PROJECT ENVIRONMENTAL RISK MANAGEMENT

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Abstract

Engineering projects both for green field or existing sites offer a great opportunity for the reduction of risk, and consequently improvement in environmental performance. Alcoa has developed an environmental risk management process to ensure the design engineer is aware of the environmental aspects that need to be addressed in their project's design.

The risk assessment process developed is based in the AS/NZ 4360. The generic steps being:

- set the context for which the risk assessment will apply,
- identify the environmental aspects,
- determine the probability and consequences of these aspects and
- rank the risk.

There are several factors that are key to conducting a successful environmental risk assessment. Firstly it is important to have the right team members to ensure the relevant knowledge base is present. Conducting the assessment at the right point in the project development is also critical to success. If the assessment is too early, nothing is defined and hence there is nothing to assess. If it is too late and budgets and design have been finalised, strong resistance can be encountered in trying to reduce any identified unacceptable risks. Finally, we have found that a management program must be in place to follow these issues through the design process to ensure adequate solutions are found which do not shift the problem to another area.

Conducting Environmental Risk Assessments within Alcoa West Australian operations delivered a quantifiable improvement in the quality of projects delivered.

1. Introduction

Engineering projects both for green field or existing sites offer a great opportunity for the reduction of risk, and consequently improvement in environmental performance. Alcoa has developed an environmental risk management process to ensure the design engineer is aware of the environmental aspects that need to be addressed in their project's design.

2. Background

The introduction of ISO 14001 has brought risk management to the forefront of the environmental field. Environmental aspect identification required organisation to formally identify their environmental risks. Determination of the significant aspects required organisations to analyse and rank these risks. The remainder of the standard details the generic processes for risk management.

Subsequently a number of other risk standards have been developed including HB 203:2000 Environmental Risk Management — Principles and Process, AS 4360 — 1999 Risk Management and a draft ISO standard for Risk Management.

Further to these standards the field of risk communication has been growing. The importance of sharing process and results with stakeholders is critical in the success of these processes.

3. Risk Management Process

Risk management involves the identification of the risk, determination of its acceptability and then as required the treatment of this risk to ensure it is taken to an acceptable level.

It is extremely important to have the right team members present when conducting a risk assessment. This ensures the best knowledge base. The details of their knowledge can be checked/confirmed with the reports and databases but without the right people the reports and databases are relatively useless. Accordingly the results of the assessment are likely to in appropriate. In contrast, with too many people the processes will be difficult to facilitate and tend to drag with considerable debate that provides little improvement to the results of the assessment.

The following is a discussion of the steps taken in conducting risk assessment and then treatment. A template for recording the results can be found in Appendix 1.

3.1 *Establish Context*

The first step in the process of risk assessment is to define the scope of the application. Each time a study is initiated, specific boundaries must be set, including:

- **Geographical area** — facility, department, equipment or area
- **Phase of Operation** — design, installation, start-up, operation, trouble-shooting, maintenance, upset condition, emergency condition
- **Nature of Study** — identify specific type of hazard or all hazards
- **Establish the Criteria** — where existing Risk Criteria are not suitable, develop the risk criteria for the particular risk assessment.

3.2 *Identify Risks*

The objective of this step is to identify all risks applicable to the scope, including what, why and how risks can arise. There are several methods available to assist this phase of the study. Alcoa generally use a structured brainstorming process as an effective way of gathering the collective information from the team. It is important when identifying risk that one considers the various phases of operations including: start-up, shutdown, maintenance emergencies etc. See Appendix 2 for a copy of the matrix

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that is used as a tool in the brainstorming to ensure all aspects of the project are covered.

At this step of risk identification the aspects, impacts and planned controls are identified and documented for further assessment. It is important to document the planned control and hence the basis for which the assessment will be carried out. Examples of risk controls include engineered features, operating procedures, warning devices, guards and barriers.

3.3 *Analyse Risks*

The purpose of risk analysis is to consider the relative risk of each identified risk in terms of potential severity (consequences) and probability (frequency) of an incident resulting from the identified risk. Free and open discussion of uncertainties must occur for the effective use of risk analysis.

Analysis of risk can be either qualitative or quantitative in nature. Within Alcoa we have found that qualitative studies provide reliable results with significantly less work. Thus are more readily undertaken.

Qualitative analysis relies upon the judgment and experience of those persons conducting the analysis. Care must be exercised to ensure that when using qualitative analysis, that the most credible severity and probability estimates are used, not the worst case imaginable. If several outcomes/level of impacts are possible each level impact should be assessed separately as the probability and consequences is likely to be different.

A recent addition to the Alcoa process is a rating of confidence regarding the probability and consequence is determined. This is then used in the final evaluation when determining what if any further investigations are required.

The definitions for consequence and probability are given in Tables 1 and 2. The table of consequences has three columns for environment, regulatory and community risk. Within Alcoa we have found it useful to break these issues up when ranking the risk. Taking the category with the highest raking as the consequence ranking. The issue of ranking even more disciplines such as safety shall be discussed in Discussion and Conclusions.

3.4 *Evaluate Risks*

The purpose of risk evaluation is to compare and identified severity and probability of a risk to pre-established criteria. This step is accomplished by plotting the risk analysis results on a matrix, resulting in an overall risk rating for each identified risk that has been analysed. This evaluation separates and priorities risks to aid in determining the allocation of resources to the required corrective or preventative actions.

Table 1 — Probability Definitions

Rating	**LIKELIHOOD** The potential for problems to occur and lead to the assessed consequences			
A	Almost certain	Very high, may occur at least several times per year	Probability over 0.8	A similar outcome has arisen several times per year in the same location, operation or activity
B	Likely	High, may arise about once per year	Probability 0.5–0.8	A similar outcome has arisen several times per year in Alcoa
C	Possible	Possible, may arise at least once in a one to ten year period	Probability 0.1–0.5	A similar outcome has arisen at some time previously in Alcoa
D	Unlikely	Not impossible, likely to occur during the next ten to twenty-five years	Probability 0.04–0.1	A similar outcome has arisen at some time previously in Alcoa worldwide
E	Rare	Very low, very unlikely during the next twenty-five years	Probability less than 0.04	A similar outcome has arisen in the world-wide industry, but not in Alcoa worldwide

Table 2 — Consequences

Rating		**Environment**	**Regulatory**	**Image & Reputation**
A	Catastrophic	Long term environmental damage (5 years or longer), requiring >$5 million to study or correct or in penalties	Regulatory intervention and prosecution possible	Damage to corporate reputation at international level; raised in international media Major loss of shareholder, political or community support
B	Major	Medium-term (1-5 yr) environmental damage, requiring $1 to 5 million to study or correct	Breach of licenses, legislation, regulation or Corporate-mandated standards	Damage to corporate reputation at national level; raised in national media Significant decrease in shareholder, political or community support
C	Moderate	Short-term (<1 yr) environmental damage, requiring up to $1 million to correct	Breach of standards, guidelines or impending legislation, or subject raised as a corporate concern through audit findings or voluntary agreements	Adverse news in state or regional media Decrease in shareholder, political or community support
D	Minor	Environmental damage, requiring up to $250,000 to study or correct	Exceedance of internal procedures or guidelines	Adverse news in local media Concerns on performance raised by shareholders, political or the community
E	Insignificant	Negligible environmental impact, managed within operating budgets	No breach of licenses, standards, guidelines or related audit findings	Reference to community consultation group Public awareness may exist, but there is no public concern

Table 3 — Risk Matrix

		Consequence				
Likelihood		Insignificant	Minor	Moderate	Major	Catastrophic
		V	IV	III	II	I
A	Almost certain	Low	Medium	High	High	Extreme
B	Likely	Low	Medium	Medium	High	Extreme
C	Possible	Low	Medium	Medium	High	High
D	Unlikely	Low	Low	Medium	Medium	High
E	Rare	Low	Low	Medium	Medium	Medium

3.5 *Treat Risks*

Treating risks includes the corrective or preventive actions taken as a result of the risk evaluation. The real benefit occurs at this stage where unacceptable risks are treated to become acceptable. In fact one is more liable having identified the risk and done nothing about it than without identification.

The purpose of implementing countermeasures is to reduce the overall risk rating. This can be accomplished by reducing the potential severity and/or the probability of occurrence. All actions must be seen through to completion. The countermeasures can take many forms including:

- Eliminating tasks or equipment
- Administrative procedures
- Training
- Personal Protective Equipment
- Equipment modification
- Installation of barriers or warning devices

The level of accountability and responsibility of a risk treatment is dependent on the level of risk identified in the risk assessment. Table 4 below details the relative levels used at Alcoa.

Table 4 — Risk Level Treatment

Risk Level	Responsibility/Accountability
Extreme	Executive Management
High	Management or Supervisor
Medium	Individual
Low	Within Operational processes

3.6 *Review*

Periodic review and re-evaluation is critical to the ongoing effectiveness of the risk management process. Each project or study that is completed is only one step in the risk management cycle. Once countermeasures are implemented, risk should be reanalysed to ensure the desired results were achieved.

Facility leadership must ensure that the overall risk management plan remains current and relevant to the existing climate.

4. Discussion and Conclusions

Qualitative risk assessments have been found to be an excellent means of collating information held by a group of peoples and reaching a consensus on the projects viability. The transparency of the process facilitates participators and stakeholders alike to accept the outcomes. Transparent process also makes the accepting of risk easier. In an environment of risk adverse engineers' decisions are often overly cautious. This process allows the risks to be clearly explained to all and hence when accepted shared.

Initially our Americans partners have been reluctant to accept the merits of qualitative risk assessments. They have been driven by the superfunds site investigations and the USEPA down the path of quantitative risk assessments. Through application of this process to determine risk regarding mercury emission for all refineries worldwide we have been able to demonstrate the merits of qualitative assessments. The process is being readily undertaken at all locations as a result of its simplicity and relatively short time to undertake the study. The overall cost was orders of magnitude lower than a quantitative analysis and yet producing extremely useful results that enabled the organisation to priorities any research and funding.

In an effort to be more efficient Alcoa has grappled with the question of whether risk assessments should be conduct for more than on disciple (eg safety, finance etc) at a time. Alcoa has risk criteria for 8 difference categories. Generally it has been found that when conducting detailed risk assessment it is advised to cover one discipline but when conducting high level assessment all disciplines can be covered well concurrently.

Communication risk is important. To facilitate this all risk analysis must be open and transparent — underlying assumptions, uncertainties, and methods must be understood, communicated, and documented. Throughout the process communication must be an ongoing dialogue among interested stakeholders. Feedback should be actively sought to minimise misunderstandings. It is human nature to want to avoid exposing all of the details of assumptions and uncertainties that are an inevitable part of the risk analysis process. However, it is essential to long-term confidence in the process that assumptions and uncertainties be openly discussed.

To implement an effective risk management system one must ensure the culture of risk assessment and management if fully adopted. Using a simple and transparent process and ensuring good communication will enhance any operations decision making and effective utilisation of resources.

References

ID #02-15 (04/15/02) Statement on the Role of Risk Analysis in Decision-making. AMSE International position Statement 2002.

Australia/New Zealand Standard AS/NZS 4360. 1999 Risk Management.

DRAFT ISO GUIDE 73 (Geneva edition — July 27, 2001) — Risk Management — Vocabulary — Guidelines for use in standards.

Appendix 1 — Environmental Risk Assessment Template

	Environmental Risk Assessment for											
	Date Held:											
	Project No.:											
	Facilitator:											
	Present:											
	Comments:											
No	**Project Phase**	**Aspect**	**Impact**	**Control**	**Prob**	**Severity**	**Category**	**Risk**	**Actions**	**Responsible**	**Date**	**Comments**
	Start-up	Purging of gas system	Increased ambient dust	ESP	A	IV	Env	Med				

Appendix 2 — Brainstorming Matrix

Environmental	Start Up	Shut down	Normal Operations	Up/Downstream Process	Emergency	Maintenance
Abrasive Blasting						
Caustic Mists						
Contamination of Soil and Water						
Dark Smoke						
Dieback						
Dust						
Fauna						
Greenhouse Gases						
Hazardous Materials						
Mercury and other heavy metals						
Natural Water Courses						
Noise						
Odour						
Ozone Depleting Substances						
Raw Material and Resource Usage						
Residue Management						
Sewage						
SO 2 /NOx/ VOCs						
Vegetation						
Waste Generation and Disposal						
Waste water						