Environment Canada | Ontario Region | Environmental Protection Branch

TABS ON CONTAMINATED SITES

Contaminated Sites Program - Federal Sites

This is one in a series of Technical Assistance Bulletins (TABs) prepared by Environment Canada-Ontario Region for Federal Facilities operating in Ontario.

TAB #18

Risk Management for Contaminated Sites

Acceptable & Unacceptable Risk

DESCRIPTION:
Risk assessment and its management framework are tools that are available at all stages in the history of a contaminated site. For example, risk management may be used in the concept design, operation, privatization and termination stages of a project. The earlier the method is applied, the easier and cheaper the decisions affecting risk can be implemented. In this TAB, an understanding of the meaning and application of 'risk management' is further explored (see **TAB #17**: *Risk Management for Contaminated Sites - Framework*).

1. DECIDING IF RISK IS "ACCEPTABLE"

During the decision making step, risk is one of the specific factors to be considered. The particular approach and factors considered, will depend on the situation and the input of regulatory authorities. The results from the risk assessment analysis should be compared to the established target levels.

Other factors to be considered, include:

- professional engineering and scientific judgement;
- public perception of risk (discussed below); and,
- cost (including capital, operating).

Risk perception will greatly influence the type or level of risk considered •acceptable•. The perception of risk may not be the same as the level of risk assumed by those undertaking the study. Public outcry can greatly influence decisions. For this reason, risk communication should be made an integral part of the risk management process. Successful risk communication requires the involvement of the community in the decision making process.The following is an example of how risk can be categorized.

2. DEVELOPING AND EVALUATING ALTERNATIVE MEASURES

Risk control measures should be in place to **prevent** high risk or harmful events, **mitigate** the severity should such an event occur, and **recover** should an incident occur (i.e. emergency response). Further control measures may be required before risk is considered •acceptable•. Risk control is particularly useful as a prevention tool. By reducing risks in a process, or from a contaminated site before an incident occurs, the high costs directed towards remediation (mitigation) and recovery are eliminated. This is why risk management can be a cost effective tool once implemented. The following example shows the increase in cost

savings with an implementation of a risk management plan.

Risk reduction measures can reduce or transfer risk by a variety of ways, including:

EXAMPLE:
The level of effort invested in identifying and prioritizing risks will enhance the effectiveness of decision making and hence, cost savings. For example, a risk management approach was adopted for several remote oil and gas facilities. Inspection, maintenance, and related spill prevention costs with and without risk based approaches were projected. As the level of complexity of risk management increased (from qualitative to quantitative) the projected cost savings increased substantially.

Current annual cost for each facility (without risk-based approach) = $2.5 Million
Annual cost after implementation of Risk Management (Phase I) = $0.5 Million
Annual cost after implementation of Risk Management (Phase II) = $0.125 Million

- preventing chronic or acute incidents (e.g. locking exposure pathways with controls);
- reducing exposure in terms of duration or concentration of living organisms;
- reducing discharges to the environment;
- reducing the risk to site workers;
- replacing activity or process that causes risk (e.g. excavating source of release); and,
- using alternate remediation technology.

At a contaminated site, different remedial options may offer different advantages and disadvantages. Selection of alternate remediation and monitoring methods may be used along with the use of engineering controls, monitoring controls, administrative controls, and personal protective equipment. When developing and evaluating risk control measures, some additional factors should be considered, including:

- hazards and risk caused from risk reduction and control measures;
- ease of implementation (e.g. is the technology proven?);
- effectiveness (e.g.. is the technology effective over the short-term or the long-term?); and,
- costs of implementation, monitoring and control.

3. DEMONSTRATING "ACCEPTABLE" RISK REDUCTION

When deciding on risk control measures, it is necessary to justify that reasonable measures have been taken to ensure risk reduction (see **Figure 1**). This will help in deciding if the risk is •acceptable•. Decision making methodologies have been developed for evaluating risk reduction alternatives. These methodologies may be interpreted and implemented differently. They should be used only after consultation with risk management specialists and regulating authorities.

4. RISK CATEGORIZATION

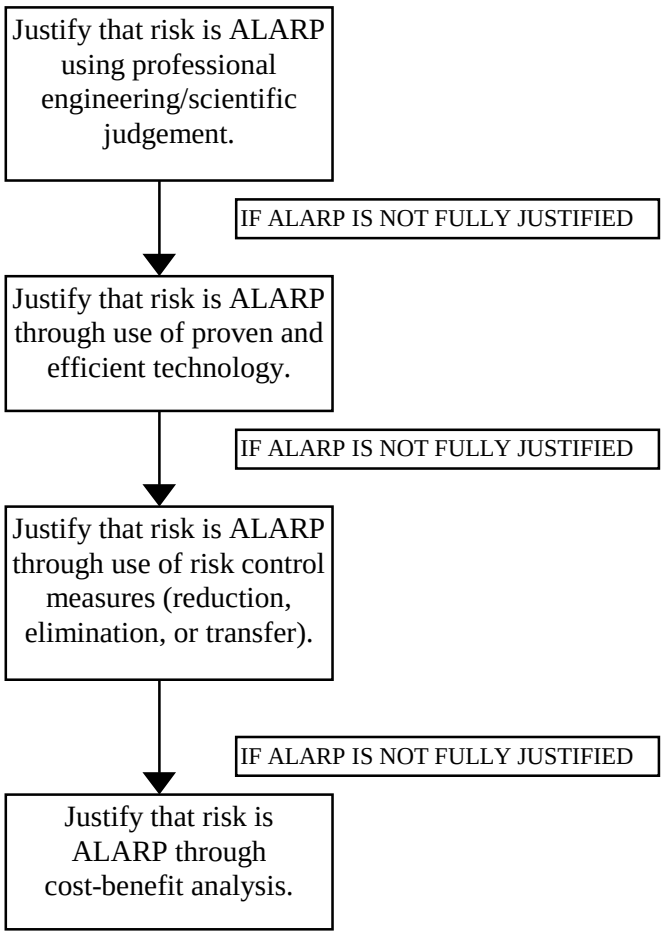
Besides regarding risk as "acceptable" or "unacceptable", it can also be labelled as "negligible", "intolerable" or "tolerable." Example 1 illustrates the latter categorization.

5. PLANNING

Plans should be documented throughout the risk management process. The use of risk management as a decision making tool and as a method of ***due diligence*** requires extensive planning and documentation. As a management system, it is imperative that decisions, judgements and any action resulting from the risk assessment stage are clearly documented. The entire basis of risk management is to identify, prioritize and consider risks as either acceptable, or unacceptable. Each identified risk should be •closed out• with justification as to why it is acceptable, unacceptable, significant or not significant.

The following should be completed or updated during the planning stage:

FIGURE 1: Recommended Procedure to Justify Risk Reduction: ALARP



EXAMPLE 1: (Refer to ALARP Diagram in TAB #17)

If Target Level A = 10^{-4}
If Target Level B = 10^{-6}

And	Then
Risk is found to be 2 x 10^{-7}	Risk is in "***Negligible"*** Region and is acceptable. (Risk is less than B)
Risk is found to be 7 x 10^{-3}	Risk is in ***"Intolerable"*** Region and further risk reduction measures are required to proceed. (Risk is greater than A)
Risk is found to be 3 x 10^{-5}	Risk is in ***"Tolerable"*** Region. (Risk is less than A and greater than B.) Risk is acceptable if it can be justified that all reasonable and practicable measures have been taken to reduce and control risk.

- a clear description of the performance objectives and regulatory requirements (Target Levels);
- details on how objectives will be met;
- designation of responsibility for achieving and maintaining Target Levels;
- details concerning •on-going• implementation and monitoring;
- resources required for •on-going• implementation and monitoring;
- details of responsibilities for financial resources and assurance of asset stability;
- documented significant hazards (including source and effect) and associated risk reduction measures;
- mechanism, procedure, funding and responsibility for action should non-compliance or failure in meeting objectives arise;
- time scales for implementation;
- mechanisms for evaluation and follow up;
- programs for motivating and encouraging personnel towards objectives;
- emergency response procedures; and,
- safe work procedures.

6. IMPLEMENTATION AND MONITORING

There are two types of monitoring that should be used at a contaminated site:

- active; and,
- reactive.

Active monitoring is concerned with the achievement of plans, objectives and extent of compliance in the absence of an incident, accident or damage.

Examples of active monitoring are:

- indirect (managers check effectiveness of the monitoring activities carried out by their subordinates);
- periodic reports;
- physical inspections of the site;
- environmental monitoring;
- health monitoring;
- communications with municipality and community;
- direct observation, by site supervisors, of work performed to ensure compliance with procedures; and,
- quality control measures.

Reactive monitoring involves recognizing and reporting accidents or incidents. Reactive monitoring may require that employees are trained to recognize and appreciate the importance of reporting. Cross referencing documentation may also be used to reveal inconsistencies.

Examples of elements that lead to reactive monitoring, include:

- ill health to humans and/or animals;
- injuries;
- releases;
- damage to environment or ecosystems; and,
- breakdowns in management system.

SUMMARY

Risk management is a systematic process which can be applied at contaminated sites to objectively deal with a wide variety of health, safety and environmental issues. The process of risk management starts off with the definition of the objectives, assumptions and formal Target Levels (performance objectives and legislative requirements). Significant hazards are then identified and their risks determined in more detail. Results from this study are then compared against the target criteria, and those risks that are still not fully •acceptable• can be further reduced using risk control measures. Continuous monitoring provides feedback for hazard identification, and the cycle can be continuous.

GLOSSARY OF TERMS

ALARP (As Low as Reasonably Practicable): A methodology for justifying if risk control measures have reduced risks to reasonable and practicable levels.

Carcinogen: Chemical that may induce cancer (tumour effects).

Hazard: A source of potential harm or a situation with the potential for harm in terms of human injury, damage to health, property or the environment, or some combination of these.

Residual Risk: The risk remaining after reduction is effected by all appropriate risk control measures.

Risk: A measure of the probability and severity of an adverse effect to health, property or the environment.

Risk Assessment: The overall process of risk analysis and risk evaluation.

Risk Control: The process of decision making for managing risk and the implementation, enforcement and re-evaluation from time to time, using the results of risk assessment as an input.

Risk Management: The systematic application of management policies, procedures, and practices to the tasks of analyzing, evaluating, controlling and communicating risk.

Target Levels: Performance objectives and legislative requirements. Some are qualitative and some can be quantitative. May contain regions where further justification is required using method such as ALARP.

Threshold Acting Chemicals: Chemicals that display a threshold effect (below a specific dose, they fail to induce any adverse effect).

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