Emergency Response Planning For Shaft Sinking

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Workplace Safety North recognizes that individual companies must develop health and safety policies and programs which apply to their workplaces and comply with appropriate legislation. The information contained in this reference material is distributed as a guide only to assist in developing those policies and programs.

While WSN cannot guarantee the absolute accuracy or sufficiency of this information, we will be pleased to respond to individual inquiries about this information at any time.

About Workplace Safety North

Workplace Safety North (WSN) provides northern Ontario's businesses, industries and services with occupational health and safety resources, training and consulting, to help companies achieve the goal of zero workplace injuries and illnesses. In addition to serving all northern Ontario firms, we provide province-wide services for forestry, mining, smelters, refineries, pulp & paper, and printing industries. WSN was established in January 2010, a product of the merger between three health and safety associations for the mining, forestry and pulp and paper industries in Ontario. Each of the founding organizations has roots stretching back more than 80 years. WSN is a not-for-profit association governed by a board of directors drawn from the industries we serve. Funding for the association comes from dues paid by companies to the provincial Workplace Safety and Insurance Board.

Our Vision and Mission

We believe illnesses and injuries can and must be prevented. Belief in prevention drives action and commitment to change.

Our vision

Every worker, home safe and healthy.

Our mission

We are a force for positive action – anticipating and responding to the greatest needs of our clients, and bringing together our partners, members, and diverse communities to build safer, healthier, stronger workplaces.

We will accomplish our mission by being…

Experts: mobilizing our know-how in the management of high-risk hazards.

Knowledge Brokers: acquiring and creating knowledge unique to our industries, and optimizing information exchange.

Change Agents: facilitating organizational improvement through auditing, consulting and training.

Champions: advocating workplace health and safety in Northern Ontario communities.

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Emergency Response Planning For Shaft Sinking

Objective

Shaft sinking and shaft rehabilitation are unique mining operations because of the specialized nature of the work being performed and the severity of the hazards involved. The process is further complicated because shaft contractors find it difficult to hire, train and maintain crews due to the cyclical and transient nature of the business. The entire mining industry is suffering from a shortage of trained miners and low recruiting levels. These conditions necessitate the establishment and maintenance of an emergency plan for each project.

The purpose of this guideline is to assist mining operations and shaft contractors to:

1. Create a new Emergency Response Plan for shaft sinking and rehabilitation operations or
2. Revise an existing plan

What is an emergency?

An emergency is any unforeseen event which has the potential to:

1. Cause death or injury to employees, customers or members of the general public
2. Disrupt or shut down business operations
3. Physically damage equipment and/or the environment
4. Jeopardize a company's financial viability
5. Threaten a company's public image or reputation.

What is emergency management?

Emergency management is the process of:

1. Planning and preparing for an emergency
2. Organizing a response to an emergency
3. Recovering from an emergency

Why have an emergency response plan?

1. Preservation of life is always the first and most important goal of emergency response.
2. An objective of any plan is the protection of the health and safety of employees, contractors, visitors and emergency responders.
3. Emergency plans are required by legislation in Ontario (Reg 854 Ss 25, 41; Reg 213 Ss 17, 18, 264 - please refer to the addendum for details).
4. In the event of an accident, it would be difficult to prove "due diligence" without proof of the prior existence of an emergency response plan as well as the equipment and training required. Having an emergency response plan and procedure can reduce a company's exposure to civil or criminal liability in the event of an incident and may reduce insurance premiums.
5. An emergency response plan is intended to control losses to people, equipment, materials and environment (PEME) – the central tenet of loss control.

Nine Steps to developing an Emergency Response Plan

1. Establish a planning team

Demonstrate shaft contractor management's commitment to the project by appointing a competent team leader and authorizing the leader and the team he assembles to take the necessary steps to develop an Emergency Response Plan. Management should provide the leader with expectations for deliverables and a deadline and budget, if required.

The size of the team charged with developing or refining an Emergency Response Plan depends on the company's location, operations and resources. A mine in a rural or remote location will have to be more self-reliant in the event of an emergency than one located close to supportive police, fire and medical services. Such variables will largely determine the nature and scope of the planning process.

The team may elect to meet with municipal and provincial government agencies, first response organizations and others to obtain information. Meetings may also be held with client company personnel such as Mine Rescue, JHSC, worker safety and health representatives, engineering, maintenance, human resources, purchasing and others.

With the client mine's directives and deadlines in mind, the team should also establish schedules and budget for their work and have these approved, if necessary.

2. Evaluate current plans, procedures and incident or drill records

The contractor company may have an existing Emergency Response Plan which only needs review and revision to make sure it fits the conditions of the current project and meets the requirements of the client mine's management. The team should also review records of the company's response to any previous emergency events or drills.

Documents to review:

- Health and safety policy
- Evacuation plan
- Fall recovery procedure
- Fire protection and fire fighting plans and responsibilities
- Security procedures
- Mutual aid agreements with other companies
- Risk management plan
- Records from previous incidents and drills
- JHSC inspection records
- Minutes from JHSC meetings
- Accident investigation records
- Records of past meetings with first responders (fire, police, medical, etc.)
- Records of media relations from previous incidents

3. Identify hazards, estimate probability and assess potential impact on people, property and business

A good starting point is to create an inventory of emergencies which have or could have occurred in:

- The upper shaft
- The shaft bottom
- A shaft station
- The headframe
- The galloway

Review the conditions for the existence of the following hazards:

- Fire- both fueled and electric – NB hot work, welding, cutting, grinding – timbered shafts are most likely to burn – have electrical emergency shut-off switches been installed on all levels of the Galloway?
- Methane – was methane found during the diamond drill program?
- Inrush of water – are there lakes, rivers or streams in the vicinity – is the ground wet – were large quantities of water encountered during the diamond drill program?
- Gases, smoke or other contaminants – is ventilation adequate – is there backup in case of a power failure?
- Blasting malfunction – central blast – are there clear procedures?
- Post-blast gases – procedure for gas checking
- Personnel falls from elevations – fall protection – fall arrest PPE and training – procedure for recovery from a fall
- Falling equipment/supplies – procedure for securing loads or materials being hoisted into the shaft
- Rockburst – seismicity of the ground – is there seismic sensing equipment installed – method of ground support to be used – design of the shaft pillar and shaft – results of diamond drill program for shaft and pillar
- Electrocution
- Electrical failure
- Hoist failure
- Other equipment failure

Take into account such factors as:

- Patterns of extreme weather such as heavy snow, extreme heat or cold, freezing rain, drought, tornadoes, excessive rain
- Proximity to flood plains, seismic faults, dams, water tables, lakes, rivers, streams
- The state of the roads leading to and from your facility – are they ever impassable due to heavy snow or reduced visibility – what is the local accident frequency? - estimate the effect on response time for outside responders in an emergency situation
- Typical employee drive time to and from work
- Historical utility down time for telephone, cell phone, electricity, natural gas, municipal sewer and water service

A blank Vulnerability Analysis Chart has been included in the addendum which uses a

numerical scoring system to estimate impact. The safest condition is the one with the lowest score. Use the chart to estimate the probability of an emergency happening. This is a purely subjective rating but the outcome may be useful.

4. Emergency resources

The location of the mine will have a great deal to do with the emergency resources available and the time required for them to respond. Mines located near cities will have better and quicker access to resources than mines located in rural or remote locations.

In general, the more remote the site the fewer emergency resources will be available.

More than listing telephone numbers in the emergency procedure, many companies maintain an active relationship with some or all emergency resource providers providing them with site plans, plant tours and notification when there are major changes to plant, process or materials.

Resources include but may not be limited to:

- Self-rescuers have been used in mines for years and are credited with saving many lives throughout the world. They are currently used in two Ontario mines and may be especially beneficial for shaft-sinking crews where escape opportunities are limited. They may also be beneficial due to the limited access to the Galloway and shaft bottom for Mine Rescue or first responder personnel. Manufacturers of self-rescue units invariably certify the equipment for escape only and not for regular work applications.
- First Aid: Regulation 1101 specifies only minimal first aid supplies and training for a small work detail such as a shaft-sinking crew which typically employs more than five but less than 15 workers. Shaft contractors may wish to expand the first aid supply inventory and ensure that at least one worker per shift has advanced first aid training.
- Mine Rescue assistance may be required for a number of types of emergency including fire, fall recovery or run-of-muck, rockburst or flooding.
- Fire assistance may include full-time professional fire fighters, part-time volunteer departments, Mine Rescue personnel or company employees trained and equipped to fight fires. Appropriate fire fighting equipment must be available at the working level.
- Police services may be provided by OPP, RCMP, municipal or First Nations police forces.
- SAR – Search and Rescue: teams of trained and equipped volunteers prepared to search for missing persons or respond to other types of emergencies.
- Medical: Mine Rescue, provincial or local ambulance service; hospital; local doctor; air ambulance.

- Municipal government, public works department: may provide assistance with situations involving water, sewer, snow removal or other services.
- Electrical utility: Ontario Hydro and/or municipal or regional electricity utility may provide assistance with situations involving overhead or underground power lines.
- Ministry of Labour may be consulted.

Special considerations for Mine Rescue

Shaft-sinking crews are typically too small to be able to field their own Mine Rescue teams and an aid plan may have to be developed between the shaft sinking contractor and the client mine for the provision of Mine Rescue services in the event of an accident. In this case, mine management will have to determine whether the availability and shift assignment of its trained Mine Rescue personnel will be sufficient to also cover the emergency requirements for the new shaft.

A "Point-In-Time" evaluation of the availability of trained and equipped Mine Rescue personnel should be carried out as part of the emergency preparedness plan development. Please refer to the addendum for more information.

The size of the bucket(s) being used in the shaft sinking operation may be a determining factor in how many Mine Rescue personnel, under oxygen and carrying rescue equipment, may be carried into the shaft at once. In most cases, the bucket may be too small to carry an entire team to surface at once.

Mine Rescue personnel may be totally unfamiliar with the shaft sinking process or the equipment involved. The shaft sinking contractor should guarantee the availability of at least one Mine Rescue trained employee per shift to act as a guide for a Mine Rescue team if an accident occurs. Mine Rescue trained means personnel with current standing in Basic and Standard Mine Rescue.

5. Review codes and regulations

Some emergency situations may be caused or complicated by failing to follow the dictates of one or more codes of practice. Legislation is in place to direct companies on procedures to follow and notification to be given in case of an emergency. Codes and regulations include but may not be limited to:

- National Fire Code: details fire prevention characteristics to be included in residential and commercial buildings as well as installation, testing and use of fire emergency systems
- Regulation 164 – Ontario Electrical Safety Code: Specifies acceptable practices for

the specification, installation, use and maintenance of electrical systems

- The Explosives Act: federal legislation governing the manufacture, testing, sale, storage, transportation and importation of explosives
- Occupational Health and Safety Act: the basis of all health and safety legislation in the province of Ontario
- Regulation 854 – Mines and Mining Plants: health and safety legislation specifically relating to mines and mining plants
- Regulation 213 – Construction Projects: health and safety legislation specifically relating to the construction industry – some sections may apply to mining
- Regulation 1101: legislation which specifies first aid procedures and supplies according to the size of the company
- Environmental Protection Act: legislation governing the control of materials which, if released, could harm the environment, and the remediation of spills once they do occur
- Ontario Mining Act: legislation which regulates the establishment and operation of mines in the province
- Handbook of Training in Mine Rescue and Recovery Operations

From time to time the Ministry of Labour publishes guidelines to expand and explain fine points of legislation. The following Guidelines for Regulation 854, Mines and Mining Plants, may be pertinent to shaft sinking and emergency preparedness:

- Flammable Gas In Underground Workings – R.S. 21(5) & R.S. 35
- Requirements Of A Warning System In Case Of An Underground Mine Fire –R.S. 25
- Reducing Risk Of Fire During Shaft Sinking – R.S. 25
- Self-Rescuers – R.S. 25(1)
- Underground Fire Fighting Equipment – R.S. 28
- Fire Suppression For Fueling Systems – R.S. 28(2)(a)
- Fire Suppression Systems – R.S. 28(2)(a)(i)
- Fire Code – R.S. 41

6. Training programs

Everyone who works for the company requires some type of training. Employees engaged in shaft work require Common Core Training plus specialty modules which may include:

U0074 Mine Hoist Operation- Friction Or Drum
U0083 Operate Cage
U0066 Shaft Sinking – Timber Lined
U0087 Shaft Sinking – Concrete Lined

Training for emergency response may include safety meetings, reviews of procedures, use of fire extinguishers, evacuation drills, fire survival techniques, refuge stations or full-scale disaster exercises. Some or all employees may be trained in first aid and CPR. WHMIS training is already mandatory. A special training program may have to be developed for shaft-sinking employees designated to act as guides for Mine Rescue.

Typically, a company will assign someone responsibility for managing the emergency response training program. The training plan should speak to the following considerations:

- Who is to be trained?
- Who will do the training for employees, contractors, community responders?
- What type of training is required?
- What training is required for specialist employees?
- What training is required for contractors and their employees?
- What orientation training is required for visitors and new employees?
- How can members of the community first response teams be involved with the training programs?
- How will training programs be evaluated?
- How often should refresher training be given?
- How and where to store training records – paper, digital? – who to maintain records?

Training programs may include some or all of the following forms:

- Orientation, classroom and safety meeting sessions
- Tabletop exercises – members of the emergency management group meet to review their responsibilities and discuss appropriate reactions to various scenarios
- Drills – realistic exercises may include all aspects of an emergency response such as evacuations and medical events – community first response services may be involved

Due diligence requires the maintenance of complete training records for all personnel.

7. Communication

Effective communication is essential to report emergencies to first response support teams, employees, neighboring businesses and residences, the community, news media and other interested parties such as employees' families and company customers. Even a temporary communication disruption can have a serious effect on the response process. An Emergency Response Organization Chart can play a major role in maintaining effective communication especially during a crisis.

The first requirement is a means for alerting all personnel on the site to the emergency. A loud, horn or siren may be effective for most people but drill operators may not be able to hear the warning and a flashing light system may be added. The system should be tested on a regularly-scheduled basis. The Ontario Office of the Fire Marshall recommends that each employee participate in a fire drill at least once per year.

Some notification for outside agencies may be required by law. A list of "Legislated Requirements for Accident/Incident Reporting" is included with this guideline as an addendum. Note that, in some cases, "immediate notification" is required. Someone on the emergency team should have responsibility for making reports as required by legislation.

Since many mines are in rural locations, the 911 Emergency Locator Number becomes a critical component of the notification sent to police, fire and medical first response providers. The Locator Number should be known to all employees, posted at all telephone locations and prominently displayed at the entrance to the operation.

Dealing with the news media at the time of an emergency situation can present a special challenge. Experts recommend only one trained person be allowed to brief the media on behalf of the company. Media representatives should not be given free access to the job site. To be allowed on site they must be provided with PPE and escorted at all times for their own safety. Where possible, information for media distribution should be printed and distributed as a press release.

8. Write the plan

Every component of every emergency response plan requires the approval of some level of management. Plan development will proceed more smoothly and with fewer revisions if the approvals process and deadlines are established and understood beforehand.

Not everyone is capable of writing clear, concise copy. Encourage everyone participating in the actual plan development to record information in point form. The project leader should assign the writing tasks to those who are most knowledgeable about sections of the content.

JHSC members and worker representatives must be included in the plan development process.

Be sure to clearly mark interim materials as “Draft” and not for distribution. Including computer file names for each section of the plan helps to keep the material organized and offers an additional option for including a means of dating each revision for version control.

An editorial review of advanced plan materials by an editor who was not involved in the development or writing of the content will help to ensure consistency of presentation style while fixing annoying typographic and grammatical errors.

The approvals process should include critical review of the content and may result in one or more section revisions which is good because this is the time to get these details right before the plan is published and put into effect. The plan should also include a process for information input and future plan upgrades as required.

Finally, when the plan is formally approved by the client company, the plan may be published.

9. Implement the plan

There are several aspects to plan implementation:

- Management can indicate its “buy-in” to the plan by adding a launch covering letter signed and dated by the most senior manager for the site or operation.
- The employee introduction to the emergency plan may take place through safety meetings, orientation meetings or specific training programs.
- Emergency preparedness information from the plan may be distributed or promoted through posters, bulletin boards and employee newsletters.
- Supervisors should make a habit of asking employees what they would do if a fire (explosion, hurricane, etc) occurs.
- Plan implementation should include a launch with police, fire, medical and other support services.
- Drills should be planned to be as realistic as possible and may include participation by outside support services.

Emergency Response Planning For Shaft Sinking

Appendices

1. **Legislated Requirements For Accident/Incident Reporting**
2. **Vulnerability Analysis Chart and Sample**
3. **Surface Emergency Response Checklist**
4. **Sample Plan**

Legislated Requirements For Accident/Incident Reporting

LEGAL REQUIREMENTS FOR REPORTING ACCIDENTS AND INCIDENTS						
Accident/Incident		**Legislation Act/ Regulations**	**Requirement**	**In What Form**	**When**	**To Whom**
Event	**Result**					
Any Accident	***Death*** while on the job, on company business or non employee on company property.	Coroners Act S. 10	Report facts and circumstances relating to death. Inquest will be held.	Most direct means available	Immediately	Police or Coroner
Any Accident	***Medical treatment required (includes death).***	Workplace Safety & Insurance Act (WSIA) S. 21	Report extent of injuries and cause of accident.	Written Form 7	Within 72 hours	Workplace Safety & Insurance Board
			Assist physician in supplying diagnosis and treatment details to the WSIB.	Written Form 156	Prior to receiving medical treatment	To physician
Any Accident	***Employee Death or Critical Injury***, ie. A. life threatening. B. Unconsciousness. C. Severe bleeding D. Fractures other than fingers or toes. E. Amputation of leg, arm, hand or foot. F. Burns to major portion of body. G. Loss of sight. See O. Reg. 834 (RSO 1990)	Occupational Health and Safety Act S. 8(14) S. 9(31) S. 51 S. 52 S. 53 Reg. 834 Critical Injury Defined Reg. 854 S. 21(1)	Report occurrence and available details.	Verbal	Immediately	MOL Inspector, Joint Health and Safety Committee Representative or Health and Safety Representative, Trade Union
			Record details of accident, name and address of employer; injured; and physician	Written	Within 48 hours	Director of Occupational Health and Safety Division of the MOL.
			MOL will investigate.			
Any Accident	***Medical attention required and the worker is disabled from performing normal work or occupational illness*** is reported.	Occupational Health and Safety Act S. 52 Reg. 854 S. 21(2)	Report details of event and investigation. Investigate to find conditions contributing to the accident. Take steps to prevent a reoccurrence if possible.	Written	Within four days	MOL Inspector, Joint Health and Safety Committee Representative or Health and Safety Representative, Trade Union. Director of Occupational Health and Safety Division of the MOL.
Any Accident	***Medical attention required but worker not disabled.***	Occupational Health and Safety Act , S. 53 Reg. 854 Section 21 (3,4,5)	Record details of event.	Written	Immediately	Retain records for review by Inspector.
Any Accident	***First Aid only***.	First aid Regulation (1101) S. 5	Record name, date, treatment or advice given to worker.	Written	Immediately	Records on file

LEGAL REQUIREMENTS FOR REPORTING ACCIDENTS AND INCIDENTS						
Accident/Incident		**Legislation Act/ Regulations**	**Requirement**	**In What Form**	**When**	**To Whom**
Event	**Result**					
Worker reports ***Industrial Disease***	Employee may be eligible for Compensation.	WSI Act S. 21	Report history of employee pertaining to causation of industrial disease.	Written Form 7	Within 72 hours	WSIB
Recurrence of prior injury	Employee disabled from doing usual work	WSI Act S. 21	Report details of recurrent injury.	Written Form 7 Form 156 Use original claim number	Within 72 hours	WSIB Physician
Worker on Compensation returns to work	Employee no longer eligible for same level of compensation, if any.		Report employee's return to work and details of pay and absence.	Written Form 9	As soon as possible	WSIB
Reportable Occurrence involving	A. Failure to hoist sheave, hoisting rope, shaft conveyance, shaft timber. B. Flammable gas present in underground mine C. Spontaneous heating with evolution of gas. D. Major failure or damage to equipment. E. Rockburst > 5 tonnes F. Uncontrolled.fall of ground > 50 tonnes. G. Defective explosives. H. Dam or bulkhead failure. I. Run of material. J. Unexpected explosion. K. Flood. L. Fire.	OHSA S. 53 Reg. 854 S. 21 (5)	Report details of incident • What • When • Damage • Injuries MOL may investigate.	Written	Within two days	MOL district office

LEGAL REQUIREMENTS FOR REPORTING ACCIDENTS AND INCIDENTS

Accident/Incident		Legislation Act/ Regulations	Requirement	In What Form	When	To Whom
Event	**Result**					
Motor vehicle accident	Personal injuries or property damage in excess of $1000	Highway Traffic Act S.199 Reg. 596 S. 11	Report occurrence. **If non company vehicles involved or off company property**.	Verbally	Immediately	Police
Contaminants (see Act) released to environment in excess of legal limits.	Injury, likely injury, or property damage even if no injury is likely.	Environmental Protection Act S. 15	Report occurrence and available details of event.	Most direct means available	Immediately	Ministry of the Environment
Spills of Contaminants	Injury, likely injury or property damage.	Environmental Protection Act S. 92	Report occurrence and available details of event.	Most direct means available.	Immediately	Ministry of Environment plus local municipality.
Pesticides released into environment.	Injury, likely injury or likely property damage.	Pesticides Act S. 29	Report occurrence and available details of the event	Most direct means available	Immediately	Director of the Ministry of the Environment
Discharge emission or escape of dangerous goods (see Act) or an emission of ionizing radiation in excess of AEC limits during transport.		Transportation of Dangerous Goods Act S. 18	Report occurrence and available details of the event.	Most direct means available.	Immediately	Inspector for the Ministry of Transport (Federal).
Explosion or rupture of boiler, pressure vessel or plant.	Death, injury or property damage.	Technical Standards and Safety Act Reg. 219	Report full details of incident	Most direct means available.	Within 48 Hours	Director of Technical Standards & Safety Authority.
Accidental fire or explosion due to spills or leaks when handling gasoline.		Technical Standards and Safety Act Reg. 217	Report occurrence and available details of event.	Telephone, FAX	Immediately	Inspector of Technical Standards & Safety Authority

LEGAL REQUIREMENTS FOR REPORTING ACCIDENTS AND INCIDENTS						
Accident/Incident		**Legislation Act/ Regulations**	**Requirement**	**In What Form**	**When**	**To Whom**
Event	**Result**					
Compressed Natural Gas	• Asphyxiation • CO poisoning • Explosion • Fire	TSSA Reg. 214 S. 16	Report occurrence	Phone, FAX or other electronic communication	Immediately	Inspector
Propane	• Asphyxiation • CO poisoning • Explosion • Fire • Accidental release • Vent • Spill	TSSA Reg. 211 S.15	Report occurrence	Phone, FAX or other electronic communication	Immediately	Inspector
Gaseous Fuels	• Asphyxiation • CO poisoning • Explosion • Fire	TSSA Reg. 212 S. 12	Report occurrence	Phone, FAX or other electronic communication	Immediately	Inspector
Fuel Oil	• Asphyxiation • CO poisoning • Accidental release • Leak • Explosion • Fire	TSSA Reg. 213 S. 21	Report occurrence	Phone, FAX or other electronic communication	Immediately	Inspector
Elevators	• Death or serious injury • Injury • Hazardous condition • Fire	TSSA Reg. 209 S. 36	Report occurrence	Telephone	Immediately	Director

Vulnerability Analysis Chart

This is a simple chart which anyone can use to evaluate the hazard exposure for a company. It is very subjective but valuable because it forces organization of thought and provides a simple measurement system. A blank form is provided here to photocopy. An example of a typical analysis for a shaft-sinking operation is also included. The reasoning behind the selections follows:

Fire
Probability is rated as 3/5 because of fuel in vehicles, timber in the shaft, equipment, electricity etc. The human impact of a vehicle or fuel fire could be extremely serious (5/5), the impact on property also very serious due to loss of equipment (5/5) and the loss of production and business also high (5/5). Fire-fighting capability through the company mine rescue crew is good, since they have a sufficient number of men to form a team on surface (2/5), although additional crews may take time to respond (4/5). The total score is 24; a hazard demanding planning and consideration.

Floods and Tornadoes
We're on high ground with no major water sources in the area. There has never been a tornado in this region. Our exposure to these two natural elements is low with total score of 10 and 15 respectively.

Falls from Heights
Workers frequently work at heights, and although a fall protection program is in place, the possibility of an accident is rated at 4 when compared to other jobs on the site. Human impact of such an accident would be very high (5) as would business impact (5). Training is good, but resources to carry out a rescue in the event of a fall are questionable (5). External resources are excellent, but are distant from our location (3). With a score of 25, this is our most serious hazard.

Note:
You may or may not agree with the way this sample was compiled but you can see how the thought process, reasoning and scoring could work.

Vulnerability Analysis Chart

TYPE OF EMERGENCY	Probability	Human Impact	Property Impact	Business Impact	Internal Resources	External Resources	Total
	High **5** ⟷ Low **1**	High Impact **5** ⟷ Low Impact **1**			Weak Resources **5** ⟷ Strong Resources **1**		
Fire	3	5	5	5	2	4	24
Flood	1	1	2	2	2	2	10
Tornado	1	4	1	1	4	4	15
Falls from heights	4	5	3	5	5	3	25

The lower the score the better

Vulnerability Analysis Chart

TYPE OF EMERGENCY	Probability	Human Impact	Property Impact	Business Impact	Internal Resources	External Resources	Total
	High 5 ⟷ Low 1	High Impact 5 ⟷ Low Impact 1			Weak Resources 5 ⟷ Strong Resources 1		

The lower the score the better

Shaft-Sinking/Rehabilitation Emergency Response Checklist

Emergency Response Plan

- ☐ Is there a written emergency plan? Yes___ No___
- ☐ Has it been updated within the past 12 months? Yes___ No___
- ☐ Have there been operational changes that affect the plan since the last update? Yes___ No___
- ☐ Does the plan cover the highest probability emergencies? Yes___ No___
- ☐ Does the plan identify where all employees are to gather in the event of an emergency? Yes___ No___
- ☐ Is the list of trained emergency response personnel posted? Yes___ No___
- ☐ Is the list up to date? Yes___ No___
- ☐ Are mutual arrangements addressed in the plan? Yes___ No___
- ☐ Have the mutual aid agreements been tested? Yes___ No___
- ☐ Did the employees respond to these tests? Yes___ No___
- ☐ Were the response times recorded? Yes___ No___
- ☐ Are all contractors accounted for in the plan? Yes___ No___
- ☐ Is there an alarm system to warn of an emergency? Yes___ No___
- ☐ Are the emergency contact numbers posted? At all telephones? Yes___ No___
- ☐ Do all workers know the site 911 identification number? Yes___ No___

Emergency Response Training

- ☐ Have employees received the required training? Yes___ No___
- ☐ Are records of training maintained? Yes___ No___
- ☐ Are emergency response personnel identified? Yes___ No___
- ☐ Is the checklist for emergency response personnel maintained? Yes___ No___

Emergency Response Evaluation

- ☐ Are emergency drills held for each shift annually? Yes___ No___
- ☐ Are reports of the drills maintained? Yes___ No___
- ☐ Are follow-up debriefings conducted? Yes___ No___
- ☐ Are point-in-time evaluations conducted? Yes___ No___

Rescue Incidents

- ☐ Have there been incidents where emergency response personnel were engaged? Yes___ No___
- ☐ Have reports of these events been kept? Yes___ No___
- ☐ Are follow-up debriefings conducted? Yes___ No___

Emergency Response Resources

- ☐ Is emergency response equipment kept at each site? Yes___ No___
- ☐ Is there adequate equipment for the size of the site? Yes___ No___
- ☐ Are equipment and materials stored properly? Yes___ No___
- ☐ Is there a checklist for the equipment and supplies? Yes___ No___
- ☐ Is someone officially responsible for maintaining the equipment and material? Yes___ No___

Worker Training

- ☐ Are all employees trained to follow an evacuation procedure? Yes___ No___
- ☐ Are all contractor employees trained to follow the evacuation procedure? Yes___ No___
- ☐ Does everyone know where to gather in the event of an evacuation? Yes___ No___
- ☐ Is there a plan to deal with missing persons from the head count? Yes___ No___
- ☐ Are there enough workers trained in emergency response? Yes___ No___
- ☐ Are there enough workers trained in first aid? Yes___ No___
- ☐ Have emergency response personnel been trained for all emergencies? Yes___ No___

Checklist reviewed by: _____

Date:_____

“Point-In-Time Evaluation”

Background

- The existing MOL Mine Rescue guideline is prescriptive (requires specific number of trained mine rescue men based on the number of underground employees).
- This does not necessarily ensure adequate emergency response capability.
- Mine rescue men may not be readily available due to personal reasons (sickness, vacation etc.), geography (remote sites), inclement weather conditions, shift scheduling and shift rotation etc.
- Mine operators are required to ensure an adequate number of trained mine rescue men are maintained and are available to respond in the event of an emergency.

Objective

- To provide a tool that will assist mine operators to:
  - assess their response capability and
  - identify the required number of trained mine rescue men that are needed for the site.

Procedure

- Obtain and review the operation’s emergency plan.
- Obtain the roster of active mine rescue men for the operation.
- Conduct a series of “Point-in-Time Evaluations” ensuring any fluctuations in workforce are covered.
- Assess the adequacy and availability of trained mine rescue men.
- Make adjustments to the number of trained men available to ensure adequate response.

“Point-In-Time Evaluation” Procedure

- Select a point in time.
- All available mine rescue manpower estimates are referenced to this point.
- Assume there is an emergency situation requiring mine rescue response.
- If stench were injected at this point in time where does the emergency plan require underground workers to report to?
- Establish where all mine rescue men identified on the mine rescue roster are at this point in time. They may be underground (unavailable because they are in the refuge station due to the emergency), on surface, at home or elsewhere.

- Are there men who are not available due to vacation, shift work, shift rotation sickness or other reasons?
- Do you have enough trained men available to respond to this situation?
- This procedure should be repeated on other shifts, varying days of the week and other points in time.
- Record the results in a permanent log book for future reference.
- Make adjustments to your emergency plan and ensure an adequate number of trained mine rescue men are available.
- It is recommended to conduct this assessment monthly until you are comfortable that the results offer adequate emergency response capability.

SUBJECT: REDUCING RISK OF FIRE DURING SHAFT SINKING

Existing pertinent legislation:

25. (1) Procedures in case of a fire in an underground mine, or in a structure or building on the surface at an underground mine, that may be a hazard to workers in the mine shall be prepared by the supervisor in charge of the mine.

(2) An alarm system, that is effective to warn workers in an underground mine of a fire that is likely to endanger their safety, shall be provided.

(3) The procedures required by subsection (1), or extracts therefrom, and a notice explaining the alarm system shall be set out in writing and shall be posted and kept posted in the shaft house and in a conspicuous place or places where they are most likely to come to the attention of a worker.

(4) Every worker shall be advised by a supervisor of the procedures and the alarm system.

(5) Once in at least every twelve months during each production shift a fire alarm test of the procedures shall be conducted.

(6) The alarm system in an underground mine shall,

(a) consist of the introduction into all workplaces of sufficient quantities of ethyl mercaptan gas or similar gas to be readily detectable by all workers; and
(b) be kept ready for immediate use.

(7) Despite clause (6) (a), an alternative means of alarm may be used if the alarm system is agreed upon by the employer and the joint health and safety committee or the health and safety representative, if any, for the workplace.

(8) A report of each fire alarm test of the procedures mentioned in subsection (5) shall be kept available at the mine for three years.

HISTORY:

Section 25 is intended to lay out the basic requirements for a fire procedure for underground mines. This guideline includes the fire procedure along with procedures and equipment and workplace design intended to reduce the risk of fire.

Modern shaft sinking utilizes mechanized mining methods using equipment such as electrical hydraulic jumbos. This includes electrical equipment, hydraulic drills utilizing many gallons of flammable hydraulic oil, and high intensity lighting. A fire in a shaft is one of the greatest dangers for underground workers.

The following two major fires occurred in Ontario:

1. March 15, 1991 - Falconbridge Ltd. - Craig Mine

Incident: Molten slag from a welding operation ignited grease and /or oil and electric cable insulation inside the box column of a sinking stage. Fire extinguishers were unsuccessful in extinguishing the fire. The workers were evacuated from the bottom of the shaft.

Cause: Welding.

Preventive Action: More vigilance to wetting down area prior to welding.

2. June 28, 1996 - INCO - Victor Shaft

Incident: A fire occurred in the area of the bottom deck of the Galloway in a mechanized shaft sinking operation. The cause of the fire was determined to be the ignition of a spray of hydraulic oil, which came in contact with an unshielded quartz halogen shaft light. Following the fire a detailed investigation was carried out.

See appendix D for other incidents.

PERFORMANCE OBJECTIVE:

The performance objectives are to reduce the risk of fire from occurring during shaft sinking and to have a fire procedure developed specifically for an underground shaft fire.

HAZARD:

A fire occurring during shaft sinking is very dangerous due to the fact that there is no way to escape the smoke and flames.

GUIDELINES FOR COMPLIANCE:

Introduction

Following investigations, the Provincial Coordinator - Mining, Occupational Health and Safety Branch, M.O.L. requested the Ontario Mine Contractors Safety Association (OMCSA) assist in reviewing fire prevention and emergency preparedness during shaft sinking.

At the July 17, 1996 meeting in Sudbury, subcommittees were established to review and make recommendations on the following:

a) emergency preparedness plans
b) mine rescue services
c) drilling equipment
d) airlines to the shaft bottom
e) fire suppression systems
f) self-rescuers/breathing equipment
g) cutting and welding
h) shaft bottom lighting
i) wiring
j) communications
k) ventilation
l) hydraulic fluids

Firms and groups involved in this Task Force included:
J.S. Redpath
Ram Raising Ltd
McIntyre & Associates Ltd
Dynatec Mining Ltd
Graham Mining Ltd
Manioc Development Inc.
MacIsaac Mining & Tunnelling Ltd
Moran Mining
Aurora Quarrying Ltd
TMCC Ltd
Ross Finlay Ltd
BLM Mining Services Inc.
Barrick Gold Corp.
Ontario Natural Resources Safety Ass.
Inco Ltd
Ministry of Labour
Mine Rescue Services
Ontario Mining Association

These recommendations were developed based on detailed reviews of mechanized shaft sinking operation, but the guidelines are also applicable to traditional shaft sinking projects.

The OMCSA believes that improved fire prevention and emergency preparedness is best achieved through joint owner-contractor reviews of these issues prior to the sinking phase of the project.

Owner-Contractor Emergency Preparedness Plan

The Owner and Contractor, prior to sinking, should develop an emergency preparedness plan for fires. This should consider but not be restricted to:

- Identifying a person(s) responsible for the plan and the location of the emergency preparedness plan document.
- Outlining a plan review process.
- Evaluating risks of air contamination from surface sources.
- Identifying the type and location of on-site emergency rescue equipment including breathing apparatus.
- Identifying the emergency control centre and pre-designating the control officer.
- Establishing an alarm system. (Refer to H & S Guideline for section 25,
- "Requirements of a Warning System in Case of an Underground Mine Fire")
- Identifying availability of first aid, medical aid and ambulance services and other
- outside resources.
- Special emergency training requirements for on-site personnel. (i.e. training in self contained breathing apparatus.)
- Discuss the need for media notification and media management.
-

Mine Rescue Services

The Mine Rescue services should review mine rescue training and requirements specifically as they relate to shaft sinking. The review should include but not be restricted to:

- Agreement on provision of and availability of trained mine rescue personnel along with call-out lists.
- Reviewing the plan with the mine rescue services to identify equipment and availability of trained mine rescue personnel.

- An on-site shaft sinking visit by the mine rescue training officers.

Drilling Equipment

For electric hydraulic equipment in a shaft operation, a written procedure for preventive maintenance should be established (to include leakage control) by the Contractor. A maintenance log should be maintained on this equipment to monitor compliance with the program.

Airline to the Shaft Bottom

An independent compressed airline from the main header to the shaft bottom shall be available at all times. This airline should be clearly marked and made of fire resistant material.

During orientation of new employees, and in the site emergency procedures, the airline purpose, location and instructions for use should be reviewed.

Fire Suppression

Regulation 854 Section 28 (2)(i) specifies a fire suppression system requirement for any U/G equipment containing more than 100 litres of flammable hydraulic fluids. The MOL Guidelines for U/G Fire Fighting Equipment, H&S Guideline for section 28 also suggests equipment and systems for fire fighting underground. In addition to the regulations and guidelines, the following recommendations for a fire suppression system are made:

- The system should have an initiation button for the fire suppression system easily accessible to the operator during operation and a second initiation button in the vicinity of the power pack.
- The system should have nozzles directed at the power pack and at additional areas as deemed appropriate.
- The system should have a detailed maintenance program reviewed and be developed in consultation with the supplier and maintenance of the system should be entered in a logbook.
- All underground personnel should have training in the operation of the system as part of the initial orientation and emergency procedures for the project.

- Suitable fire extinguishers should be available on each deck of the working stage and conspicuously located to ensure visibility and maintenance. Identifying the location and training for the operation of these units should form part of the project orientation and emergency procedures. Reference the MOL Guidelines for type and size of extinguisher.

Hydraulic Fluids

After an in-depth review of the composition, characteristics, advantages and disadvantages of currently available hydraulic fluids, it is recommended to continue the use of mineral oil as a hydraulic fluid in shaft sinking operations.

See appendix B for a description of available fire resistant fluids.

Cutting and Welding

The requirements for cutting and welding are currently covered in sections 36 and 194.

Shaft Bottom Lighting

In general the light shall be arranged or be protected so it is not a source of ignition. Where hydraulic fluid is used the external surface temperature of the lighting fixtures at the shaft bottom shall not get above the flash point of hydraulic oil (388°F). The lighting system shall have a suitable illumination to meet requirements of section 262. For backup lighting every person going into the shaft must carry a cap lamp which must have a peak illumination of 1500 lux (sec. 69).

Section 163 (3) requires that lamps be installed and protected to prevent heat generated from causing a fire, also see the Ontario electrical safety code clauses 2-300 1),4), and 2-302 for maintenance of electrical equipment including lighting fixtures.

Wiring

Ground Fault and Leakage

Refer to sections 164 (Ground Fault Protection), 175 (Power Cables), 235 (Shaft Signal System) and also 155 (Good Electrical Practices) of the regulations. When using a Galloway stage with electric hydraulic equipment, the emergency electrical shutoff buttons should be installed on all levels of the Galloway and on the drills that would automatically shut all power to the Galloway stage when depressed.

Shaft Signal Communications

A second means of communication in addition to the shaft signaling system shall be accessible to workers on both the Galloway and shaft bottom horizons and will be maintained.

When a bell cord is used, it should be of fire resistant material.

Ventilation

Pipes or ducts used to convey ventilation should be fabricated of material, which will not continue to burn after removal of the heat source.

See appendix C - Hazard Alert

Self Rescuers - Breathing Equipment

The need for self rescuers or auxiliary air supply should be determined following a review of the shaft sinking operation by the Mine Rescue Training Officer(s) as recommended in Part A and Part B of this document.

Refer to the H&S Guideline for section 25 (1), "Self Rescuers"

Note: All regulations referred to in this report are from Regulation 854, Mines and Mining Plants.

REVIEWED BY THE MINING PROGRAM PROVINCIAL ADVISORY COMMITTEE and APPROVED BY THE PROVINCIAL MINING CO-ORDINATOR

DATE: May 1999

Revised August 2002

APPENDIX A

Inco Ltd. – Victor Mine

June 28, 1996

A serious fire occurred during shaft sinking on June 28, 1996.

In a large concrete-lined shaft being sunk, a contractor had a fire on and just below the lower deck of a five-deck Galloway stage located at the 2140 foot level. They were using the latest equipment, including four electric-hydraulic drills, a cut drill and high intensity lights. It appears that a spray of oil from an operating drill was ignited by coming in contact with an uncovered quartz-halogen lamp. The spray of oil came from a loose regulating plug on the drill. The external temperature of the lamp far exceeded the flash point of the oil. Forty gallons of fluid were burned, as well as vent tubing and other supplies. Three workers were burned, and the whole crew of nine were exposed to smoke inhalation. Five men were drilling with three of the four jumbos on the bench and three workers were on the bottom deck of the Galloway. The following account is from the mine contractor's report.

Beginning of the Incident:

At 9:40 a.m. the fire began near the upper control area on the number 3 jumbo. The worker collaring a hole with #3 jumbo noticed a light from above. He looked up and saw flames from the upper part of his jumbo, just below the Galloway. This was also observed by others on the shaft bottom and the men on the Galloway. Within seconds, the flames engulfed the bottom deck of the Galloway. The fire was described, by the men on the Galloway, as covering an area about 10 feet wide by 15 feet high on the west side, by the
vent duct. One of the men on the Galloway rang 9 bells. The crew on the shaft bottom tried to ring the bells as well but the bell line fell, burned off.

Upon hearing the bells, the hoistman stopped the bucket. He was not able to establish communications with the shaft bottom. The electrician in the bucket contacted him by radio and confirmed that there was a fire on the Galloway, he started back down with the bucket while trying to contact the Galloway. When the bucket chaired on the top deck, the hoistman lost communications with the electrician in the bucket. He lowered the bucket to the bottom deck and waited for 60 seconds, then pulled the bucket back up to surface.

Crew on the Galloway:

The crew on the Galloway first noticed flames of 2 to 3 feet high. They rang nine bells and were about to try to put it out when the flames grew quickly. One of the crew turned on the compressed air but it seemed to make the situation worse so they turned it off. They gathered by the ladder (other side of #2 jumbo). The heat was intense so they crouched down on the floor, and covered themselves with their oiler jackets to try to shield from the heat. Breathing had become very difficult. In a very short time, the fire was almost out.
Flames of about 1 foot high were still burning.

At that time the bucket arrived at the bottom deck. The three men on the Galloway climbed in the bucket and tried to signal the bucket down to pick up the rest of the crew but the bell cord was gone. They tried the phones but they were not working. They also tried to climb to the next deck but the ladder was too hot and there was still too much smoke. The bucket then went to surface.

Crew on the shaft bottom:

Within seconds after noticing the flames on the #3 jumbo, the flames increased in size, and the vent duct caught fire, pieces of it began falling to the shaft bottom. Some of the crew on the bottom thought that the fire suppression system on the jumbo had activated because the flames went out so quickly. Upon investigation, it was found that the system did not activate, being a manual system. Smoke was coming down, and the crew huddled together first by #3 jumbo, but after more vent duct fell they moved to the #1 jumbo. Two men detached the compressed air hose from the pump and used it for air. They then waited till the smoke cleared which was estimated to be 20 to 30 minutes.

Once the smoke had cleared, two of the crew climbed a jumbo to the bottom deck of the Galloway They were looking for the men that were on the deck at that time. They continued up to the top deck, where they believed the bells were operable. They rang 3 long bells, then rang 2-2-2 to call the bucket down to the Galloway. The hoistman did not indicate hearing these bells in his statement.

On Surface:

Emergency 911 was called and Mine Rescue, and the Ministry of Labour were notified immediately. When the three (3) injured men were brought to surface, they were administered first aid by the site first aid attendant. They were airlifted to the Sudbury General Hospital. Response time was approximately 10 minutes from their arrival on surface. After the injured crew was brought up, it was decided that the smoke was too thick for anyone to go back down again.

After approximately 30 minutes, the hoistman heard on the phone voices below and notified the Shaft Superintendent that there were people trying to make contact. Three men took the bucket down with bell cord to re-establish the bell line. The hoistman lowered the bucket to the 1000-foot level and confirmed the bell line. In contact with the hoistman by radio, the men confirmed that they saw cap lamps on the top deck of the Galloway. They went down to 2000 level and checked the bell line, and tied it off. They then went down to the top deck and picked up the men. Approximate time was 10:30 a.m.

None of the shaft bottom crew, the rescue crew, or the shaft electrician sustained any injuries.

APPENDIX B

Fire Resistant Hydraulic Fluids

The term **"Fire Resistant"** can be defined as:

"The ability of a fluid to resist ignition: its reluctance to propagate flame (or support combustion) when a source of ignition is present and its ability to self extinguish when such a source is removed."

The standard CAN/CSA-M423-M87 "Fire Resistant Hydraulic Fluids" covers the fire resistance, toxicity, and stability with respect to separation of water-in-oil emulsions of hydraulic fluids intended for use at mines. The fire resistance tests include a spray ignition test and wick (flammability) tests.

The standard covers fluid in the following categories:

(a) Category 1 - fluid that shows no measurable flame persistence (i.e., less than 1 second) in either of the flammability tests specified in the standard.

(b) Category 2 - fluid that passes both the spray and wick flammability tests specified in the standard.

(c) Category 3 - fluid that passes the spray ignition test specified this standard but may not be capable of passing the wick test.

There are presently the following types of fluids being used that can meet some of the tests required to fire resistant hydraulic fluids.

F1. Oil in Water Emulsions - ISO Designation HFA Fluids

These are typically 5% oil/95% water mixtures and are used in mining for coal face roof support systems. The fire resistance property comes from the large percentage of water in the fluid.

F2. Invert Emulsions - ISO Designation HFB Fluids

These materials are two-phase fluids which usually contain 40% water as homogeneously dispersed particles of micronic or in the case of advanced products, submicronic proportions, suspended within a 60% continuous oil phase. The fire resistance property comes from the large percentage of water in the fluid.

This oil can replace mineral oils without changing seals and packing. However they have the following disadvantages:

• they retain and carry along contaminants more readily than mineral oil

- water levels must be maintained to retain their fire resistant properties
- operating temperatures must be lower than with mineral oils
- operating ambient temperature range is down to about minus 10 degrees Celsius.

F3. Water Glycol Fluids - ISO Designation HFC Fluids

These are true solutions comprising up to 45% water blended into selected polyglycols with additional additives and inhibitors. The fire resistance property comes from the large percentage of water in the fluid.

This material has the following disadvantages:

- water levels must be maintained to retain their fire resistant properties
- it is incompatible with some seals
- operating ambient temperature range is down to about minus 40 degrees Celsius.

F4. Synthetic Fluids - ISO Designation HFD Fluids

Included in these are phosphate esters, which are synthetic materials, obtained by chemical process and derive their fire resistant properties from their molecular structure. In terms of lubrication performance, these fluids are comparable with mineral oil. They are considerable more expensive than mineral oil.

The only present use of these fluids in mining is in British Columbia, where mining regulation 4.8.3 requires that only fluid meeting Category 1 or 2 of CSA M423 can be used for underground hydraulic systems greater than 10 liters in capacity - there are some exemptions for engine systems, totally enclosed brakes, etc.

APPENDIX C

HAZARD ALERT

Polyethylene Ventilation Material in Underground Mines

HAZARD:

Ventilation ducting which is not fire-retardant poses a serious hazard in underground mines. In a recent incident, more than 70 feet of polyethylene ducting burned after it was ignited during blasting. A section of timbered muck fencing was also charred when molten fragments of ventilation material dripped onto it. An investigation found the ventilation material was not fire retardant. Most, though not all, of the ventilation material sold is fire-retardant PVC or polyethylene. Material which is not fire-retardant is ignited easily by a burning match or lighter. The material will melt and drip flaming embers which can ignite other combustible materials. Polyethylene which has been treated to make it fire-retardant may still melt and drip, but the fire will not propagate horizontally along the ducting, and will self-extinguish when the heat source is removed.

PREVENTION:

* Always purchase fire-retardant ventilation materials. To be fire-retardant, ventilation materials must meet CAN/CSA-M427-M91, Fire Performance and Antistatic Requirement for Ventilation Materials. Because of the possibility of a chimney effect, ventilation material used in vertical applications such as shafts, must meet more stringent requirements.

* If non-fire-retardant polyethylene is used, the material should only be used in areas where the propagation of a fire and the products of combustion are of little concern.

Produced by the Mines and Aggregates Safety and Health Association

MASHA
690 McKeown Ave,
North Bay ON P1B 9P1
PHONE: (705) 474-7233 FAX: (705) 472-5800

Information courtesy of Ministry of Labour, Provincial Mining Specialist

APPENDIX D

BACKGROUND:

The OMCSA Task Force on "Fires in Shaft Sinking" met on August 20, 1996 and assigned the task of contacting other jurisdictions to find out their experience in shaft fires and find pertinent regulations or standards. Letters requesting information were sent to the following organizations.

- Mine Safety and Health Administration (MSHA) - U.S.A.
- Health and Safety Executive - United Kingdom
- Dept. of Minerals - Republic of South Africa
- Chief Inspectors across Canada
- Mining Jurisdictions in Australia

Eleven replies were received, with most saying that they had little information on actual fires during shaft sinking. Two replies offered the recommendation that fire resistant hydraulic fluids should be used in such circumstances. MSHA sent us copies of 10 shaft fires in coal mines.

INCIDENTS DURING SHAFT SINKING:

Ontario Fires

The following incident occurred in Ontario. It is the only shaft sinking fire that I could find in the files dating back to 1980.

March 15, 1991 - Dynatec Mining Ltd. - Craig Mine

Incident: Molten slag from a welding operation ignited grease and /or oil and electric cable insulation inside the box column of a sinking stage. Fire extinguishers were unsuccessful in extinguishing the fire. The workers were evacuated from the bottom of the shaft.

Cause: welding.

Preventive Action: More vigilance to wetting down area prior to welding.

U.S.A. Fires

The 10 shaft fires reported by MSHA included 4 during shaft sinking - two of the fires were caused by welding/burning and explosives caused the other two during blasting. The fires occurred in the period from 1970 to 1988. Of the 6 non-shaft sinking fires, all were caused by welding/burning.

One fire occurred in some wooden cribbing at the bottom of an airshaft under development. Welding had taken place for 1.5 hours in the area, but also an electric cable ran into the cribbing. The entire area was destroyed during the fire so that the cause could never be accurately determined.

The second fire caused by welding/burning occurred in the shaft, just above a work deck. Brattice cloth material lining the shaft wall caught fire after a hole was burned in a steel concrete form. A glow was observed coming from behind the form and further examination revealed that the brattice material was burning. An attempt was made to put out the flame but the fire extinguisher was inoperable. The brattice material was burning rapidly and the 5-man crew immediately exited the shaft by the main hoist. The fire burned a section of brattice cloth approximately 25 feet wide and vertically upward for a distance of 136 feet. The investigation showed that the brattice material did not support combustion but that there was methane between the concrete form and the shaft wall and this caused most of the damage.

Safety Alert about Self Rescuers from Queensland, Australia

A safety Alert was made on June 6, 1996 by the Department of Mines & Energy, Coal Mines Inspectorate after an explosion in a colliery involving self-rescuers. Quoting from this Alert:

> "When the explosion occurred, a miner was located in the crib room. As is commonly done, he had removed his self-rescuer and placed it beside him. The explosion threw him some meters and in the resulting zero visibility he was disoriented and unable to find his selfrescuer. His mates, with self-rescuers on, assisted him but quickly found that it took all their efforts to manage their own escape. They had to make the dreadful decision to leave him."

The conclusion states "You must keep your self rescuer on you at all times."

PERTINENT REGULATIONS:

Hydraulic Fluids

British Columbia
4.8.3 Fire-resistant fluids meeting the requirements of CSA Standard CAN/CSAM423-M87 "Fire Resistant Hydraulic Fluids", Category 1 or 2, shall be used in hydraulic systems of greater than 10 L capacity installed on equipment in use underground except in the following cases:
(1) in engine hydraulic systems such as hydraulic valve lifters, hydraulic cooling fan drivers, lubricating system, fuel injection systems, torque converters, transmissions, and axles, and

(2) in braking systems employing totally enclosed friction elements immersed in a liquid coolant, and in braking systems whose hydraulics are independent of any other hydraulic system.

United Kingdom
The Mines Miscellaneous Health and Safety Provisions Regulations 1995.

> 8 (1) Subject to the provisions of paragraph (2) the manager of every mine shall ensure so far as is reasonably practicable that only hydraulic fluids which are both difficult to ignite and satisfy any specifications relating to fire resistance and hygiene approved for the purposes of this regulation are used at the mine.
>
> (2) Where it is not reasonably practicable to use hydraulic fluids, which satisfy the requirements of paragraph (1) the manager shall ensure that appropriate action is taken to avoid any increased risk of fire resulting from the use of the hydraulic fluid.

Hoist Signaling Systems

Mine Safety & Health Administration

> 57.19090 Dual signaling systems.
> There shall be at least two effective approved methods of signaling between each of the shaft stations and the hoist room, one of which shall be a telephone or speaking tube.

Hoist Communication Systems

Western Australia - 1995

> 10.15. (1) The manager of an underground mine must ensure that, unless exempted in writing by the district inspector, a direct form of electronic communication is provided in the mine between the surface and convenient places underground in that mine.

Fire Suppression Systems

Western Australia - 1995

> 10.59. (3) The manager of an underground mine must ensure that, so far as is practicable, automatic fixed fire suppression systems are installed and properly maintained at all underground locations in the mine where oils, fuels or lubricants are stored or dispensed.

British Columbia

4.9.6 (1) All mobile equipment capable of containing more than 25 L of flammable fluids and used in underground mines shall be fitted with a multi-nozzle fire suppression system which operates automatically in the event of a fire. Manual activation of the system shall also be possible from each side of the machine and at the operator's station.

(2) Actuation of the fire suppression system shall also cause engine shutdown.

Northwest Territories - 1988

10.42 (1) Mining equipment equipped with an internal combustion engine and a pressurized hydraulic fluid system that could present a fire hazard if leaking hydraulic fluids contact the engine or exhaust system, shall be fitted with a multi-nozzle fire suppression system in the fire hazard area of the equipment.

(2) The fire suppression system shall provide for manual activation from each side of the equipment and at the operator's station.

(3) Activation of the fire suppression system shall also cause automatic engine shutdown, subject to the override system required by subsection 10.41(3).