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NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

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NWMO BACKGROUND PAPERS
7. INSTITUTIONS AND GOVERNANCE

7-7 RELEVANCE OF INTERNATIONAL EXPERIENCES IN THE SOUND MANAGEMENT OF CHEMICALS TO THE LONG TERM MANAGEMENT OF USED NUCLEAR FUEL IN CANADA

John Buccini

NWMO Background Papers

NWMO has commissioned a series of background papers which present concepts and contextual information about the state of our knowledge on important topics related to the management of radioactive waste. The intent of these background papers is to provide input to defining possible approaches for the long-term management of used nuclear fuel and to contribute to an informed dialogue with the public and other stakeholders. The papers currently available are posted on NWMO's web site. Additional papers may be commissioned.

The topics of the background papers can be classified under the following broad headings:

1. **Guiding Concepts** – describe key concepts which can help guide an informed dialogue with the public and other stakeholders on the topic of radioactive waste management. They include perspectives on risk, security, the precautionary approach, adaptive management, traditional knowledge and sustainable development.
2. **Social and Ethical Dimensions** - provide perspectives on the social and ethical dimensions of radioactive waste management. They include background papers prepared for roundtable discussions.
3. **Health and Safety** – provide information on the status of relevant research, technologies, standards and procedures to reduce radiation and security risk associated with radioactive waste management.
4. **Science and Environment** – provide information on the current status of relevant research on ecosystem processes and environmental management issues. They include descriptions of the current efforts, as well as the status of research into our understanding of the biosphere and geosphere.
5. **Economic Factors** - provide insight into the economic factors and financial requirements for the long-term management of used nuclear fuel.
6. **Technical Methods** - provide general descriptions of the three methods for the long-term management of used nuclear fuel as defined in the NFWA, as well as other possible methods and related system requirements.
7. **Institutions and Governance** - outline the current relevant legal, administrative and institutional requirements that may be applicable to the long-term management of spent nuclear fuel in Canada, including legislation, regulations, guidelines, protocols, directives, policies and procedures of various jurisdictions.

Relevance of International Experiences in the Sound Management of Chemicals to the Long Term Management of Used Nuclear Fuel In Canada

A Report Prepared for the
Nuclear Waste Management Organization

By:

John Buccini

December 29, 2003

Author's Biography

The author received his doctorate in organic chemistry at the University of Manitoba in 1970 and pursued post-doctoral research at Carleton University in Ottawa. In 1972, he joined the Canadian Department of National Health and Welfare and participated in developing risk assessments on chemical and microbiological agents in the environment, the workplace, the home, consumer products, pesticides and products used in the treatment and distribution of potable water. Between 1982 and 2000, he served as a program manager with Environment Canada, where he was involved at the national and international levels in science-based regulatory programs concerned with the development and implementation of legislation, policies and programs to assess and manage the risks posed by industrial chemicals, pesticides and novel biotechnology products. The author has over 20 years of experience in working with international organizations that are engaged in developing and implementing policies and programs on toxic chemicals and he has served in leadership roles in the OECD Chemicals Programme, the North American Commission on Environmental Cooperation, the Intergovernmental Forum on Chemical Safety and United Nations Environment Programme. Since 1998, he has served as the Chair of the Intergovernmental Negotiating Committee established by the United Nations Environment Programme to negotiate the Stockholm Convention on Persistent Organic Pollutants (POPs), which was adopted in 2001.

Abstract

This report is intended to provide information that might be of interest to NWMO in addressing its current task of developing a proposal for the long term management of used nuclear fuel in Canada. A description is provided of the environmental behaviour of chemicals and the processes that are used to identify their hazards, assess possible risks and impose risk management actions to reduce or eliminate any unacceptable risks. A brief overview is included of 50 global and regional conventions and protocols and approximately 40 programs and initiatives that have been developed to address chemicals issues. Several principles and concepts are discussed with regard to their influence in the development and implementation of current national and international measures to address the sound management of chemicals. These include the importance of knowledge as the basis for decision making, information exchange mechanisms between governments, measures to ensure public access to information and stakeholder participation in decision making, life cycle analysis in risk assessment, the use of precautionary approaches to anticipate and prevent the health and environmental effects of chemicals, the Polluter-Pays Principle, waste minimization and extended producer responsibilities (EPR), and an international voluntary industry program called *Responsible Care* ®. A discussion is included of the possible relevance of these principles and concepts to NWMO in the development of proposals for the long term management of used nuclear fuel in Canada. Appendix I provides a summary of the historical developments that have shaped the current chemicals agenda since the mid-nineteenth century and an overview of approximately 90 international agreements, programs and initiatives that contribute to the global chemicals management regime. Appendix II provides a brief description of the global chemicals industry, including developments over the past thirty years and a projection to the year 2020.

FOREWORD

This report was prepared for the Nuclear Waste Management Organization (NWMO) to inform ongoing consultations concerning the development of approaches for the management of used nuclear fuel, a by-product of the generation of electricity in nuclear fuel plants. The report provides an overview of the current international management regimes for chemical substances and includes information on several key principles and issues that have influenced the development of the current chemicals agenda. This information is presented within the context of its possible relevance to NWMO interests with regard to the management of spent nuclear fuel. While providing information of possible relevance to NWMO programs, this report does not propose direction for NWMO's work. The latter can only be produced by NWMO following its own analysis, consultations and strategic discussions of issues related to the long term management of used nuclear fuel In Canada.

Author's Note: Some portions of this report draw on the report *Global Pursuit of the Sound Management of Chemicals* by the same author that was published in November 2003 by the World Bank. Portions of this latter report have been used with the permission of the World Bank. The full report is available from the World Bank.

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Terms and acronyms used in this report:

AMAP	Arctic Monitoring and Assessment Program
BAT	best available techniques
BEP	best environmental practices
DDT	1,1'-(2,2,2-trichloroethylidene)*bis*(4-chlorobenzene)
EPR	extended producer responsibility
EU	European Union
FAO	Food and Agriculture Organization
GEF	Global Environment Facility
GLP	Good Laboratory Practice
IFCS	Intergovernmental Forum on Chemical Safety
ICCA	International Council of Chemicals Associations
IGO	intergovernmental organization
ILO	International Labour Organization
IMO	International Maritime Organization
IOMC	Inter-Organization Programme for the Sound Management of Chemicals (membership currently includes FAO, ILO, OECD, UNEP, UNIDO, UNITAR and WHO)
IPCS	International Program for Chemical Safety
NACEC	North American Commission on Environmental Cooperation
NWMO	Nuclear Waste Management Organization
MAD	Mutual Acceptance of Data
OECD	Organization for Economic Cooperation and Development
OPCW	Organisation for the Prohibition of Chemical Weapons
OSPAR	Oslo-Paris Commission
PAH	Polynuclear aromatic hydrocarbons
PBTs	Persistent bioaccumulative and toxic substances
PCBs	polychlorinated biphenyls
Pesticides	A general term that includes insecticides, herbicides, fungicides and antimicrobials.
PIC	prior informed consent
POPs	persistent organic pollutants
PRTR(s)	pollutant release and transfer register(s)
SAICM	strategic approach to international chemicals management
TBT	tributyl tin
TSP	Total suspended particulates (in air)
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
USA	United States of America
WHO	World Health Organization
WSSD	World Summit on Sustainable Development

EXECUTIVE SUMMARY

This report reviews principles and concepts that have influenced the development of international agreements, programs and initiatives that address the health and environmental risks resulting from the generation, use and/or release of chemical substances due to their physical and chemical properties. A separate radiation protection regime for nuclear and radioactive materials has been developed to address similar risks that may result from the generation, use and/or release of some chemicals due to their radiological properties. As chemicals are involved in both regimes, the objective of this report is to provide information on the global chemicals management regime that might be relevant to NWMO in the development of proposals for the long term management of used nuclear fuel in Canada.

Chemicals are used in producing almost all man-made products, formulations and articles and new ones are constantly being developed. In addition to the thousands of commercial chemicals that are produced each year, many chemicals are unintentionally produced as by-products in industrial, manufacturing and combustion processes. These by-products may be present as contaminants in products, formulations, articles, wastes and releases to air and water. Both intentionally and unintentionally produced chemicals are released into the environment, leading to degradation of environmental media and consequential exposure of humans and wildlife. Policies for the sound management of chemicals are now recognized as essential components of overall public policy in countries at all stages of development due to the potential impacts of chemicals on human health, the environment, economic growth and development and, ultimately, global sustainable development.

Upon release into the environment, a chemical becomes distributed in different media, undergoes transport over short or long distances, is transformed into other chemicals and eventually the chemical and/or its transformation products are distributed between soil, sediment, water, air and living organisms. Processes have been developed to identify the hazards of chemicals, assess the pertinent risks and, where there have been found to be unacceptable risks, impose risk management actions to reduce or eliminate the risks. The four main processes that are most often involved in this are problem identification and priority setting, risk assessment, risk management, and monitoring and evaluation. These processes are followed in countries with well-established risk assessment and management programs, such as most developed countries, and are incorporated into some current international chemicals agreements.

The current global chemicals management regime includes at least 50 legal agreements, all but two of which were developed over the past three decades and most of which are less than 15 years old. These agreements address the following main areas of interest: occupational risks; biodiversity impacts; air pollution; water pollution; prevention of accidents and emergency response measures; transportation and storage; trade; chemical weapons; production, use or release to any environmental medium; and transboundary movement and disposal of hazardous wastes. About 40 programs and initiatives contribute to the global chemicals regime. Several were started following the creation of the UN in 1945 and others began in response to scientific and other developments such as the UNCED Conference in 1992, which called for enhanced action by all stakeholders in pursuit of the sound management of chemicals. The following key concepts and principles have influenced the development and implementation of national and international measures to address the sound management of chemicals and are relevant to the current task of NWMO.

Knowledge has always been the currency for decision-making related to chemicals management. The dependency on sound and reliable information was formally recognized in 1978 when OECD countries began developing internationally agreed procedures to determine the physical and toxicological properties of chemicals and to ensure that these data would be reliable and accepted by countries for national decision-making. OECD also developed guidelines concerning access to confidential data and

information exchange procedures to promote the sharing of information on potential problems with chemicals and on the regulation and marketing of chemicals.

In the early 1970's, recognizing that national decisions to control chemicals and pesticides could impact on trade, health and/or the environment of other countries, actions were taken to ensure that potentially affected countries would receive appropriate information. These actions progressed from a voluntary information exchange program between OECD countries, to a voluntary UNEP international mechanism to provide notification of the intent to export banned or severely restricted chemicals and pesticides, and finally to a legally binding UNEP global convention on prior informed consent (PIC) for such substances. These actions were based on the principle that decisions on hazardous materials should not be made in isolation of the interests of those who may consequentially be impacted by such decisions. This experience demonstrates the need for and value of mechanisms to ensure that potential recipients of hazardous materials may be enabled to make informed decisions prior to receiving any such materials.

Public access to information and participation in decision making have been important issues throughout the development of national and international approaches to the sound management of chemicals. The term right-to-know is now used to describe the rights of people to have access to information on issues that affect them. This includes issues related to chemicals that may affect individuals or communities, such as workplace safety, preparation for and response to accidents at industrial sites, public information on releases of chemicals from sites that manufacture or handle chemicals, and involvement of national stakeholders in national plans to implement convention obligations. There is a clear international trend to provide, at the national level, the widest possible access to information on environmental issues and to ensure that open, inclusive and transparent processes are followed in taking related decisions and in seeking access to justice in environmental matters.

Comprehensive "life cycle" assessment approaches have been used for many years to identify, early in the planning process, the potential risks associated with chemicals to permit the design and implementation of appropriate risk management measures. This has been accompanied by the "cradle-to-grave" management approach, in which identified risks are subjected to management measures at appropriate stages of the life cycle. More recently, the "cradle-to-cradle" approach was introduced with the objective of designing a product so that when it completes its originally planned use or lifespan, it constitutes an input to another process or product and, thus, is not a waste. Another approach involves the use of "sustainable chemistry", the objective of which is to reduce the health and environmental impacts associated with the production and use of chemicals by maximizing resource efficiency, conserving energy and non-renewable resources, minimizing risk, preventing pollution, minimizing waste at all stages of a product's life cycle and developing durable products that could be re-used and recycled.

The application of the precautionary approach has had a significant impact on several components of the current global chemicals regime, especially the development of regional and global environmental agreements and national laws over the past 15-20 years. There has been a growing trend to incorporation of references to precaution in the preambular and operative sections of international legal instruments and recently developed Canadian federal legislation on toxic chemicals and pesticides. A recent federal government policy paper addresses the general application of precaution in science-based decision making about risk. Thus, the application of precaution is now an important factor that influences the development of policy and legislation to control toxic substances and current expectations are that major risk management decisions will incorporate precaution in an appropriate and meaningful manner.

Over the past 30 years, as chemicals issues became truly global concerns, demands grew for all industry sectors that contributed to environmental chemical pollution to accept increased responsibility for preventing the health and environmental consequences of its operations and to reflect more fully the costs of health and environmental protection in the price of its products. In 1972, the OECD adopted the

Polluter-Pays Principle which states that the costs of carrying out national pollution prevention and control measures should be reflected in the cost of goods and services that cause pollution during production, consumption or accidents at industrial sites. Introduction and application of this principle changed the mind-set of both industry and government and has resulted in many significant changes in behaviour over the past three decades.

In the early 1990's, OECD developed guidance for waste minimization practices and for extended producer responsibility (EPR). The latter was a policy approach to extend the typical environmental responsibilities of producers and importers to include responsibility for the treatment or disposal of post-consumer products. EPR may be viewed as an extension of the Polluter-Pays Principle, as the responsibility for addressing disposal aspects of post-consumer products would be assigned to the producers and/or importers of these products.

Responsible Care ® is a voluntary initiative of the chemicals industry. Initiated in 1985 in Canada, it is now operated in 47 countries that account for 85% of the global production of chemicals by the International Council of Chemicals Association, a council of trade associations representing chemical manufacturers at the national or regional level. The program addresses all aspects of chemical industry operations and the complete life cycle of products and wastes. It is intended to contribute to sustainable development of local communities and of society as a whole by improving all aspects of the chemical industry's health, safety and environmental performance, communication and public accountability. This initiative may be extended to chemical and allied industries, including the supply chain, and partners in related industries have been encouraged to tailor it to fit their own organizations.

The author identified several issues related to these principles and concepts that may be relevant to the development of proposals for the long term management of used nuclear fuel. Concerning access to information and decision making, it was suggested that the following aspects be clarified: the knowledge base on which proposals and decisions would be based; accessibility of the knowledge base to all stakeholders; confidentiality of data; disclosure of uncertainties and unknowns in the knowledge base; the nature of the multistakeholder consultation process; the role of stakeholders in decision making; provisions for openness, inclusiveness and transparency in decision-making; and involvement of affected jurisdictions and communities to address any PIC issues.

With regard to risk assessment and risk management, it was suggested that the NWMO proposal should clarify whether a life cycle risk assessment is used, include the results of the risk assessment and, at a minimum, incorporate a cradle-to-grave approach in the risk management aspects. As cradle-to-cradle risk management approaches are now being used in the chemicals area, it was noted that it might be worth exploring the practicality of such approaches for this industry. The NWMO proposal is likely to be evaluated on the manner in which it incorporates the precautionary approach, given relevant developments at the national and international level, especially in light of the uncertainties in the data to be used and the time periods that will be considered for management of used nuclear fuel. Therefore, it might be advisable to explain how precaution has been factored into the proposal.

With regard to industry roles and responsibilities, the nuclear power industry has created a trust fund to address its financial obligations for the long term management of used nuclear fuel, thus demonstrating that the industry is addressing the Polluter-Pays Principle. However, noting the long term nature of managing used nuclear fuel, it will have to be demonstrated that the measures that will be proposed in this regard will be sufficient and sustainable in the long term. As the issue before NWMO relates to waste, it seems appropriate to examine whether the industry has fully explored its options for waste minimization while it is seeking solutions for its current waste dilemma. Furthermore, it might be appropriate to challenge the industry to address whether an examination of extended producer responsibilities could assist in minimizing the wastes produced or, possibly, be used to extend responsibility for nuclear wastes

to the original suppliers of the fuel. Finally, it is noted that the international chemicals industry adopted a voluntary program to address public concerns about the manufacture, distribution and use of chemicals and to regain public trust in its industry. If the nuclear industry finds itself with similar needs today, perhaps it might be appropriate to consider developing and implementing a modified form of *Responsible Care* for the nuclear power sector.

While the global chemicals regime was established to address the health and environmental risks presented by the physical and chemical properties of non-radioactive substances, many of the issues relating to knowledge development, access to information, stakeholder involvement in decision-making, making risk assessment and risk management decisions, applying the precautionary approach, and the roles and responsibilities of industry are common to both the chemicals and nuclear industries. The present examination of experiences in developing the global chemicals regime has identified some concepts and principles that could be worth exploring, and possibly exploiting, in the pursuit of the long term management of used nuclear fuel in Canada.

1.0 INTRODUCTION

All living and inanimate matter is made from the more than 100 chemical elements that are found in our world. In our daily lives, we encounter chemicals in elemental form (*e.g.,* nitrogen and oxygen in the air we breathe) and in the form of different combinations of elements (*e.g.,* hydrogen and oxygen combined in the form of water). Simply stated, a chemical may be either an element or a compound that is formed by a combination of elements. An organic compound includes the element carbon in it and inorganic compounds do not. Hundreds of thousands of natural and synthetic compounds of both types exist. In addition, compounds exist that include both carbon and metallic elements and these are referred to as organometallic compounds. Some chemical compounds are radioactive in nature, including those that are used in the nuclear production of power and in some medical applications.

Chemicals are recognized as essential components of modern societies because they contribute in numerous ways to establish and/or preserve an elevated standard of living in countries at all stages of development. They are used in producing almost all man-made products, formulations and articles and, while some of these uses may be obvious to the public (*e.g.,* shampoos, cleaning products, etc.), many are not so evident (*e.g.,* high technology materials used in telecommunications). With continuing demands for new and improved materials, new chemicals are constantly being developed and these have enabled recent advances in such high technology areas as electronics, bioengineering and telecommunications. In addition to the tens of thousands of chemicals that are currently produced each year for commercial purposes, many chemicals are unintentionally produced as by-products in industrial, manufacturing and combustion processes and these unintended by-products may be present as contaminants in products, formulations, articles, wastes and releases to air and water. Consequently, both intentionally and unintentionally produced chemicals are released into the environment, leading to degradation of environmental media and consequential exposure of humans and wildlife.

1.1 Relevance of Management Regimes for Chemical Substances to NWMO

Chemicals play important roles in addressing current issues, such as health care, food production and telecommunications, and they are used in developing solutions to a wide variety of problems. However, human exposure, environmental contamination and hazardous waste generation may result from the release to the environment of chemicals as a result of their production and use in the thousands of formulations, products and articles in the modern marketplace. While chemicals were seen to be an important factor in several issues for many years, public concerns have resulted in the emergence of chemicals safety as a mainstream issue in its own right. Policies for the sound management of chemicals are now recognized as essential components of overall public policy in countries at all stages of development due to the potential impacts of chemicals on human health, the environment, economic growth and development and, ultimately, global sustainable development.

This report includes a review of several key principles and concepts that have influenced the development of the international management regime that has been established to address the potential health and environmental risks that may result from the generation, use and/or release of chemical substances due to their physical and chemical properties. A separate regime, the radiation protection regime for nuclear and radioactive materials, has been developed to address the health and environmental risks that may result from the generation, use and/or release of some chemicals due to their radiological properties. However, while the contributing factor to the hazards is different (physical and/or chemical properties *vs*. radiological properties), in each case chemical substances are the sources of concern. Indeed, in some cases, a radioactive chemical can pose a *chemical* toxicological risk at a lower level of exposure than that

which creates a *radiological* risk. In the context of the present report, the following statement, included as a conclusion in a recent report[1] to NWMO, is pertinent.

> "Given that the same processes are involved in transport of stable elements and radionuclides, that both may be chemically toxic, and that most of the mass of spent fuel waste (U-238) is more chemically toxic than radiotoxic, it may be expected that the level of effort devoted to assessment of chemical toxicity issues, especially over long time periods after significant radioactive decay has occurred, would be similar to the effort involved in assessment of radiotoxicity. Demonstration of radiological safety does not necessarily imply that there are no chemical toxicity issues."

Thus an examination of relevant experiences gained in developing the current international management regime for chemical substances may yield some parallels or "lessons learned" that could prove to be of interest to NWMO in addressing its current task of developing a solution to the long term management of used nuclear fuel.

1.2 The Approach Used in this Report

Section 1 of this report introduces some basic considerations involved in assessing the environmental behaviour of chemicals and provides a brief description of the processes that are normally used in assessing and managing the risks posed by chemicals in the environment.

Section 2 includes a brief review of the development of the current global chemicals management regime and provides information on seven key principles and concepts that have influenced the development of many of the current international and national agreements, programs and initiatives to address the risks posed by chemicals. This section concludes with a discussion of the possible relevance of these principles and concepts to future decisions for the long term management of used nuclear fuel in Canada. While this report highlights the possible relevance of the international chemicals agenda to future decisions for the long term management of used nuclear fuel in Canada, it does not contain direction for the work of NWMO. The latter can only be produced by NWMO following its own analysis, consultations and strategic discussions.

Detailed background information on the global chemicals regime is provided in Appendix I, which includes an historical perspective of the developments that have contributed to the current state of play in the international chemicals agenda and a summary of the current regional and international chemicals agreements, programs and initiatives. Additional background information is provided in Appendix II, which contains a brief description of the global chemicals industry, including developments over the past thirty years and a projection to the year 2020.

1.3 Assessing and Managing the Risks of Chemicals

Once released into the environment, a chemical substance will be subjected to a series of natural processes that are determined by the physical and chemical properties of the substance, the conditions of its release to the environment (*e.g.,* emissions to air, water or soil; point sources *vs.* diffuse sources), and environmental conditions (*e.g.,* temperature of the receiving medium, amount of sunlight). As a result of these factors, a released chemical will become distributed in different media (air, water, sediment, soil, plants, animals, humans), undergo transport over short or long distances as a result of natural environmental processes (usually involving air and/or water), and undergo transformation and

[1] *The Chemical Toxicity Potential of CANDU Spent Fuel*, a report prepared for NWMO by Stantec Consulting Ltd. (2nd draft, December 2003).

degradation into other chemicals. Eventually, the chemical and/or its transformation products will be distributed between soil, sediment, water, air and living organisms. It is generally accepted that chemical substances exhibit this ***multimedia behaviour*** in the environment.

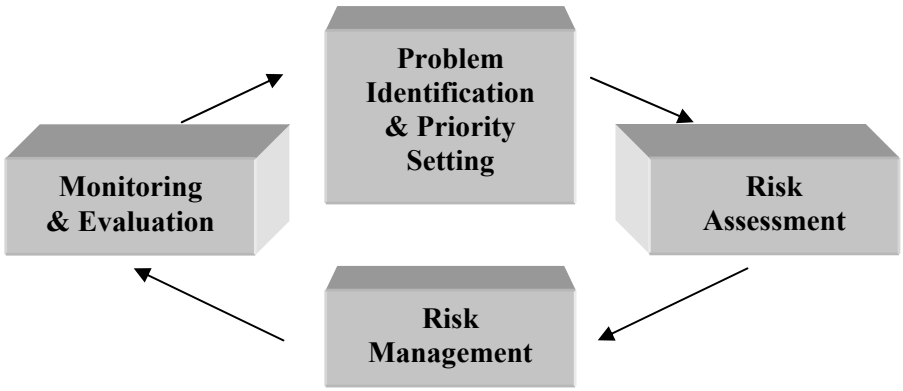
Because the specific properties, release conditions and environmental fate are unique to each substance, chemicals need to be assessed systematically to see whether they will be broadly distributed following release to the environment or will preferentially concentrate in one medium (air, water, sediment, soil, or biota). Systematic assessments are important in ascertaining the nature and extent of local, regional and global impacts of chemicals that are released to the environment as a result of their generation, use, release and/or disposal. In assessing the risks posed by a chemical it is important to include consideration of releases from the widest range of activities including during research and development, manufacturing and processing, handling and transportation, storage, accidents involving manufacturing and transportation, the use of products and articles, and disposal of wastes from manufacturing processes and from the end-of-life stage of products. This is sometimes referred to as assessing the ***life cycle*** of the chemical.

The generation and release of intentionally and unintentionally produced chemicals has led to local, regional and global contamination of the environment, with consequent exposure of humans and wildlife. While many environmental contaminants degrade quickly in the environment, some chemicals are released in quantities, concentrations or under conditions such that elevated concentrations are sustained in environmental media. Some other chemicals have a combination of physical and chemical properties such that once released to the environment, they degrade very slowly and remain in environmental media and organisms for years or even decades, even when released in relatively small quantities, and are said to be ***persistent***. Natural environmental processes can distribute these persistent substances over long distances, leading to regional and global contamination. Some of these environmental contaminants are taken up by wildlife and are retained in their bodies at concentrations higher than in their food and water: such substances are said to be ***bioaccumulative***. When predators at higher levels in the food chain consume contaminated flora or wildlife, this can result in very high body burdens of contaminants and this effect is referred to as ***biomagnification***. In recent decades, there has been increased attention paid to addressing the risks posed by substances that are persistent, bioaccumulative and toxic (PBT), including persistent organic pollutants (POPs) and some metal compounds.

Other environmental impacts of chemicals are resulting from the accumulation of a wide range of products, formulations and articles in homes and workplaces around the world. In addition to the environmental and health impacts that are associated with the production, distribution and use of these materials, the "inventories" that are being accumulated present a huge burden on waste management systems when these materials are no longer wanted or needed. For example, laptops, desktops and monitors are piling up in waste sites because they do not function properly or meet current expectations after less than five years of use. The hazardous chemicals in these materials represent a demand on a waste management system that was not designed to respond to these waste streams. In addition, there are health and environmental impacts resulting from toxic chemicals released during accidental fires in homes and buildings and at recycling depots.

The exposure of humans and wildlife to toxic chemicals can result in either ***acute*** or ***long-term*** effects. Some chemicals, such as PCBs or pesticides, can act directly on organisms. Others cause changes in the environment that create hazards to humans or wildlife, such as volatile organic chemicals and oxides of nitrogen that give rise to tropospheric ozone (or "smog"), and chlorofluorocarbons that degrade the stratospheric ozone layer allowing increased ultraviolet radiation to impact on the earth's surface. Recent scientific investigations have been unable to demonstrate a "no effect" level for some pollutants on humans (*e.g.,* sulfate particles in air, lead levels in children) and this has recently raised concerns and questions about the adequacy of past health protection measures.

In order to assess the health and environmental risks of chemicals, the physical, chemical and toxicological properties of intentionally produced chemicals and unintentionally produced by-products need to be known and assessed. Processes have been developed to identify possible hazards of chemicals, assess the pertinent risks and, where there have been found to be unacceptable risks, impose risk management actions to reduce or eliminate the risks. The following cyclical model can be used to show the relationship between the four main processes that are most often used: problem identification and priority setting, risk assessment, risk management, and monitoring and evaluation. Public participation in these stages varies with the consultation policies and legal or other mandates pertaining to the processes.



At the ***problem identification and priority setting*** stage, scientific analysis is conducted using information and data on chemicals from a wide range of available sources, such as routine or targeted environmental or human health monitoring programs, laboratory or field toxicology studies, and government programs involving the screening of new or existing chemicals. Should a chemical be identified as a priority for further action, a decision could be taken to proceed with a risk assessment to confirm whether initial indications of a problem are valid or not.

During the ***risk assessment*** stage, efforts are directed at determining whether a chemical poses a risk to human health or the environment. This is carried out performing a critical review of available data on: sources of releases to the environment; presence, levels and trends in environmental media and organisms; and exposure of and effects on humans and environmental organisms. While risk assessment methods may vary significantly from one jurisdiction to another, international organizations such as the Organization for Economic Cooperation and Development (OECD) and the World Health Organization (WHO) have been making efforts for several years to bring some commonality to the approaches used.

Chemicals that are found to pose unacceptable risks may be subjected to ***risk management***, wherein consideration is given to the need to impose measures to reduce or eliminate the risk. In addition to the scientific information developed during the risk assessment, decision makers consider key factors such as socio-economic considerations, the availability of technology and alternative products and processes, international comparisons and impacts, and communication and consultation with the public and those stakeholders that will be affected by proposed changes. This is a complex stage that usually involves political considerations.

Monitoring and evaluation of the effectiveness of implemented risk management measures involves scientific activities at the national and/or international level. These activities are similar in nature to those involved in problem identification and priority setting and if inadequate or inappropriate risk management measures are implemented, activities at this stage can result in the identification of new aspects of an

issue that had previously been addressed. Compliance and enforcement activities related to legal and regulatory regimes would also be included within this stage.

This four-stage cyclical model reflects practices in countries with well-established risk assessment and management programs, such as in most developed countries. For countries with economies in transition and developing countries, not all these stages may be followed, at least not in all cases, due to inadequate legal measures and/or lack of scientific and technical staff and resources to carry out the required activities to identify, assess, manage and monitor toxic substances. The need to increase the capacity for the sound management of chemicals in many countries has been acknowledged as a key issue in pursuing the sound management of chemicals at the global level.

This four-stage model also reflects approaches incorporated into some current international chemicals agreements. However, recognizing the difficulties that are normally involved in taking a chemical through the four-stage model at the national level, it is not surprising to learn that much more time is required to do so at the regional or global level due the different political, legal and social factors involved and the need to develop the broad consensus required to make a decision to take action and sustain the necessary effort to implement that action over time.

2.0 PRINCIPLES AND CONCEPTS

This section begins with an overview of the regional and global agreements, programs and initiatives that collectively form the global chemicals management regime (based on detailed information contained in Appendix I). This is followed by discussions of principles and concepts in three key areas that have influenced the development and implementation of current international and national measures to address the sound management of chemicals. Subsection 2.2 addresses the importance of knowledge as the basis for decision making, information exchange mechanisms between governments, public access to information and stakeholder participation in decision-making. Subsection 2.3 addresses issues that have influenced risk assessment and risk management approaches, including application of life-cycle measures and using precautionary approaches to anticipate and prevent the health and environmental effects of chemicals. Subsection 2.4 reviews three aspects of the evolving roles and responsibilities of industry in pursuing the sound management of chemicals over the past three decades. A discussion of the possible relevance of these principles and concepts to future decisions for the long term management of used nuclear fuel in Canada is included in subsection 2.5.

2.1 Overview of the Current Chemicals Regime

The present review of international chemicals management regimes includes 22 global and 28 regional legal agreements (*i.e.,* conventions and protocols) and about 40 programs and initiatives undertaken by intergovernmental organizations (IGOs), groups of countries and international organizations (see Appendix I for detail). While not exhaustive, this review provided sufficient information to assess the current state of play at the regional and global levels and to allow information and conclusions to be presented for the purposes of this report.

Of the current global and regional agreements that are listed in Table 1, only 2 were adopted before 1971, while 7 were adopted in the 1970's, 13 in the 1980's and 28 since 1990. Thus, the agreements that contribute to the current chemicals regime have been developed over the past 3 decades, and most of them are less than 15 years old. These agreements were developed to address the following main areas of interest, although many of them will impact on more than one area:

1. occupational risks of chemicals;
2. biodiversity impacts from a range of threats, including chemicals;
3. air pollution by chemical products and by-products;
4. water pollution by several sources, including chemicals;
5. prevention of accidents and development of emergency response measures at industrial sites that manufacture, use or store hazardous chemicals;
6. transportation and storage of dangerous chemicals and products;
7. trade in specified hazardous chemicals and pesticides;
8. prohibition and destruction of chemical weapons;
9. production, use or release to any environmental medium of specified chemical products and by-products; and
10. transboundary movement and disposal of hazardous wastes.

Table 2 includes information on programs and initiatives on the sound management of chemicals that are undertaken by 13 IGOs, one group of countries and an international industry organization. This is not a complete list of players or of programs. For example, the table does not include the numerous activities performed by the nine IGOs identified in Table 1 that provide secretariats for Conventions or Protocols. However, this table gives a sense of the scope and nature of the programs that are ongoing.

Table 1: Main Areas of Interest for Global and Regional Agreements		
Main Area of Interest	**Global Agreements**	**Regional Agreements**
Occupational risks of chemicals	●ILO conventions (7) on white lead, benzene, carcinogens, air pollutants, asbestos, chemicals, and major industrial accidents	
Biodiversity impacts from a range of threats, including chemicals	●UNEP Convention on Biological Diversity ●Cartagena Protocol on Biosafety	
Air pollution by chemical products and by-products	●UNEP Vienna Convention to Protect the Ozone Layer ●Montreal Protocol ●UNEP Framework Convention on Climate Change ●Kyoto Protocol	●UNECE Convention on Long Range Transboundary Air Pollution and its 8 Protocols
Water pollution by several sources, including chemicals	●IMO Convention on Pollution from Ships ●IMO Convention on Oil Pollution Preparedness, Response and Cooperation ●Protocol on Pollution Incidents by Hazardous and Noxious Substances ●IMO Convention on Harmful Anti-fouling Systems on Ships	●UNEP regional seas agreements (10) ●OSPAR Convention ●Helsinki Convention ●UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes ●Protocol on Water and Health
Prevention of industrial chemicals accidents and preparation of emergency response measures	●ILO Convention 174: Prevention of Major Industrial Accidents	●UNECE Convention on the Transboundary Effects of Industrial Accidents
Transportation and storage of dangerous chemicals and products		●UNECE European Agreements Concerning the International Carriage of Dangerous Goods: - by Road, and - by Inland Waterways
Trade in hazardous chemicals and pesticides	●UNEP/FAO Rotterdam Convention on Prior Informed Consent (PIC)	
Prohibition and destruction of chemical weapons	●OPCW Convention on Prohibition and Destruction of Chemical Weapons	
Production, use or release to any environmental medium of specified chemical products and by-products	●UNEP Stockholm Convention on Persistent Organic Pollutants	●UNECE Protocol on Pollutant Release and Transfer Registers ●North American Agreement on Environmental Cooperation
Transboundary movement and disposal of hazardous wastes	●UNEP Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal ●Protocol on liability and compensation	

Table 2: Main Areas of Interest for International Programs and Initiatives		
Main Interest	**Intergovernmental Organizations**	**Others**
Workers' health	•ILO: recommendations, codes, guidance manuals	
Air pollution	•WHO: advice on the health impacts of ozone depletion and climate change	•AMAP: monitoring of humans, wildlife and media in the North
Water pollution	•IMO: recommendations, codes, standards, guidelines •UNEP: Global Program for Protection of the Marine Environment from Land Based Sources of Pollution	
Accidents and emergency response	•IOMC: coordination of relevant IGO work •WHO/IPCS: advice on poison control centres and preparation and response to chemicals emergencies •UNEP: APPELL program supports preparations for emergencies at the local level	
Transportation and storage	•UNECE: advice and codes on the transportation of dangerous goods	
Waste issues	•OECD waste program: -hazardous waste -waste minimization -extended producer responsibility (EPR) •WHO: advice on hazardous waste management	
General controls on specific chemicals and by-products	•EU: proposed regulatory approach for industrial chemicals •FAO: pesticide specifications -international code of conduct on distribution and use of pesticides -maximum levels in food -voluntary PIC procedure -disposal of obsolete pesticide stocks in Africa •UNEP: technical assistance and capacity building -voluntary PIC procedure -phasing out lead in gasoline -global action plan on mercury -strategic approach to international chemicals management -ozone phase-out program -cleaner industrial production program •UNIDO: cleaner industrial production and ozone phase-out programs	•ICCA: *Responsible Care* voluntary industry program in 47 countries
UNCED Goals (Agenda 21, Chapter 19)	•IFCS: coordination of government efforts on all 6 goals •IOMC: coordination of IGO efforts on all 6 goals -globally harmonized system for classification and labelling of chemicals -PRTRs •UNITAR: training, technical assistance and capacity building	•ICCA: capacity building project for developing countries
Risk Assessment	•IOMC: coordination of IGO efforts on methods development and harmonization •OECD: test guidelines, good laboratory practices (GLP) and mutual acceptance of data (MAD) programs •WHO/IPCS: development of methods -assessment of specific chemicals and new pesticides	•ICCA: research initiative to identify hazards of high volume chemicals

Some of the chemicals programs of the relevant UN specialized agencies (FAO, ILO, IMO and WHO) were initiated shortly after the creation of the UN in 1945. Several were initiated in later years in response to scientific and other developments and others were started following the UNCED Conference in 1992 in response to the call in *Agenda 21*, Chapter 19 for enhanced action by all stakeholders in pursuit of the sound management of chemicals. These activities address various aspects of the life cycle of intentionally and unintentionally produced chemicals and all address at least one aspect of problem identification and priority setting, risk assessment, risk management, and monitoring and evaluation. Table 2 shows that IGOs are very active in all aspects of the international chemicals agenda, both in coordinating work and in developing and implementing programs. Considerable work is done in developing policy instruments, action plans, scientific tools for use in chemicals management (*e.g.,* test guidelines, risk assessment methods), recommendations, codes, guidance and training materials.

Although IGOs are indicated as the leads on many of these initiatives and programs, it is important to recognize that up to 180 governments are represented on the governing bodies of these organizations and it is these representatives that mandate the organizations to carry out the programs. Thus, IGO activities reflect the will of national governments to implement coordinated international programs to increase coherence in the approach to the sound management of chemicals on a national and international basis. Programs have been successfully implemented by these IGOs to pursue global approaches to several issues, including cleaner industrial production, the removal of lead from automobile gasoline, the production, distribution and use of pesticides, and the phase-out of ozone depleting substances. Such programs have been essential in providing much-needed technical and financial assistance to developing countries and countries with economies in transition in order to make progress on the chemicals agenda.

While many international legal agreements, programs and initiatives are already in place to address the problems associated with a wide range of chemicals, this does not mean that everything is under control, or soon will be. History has shown that society has rarely been sufficiently aware of the nature or extent of chemicals problems to take anticipatory action. Typically, scientific or other developments elevate problems to public attention before the need or political will to address them was apparent. Without significant changes occurring, there is every reason to expect that this will continue to be the practice in the future. This may be one reason why the application of the precautionary approach has become so important in the development of international agreements and national laws in recent years (section 2.3.2). Perhaps the application of this approach may effect changes in the nature of future responses.

Furthermore, as the majority of the components of the current chemicals regime were developed in the last 15 years or so, there has been a sharp increase in the demand for activities at the national level to ratify and implement agreements, develop and implement national programs, etc. and it is now evident that developing countries and countries with economies in transition are unable to keep up with recent developments in the chemicals regime without significant technical and financial assistance. Efforts are now underway to see how the global community can develop and implement a plan to enable these countries to catch-up to the developed countries. In addition, there are clear signs that the developed countries are also having problems in keeping up with the requirements of the current chemicals regime. Thus, it is not likely that many new chemicals agreements will be developed in the next few years, and this may give the international community the time needed to catch-up with the requirements of the current regime. As noted in Appendix I, the ongoing development of a strategic approach to the implementation of international chemicals management may prove to be a much needed and overdue exercise in coordination and planning that will bring improved coherence to the global chemicals regime.

2.2 Information Issues

The need for access to the information on which national risk assessment and risk management decisions were based proved to be the historical stimulus for several early international initiatives and agreements

between countries for exchanges of information on chemicals. This portion of the report examines the nature of the information used to make decisions, the evolution of international information exchange procedures, and recent developments in public access to information and participation in decision making.

2.2.1 Knowledge as the Basis for Making Decisions

As noted in section 1.3, processes have been developed over the past several decades to identify possible hazards posed by chemicals, assess the pertinent risks and, where there are found to be unacceptable risks, impose risk management actions to reduce or eliminate the risks. A cyclical model was introduced to show the relationship between the four main processes that are most often used: problem identification and priority setting, risk assessment, risk management, and monitoring and evaluation. Decision-making that is related to any of these four processes has always been dependent on the availability of sound and reliable scientific and technical information, complemented at appropriate times by other types of information, such as on socio-economic considerations. For example, periodic improvements in measuring smaller amounts of contaminants in humans, biota and environmental media and in identifying more sensitive indicators of exposure and new toxicological end-points have resulted in identification of new aspects of chemicals that required the attention of the international community (*e.g.,* POPs, stratospheric ozone depletion, endocrine disrupting substances, etc.).

OECD acknowledged the need for reliable scientific information in 1978 and established a program for developing internationally agreed test guidelines to determine the physical, chemical and toxicological properties of chemicals as well as methods to ensure the reliability of these data through good laboratory practices (GLP). It also established mutual acceptance of data (MAD) procedures to ensure that data developed following the test guidelines and GLP procedures would be accepted by member countries for use in national decision-making. These measures were accompanied by information exchange procedures to promote the sharing of information on potential problems with chemicals, the regulation of chemicals, the marketing of chemicals, and guidelines concerning access to confidential data. All have proven to be valuable and they are now accepted as the global standards, even by countries that are not members of OECD.

Knowledge has always been the currency for decision-making. Occasionally, the term "sound science" has been used to indicate this reliance on a firm knowledge base to enable making decisions on chemicals for any of the four steps in the model. However, it should be noted that use of the term *sound science* is not universally embraced. Some stakeholders view the term as inappropriate as they fear that a call for basing an impending decision on *sound* science is intended to mean that *more* science will always be needed, resulting in postponement of a decision that would otherwise be taken to complete a risk assessment or initiate risk management action.

While it can be anticipated that NWMO recommendations for the long term management of used nuclear fuel will be based on the best and most reliable data and information that are available, it is reasonable to expect that there will be uncertainties and unknowns that will have to be factored into the decision making process. In considering matters related to the use of information in the NWMO decision making process, it might be useful to reflect on the experiences and issues in the chemicals area concerning public access to information and participation in decision making (section 2.2.3) and the application of precaution in making risk management decisions (section 2.3.2).

2.2.2 Information Exchange and Prior Informed Consent (PIC)

In the 1960's and 1970's, national governments were implementing domestic regimes for protecting health and environment from possible unintended effects of pesticides and industrial chemicals. Several OECD member countries became concerned that the uncoordinated establishment of such programs could

lead to incompatible approaches being implemented, resulting in undesirable effects on international trade, such as creating non-tariff barriers to trade, and other implications. In 1971, the OECD agreed to implement a procedure that required member states to notify one another of recent or proposed legislative and regulatory measures on chemicals that were intended to protect health or the environment. Following receipt of a notification, any member country could request a consultation on the measures. Implementation of this procedure resulted in consultations being held in 1972 and 1976 that eventually led to collective OECD action to limit the production and use of PCBs in 1973. This OECD notification and consultation procedure initiated three decades of progressively broader international action to ensure the availability of information when a country intended to or took action on chemicals that could impact on trade, health and /or environment. As the following historical summary demonstrates, progress in this area was slow and developments were of an incremental nature.

The next steps in the sequence were taken recognizing that almost all countries were importers of chemicals and that there were concerns that developing countries, in particular, did not have in place regimes to evaluate and/or manage the risks associated with some chemicals. Furthermore, there were concerns that the quality of products exported to some developing countries (*e.g.,* pesticides, pharmaceuticals) might not be of the same quality as those products in the exporting countries. Thus it was perceived that procedures were needed to support the development of chemicals control regimes in importing countries and action was taken by both the UN and OECD to address this matter.

UNEP first took action on this issue in 1977[2] when it urged governments to ensure that potentially harmful chemicals "in whatever form or commodity, which are unacceptable for domestic purposes in the exporting country, are not permitted to be exported without the knowledge and consent of appropriate authorities in the importing country". It also requested that assistance be provided to developing countries to strengthen their domestic capabilities for evaluating chemicals, foods, drugs and cosmetics that were being distributed within their countries. In 1978[3], UNEP again addressed this issue and requested that exporting countries prevent the export of items which were restricted or not registered for use in their countries until they knew that the importing counties had been provided with test data, assessments of health and environmental effects of these chemicals and safe use information, to allow informed decisions to be made on the import and use of the products.

In 1979 and 1980, the UN General Assembly addressed matters relating to the exchange of information on banned hazardous products and unsafe pharmaceuticals and in 1982 adopted a resolution concerning products harmful to health and the environment. This resulted in the development in 1983 of the first version of the *Consolidated List of Products Whose Consumption and/or Sale Have Been Banned, Withdrawn, Severely Restricted or Not Approved by Governments*, which contained information on pharmaceutical, agricultural and consumer products that at least one government had controlled. The list was updated periodically to inform countries of the nature of and basis for control actions that had been taken.

In the late 1970's and early 1980's, OECD programs were established to share the burden of identifying and controlling the risks associated with new and in-use chemicals. It was realized that information exchange between countries would be key to implementing cooperative efforts to use existing data, avoid unnecessary duplication of effort in developing data on chemicals, utilize human and other resources more effectively, and reduce the number of animals used in testing. The importance was also recognized of the need to provide the public with information and, if necessary, disclose data related to the health and environmental assessment of chemicals. While it was recognized that industry had large volumes of information on the physical, chemical and toxicological properties of chemicals, much of it was regarded

[2] UNEP Governing Council Decision 85(V), *Human and Environmental Health* (25 May 1977).
[3] UNEP Governing Council Decision 6/4, *Health of People and of the Environment* (24 May 1978).

as confidential business information. In 1983, OECD issued recommendations to facilitate the exchange of information, identified which types of information may not be claimed to be confidential[4], and issued guidelines on agreements for sharing confidential information between countries[5].

In 1984, after five years of consultations on issues related to the export of hazardous chemicals, the OECD recommended to its member states that if an exported chemical is banned or severely restricted in the exporting member country, the latter should provide information to enable an importing country to make timely and informed decisions concerning that chemical[6]. It was further recommended that export notifications should, where possible, be provided in advance of the export, but such attempts should not result in delaying the export. The OECD approach, including *Guiding Principles On Information Exchange Related To Export Of Banned Or Severely Restricted Chemicals,* was intended to also apply to exports to countries that were not members of OECD.

A UNEP expert meeting in 1981 recommended the development of measures to control international trade in hazardous chemicals, especially where action had been taken in the exporting country to ban or restrict such chemicals. In 1982, UNEP agreed to this and initiated a process that led to the development in 1984 of a provisional notification scheme for banned and severely restricted chemicals that was very similar to the one that had been developed at OECD, but with global application. In 1987, this provisional scheme was replaced with a voluntary UNEP global program based on the *London Guidelines for the Exchange of Information on Chemicals in International Trade,* which were amended in 1989 to include provision for prior informed consent (PIC) and to involve both FAO and UNEP in implementation[7]. The FAO also amended its 1985 *Code of Conduct on the Distribution and Use of Pesticides* to incorporate PIC requirements to match those of the London Guidelines[8].

The London Guidelines were intended to increase chemical safety in all countries by stimulating the exchange of information on hazardous chemicals in international trade. Under this voluntary program, countries designated a national point of contact for communications and would notify UNEP whenever they banned or severely restricted a chemical. UNEP maintained a database based on these notifications and, over time, twenty-two chemicals were included on a list of chemicals that were controlled in several countries and each country was asked to make a determination of whether it wished to allow import of these chemicals. For chemicals not on this list, individual notifications were sent to the proposed importing country prior to a first time shipment of a controlled chemical. Under the PIC provision, for chemicals that had been banned or severely restricted by an exporting country to protect health or the environment, an export should not proceed without an importing country agreeing to the shipment or contrary to the decision of the importing country.

While over 150 countries were participating in the voluntary PIC procedure, support developed for converting the procedure into a global legally binding mechanism and this was one of the recommendations included in 1992 in Chapter 19 of *Agenda 21*[9]. Following separate decisions in support

[4] Recommendation C(83)98 of the OECD Council, *OECD List of Non-Confidential Data on Chemicals* (26 July 1983).
[5] Recommendation C(83)97 of the OECD Council, *Exchange of Confidential Data on Chemicals* (26 July 1983).

[6] Recommendation C(84)37 of the OECD Council, *Information Exchange related to Export of Banned or Severely Restricted Chemicals* (4 April 1984).
[7] UNEP Governing Council Decision 15/30 (25 May 1989).
[8] Decision adopted by the 25th Session of the FAO Conference (November 1989).
[9] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.1.8 and corrigenda), Vol. I: *Resolutions Adopted by the Conference*, resolution 1, annex II.

of this by FAO (1994) and UNEP (1995), negotiations to develop the Rotterdam Convention began in 1996. The Convention was adopted in 1998 and will enter into force in February 2004, 31 years after OECD established the first voluntary notification and consultation procedure to alert other countries of national developments in controlling hazardous chemicals.

Experience in this area demonstrates that concerns are likely to arise when decisions or actions taken by one party are seen to have considerable impact on the responsibilities or welfare of another. In the present example, national decisions on the control of chemicals and pesticides were seen as potentially impacting on trade, health and/or the environment of other countries. Upon recognizing this problem, progressively stronger actions were taken over the years to ensure that all affected parties received the appropriate information to allow them an opportunity to respond in a timely manner. While it took over 30 years to progress from problem identification, to a voluntary approach by one group of countries, to a voluntary international mechanism, to a legal framework at the global level, it has been accepted for many years that decisions should not be made in isolation of the interests of those who may consequentially be impacted by such decisions.

Experience in this area has not been confined to the import and export of chemicals and pesticides. The *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989)* and the *Cartagena Protocol on Biosafety* (developed in 1999 under the UN *Convention on Biological Diversity*) have similar PIC provisions to allow importing countries to make national decisions on the import of hazardous wastes and living modified organisms, respectively, based on information provided by the proposed exporting country.

Thus, there is considerable experience to consider in the area of information exchange between different jurisdictions including confidentiality of data, access to data and prior informed consent procedures. This experience demonstrates the need for and value of mechanisms to ensure that potential recipients of hazardous materials may be enabled to make *informed* decisions prior to receiving any such materials. Given that the NIMBY ("not in my back yard") syndrome is so well known today, it is readily apparent that major decisions affecting society must be taken in a timely manner and using an open, inclusive and transparent process.

2.2.3 Public Access to Information and Participation in Decision Making

In subsection 2.2.1, it was acknowledged that reliable information was a prerequisite for making decisions related to the sound management of chemicals. In subsection 2.2.2, it was shown that the timely sharing of information between governments was recognized as a key issue that had to be addressed in elaborating the current international management regime for chemicals. This section addresses aspects related to public access to information and participation in decision making, which have been important issues throughout the development of national and international approaches to the sound management of chemicals.

The term *right-to-know* is now used in many areas to describe the rights of individuals or groups of people to have access to information on issues that could affect them. This includes issues related to chemicals that may affect individuals or communities. In the workplace, this term has been used to reflect that workers should have access to information on the chemical hazards and risks that they may encounter in their work and well-established information and labelling practices have been implemented to achieve this.

Following a series of accidental releases of chemicals from manufacturing plants in several countries during the 1970's and 1980's, programs were developed by intergovernmental organizations to ensure that preparations are made for the prevention of and response to accidents at industrial sites where

hazardous chemicals are stored or used. This includes ensuring that workers and the communities where such sites are located are aware of the hazards, are involved in such preparations and will be advised of any episodes at such sites.

In the environmental area, some countries now require public release of facility-based information on the annual releases of chemicals that are occurring from sites that manufacture or handle specified chemicals. This is accomplished by the operation of pollutant release and transfer registers (PRTRs), one purpose of which is to promote the prevention of pollution at source. Experience in countries that have established PRTRs (*e.g.,* Canada, USA) has shown that publication of release data on a facility basis has resulted in marked reductions in releases from reporting sites and the ability of these registers to achieve pollution reductions without direct government intervention is one of the major attractions of establishing PRTRs. The OECD has developed guidance to assist countries in developing and implementing PRTRs. In May 2003, the UNECE adopted the *Protocol on Pollutant Release and Transfer Registers*, which will require each Party to establish and maintain a publicly accessible national PRTR with an objective of enhancing "public access to information through the establishment of coherent, integrated, nationwide pollutant release and transfer registers (PRTRs) in accordance with the provisions of this Protocol, which could facilitate public participation in environmental decision-making as well as contribute to the prevention and reduction of pollution of the environment".

The most recently developed global agreement on chemicals is the 2001 Stockholm Convention on Persistent Organic Pollutants (POPs). The following partial list of obligations for Parties under this convention gives a good indication of the current approach to public access to information and public involvement in developing and implementing measures for the sound management of chemicals:

- consult national stakeholders in developing, implementing and updating national plans to implement Party obligations;
- ensure the public has access to up-to-date information on POPs and their alternatives;
- encourage industry and professional users to promote and facilitate provision of information at the national and other levels;
- use a range of approaches to provide information which may include information centres at national and regional levels;
- develop mechanisms (such as PRTRs) to collect and disseminate information on annual amounts of POPs that are released or disposed of; and
- promote and facilitate the following as they relate to POPs and alternatives to POPs:
    - awareness among policy and decision makers;
    - development and implementation of educational and public awareness programs;
    - public participation in developing and implementing measures to address POPs;
    - training and development programs for stakeholders; and
    - development, exchange and implementation of education and training programs at national and international levels.

One recent example of a general approach to dealing with public access to environmental information is the UNECE[10] *Convention On Access To Information, Public Participation In Decision-Making And Access To Justice In Environmental Matters,* which entered into force in October 2001. The objective of this convention is "In order to contribute to the protection of the right of every person of present and future generations to live in an environment adequate to his or her health and well-being, each Party shall guarantee the rights of access to information, public participation in decision-making, and access to justice in environmental matters in accordance with the provisions of this Convention". Without derogating from existing rights of access to information, public participation in decision-making and

[10] Note that while Canada is a member of UNECE, it has neither signed nor ratified this convention.

access to justice in environmental matters, and recognizing that Parties may introduce or maintain broader measures for addressing these three topics, obligations of Parties under this convention include:

- taking necessary legislative, regulatory and other measures to establish and maintain a clear, transparent and consistent implementation framework for the Convention;
- ensuring that officials and authorities assist the public in seeking access to information, in facilitating participation in decision-making and in seeking access to justice in environmental matters;
- promoting environmental education and awareness among the public, especially concerning access to information, participation in decision-making and access to justice in environmental matters;
- providing appropriate recognition of and support to associations, organizations or groups promoting environmental protection;
- promoting the application of Convention principles in international environmental decision-making processes and within the framework of international organizations on environmental issues; and
- providing public access to information, participation in decision-making and justice in environmental matters, without discrimination as to citizenship, nationality or domicile.

Thus, there is a clear trend in the international community to provide, at the national level, the widest possible access to information on environmental issues and to ensure that open, inclusive and transparent processes are followed in taking related decisions. Such approaches would merit consideration in planning the long term management of used nuclear fuel in Canada.

2.3 Influences on Risk Assessment and Risk Management Practices

The following subsections address two major influences on risk assessment and management practices in recent decades. The first relates to life cycle approaches to the assessment and management of chemical risks. While such approaches have found application in many other areas, they have certainly shaped the practices that have been used for chemicals over the past few decades. This is followed by a discussion of the influence of precaution in the development of international agreements and Canadian legislation and policy.

2.3.1 Life Cycle Approaches

In the early 1980's, it was recognized that there was a need to shift efforts to the prevention of environmental problems associated with chemicals, rather than constantly reacting to them. To accomplish this, a comprehensive approach was adopted to identify, at the earliest possible moment in the planning process, the potential risks associated with chemicals, including their formulations and products, to permit the design and implementation of appropriate risk management measures. This concept was referred to as ***life cycle assessment*** and it was used to ensure that all relevant risks of a chemical would be assessed at the research and development, market introduction, transportation, distribution, storage, use and disposal stages of a chemical's life cycle. While application of the life cycle assessment approach has not been limited to chemicals issues, it has been used extensively in this field and has been accompanied by the ***cradle-to-grave management*** approach, in which the risks that were identified during life cycle analysis are subjected to management measures at each appropriate stage of the cycle. These approaches also stressed the need to address, at the planning phase, what the disposal options would be for a particular chemical or product, something that historically had not received enough attention.

In the 1990's, the cradle-to-grave approach was supplemented with the ***cradle-to-cradle*** approach, in which the objective is to design a product so that when it completes its originally planned use or lifespan,

it will constitute an input to another process or product and, thus, not constitute a waste product at that point in time.

In 1998, OECD launched a research and development initiative under its risk management program on ***sustainable chemistry***. The latter was defined as "the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes". The objective of this initiative was to find ways to reduce the health and environmental impacts associated with the production and use of chemicals by maximizing resource efficiency, conserving energy and non-renewable resources, minimizing risk, preventing pollution, minimizing waste at all stages of a product's life-cycle, and developing durable products that could be re-used and recycled. In 2002, OECD published a report[11] entitled *Guidance For Establishing Research And Development Programmes In Sustainable Chemistry* that provides some examples of this approach that were developed at the national level and involve:

- using alternative feed stocks, synthetic pathways, reaction processes or conditions to reduce energy consumption, minimize the use or release of hazardous chemicals and reduce wastes; and
- designing chemical products that minimize impacts on human health and the environment, have inherently less hazardous properties or have reduced toxicity, flammability or explosion potential.

The recently adopted Stockholm Convention on POPs addresses the life cycle of the 12 chemicals that are controlled under the convention. Recognizing that it is not a sustainable practice to allow the release to the environment of these persistent, bioaccumulative and toxic chemicals, the convention includes specific provisions for both intentionally and unintentionally produced POPs. These provisions require Parties to take measures to prevent or minimize environmental releases during the life cycle of intentionally produced POPs that may continue to be produced prior to their elimination from the market. To prevent the formation or minimize the releases of unintentionally produced POPs, Parties must take a wide range of measures, including exploring the use of substitute materials and processes and application of best available techniques (BAT) and best environmental practices (BEP) to a wide range of industrial processes and waste treatment and disposal activities. Parties must also take specified measures for the management and ultimate disposal of all POPs to ensure that they are not released to the environment.

Thus, current national and international approaches to the sound management of chemicals include policies and programs to assess risks associated with all aspects of the life cycle of a new or in-use chemical, implement comprehensive risk management measures on a life-cycle basis, and promote the development of new chemical products and processes that will have reduced impacts on health and the environment.

2.3.2 Precautionary Approaches

One aspect of the global chemicals management regime that has had a significant impact on decision making in recent years is the concept of precaution. Sometimes referred to as the *precautionary principle*, the *precautionary approach* or simply as *precaution*, this concept has featured prominently in the development of several components of the modern chemicals regime, especially regional and global environmental agreements and national laws. As this topic was the subject of a separate paper[12] prepared in September 2003 for the NWMO and an extensive review in 2001[13], the present paper does not attempt to provide a detailed review of the concept of precaution. Instead, it will draw attention to some

[11] OECD Environment, Health and Safety Publications, Series on Risk Management, No. 15, *Need For Research And Development Programmes In Sustainable Chemistry*, [ENV/JM/MONO(2002)12].

[12] *The Precautionary Approach to Risk Appraisal*, Andy Stirling, University of Sussex, UK, Background Paper 1-2 on the NWMO website (www.nwmo.ca).

[13] *Late lessons from early warnings: the precautionary principle 1896–2000*, Environmental Issue Report No. 22, European Environment Agency, Copenhagen (2001) [ISBN 92-9167-323-4].

international and Canadian examples where the concept of precaution has been applied in the chemicals area and examine the trends in this area.

Adopted in 1985, the *Vienna Convention on the Protection of the Ozone Layer* was one of the earliest global agreements to be developed specifically to address an environmental problem that was caused by chemicals – the depletion of the stratospheric ozone layer by the release of ozone depleting substances such as chlorofluorocarbons (CFCs). This convention contains one reference in its Preamble (*i.e.,* is not legally binding), to acknowledge that some precautionary measures actions had already been taken, but it does not propose that the convention implement precautionary measures (Table 3). However, by 1987, when the subsidiary *Montreal Protocol on Substances That Deplete the Ozone Layer* was adopted, the Protocol included a much stronger statement (Table 3) to reflect the nature of the obligations that were included in the Protocol. The Preamble was subsequently amended in 1990 to include the second statement in Table 3 to acknowledge that precautionary measures had now been taken. However, no reference to precaution was included in either the Preamble or operative provisions of the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal*, which was developed at about the same time as the Montreal Protocol and adopted in 1989.

Table 3: References to Precaution in Global Agreements	
Vienna Convention (1985)	
Preamble	*Mindful also* of the **precautionary measures** for the protection of the ozone layer which have already been taken at the national and international levels,
Montreal Protocol (1987)	
Preamble	*Determined* to protect the ozone layer by taking **precautionary measures** to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in scientific knowledge, taking into account technical and economic considerations and bearing in mind the developmental needs of developing countries,
Preamble	*Noting* the **precautionary measures** for controlling emissions of certain chlorofluorocarbons that have already been taken at national and regional levels,
UNCED (1992)	
Rio Declaration: Principle 15	In order to protect the environment, the **precautionary approach** shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
Stockholm Convention on POPs (2001)	
Preamble	Acknowledging that **precaution** underlies the concerns of all the Parties and is embedded within this Convention,
Article 1 (Objective)	Mindful of the **precautionary approach** as set forth in Principle 15 of the Rio Declaration on Environment and Development, the objective of this Convention is to protect human health and the environment from persistent organic pollutants.
Article 8 (Addition of Chemicals to the Convention)	9. ….. The Conference of the Parties, taking due account of the recommendations of the Committee, including any scientific uncertainty, shall decide, in a **precautionary manner**, whether to list the chemical, and specify its related control measures, in Annexes A, B and/or C.
Annex C, Part V, Section B (BAT Guidance)	…In determining best available techniques, special consideration should be given, generally or in specific cases, to the following factors, bearing in mind the likely costs and benefits of a measure and consideration of **precaution and prevention**.

The UNCED Conference in 1992 proved to be a milestone in international environmental policy in many ways, not the least of which was the inclusion of Principle 15 on the precautionary approach (Table 3) in the *Rio Declaration on Environment and Development*. The significance of this event must be stressed. The UNCED conference had attracted a wide range of stakeholders from industry, public interest groups and governments, in the latter case including numerous Heads of State, and all players at the highest levels of representation supported the Declaration. Thus Principle 15, which was intended for application to a wide range of environmental threats, was accepted as one of the Rio principles that should contribute to sustainable development. This result led to numerous intense discussions during the subsequent development of international agreements and domestic laws on many issues, especially those pertaining to toxic chemicals. While the notion of *precaution* was originally used, in practice the concept has been extended to include reference to *preventive* measures in many agreements and laws.

In 1992, two regional Conventions were adopted to address chemical pollution of the seas, including pollution caused by hazardous chemicals. The OSPAR Convention was developed to protect the Northeast Atlantic marine area and it included references to the "precautionary principle" in the Preamble and the General Obligations sections (Table 4). The Helsinki Convention was developed to protect the Baltic Sea area and includes measures to address several toxic chemicals that are listed in Annex I of the convention (Harmful Substances). This convention includes reference to the "precautionary principle" in a section on Fundamental Principles and Obligations and in an annex that provides guidance on the use of BAT (Table 4). It is noteworthy that these two closely related conventions were adopted within 6 months of each other (as well as the Rio Principle 15), both made reference to the *precautionary principle*, rather than to an *approach*, and both included precautionary measures in their operative provisions, which meant that they were legally binding.

In the UNECE Protocols on Persistent Organic Pollutants (1998), Heavy Metals (1998) and Pollutant Release and Transfer Registers (2003), each includes a mention of the *precautionary approach* in the Preamble and the most recent Protocol includes another statement in its General Provisions (Table 4).

The most recent global chemicals convention is the 2001 Stockholm Convention on POPs. The incorporation of precaution in this convention was viewed as critical by many negotiators and this led to many heated and protracted negotiations. The issues pertaining to precaution were among the last to be resolved and negotiation of the convention would not have been concluded if they were not satisfactorily dealt with. Precaution is explicitly mentioned in the Preamble, the Objective, the procedure for review and addition of chemicals to the convention, and in developing general guidance on BAT for unintentionally produced POPs (Table 3). Other implicit aspects of precaution were reflected in Party obligations to:

- prevent the production and use of new pesticides or new industrial chemicals which exhibit POPs characteristics (as specified in Annex D of the convention);
- take into consideration POPs characteristics when conducting assessments of pesticides or industrial chemicals that are currently in use;
- prevent or minimize human exposure and release into the environment of POPs that are produced and/or used under the exemptions provisions of the convention; and
- promote the development and, as appropriate, require the use of substitute or modified materials, products and processes to prevent the formation and release of unintentionally produced POPs.

The final area of interest involves the use of precaution in Canadian legislation and policy. The main federal toxic chemicals legislation, the Canadian Environmental Protection Act (CEPA), was first passed in 1988 and then amended in 1999. The latest version now includes direct reference to the precautionary principle in at least three places. The first is a statement in the Preamble that reflects the Rio Principle 15.

"Whereas the Government of Canada is committed to implementing the precautionary principle that, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation;"

Table 4: References to Precaution in Regional Agreements	
OSPAR Convention (1992)	
Preamble	CONSIDERING that the present Oslo and Paris Conventions do not adequately control some of the many sources of pollution, and that it is therefore justifiable to replace them with the present Convention, which addresses all sources of pollution of the marine environment and the adverse effects of human activities upon it, takes into account the **precautionary principle** and strengthens regional cooperation;
Article 2 (General Obligations) Paragraph 2,	The Contracting Parties shall apply: (a) the **precautionary principle**, by virtue of which preventive measures are to be taken when there are reasonable grounds for concern that substances or energy introduced, directly or indirectly, into the marine environment may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship between the inputs and the effects;
Helsinki Convention (1992)	
Article 3 (Fundamental principles and obligations)	2. The Contracting Parties shall apply the **precautionary principle**, i.e., to take preventive measures when there is reason to assume that substances or energy introduced, directly or indirectly, into the marine environment may create hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea even when there is no conclusive evidence of a causal relationship between inputs and their alleged effects.
Annex II (Criteria for the use of BEP & BAT)	2. In determining in general or individual cases what combination of measures constitute Best Environmental Practice, particular consideration should be given to: - the **precautionary principle**; - ….
UNECE Protocol on POPs (1998)	
Preamble	Resolved to take measures to anticipate, prevent or minimize emissions of persistent organic pollutants, taking into account the application of the **precautionary approach**, as set forth in principle 15 of the Rio Declaration on Environment and Development,
UNECE Protocol on Heavy Metals (1998)	
Preamble	Resolved to take measures to anticipate, prevent or minimize emissions of certain heavy metals and their related compounds, taking into account the application of the **precautionary approach**, as set forth in principle 15 of the Rio Declaration on Environment and Development,
UNECE Protocol on PRTRs (2003)	
Preamble	*Wishing also* to ensure that the development of such systems takes into account principles contributing to sustainable development such as the **precautionary approach** set forth in principle 15 of the 1992 Rio Declaration on Environment and Development,
Article 3 (General Provisions)	4. In the implementation of this Protocol, each Party shall be guided by the **precautionary approach** as set forth in principle 15 of the 1992 Rio Declaration on Environment and Development.

A second statement in the preamble reflects the importance that the Government attaches to addressing the problems posed by substances that, upon release to the environment, undergo wide spread geographic distribution by natural environmental processes, a situation that emphasizes the need for preventive measures. This is particularly the case for persistent toxic substances, for which precautionary measures are often recommended, and new measures were introduced in the revised CEPA to address these substances.

> "Whereas the Government of Canada recognizes that the risk of toxic substances in the environment is a matter of national concern and that toxic substances, once introduced into the environment, cannot always be contained within geographic boundaries;"

The second reference to the precautionary principle occurs in the Administrative Duties section of the Act, which would indicate that it should be applied to all provisions of CEPA.

> **"**2. (1) In the administration of this Act, the Government of Canada shall, having regard to the Constitution and laws of Canada and subject to subsection (1.1),
> (a) exercise its powers in a manner that protects the environment and human health, applies the precautionary principle that, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation, and promotes and reinforces enforceable pollution prevention approaches;"

The third reference occurs in Part 5 (Controlling Toxic Substances) and applies to decision making on the risk assessment of chemicals.

> "76.1 When the Ministers are conducting and interpreting the results of
> (a) a screening assessment under section 74,
> (b) a review of a decision of another jurisdiction under subsection 75(3) that, in their opinion, is based on scientific considerations and is relevant to Canada, or
> (c) an assessment whether a substance specified on the Priority Substances List is toxic or capable of becoming toxic, the Ministers shall apply a weight of evidence approach and the precautionary principle."

The Canadian Pest Control Products Act was revised in 2002 and it now includes the following provision in Article 20, which outlines the Minister's powers to cancel or amend the registration of a product. Examination shows that this is *verbatim* the UNCED Principle 15 with the insertion of the phrase "adverse health impact or" prior to "environmental degradation. This provision certainly removes any doubt that the Rio formulation was intended to apply to health protection, at least for pesticides in Canada.

> "(2) Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent adverse health impact or environmental degradation."

Lastly, the Privy Council Office of the Government of Canada released a report in 2003 entitled *A Framework for the Application of Precaution in Science-Based Decision Making About Risk*. This report[14] was released to:

[14] Available on the internet at:
http://www.pco-bcp.gc.ca/default.asp?Language=E&Page=publications&Sub=precaution&Doc=precaution_e.htm

- "improve the predictability, credibility and consistency of the federal government's application of precaution to ensure adequate, reasonable and cost-effective decisions;
- support sound federal government decision making while minimizing crises and controversies and capitalizing on opportunities;
- increase public and stakeholder confidence, in Canada and abroad, that federal precautionary decision making is rigorous, sound and credible; and
- increase Canada's ability to positively influence international standards and the application of precaution."

The framework may also provide a means to assess "whether precautionary decision making is in keeping with Canadians' social, environmental and economic values and priorities". The report provides general principles for applying precaution to science-based decision making and also proposes that precautionary measures should:

- be subject to reconsideration, on the basis of the evolution of science, technology and society's chosen level of protection;
- be proportional to the potential severity of the risk being addressed and to society's chosen level of protection;
- be non-discriminatory and consistent with measures taken in similar circumstances;
- be cost-effective, with the goal of generating both an overall net benefit for society at least cost and efficiency in the choice of measures; and
- apply the least trade-restrictive measure where more than one option reasonably meets the above characteristics.

There has clearly been a growing trend to incorporate references to precaution in the preambular and operative sections of international legal instruments that address the risks posed by toxic chemicals and in recently developed Canadian federal legislation and government policies concerning the management of risk. Thus, the issue of precaution has emerged over the past 10-15 years to become an important factor influencing the development of policy and legislation to control toxic substances and current expectations are that major risk management decisions will incorporate precaution in an appropriate and meaningful manner. This should be taken into consideration by NWMO in assessing options for the long term management of used nuclear fuel in Canada.

A word on caution must be added concerning precaution. While the above noted examples demonstrate the progressive impact that precaution has had on developing legal instruments to address toxic chemicals issues, there are cases in other areas where the application of precaution has led to major international disagreements. One example was the action taken by the EU in 1985 to ban the importation of hormone-treated beef from the USA on the basis that insufficient information had been developed to adequately demonstrate the safety of such products. This action was viewed by the USA as using the precautionary approach to achieve a trade objective and the creation of a non-tariff barrier to trade. Incidents such as this have resulted in suspicions being raised with regard to motives behind proposals in certain cases and considerable attention being paid to each new possible application of the precautionary approach.

2.4 Roles and Responsibilities of Industry

Over the past 30 years, as chemicals issues developed into truly global concerns, there were growing demands for all industry sectors that contributed to environmental chemical pollution to accept increased responsibility for preventing the health and environmental consequences of its operations and to reflect more fully the costs of health and environmental protection in the price of its products. The following

subsections address the development by OECD governments of the Polluter-Pays Principle and waste minimization and prevention programs and a voluntary initiative by the international chemicals industry to improve its health, safety and environmental performance and address communication and public accountability issues.

2.4.1 Polluter-Pays Principle

Shortly after the OECD Environment Committee was established in 1970, it acknowledged that whenever the cost of environmental degradation was not factored into the price of goods and services, the market did not reflect the scarcity of environmental resources at the national and international levels. To protect these resources from degradation related to production and consumption activities, it was proposed that government measures were warranted to protect the environment and improve the allocation of resources by ensuring that the price of goods reflects more closely the scarcity (and vulnerability) of the environmental resources on which those goods depend.

In 1972, the OECD recommended[15] that governments should, in determining national environmental control policies and measures, observe *Guiding Principles Concerning the International Economic Aspects of Environmental Policies,* with particular reference to their economic and trade implications. One of these was the Polluter-Pays Principle that should be used "for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment". This principle states that polluters should bear the expenses of carrying out national pollution prevention and control measures designed to protect the environment and that the cost of control measures should be reflected in the cost of goods and services that cause pollution during production and/or consumption. Furthermore, such measures should not be accompanied by subsidies that would create significant distortions in international trade and investment.

OECD revisited this topic in 1974 and noted that[16]:

- "In exceptional circumstances, such as the rapid implementation of a compelling and especially stringent pollution control regime, socio-economic problems may develop of such significance as to justify consideration of the granting of governmental assistance, if the environmental policy objectives of a Member country are to be realized within a prescribed and specific time;"
- "Aid given for the purpose of stimulating experimentation with new pollution-control technologies and development of new pollution-abatement equipment is not necessarily incompatible with the Polluter-Pays Principle;" and
- "Where measures taken to promote a country's specific socio-economic objectives, such as the reduction of serious inter-regional imbalances, would have the incidental effect of constituting aid for pollution-control purposes, the granting of such aid would not be inconsistent with the Polluter-Pays Principle."

Noting these observations and the need for additional clarification, OECD recommended continued uniform observance of the Polluter-Pays Principle and that, as a general rule, assistance should not be provided to polluters in bearing the costs of pollution control through subsidies, tax advantages or other measures. The granting of any such assistance for pollution control should be strictly limited and:

- be selective and restricted to those parts of the economy (*e.g.,* industries, areas or plants) where severe difficulties would otherwise occur; and

[15] Recommendation C(72)128 of the OECD Council, *Guiding Principles Concerning International Economic Aspects of Environmental Policies* (26 May 1972).

[16] Recommendation C(74)223 of the OECD Council, *Implementation of the Polluter-Pays Principle* (14 November 1974)

- be limited to well-defined transitional periods, laid down in advance and adapted to the specific socioeconomic problems associated with implementing a national environmental programme; and
- not create significant distortions in international trade and investment.

Should a member country give assistance to new plants to address cases of exceptional difficulty, the conditions must be more strict than those for existing plants and criteria must be developed to base this differentiation. All such assistance systems were to be notified to member countries, preferably prior to their implementation, to allow potentially affected countries to request a consultation to address any problems that might be caused by such approaches.

In response to several accidents at chemical production sites such as those that occurred in Seveso (1976), Bhopal (1984) and Basel (1986), OECD again revisited the Polluter-Pays Principle as part of the development of its 1988 guidelines[17] for prevention and response measures for hazardous chemical installations. Detailed recommendations[18] were made in 1989 pertaining to the application of this principle to preventive and response measures associated with such accidents that included the following 3 points.

- "In matters of accidental pollution risks, the Polluter-Pays Principle implies that the operator of a hazardous installation should bear the cost of reasonable measures to prevent and control accidental pollution from that installation which are introduced by public authorities in Member countries in conformity with domestic law prior to the occurrence of an accident in order to protect human health or the environment."
- "Domestic law which provides that the cost of reasonable measures to control accidental pollution after an accident should be collected as expeditiously as possible from the legal or natural person who is at the origin of the accident, is consistent with the Polluter-Pays Principle."
- "If the accidental pollution is caused solely by an event for which the operator clearly cannot be considered liable under national law, such as a serious natural disaster that the operator cannot reasonably have foreseen, it is consistent with the Polluter-Pays Principle that public authorities do not charge the cost of control measures to the operator."

The Polluter-Pays Principle reflected a new appreciation that the environment had a finite capacity to accept pollutants, and that industry would have to respect the economic and other values attached to environmental media. As noted by the OECD in 1972, the principle was to be used for allocating costs of pollution prevention and control measures in order to encourage rational use of scarce environmental resources and prevent distortions in international trade and investment. Introduction and application of this principle changed the mind-set of both industry and government and led to numerous changes in behaviour over the past three decades. Some examples of implementation of this principle include: shifting the burden from government to industry for routine monitoring of environmental media to ensure compliance with regulatory programs; recovery from industry of costs to government for operating health and environmental protection programs related to notification and/or registration of new industrial chemicals and pesticides; and increasing demands for industry to minimize its outputs to air, water and municipal waste streams by reducing, reusing and recycling materials in its processes. The experience gained by chemicals industry in implementing the Polluter-Pays Principle may be of interest in evaluating options for the long term management of used nuclear fuel in Canada.

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[17] Decision-Recommendation C(88)85 of the OECD Council, *Provision of Information to the Public and Public Participation in Decision-making Processes related to the Prevention of, and Response to, Accidents Involving Hazardous Substances (8 July 1988)*.

[18] Recommendation C(89)88 of the OECD Council, *Application of the Polluter-Pays Principle to Accidental Pollution* (7 July 1989).

2.4.2 Waste Minimization and Extended Producer Responsibility (EPR)

In the early 1990's, OECD countries recognized the need to address growing volumes of municipal and industrial wastes and acknowledged that various practices were resulting in an inefficient use of materials and energy. It was noted that since 1980, the volume of municipal wastes had grown in a one-to-one relationship with increase in GDP. With a forecasted doubling of GDP from 1980 to 2020, governments were seized with the need for measures to decrease the amount of wastes that would be produced as disposal costs were growing at an unacceptable rate and there was a looming shortage of disposal sites. OECD responded by undertaking two companion initiatives to address the issues.

In the first initiative, guidance was developed for *waste minimization* practices to address such issues as strategic waste prevention, material flow accounting practices, indicators to assess overall performance in waste prevention, and the use of economic incentives in waste service contracts to support waste minimization.

The second initiative addressed *extended producer responsibility* (EPR), a policy approach to extend the typical environmental responsibilities of producers and importers (*e.g.,* management of releases from such activities as manufacturing, transportation and distribution) to include responsibility for the treatment or disposal of post-consumer products. In some respects, the development of EPR could be viewed as an extension of the Polluter-Pays Principle, as the responsibility for addressing disposal aspects of post-consumer products would be assigned to the producers and/or importers of these products. Various approaches to EPR were examined to develop information for governments to consider in establishing their domestic policies and programs. This work resulted in the publication in 2001 of *Extended Producer Responsibility, A Guidance Manual for Governments.* This publication contains considerable information on the potential costs and benefits associated with EPR and identifies incentives that could be used to prevent wastes at the source, promote products that are "designed for the environment", and help meet goals that may be established for public recycling and materials management. The report gives examples of current programs (*e.g.,* packaging reduction and "take-back" initiatives) and notes that the current applications of EPR include new products, product groups and waste streams such as electrical appliances and electronics.

2.4.3 Responsible Care ®

While groups of countries or intergovernmental organizations undertake most international programs and initiatives, some voluntary initiatives have been undertaken by industry organizations. One example is *Responsible Care ®,* initiated in 1985 by the Canadian Chemical Producers Association (CCPA) to address public concerns about the manufacture, distribution and use of chemicals. CCPA published statements of ethics and principles for its members and established a national advisory panel (comprising critics from outside the industry) to: sensitize the industry to public concerns concerning the chemical industry and related issues; identify opportunity areas for enhanced information, dialogue and improved relations with the public; provide perspectives on a wide range of issues; and establish a continuing dialogue and information exchange between its members and key opinion leaders at the national, regional and local levels. The objective of the initiative was to regain public trust in the chemical industry by engaging the public in dialogue about their concerns and aspirations, through commitment by CCPA members to demonstrate their improvements over time, through sharing information, and by subjecting members to public and peer reviews against their commitments using agreed performance indicators and verification procedures.

Responsible care currently operates in 47 countries that account for 85% of the global production of chemicals. The international program is operated by the International Council of Chemicals Association (ICCA), a council of trade associations that represents chemical manufacturers at the national or regional

level. This program is intended to contribute to sustainable development of local communities and of society as a whole by focusing on improving all aspects of the chemical industry's health, safety and environmental performance and on communication and public accountability. This program commits companies, through their national associations, to a collective effort to:

- "continuously improve their company's and the chemical industry's performance in protecting people and the environment throughout the life cycle of their products and processes;
- contribute to the sustainable development of local communities and of society as a whole;
- inform their publics of the risks and benefits of what they make and do, and about their performance, achievements and challenges;
- dialogue and work with their stakeholders at the local, national and international level to understand and address their concerns and aspirations;
- cooperate with governments and organizations at all levels in the development and implementation of effective regulations and standards, and to meet or exceed those requirements; and
- extend Responsible Care to all those who manage chemicals."

ICCA monitors eight fundamental features of national *Responsible Care* programs to ensure global consistency in implementing the initiative for both industry and its stakeholders. National chemical associations are required to develop credible verification processes to demonstrate that member companies meet *Responsible Care* expectations. ICCA plans to extend implementation of this program to chemical and allied industries, including the supply chain, and to encourage partners in related industries to tailor the initiative to fit their own organizations.

Responsible Care programs address all aspects of chemical industry operations and the complete life cycle of products and wastes. Noting that the chemicals industry has been encouraging partners in related industries to consider adapting this program to suit their particular needs and situations, it might be appropriate to examine the experience gained by national chemical associations and consider whether it would be appropriate to develop and implement a modified form of Responsible Care for the nuclear power sector. A word of caution is in order in closing on this subject. Even when this program is rigorously implemented, some stakeholders retain their suspicions and distrust of the industry.

2.5 Relevance of Chemicals Experience to the NWMO Mandate

Efforts over the past three decades have yielded global and regional regimes for the sound management of chemicals. This paper has examined several important principles and concepts that have influenced the development of the current international chemicals regime and continue to influence decision making of national authorities in implementing programs for the sound management of chemicals. This report is provided to NWMO as it develops proposals for the long term management of used nuclear fuel in Canada and the immediate relevance of practices relating to chemicals issues may, perhaps, not be obvious. However, the substances involved in both the chemicals and nuclear regimes are the same – chemicals – and the connection may be stronger than it first appears. As noted[1] in section 1.1, a separate report prepared for NWMO concludes ".. it may be expected that the level of effort devoted to assessment of chemical toxicity issues, especially over long time periods after significant radioactive decay has occurred, would be similar to the effort involved in assessment of radiotoxicity. Demonstration of radiological safety does not necessarily imply that there are no chemical toxicity issues".

While the global chemicals regime was established to address the health and environmental risks presented by the physical and chemical properties of non-radioactive substances, many of the issues relating to knowledge development, access to information, stakeholder involvement in decision-making, making risk assessment and risk management decisions, applying the precautionary approach, and the

roles and responsibilities of industry are common to both the chemicals and nuclear industry. Thus, this examination of the chemicals regime may provide some experiences that could be worth exploring, and possibly exploiting, in the pursuit of the long term management of used nuclear fuel in Canada.

In its recent publications, NWMO has acknowledged that it is facing many of the same difficult issues that were - and are - addressed in relation to chemicals issues. One NWMO report[19] identified numerous concerns about proposals for the long term management of used nuclear fuel in Canada expressed by participants in public hearings during 1996-97, a selection of which are quoted below. It was noted that these were not intended to represent the views of the public, Aboriginal peoples or any organization or community.

- The process for developing the regulations and standards did not adequately involve the public or address social concerns.
- Policy and decision-making processes used to select and approve the concept were not adequate.
- The process for and determination of acceptable levels of risk was inappropriate and deficient.
- The safety of the concept was not adequately demonstrated.
- The concept relied upon regulations and standards that did not adequately protect human and environmental health.
- The concept proposed inadequate or inappropriate security, safeguards and emergency response measures.
- Scientific knowledge, analytical capabilities (e.g., computer modelling), engineering and current technology were insufficient to design, build and operate a safe disposal facility or to make predictions over the long time frame.
- The proponent, the industry, the regulator and government did not have the trust or the credibility of the public to undertake, regulate or oversee this project.
- The ethical analysis component of the assessment was inadequate.
- Financial impacts were not fully addressed and there was no guarantee that a segregated or dedicated fund would be established to fund disposal.

Another NWMO publication[20] recently identified the need to take into account the following issues, some of which parallel those that were discussed in the previous parts of this report in the context of chemicals.

- "Transparency, opportunity for full public engagement and the potential to have real influence on decision-making will be critical factors influencing the social acceptability and sense of public ownership of management approaches. This is particularly important given that some NGOs and members of the public lack trust in nuclear organizations and regulatory agencies. Engagement and review mechanisms to address perceived bias in proponent-based Environmental Assessment studies and the provision of appropriate resources for interveners to participate meaningfully in the engagement process will also be important factors in increasing confidence in the technical viability of management approaches and acceptance of decision-making outcomes. In this regard, decision-making by a third party, independent and technically informed adjudicating body (e.g. panel) is deemed by many to be the preferred approach.
- First Nations people want to be acknowledged as a unique stakeholder by virtue of their Aboriginal and Treaty Rights, their traditional relationship to "mother earth" and their spiritual, cultural and social values. Acknowledgement of and respect for their interests and insights can

[19] *Social Issues Associated With the Atomic Energy of Canada Limited Nuclear Fuel Waste Management and Disposal Concept*, Mark Stevenson (June 2003), Background Paper 2-2 on the NMWO website (**www.nwmo.ca**).
[20] *Long-Term Management of Nuclear Fuel Waste Issues and Concerns Raised at Nuclear Facility Sites 1996 – 2003*, F. Chris Haussmann and Peter G. Mueller (November 2003), Background Paper 2-4 on the NMWO website (**www.nwmo.ca**).

play an important role in shaping ethically, socially and environmentally acceptable approaches to the long-term waste management of Canada's used nuclear fuel. First Nations people want to be assured that:

-Their way of life will not be unduly put at risk;

-They will have adequate resources (financial, human, technical and time) to participate fully, meaningfully and continuously in the consultation, assessment and implementation process from planning to final monitoring; and

- They will share equitably in the economic benefits.

- The location of many nuclear facilities close to large population centers and adjacent to watercourses which supply drinking water to those populations, coupled with the events of September 11, 2001 have heightened public awareness with respect to potential terrorist threats against nuclear installations. The public in general and host communities in particular want to be assured that management approaches enhance public safety by taking this new security environment into account and reducing terrorist access to nuclear materials.
- Canadians will want to be assured that deregulation and privatization in the electricity sector will not result in the transfer of responsibility for nuclear waste to profit-oriented private sector organizations. To be socially acceptable, management approaches must be based on institutions under public control and scrutiny.
- Used nuclear fuel will need to be isolated and contained for millennia, during which time institutional and governance environments will change in unpredictable ways. The public and host communities want to be assured that current and future generations will have the technical and financial resources required to implement and sustain the management approach, to provide for long-term monitoring and to fund mitigation, should it be required.
- Management approaches need to ensure that the economic viability of a host community is maintained and enhanced, that property and business values are protected and that the residents of the host community benefit in an equitable way from the economic opportunities generated by the management approach.
- To be acceptable to host communities and the wider public, management approaches must be based on state-of-the-art technologies and best practices designed to safeguard human health and environmental integrity now and in the long term. At the same time, innovation must be balanced with evidence that the technologies adopted are proven, reliable and durable. Flexibility to incorporate new advances in technology, whether for materials recycling, containment or monitoring is seen as a valued feature in facility design.
- Public anxiety about their health or radionuclides in the air, drinking water and the food chain may not be calmed by technical and scientific studies or risk analyses suggesting negligible impact on the ecosystem and human populations. The explicit inclusion in the management approach of monitoring regimes designed and implemented around public and local involvement can play an important role in enhancing confidence in safety projections and ensuring public trust in ongoing system performance. In the event that periodic reassessments of the management approach are undertaken, public involvement in ongoing monitoring regimes will increase trust in the data used to arrive at conclusions."

In its most recent publication[21], NWMO has identified the following as issues that need to be addressed in evaluating options for used nuclear fuel management approaches:

- impacts on human health and safety;
- scientific risks and uncertainties;
- risks associated with transporting used nuclear fuel;

[21] *Asking the Right Questions? The Future Management of Canada's Used Nuclear Fuel*, (November 28, 2003) available on the NWMO website (**www.nwmo.ca**).

- adequate regulation and oversight;
- fairness and equity for future generations;
- adequate funds for proper implementation and operation;
- relationship of this policy decision to others, *e.g.,* the future of nuclear energy; and
- aboriginal values as part of decision-making.

In addressing these issues, NWMO has acknowledged the need for:

- multi-party evaluation, including scientists, engineers, communities with nuclear waste and the public;
- inclusion and consideration of a diversity of views; and
- paying close attention to those Canadian regulatory standards already in place, and the evolving regulation and standards around the world.

It appears that NWMO is facing a difficult task, indeed, with some members of the public expressing concerns about process, competence, trust, ethics, credibility, etc.. In meeting its challenges in the coming months, the following comments are offered by the author based on the discussion in this report of the principles and concepts that have influenced the outcome of many chemicals issues. These comments relate to the process to be used, the proposal that will be produced and the industries involved.

Concerning the process, and given the public concerns with regard to access to information and decision making, it might be beneficial if the following aspects were clarified at the outset: the knowledge base on which proposals and decisions would be based; accessibility of the knowledge base to all stakeholders; confidentiality of data; disclosure of uncertainties and unknowns in the knowledge base; the nature of the multistakeholder consultation process; the role of stakeholders in decision making; provisions for openness, inclusiveness and transparency in decision-making; and involvement of affected jurisdictions and communities to address any PIC issues.

With regard to issues relating to risk assessment and risk management in the NWMO proposal, the latter should clarify whether a life cycle risk assessment is used, include the results of the risk assessment and, at a minimum, incorporate a cradle-to-grave approach in the risk management aspects. As noted in the discussion on chemicals, there are now cradle-to-cradle approaches being used to minimize the consumption of materials and energy in producing new chemicals and to design new chemical products so that at the end of their life cycle, instead of being a waste, they are an input to another product or process. The author is not qualified to know whether such cradle-to-cradle approaches are possible or practical for nuclear fuel but it may be worth exploring this for completeness.

Another factor that can be expected to figure conspicuously in the proposal will be the manner in which the precautionary approach is applied, a topic that has already been the subject of a paper for NMWO[22]. As the discussion in section 2.3.2 demonstrated, over the last 15 years or so, reference to precautionary approaches have been included in international agreements on chemicals. These references were first included in the preamble sections of (*i.e.,* not legally binding) and then complemented by explicit mention in the operative provisions of treaties (*i.e.,* legally binding). Recent Canadian law dealing with pesticides and toxic chemicals follows the latter approach. Given the recent Canadian policies concerning the application of precaution and developments at the international level, it would be reasonable to expect that the NWMO proposal should adequately reflect a precautionary approach. Given the uncertainties involved in the data to be used and the very long time periods that will be considered for "long term management" of used nuclear fuel, it would be advisable to explain how the precautionary approach has been applied in developing any proposal.

[22] *The Precautionary Approach to Risk Appraisal*, Andy Stirling, available on the NWMO website (**www.nwmo.ca**)

The discussion on the chemicals regime addressed three aspects related to the roles and responsibilities of industry: the Polluter-Pays Principle; waste minimization and extended producer responsibility (EPR); and voluntary industry initiatives. It is clear that the nuclear power industry has created a trust fund to address its financial obligations for the long term management of used nuclear fuel and this demonstrates that the industry is accepting its responsibilities under the Polluter-Pays Principle. However, given the long term nature of the management of used nuclear fuel, it will have to be demonstrated that the measures that will be proposed in this regard will be sufficient and sustainable in the long term. As the issue before NWMO relates to waste, it seems appropriate to examine whether the industry has fully explored its options for waste minimization while it is seeking solutions for its current waste dilemma. Furthermore, it might be appropriate to challenge the industry to address whether an examination of extended producer responsibilities could assist in minimizing the wastes produced or, possibly, be used to extend responsibility for nuclear wastes to the original suppliers of the fuel. There is a precedent in the chemicals area where the original producers of nickel-cadmium (NiCd) rechargeable batteries agreed to establish a voluntary industry-wide take-back program to retrieve a wide range of consumer and industrial batteries at the end of their useful life. This was done to remove persistent toxic chemicals from municipal and industrial waste streams and to encourage recycling of the metal content.

As mentioned in section 2.4.3, the international chemicals industry has adopted a voluntary *Responsible Care* program that was originally set up in Canada to address public concerns about the manufacture, distribution and use of chemicals and that now operates in 47 countries accounting for 85% of the global production of chemicals. The original objective was to regain public trust in the chemical industry. Perhaps this is a situation similar to what the nuclear power industry is facing today. As the chemicals industry has been encouraging partners in related industries to consider adapting this program to suit their particular needs and situations, it might be appropriate to examine the Canadian and international experiences and consider whether it would be appropriate to develop and implement a modified form of Responsible Care for the nuclear power sector. It should be noted that if the nuclear industry were to consider developing such an industry voluntary program, even the most optimistic persons involved should expect that there would remain some stakeholders who would retain their suspicions and distrust of the industry.

There are many challenges and opportunities that will be presented to NWMO as it pursues the development of proposals for long term nuclear management of nuclear waste in Canada. Given the position that the Canadian nuclear industry enjoys as a global supplier of nuclear power technology, the conduct of this exercise will likely be watched with great interest and there may well be opportunities for international cooperation and for Canadians and others to learn from this activity.

Appendix I: The Global Regime for the Sound Management of Chemicals

Introduction

Since initiation of large-scale production of chemicals in the mid-19th century, there has been increasing recognition that the production and use of chemicals could cause adverse impacts on health and the environment. This recognition led to early responses being taken to address health risks from uses such as warfare agents, pharmaceuticals and narcotics, from occupational exposure to chemicals and from chemicals present as contaminants in environmental media and food. Over the last fifty years or so, the global community has developed similar responses to address the impacts of chemicals on environmental media and organisms. This appendix begins with a review of events relating to chemicals issues from the mid-19th century to 1992, immediately prior to the UN Conference on Environment and Development (UNCED), a pivotal historical event in the development of the current chemicals regime. This is followed by a discussion of the UNCED results and the main developments since that meeting that have shaped the modern global chemicals regime. The last portion of this appendix includes a brief summary of the 50 global and regional agreements and approximately 40 international programs and initiatives that constitute the global regime for the sound management for chemicals. In addition to this information on the global chemicals regime, Appendix II contains a brief description of the global chemicals industry, including developments over the past thirty years and a projection to the year 2020.

Historical Perspective Prior to 1992[23]

Shortly after initiation of the large-scale production of chemicals in Europe in the mid-19th century it became apparent that the large-scale development and use of chemical weapons was feasible. In response, the *Brussels Convention on the Law and Customs of War* was adopted in 1874 to prohibit the use of poison or poisoned weapons and the use of arms, projectiles or material to cause unnecessary suffering. This was followed in 1889 by an international peace conference that led to the signing of an agreement to prohibit the use of projectiles filled with poison gas. In spite of this, chlorine, phosgene and mustard gases were used on troops in World War I as were other chemical agents in subsequent conflicts and additional international agreements have been developed to prohibit the manufacture and stockpiling of chemical weapons of mass destruction. However, recent terrorist attacks in the US and elsewhere have again heightened concerns that chemical agents may be used in attacks on both military and civilian populations.

The need for establishing international standards for pharmaceuticals resulted in the 1906 *International Formulary* to address nomenclature, methods of preparation and standards for 41 medicines. Subsequent work was carried out under the League of Nations and, following establishment of the United Nations in 1945, the World Health Organization (WHO) released the first *Pharmacopeia Internationalis* in 1951 and it has continued to set international drug standards. While the present report does not address standards for drugs as part of the global regime for chemicals, it should be noted that the processes involved in the manufacture of chemical drugs are just like any other chemical manufacturing processes. The issues relating to occupational exposure, factory emissions, wastes, etc. would apply to this industry sector and the fact that drugs are biologically active chemicals should only heighten interest in them. Indeed, recent studies have shown that sewage treatment processes do not eliminate human drugs from sewage effluents, especially birth control drugs (*i.e.,* hormones). Thus, releases from sewage treatment facilities of these

[23] A detailed review of several aspects of this topic is available in *International Approaches to Chemicals Control, A Historical Overview*, Rune Lönngren, The National Chemicals Inspectorate, Sweden (1992), ISBN: 91-7932-032-5.

drugs, or their metabolites, may be cause for concern due to the possible impacts on fish and wildlife as a result of long-term exposure to even low environmental levels of these substances.

Narcotics also received early interest, with the development in 1912 of the *Hague Convention on Exercising Control Over Opium*, which entered into force in 1920 following creation of the League of Nations. After the United Nations was formed in 1945, considerable efforts were made to address this problem and international conventions were signed in 1961, 1971 and 1988. However, the illicit market for narcotic drugs remains a multi-billion dollar per year business. In addition to the obvious health and social problems related to drug addiction, other problems include the uncontrolled release to the environment of chemicals used in making illicit narcotics and the environmental releases of large amounts of pesticides and other chemicals that are used in anti-drug programs in an attempt to destroy drug crops.

The early recognition that occupational exposure to chemicals could cause health effects led to the establishment of the International Labour Organization (ILO) in 1919. Recommendations were immediately issued to address the health hazards of using lead oxide pigments in paints and white phosphorus in the manufacture of matches and this was followed in 1921 by a convention to further address the hazards posed by the use of lead oxide in paints. Since then, ILO has continued to develop conventions and recommendations to protect workers from the hazards of chemicals.

The increasing use of chemicals was particularly noticeable during the first half of the 20th century, with the appearance during the 1930's and 1940's of such products as detergents, synthetic drugs and polychlorinated biphenyls (PCBs) and the use of DDT as an insecticide. However, the early attempts to manage the risks posed by environmental contamination involved problems involving relatively high levels of industrial pollutants. For example, early efforts were made to reduce air pollution based on problems related to odours, visible releases of 'soot and smoke' (particulate pollutants such as PAHs, metals, etc.) and dust deposition. Control efforts produced noticeable decreases in odours and in releases of pollutants such as particulate matter from such sources as industrial operations, including combustion of coal and other fuels. This is sometimes referred to as the "macropollutant" era, as actions were triggered by the obvious releases of 'bulk' pollutants from stacks and industrial sites.

The formation of the United Nations in 1945 was followed by the establishment of several intergovernmental organizations (*e.g.,* FAO, IMO, WHO, UNECE) that have been active in developing and implementing agreements and programs that directly or indirectly address a wide range of chemicals issues. However, a series of events would demonstrate the need for international action to address chemicals issues.

In the 1950's and 1960's, reports appeared of serious health impacts related to environmental exposure to chemicals. Between 1955 and 1965, severe health effects were reported in two Japanese communities. These effects were attributed to the consumption of high levels of methyl mercury present in fish and shellfish that had been contaminated as a result of the release of mercury-contaminated wastewater from acetaldehyde manufacturing plants. Similar episodes were soon reported in other countries involving fish and wildlife contamination by mercury releases from chloralkali plants and the use of mercury compounds to treat grain seeds. By the mid-1960's, PCBs were known to be environmental pollutants that were capable of wide geographic distribution following their release to the environment. In 1962, Rachel Carson published her book *Silent Spring,* drawing attention to the effects caused by the widespread and growing use of pesticides on wildlife populations. Many countries had developed national regulatory programs in the 1940's and 1950's to assess the effectiveness and health and environmental implications of pesticides, and to control their sale and use. However, Carson's book drew attention to the largely unrecognized problems that can result from long-term low-level exposures to environmental levels of chemicals such as pesticides. Thus, as progress was made in reducing the release of macropollutants, scientific advances led to the measurement of smaller quantities of chemicals in

environmental media and biota, the determination of adverse effects at lower doses, the demonstration that chemical exposures could produce birth defects and cancers, the identification of more subtle toxicological end-points and an increased understanding of the need to determine the environmental behaviour and transformation of chemicals. This led to a greater awareness of the potential effects of long-term low-level exposure to chemicals in the environment and we entered the "minipollutant" era.

By the 1960's, numerous countries had established regulations to address food additives, drugs and pesticides and it became increasingly apparent that there was a need to be aware of and coordinate actions taken at the national level to prevent serious disruptions in trade between nations as a result of uncoordinated national regulatory approaches. With increasing concerns about chemicals in the environment, a number of international organizations established programs to address the scientific and other aspects of issues. The WHO and FAO established cooperative programs to address food contaminants and pesticides, including a joint WHO/FAO expert group to address standards for food additives and pesticide residues. The OECD created an Environment Committee in 1970 and, in 1971, set up a group to promote cooperative actions on research, information sharing, risk assessment and risk management actions on pesticides and industrial chemicals.

It was in this climate of an emerging awareness of the need for international cooperative action to address several environmental issues, including the potential health and environmental risks presented by pesticides and industrial chemicals, that the UN General Assembly agreed to convene a Conference on the Human Development in June 1972 to examine the state of the global environment and to identify problems and needs for action. The conference was held in Sweden and addressed six problem areas arising from the impacts of humans on the global environment, one of which concerned chemicals. A conference declaration was issued that noted the need for extensive international cooperation of countries and intergovernmental organizations to address those international problems that were of a regional or global nature.

The conference identified the need for actions to prevent pollution of the seas and to halt the discharge of toxic substances in quantities or concentrations that exceeded the capacity of the environment to "render them harmless". The conference also adopted an Action Plan for the Human Environment that included 109 recommendations, of which 25 pertained to chemicals. One of these stressed the need to increase the capability of the UN system: to provide awareness and advance warning of the deleterious effects of man-made pollutants; to ensure that national policy makers had access to such information; to improve the international acceptability of procedures for testing chemicals; and to build an international database on manmade chemicals. Some recommendations sought to minimize the release to the environment of toxic or dangerous substances, especially persistent substances (*e.g.,* heavy metals and organochlorine compounds), and to develop monitoring, epidemiological and experimental research programmes to generate data essential for early warning, the prevention of deleterious effects on humans and the assessment of potential human health risks. Other recommendations identified the need to address the environmental effects related to the production and use of energy, including releases of carbon dioxide, sulfur dioxide, oxidants, nitrogen oxides, particulates, oil and radioactivity.

One recommendation from this conference led to the establishment of UNEP in 1972 as a permanent UN body responsible for protection and improvement of the environment, and others led to the establishment or expansion of chemicals programs in ILO, OECD and WHO. The conference outputs sparked a 30-year period of developing regional and global legal agreements, programs and other initiatives that have contributed to the current international chemicals regime. However, as time would tell, some of the developments in chemicals control would prove to be the result of unplanned events, such as chemical accidents.

A number of accidents were reported at chemical manufacturing sites in the 1970's in Canada, UK, USA, Netherlands and Italy, including a highly publicized one that involved the airborne release of the pesticide 2,4,5-trichlorophenol and a highly toxic byproduct (dioxin) in Seveso, Italy, in July 1976. The latter accident exposed tens of thousands of people living in the local area, as well as domestic animals and wildlife. This incident led to the development of the EU Seveso Directive in 1982 that imposed requirements for public information about major industrial hazards and appropriate safety measures in the event of an accident. This Directive reflected that industrial workers and the public should know about hazards that threaten them and related safety procedures and it marked the first time that the principle of "need to know" was enshrined in EU legislation.

In December 1984 a disastrous accident occurred at a chemical plant in Bhopal, India, which led to the deaths of thousands of local residents and serious health effects in tens of thousands that have since resulted in a large number of premature deaths. This was followed in November 1986 by a fire at a pesticide storehouse near Basel, Switzerland, resulting in the release of several tonnes of highly toxic chemicals into the atmosphere, soil, groundwater and the Rhine River. The biota in the Rhine was heavily damaged, with complete eradication of some aquatic organisms for a distance of 400 km. These two accidents led to the initiation of programs to prevent chemical accidents and to require planning for accident prevention, preparation and response in the OECD, ILO and IMO.

During the 1970's and 1980's, there was an increasing awareness of toxic effects that were attributable to very low concentrations of chemicals in the environment. The era of "micropollutants" was entered during this period and concerns persist today that there may be population level effects occurring in present or future generations of wildlife and/or humans as a result of the widespread presence in the environment of complex mixtures of pesticides, industrial chemicals and by-products. Most attention in this regard is directed to substances that are persistent, toxic and bioaccumulative (the "PBTs"). One notable example from this period was the recognition that subtle adverse effects were occurring, particularly in children, as a result of human exposures to lead in vehicle exhaust due to the widespread use of lead additives as octane enhancers in motor gasoline. Actions were taken in many countries to reduce and eventually phase out the use of lead additives, although the problem remains to be addressed in several countries.

During this period, new or augmented chemicals management programs were initiated at the national, regional and international levels to address the risks posed by pesticides and new and in-use industrial chemicals. This was especially the case within OECD countries where several countries and the EU adopted what is sometimes referred to as the "second wave" of chemicals legislation. In 1977, the OECD identified the need for a cooperative international approach to allow harmonization of national systems before final legislation and regulations were completed and to address needs for adopting improved test methods, improved data and information exchange, and harmonization of specific control measures. In 1977-78, the OECD initiated programs to address the following key issues:

- standardized test guidelines, to determine the physical, chemical and toxicological properties of chemicals for use in risk assessment activities;
- good laboratory practices (GLP), to ensure that the generation of laboratory data, using OECD test guidelines for the physical, chemical and toxicological properties of chemicals, would be acceptable for use by all OECD countries in making national regulatory decisions;
- mutual acceptance of data (MAD) procedures, to ensure that data developed according to GLP would be accepted by all countries for use in making regulatory decisions;
- information exchange procedures, including identification of potential problems with chemicals, the regulation of chemicals, and information that should accompany marketed chemicals;
- aspects related to the treatment and possible sharing of confidential data; and
- development of an international glossary of key terms that were relevant in the chemicals area.

This interest in chemicals issues continues to this day and, as a result, the OECD has remained the pre-eminent international forum for the development of methods for characterizing the physical, chemical and toxicological properties of chemicals and pesticides and in developing the tools that may be used in planning risk management actions at the national level.

The recognition that trade in hazardous chemicals was creating problems in some importing countries led to the development of export notification measures at the OECD in the mid-1980's. This was soon overtaken by the implementation of a voluntary global program featuring the UNEP *London Guidelines for the Exchange of Information on Chemicals in International Trade*. In recent years, this was replaced by a global legally binding mechanism that includes the concept of "prior informed consent" under the UNEP-FAO Rotterdam Convention, which will enter into force in February 2004.

Another issue that was recognized during the 1980's was the threat posed to the earth's stratospheric ozone layer by ozone depleting substances. This resulted in the adoption of the Vienna Convention in 1985 and the Montreal Protocol in 1987 that has since been used to control the manufacture, use and release of about 100 industrial chemicals and some pesticides.

Shaping the Current Global Chemicals Regime

Concerns about the health and environmental effects resulting from production, use and release of chemicals were already evident at the international level by 1992 and were featured in discussions among numerous Heads of State at the United Nations Conference on Environment and Development (UNCED) that was held in Rio de Janeiro, Brazil. The meeting produced a report entitled *Agenda 21* which addressed a wide range of environment and development needs for pursuing sustainable development in the 21st century. This section describes some of the main impacts of UNCED and other recent pertinent events. The following section provides an overview of the current global chemicals regime.

Chapter 19 of *Agenda 21* (*Environmentally Sound Management Of Toxic Chemicals, Including Prevention Of Illegal International Traffic In Toxic And Dangerous Products*) directly addressed the issues of toxic chemicals and its main outcomes are summarized below. Chapter 20 (*Environmentally Sound Management Of Hazardous Wastes, Including Prevention Of Illegal International Traffic In Hazardous Wastes*) and Chapter 37 (*National Mechanisms And International Cooperation For Capacity-Building In Developing Countries*) addressed other key aspects of international efforts to achieve the sound management of chemicals. In the context of the present report, it is noteworthy that Chapter 22 addressed *Safe And Environmentally Sound Management Of Radioactive Wastes* and agreed on an objective "to ensure that radioactive wastes are safely managed, transported, stored and disposed of, with a view to protecting human health and the environment, within a wider framework of an interactive and integrated approach to radioactive waste management and safety".

The UNCED meeting was a pivotal historical event in the development of the sound management of chemicals as an international issue, as the participation of Heads of State provided the strong political element needed to elevate chemicals to the status of a high priority issue. Chapter 19 made recommendations to address the global problems posed by toxic chemicals and identified the following six program areas and objectives for the global community. These have influenced the international chemicals agenda since 1992.

- **Expanding and accelerating international assessment of chemical risks.** Objective: to strengthen international risk assessment, assess several hundred priority chemicals or groups of chemicals by 2000, and produce exposure guidelines for a large number of toxic chemicals.

- **Harmonization of classification and labelling of chemicals.** Objective: to develop, by 2000, a globally harmonized hazard classification and labelling system, including material safety data sheets and easily understandable symbols.
- **Information exchange on toxic chemicals and chemical risks.** Objective: to increase the exchange of information on chemical safety, use and emissions among all involved stakeholders, and achieve full participation in and implementation of the procedure for prior informed consent (PIC) by the year 2000.
- **Establishment of risk reduction programs.** Objective: to eliminate unacceptable or unreasonable risks posed by toxic chemicals and, where economically feasible, to reduce such risks through risk reduction and precautionary measures based on life-cycle analyses.
- **Strengthening of national capabilities and capacities for managing chemicals.** Objective: all countries should have in place, by 2000, national systems for the sound management of chemicals.
- **Prevention of illegal international traffic in toxic and dangerous products.** Objective: to reinforce national capacities to detect and prevent traffic in toxic and dangerous products that contravenes national legislation or international legal instruments.

Since UNCED, there have been many accomplishments in the area of chemical safety. Global and regional programs on toxic chemicals have been initiated or strengthened to respond to the challenges in Chapter 19. The Intergovernmental Forum on Chemical Safety (IFCS) and Inter-Organization Programme for the Sound Management of Chemicals (IOMC) were established to coordinate international efforts to advance the sound management of chemicals and achieve progress on the goals in Chapter 19. Risk assessments have been produced on hundreds of chemicals and initiatives are underway to generate data and assessments on thousands of high production volume chemicals. In terms of managing the risks of toxic chemicals, several conventions and protocols have been adopted at the global level (*e.g.,* climate change, Stockholm Convention on POPs, Rotterdam Convention on PIC) and regional level (*e.g.,* UNECE Protocols on POPs, heavy metals, PRTRs, sulphur emissions and volatile organic substances; UNEP regional seas conventions) and development of a globally harmonized system for classification and labelling of chemicals has been completed.

However, new chemicals issues continue to appear on the horizon. In some cases, issues surface as scientists improve their abilities to detect environmental contaminants in increasingly smaller amounts in humans, biota and environmental media or as new toxicological discoveries are made. One example involves the confirmation of endocrine disrupting chemicals in the environment where it has been shown that, even at very low levels in the environment, some chemicals have the ability to interfere with the functioning of the endocrine systems of fish and wildlife, in some cases causing changes in the organs or sex of species. One clear example is an ingredient widely used in anti-fouling paints on the hulls of ships (tributyl tin, TBT) that caused deformations and sex changes in marine organisms. This result led to the adoption in 2001 of a global IMO convention to phase out the use of TBT. While it is already accepted that endocrine disruption has occurred in fish and wildlife, there is no clear agreement on whether environmental contaminants are interfering with the endocrine systems of humans and this hotly debated topic continues to be the subject of intense research efforts.

In October 2000, governments and other stakeholder participants in the IFCS developed the *Bahia Declaration on Chemical Safety* and the *Priorities for Action Beyond 2000* and urged the international community to promote measures to ensure that all countries have the capacity for the sound management of chemicals. It was stressed that coordinated national policies, legislation and infrastructure and sufficient resources would be needed to do this. IFCS participants committed to improved cooperation and the pursuit of increased and stable levels of resources to address identified priorities and deficiencies.

Twenty-one goals were specified for the period 2000-2005 relating to the six UNCED priority program areas.

In 2002, in response to these IFCS recommendations, and acknowledging the large number of agreements, programs and initiatives in the global chemicals agenda, governments and other stakeholders agreed that UNEP should proceed with development of a strategic approach to international chemicals management (SAICM). This would be done in cooperation with relevant stakeholders including governments, IOMC, IFCS, the Global Environment Facility (GEF) and other major agencies responsible for the funding and delivery of international development cooperation. It was also agreed that the following issues would be important considerations in the development process:

- coordination should be improved between global and regional legal instruments, bodies and institutions with chemicals programs, and organizations responsible for chemicals policies and those responsible for development programs;
- the link between sound chemicals management and sustainable development should be strengthened;
- a global approach is needed to address the global nature of chemicals issues, due to the existence of a global chemicals market, the growing use of and dependency on chemicals, and the corresponding growth in chemicals management and disposal problems at all levels;
- interaction among all stakeholders should be improved to increase transparency and public participation in identifying priorities in chemicals management;
- industry should accept increased responsibility in the field of chemical safety*;*
- priority setting and increased focus and coherence are needed, given the large number of agreements on chemicals that have been developed in the last 10-15 years;
- capacity-building is a key element in implementing the sound management of chemicals at the global level, especially with the ongoing shift in production of high volume chemicals from developed to developing countries;
- developing countries and countries with economies in transition need capacity-building and technical and financial assistance to meet current health and environmental protection requirements;
- increased and more stable flows of resources are needed; and
- multilateral funding agencies should be involved in SAICM development.

To further the development of a SAICM, UNEP was mandated to convene an open, transparent and inclusive consultative process, involving participation of representatives of all relevant stakeholder groups, including agencies responsible for the funding and delivery of international development cooperation.

Also in 2002, another aspect of the chemicals agenda was recognized in a report from the World Bank[24] that demonstrated links between toxic chemicals and poverty. The report points out that even when the basic needs of poor people are met for food, drinking water and shelter, the poor, especially children, are likely to receive elevated exposures to chemicals and pollutants, and they are more susceptible to such exposures than people in higher economic states. The indoor burning of wood, fossil fuels and animal wastes for domestic heating and food preparation are significant sources of air pollutants that are related to respiratory and other diseases. These pollutants include sulphur and nitrogen oxides and total suspended particulate matter (TSP). Levels of sulphur oxides and TSP in developing countries are 1.6 - 2.3 and 3 - 6 times higher, respectively, than levels in developed countries. Accidental contamination of

[24] *Toxics and Poverty: The impact of Toxic Substances On the Poor in Developing Countries*, prepared by Lynn Goldman and Nga Tran for the World Bank, World Bank, Washington DC (August 2002).

food and drinking water by pesticides is common due to poor practices in handling, storing and usage. This is compounded by the prevalence of older, riskier pesticide products which are off patent (and therefore cheaper) and that have been replaced in developed countries by safer products. It was also noted that there is a greater risk of human exposure to pesticides per capita in developing countries, as there is a higher proportion of the population in these countries living in rural agricultural areas. Lead toxicity was another important concern, with the highest exposures experienced by children living in poverty and suffering malnutrition. The report noted that poverty and lead exposure occur everywhere in the world, including OECD countries, and that the impacts of toxic chemicals on poor people are not limited to developing countries.

In September 2002, the World Summit on Sustainable Development (WSSD) was held in Johannesburg, South Africa, to address a broad range of sustainable development issues and review progress in implementing *Agenda 21*. The UNEP decision to develop a SAICM and the release of the World Bank report on toxics and poverty were particularly well timed to inform the Johannesburg Summit on chemicals issues. It was evident that despite all the progress that had been made in international approaches to the sound management of chemicals, much more work was needed to address the capacity building needs of developing countries and the concerns about chemicals that:

- are already known to be of concern (*e.g.,* POPs, heavy metals, etc.);
- possess certain physical and chemical properties (*e.g.,* persistent toxic chemicals, volatile organic chemicals that cause smog);
- cause toxicological effects of concern (*e.g.,* endocrine disruption, cancer);
- affect certain target groups (*e.g.,* the poor, pregnant women, children, elderly, aboriginal populations); or
- are produced in large volumes and lack data on their physical and chemical properties.

The Johannesburg Summit adopted a Plan of Implementation[25] that, in its chapter III, "Changing unsustainable patterns of consumption and production":

- set a goal that, by 2020, "chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment, using transparent science-based risk assessment procedures and science-based risk management procedures, taking into account the precautionary approach, as set out in principle 15 of the Rio Declaration on Environment and Development, and support developing countries in strengthening their capacity for the sound management of chemicals and hazardous waste by providing technical and financial assistance"; and
- endorsed the further development of a SAICM based on the IFCS Bahia documents, by 2005, and urged UNEP, IFCS, other international organizations dealing with chemical management and other relevant international organizations and actors to cooperate closely in that regard.

During 2003, and in response to the decisions taken by UNEP and the Johannesburg Summit, the policy bodies of WHO and ILO endorsed the development of SAICM and the participation of their organizations in the development process.

UNEP held the first SAICM preparatory meeting in November 2003 with the support of governments, the IOMC, IFCS, UNDP, the World Bank and other relevant organizations. This process should culminate in early 2006 with a high level UNEP international conference to adopt the completed SAICM document and invite other relevant organizations also to endorse it. Thus, there is a clear mandate to pursue the SAICM initiative, the link between the policy and development elements has been explicitly made, and

[25] *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August – 4 September 2002* (United Nations publication, Sales No. E. 03. II. A. 1 and corrigendum), chap. I, resolution 2, annex.

interest in shaping the future international chemicals agenda has been demonstrated at the political level. This will likely sustain interest in advancing the sound management of chemicals for many years to come.

The Current International Chemicals Management Regime[26]

The current international chemicals management regime consists of a series of global, regional and subregional legal agreements (*i.e.,* conventions and protocols) and programs and initiatives undertaken by groups of countries, intergovernmental organizations, or international organizations and bodies. Tables 5 and 6 list global and regional agreements that address chemicals issues, and Table 7 lists several current international programs and initiatives pertaining to the sound management of chemicals. While this list is not complete, it is certainly representative of the current situation and serves to demonstrate the nature and complexity of the international chemicals regime and the progress that has been achieved, particularly since the UNCED meeting in 1992.

As noted in Section 2.1, of the current 22 global and 28 regional agreements that are listed in Tables 5 and 6, respectively, only 2 were adopted before 1971, while 7 were adopted in the 1970's, 13 in the 1980's and 28 since 1990. Thus, the agreements that contribute to the current chemicals regime have been developed over the past 3 decades, and most of them are less than 15 years old. These agreements were developed to address the following main areas of interest, although many of them will impact on more than one area:

1. occupational risks of chemicals;
2. protection of biodiversity from a range of threats, including chemicals;
3. air pollution by chemical products and by-products;
4. water pollution by several sources, including chemicals;
5. prevention of accidents and development of emergency response measures at industrial sites that manufacture, use or store hazardous chemicals;
6. safe transportation and storage of dangerous chemicals and products;
7. trade in specified hazardous chemical and pesticides;
8. prohibition and destruction of chemical weapons;
9. production, use or release to any environmental media of specified chemical products and by-products; and
10. transboundary movement and disposal of hazardous wastes.

The fifteen groups of countries or organizations listed in Table 7 undertake activities concerning the sound management of chemicals. This is not a complete list of players or of programs. For example, the table does not include the significant number of activities performed by IGOs that provide secretariats for Conventions or Protocols (ILO, IMO, UNEP, FAO, UNECE). However, this list gives a sense of the scope and nature of the programs that are ongoing and an indication of when they began. Some of the chemicals programs of the relevant UN specialized agencies (FAO, ILO, IMO and WHO) were initiated shortly after the creation of the UN in 1945. Others were initiated in later years in response to international developments in the chemicals area, with several beginning after the UNCED meeting in 1992 in response to the call in *Agenda 21*, Chapter 19 for enhanced action by all stakeholders in pursuit of the sound management of chemicals. These activities address various aspects of the life cycle of intentionally and unintentionally produced chemicals, and all address at least one aspect of problem identification and priority setting, risk assessment, risk management, and monitoring and evaluation. Table 7 shows that IGOs are very active in all facets of the international chemicals agenda, both in coordinating work and in developing and implementing programs. Considerable work is done on policy

[26] This summary includes information from the report *Global Pursuit of the Sound Management of Chemicals*, prepared for the Word Bank by John Buccini, World Bank, Washington DC (First printing, November 2003).

instruments, action plans, developing scientific tools for use in chemicals management (*e.g.,* test guidelines, risk assessment methods), and recommendations, codes, guidance and training materials.

Only two "other" groups of players are identified in the Table. One involves eight circumpolar nations that have carried out work under the Arctic Monitoring and Assessment Program (AMAP) to assess the impact on the polar region of atmospheric contaminants (*e.g.,* POPs, heavy metals). The other is the International Council of Chemicals Associations (ICCA), a group of national and regional chemicals associations that have implemented voluntary programs in the chemicals area.

Table 5: Global Agreements on Chemicals		
Organization	**In force**	**Name of Agreement (date of adoption)**
International Labour Organization (ILO)	1923	Convention 13: Use of White Lead in Painting (1921)
	1973	Convention 136: Protection Against Hazards of Poisoning Arising from Benzene (1971)
	1976	Convention 139: Prevention and Control of Occupational Hazards caused by Carcinogenic Substances and Agents (1974)
	1979	Convention 148: Protection of Workers against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration (1977)
	1989	Convention 162: Safety in the Use of Asbestos (1986)
	1993	Convention 170: Safety in the Use of Chemicals at Work (1990)
	1997	Convention 174: Prevention of Major Industrial Accidents (1993)
International Maritime Organization (IMO)	1983	Convention for the Prevention of Pollution from Ships (1973, 1978)
	1995	Convention on Oil Pollution Preparedness, Response and Cooperation (1990)
	No	Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances (2000)
	No	Convention on the Control of Harmful Anti-fouling Systems on Ships (2001)
Organisation for the Prohibition of Chemical Weapons (OPCW)	1997	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and Their Destruction (1992)
United Nations Environment Programme (UNEP)	1988	Vienna Convention on the Protection of the Ozone Layer (1985)
	1989	Montreal Protocol on Substances That Deplete the Ozone Layer (1987)
	1992	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989)
	No	Protocol on Liability and Compensation for Damage Resulting from Transboundary Movement of Hazardous Wastes and their Disposal (1999)
	1994	United Nations Framework Convention on Climate Change (1992)
	No	Kyoto Protocol (1997)
	1993	Convention on Biological Diversity (1992)
	2003	Cartegena Protocol on Biosafety (1999)
	No	Stockholm Convention on Persistent Organic Pollutants (2001)
UNEP and Food and Agriculture Organization (FAO)	2004	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998)

Table 6: Regional Agreements on Chemicals		
Organization	**In force**	**Name of Agreement (date of adoption)**
United Nations Environment Programme (UNEP)	1987	Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (1976)
	1979	Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution (1978)
	1984	Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (1981)
	1986	Lima Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific (1981)
	1985	Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (1982)
	1996	Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (1983)
	No	Protocol Concerning Pollution from Land-Based Sources and Activities (1999)
	1996	Convention for the Protection, Management, and Development of the Marine and Coastal Environment of the Eastern African Region (1985)
	1990	Noumea Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (1986)
	1994	Bucharest Convention on the Protection of the Black Sea against Pollution (1992)
United Nations Economic Commission for Europe (UNECE)	1968	European Agreement Concerning the International Carriage of Dangerous Goods by Road (1957, amended 1985)
	1983	Convention on Long Range Transboundary Air Pollution (1979)
	1987	Protocol on Long-term Financing of the Cooperative Program for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (1984)
	1987	Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at Least 30 Per Cent (1985)
	1991	Protocol on Control of the Emissions of Nitrogen Oxides or their Transboundary Fluxes (1988)
	1997	Protocol on Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes (1991)
	1998	Protocol on Further Reduction of Sulphur Emissions (1994)
	2003	Protocol on Heavy Metals (1998)
	2003	Protocol on Persistent Organic Pollutants (POPs) (1998)
	No	Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (1999)
	1996	Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992)
	No	Protocol on Water and Health (1999)
	2000	Convention on the Transboundary Effects of Industrial Accidents (1992)
	No	European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (2000)
	No	Protocol on Pollutant Release and Transfer Registers (2003)
OSPAR Commission	1998	Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR Convention) (1992)
Helsinki Commission	2000	Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area (1992)
North American Commission for Environmental Cooperation	1994	North American Agreement on Environmental Cooperation (1994)

Table 7: International Programs and Initiatives on Chemicals	
Organization	**Program/Initiative**
Eight Circumpolar Countries	Arctic Monitoring and Assessment Program (1991)
EU	White Paper on Chemicals (2001)
FAO (1945)	Pesticide specifications and recommended maximum levels in food (1963+)
	International Code of Conduct on Distribution and Use of Pesticides (1985, 2002)
	Voluntary procedure on prior informed consent (1989)
	Stockpiles of obsolete and unwanted stocks of pesticides
IFCS (1994)	Priorities for action beyond 2000 (2000)
ICCA	Initiative on HPV chemicals and long-range research initiative
	'Responsible Care' (1985) (described in section 2.4.3)
	Proposed capacity-building project
ILO (1919)	Codes of practice and manuals
IMO (1948)	Codes of practice, standards, recommendations and guidelines
IPCS (1980)	Health and environmental risk evaluations of specific chemicals
	Risk assessment methodologies
	Chemical emergencies and poison control centres
IOMC (1995)	Coordinating efforts on the six UNCED priority areas in Chapter 19
	Global Harmonized System of Classification and Labeling of Chemicals (2002)
	Pollutant release and transfer registers (PRTRs)
	Chemical accidents
	Risk assessment methodologies
OECD	Environmental Health and Safety Program (1971)
	Waste Program (1974)
UNECE (1947)	Codes of practice, standards, etc.
	Recommendations on the Transport of Dangerous Goods
	Country performance reviews
UNEP (1972)	Chemicals Program (1974) - voluntary PIC, technical assistance, capacity-building
	APELL (1988)
	Cleaner Production (1989)
	OzonAction program
	Global Program for Protection of the Marine Environment (1995)
	International action on mercury and its compounds (2001)
	Phasing out the use of lead in motor gasoline (2001)
	Strategic Approach to International Chemicals Management (2001)
UNIDO (1967)	Cleaner production and environmental management program
	Phasing out ozone depleting substances
UNITAR (1965)	Guidance, training, technical assistance and capacity-building
WHO (1945)	Risk assessment methodologies
	Risk assessment of new pesticides, climate change and ozone depletion
	Advice on hazardous waste management and emergencies preparation and response

Appendix II: The Global Chemicals Industry

As all industry sectors consume chemicals, they all contribute to the loadings of chemicals to the environment through losses from industrial sites and waste disposal practices, distribution of products, formulations and articles[27] that eventually result in the releases of chemicals to the environment, or the generation of by-products in industrial and combustion processes. However, within the industrial sector, the chemicals industry is frequently regarded as a prime contributor and while it is among the most highly regulated in the world, concerns remain that the release of intentionally and unintentionally produced chemicals during manufacture, use, transportation, storage or disposal of chemicals and related wastes may be causing damage to environmental organisms or humans. The following brief description of the global chemicals industry includes developments over the past thirty years and a projection to the year 2020. It is based on a 2001 report[28] that includes an excellent review of the current situation and some predictions for the period ending in 2020. While most of the data and information relate to the thirty OECD countries, sufficient observations and conclusions were included on non-OECD countries to make the report of general interest and importance.

The modern chemicals industry originated with the commencement of large scale manufacturing within the European chemicals industry in the mid-nineteenth century. Since then, this industry has transformed raw materials into hundreds of thousands of commodity and specialty chemicals and has played a central role in enabling technological change in all sectors of society through its innumerable innovations in both products and processes. Many of these have become commonplace and are now viewed as essential in elevating and/or maintaining a high standard of living in countries around the world. This research-intensive industry has evolved for over 150 years and will continue to do so as it responds to the never-ending demands for innovation to meet the constantly changing needs of the global community. In modern terminology, the chemicals industry could easily be regarded as the world's first high technology industry.

The global chemicals industry is highly diversified in terms of the nature, size and geographic location of the companies involved. It employs more than 10 million people and accounts for 7% of global income, 9% of international trade and an estimated US$ 1.5 trillion in sales in 1998, more than twice the size of the global market for telecommunications equipment and services. The top 10 companies in 2000 had revenues of US$ 10-30 billion, employed tens of thousands of workers at numerous sites around the globe and produced very large amounts of chemicals. However, most chemical producers have less than 50 employees (many have less than 10) and produce the largest number of substances, albeit in relatively small accounts.

This industry is also highly diversified in terms of the number, types and volume of products produced. Primary producers convert basic materials into bulk commodity chemicals, which are sold to downstream producers and processors for conversion into other chemicals, formulations, products or articles. Many manufacturing stages may be involved between the primary producer and the final industrial or public consumer of a chemical or product. Tens of thousands of chemicals are in commercial use at any time and this mix is constantly changing as older chemicals are withdrawn from use and a few hundred new ones are introduced annually. While some chemicals are produced in very large volumes (*e.g.,* global consumption of ethylene dichloride in 1997 was 37 million tonnes), most are produced in very small volumes. For example, about 1% of the commercial chemicals in Japan and the EU are produced at a rate of more than one million tonnes/year and account for over 75% of the total chemicals production.

[27] An *article* is a manufactured item that is formed into a specific physical shape or design during manufacture and has, for its final use, a function or functions dependent in whole or in part on its shape or design

[28] *OECD Environmental Outlook for the Chemicals Industry*, OECD Paris, France, (2001), available on the OECD website (www.oecd.org/ehs).

However, about 90% of commercial chemicals are produced in less than 10,000 tonnes/year and account for only 1% of the total volume. Current global production, distribution, transformation and formulation of chemicals results in hundreds of thousands of products, articles and formulations in the marketplace at any time, most of which are produced in relatively small amounts.

Over the past 30 years, the global chemicals industry has experienced steady growth in production, consumption and trade. The value of chemical shipments increased almost nine-fold from 1970 to 1998 and there is now a genuine global chemicals industry, with 16 countries accounting for about 80% of global production. In some countries, this industry accounts for 10-30% of manufacturing and is now a significant economic sector. Global expansion was aided by world economic growth and:

- the emergence of multinational chemical companies as OECD-based companies invested in non-OECD countries, a trend that is expected to continue;
- increased investments in many domestic chemical industries, leading to some countries becoming major suppliers of specialty and bulk chemicals;
- development of truly global markets for chemicals;
- decreased tariffs and other trade barriers; and
- significant advances in telecommunications and transportation.

The chemicals industry is undergoing changes in terms of what is being produced and where it takes place. The production for all chemical sectors is currently higher in OECD countries than in non-OECD countries and the *per capita* consumption of chemicals in the developed world is also far greater than in the developing world. This suggests that there is considerable scope for increased consumption of chemicals in the developing world. While the global output of chemicals in 2020 is expected to increase by 85% over 1995 levels, the OECD countries' majority share of global output (78% in 1998) will decrease by about 10%, due to stronger growth in non-OECD countries, and the developing world share will increase from 23% of global demand and 21% of production in 1995 to 33% and 31%, respectively. Thus, the total demand for chemicals is predicted to increase more rapidly in developing than in developed regions. It is also expected that production of high volume basic chemicals will shift to non-OECD countries as OECD countries shift to specialty and life science chemicals. There will likely be fewer and larger multinationals due to:

- increasing scale and growth of the industry;
- continuing globalization;
- increased market openness and competition; and
- regulatory requirements to protect health and the environment that will lead to company mergers and alliances to achieve efficiencies and economies of scale.

This industry is responding to the concerns of governments and the public about the release of chemicals to the environment during manufacturing, processing, transportation, storage, waste disposal, accidents and the use and disposal of products, articles and formulations. In many countries, the chemicals industry has instituted the voluntary *Responsible Care* ® program (see section 3.3.3) and/or taken actions to reduce, reuse and recycle materials, decrease releases to the environment, and prevent or minimize the generation or release of unwanted by-products. However, concerns remain about the impacts of the remaining releases and those of products produced by the chemicals industry when they are used and/or released to the environment by industrial consumers or the public. Concerning greenhouse gases, the chemicals industry accounted for only a small proportion of the emissions from all OECD sources in 1997. However, this could change over the next 20 years if the predicted growth in the chemicals industry takes place. Predicted growth could become especially important in non-OECD countries that rely on coal and other fuels that contribute more to greenhouse gas (and toxic chemical) emissions, given their growth in energy usage from 20% of the energy used in the chemicals sector in 1971 to 43% in 1998, and the prediction of stronger growth in these countries by 2020.