

## INDUSTRIAL SITE DECOMMISSIONING

M.J. RIDDLE, A.E. OSBORNE, AND R.B. GEDDES

MONENCO CONSULTANTS LIMITED

### ABSTRACT

Monenco Consultants Limited of Calgary has been actively working on industrial site decommissioning projects for over seven years. Decommissioning work has included site investigations and environmental audits all the way to development of cleanup criteria and materials removal from industrial sites. This background and experience has been integrated into this presentation on industrial site decommissioning.

### INTRODUCTION

A company decision to close an industrial plant is based almost exclusively on economics. Generally, in preparation for a senior management decision regarding plant closure, a significant planning exercise is completed. The economic, human and political aspects of a plant closure are normally stressed; however, at this point in the planning process, company management has probably not had a proper basis to adequately consider the environmental implications of closing a plant, particularly the need for a cleanup program.

Plant closure is more extensive than simply shutting down the process and dismantling and removing the equipment, buildings and attendant facilities. Years of plant operations have frequently resulted in accumulations of liquid and solid wastes, as well as sludges and sediments from wastewater treatment and product storage. In addition, during the operating life of a plant, spills and leaks of process chemicals, products and by-products may have caused contamination in the plant area. As a result, the overall plant shutdown program must include consideration of probable contaminated soils, sludges, sediments, surface waters and groundwaters and the subsequent formulation of a cleanup program aimed at leaving the site in a safe condition, from both an environmental and human health standpoint, consistent with the proposed future use of the site.

### WHAT IS DECOMMISSIONING

The decommissioning and cleanup of an industrial plant site is not unlike plant design, construction and commissioning, in as much as decommissioning activities require conceptual and detailed planning, management systems, site investigations, design of remedial actions, demolition and site cleanup, cost controls and approvals. Accordingly, decommissioning and cleanup programs require significant commitments of corporate resources.

The objective of industrial site decommissioning is to leave the site in a safe condition consistent with its proposed future use. Environmental and human health concerns are key ingredients in any determination of what is a "safe condition". Decommissioning can provide a significant benefit to the company through the sale or reuse of the site for industrial or other land uses.

A successful industrial site decommissioning and cleanup program will consider the following factors:

1. Management, planning, scheduling and cost estimating;
2. Shutdown of process equipment;
3. Disposal of excess raw materials, intermediates and final products as well as other supplies;
4. Lay off, transfer, or retirement of plant site employees;
5. Assessment of the nature and extent of site contamination;
6. Development of site cleanup criteria;
7. Development and implementation of a site cleanup plan;
8. Dismantling and disposal of equipment and other on-site facilities;
9. Future use evaluations or disposal of the plant site; and
10. Liaison with the public, government and the media.

It must be recognized that each site is different, and will therefore require consideration of the above factors to differing degrees.

#### POTENTIAL DECOMMISSIONING SITES IN ALBERTA

It is estimated that by 1990 approximately 20% of Canada's pre-1984 industrial capacity will be shutdown for economic reasons. This massive plant closure program will be brought about largely by obsolescence, decline in feedstock and age of industrial facilities constructed in the 1940s, 50s, and 60s. Certainly, changes in industry from manufacturing to a more service-based economy will have a major impact on decisions regarding plant closure. This situation will be further exacerbated by the impact of high technology.

In Alberta, the hub of Canadian oil and gas activity, there are over 400 gas processing plants (OilWeek, 1986 January 1) and four operating oil refineries. Of the gas plants listed, approximately 16 are currently described as demolished, abandoned, shutdown or partially operative. Three oil refineries have been closed over the last 20 years in Alberta; the Texaco Canada refinery in Edmonton, the Gulf asphalt refinery in Calgary and the now notorious Imperial Oil refinery, located on Ogden Road in Calgary. Approximately 30 more gas plants are likely to be closed down between now and 1990.

As well as process facilities associated with the oil and gas industry, there are a number of other types of operations that require adequate decommissioning and cleanup. These operations include: fertilizer and chemical plants, battery plants, rail yards and loading docks, industrial waste handling and disposal facilities and thermal electric power plants. It is estimated that in Alberta, 10 major industrial facilities are likely to be closed down between now and 1990.

The potential application of the decommissioning process exists across Alberta in a wide range of industries. A few facilities previously shut down in Alberta have been decommissioned and cleaned up. The Gulf gas plant in Pincher Creek and a major explosive plant in Calgary are two well known examples. However, major steps in the decommissioning process, such as the development and implementation of a cleanup plan based on future land use evaluations, have often been omitted or indefinitely postponed at other less publicly well known sites.

#### DIFFERENCES AND SIMILARITIES BETWEEN DECOMMISSIONING AND TRADITIONAL RECLAMATION

The process of reclamation, although often directed at a different set of problems than decommissioning, has many similarities. These similarities include:

1. A need for corporate and government commitment;
2. Long-term approach is recommended;
3. Equipment to protect the environment and human health and well-being;
4. Concern about re-use of a resource (land); and
5. Technical details (site evaluation, sampling, analysis, quality control, materials handling, etc.).

The main differences between reclamation and decommissioning include:

1. Reclamation deals mainly with disturbed land usually in the context of resource extraction (e.g., surface mining); and
2. Decommissioning is concerned with the rehabilitation of land used by an industrial facility.

#### HOW WILL DECOMMISSIONING BE DONE?

Monenco Consultants Limited has published a guide to the Environmental Aspects of Decommissioning Industrial Sites (Monenco Consultants Limited 1985). The guide points out that industrial site cleanup activities will vary from site-to-site and will be specific to industry type, products and by-products, age of the plant, location of the site (geography, geology, hydrogeology, climate), waste management practices and proposed future land use. Provincial and local government concerns may also influence the approach to cleanup.

The decommissioning guide stresses the need to facilitate the development of a cleanup program that will be:

1. Sensitive and flexible to industrial site conditions; and
2. Cost effective.

The guide identifies a number of important factors to consider in the planning and implementation of industrial site decommissioning and cleanup. These factors are as follows:

1. Decommissioning planning;
2. Plant site assessment;
3. Site investigation using a phased approach;
4. Establishment of cleanup criteria (how clean is clean?) based on either existing standards (absolute methods) or on risk assessment techniques (relative methods);
5. Site cleanup;
6. Confirmatory analysis;
7. Long-term monitoring;
8. Regulatory agency involvement; and
9. Public relations.

For existing facilities, implementation of cost effective preventive measures can ultimately reduce the cost of decommissioning. Moreover, follow-up, through environmental audits is necessary to ensure the measures are applied in an effective manner.

#### THE ROLES OF GOVERNMENT, INDUSTRY AND THE PUBLIC IN DECOMMISSIONING

In Canada, jurisdiction for decommissioning activities is primarily a provincial concern. While certain provincial and federal environmental regulations respecting discharges of wastewaters to surface waters and the operation of landfill sites can be applied to the cleanup of industrial plant sites, only the Province of Ontario has developed guidelines specific to the decommissioning of industrial plant sites. Generally, regulatory agencies approach plant decommissioning on a case-by-case basis. Quebec and Alberta are presently studying possible guidelines but have no specific decommissioning/cleanup legislation to date.

The topic of public and private responsibility in industrial site decommissioning was recently evaluated at two national workshops in Calgary and in Ottawa. At these workshops, discussion groups made up of members of private industry, government and public awareness groups outlined their view of what roles each should play in decommissioning (Environment Canada 1986). The identified roles of the governments, the public and industry are as follows:

##### Recommended Federal Role

- a. Leadership role (to coordinate and to facilitate)
  - Develop or support the establishment of cleanup criteria;
  - Develop national decommissioning guidelines or a procedure for establishing cleanup criteria; and
  - Develop research and development programs for cleanup technologies.
- b. Shared role (with other governments) - Information transfer and public education.



- c. Exclusive role for the administration of decommissioning activities on Federal lands and facilities. Federal lands and facilities should comply with provincial requirements and should have exemplary decommissioning programs.

#### **Recommended Provincial Role**

- a. Legislative authority to issue decommissioning permits and certificates of compliance (it was noted that the provinces should exercise better control over decommissioning activities).
- b. A major provincial role is to develop guidelines and liaison with federal counterparts to adopt national cleanup criteria.
- c. Exercise authority over industrial cleanup activity by ensuring cleanup is carried out effectively and that adequate funds are provided for long-term monitoring.
- d. Land title should be used as a method of restricting future land use.
- e. Provinces should assist small industries (plants) in their decommissioning activities.
- f. The public should be assisted to provide input to decommissioning activities such as education and government liaison.

#### **Recommended Municipal Role**

- a. Responsible for land use designation (zoning). The zoning system should "flag" potential problems and zoning restrictions should remain in effect in perpetuity (Municipal rezoning may conflict with environmental protection, e.g., should a decommissioned refinery site be zoned industrial forever?)
- b. Regional Medical Officer of Health should be involved in decommissioning activities.

#### **Recommended Public Role**

- a. Industries have several publics including immediate plant neighbours, business community, local government, environmental groups and the media. Industry must decide which publics to involve and when.
- b. The public's major role is in education.
- c. Public input to decommissioning is necessary, but effective mechanisms to allow realistic input need to be developed. Formal hearings are one approach but these tend to be rigid and legalistic. Informal meetings are preferred.

- d. There should be public input to criteria development and the forum and method of effective input needs to be developed (use selected public representatives, advance notices, mailings lists, etc.).
- e. The public should be informed using literature, seminars, etc.
- f. The public has a responsibility to ensure that their interests are being well served by federal, provincial, municipal and industrial parties in the decommissioning process. The public plays an invaluable watch dog role.

### **Responsibilities of Industry**

Industry can be held responsible in a number of areas including:

- a. Development of decommissioning and cleanup programs;
- b. Establishment of site-specific cleanup criteria;
- c. Implementation of cleanup programs;
- d. Ensuring adequate government and public involvement; and
- e. Payment of decommissioning and cleanup costs.

### **WHAT IS THE COST?**

The costs of plant site decommissioning vary with the size of the industrial facility, the type of contamination present on site, the degree of contamination present and the type of waste management control practiced over the life of the facility. End land use and the level of cleanup required to render the end land use safe also have a strong influence over cleanup costs.

Key factors in decommissioning costs are site conditions and cleanup criteria. All costs are derived from these two knowns. Since site conditions are fixed the only variable is the level of cleanup. The level of cleanup will then determine the cost.

Recent newspaper and magazine articles would lead us to believe that decommissioning is indeed expensive. Decommissioning costs can run into the millions of dollars, however, one must evaluate the relative cost in light of the per unit value of the product produced over the life the plant. For example, if cleanup of an oil refinery was to cost \$100 000 000 and the refinery processed 500 000 000 barrels of oil over its lifetime, the cost per barrel would be \$0.20. If appropriate waste management and materials handling procedures were followed at the plant site from the outset this cost could be reduced substantially.

A recent study conducted by Monenco Consultants Limited (1986) developed some estimates for cleanup costs associated with coal-fired thermal plants. Some representative costs derived during this study are outlined in Table 1.

## CONCLUSIONS

There are numerous industrial installations which become obsolete every year and are shut down and dismantled. These installations are potential sources of contaminants, which are a potential threat to human health, the environment, as well as future personal and corporate prosperity.

The protection of human health and the environment from the adverse effects of toxic substances is of paramount importance in the decommissioning of industrial sites. Within the past several years, a number of jurisdictions in Canada, the United States and Europe have come to realize the potential health and environmental problems associated with contaminants deposited in the soil by industrial activity, and their possible migration into other environmental media (e.g., air, groundwater, surface water).

In both Canada and the United States, all encompassing environmental legislation is often applied to abandoned, mothballed, and decommissioned industrial plants. This legislation provides the mandate for regulatory agencies to control contamination or pollution of water and soil, and to develop regulations to control practices or activities such as the closure of an industrial plant. Few regulations deal specifically with decommissioning, however, and most regulatory activities rely on the application of guidelines or site-specific approaches.

Given the legislative environment in Alberta, industries must find their own path through the decommissioning process. The approach they follow may in part be based upon good corporate citizenship, economics at the time and public or governmental interest in the particular plant site closure. The final results and cost of the decommissioning program will ultimately depend on the:

1. Physical characteristics of the plant setting;
2. Type and extent of contamination;
3. Level of cleanup required; and
4. Method used to carry out the decommissioning program.

Table 1. Cost breakdown for selected decommissioning activities.

Environmental Concern	Remedial Basis of Technique	Unit Price	Measurement
<u>Coal-Fired Generating Station Ash Disposal Areas</u>			
Soil, Groundwater and Surface Water	Capping	\$1.00/m <sup>2</sup> to \$4.00/m <sup>2</sup>	Disposal Site Area
	Groundwater Collection and Treatment	\$0.50/m <sup>2</sup> to \$10.00/m <sup>2</sup>	Disposal Site Area
<u>Waste Impoundments</u>			
Contaminated Sludge	Treatment/ Secure Landfill	\$100/m <sup>3</sup> to \$300/m <sup>3</sup>	Sludge Volume
Contaminated Soil	Treatment/ Secure Landfill	\$100/m <sup>3</sup> to \$300/m <sup>3</sup>	Soil Volume
	Off-Site Disposal of Contaminated Sludges and Soils	\$300/m <sup>3</sup> to \$1000/m <sup>3</sup>	Sludge/Soil Volume
<u>Process Buildings</u>			
Asbestos	Removal	\$140/m <sup>2</sup>	Asbestos Area
Gutters/Sumps	Cleaning/ Treatment and Disposal Off-Site	\$1700/m <sup>3</sup>	Sludge



In the end, well organized, carefully developed program will leave a particular site safe for future use without imposing unreasonable financial burdens on the various parties involved.

### RECOMMENDATIONS

There are a number of recommendations that have come to light over the past few years as a result of workshops and a heightened public awareness of environmental issues. Some of these recommendations are:

1. Decommissioning and cleanup should be a regulated activity because plant site closure can often result in legal and human health problems;
2. Decommissioned industrial sites, no matter where they are situated, should be cleaned up and left "safe from an environmental and human health standpoint";
3. The cost of decommissioning should be built into the cost of doing business. Technologies are available to cleanup decommissioned sites in a cost effective manner;
4. Government must assume a role in the regulation of decommissioning activities, program approval and certification of site cleanliness.
5. Industry must assume a responsible role in adopting environmentally sound practices and should pay the cost of remedying any environmental concerns;
6. The public must strive to become aware of environmental issues and potential legal and human health risks involved with plant decommissioning activity. The public must also ensure that a forum is available for these issues to be discussed.

### LITERATURE CITED

- Environment Canada. 1986. Workshop on industrial site decommissioning clean-up and re-use. Ottawa, Ontario.
- Monenco Consultants Limited. 1985. Guide to environmental aspects of decommissioning industrial sites. Sponsored by Supply and Services Canada, Ottawa.
- Monenco Consultants Limited. 1986. Environmental and economic implications of decommissioning fossil-fuelled steam electric generating stations - Phase I. Environment Canada, Ottawa, Ontario.
- Oilweek. 1986. Gas processing plant capacities. January 1 issue.

# Proceedings of a Symposium

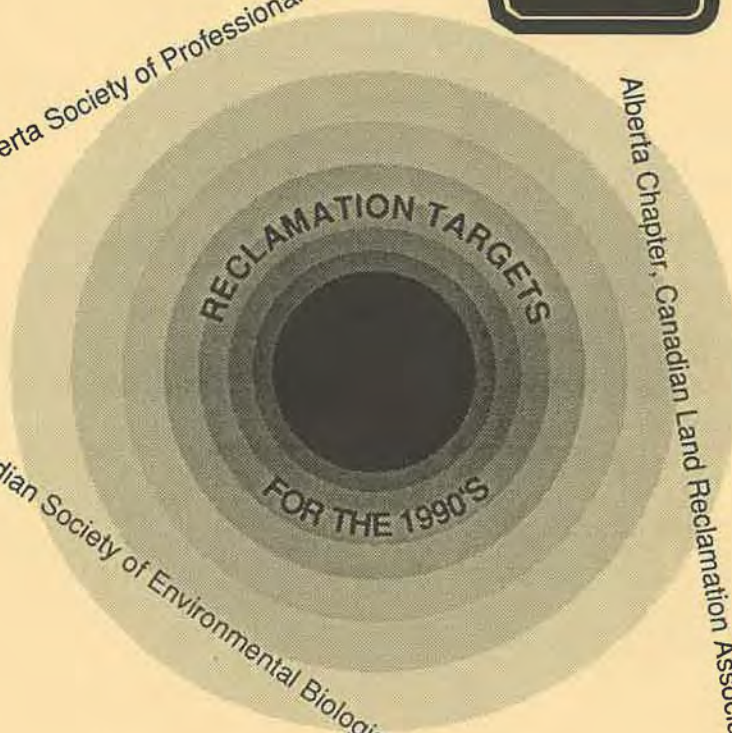


The Alberta Society of Professional Biologists



The Canadian Society of Environmental Biologists, Alberta Chapter

Alberta Chapter, Canadian Land Reclamation Association



Held May 4 & 5, 1987  
Edmonton, Alberta

RECLAMATION TARGETS FOR THE 1990s

PROCEEDINGS OF A SYMPOSIUM SPONSORED BY

THE ALBERTA SOCIETY OF PROFESSIONAL BIOLOGISTS

THE ALBERTA CHAPTER/CANADIAN LAND RECLAMATION ASSOCIATION

AND

THE CANADIAN SOCIETY OF ENVIRONMENTAL BIOLOGISTS - ALBERTA CHAPTER

WESTIN HOTEL  
EDMONTON, ALBERTA  
MAY 4 & 5, 1987

C.B. POWTER, EDITOR

COPIES OF THIS DOCUMENT ARE AVAILABLE AT \$ 15.00

The Secretary  
Alberta Society of  
Professional Biologists  
P.O. Box 566  
Edmonton, Alberta  
T5J 2K8

Canadian Society of  
Environmental Biologists  
P.O. Box 12  
Substation 11  
Edmonton, Alberta  
T6G 2EC

## ACKNOWLEDGEMENTS

The Symposium was organized by Mr. David Reid (Alberta Society of Professional Biologists), Mr. Chris Powter (Alberta Chapter, Canadian Land Reclamation Association), and Mr. Brian Free (Canadian Society of Environmental Biologists - Alberta Chapter). This event marked the first time these three organizations had joined together in a common effort to address an important issue of the day. By all accounts the effort was a success and will serve as a model for future joint efforts.

The Organizing Committee would like to thank:

Mr. J. Green, Mr. B. Free, Ms. N. Ross and Mr. C. Powter: Session Chairmen

Mr. D. Reid and Ms. N. Ross: Corporate donations

Mr. P. Jalkotzy: Displays

Ms. E. Cabral and Mr. D. Walker: Audio-visual

Ms. C. Watson: Press

Ms. J. Smith, Mr. J. Rettalack, Ms. D. Egglestone: Registration

Mr. G. Ash: Accounting

Mr. C. Powter: Hotel, Brochure, Proceedings, Mailing, Registration

Ms. L. Allen: Mailing, Registration

Ms. M. Canafranca and Ms. S. Inn: Typing of the Proceedings

Mr. D. Walker: Cover design

The Organizing Committee would also like to thank the following sponsors, without whom the Symposium could not have been a success:

TRAVEL	Canadian Air Lines (PWA/Time Air)
BROCHURE PREPARATION	Alberta Environment, Research Management Division
BROCHURE DISTRIBUTION	Alberta Environment, Research Management Division Alberta Environment, Land Reclamation Division Alberta Forestry, Lands & Wildlife Alberta Society of Professional Biologists Canadian Society of Environmental Biologists
REGISTRATION PACKAGE	Alberta Agriculture Alberta Environment Alberta Forest Service Alberta Power Limited Alberta Treasury Branches

REGISTRATION  
PACKAGE

Calgary Convention Centre  
Canadian Land Reclamation Association  
City of Edmonton  
Luscar Limited  
Northwestern Utilities Limited

CORPORATE  
DONATIONS

Amoco Canada Petroleum Company Ltd.  
Chevron Canada Resources Ltd.  
Delta Environmental Management Group Ltd.  
Dome Petroleum Limited  
Energy Resources Conservation Board  
Esso Resources Canada Limited  
Gulf Canada Corporation  
Hardy BBT Ltd.  
Integrated Environments Ltd.  
Interprovincial Pipe Line Limited  
Mobil Oil Canada Ltd.  
Monenco Consultants Limited  
Petro-Canada Inc.  
Shell Canada Limited  
Western Oilfield Environmental Services Ltd.

DISPLAYS

Alberta Environment  
Canadian Forestry Equipment Ltd.  
Chemex Labs (Alberta) Ltd.  
Ducks Unlimited Canada  
Environment Canada, Canadian Wildlife Service  
Lakeland College  
Norwest Soil Research Ltd.  
Prairie Seeds

PROCEEDINGS

Alberta Environment, Research Management Division

And a special thank you to our two guest speakers:

Dr. David Samuel, University of West Virginia who spoke on Reclamation to Wildlife Habitat in the United States

Dr. Larry Holbrook, Biotechnica International of Canada, Calgary, Alberta who spoke on Biotechnology and Biologists

- and -

to the Hon. Ken Kowalski, Minister of Environment, for delivering the opening address.



## MESSAGE FROM THE ORGANIZING COMMITTEE

Reclamation practitioners and researchers have gone a long way to solving the problems posed by such disturbances as mining, drilling and pipeline construction. The future challenge for reclamation lies in applying our expertise in other areas such as industrial site decommissioning, habitat creation and restoration, and urban design.

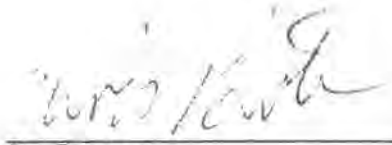
The Symposium was designed to expose participants to a wide variety of "new" areas where reclamation science could be applied. These were the "targets" referred to in the Symposium title. The speakers did an excellent job in meeting this goal. Some of the participants felt the Symposium had not provided enough information on new methods to be employed in reclaiming these new disturbance types. While this was not the goal of the Symposium it remains a valid concern that should be addressed in a future symposium.

Finally, the Hon. Ken Kowalski, Minister of Environment, encouraged all participants to get out and preach the need for, and successes of, reclamation, and indeed all environmental programs. Telling ourselves in conferences how wonderful we are is preaching to the converted. We need to let those who benefit from our labours, that amorphous group known as the public, know what we have done for them. This, too, should be the topic of a future symposium.


The papers in this proceedings have been edited and retyped into a common format. The contents of the papers are essentially unchanged from the submitted manuscripts of the authors.



D. Reid  
ASPB



C. Powter  
AC/CLRA



B. Free  
CSEB - Alberta Chapter

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS .....	iii
MESSAGE FROM THE ORGANIZING COMMITTEE .....	v
The Evolution of Reclamation Practice - from Complex to Simple - Dr. P. Ziemkiewicz .....	1
Regulatory Response to Changing Reclamation Demands - Mr. D.L. Bratton .....	5
Reclamation and Industry in Alberta Today and Tomorrow (1990s) - Dr. A.W. Fedkenheuer .....	13
Successful Landscape Manipulation in the Urban Fringe - From a Gravel Pit to a Lake - Mr. G. Browning .....	24
Reclamation to Wildlife Habitat - Goals and Delivery - Mr. C.W.B. Stubbs .....	30
Emerging Issues - Land Degradation - Dr. D.S. Chanasyk .....	35
Industrial Site Decommissioning - Mr. M.J. Riddle, Mr. A.E. Osborne, and Mr. R.B. Geddes .....	46
The Reclamation and Management of Garbage Dumps and Gravel Pits in Alberta - Mr. L.M. Kryviak .....	55
Case Study - Greening Cities - Mr. L.R. Paterson .....	60
Reclamation of Ducks Unlimited Habitat Projects in Alberta - Mr. J.W. Martin .....	67
Buck for Wildlife's Volunteer Fisheries Habitat Enhancement Program - Mr. W.E. Griffiths .....	74
Soil Salinity in Alberta - Mr. L.A. Leskiw .....	80
PANEL DISCUSSION - What is Successful Reclamation?	
Government Perception - Mr. L.K. Brocke .....	97

continued ...

TABLE OF CONTENTS (CONCLUDED)

	Page
Industry Perception	
- Mr. P.D. Lulman .....	99
A Biologist's Perception	
- Dr. D. Parkinson .....	101
A Landscape Architect's Perception	
- Mr. L.R. Paterson .....	103
The Public's Perception	
- Mr. C. Wallis .....	107
Symposium Summary	
- Mr. R. Johnson .....	111
LIST OF PARTICIPANTS .....	115