss.
- A near miss (or incident) is an accident that results in no apparent loss. So it is an unplanned, uncontrolled event that has not led to injury, damage or some other loss, but could have in slightly different circumstances.
- Work-related ill-health (physiological and psychological) concerns people who are made ill by their work
- Hazard is something with the potential to cause harm. The harm will vary in severity –some hazards may cause death, some serious illness or disability, others only cuts and bruises
- Risk is a combination of the probability (likelihood) of that harm actually occurring, and the severity of the consequences.

The risks are ranked: Low, Medium or High. This ranking is assessed qualitatively using the criteria shown in Table-1

PRINCIPLE AND OBJECTIVES OF RISK ASSESSMENT

A suitable and sufficient risk assessment needs to identify all those that are potentially at risk and how. When considering who is at risk, it is important to all those who may be affected by the activity being assessed, not just those directly involved. Therefore the assessment would need to consider;

- Employees
- Contractors,
- Visitors
- General public

- Plantation and Wild life

The sources and forms of harm are broadly - people, equipment, materials and environment;

- People: commit unsafe acts, are infectious or violent
- Equipment: Plant, machinery and tools have four broad categories of hazard associated with them – mechanical, chemical, electrical and physical.
- Materials: can cause harm because they might hazardous to health, combustible, heavy, and cause slips and trips.
- Environment: the environment can cause harm due to poor lighting, extreme temperatures, enclosed workspace or work at height.

Risk assessment is not only concerned with injuries in the workplace but also possible occupational health problems. Health hazards fall into four categories;
Chemical: paints, solvents, fumes
Biological: bacteria e.g. leptospirosis, viruses
Physical: noise, vibration, radiation
Psychological: occupational stress

Before commencement of seismic activities environmental studies are planned if exploration activity falls in environmental protected areas as declared by local government and international environmental agencies. Normally an environment impact assessment study (EIA) takes five to six months to get NOC from the local environmental agencies, after that a project initiate report (PIR) needs to be submitted, two weeks prior to start seismic activities in the area. The environment assessments recommended before commencement of work in the sensitive areas as shown in Fig.1, are the followings

- Environment Impact Assessment (EIA): all projects situated in environmentally sensitive area (Wildlife Sanctuary, Game reserve)
- Initial Environment Examination (IEE): All projects situated in less sensitive areas or non protected areas

These assessments identify the potential impacts arising from each phase of the proposed exploratory activities.

These include effects of the proposed exploratory activities on the physical, biological, socio-economic, archaeological and cultural environments of the area. A public hearing and independent monitoring is exercised to defend the EIA in front of primary and secondary stakeholders while for IEE both are not required.

The outcome of a risk assessment should be an inventory of actions, in priority order, to devise, maintain or improve controls. The action plan should be reviewed before implementation. It is therefore essential that a mechanism for prioritization is considered. Any action plan must be SMART;

- Specific

- Measurable
- Achievable
- Realistic
- Timely

The general control hierarchy is to Eliminate or reduce the hazard, Isolate the hazardous location, define Controls measures, provide Personnel protective Equipment (PPE) and enforcement of the rules, disciplinary procedures, safety signs.

RISK ASSESSMENT OF LAND SEISMIC CREW

The seismic activities are full of hazards and risks, so before the commencement of the project a risk assessment is made to assess the hazards of the area. Management and Independent monitoring consultant (IMC) from environmental agencies identified the hazards and occupational risk related to health, safety and environment, as well as to point out the preventive and corrective actions in the range of safety and hygiene of work.

Also hazards are reported by using STOP cards and logged in hazard tracking registers. All the corrective and necessary actions are discussed and implemented to eliminate these hazards. All the hazards, which were reported in daily HSE reports, are discussed and finalize the action plan. The target dates are set to close the action items and reviewed on daily basis. Health and safety is paramount to seismic data acquisition operations. Below are the few common hazards during any seismic data acquisition activity. (Table 2– Example of Risk Assessment for Seismic activity).

Fire: Seismic base camp has higher risk areas of fire. Electrical fires pose a threat to employees in that they may induce electrical shock, cause destruction of property and smoke inhalation. Gas is used in various types of equipment on a seismic crew. Gas fires can be ignited from many sources which pose a risk to employees working in close proximity. The storage of used oils in workshops and staging areas poses a risk of fire if not handled and stored properly. Oil fires are typically caused by welding, cigarettes or sparks from workshop areas. Untidy work areas also pose threats of all kind of fires. This can cause environmental and equipment damage. A pre-audit of facility must be done before employees arrive. Regular audits of electric, gas and oil storage areas, mechanical areas, adequate signage, follow storage and electric procedures, guidelines for cleanliness of workshop area.

Noise: Generators in seismic camp required for electricity might produce noise levels above 85db and require proper safety equipment to be worn, if personnel protective equipment (PPE) is not worn this may have an effect on hearing. Proper signage and PPE must be in place. Generator area must be isolated from rest of the camp area and only authorized persons (or people) allowed to enter in the area.

Manual handling: could be one of the most common risks on seismic crew. Employees may try to lift heavy or awkward objects or equipment by themselves - resulting in an injury. Induction training uses the buddysystem and wait for additional assistance before lifting a heavy or awkward object. Team lifts should be used when lifting any object over 75lbs. It is recommended to assess the load prior to commencing task, and manual handling training to all employees.

Driving: is as always the number one hazard. Specific training is to be given to all relevant drivers with regards to sand and subkha driving and constant monitoring and disciplinary action taken if required as per company policy. There is a potential for contact to occur between vehicles and pedestrians or local vehicle, in urban and/or populated areas. This could result in injuries or even death to people and damage to assets and company reputation. Limit speed in urban or populated areas. Always notify the local population about the increased volume of traffic in the area, and posting of signs reminding both drivers and pedestrians of the risk of contact.

Weather: The dramatic daily temperature climb also becomes a risk. The exposure to low or high temperatures may cause body temperature to minimize or maximize to critical levels. Workers exposed to cold or hot environments are at constant risk. All employees need to be educated about the importance of regular fluid intake. Iso-static drinks can be provided to prevent dehydration. Safety meetings, regular rest breaks, provide proper PPE. Use buddy system.

Local community: Safety for both the public and employees is of major concern. With respect to minimizing injuries and security issues, the utmost of care must be taken when planning the site-specific training program for all staff, highlighting the risks associated with working so close to town. Security issues for base and fly camps need to be investigated. Children will be all around the area and it is anticipated that there will be a high interest in the vibrators when they pass through residential areas, so additional supervision and precautions are required to operate in populated areas.

Seismic explosive: operation, selection and use of main storage magazine is very important, inspect the location. Improve substandard conditions (cut grass, improve fencing, place posters as per company procedures, Local Government standards, and approved by exploration company and environment consultant). Always place guards for security. The magazine is to have 2-tamper proof locks, the key to one with the guard and the other with the Party Manager or his delegate.

Security: Personnel security is a major area of concern and has been extensively covered in senior staff meetings and junior staff toolbox meetings. Essentially, everyone has to be extremely vigilant and aware of the surroundings, vehicles must not to travel alone and also every possible attempt is to be made as to not annoy in any way the local populace.

Health: related hazard could be drinking water. It is recommended to test the drinking water for the physical properties and microbial factors in the incubator. In desert or environmentally protected areas, workers can encounter various species of snakes throughout their daily activities. This poses a serious threat of snake bite. This has potential for a serious injury or fatality. Induction, training, importance of PPE must discuss in safety meetings

Chemicals: Employees may be exposed to hazardous chemicals or substances during work activities. This poses a threat to all personnel working with these products. Activate emergency response plan (ERP) if personal injury occurs. Ensure eye wash stations and first aid kits are properly placed throughout appropriate areas. All authorized persons have required induction of chemical handling. Proper PPE will be worn at all times and adequate signage around hazardous areas.

CONCLUSIONS

The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the commitment to, and proficiency of, an organization's health and safety management.

Workplace health and safety is important as a commitment to employees, contractors, visitors, families and friends. It is also important as an investment to the business, and because it is a legal duty. Thus there are 3 main reasons for maintaining and promoting health and safety in the workplace:

- Moral: Injury accidents lead to pain and suffering, not only to the victim, but to their family and friends as well.
- Social: Successful organizations have good personnel management. Because of pleasant atmosphere, openness and trust, democratic discussion in everyday work, good managerial skills, the ability to influence one's own work, training opportunities, concern for health and work ability, and permanent employment. Thus good employers will evolve their working practices in- line with society's expectations.
- Economic: Accidents cost a great deal of money, especially when we add the damage caused by some accidents. Employers also sustain costs as a result of an accident (such as fines, damage to buildings, plant and material, production delays, fines, claims and legal fees, increased insurance premiums, loss of reputation etc).

A risk assessment is an important step in protecting workers and business, as well as complying with the law. It helps to focus on the risks that really matter in workplace – the ones with the potential to cause real harm. In many instances, straightforward measures can readily control risks, for example ensuring spillages are cleaned up promptly so people do not slip, or cupboard drawers are kept closed to ensure people do not trip. For most, that means simple, cheap and effective measures to ensure health and safety protection of most valuable workforce. The law is not expected to eliminate all risks, but organizations are required to protect people as far as 'reasonably practicable'.

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[3] WesternGeco and BGP (Pakistan) HSE Procedure, Risk Assessment and reports. 164

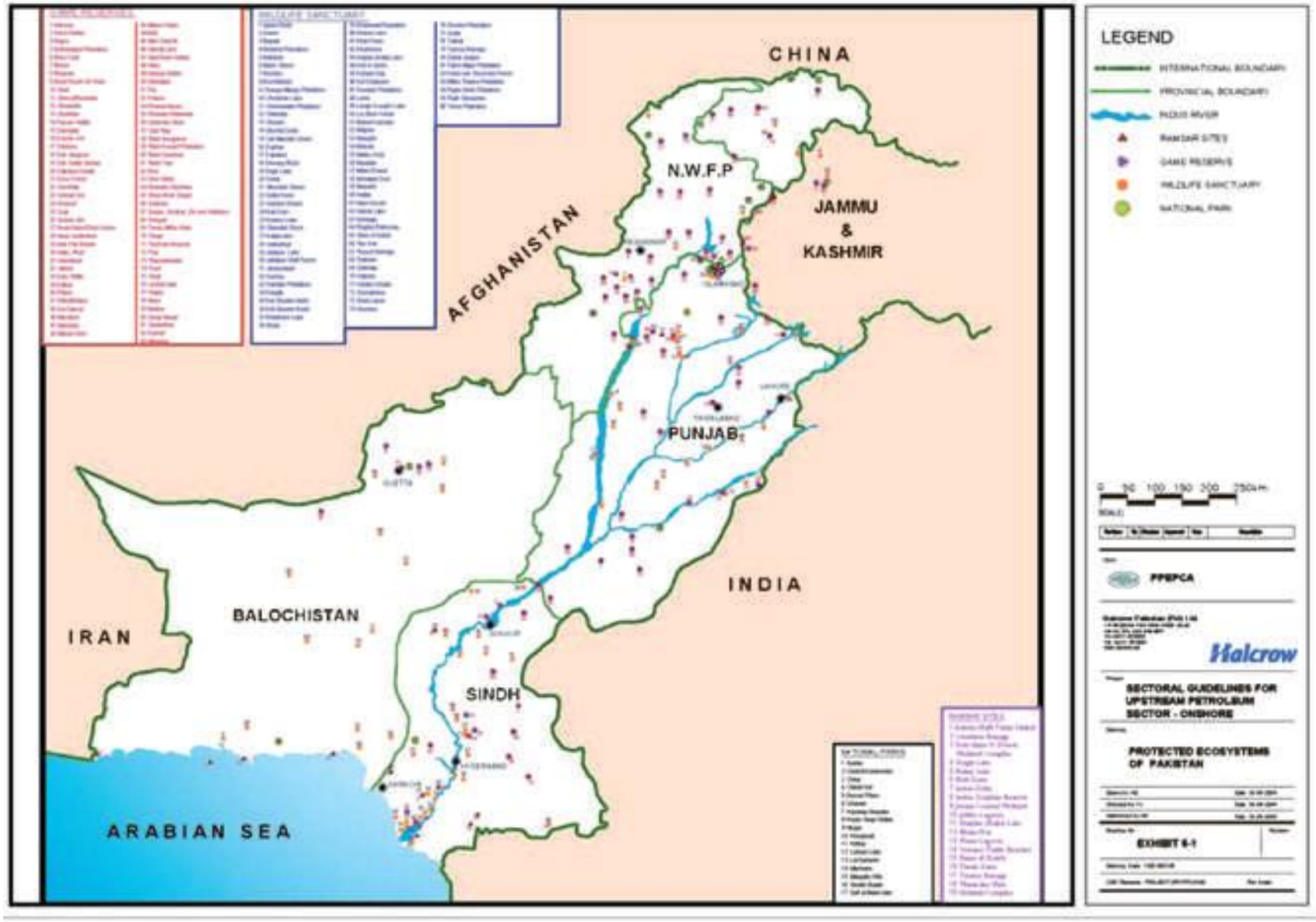

Fig. 1 - Pakistan map showing the sensitive areas required EIA or IEE before commencement of any exploration activity

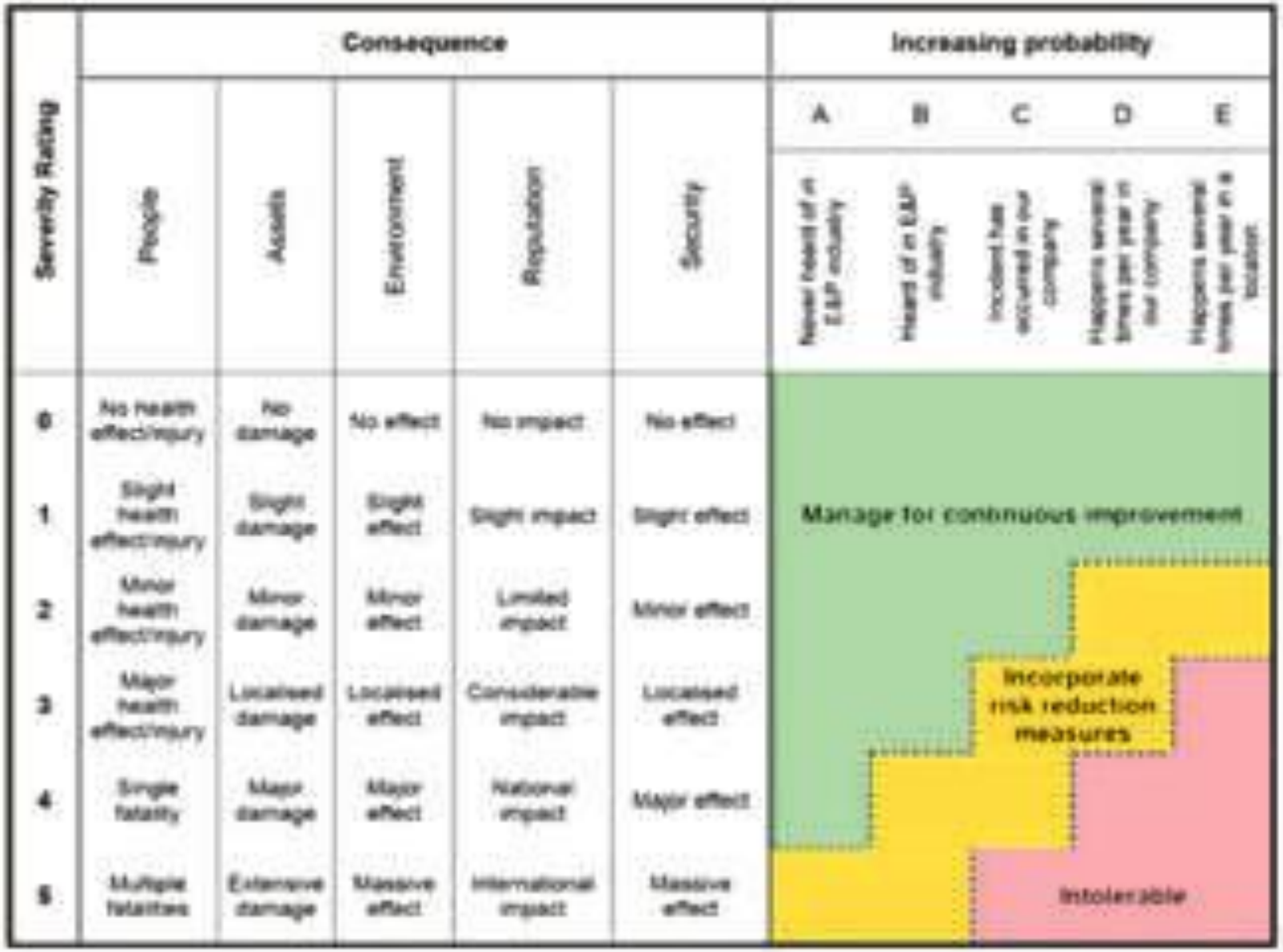

Table - 1: Qualitative Risk Assessment Matrix

Risk	Hazard	Description	Mitigation Measures	Impacts	Risk Rating	Target
Fires	Electrical/Gas/Fuel Fire	Base camp has higher risk areas of electrical fire. Electrical fires pose a threat to employees in that they may induce electrical shock, cause destruction of property and smoke inhalation.Gas is used in various types of equipment on a seismic crew. Gas fires can be ignited from many sources which pose a risk to employees working in close proximity. This can result in equipment and or environmental damage and burns to personnel. The storage of used oils in workshops and staging areas poses a risk of fire if not handled and stored properly. Oil fires are typically caused by welding, cigarettes or sparks from workshop areas. Untidy work areas also pose threats of oil fires. This can cause environmental and equipment damage.	Only certified electrician to construct electrical component of base camp, A pre-audit of facility must be done before employees arrive.Regular audits of gas/gas storage areas, adequate signage, follow storage procedures.Follow guidelines for cleanliness of workshop area, regular audits of all mechanical areas.	People, Asset, Equipment	Medium	All personnel living in base camp.
Camp Facilities	Working at Height	Working at height is carried out on trailers in camp, and on some heavy vehicles.	Use of ladders, trained & authorized personnel. PPE, PTW, Toolbox, training.	People	Medium	Personnel assigned to the specific task.
Vibrators	High Pressure Hydraulic Hoses	Hydraulic hoses may break causing serious injury, environmental spills and damage to vehicle. Mechanics must always be aware of the potential hazards when working on this type of equipment.	Trained personnel only to perform repairs, follow procedures for working on high pressure systems.	People, Environment, Asset	Medium	Mechanical staff, Field employees.
Drilling Activities	Hooking Drill component To Long line	Pinch points. Snagging gloves or loose clothing on the hook.	Orientations with all drill personnel. Training with all drill personnel. No loose clothing to be worn. Wear properly fitted gloves.	People, Asset	High	All Drill personnel
Occupational Health Hazards	Heavy Lifting	Employees may try to lift heavy or awkward objects or equipment by themselves - resulting in an injury.	Induction training, use the buddy-system and wait for additional assistance before lifting a heavy or awkward object. Team lifts should be used when lifting any object over 75lbs. Assessment of load prior to commencing task. Manual handling training.	People, Reputation	High	Personnel assigned to the specific task.
Wildlife	Snakes - Poisonous.	In this area, workers will encounter various species of snakes throughout their daily activities. This poses a serious threat of snake bite. This has potential for a serious injury or fatality.	Induction, training, wear proper PPE, regular safety meetings to discuss snake encounters when working in high risk areas, identify all local poisonous snakes.	People	Medium	All field workers
Exposure	Exposure to Hazardous Chemical or Substance	Employees may be exposed to hazardous chemicals or substances during work activities. This poses a threat to all personnel working with these products.	Activate ERP if personal injury occurs. Ensure eye wash stations and first aid kits are properly placed throughout appropriate areas. Special induction for all handlers of chemical substances. Only authorized personnel to work in these areas. Proper PPE will be worn at all times. Adequate signage around hazardous areas.	People, Reputation	Medium	Personnel assigned to the specific task of handling such items.
Environmental Health Hazards	Exposure to low or high Temperatures	The exposure to low or high temperatures may cause body temperature to minimize or maximize to critical levels. Workers exposed to cold or hot environments are at constant risk.	Orientation, safety meetings, regular rest breaks, provide proper PPE. Use buddy system.	People	Medium	All employees
Smoking	Smoking	Smoking on the job poses a risk of fires in the field, vehicles, trailers.	Follow company policies and procedures. Inspect fire extinguishers and smoke alarms on a regular basis.	People, Environment, Asset, Reputation	High	All personnel
Terrain	Environmental Damage from Vehicles	Driving vehicles over various types of terrain is common practice in our industry. This has the potential to cause rutting and destruction of vegetation.	Ensure EIA limitations are understood by all drivers. Stop movement of vehicles if necessary. Ensure drivers understand risks involved regarding environmental damage.	Environment, Reputation	Low	The environment
People	Local Community	There is a potential for contact to occur between vehicles and pedestrians or local vehicle, in urban and/or populated areas. This could result in injuries or even death to people and damage to assets and company reputation.	Limiting speeds in urban or populated areas. Local population being notified of the increased volume of traffic in the area. Posting of signs reminding both drivers and pedestrians of the risk of contact. Warning signals, such as sirens, strobe lights, etc.	People, Asset, Reputation	Medium	All pedestrians in the area
Vehicles	Towing trailers	Towing trailers without checking the tow hitch, safety chains or other required equipment. Towing beyond the recommended speed. Operator not trained to drive with trailers under tow. Not using a second person (spotter) while reversing with a towed trailer.	A camp move plan listing vehicles with specific drivers, routes, speed, convoy discipline and no overtaking, will be produced by the Party Chief and Chief Mechanic a couple of days before the intended move, a toolbox meeting will be held with all Staff personnel involved the previous night, toolbox meeting will be held with all drivers on the morning of the camp move.	People, Reputation	Medium	Vehicles and personnel

Table - 2: Risk assessment of seismic data acquisition (an example)