RISK MANAGEMENT
AN OIL AND GAS INDUSTRY PERSPECTIVE

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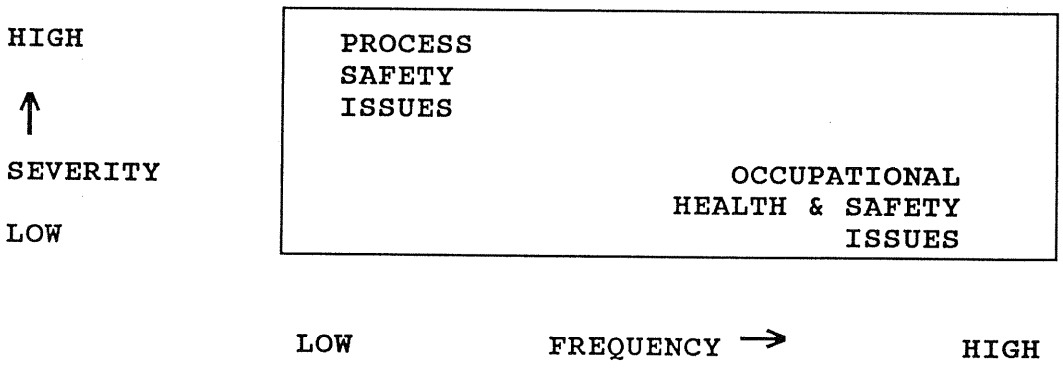
INTRODUCTION

Risk Management has always been an integral part of Oil and Gas Industry activities. The presence of large volumes of toxic and flammable materials, the use of high pressures and temperatures, the high capital cost of plant and equipment and the potential for off-site impacts up to kilometres beyond plant boundaries, has meant that risk management has been an essential strategy for the industry's survival.

The purpose of this paper is to provide an overview of some of the key aspects of risk management as practiced from a safety point of view in the Oil and Gas Industry.

SAFETY MANAGEMENT

In the Oil and Gas Industry, a key distinction is made between two types of safety management - occupational safety and process safety. Occupational safety refers to those incidents/situations where the outcome is injury to an individual or relatively minor property damage. Process safety refers to those types of incidents/situations where the nature of the hazard is intrinsic to the process itself and where the potential consequences are major. The figure below illustrates the relationship between the two areas of safety management.



Occupational health and safety refers to those types of incidents that have (or may have) a relatively high frequency but relatively low severity e.g. first aid, medical treatment injuries. Process safety on the other hand, refers to those types of incidents that have (or may have) a relatively low frequency but high severity, e.g. refer contents of Table 1.

This distinction is important because it necessitates a different approach to safety management in each situation. For occupational health and safety, issues can be addressed by

- Incident investigation
- Review of historical dates
- Risk management (predictive)

For process safety, issues are addressed by

- Incident investigation
- Risk management

Given the relatively small number of incidents, process safety management must rely upon predictive risk management approaches. It is this latter topic that the current papers seek to address by providing an overview of the elements of a process safety management system.

SELECTED MAJOR INCIDENTS IN THE PROCESS INDUSTRIES				
Date	Location	Chemical	Event	Death/Injury
1921	Oppau , Germany	amm. nitrate	explosion	561d
1942	Honkeiko	coal dust	explosion	1572d
1944	Cleveland, USA	LNG	explosion	131d
1947	Texas, USA	Amm. nitrate	explosion	576d
1948	Ludwigshafen	dimet. ether	explosion	207d
1956	Cali, Colombia	dynamite	explosion	1100d
1968	Hull, UK	acetic acid	explosion	2d, 13i
1969	Basle, Switzerland	nitro liq.	explosion	3d, 28i
1969	Teeside, UK	cyclohexane	fire	2d, 23i
1970	Philadelphia, USA	cat. crack	fire	1d, 50i
1971	Houston, USA	VCM	BLEVE	1d, 50i
1972	Brazil	butane	explosion	37d, 53i
1972	Netherlands	hydrogen	explosion	4d, 4i
1973	Potschefstroom	ammonia	toxic	18d
1974	Flixborough, UK	cyclohexane	UVCE	28d, 53i
1975	Antwerp, Belgium	ethylene	explosion	6d
1976	Baton Rouge, USA	chlorine	toxic	10,000 evac
1976	Houston, USA	ammonia	toxic	6d, 200i
1976	Seveso, Italy	dioxin	toxic	1000+ i
1977	Columbia	ammonia	toxic	30d, 22i
1978	San Carlos de la Rapita, Spain	propylene	fire/explosion	211d
1978	Chicago, USA	H2S	toxic	8d, 29i
1979	Bantry Bay, Eire	oil	explosion	50d
1984	Bhopal, India	MIC	toxic	2500d, 250,000+i
1984	Mexico City	LPG	fire/explosion	450+ d
1986	Rhodes, NSW	oil	explosion	5d
1986	Chernobyl, USSR	nuclear	fire/radiation	31d
1986	Sandoz	various	fire	environmental
1987	Laverton, Vic	hot-metal	explosion	2d
1987	Cairns, Qld	LPG	BLEVE	1d, 5i
1989	Ufa, USSR	LPG	explosion	?d, ?i
1989	Pasedena, USA	gas	explosion	23d
1990	Sydney	LPG	BLEVE	damage

PROCESS SAFETY MANAGEMENT

The requirements for process safety management in the Oil and Gas Industry are addressed by various items of legislation and codes throughout the world. For example, the American Petroleum Institute has issued API Code 750 "Management of Process Hazards". Issues typically addressed by such codes include:

- Process knowledge and documentation
- Process hazards analysis
- Operating procedures
- Training
- Management of contractors
- Pre-start up safety review
- Process and equipment integrity
- Safe work practices
- Management of change
- Incident investigation
- Emergency response
- Accountability
- Human factors
- Standards, codes and laws
- Enhancement of process safety knowledge
- Audit of process safety management systems

The following sections provide a summary of the key aspects required to be addressed under some of these elements.

PROCESS SAFETY INFORMATION

- Process chemicals
- Process design information/technology
- Mechanical design information/technology

PROCESS HAZARDS ANALYSIS

- Possible methodologies
- Content of assessment
- Requirements for analysis team

OPERATING PROCEDURES

- Operating phases
- Operating limits
- Safety and health considerations
- Changes
- Safe work practices

TRAINING

- Induction
- Refresher
- Nature of records

CONTRACTORS

- Employer's responsibilities
- Contractor's responsibilities

PROCESS/EQUIPMENT INTEGRITY

- Critical equipment
- Written procedures
- Maintenance training
- Inspection and testing
- Quality assurance

MANAGEMENT OF CHANGE

- What is change?
- Modification assessment

EMERGENCY RESPONSE

- Action plan
- Alarm system
- Training of response personnel
- Control centre facilities

APPLICABILITY TO MINING INDUSTRY

It is not possible in this short paper to explore the applicability of each of the abovementioned elements of a process safety management system to the Mining Industry. Obviously, many are directly applicable, and many are currently addressed in various manners. It is worthwhile, however, to indicate briefly how one specialised technique could be applied within the Mining Industry.

THE HAZARD AND OPERABILITY (HAZOP) STUDY

HAZOP is technique used to identify hazard and operability problems in a design. HAZOP uses an inter-disciplinary team drawn from those groups with particular interest in a process, e.g. design, operations, safety, maintenance personnel. Hazard and operability problems are identified by considering if and how deviations might occur from design behaviour. This is done by the use of a set of "guide words" which are used to suggest possible deviations.

In the Oil and Gas Industry, a customised set of guide words is used, but these are based upon a more basic set:

None	As well as
More of	More than
Less of	Other than
Reverse	Sooner than
Part of	Later than

It is a relatively simple task to develop a set of industry or process specific guide words. This is done by identifying key process parameters and variables and applying the general guide word to each parameter or variable. For example, if material flow is a key parameter:

none + flow	=	no flow
more of + flow	=	more flow
		etc. etc.

These specific guide words can then be applied to the process with the aim of determining whether deviations from design behaviour could lead to situations of high flow, no flow etc. Thus, hazards and operability problems are identified. The set of guide words used in a Mining Industry application are likely to be different from those used in an Oil and Gas Industry application, but the basic HAZOP methodology would still apply.

CONCLUSION:

The aim of this paper has been to provide an overview of some of the key aspects of process safety management in the Oil and Gas Industry. It has also aimed to provide an indication of how one specialised technique (i.e. HAZOP) can be generalised to apply in the Mining Industry. Developing and modifying Oil and Gas Industry approaches to risk management is potentially a mechanism for culture change in the Mining Industry.