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Guidebook on the development of regulations for uranium deposit development and production

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FOREWORD

Nuclear power generation worldwide is expected to follow a modest but steady growth at an annual rate of between 1.5 to 2.5% to the year of 2010. A higher rate of growth is expected for the Middle East, South Asia and Latin America. In accordance with this projection, the cumulative uranium requirement from 1995 to 2010 is estimated to be in the order of 1.1 million tonnes. A large part of this requirement has to come from new uranium production centres that have not yet been developed.

Concern for health and safety and the earth's environment has grown rapidly during the past two decades. Exploitation of any mineral commodity, uranium included, involves the modification of the surrounding lands. Appropriate regulations governing such activities can assure good practices and minimize possible negative impacts on the environment, and on the health and safety of workers. Uranium exploration, development and production has had a long history in the mineral industry. However, because of its radioactive character, work related to the mining and milling of uranium requires additional measures or regulations to ensure that potential impacts can be properly controlled. Public concern with the perceived hazards of radioactive substances, together with industry recognition of the need for uniform standards, has accentuated the need for a more uniform approach to regulating these activities that will assure good practices and at the same time not impede the production of a necessary mineral commodity.

The main purpose of this guidebook is to discuss the various factors and questions that need to be considered by Government organizations in formulating and implementing a regulatory regime to control uranium resource projects. It also provides examples of regulatory requirements in countries where such regulations have evolved into more mature stages. It provides useful policy and technical guidance and directs the user to where greater detail can be found in the existing literature.

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EDITORIAL NOTE

In preparing this publication for press, staff of the IAEA have made up the pages from the original manuscript(s). The views expressed do not necessarily reflect those of the governments of the nominating Member States or of the nominating organizations.

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1. INTRODUCTION

The exploitation of uranium started in the early 1800s not long after the discovery of the element by Martin Klaproth in 1789. Early production was small and was used primarily as colouring agents in ceramics, glassmaking and steelmaking. The next generation of uranium mining, started in the early 1900s, was for the isolation of radium. By then, these activities had spread from Europe to the United States of America and Africa.

Uranium production started to grow from the mid 1940s, initially for the production of nuclear weapons, and then to fuel nuclear power generation. The world's uranium production reached its peak in 1981 when over 67 000 tonnes of U was produced. This period of over production was followed by a market crash. Since then, uranium production continued to decrease and total world output has been below reactor related demand since 1989. In 1993 nearly 32 700 tonnes U was produced from 26 countries. Production from Australia, Canada, France, Kazakhstan, Namibia, Niger, Russia, South Africa, Ukraine, USA and Uzbekistan accounts for about 90% of this total. Current production now represents only about 55% of the world's requirement to fuel nuclear power reactors with the remainder coming from stockpiles of previously produced uranium. It is projected that annual world reactor requirement will reach over 75 000 tonnes U by the year 2010, with cumulative requirement from 1993 to 2010 estimated to be in the order of 1.2 million tonnes U. A large fraction of this will come from existing facilities, but much will have to come from new production centres that are still to be developed.

Despite this long history, there is little uniformity in the regulatory requirements for the development and production of uranium deposits from country to country. Some countries have a very comprehensive regulatory regime while others have practically none. Growing public awareness and concern over health and safety and environmental degradation in many countries, necessitates the formulation of a sound regulatory regime that is compatible with the internationally accepted requirements. This regulatory regime should have as its ultimate goal the protection of the environment, public health, and the health and safety of the workforce, while considering the costs of production, and encouraging industrial development as dictated by the needs of society.

The objective of this report is to provide a general guideline for the development of regulations for uranium deposit development and production. The guidebook is primarily directed at Government organizations that are responsible for the preparation of such regulations as well as those that must implement and administer them. The report deals with the various factors and questions that need to be considered rather than on the regulatory standards or practices themselves. While identifying areas of activities at the different stages of uranium exploration, development, construction, production, decommissioning and rehabilitation that may be subject to regulation, it does not include the description of these technical requirements nor how they should be met.

Mining operations of all types pose potential hazards to the environment and to health and safety. Most countries have legislation to control these activities, as well as general legislation for matters such as environmental protection and occupational health and safety. Because of the radioactive nature of uranium and its ores, and the potential hazard that can be caused by such activities, the exploration, development and production of uranium and other radioactive mineral deposits present particular factors which must be addressed by the regulatory regime. However it is important that such additional requirements are seen as complementary to the existing regulatory requirements, and are broadly consistent with them.

This report is primarily concerned with the regulatory requirements specific to the mining and milling of uranium, additional to those required for other minerals in general. It discusses all the normal stages of mineral exploitation from exploration to decommissioning and rehabilitation. It does not discuss activities beyond the production of uranium concentrate (yellow cake). It assumes that relevant legislation related to mining (in general), environmental protection, radiation protection, occupational health and safety, waste disposal and other similar matters are already in place.

This report does not address the particular regulatory standards requirements and limits that should be established. However *Section 5 includes a directory to internationally recognized codes, standards and recommendations which provide guidance to the requirements that should be set.*

For the purpose of illustration, outlines of the regulatory regimes in several uranium producing countries with long history of mining and corresponding regulatory development is provided in Appendix I.

2. BASIC CONSIDERATIONS IN DEVELOPING AND REGULATING FOR URANIUM DEPOSIT DEVELOPMENT AND PRODUCTION

This section will discuss the basic considerations for developing regulations and establishing and administering regulatory programmes necessary for safe and environmentally sound uranium deposit development and production.

2.1. THE NEED FOR LAWS

Nations that have uranium deposit activities requiring regulatory control will need to consider the development of basic laws. Such laws establish the government's policy on uranium development and production and the legal basis for the regulating agency to administer the regulatory programme. Ideally, these laws should provide general direction on protection of the public, workers and the environment from the harmful effects of radiation. To have a strong, efficient and stable regulatory programme that adequately considers the interests of the nation, the regulated industry, and protects the health and safety of the public, it must be based on laws that have directed the establishment of standards and the associated regulatory authority and structure.

2.1.1. Interests Involved

2.1.1.1. National

Laws that provide for uranium development and production should recognize national interests in developing natural resources for the benefit of the citizens, in providing jobs for the citizens, and in appropriately protecting the public and the environment. The government must also weigh the potential irreversible impacts of mining and uranium production against these interests. These considerations, however, are similar to those for any natural resource development. Once the decision is made to allow uranium production, the only additional issues to be addressed are the potential for increased exposure to radioactivity during operation, and the long-term impacts of the radioactive waste generated.

2.1.1.2. Public and Environmental

Public concerns and environmental effects will need to be considered in developing laws, and these must be weighed against potential favourable impacts. Those that should be considered in developing laws include

- Assuring that public concerns have legally recognized avenues for consideration in the process, and

- By directing that socio-economic as well as environmental effects be fully considered in any uranium deposit production and development project.

2.1.1.3. Uranium Industry

Establishment of appropriate laws provides accountability, stability and predictability to the regulated uranium industry. This is important to provide the necessary confidence to allow the industry to pursue their interests with the assurance that they know fully the current regulations with which they will be expected to comply. For an enterprise to pursue uranium deposit development and production, they must be assured that the rules with which they must comply with are fair, reasonably stable, and allow them to operate in a manner that will make the operation feasible and economic.

2.1.1.4. Independence

Laws should be structured so that the regulatory agency will be established separately and independently from those government activities that have an interest in promoting development of mining and production activities. This is to prevent conflicts of interests between other government agencies, the public, the industry, and the regulatory agency. Any agency that is not free of these types of pressures cannot function adequately to protect all affected parties.

2.1.2. Provision for Agency Funding

Governments should consider the framework for funding regulatory programmes. Although governments routinely deal with funding of programmes, experience has shown that funding for regulating nuclear material is particularly important. Funding can be accomplished by direct appropriation as a budget item in the government's budget, by collecting fees from the regulated industry for permitting, licensing and inspection, by taxes on the industry that are applied directly to the regulatory authority's budget, by royalties on the extraction of the uranium (if uranium is considered to be the property of the government rather than private property), or various combinations of these. Caution should be exercised, however, on relying heavily on royalties or taxes based on production of the uranium ore or its finished product. Such funding can fluctuate dramatically and undermine the stability of the regulatory agency. This is especially true after uranium production has ceased. Although the operator is not providing any revenues, the need for regulation remains until the operation is decommissioned and rehabilitation is complete. In general, if the agency is to be funded from some charge on operators, that charge should be restricted to the amount actually needed for adequate operation of the agency, and not be used to raise additional revenue.

In addition to a working budget for the agency, it may be desirable to ensure that funds will be available as required to ensure that all projects are decommissioned and rehabilitated to a satisfactory standard. These assurances should be in some form of surety that will fund the decommissioning and rehabilitation of the facilities by a third party, in the event of a default by the enterprise. The funds from these sureties may be in the name of the government, or an agent for the government, and should be restricted from being diverted from the necessary decommissioning and rehabilitation. The sureties are generally based on approved decommissioning and rehabilitation plans and should be regularly reviewed by the regulatory agency to assure that the amounts remain adequate and the surety instruments remain viable. As rehabilitation is satisfactorily completed, surplus funds are returned to the operator. It should be noted that some governments authorize the replacement of the sureties by tax-free financial provisions retained from the mine revenues.

2.2. DEVELOPMENT OF STANDARDS

The risks due to uranium mining and milling activities, the benefits of developing the resource, and the environmental impacts should be clearly understood by the government and the public. This is best conveyed by having the goals and objectives of the standards clearly articulated. Open public forums that allow for discussions of the goals and objectives are useful in this endeavor. Another important aspect is that the language of the regulations should be as simple and

straightforward as possible. Language that can lead to broad interpretations should be avoided to prevent the perception that requirements are changing, depending on vague and poorly articulated circumstances. This can result in continual disagreements that divert attention from the primary goals of the regulations. On the other hand, standards that are overly specific can lead to regulatory nightmares, because standards are very difficult to modify, especially when relaxation is necessary. The focus should be on flexibility.

2.2.1. Compatibility with Existing Standards

In general, standards required for uranium resource operations should be compatible with or derived from those applied to similar types of activities not involving uranium. Although the radioactive nature of uranium presents unique problems, they are not of such magnitude as to require the imposition of standards that are greatly in excess of those required in well regulated non-uranium operations. Requirements should build on any experience gained in non-uranium operations, and procedures and techniques which have been proved, rather than seeking to impose procedures that are entirely new.

2.2.2. Prescriptive and Non-prescriptive Standards

Prescriptive standards are standards which specify requirements which must be followed, while non-prescriptive standards specify a goal that must be achieved but do not specify how it is to be achieved. While some standards, by their nature must be prescriptive, non-prescriptive standards are very often preferable. Non-prescriptive standards allow the operator to choose a way of meeting the requirement that best meets the circumstances of the particular operation. For example, in the case of limits on liquid discharges, a prescriptive standard would require that effluent be treated in a specified manner before discharge. A non-prescriptive standard would specify effluent concentration limits, but allow each operation to determine how those limits will be met. The limits might be met by treatment of the effluent before release or discharge, design of the operating processes to reduce the amount and concentrations of constituents to be discharged, recycling of potential effluents without discharging, or other methods that might accomplish the same objective.

Some requirements will need to be non-prescriptive. A requirement that an operator submit waste management plans to the regulatory agency for approval is an example of a non-prescriptive standard. Non-prescriptive requirements recognize that there are often a number of alternative ways of satisfying the intentions of the requirement, and it may be impossible or impractical to specify numerical or prescriptive standards.

2.2.3. Public Information and Participation

As discussed in Section 2.2.4, it is highly recommended that international radiation protection standards be adopted. Whether international standards are adopted, or some other standards, the procedure of adoption should be a public process. It is important that the concerns and opinions of the general public, public interest groups, environmental groups, and the regulated industry are heard and considered in the process. Such a process will promote open discussions and consideration of all viewpoints. Public confidence will be enhanced by dissemination of appropriate information from all parties. Depending on the "culture", addressing public consensus can lead to different levels of regulatory control between countries. This in turn can operate against having a reasonable level of uniformity in standards from one nation to the next.

2.2.4. International Standards

Because of the unique nature of radiation hazards, specific standards are required to provide adequate protection to those exposed, either occupationally or environmentally. Establishment of appropriate radiation standards for particular circumstances is complex, with allowances for such factors as the type and energy of the radiation, the pathway of exposure (inhalation, ingestion, etc.) and characteristics of the exposed individuals (age, sex, etc.) However, appropriate standards have been developed by international bodies such as the International Commission on Radiological Protection (ICRP), and it is recommended that any standards set be compatible with them. They are based on careful review of studies of the effects of radiation, and are developed from consideration of the balance between the risks of radiation exposure, the potential for protection from exposure and the costs of such protection. Use of these standards will lead to a uniform degree of protection throughout the uranium production industry. (See Section 5 for details of such standards.) Considering the broad requirements necessary for mineral resource development in general, the additional requirements necessary for uranium deposit development and production are relatively small. The potential impacts due primarily to radiation, however, should be specifically addressed.

2.2.5. Balancing of Interests

In all activities, a balance must be achieved between the benefits of the activity, and the risks or detriments that arise from it. This is specifically recognized in the setting of radiation protection standards, such as limits to the radiation doses received by workers or the public. However this principal should also be applied to the setting of more general requirements, to ensure that the degree of protection provided is optimized.

While setting of standards which do not offer adequate protection is not acceptable, it must be recognized that the imposition of over-stringent requirements imposes costs on the operation. This can divert protective efforts from areas in which they are more important, or ultimately make the project uneconomic. Again it is emphasized that radiological hazards are only one of a range of potential hazards that might be encountered in a uranium resource project, and unnecessarily stringent requirements may not make any real contribution to the reduction of the overall risks.

As an example, individual monitoring of radiation exposures to workers is usually required during the operating phases of a project. However, during exploration, exposures are generally much lower, and the period of exposure less. Therefore a full programme of individual monitoring of workers would probably not be justified during exploration.

2.2.6. Regulatory Guidance and Codes of Practice

Once standards and regulations are adopted by the government, through its regulatory agency, there will usually be a need to provide additional regulatory guidance. This guidance is generally developed to communicate to the regulated industry and the public, specific methods and procedures that the regulatory authority have found acceptable in meeting the standards. These guides, or codes of practice, do not have the force of regulations, but rather show one or more ways the regulatory authority has found acceptable to meet the requirements. Individual uranium enterprises should always have the option of proposing alternative means of meeting requirements; the guidance only indicates approaches that are acceptable.

These guides and codes should, however, be made available to the public and the regulated industry before they are published, to assure understanding and acceptance of the methods or procedures. Guides and codes of practice can also be developed and adopted by the uranium industry or other organizations. In many cases, after review and public comment, these can be adopted by the

regulatory agency as acceptable procedures. There are also good examples of these documents in the cases for several countries described in Appendix I.

2.3. ADMINISTERING THE REGULATORY PROGRAMME

2.3.1. The Regulatory Agency

It is essential, once appropriate standards and regulations have been put in place, that there be sound administration of the regulatory programme that is managed and staffed by competent technical personnel. The administration should be to the extent possible, in the hands of one agency to avoid the dilution of skills and effectiveness amongst several agencies.

2.3.2. Qualification and Training of Staff

Because the primary protection to be administered is related to radiation, the regulatory staff must be especially qualified. This applies to both licensing and inspection personnel. Because of the wide variety of activities that are involved, from exploration through decommissioning and rehabilitation of production facilities, the staff will need to be competent in a number of technical disciplines. The state of the art is continually evolving in these areas, and the staff will need to be provided with specialized training and experience to adequately administer the regulatory programme. The cost of developing this specialized knowledge can be considerable. It is therefore important to retain the qualified staff. The staff, therefore, should be compensated adequately to assure its stability. In many nations, this type of training can be provided by commercial and government laboratories that are qualified in such areas as radiation health physics, geology, hydrology, meteorology, civil engineering, and nuclear chemistry processes. A fully qualified, experienced staff increases public confidence in actions and determinations of the regulated industry. Furthermore, a highly qualified staff engenders the confidence and respect within the regulated industry itself.

2.3.3. Activities of the Regulatory Agency

2.3.3.1. Standard Setting

The first task of a newly-formed regulatory agency will be directing the development of the standards and requirements. The recommended procedures for this effort are discussed in detail elsewhere in this guide. The regulatory agency is the logical body to manage this activity as it is responsible for imposing the requirements after promulgation. As noted, the procedure should be a public activity that considers the concerns of the public, the industry, the work force, and the environment. In addition, it will be the responsibility of the regulatory agency to revise, update, and otherwise modify requirements from time-to-time, as circumstances warrant.

2.3.3.2. Administrative Procedures

The Agency should also develop administrative procedures for such matters as applications for Licences, etc. These would include information which must be submitted in support of an application, procedures for review of an application, and the granting of Licences, including any appeal procedures, any reporting requirements of licensees, etc. Administrative procedures should also address post-operational requirements. Financial arrangements for collection of licence fees, deposition of bonds and sureties, etc., and any other charges must be made, if required. It is common for agencies to develop and, to encourage the issuance of, codes of practice and regulatory guides, to supplement the standards and requirements. These are often time consuming and laborious tasks, but assisting all parties to be fully aware of all requirements, procedures, etc., can lead to more efficient operation of the agency.

2.3.3.3. Oversight of operations

The Agency should maintain regulatory oversight of operations. The first level of such oversight is the review and evaluation of reports from operators. Depending on the level of activity and the potential for safety concerns, reports may be required annually, quarterly, monthly, or, in special circumstances more often.

Typically annual reports address such items as an overview of current and planned operations, results of radiation dose assessment programmes,and evaluation of radiation protection programmes, adequacy of bonding, evaluation of the waste management system, including structural safety of tailings impoundments, any changes in land use in the immediate vicinity that may affect, or be affected by, the permitted operations, and reports evaluating the adequacy of radiation safety programmes.

Reports may be required more often than monthly but they are generally restricted to such matters as accidents or equipment failures that result in, or have the potential to result in, significant radiation exposure or significant environmental harm. In these cases the operator is usually required to make an immediate report by telephone, followed by a written report in a very short time. These types of reports require, obviously, that the regulatory staff immediately respond. The response may include dispatching staff to the site, issuing notices to the public, assisting the operator and local emergency officials, and generally providing support as needed.

2.3.3.4. Inspections

Inspections of the uranium activities are essential to assure compliance with all standards and regulations, and to maintain public trust. Inspections are usually routine and are carried out on a regular basis as a matter of course. They may also be reactive, however, to respond to unexpected occurrences such as accidents, or allegations of non-compliance from either workers or the public.

Inspections may be announced beforehand to the licensees or they may be unannounced, depending on the circumstances. Announced visits generally facilitate assistance from the operator to for example, allow the inspection of records, or to ensure that the appropriate operations are in fact being conducted during the inspection. Unannounced inspections are valuable, particularly during operations, to be able to view the activities as they are routinely performed, and not after the licensee has had the opportunity to prepare for the inspection. However, if the licensees are not abiding by the regulations and their licence requirements, last-minute preparations will not normally conceal this fact. Unannounced inspections should generally be a part of the inspection programme, in part to promote public confidence in the inspection process.

There are numerous ways in which inspections are managed and performed. In some cases, inspectors are trained to be fully knowledgeable in all the various activities at a particular type of facility. The inspectors might then become the representatives of several regulatory agencies. This allows the inspectors to have an overview of all activities on the site. In other instances, inspectors are trained in specialized technical disciplines, and limit their inspections to that specialty. This allows the inspectors to concentrate in only one or a few technical areas and maintain high levels of competence throughout the industry, but may mean that the project as a whole, or even individual aspects of the project, might be inspected by several different inspectors. Another approach is to allow an independent facility such as an approved laboratory, to perform surveys and measurements at uranium facilities and independently report the results. If this approach is used, the agency will need to develop inspection protocols and procedures, certify laboratory and other test procedures and generally ensure that the inspecting organization maintains an acceptable level of competence. Depending on the circumstances, any of these approaches can be effective in assuring compliance with the requirements.

2.3.3.5. Enforcement

As licensing actions and inspections are conducted, noncompliance with requirements may be detected from time to time. The regulatory authority will need to have an enforcement system in place to appropriately address such violations. With no enforcement system in place, or an ineffective one, there may be less incentive for compliance. An effective enforcement system, therefore, should be in place and utilized as necessary. The regulatory legislation will in general define the enforcement options available to the agency: they may for instance allow the agency itself to impose penalties such as fines, or they may require that prosecution be instigated through a judicial process. The legislation may also restrict the agencies ability to exercise discretion in enforcement where this is considered desirable. It is generally desirable for the enforcement system to have some flexibility in how it is administered, to allow for considerations of the operator's previous record of compliance, his actions to correct the causes of a violation, the significance or potential significance of the violation, and other factors. This flexibility should be tempered somewhat to prevent the perception that the requirements are not being properly enforced, or that some operators are receiving favourable treatment. Generally, this can be accommodated by having enforcement decisions reviewed by regulatory authorities outside of the enforcement personnel, by independent review panels, and/or by providing an enforcement appeals system. It is also helpful if the enforcement process is open to the public.

2.3.3.6. Confidentiality

Regulations need to recognize the needs of the industry and assure that information supplied to the agency remains confidential. While some reported information must be made available in the public domain, uranium enterprises that have invested considerable resources to develop basic information on, for example, the geology and geochemistry of the ore zone, the grade of the ore, and the extent of the deposits, need to be able to maintain the confidentiality of this information. This is the case with respect to the efforts of the enterprise to determine the most economical procedures and processes to produce its final product. Although the regulatory authority may have need for some of this information, to allow it to make informed decisions on the proposed developments, the enterprise must be assured that the information will be protected as confidential and returned to the enterprise without being prematurely exposed to public perusal. If the operator can be assured of confidentiality, it will be likely to cooperate more fully with the agency in discussing such matters as possible future plans, potential problems and other priority subjects.

There is also a need for some of the agency's material to be kept confidential. For example inspectors may be inhibited from fully reporting, particularly in areas of potential problems, "near misses", or matters of professional judgement (rather than objective fact) if their reports are likely to enter the public domain. Operators however should have the right to see and respond to inspection reports, and the public has the right to general information to determine that the operation is (or is not) complying with requirements.

Information on individuals, particularly medical records or radiation dose records should in general be kept strictly confidential.

2.3.3.7. Record Keeping

The agency should be responsible for keeping proper records. These include records of its own activities, for example the issuing of licences, results of inspections, and enforcement activities, and information supplied to it by operators, including operational reports and details of accidents, etc. Since radiation effects are determined by cumulative doses received over very long periods (lifetimes), it is important to retain accurate records of these doses. As individuals may move in and out of the industry, or transfer between operators, dose records for each individual should be collected and compiled in a central repository. Records of statutory health examinations should also be kept. Such records should be strictly confidential, although access may be allowed under strictly controlled

conditions to appropriate organizations for research or health assessments. Regulations requiring proper record keeping and registration in a central repository, and ensuring confidentially, should be established.

2.3.3.8. Public Information

Regulatory agencies should have active programmes to inform the public of its activities and provide for public input. Unless the public is adequately informed, a public perception that the regulatory agency is cooperating too closely with the uranium industry may develop.

Public information programmes would include the dissemination of the results of environmental monitoring and measurements, or new developments or changes in operations to the public. Public meetings might be part of this process. These programmes should include methods for accepting and acting on public comments and concerns of the regulatory programme and process.

3. LEGISLATIVE APPROACHES

Any approach to legislating for the development and production of uranium deposits must be compatible with the general legislative frame-work of the country or region. However, within that overall framework, there are usually a number of areas where different aspects of uranium deposit development and production regulation could be accommodated.

The aim of this section is to introduce some of the factors which might be important in determining how such legislation might be framed, and administered.

3.1. LEGISLATIVE JURISDICTION

Many countries are divided into regions having their own legislative authority, and in some cases these regions may be further subdivided. For the purposes of this discussion, the respective authorities will be referred to as National, Provincial, and Local Governments respectively. The division of responsibilities between these arms of Government will vary from country to country, however some general comments can be made.

3.1.1. National Government

The National Government will almost certainly be the authority determining the questions of foreign ownership of the resource, foreign exchange controls, export of product, etc. Uranium's former status as a "strategic" material, and concerns about its possible diversion to clandestine weapons production, has in many countries lead to special legislation to control it being enacted at the National level.

In countries where a Provincial Government is responsible for the regulation of safety and health issues, it is quite common for the National body to be responsible in some way for the establishment of standards which are then applied by the provinces. The National Government may oversee the Provinces' administration of the standards, to ensure that they are being properly implemented, but would normally not be directly involved in the enforcement procedure. This procedure has the advantage of uniformity in requirements across the country, while allowing for local differences in the way in which they are applied.

3.1.2. Provincial Government

Provincial Governments usually have the responsibility for regional matters that are not of National or International concern. Some of the matters that affect uranium mining and milling and are commonly regulated at the Provincial level include:

- occupational health and safety,
- land and water tenure,
- general regulation of mining activities,
- environmental protection.

3.1.3. Local Government

Local Government authorities seldom have any direct responsibility in the regulation of uranium mining, but are often involved in some ancillary aspects of mining, for example:

- provision of infrastructure — roads, power, water, etc.,
- local planning and development issues,
- local waste management issues.

Where deposits are located in remote sparsely populated areas, there may be no effective local government. Services normally provided to both the operation and to employees or local residents by local government may need to be provided by the project operator.

3.2. RELATIONSHIPS WITH OTHER LEGISLATION

No matter what jurisdiction is being considered for control of uranium mining and milling, there will be existing legislation which is to some extent relevant to or impinges on the project. This section discusses some of these types of legislation and how they can relate to uranium resource activities.

3.2.1. Occupational Health and Safety Legislation

Most countries have legislation to control conditions of employment to ensure that the health of workers is not endangered. Types of issues addressed include

- Responsibility for work site safety;
- Procedures for identification of hazards;
- Provision of protective equipment, clothing, etc.;
- Standards and limits that must be met;
- Requirements for monitoring of hazards;
- Requirements for safety training of supervisors and workers;
- Provisions for inspections;
- Provision of first-aid, rescue and similar services;
- Medical surveillance of workers;
- Relevant record keeping.

This type of legislation is in general directly applicable to workers in uranium mining and milling.

3.2.2. Mining Legislation

Mining legislation generally covers two distinct areas. The first is the control of title or ownership of mineral deposits, and the second the regulation of safety and environmental protection of mining operations.

Issues of resource ownership include such matters as

- Who may prospect for minerals;
- Are prospecting rights exclusive;
- How does the prospector gain title to any discoveries;
- What are the rights of owners of land on which minerals are discovered;
- What royalties or other fees must be paid on minerals extracted;
- Under what conditions are rights transferable.

This type of legislation often includes provisions for rehabilitation of the mine and mill site before the operator's obligations are terminated: bonds or escrow funds can be required as security for satisfactory environmental performance.

Mine safety legislation generally covers the same areas as occupational health and safety legislation, which is concerned with the particular hazards of mining. Thus there will usually be specific provisions for control of rockfalls, handling explosives, dust suppression and ventilation of underground workings.

3.2.3. Radiation Protection Legislation

Radiation safety legislation generally covers the whole range of uses of radiation and radioactive material, including medical uses (with provisions for protection of both patients and operators), scientific and industrial uses, nuclear power generation (where applicable), transport of radioactive material, waste disposal.

Radiation safety legislation usually includes measures for the protection of, in addition to workers and the public (including those receiving radiation for medical purposes) from the harmful effects of radiation or radioactive contamination. The ICRP and the Basic Radiation Safety Standards (BSS) for example, do not deal with protection of the environment itself.

Matters which would generally be addressed include

- responsibility for radiation safety,
- radiation protection standards and limits,
- requirements for monitoring,
- requirements for record keeping,
- licensing of users,
- registration of sources of radiation,
- requirements for waste disposal,
- requirements for medical examinations.

Much of this type of legislation is directly applicable to the radiation aspects of mining and processing radioactive ores.

3.2.4. Environmental Protection Legislation

Aspects of environmental protection legislation will generally be relevant to uranium resource projects. This legislation generally covers such matters as

- Examination of environmental impact of proposals;
- Limitation of discharges into the atmosphere, groundwater and surface waters;
- Control of all types of environmental damage;
- Management of wastes;
- Rehabilitation of the site;
- Monitoring of environmental effects.

3.2.5. Special Purpose Controls

It is possible that control of uranium resource projects could be implemented by special legislation which removes uranium projects from the jurisdiction of other relevant legislation (e.g. environmental protection, mine safety, radiation protection, etc.) and substitutes a new set of controls. These may combine the desired elements of existing legislation with additional controls specific to uranium mining and milling.

This can simplify the requirements and administrative procedures that must be met, and act as an inducement to establishment of the project by eliminating some duplication or conflicting requirements. However, there may be significant difficulties in this approach. Unless general regulatory control over the project is to be reduced below that for other projects not subject to the special legislation, the full range of environmental, mine safety and other controls will still need to be implemented. Either administrative and specialist staff for such controls must be provided for under the special legislation, or the existing agencies must continue to perform these functions, but under the special legislation. The resultant overall simplification may be limited.

3.3. HIERARCHY OF CONTROLS

In a system of legislative controls, there are a number of levels at which the appropriate controls can be implemented. This section discusses these levels and the types of control that are appropriate at each level.

3.3.1. Statutes

This term is used to mean "laws" made at the highest level of legislative power, such as Acts of Parliament, Presidential Decrees, etc. They are often concerned mainly with matters of general policy, rather than detailed requirements. Examples of the types of matters that might be included in this form of legislation are

- Whether a practice is to be allowed;
- Requirements for licences, permits, etc.;
- Requirements for fees, etc. to be paid;
- Authorization of subsidiary legislation (regulations, etc.);
- Procedures for setting detailed requirements;
- Procedures for prosecuting or otherwise dealing with breaches or offenses.

3.3.2. Regulations

Regulations are legal requirements enforceable in courts but are subordinate to statutes. They generally involve a less formal process than do statutes in order to become law, and can be much more readily introduced amended or repealed as circumstances change. They are widely used to fill in the details of the legislative structure set up by Statutes. The range of matters that can be covered in Regulations is generally set by the relevant Statute, but matters such as the following could be included in regulations:

- Numerical values of limits, standards;
- Details of fees, royalties, etc. to be paid;
- Procedures for applications for licences, permits, etc.;
- Requirements for reporting to Authorities, including progress of operation, production statistics, results of monitoring, incidents and emergencies;
- Details of safety requirements;
- Powers and duties of regulatory inspectors, etc.

It is usual for regulations to apply equally to the whole jurisdiction i.e. to the whole Nation or Province. They are therefore often difficult to apply to aspects of operations that are specific to a particular site or operating process.

3.3.3. Conditions on Permits, Licences, etc.

Where there are requirements for a licence or permit to be held in order to operate a mine, etc., there are usually provisions allowing conditions to be placed on the licence or permit. These conditions can be a very useful and powerful means of applying controls on the operation. The most important advantage of this method of regulation is that the controls can be made specific to the particular project, and can take into account such matters as the climate and topography of the area, and the mining and milling techniques employed. One disadvantage is that if it is not carefully administered it can lead to, or appear to lead to inequalities in the level of protection and control: this is often contrary to the objective of using the aim in making the site specific controls.

Methods of waste disposal are matters which are usually highly site specific and are therefore often controlled by these types of provisions.

3.3.4. Requirements of Inspectors

There will inevitably be aspects of a project that cannot be put in objective terms, for example the degree of cleanliness that should be maintained in a plant. Such matters are then frequently left to the judgement of an inspector from the appropriate regulatory authority. This power might be given to inspectors as a specific requirement of a regulation or licence condition e.g. "the plant shall be kept clean to the satisfaction of an Inspector..". In some cases inspectors are given wide ranging general powers to issue orders, including the power to order work to cease until specified improvements have been made. Such powers are often limited, however, to situations where an immediate danger must be alleviated.

Reliance on the individual judgement of an Inspector, who can exert powerful sanctions on a project, can only be an acceptable method of regulation if the inspector has considerable training

and experience, in both the technical aspects of the work and in management and personal relations. Inspectors must also be well supervised and accountable. Appeal or review mechanisms to resolve cases where decisions are considered unreasonable may be necessary. However where these conditions can be met, and an effective relationship between the inspectorate and the operator can be developed, then this can be an efficient part of an overall regulatory regime.

3.4. PRINCIPLES OF GOOD REGULATION

No matter what form of regulation is to be applied, there are generally accepted principles of good regulation that should be applied.

- Minimizing the impact of regulation. Regulations should be designed so that they achieve their desired objective with the minimum of other effects. Implicit within this is the desirability of minimizing the amount of regulation consistent with achieving basic objectives.

- Predictability of outcomes. The consequences of the regulatory requirements should be clearly identifiable. Wherever possible, performance based requirements that specify outcomes to be met should be used, rather than prescribing methods of achieving the desired outcomes.

- Uniformity. There are many benefits in applying standards that are compatible with relevant nationally or internationally recognized standards.

- Review of regulations. Regulations should be reviewed regularly, to ensure that they are achieving their desired objectives and that any undesirable effects are minimized.

- Flexibility of standards and regulations. Regulations should be framed so that can be quickly updated or revised if the need arises.

- Exercise of bureaucratic discretion. Regulations which allow for the exercise of some discretion in their application can be effective in providing flexibility to meet unusual or changing circumstances. However it is important that the exercise of such discretion be transparent, fair to those affected, and subject to appropriate review processes.

3.5. REGULATORY ADMINISTRATION

No matter how controls are applied by legislation there will be the need to administer the regulatory requirements. The way in which legislative controls are applied and administered is frequently more important to the outcome then the nature of the legislation.

3.5.1. Integrated Approach

It will be most unusual for a uranium development to be regulated under just one piece of legislation with a single administrative body. In almost all cases there will be different pieces of legislation that will each be applied by their own administration. Indeed, in some cases, the regulatory authority can change as the project moves through its various stages. For example responsibilities for health and safety in a mill could be in the hands of one authority during construction, and a different authority during operation. Similarly, environmental protection requirements can be governed by one set of legislation during operation, and different legislation during rehabilitation.

It is essential that there be the maximum degree of co-operation between the various regulating agencies. Not only will this avoid outright contradictions between the requirements of different agencies, but only in this way will it be possible for the overall regulatory regime to achieve, to the greatest extent possible, its aims.

When the regulatory requirements are all under one jurisdiction, then coordination can be formally required by either administrative instruction to government departments, or by Statute. Such a requirement might appoint one department or minister as the "postbox" through which all regulatory matters must pass, and who is responsible for coordination and facilitation of Governmental responses. Such formal arrangements can work very well in expediting major policy requirements. However, unless they are administered with discretion they can be bogged down with minor matters. It is also difficult to apply with "on the spot" requirements to problems, where the requirements are those of individual departmental inspectors. A general policy of co-operation is necessary to resolve such potential conflicts.

Similar potential conflicts of requirements can occur between different jurisdictions. These can also, in some cases be resolved by formal requirements for separation of responsibilities, or for cooperative administration. In many cases national governments delegate, in some way, many of the day to day administrative requirements to the provincial governments (such as physical inspection), while retaining a general oversight of the performance of the operator in meeting requirements and of the provincial government in enforcing them. In other cases, the national government may decide that some or all aspects of a project are of such national significance, that they require the active participation of the national government in the regulatory administration. In both cases co-operation provides the best opportunity of achieving the objectives of all parties.

The operator has a vital role in assisting cooperative, efficient administration of the requirements under which it must operate. The most obvious way is by keeping all appropriate agencies well informed of plans, progress, and problems at the earliest opportunity. There is often a tendency for operators to compartmentalize communication with the regulatory authorities, and restrict discussion with regulatory agencies to those matters for which the particular agency has clear responsibility. However, any resulting lack of information by individual authorities of matters which the operator may believe is outside their direct responsibility is often a major factor in the imposition of incompatible or impractical requirements on the project.

The need for integration extends to the "on the spot inspectors" enforcing the legislation. On the one hand it is inefficient (for both the regulatory authorities and the operators) to have a number of inspectors visiting, each enforcing only one set of regulations and inspecting only one aspect of the operation. On the other hand it is difficult to have inspectors who are knowledgeable with regard to all requirements that must be enforced.

Where appropriate it is desirable that legislation authorizing inspection under one set of legislation also allow inspection in relation to relevant parts of allied legislation. To be effective, it is essential that such inspectors be well trained, both in the required technical aspects, and the inspection and enforcement policies of the different agencies involved. Again, a cooperative approach is vital.

4. STAGES OF REGULATORY CONTROL

As a uranium resource project progresses from exploration through development and production to eventual decommissioning, the regulatory requirements will change. This section is intended as a guide to the general rights and requirements that would be expected to apply to any mining or milling project, as well as the additional rights or requirements that might be appropriate because uranium is involved.

4.1. PRE-EXPLORATION

Before a decision is made to prospect for minerals in a country, a mining company will need to know the basic requirements for operating there. Usually these will be mainly questions of financial policy, such as:

- Will my company be allowed to operate?
- Will domestic equity or local partners be necessary?
- Are there restraints on raising capital?
- What taxes must be paid on profits?
- Can profits be repatriated?
- Can foreign nationals be employed?

It would be expected that the answers to these questions would be independent of the type of project or the nature of the mineral being prospected for. There are, however, sometimes situations in which special arrangements are made to provide more favourable terms for some projects on the grounds of national interest, for example developing remote or disadvantaged areas.

National governments may also have policies relating to the non-proliferation of nuclear weapons which limit the countries to which uranium can be sold. It is preferable that the investors be made aware of such a policy before any money is spent.

4.1.1. Legislative Requirements

No specific legislation related to uranium needs to be applied at this stage. However the proponent's decision making will be assisted if at least the broad outlines of the requirements that would be applied to a uranium resource project are available. These could for example be expressed as an intention to apply the requirements of the relevant IAEA Safety Standards. It would also be helpful to nominate the Agency or Ministry that would be responsible for the administration of these requirements.

4.2. EXPLORATION

"Exploration" will be used to mean all stages up to the identification of a potentially exploitable resource. Typical activities which would be conducted during the exploration phase include:

- regional geological investigations,
- aerial surveys or other remote sensing activities,
- geochemical surveys,
- geophysical surveys,
- exploratory drilling,
- exploratory excavations.

4.2.1. Rights of the Proponent

At the exploration stage, the proponent will be mainly interested in:

- Continuity of exploration rights i.e. how long can they be held, can they be renewed or extended, are they transferable?

- Exclusivity of the rights: can others prospect on the proponent's area?

- Rights to any minerals that may be discovered: are they automatically awarded to the discoverer, or can they be given to others?

These rights would not be expected to be any different in the case of prospecting for uranium than for prospecting for any other mineral.

4.2.2. Responsibilities

The main responsibilities of the exploration company include

- To pay the appropriate fees.

- To explore. Generally there is a requirement that the holder of a permit to explore will lose some or all of his rights over an area if he does not actively explore. The requirement may be expressed in terms of expenditure on exploration, or the employment of labour, and may be proportional to the size of the permit.

- To keep the authority informed of progress and results. Much of this information is generally kept confidential by the authority during the life of the permit, but may be released thereafter for the benefit of future prospectors.

- To protect the environment from damage during exploration and rehabilitate any unavoidable damage, including the adequate sealing of all boreholes.

- To protect the health and safety of the workforce.

When exploration is for uranium, there are generally no additional regulatory requirements for the first four points above. It is possible that some radiation protection procedures may need to be implemented for workers that handle uranium ore samples, but normally these would only involve providing washing facilities, and adequate dust suppression for those cutting or splitting samples etc. These measures would normally be covered by general occupational health and safety standards. There may be requirements for transport of radioactive ore samples, but these would normally be covered by existing requirements for transport of radioactive materials.

The only situation where significant radiation protection measures might be required in exploration is in underground exploration, where quite significant doses could be received. Underground exploration is in some ways in a different class to other exploration activities, as the potential for environmental damage, and the general scale of operation is much greater. Often additional authorization is needed to conduct underground exploration activities. It would be appropriate to include any radiation protection requirements as conditions of that authorization. The procedures necessary would be similar in nature to those in underground production, although the scale is likely to be much smaller.

4.2.3. Legislative Requirements

Specific legislation to protect the workers and environment should ideally be in place when exploration starts, although such provisions would not come into operation until some point after uranium mineralization is identified.

It is essential that this point be clearly identified in the legislation. For example IAEA Safety Series No. 26 suggests exempting material less than 0.05 wt% uranium. There may be a need to specify some minimum quantity as well as grade, so that very small intersections above the grade limit are excluded.

Once this point is reached, it is commonly required that the appropriate authority is notified, and some basic radiation protection measures come into force. These include

- the requirement to meet radiation dose limits. It should be clear that it is the operator's responsibility to ensure compliance with these limits;
- requirements for radiation surveys to ensure dose limits will not be exceeded;
- requirements for provision of basic radiation protection measures (hand washing facilities, dust suppression, etc.) as necessary;
- requirements to inform workers of hazards of radiation exposure and safe working procedures;
- Where underground exploration is involved, there is the potential for radiation doses comparable with those in underground mining, and the measures discussed below (Section 4.5, Production) would be required.

Except in the case of underground exploration, it is unlikely that any additional legislative measures specific for uranium would be needed to limit environmental effects.

Legislation to control the transport of radioactive ore samples, etc. in "public" areas outside the area of operations should be in place. The IAEA "Regulations for the Safe Transport of Radioactive Materials" provide a comprehensive, internationally accepted set of requirements which could be imposed, for example by a condition on the exploration permit.

4.3. DEVELOPMENT

"Development" is used here to describe the period between the recognition of a potentially exploitable orebody, and the commencement of construction of facilities for commercial scale production. The major activities in this period might include:

- detailed geological investigations (including drilling and tunnelling),
- mining and metallurgical investigations,
- detailed environmental assessment,
- development of detailed plans for mining, processing and waste disposal,
- assessment of infrastructure requirements,
- financial evaluation.

It is important that regulatory agencies be aware of the proponent's progress toward operation, and that the development of the regulatory requirements at least keep pace with the development of the project. It is clearly undesirable for all concerned if operation is delayed because regulations are not complete, or if operations commence without regulations being in force. Many engineering design criteria cannot be set if the standards which the operation must meet are not finalized. A preapplication conference would be appropriate during this development period. This is another area where a high degree of co-operation between the proponent and the regulatory agencies is very important, particularly in the development of appropriate site- or process-specific requirements.

4.3.1. Rights of the Proponent

At the development stage, the main concerns of the proponent will be in many ways similar to those of pre-exploration and exploration, but they will be focused on the particular orebody(s) that have been found. As it may take a number of years to evaluate the proposed development, make

financial and marketing arrangements, etc., the proponent's continuity of ownership of mineral rights over this period will be very important.

As the proposed project unfolds, and in particular its size becomes well defined, there may be changes in some requirements, such as the amount of local equity which will be required, or the extent to which the Government will contribute to infrastructure. The rights of the proponent would be similar for development of a uranium deposit as for development of other mineral deposits.

4.3.2. Responsibilities of the Proponent

The proponent's general responsibilities will be similar to those during exploration. However, the activities can be more intense and directed to a smaller area, and the potential for environmental damage in particular may be greater than during exploration.

The first activities with increased potential for environmental damage are the extraction of bulk ore samples (particularly by underground excavation) and in large scale metallurgical testing, pilot plant operation and associated waste disposal.

- Bulk sampling. Where samples can be readily obtained from small scale surface excavations (pits or trenches) there would normally be no additional requirements. However when large samples are required or when large amounts of overburden will need to be removed, then it would be normal for that activity to need approval.

- Pilot plant operation. Construction and operation of a pilot plant would generally require some form of approval. Such approval would need to include any radiation safety provisions that might be necessary, although in a pilot operation processing relatively small quantities and operating for a relatively short time, these would not normally need to be very extensive. If the pilot processing includes preparation of a uranium concentrate, then steps will need to be taken to provide security for this product. The pilot operation would need to demonstrate successful restoration, prior to licensing the full mining operation.

- Waste disposal. Plans will need to be made for the disposal of wastes generated by bulk sampling or pilot plant operations. The radionuclide content of, in particular, uranium mill wastes will generally mean that such wastes will require a higher standard of management than wastes from mining operations of ore with low radioactive concentration.

4.3.3. Legislative Requirements

Legislative requirements for operations conducted during the development stage are generally similar to those for exploration. However, where underground exploration, trial mining, or pilot plant operation are involved, some of the requirements discussed under 4.5 Operation below may be necessary.

Most operators would be unwilling to proceed beyond the development stage until they know what legislative requirements will apply to the operating project.

4.4. CONSTRUCTION

The degree of protection of the health of workers, and of the environment, which can be achieved will be determined to a very large degree by the facilities that are constructed. The stage of construction is thus the "point of no return" for many aspects of radiation protection, both occupational and environmental. For that reason it is essential that before construction commences,

the operator is fully aware of all the requirements and standards that the operation will be required to meet, both during operation and, to the extent possible, after rehabilitation. It is similarly essential that the regulating authorities are fully aware of all aspects of the proposed project.

It is in the interests of both parties (the operator and the regulating authority) that there be a formal agreement to the construction of the project facilities, including those aspects which relate to radiation or environmental protection. This can be in the form of approval of plans, specifications and design criteria submitted to the regulatory authority. In the case of the waste disposal system, it would normally be expected at a minimum that an outline (but not details) of the proposed rehabilitation methods be included in the application, including requirements in the case of temporary cessation of operations.

Approval of the plans, etc. by the regulatory authorities would not absolve the proponent from the responsibility of meeting requirements (such as dose limits or emission standards), where it was found that the designs submitted were not adequate to meet those requirements. However where the approved plans are shown to be adequate to meet the approved design criteria, then approval to operate should not be withheld.

4.4.1. Rights of the Proponent

Once the proponent has decided to proceed with the project, and before committing funds to construction, he will seek to convert the rights held during exploration and development into the explicit right to mine the deposit, process the ore and sell the product.

This is commonly done by the granting of a mining lease or permit over the area of the deposit. Such a lease or permit should specify

- the area, and if appropriate the depths to which the lease applies,
- the period for which it is valid,
- whether it is renewable or transferable, and under what conditions,
- what operations may be conducted, including any maximum or minimum production limits,
- all requirements for reporting of operations, production, etc. to the authority,
- all fees, royalties, etc. that must be paid,
- responsibilities for rehabilitating the operational area.

4.4.2. Responsibilities during construction

The operator's main responsibility during construction is to ensure that construction is in accordance with any plans or undertakings which have been approved by the regulatory authorities, and to standards which will allow regulatory requirements to be met. The operator is also responsible for protection of the health of workers, and of the environment, during construction.

4.4.3. Regulatory Requirements

No regulatory requirements other than those applicable to construction activities generally are necessary to control the construction operations themselves.

However, if the overall regulatory scheme includes requirements for issuing of approvals or authorizations for construction, and particularly for construction of waste management facilities, then these must be in place at this stage. It will also be necessary for legislation establishing the regulatory agency, and to allow the appointment of staff, inspectors, etc. to be in place.

4.5. PRODUCTION

Production is the phase of the project where radiation exposures arising from radioactive ores and concentrates will be of most significance, as the largest quantities of such material will be handled and normally this stage of the project will last much longer than the others. Most of the radioactive waste is also produced during this stage. Nevertheless, the radiological issues will only be part (and often a small part) of the overall operation of the project, and must still be considered in context with all the other legislative and other requirements that must be met.

4.5.1. Rights of the Proponent

Operation is the culmination of the proponent's plans and investments over the previous stages of the project. The proponent has the right to mine, and extract and sell the mine products. In so far as they can be determined by government, the conditions under which the project operates (such as standards and limits which must be met) should be well established and stable. Any significant changes to such requirements should not be made without consultation with the operator.

4.5.2. Responsibilities of the Proponent

The main responsibilities during production are to:

- meet requirements of the mining lease in terms of fees, reporting, production, etc.,
- protect the health and safety of the workforce,
- protect the environment from harm.

While these general responsibilities will be the same for any type of mining or milling operation, the particular risks arising from the mining and milling of radioactive ores will generally require that a higher standard of protection of occupational health and of environmental protection will be needed.

The requirements concerning occupational radiation protection should include:

- informing the workers of radiation hazards, and training them in procedures and work practices to reduce such hazards;
- facilities and procedures to protect workers from radiation, and in particular to ensure that doses are below the appropriate limits;
- monitoring radiation levels and determining the radiation doses to workers arising from their work;
- recording results of monitoring and radiation dose determinations;
- assessment of the adequacy of radiation protection measures;
- providing suitable supervision of workers to ensure that the appropriate radiation protection measures are adopted;
- medical assessment of workers.

Requirements designed to protect the environment from radiological problems would include:

- management of all wastes, by means of good engineering practices and operating procedures, so as to minimize their potential radiological impact;

- monitoring of the environment, including in general, air, ground and surface waters, soil and biota for radiological contamination;

- determination of radiation doses that might be received by members of the public as a result of the operation.

4.5.3. Legislative Requirements

The full set of Legislative requirements should be in place before commencement of production. These include:

- technical requirements such as those described in IAEA Safety Series Nos 6, 9, 26, 85 (No. 85 will be superseded by RADWASS Safety Standard III-S-5),

- administrative requirements such as Licences, approvals for operation, etc.,

- requirements for reporting of operations, monitoring results, etc.,

- procedures for inspections, etc.,

- procedures for dealing with breaches of requirements.

As the project may close at any time, it is essential that legislative requirements for decommissioning and rehabilitation are in place at commencement of operations, including

- standards for rehabilitation,

- quality assurance for rehabilitation, including periods during which successful rehabilitation must be demonstrated,

- procedures for return of bonds, escrow funds, etc., held against successful rehabilitation,

- procedures for final discharge of responsibility of the site.

4.6. DECOMMISSIONING AND REHABILITATION

All mines will eventually close, through exhaustion of the ore resource or changing economic circumstances. Once ore producing and processing operations cease, the project will be decommissioned, and the area of operations rehabilitated. The aims of decommissioning and rehabilitation are to:

- recover any plant equipment, etc. that may have value;

- ensure, to the extent possible the physical safety of the site by capping shafts, reducing pit slopes, demolishing potentially dangerous structures, etc.;

- ensure that all wastes remaining on the site are disposed of such a way that any potential for release, and contamination of the environment is minimized.

The extent to which the last aim in particular can be met is to a very large extent dependent on the way in which the operation has been designed and operated, and in particular the waste management practices adopted. Therefore, as has been noted above, it is essential that both the operators and the regulatory authorities give consideration to the requirements for rehabilitation at early stages of planning. Again close co-operation between the operators and regulatory authorities will be necessary.

Rehabilitation is often progressive, with portions of the operation being rehabilitated as they are concluded. However the operator may wish to delay rehabilitation of some parts of the project after cessation of production in the hope that improved circumstances may allow recommencement of operations. The requirements which must be met during such a delay period would generally include

- maintenance of waste containment structures,
- continuation of environmental monitoring.

The requirements in such circumstances should generally be determined in principle before operations commence.

Following completion of the engineering works associated with rehabilitation, it is common practice to assess the performance of the rehabilitated site over a period of time. During this time the operator will generally be required to conduct appropriate monitoring, and to remedy any failures or weaknesses that may become apparent. The operator's liability is generally not considered to be discharged until demonstration of satisfactory performance of the rehabilitation. In some cases a portion of the bond monies may be retained in order to pay for long term monitoring by the regulatory agency.

It is possible that when the project is closed there may be stockpiles of untreated ore, concentrates, or mineralized material that is (at present) not economically recoverable. The rights of ownership of, and the responsibility for these materials may need to be considered.

4.6.1. Rights of the Proponent

Once the operator has made the decision to permanently cease operations, their aim is generally to expeditiously meet all their remaining obligations and thus be free of any further liability in respect of the project. The operator will also wish to recover the balance of any bond or escrow fund which was held against the discharge of their obligations. A clear and detailed set of specifications for rehabilitation should be established, including the following points:

- the nature of the rehabilitation works that must be undertaken,
- the requirements, standards, etc. which must be met by the rehabilitation,
- standards of decontamination for salvageable materials to be removed from the site,
- any monitoring of the rehabilitated site that may be necessary,
- the period of time over which successful rehabilitation must be demonstrated,
- responsibilities for repair of any failures of the rehabilitation in that period.

Once the requirements have been met, the operator has the right to be discharged of all further obligations in respect of the project and be paid the balance of unused funds.

4.6.2. Responsibilities of the Proponent

During the rehabilitation operations the operator will still have general responsibilities for the health and safety of his workforce, and for the protection of the environment. These responsibilities

are in principle no different to those discussed under Section 4.5., although of course there will be differences in the details due to the different operations involved.

The engineering activities involved in rehabilitation must often be effective for a very long period of time, and rectification of failures may be very difficult and expensive if not impossible. For this reason the proponent is responsible for ensuring that such work is carried out to the highest standards. Again close co-operation is required between the operator and the regulating authorities to identify and rectify any unexpected problems that may arise during rehabilitation.

4.6.3. Legislative Requirements

As noted above, the legislation governing decommissioning and rehabilitation should be in place at the commencement of operation.

5. TECHNICAL REQUIREMENTS FOR PROJECT REGULATION

There is a large well developed body of material available on the technical requirements that should be met by uranium mining projects. This material covers such matters as radiation exposure limits that must be met by operations, design requirements of waste management systems, requirements for monitoring, etc. It is not the aim of this Guide to discuss these matters in detail, however this section is intended to provide a brief overview and some guidance to sources of technical material that might be included in regulatory requirements. To assure the most recent information is available, the relevant bodies discussed in the following section should be contacted when regulations are being developed

5.1. RELEVANT BODIES

5.1.1. International Commission on Radiological Protection

The mining and milling of uranium differs from the mining and milling of some other metals, because the additional regulatory regime required for production of uranium is related to the radioactive nature of uranium, its ores and associated wastes. The principal international body for providing radiation protection recommendations is the International Commission on Radiological Protection (ICRP).

The ICRP's recommendations are primarily directed towards establishing a well founded scientific and philosophical basis for radiation protection generally, from which specific requirements for particular circumstances can be developed. Some ICRP recommendations however do extend to practical advice to address specific situations.

5.1.2. International Atomic Energy Agency

The IAEA publishes a considerable amount of material on radiation protection, some of which is particularly relevant to uranium mining and milling. Generally IAEA publications are more practically oriented than those of ICRP, and in some cases can be incorporated more or less directly into legislative requirements.

The IAEA Safety Series includes "Safety Fundamentals" (Basic objectives, concepts and principles), "Safety Standards" (Basic Requirements which must be satisfied to ensure safety), "Safety Guides" (Recommendations, on the basis of experience, relating to the fulfillment of basic requirements), and "Safety Practices" (Practical examples and methods). In addition Technical

Reports, Conference Proceedings and Technical Guides provide useful material. A number of "Safety Standards" are produced in conjunction with other organizations such as the World Health Organization (WHO) or the International Labour Organization (ILO). Safety Fundamentals and Safety Standards are available in six languages (Arabic, Chinese, English, French, Russian, Spanish).

5.1.3. Nuclear Energy Agency

The Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD) has a primary objective of promoting co-operation between its Member governments on the safety and regulatory aspects of nuclear development. A number of publications which are relevant to uranium mining and milling have been published by NEA (in English and French). NEA works in close collaboration with IAEA.

5.1.4. National Governments

In addition to standards developed by international bodies, a number of countries which have well developed uranium mining industries have their own standards, codes of practice, etc. These can be consulted for several reasons

- They give guidance on the actual levels, standards, etc. that are imposed in countries with established industries.
- They indicate ways in which these standards can be incorporated into the country's legislation.
- While internationally recommended practices must be generally applicable to all conditions, individual countries can and do adopt recommendations to suit the particular conditions in that country. For example, Canadian requirements could be consulted for guidance on practices which might be necessary in a cold climate, or French for temperate climates.

It should be noted however that some national requirements can lag some years behind the current international recommendations.

Brief summaries of the legislative requirements in several countries are included in Appendix I.

5.2. BASIC RADIATION PROTECTION STANDARDS

The most recent international recommendations on the basic standards for radiation protection are in ICRP publication 60 (ICRP 60) "1990 Recommendations of the International Commission on Radiological Protection".

ICRP 60 replaced ICRP 26 "Recommendations of the ICRP" (1977). While the broad thrust of the ICRP's recommendations has not changed, there are significant changes in both the framework of application and the numerical recommendations. In 1990 an Inter-Agency Committee on Radiation Safety was formed and the publication "International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources ('the Standards')" was published. The Standards are published in the IAEA Safety Series, as number SS115-I and are based on the principles of radiation protection and safety developed by the ICRP.

In ICRP 60 (as in ICRP 26) the ICRP recognizes that all radiation exposures may present some risk, and recommends a "system of dose limitation".

In relation to safety, the recommendations of the International Nuclear Safety Advisory Group (INSAG) are taken into account.

The Standards define activities that increase or could potentially increase the radiation exposure to that which people incur due to background radiation, as "practices". Activities that seek to reduce the existing radiation exposure, or likelihood of exposure, which are not part of a controlled practice, are termed "interventions". Provisions for radiation protection and safety can be made before a practice begins, while in the case of intervention, the circumstances giving rise to exposure or potential exposure already exist, and must be reduced by remedial or protective actions.

The practices for which the Standards are intended to provide the basis for protection against radiation include the entire cycle of related activities from the mining and processing of radioactive ores to the operation of nuclear reactors and fuel cycle facilities and the management of radioactive wastes; and activities such as the underground mining of coal and phosphatic and other minerals that may enhance exposure to naturally occurring radioactive substances. Situations that may require intervention include: chronic exposure to radioactive residues from past activities and events; and emergency exposure situations such as might result from accidents or from deficiencies in existing installations.

A brief summary of the principles of radiation protection and safety on which the Standards are based follows:

- A practice that entails or that could entail exposure to radiation should only be adopted if it yields sufficient benefit to the exposed individuals or to society to outweigh the radiation detriment it causes or could cause (Justification).

- Individual doses due to the combination of exposures from all relevant practices should not exceed specified dose limits.

- Radiation sources and installations should be provided with the best available protection and safety measures under the prevailing circumstances so that the magnitudes and likelihood of exposures and the numbers of individuals exposed be as low as reasonably achievable (ALARA) (Optimization).

- Radiation exposure due to sources of radiation that are not part of a practice should be reduced by intervention when this is justified, and the intervention measures should be optimized.

- In depth defensive measures should be incorporated into the design and operating procedures for radiation sources to compensate for potential failures in protection or safety measures.

- Protection and safety should be ensured by sound management and good engineering, quality assurance, training and qualification of personnel, comprehensive safety assessments and attention to lessons learned from experience and research.

In practice it is found that optimization is seldom practical as an "add-on" to an operation. To be effective the radiation protection aspects must be taken into the earliest design stages of a project, and carried through the whole of the development and operation of the project. Legislation should take this into account if possible.

The Standards' specified dose limits apply to exposures attributable to practices, with the exceptions of medical exposures and of exposures from natural sources that cannot be reasonably regarded as the responsibility of any principal party of the Standards. The specified dose limits in the Standards state that the occupational exposure of any worker shall be so controlled that the following limits be not exceeded:

- an effective dose of 20 mSv per year averaged over five consecutive years[1],
- an effective dose of 50 mSv in any single year,
- an equivalent dose to the lens of the eye of 150 mSv in a year; and
- an equivalent dose to the extremities (hands and feet) or the skin of 500 mSv in a year.

In addition, the Standards require limits on the yearly average concentration a worker may be exposed to. This is based on the ICRP recommendation that the action levels for occupational exposure to radon can fall in the range 500-1500 Bq m-3.

The Standards include dose limits for "Special circumstances", providing for particular situations when a temporary change in the dose limitation may be authorized. For a description of these circumstances as well as further guidance refer to SS No. 115-I.

The purpose of the Standards is to specify basic requirements for radiation protection and safety, with some practical guidance. The basic principles should be covered by an effective radiation protection program. They are not intended to be applied as they stand in all countries and regions but should be interpreted taking into account local situations, technical resources, the scale of installation and other factors.

The IAEA "Basic Safety Standards for Radiation Protection" (Safety Standard No. 9, 1994 edition currently in press) provides much of the material on dose limitation and calculation of doses from internal emitters that is in ICRP 60 and 61, presented in a format suitable for incorporation into regulatory requirements. In addition there is information giving practical guidance on application of the requirements.

5.3. REQUIREMENTS FOR MINING AND MILLING

In 1968 the IAEA, jointly with ILO, published a code of practice as IAEA Safety Series No. 26, which was revised jointly with ILO and WHO and in collaboration with OECD/NEA, UNSCEAR and ICRP and re-issued in 1983. IN 1976 the Agency, jointly with ILO, published Safety Series No. 43 as a Manual on Radiological Safety in Uranium and Thorium Mines and Mills. This manual was later superseded by Safety Series No. 95 published in 1989 on Radiation Monitoring in the Mining and milling of Radioactive Ores. In 1987 the Agency published Safety Series No. 82 on the Application of the Dose Limitation System in the Mining and Milling of Radioactive Ores, and in 1989 Safety Series No. 90 on the Application of the Principles for Limiting Releases of Radioactive Effluents in the Case of Mining and Milling of Radioactive Ores.

IAEA Safety Series 26 (1983) "Radiation Protection of Workers in the Mining and Milling of Radioactive Ores" included a Code of Practice and additional technical material suitable for use in a legislative regime. Some of the topics included

- General requirements and principles,
- Limits for Radiation Exposure,
- Administrative Organization of Radiation Protection,
- Surveillance,
- Engineering and Administrative Protection Measures.

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[1] The start of the averaging period shall be consistent with the first day of the relevant annual period after the date of entry into force of the Standards, with no retroactive averaging.

This publication is currently being revised. The 1983 edition of Safety Series Bi. 26 containing the Code of Practice and a Technical Addendum covered only administrative and practical radiation protection aspects, and was aimed principally at uranium and thorium mines and processing facilities. The revision will also include provisions for licensing of mining and processing activities involving radioactive ores, as well as inspection and compliance, and necessary measures for non-compliance with the conditions of licence. In addition, more coverage will be given to mines and processing facilities other than those exploiting uranium or thorium which, for radiological reasons, may require some form of regulatory supervision.

The Revised Guide will set forth the following means of ensuring regulatory control for the operators, and protection against ionizing radiation for workers engaged in the mining and processing of radioactive ores: general provisions outlining the regulatory requirements for licensing of work activities in mining and processing of radioactive ores, compliance by the operators, measures against non-compliance, responsibilities of the employer and the worker, limits on radiation exposure, administrative organization of radiation protection, radiation monitoring, medical surveillance, and engineering and protective measures. It is designed to facilitate the preparation and adoption of national and local regulation, and rules and working procedures, for radiation protection in the mining and processing of radioactive ores.

5.4. REQUIREMENTS FOR WASTE DISPOSAL

IAEA Safety Series No. 85 (1987) "Safe Management of Wastes from the Mining and Milling of Radioactive Ores" contains a Code of Practice which is suitable for incorporation in a legislative scheme, together with additional material. The Code covers Principles of radiation protection, Responsibilities, Design of waste management facilities, Operation of waste management facilities, Decommissioning, and Monitoring Surveillance and Maintenance. In addition there is a guide to the Code, which includes further explanatory material.

While the above Code provides a framework for regulation of management of wastes from mining and milling, it is not possible to specify engineering designs and similar technical requirements. These must always be developed having regard for the specific situation: climate, topography, soils, land use, mining plan and many other factors must be considered. It should be noted that IAEA Safety Series No. 85 will be superseded by RADWASS Safety Standard III-S-5 in the near future.

A number of IAEA publications provide guidance on current practices in different situations, for example IAEA Technical Report 209 "Current Practices for the Management and Confinement of Uranium Mill Tailings" (1992) provides an overview of practices which should be consulted in developing and assessing proposals for waste management. "Management of Wastes from Uranium Mining and Milling" (proceedings of a Symposium at Albuquerque 1982) provides further examples of practices.

The NEA publication "Long-term Radiological Aspects of Management of Wastes from Uranium Mining and Milling" (1984) shows how options for disposal vary for three very different climates (tropical, northern temperate, and desert). This booklet also gives examples of how the ALARA principle might be applied in choosing a waste management option. IAEA Safety Series 90 "The Application of the Principles for Limiting Releases of Radioactive Effluents in the Case of the Mining and Milling of Radioactive Ores" (1989) shows how the consequences of releases of radionuclides can be assessed, and how this information can be used in the optimization of release control requirements. IAEA Technical Report 362 "Decommissioning of Facilities for Mining and Milling of Radioactive Ores and Closeout of Residues" (1994) provides useful information on this topic.

5.5. MONITORING

The basic requirements for monitoring of both workers and the environment are covered in publications noted above, however further information is available.

The IAEA Safety Guide 84 "Basic Principles for Occupational Radiation Monitoring" (1987) provides practical advice on general monitoring and record keeping requirements, much of it in a form that could be incorporated into regulation.

IAEA Safety Guide 95 "Radiation Monitoring in the Mining and Milling of Radioactive Ores" (1989) provides detailed information on the requirements for monitoring of radiation exposures to miners.

Advice on radiological monitoring generally is provided in ICRP 35 "General Principles of Monitoring for Radiation Protection of Workers", ICRP 43 "Principles of Monitoring for the Radiation Protection of the Public" and ICRP 54 "Individual Monitoring for the Intakes of Radionuclides by Workers: Design and Interpretation". Most of this material is not suitable for incorporation into prescriptive legislation, but is useful as advisory material in preparing and assessing radiation protection programmes.

The NEA publication "Metrology and Monitoring of Radon, Thoron and their Daughter Products" provides detailed technical advice on the most difficult radiation monitoring task in underground mining.

5.6. TRANSPORT

IAEA Safety Series 6 (1988) "Regulations for the Safe Transport of Radioactive Material" is in almost universal use for International transport of radioactive material, and customer countries would only accept consignments complying with these Regulations. The "Regulations" are presented in a form suitable for direct incorporation into legislation, with only minor additions, for example to define the Country's "Competent Authorities". The Regulations include requirements for packaging and labelling of radioactive shipments, required documentation, and responsibilities of consignors and shippers.

Additional material on this Code is available in the form of IAEA Safety Series 7 "Explanatory Material for the IAEA Regulations for the Safe Transport of Radioactive Material", and Safety Series 37 "Advisory Material for the Application of the IAEA Transport Regulations". Both provide explanations and background information, but are not generally required in transport in connection with mining.

5.7. TERMINOLOGY

Like most areas, uranium resource development, and radiation protection have their own terminologies and vocabulary. The IAEA publication "Radioactive Waste Management Glossary" (1993) is a comprehensive glossary of technical terms in this area.

APPENDIX I — EXAMPLES OF NATIONAL REGULATORY REGIMES

A. REGULATION OF URANIUM MINING IN AUSTRALIA

A.1. INTRODUCTION

Australia is a major uranium producing country with current production capacity of about 3000 t per annum, and very large reserves.

Australia is a Commonwealth (Federation) of States and Territories, each of which have their own legislatures. The division of legislative responsibilities between the Commonwealth and the States or Territories is governed by the Commonwealth Constitution (1901). Not surprisingly, the Constitution is silent on issues relating to radiation, nuclear energy, etc., and hence responsibility for these matters, along with mining, health and safety and environmental protection, devolved to the States.

However, over the years various developments have seen the Commonwealth Government extend its powers into various aspects of uranium mining and milling. These developments include

- The discovery and development of major uranium deposits in the Northern Territory, which at the time was not self-governing but administered by the Commonwealth.

- Commonwealth legislation requiring that relevant environmental factors be considered in Commonwealth decision-making. Thus, for example, Commonwealth environmental standards must be met before foreign exchange or export approvals can be issued.

- The use of the Commonwealth's foreign affairs powers to make treaties on matters such as the nuclear fuel cycle, and for the protection of the environment, and to legislate to implement their provisions.

While these developments have lead to some Commonwealth involvement in the regulation of uranium mining, the day to day regulation and administration is still in the hands of the States (or Territories). Currently, the only operating uranium mines are in the Northern Territory (NT — Ranger Uranium Mines) and South Australia (SA — Olympic Dam Project). The Nabarlek Project (NT) has ceased production and is currently being decommissioned.

The Commonwealth Government's policy is not to allow development of any new uranium mines. This policy has inhibited the review or amendment of requirements for the development of new mines, although operating requirements for mines have been revised from time to time.

It is also noteworthy that both of the uranium mines operating at present operate in part under legislation which would not generally apply to other similar projects elsewhere in that State or Territory (e.g. the Supervising Scientist in NT, or the Indenture in SA).

A.2. COMMONWEALTH REQUIREMENTS

The main contributions to regulation of uranium mining by the Commonwealth has been the development of Codes of Practice, and, in the Northern Territory only, the operation of the Office of the Supervising Scientist for the Alligator Rivers Region (the Alligator Rivers are in Northern Territory, and the Region contains a number of uranium deposits, including Nabarlek and Ranger).

These contributions arose from the Commonwealth's Environment Protection (Impact of Proposals) Act 1974. The object of this Act is to ensure that matters affecting the environment are taken into account in Commonwealth decision making. An inquiry into the then proposed Ranger

uranium mine was set up under this Act in 1975. There were two main grounds for invoking this Act:- the Northern Territory was administered by the Commonwealth at that time, and Commonwealth approval would be required for export of the product. The Inquiry concluded that the potential hazards from the proposed project did not justify its not proceeding, but that the development of the project (and any other uranium mines) should be strictly regulated and controlled.

Part of the Commonwealth's response was to establish the Office of the Supervising Scientist, and to develop Codes of Practice in respect of uranium mining activities.

In addition to these specific requirements relating to uranium, there is other more general Commonwealth legislation which can affect development of all resource projects. The most important of these will be discussed briefly.

A.2.1. The Environment Protection (Alligator Rivers Region) Act 1978

This Act is an important control over development in the Alligator Rivers region of the Northern Territory. It established the statutory position of Supervising Scientist for the Alligator Rivers Region.

The role of the Supervising Scientist is to:

- develop coordinate and manage research into the effects on the environment of the region of mining and milling operations
- develop and promote standards, practices and procedures for protection of the environment and develop and promote measures for protection and restoration of the environment in the Region
- co-ordinate and supervise the implementation of requirements for environment protection under prescribed instruments

In 1978, after responsibility for general mining controls was transferred to the new Northern Territory administration, an agreement was made that regulation of uranium mining in the region should be through Territory legislation.

The Supervising Scientist does not regulate or impose environmental conditions on the mining operations and has no powers of enforcement. However, as he has a responsibility to advise the Government on the adequacy of environmental protection arrangements in the Region, he must attempt to establish whether or not the NT supervising authorities are effective.

There are over 30 pieces of legislation which are considered relevant to protection of the Alligator Rivers Region, and which the Supervising Scientist must regard in assessing the effectiveness of the NT administration. Many are of minor or restricted relevance (e.g. construction of fuel storage facilities). The major legislation will be discussed in Section A.3.

Amendments to the Act in 1994 replaced an earlier "Coordinating Committee" with two specialized committees. These committees were designed to improve the consultative arrangements for the key stakeholders and the government.

The Advisory Committee, meeting twice per year, provides a forum for information exchange and policy consultation among interested groups on the effects of uranium mining in the Alligator Rivers Region.

The Technical Committee meets annually and advises the (Commonwealth) Minister for the Environment on the research needed to maintain a satisfactory level of environmental protection in the Alligator Rivers Region.

A.2.2. Codes of practice

The Environment Protection (Nuclear Codes) Act 1978 provides for the Commonwealth to prepare, in consultation with the States and Territories, Codes of Practice relating to nuclear activities (including uranium mining and milling) to protect the health and safety of people and the environment. The implementation and enforcement of the Codes is the responsibility of the States and Territories, although there are provisions which allow the Commonwealth to intervene if it is determined that they are not being adequately applied. These provisions have never been invoked. The following three Codes have been developed under this Act:

A.2.2.1. Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores 1987

This Code was originally developed in 1980, and substantially revised in 1987. It includes comprehensive provisions for radiation protection in mining and milling, including

- requirements for approval and authorization of projects
- requirement for an overall plan for radiation protection, including
  provision of appropriate radiation protection equipment, facilities and procedures
  appropriate radiation safety training
  monitoring requirements dose assessment and record keeping
- duties and responsibilities
- radiation protection standards
- medical examinations

To assist with the interpretation and implementation of the Code's requirements, a number of advisory Guidelines have also been prepared, although they have no force in law.

A.2.2.2. Code of Practice for the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores 1982

The main requirement of this Code is that waste management practices must be developed and approved before commencement of operations. The waste management practices must ensure that release of radioactive materials (other than controlled by approved discharge limits) must be minimized by the use of best practicable technology.

Other requirements include

- pre-operational, operational and post-operational monitoring of the waste management facilities and the environment
- reporting and corrective action in the case of unplanned releases
- rehabilitation of wastes and waste management facilities
- compliance with dose limits as required in the Radiation Protection Code above.

Again a series of advisory guidelines have been prepared.

A.2.2.3. Code of Practice for the Safe Transport of Radioactive Substances 1990

This Code incorporates the IAEA Regulations for the Safe Transport of Radioactive Material 1985 (incorporating the 1988 Supplement), with minor amendments and additions to, for example, define the "Competent Authorities", and specify relationships with other appropriate requirements (e.g. requirements for transporting other dangerous goods).

The Code is generally applied by the States to the transport of all radioactive materials, not just those associated with mining or milling.

A.2.3. Environmental impact assessment

The Environment Protection (Impact of Proposals) Act 1974 was introduced to allow proper consideration of environmental factors in the Commonwealth Government's decision making processes. The Act applies to all actions of the Commonwealth which are environmentally significant. "Actions" include both physical actions by the Commonwealth (e.g. construction of airports), and administrative actions, for example Government approval of exports (for example uranium oxide export) or approval of foreign investment. "Environmentally significant" is not defined in the Act: the decision in each case is made by the relevant Commonwealth Minister.

The Act provides for four levels of environmental assessment

- Examination by a Commission of Inquiry. This has only been invoked three times, once for the Ranger Uranium project.

- Assessment by the Environment Department following the preparation and public review of an Environmental Impact Statement. This is usually only used for proposals with very significant environmental impacts (EIS).

- Assessment by the Department following the preparation and public review of a Public Environment Report (PER). The PER is a less comprehensive document than the EIS and is focused more directly on the issues considered to be most environmentally significant.

- Internal examination within the Environment Department, without preparation of an EIS or PER.

Where an environmental assessment is required under State or Territory legislation as well as by the Commonwealth (which is commonly the case), co-operative arrangements are in place to ensure that wherever possible both sets of requirements are met by the one document. These arrangements reduce, but do not always eliminate duplication. They cannot guarantee that the outcome in a particular case will be acceptable to both jurisdictions.

The responsibility for preparing PERs and EISs rests with the proponent. Issues which usually must be included include:

- project justification,
- project description,
- examination of feasible and prudent alternatives,
- description of the existing environment,
- examination of the potential impacts,
- environmental safeguards, monitoring, etc.

An EIS or PIR must be available for public comment for a minimum of 28 days. In the case of an EIS, a revised EIS (which may be a supplement to the original) must be prepared to address the public (and any official) comments. No such additional material is required for a PER. The final assessment of the document must be made within 42 days for an EIS or 28 days for a PER.

A.2.4. Radiation standard setting

The National Health and Medical Research Council is the premier Australian body in recommending limits to radiation exposure. The NHMRC has of itself no power to enforce compliance with its recommendations; such compliance must be required by separate appropriate legislation by the Commonwealth or States.

The NHMRC has in the past followed very closely the recommendations of the ICRP.

A.3. NORTHERN TERRITORY

At the time the Ranger uranium deposit was discovered in the Northern Territory, the Territory was administered by the Commonwealth. Since that time the Territory has become entirely self governing, with Commonwealth jurisdiction generally limited to the same areas as for the States. However, the Commonwealth specifically retained ownership of uranium in the Northern Territory, and this gives it a considerable powers over uranium development. In some areas requirements originally developed under the Commonwealth administration have been taken over by the Territory.

A.3.1. The "Environmental Requirements"

As noted above, an Inquiry was conducted into the proposed Ranger development. The inquiry recommended that mining could proceed, but under strictly controlled conditions. Consequently, the Commonwealth developed a number of "Environmental Requirements" based on the Inquiry recommendations. These became the basis of the legal, regulatory, and contractual arrangements applying to the Ranger project. A similar set of Requirements applies to the Nabarlek project. By agreement between the Commonwealth and the Northern Territory, these requirements (and other regulation of the mines) are applied and administered to the maximum extent possible under appropriate Territory legislation. It is part of the Supervising Scientist's duties (see above) to monitor the Territory's administration and enforcement of these requirements.

It is possible that an environmental requirement is in conflict with a requirement under other NT legislation. The NT Minister must "have primary regard to" the environmental requirements, and any advice requested from the Supervising Scientist, in determining how such a conflict between requirements should be resolved.

A.3.2. Radiation (Safety Control) Act

This Legislation is the main legislative control on the use of radioactive materials. However, mining and treatment of uranium ores is specifically excluded from the application of the Legislation.

A.3.3. Mine Management Act 1990

This Act is the main mine safety Legislation in the Territory, and is applicable to all mines, and associated mills. The Act contains general requirements for safety, including provisions for Government inspectors, responsibility of the manager for ensuring a safe working environment in the

mine, miners' powers to appoint miners' inspectors, notification of accidents, etc. There are no specific requirements concerning uranium or radiation, but neither are such matters excluded.

Regulations have been made under this Act (Mine Management Regulations), which contain more detailed requirements for Mine Safety. A specific regulation requires that the Radiation Protection Code (2.2.1 above) be applied in all mines in the Territory (although the Code itself excludes its application to mines in which ores of uranium or thorium are not present). Many of the general regulations are also directly applicable to radiation safety (e.g. requirements for ventilation).

A.3.4. Uranium Mining (Environment Control) Act 1979

This is the main Northern Territory Legislation for regulation of the environmental aspects of uranium mining and milling.

The Act has general requirements for protection of the environment, including appointment of an Environment Protection Officer, a Radiation Safety Officer and a Ventilation Officer, instructing staff in environmental requirements, appointment and duties of Inspectors, etc. However the main thrust of the Act is to require the Minister's authorizations of any developments associated with uranium mining. The Minister may grant authorizations subject to conditions. In considering applications, the Minister is required in general to have regard to the desirability of protecting the environment from harmful effects, and in the specific cases of the Ranger or Narbarlek projects to the appropriate "Environmental Requirements" (see 3.1 above).

A.3.5. Mining Act 1980

This Act is concerned with the requirements for those prospecting for minerals, and the rights of ownership and obligations in respect of any minerals discovered. All minerals in the Territory are the property of the Crown (Government), and owners of private land are not entitled to compensation for any minerals removed from their land, but compensation for any loss occasioned by mining on the land can be claimed.

The Act provides for a number of mining tenements including Exploration Licences, giving exclusive rights to prospect (with minor exceptions) over wide areas, Exploration Retention Leases, which allow the holder to carry out more intensive investigations over a potential ore body, and Mineral Leases, which entitle the holder to mine and process specified minerals on the lease. In general the rights are exclusive (that is no others have a claim to the minerals on the lease), and, subject to compliance with conditions, they can be renewed or upgraded (e.g. an Exploration Licence can be converted to a Mineral Lease). Fees must be paid for all tenements, and royalties on minerals extracted.

There are provisions for objections to granting of a tenement by adjacent landowners or others to be heard by a Warden's Court, which can also adjudicate disputes over tenements. The Warden can recommend conditions on tenements, or recommend that they are not granted. It is a general condition on all tenements that activities create as little disturbance as practicable to the environment, and rehabilitate disturbed areas.

There are special provisions for applications for tenements on "Aboriginal Land" (land reserved for the Australian native inhabitants), or on land that is in a Park or Reserve. These provisions include requirements to consult with the Commonwealth. There are also special requirements for consultation with the Commonwealth on the granting of mineral leases in respect to uranium ore, and a special royalty is payable to the Commonwealth.

A.3.6. Environmental Assessment Act

This Act aims to reduce environmental damage from development by requiring investigation and assessment of potential environmental effects. The procedures are:

Initial Notification:
The Minister is advised of a proposed development, and advice on the requirement for environmental examination is issued.

Preliminary Environmental Report:
This is intended to provide the Minister with sufficient information to decide on its likely significance or acceptability. The Minister may decide that the project can precede, that more information is required, or that an EIS is required.

Environmental Impact Statement:
When the Minister decides an EIS is required, guidelines on the required content of the EIS are prepared. A Draft EIS prepared by the proponent is available for public examination and comment for 28 days. The Draft EIS is revised in the light of public and official comments (usually in the form of a Supplement), and assessed. Approval of the proposal may be subject to conditions, and a decision on approval is generally made within 35 days of submission of the final EIS.

The need for and level of environmental assessment required is decided on consideration of both the type of project proposed, and the particular environment in which it is proposed to be sited.

A.4. SOUTH AUSTRALIA

A major copper-uranium deposit was discovered at Roxby Downs in central South Australia in 1975 (the Olympic Dam deposit). Uranium mining had been conducted in the State in the 1950s and 1960s, but this had ceased at the time of the Olympic Dam discovery. Although general mining, occupational health and safety and radiation protection legislation was in effect, the Government of the day considered that additional legislation was required to implement and control this new project. This legislation (the Indenture, see below) became the major legislative instrument for control of the project, although other new and existing legislation is also important.

A.4.1. The Roxby Downs (Indenture Ratification) Act 1982

This Act ratified the Olympic Dam and Stuart Shelf Indenture, a detailed agreement between the proposed operators (the "Joint Venturers") and the Government of South Australia. The Indenture covers a large number of matters, but some the aims of the Indenture were:

- to give the operators greater protection of their rights to operate a proposed project. There was considerable political opposition to uranium mining in the State at the time, and it was thought possible that a future Government might move to close the project.

- to give the operators protection against possible excessive taxation of the project, either directly (e.g. as royalties on production), or by charging high fees for infrastructure, etc.

- to give the Government, which was faced with the prospect of initial heavy expenditure on infrastructure, a guarantee that if this expenditure was made, the operators would proceed with the project.

- to streamline some administrative procedures. Both parties recognized that there were very many legislative and administrative requirements that would have to be met in establishing a project of the proposed scale, and mechanisms were included in the Indenture to expedite these requirements.

Some of the matters included in the Indenture include:

- Initial and subsequent obligations of the Government and operators,
- Procedures for approvals,
- Radiation protection Codes,
- Environmental protection requirements,
- Water supply, roads, electric power and other infrastructure,
- Mining leases, land tenure, etc.,
- Royalties and other payments,
- Non-discrimination, "No special taxes", etc.,
- Planning procedures and approvals,
- Enforcement, arbitration of disputes, etc.,
- Requirements in case of termination of project.

A number of the Indenture's requirements modify in some way the normal law of the State. Some of these were found to have undesirable consequences, and as a result, amendments had to be made, notably to the Radiation Protection and Control Act (see below).

A.4.2. The Radiation Protection and Control Act

Provisions for control of the radiation aspects of uranium mining and milling were included in a new Radiation Protection and Control Act, which was intended apply to all aspects of radiation protection.

The general provisions of the Act include:

- the establishment of a Committee of experts to advise the Government on matters relating to radiation;

- setting of radiation dose limits, which, for exposures associated with uranium mining (but not for any other situations) are tied to ICRP and other national and international recommendations;

- registration and licensing of sources and users;

- powers of inspectors;

- power to make regulations.

Control over uranium mining and milling was originally to be imposed via Conditions to be placed on the Mining Lease required under the Mining Act (see below). It was envisioned that the conditions would include requirements to comply with the Commonwealth's Codes of Practice. However the Indenture made this method of administration impractical by granting a Special Mining Lease (not under the Mining Act), the conditions on which were specified in the Indenture.

Consequently the Act was amended to require persons mining or milling radioactive ores to hold a Licence to do so.

An application for a mining or milling licence must include information on the following:

- plans of the mine or mill, showing mine workings and proposed developments, location of major items of equipment, stockpiles, etc.,
- descriptions of processes, working procedures, etc. to be used,
- descriptions of the methods to be used to limit radiation exposures of workers and members of the public, including details of systems and equipment to reduce the release of contaminants,
- details of radiation monitoring programmes designed to determine exposures to worker and members of the public, and to determine significant radiological effects on the environment,
- details of training of workers in the radiological aspects of their work,
- details of the wastes expected to be generated, and the methods to be used to manage them, including an outline of the proposed methods of rehabilitating waste management facilities at the end of their design life.

Uranium mining operations would also have to comply with relevant general provisions (e.g. dose limits).

A comprehensive set of Regulations under the Act has been prepared. Requirements relating to mining and milling include:

- Responsibility for radiation safety,
- Application of the Act and Regulations (e.g. what constitutes "radioactive ore"),
- Compliance with Radiation limits,
- Monitoring, dose assessment and record keeping,
- Medical examinations and records.

Regulations on transport of radioactive materials have also been made: in effect they implement the IAEA Transport Regulations.

A.4.3. The Mines and Works Inspection Act and Regulations

This Legislation provides a comprehensive set of controls on matters relating to health and safety in mining and milling. There is a whole range of requirements in such areas as mining practice, hoisting, use of explosives, use of machinery, ventilation, etc. The act requires the appointment of Inspectors of Mines having wide ranging powers including the right to issue orders prohibiting work until safety defects are remedied to the satisfaction of the Inspector.

Inspectors of Mines under this Act are ex officio 'authorized officers' under the Radiation Protection and Control Act (for matters relating to radiation in mines), and can inspect compliance with its provisions.

A.4.4. The Mining Act

The Mining Act is principally concerned with the rights to ownership of mineral deposits, and with the protection of mining claims or leases from environmental degradation. Mines Inspectors under the Mines and Works Inspection Act also administer this Act.

All minerals in the State are the property of the Crown (Government), and mining is only permitted by holders of the appropriate leases or permits. The Act provides for various types of mining tenure, including a mineral claim, exploration lease, mining lease, and retention lease. Leases are exclusive, and can be renewed or converted to a different type (e.g. an exploration lease can be converted into a mining lease) provided all conditions on the lease have been met.

The Act specifies that efforts must be made to minimize adverse environmental effects of mining operations (including exploration) and that workings must be rehabilitated before being abandoned.

A.4.5. The Planning Act

The Planning Act is the main South Australian Legislation controlling development, particularly the environmental aspects. The main legislative requirement relevant to mining is the Environmental Impact Statement.

An Environmental Impact Statement is defined as a statement of:

- the expected effects of the project upon the environment,
- the conditions (if any) that should be observed to avoid or satisfactorily manage any potentially adverse effects of the project and
- the economic social and other consequences of carrying the project into effect.

A discussion of alternatives including the option of not proceeding with the project is required in the EIS.

The procedures are as follows:

- The Minister of Environment determines if an EIS is required for a project (to date all major mining projects have required an EIS).
- In conjunction with the proponent, guidelines for the EIS are prepared by the Government. These guidelines outline the scope and the issues that must be addressed in the EIS.
- The Draft EIS is prepared by the proponent. When the Minister is satisfied that the document is adequate, the Minister releases it for public comment. Official comments (by Government Departments) are also made at this time.
- The Draft EIS is placed on public exhibition for not less than six weeks.
- The proponent prepares a Supplement to the Draft EIS, addressing the questions and comments received during the exhibition period. The supplement is released to the public.
- The Draft EIS and the Supplement are reviewed by the Government and an assessment report is prepared. The Draft EIS, the Supplement, and the Assessment Report together make up the

EIS. If the Minister is satisfied that the EIS process has been satisfactorily then the EIS is "Recognized".

- The information in the EIS is then used by the appropriate planning authority (the Planning Commission or the Governor) to decide if approval should be granted and if so, under what conditions.

A.5. BIBLIOGRAPHY

a) COMMONWEALTH GOVERNMENT

Copies for all Commonwealth legislation can be purchased through:
Australian Government Printing Service
Mail Order Sales
GPO Box 84
Canberra ACT 2601
Australia

Other Commonwealth publications can also be obtained from this address, including:

"Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores" 1987.

Guidelines to the above Code, including:

"Abnormal Exposures and Corrective Actions".

"ALARA — a practical guide".

"Storage and Packing of Uranium Concentrates".

"Training of Employees and Supervisors"

"Corrective Measures and Actions in Response to Defects".

"Safety Signs/Notices for Controlled and Supervised Areas".

"Meal/Smoking Areas and Personal Hygiene Facilities".

"Personal Respiratory Protection".

"Record Requirements".

"Appointment, Qualifications and Responsibilities of Ventilation Officers".

"Radiation Protection Aspects of Ventilation Practices".

"Planned Special, Emergency and Accidental Exposures".

"Health Surveillance".

"Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores" 1982.

Guidelines to the above Code, including:

"Development of Waste Management Program for a Uranium Mining/Milling Operation".

"Design and Operation of a Water Management System for a Uranium Mining and Milling Operation".

"Tailings Impoundment for Uranium Mines".

"Waste Rock and Ore Stockpile Management".

"The Mining of Uranium by In Situ Leaching".

"Decommissioning and Rehabilitation of Uranium Mine, Mill and Waste Disposal Sites".

"Recommendations for limiting exposure to ionizing radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation" (Published jointly by the National Health and Medical Research Council and National Occupational Health and Safety Commission).

Annual Reports of the Supervising Scientist for the Alligator Rivers Region.

b) NORTHERN TERRITORY

Copies of Northern Territory legislation can be ordered from:

Government Printing Office
GPO Box 1447
Darwin 0801
Australia

c) SOUTH AUSTRALIA

Copies of State legislation can be ordered from:

State Print
Mail Order Sales
PO Box 210
Plympton 5083
Australia

B. AN EXAMPLE OF THE CANADIAN REGULATORY PROCESS

Uranium mining in Canada is subject to federal jurisdiction under the Atomic Energy Control Act but the federal agency endorses a co-operate approach including both other federal departments and provincial departments throughout the entire operating life from the Environmental Impact Statements (EIS) review, the public hearing process and the constant regulatory review. In some cases formal arrangements have been made and form the basis for each party's involvement.

The development of a uranium mine may include licensing of the evaluation and testing phases. However when an operator decides to proceed with a new mine, the following procedure is required. The process is not specific as Canada is going through a transition in regulatory

requirements for environmental assessment. The principles are similar with both processes and are discussed in the remainder of this example.

The AECB process begins upon receipt of an application from a proponent consisting of a major EIS which is required by legislation, including but not limited to the following information:

a) a project description covering the planned scope of the operation and the status of the site;

b) the current conditions of the environment considering the air and terrestrial environment, the aquatic environment and hydrogeology;

c) waste management plans for liquids and solids including mine rock and the mitigation measures;

d) predicted workplace conditions including an assessment of potential radiation doses and the elements of the radiation protection programme;

e) socio-economic considerations as well as employment targets;

f) tailings management plans;

g) predicted environmental impacts; and

h) conceptual decommissioning plans.

The process is intended to take into consideration public and regulatory concerns early in the procedure so they may be considered in the final design and operation of the facility.

The information in the EIS does not include detailed design specifications but enough data and commitments to asses the impacts considering the current regulatory regime. The environmental assessment legislation has been changed recently, as previously noted, by previous procedure and the recently introduced Act and regulations are based upon the premise of the public's right to know and the need to have input. The administrative details may change but the objective of public input remains the same.

When a mining company advises the agencies of their intent to develop an orebody and upon receipt of the EIS, an announcement is made to the public, usually in the newspaper, advising them of the company's plans. No details are provided at this stage. Federal and provincial regulators begin to consider the content of the Environmental Impact Statement (EIS) to meet their regulatory needs as well as formally referring the project to a "hearing process". Copies of the EIS are made available for review by the public at federal and provincial offices. The objective is to provide the public with the information in time to prepare for the hearings.

The EIS preparation is now overseen by the independent panel or appointed by the Federal government or jointly by the Federal and Provincial governments if the project requires review by each level of government. The panel conducts a series of public meetings, called scoping sessions, in "impacted communities" to identify concerns prior to preparation of the EIS and to allow the proponent the opportunity to address these concerns during the more extensive hearings to follow. A document is prepared by the panel and given to the agencies and the proponent describing the areas to be included in the EIS based upon the information derived from the scoping session, regulatory inputs and the panels experience. This document forms the basis for the preparation to the EIS. The summary report on the scoping meeting captures the concerns expressed by the presenters addressing such items as intervenor funding; baseline information; project description; project alternatives; cumulative environmental effects; social impact assessment; review of past experience; land resource uses; community involvement; other regulatory procedures; public input to monitoring the

environment; predicted radiation doses; health effects; environmental impacts, both radiological and non-radiological and decommissioning. The degree to which this is a concern is explained in the document so the proponent can allocate resources accordingly.

The EIS preparation, which addresses the issues identified in the scoping session takes place over a period of a year or more and is finally presented to the regulatory agencies for review and comment. Again the details for the design are not included at this point. The intention at this juncture is to ensure that the *scope of the project* is delineated, the *methods and procedures* for the operation have been decided and the *environmental impacts have been estimated.* Some information on the rationale for the selection and rejection of different mining, milling and effluent treatment options should be included. The first item to be considered in the review is whether the proponent has provided a complete project on which to make the comments.

Following extensive review of the EIS, by all participants in the regulation of the mines, the regulatory agencies provide comments to the licensee and the panel identifying the comments as those "required to complete EIS review" or those "to be addressed later in the regulatory process" to indicate the priority and to apprise the panel of how the regulatory agencies' needs have been met by the document. Based upon the comments and the follow-up work required, the panel begins to schedule public hearings throughout the impact areas.

The hearing format allows everyone the opportunity to put their positions forward and to hear input from the other parties to the hearings. The panel, the proponent and representatives of the regulatory agencies travel to various communities and present information at each location. This allows the best opportunity for everyone to participate despite the remoteness of their community.

The panel ultimately issues a report recommending that the project proceed as is; proceed with conditions or not proceed at all. The governments consider the reports and incorporate some of the conditions into their regulatory process which begins in earnest once an application to construct, containing more detailed information is received from the proponent. For example, the panel, in a recent report, suggested establishing a mechanism for the impacted public to have input into the regulatory process on an ongoing basis. This condition was implemented by the provincial government with some support from the federal government by establishing working committees to receive and review all information relating to the environment at the mines. The new legislation tends to give the panel report more authority and to remove some of the regulators discretion.

With the disposition of the panel report, extensive work for the regulators now begins as the agencies now become involved in the detailed review and assessment of the proponents application. Requirements under the Uranium and Thorium Mining Regulations again become the main consideration. The proponent will be advised of the current requirements to obtain the necessary approvals to construct the facility such as where *quality assurance programmes* are required, when programmes requiring approval such as for *radiation protection and environmental monitoring* have to be submitted to meet the proponent's schedule, what information *supplemental to the EIS* is required and the effect of an any *changes to the methods and procedures* would have on the initial environmental impact predictions. All of these requirements are co-ordinated with other regulatory agencies such as those having an interest in fisheries, environment or occupational health and safety.

The following programmes would receive particular attention:

1) Code of practice[2] for radon progeny, gamma radiation, uranium bearing dust and bioassay programmes;

2) Ventilation, dust control and heating systems, design capacity and maintenance and inspection frequencies;

3) Environmental monitoring plans designed to measure compliance and evaluate environmental effects.

These programmes evolve and become more detailed as the operation moves from the construction phase into the operating phase. The programmes are subject to change to reflect changing operations, the increasing probability of encountering radiation and the complexity of specific facility to which they are to be applied.

If a facility has completed sufficient construction to allow them to move into the operating phase, then different and more detailed licences or permits are required by the proponent. These operating phase documents now include *enhanced codes of practice* as dictated by the operation. A document called the mining facility licensing manual is a primary licensing tool used to reference *all of the operating practices* and *approved programmes* at the facility. This document establishes the basis on which the facility can be operated. The regulations include the requirement for the *training of workers in radiation protection* to develop an appreciation how certain actions can negatively influence the workplace environment or dose rates and how other actions can be beneficial. The contents of the training programme is subject to regulatory approval. The need for monitoring of workers is explained, and the requirements under regulations are pointed out to the worker. At the end, workers complete written examinations and receive refresher training at scheduled times.

A *conceptual decommissioning plan* is now required to be a part of the initial operating licensing documentation provided. This plan would be of sufficient detail to allow for a cost estimate of the work. This plan would be reviewed, probably revised and then accepted as a first step in determining the *financial guarantee* required of the company. The financial guarantee is intended to protect the public from having to pay for remedial and decommissioning work, should the company fail. This new requirement calls for periodic review to assess how the mining and milling activities have changed the scope of the remedial work and its influence of these changes on the cost estimate. This requirement is expected to encourage rehabilitation to be undertaken during the life of the operation and not held until the end of the operating life of the facility.

Limits are placed *on production* from the facility. These limits are based upon the design capacity of the mine or more likely the mill. *Release limits* on solid and liquid effluent are clearly stated and *water quality objectives* are included by the province. In addition, an *action level concept* is used to keep liquid effluent discharges well below the discharge limits. The concept is based on the premise that the discharges can be maintained well below the limits and should be maintained at these operating points unless conditions change. Reaching or exceeding an action level only requires the operator to investigate the cause of the occurrence and return the discharges to the former level if practicable.

Reporting requirements are specified in licences or regulation so that the performance of the radiation programmes and environmental monitoring programmes can be monitored on a regular

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[2] A code of practice is a written programme which states what corrective action is required at a measured concentration, dose rate, ventilation rate or other parameter appropriate to the code. The corrective action is proportional to the concentration, dose rate, etc. and ranges from simple re-measuring at the workplace to closing down a portion or all of the workplaces. The code is proposed by the proponent and must be approved by the AECB before being implemented.

frequency. This auditing of the records is supplemented with field sampling of workplace conditions, record keeping practices and water quality sampling. An AECB inspector is charged with the responsibility to audit the company's monitoring of the workplace and the environment.

Any reports, tests and analysis that must be provided during the licensing period are specified in the licence to provide direction to the licensee.

The Canadian approach to licensing is continuous frequent assessment and review and licence modification to reflect the dynamic nature of the operations. This is supplemented with inspections, audits, reviews and confirmation of monitoring data and dose records and frequent contacts to keep abreast of changes.

Finally decommissioning or reclamation, which may have been going on as certain portions of the facility reached the end of their useful life, is the last section to be completed. The decommissioning proceeds based upon a final plan which has evolved over the life of the operation. It too has been subject to regular review and modification and will be followed by a period of monitoring by the company until the stated objectives have been reached. And lastly, the land would be returned to the province once the facility had been successfully closed.

C. JURIDICAL FRAMEWORK FOR THE EXPLORATION AND MINING OF URANIUM DEPOSITS IN FRANCE

Exploration and mining of uranium deposits in France is controlled under both the general juridical framework of mining activities, and under special requirements due to the radioactivity of the metal.

C.1. JURIDICAL FRAMEWORK OF MINING ACTIVITIES

C.1.1. Basic concept

The Mining Code differentiates between two categories of deposits of mineral or fossil substances :

(a) *The category of substances usually minable by underground methods, and then called "mines"* limited to an exhaustive list of substances grouping the fossil fuels, the metallic substances, the radioactive elements, etc.

The ownership of the deposit is kept by the State.

(b) *The category of substances usually mined by open pit, and then called "quarries"*, which group all the other mineral deposits.

The "quarry" category follows the general regulation — that is the underground quarry belongs to the owner of the surface; the "mine" category does not belong to any individual or company and can only be mined by virtue of a discretionary right granted by the state.

The mining procedures, given the absence of initial right concerning the substances, are exercised at two levels :

(a) Creation of a right — mining title — for the benefit of a designated operator : "mining right".

(b) State control of exploration and exploitation : "mining surveillance".

The opening of a mine, physical unit of production, follows three steps :

(a) discovery of a deposit by a prospector to whom is attributed an "exploration title",

(b) designation of a miner, to whom is given a temporary property right — "mining title",

(c) authorization of opening of mining works, including in advance the conditions of their closure.

C.1.2. Mining exploration

Mining exploration is free, accessible to all, only subject to the agreement of the surface owner, as long as nobody else is holding a mining right on the prospected area for the same substance.

The Mining Code created in 1955 an Exclusive Exploration Permit (EEP) granting to the holder an exclusivity of search within a given perimeter, for a given substance, and for a given duration.

The validity is for at most 5 years, and may be renewed twice for at most 5 years.

In exchange, the beneficiary promises to spend a not less than a specified amount of money on exploration. When the prospector has demonstrated the presence of an economic deposit, he may apply for a mining title.

For the request of EEP, — and for starting the linked works, for the request of a mining title — , the applicant must submit a file including either a preliminary impact statement or an impact study. These documents are submitted to a public inquiry and must indicate the possible impact of the projected works on the environment.

The holding of a EEP does not modify the relations with the surface owners: the exclusive explorer must always try to obtain their agreement prior to carrying out the work. But in case of disagreement, the explorer can use an administrative procedure to solve the problem.

C.1.3. Mining title

The finder must then obtain a right of property on his newly found deposit whether he has or not the intention of bringing it to production in a short term.

The mining *Concession* is the title which can be granted.

The Concession has a validity of at most fifty years, renewable for, at most, 25 years spans. This is a necessary condition for mining the deposit, with the same rights as the EEP.

The procedure entails a request to the administration. A public inquiry has to be carried out before agreement of the administration. For exploitation, it is necessary to ask for authorization (see B.1.4.).

C.1.4. Mining operations

The opening of a mine, which creates an industrial activity of some importance and duration is submitted to authorization, including:

- Impact study;
- Public inquiry, taking place in every local administrative area involved;
- Agreement of the Prefect of the department (county) defining the constraints relating to the protection of the environment, after consultation of the various government services.

The closure of the mine is subject to various specific regulations of abandonment, which differ according to the terms of the title.

The constraints linked to the closure and to the restoration of the mining sites are defined in advance, when applying for the authorization.

The mining law leaves room for public expression: whereas in many other fields the public is consulted only once on an already finished project, the three step mining procedure brings information to the public, and gives it a right of expression during the course of the project development.

C.2. SPECIFIC ASPECTS OF THE REGULATION IN THE CASE OF A URANIUM DEPOSIT

The general regulation for the mining industry, instituted by a ministry decision in conformity with the Mining Code, includes two titles in the Chapter "Radiation Protection":

(a) Protection of the workers,
(b) Protection of the Public, and of the environment.

The chapter "Radiation Protection" of the Mining Code (decree 89-502 dated July 13, 1989 on occupational protection and decree 90-222 on public protection) is valid for all mines and takes up the general principles and exposure limits set out in French regulations of June 20, 1966 modified on April 18, 1988. This modified regulation of June 20, 1966 is derived from the directives of the CEC (Commission of the European Communities) in line with recommendations ICRP26, ICRP30 and ICRP47.

The most important features of the French mining regulations are described hereunder.

C.2.1. Occupational protection

- implementation of the ALARA principle,

- annual dose limits, set as follows:

External Exposure (EE)	Long-live dust (LLD)			Potential Alpha Energy (PAE)	
	U238	Th232	Uranate	Rn222	Rn220
50 mSv	1 700 Bq	300 Bq	30 000 Bq 2.5 mg/day	20 mJ	60 mJ

- definition of a total annual exposure rate (TAER)

$$TEAR=\frac{EE}{50\ mSv}+\frac{LLD_{U238}}{1\ 700\ Bq}+\frac{LLD_{Th232}}{300\ Bq}+\frac{LLD_{uranate}}{30\ 000\ Bq}+\frac{PAE_{Rn222}}{20\ mJ}+\frac{PAE_{Rn220}}{60\ Bq}<1 \qquad (1)$$

This is equivalent to limiting the annual exposure from all exposure sources at 50 mSv. (Conversion factors of ICPR 26).

- compulsory setting of a special medical file and individual exposure file from the records of the total monthly exposure rate, the last 3 month exposure rate, the last 12 month exposure rate and the life time exposure,

- compulsory setting of a prescriptions file, which includes local rules issued by the Mine Management and accepted by the Mine Inspector,

- compulsory information of the personnel on the risks,

- compulsory appointment of a competent person in radiation protection,

- compulsory setting of an individual dosimetry for exposed personnel (i.e. all workers of uranium mines), using an all-risks dosimeter worn by each individual,

- special overrun procedure: if a portion of the personnel cannot comply with the TAER < 1 limit, then the Mine Inspector may authorize, after consultation of the occupational practitioner, then the TAER can be averaged over a period not exceeding 5 years, provided that the TAER will not exceed 1.5 on 12 consecutive months,

- the radiological monitoring is organized under the responsibility of the Mine Management, which must be assisted by an organization registered by the Minister of Mines and the Minister of Public Health,

- in addition to individual dosimetry of the workers, monitoring of the underground work places must be carried out at time intervals adapted to the magnitude of the exposures; actions levels (operational guidelines) are defined by the regulations,

- the ventilation technical file imposed by the Mining Code must take into account the radiological risks when they exist,

- the non-uraniferous mines must organize a measurement of radon in the exhaust air in order to demonstrate the absence of radiological risks for the personnel.

C.2.2. Protection of the public

- the radiological monitoring is organized under the responsibility of the Mine Management, which must be assisted by a registered organization,

- the natural exposure must be measured before the commencement of mining (base line),

- the dose limits for the members of the public are set to one tenth of the dose limits for the workers and the incremental total annual exposure rate related to those limits must remain less than 1, that is a maximum annual exposure of 5 mSv per year (conversion factors of ICPR 26), during the duration of mining activities,

- the management of radioactive materials is defined : rock dumps with an uranium content higher than 300 ppm, leached ores, tailings, and sump sludges must be managed and monitored until the impact on environment is found acceptable,

- the waters pumped from the mines and the process effluents must be treated under the following conditions :

Soluble Radium 226 (Bq/l)	Dilution rate in the stream	Action
> 3 700	in all cases	treatment
740 à 3 700	< 5	treatment
	> 5	no treatment
< 740	in all cases	no treatment

- the atmospheric effluents must be released at least 100 m from any dwelling,

- the atmospheric and liquid effluents must be monitored according to prescriptions of the prefectoral agreement authorizing mining activities,

- monitoring of the receiving environment,

- monitoring of air quality by continuous sampling and assays of potential alpha energy of the radon daughters and long live dust activities,

- at the decommissioning stage, the mine sites must be reclaimed and the incremental total annual exposure rate must be monitored during 1 year at least.

C.3. MAIN REFERENCES

C.3.1. Regulations for protection of the public and the environment

Law 76-629 dated July 10, 1976 on protection of the environment,

Law 76-663 dated July 19, 1976 on the facilities registered for the environment protection,

Law 83-630 dated July 12, 1983 on the democratization of public inquiries.

C.3.2. Regulations on radiation protection

Decree 66-450 dated June 20, 1966 modified by the decree 88-821 dated April 18, 1988 related to basic principles of protection against ionizing radiations,

Decree 86-1103 dated October 2, 1986 related to protection of workers against ionizing radiations.

C.3.3. Mines regulations (for all minerals)

Law 77-620 dated June 16, 1977 modifying the Mining Code,

Decrees 80-330 and 80-331 dated May 7, 1980 related to surveillance of mines and quarries and to general regulations of extraction industries (GREI),

Decree 89-502 dated July 13, 1989 complementing the GREI, related to protection of workers against ionizing radiations,

Decree 90-222 dated March 9, 1990 complementing the GREI, related to protection of workers against ionizing radiations.

C.4. CONCLUSION

French mining regulations take into account the specific problem of workers exposure to radioactive conditions in mining activities. The related steps are enforced even in non-uraniferous mines, except if a maximum exposure less than 1/10 of the dose limits can be demonstrated.

For decommissioning of processing plants and reclamation of mine sites, a closure procedure allows to carry on the rehabilitation work under control of the Mine Inspector. An abandonment procedure is followed when the Mining Permit is closed down; it defines various actions to be carried out, organization of environment monitoring, and easement to be written down at the registrar of mortgages, so that all the mining works can be deserted. This procedure is described in a Prefectoral Agreement. Afterwards, the municipal regulations are enforced.

A modification of regulations on registered facilities is currently studied in order to integrate the mines in the list of facilities registered for the protection of the environment.

D. LEGISLATION APPLICABLE TO URANIUM PRODUCING MINES IN THE REPUBLIC OF SOUTH AFRICA

D.1. INTRODUCTION

Uranium production in the Republic of South Africa commenced in 1952 as a by-product of the Witwatersrand gold mining industry which was established in the 1880s. Since the early 1970s uranium has also been produced as a by-product from an open caste copper mine.

Specific legislation has been developed since 1948 for those mines exploiting ores containing uranium and thorium. These requirements are included in legislation covering the nuclear fuel cycle including the mining of radioactive ores, uranium enrichment, nuclear power generation and radioactive waste disposal.

Application of this legislation is not confined to uranium producing mines but includes all mining and minerals processing activities involving uranium or thorium and their decay products above specified levels.

Two separate statutory organizations; the Council for Nuclear Safety (CNS) and the Atomic Energy Corporation of South Africa (AEC) are responsible for administering this legislation.

The CNS is mainly concerned with implementing legislation pertaining to radiological safety and the AEC is mainly concerned with controls over uranium and thorium as a resource and the disposal of radioactive wastes.

A number of other regulatory organizations are involved in implementing additional legislation applicable to all mining activities including those involving radioactive ores.

This legislation is concerned with the "non radiological" aspects of mining e.g. prospecting, mineral rights, planning, health and safety, hazardous waste, water quality, rehabilitation, mine closure, mine safety, effluent, etc. Mines are required to submit "EMPRs" (Environmental Management Programme Reports) for Prospecting and Mining Activities.

The complete range of legislation applicable to a uranium producing mine is therefore wide ranging, complex and administered by a number of different organizations (Refer to Appendix 1 for summary)

The following review therefore concentrates on the development of those aspects of the legislation administered by the AEC and CNS which are specific to mines exploiting materials containing uranium and thorium.

D.2. URANIUM PRODUCTION IN SOUTH AFRICA

The presence of radioactive material in the gold bearing ores of the Witwatersrand was first noted in 1915; in 1923 the material was identified as uraninite.

The gold bearing reefs of the Witwatersrand Basin were extensively assayed for uranium in the mid 1940s and full scale production first commenced at West Rand Consolidated Mine in 1952. In addition the Nuclear Fuels Corporation (Nufcor) was set up to calcine the ADU produced by the gold mines into uranium oxide.

By 1959 27 gold producing mines were feeding material to 17 uranium plants which produced 4954 tonnes of U. Production declined during the 1960s to 2262 tonnes in 1965, then increased during the 1970s to reach a peak production of 6143 tonnes in 1980 from 18 operating uranium plants. Production then declined rapidly and presently there are only five operating plants on four mines which produced a total of 1669 tonnes in 1992.

Over 99% of the uranium produced in South Africa since 1952 (approximately 142 kilotonnes) has arisen as a by-product from the gold mines of the Witwatersrand Basin; the remainder is produced by a copper mine.

A total of 27 uranium plants were constructed during the period 1952 to 1990.

D.3. OVERVIEW OF THE HISTORICAL DEVELOPMENT OF LEGISLATION UNTIL 1990

The following section provides a brief overview of the process by which the AEC, CNS and the present legislation came into existence.

Atomic Energy Board

Prior to 1948 all matters pertaining to uranium exploration and production were under the direct control of the Prime Minister in conjunction with the Uranium Research Committee.

The Atomic Energy Board (AEB) was created in 1948 specifically to oversee and coordinate the commercial exploitation of the newly discovered uranium resource; its legal powers were set down in the Atomic Energy Act of 1948.

Nuclear Safety Advisory Committee

During the 1950s a Nuclear Safety Advisory Committee (NSAC) was set up by the AEB, the committee functioned purely in an advisory capacity to the AEB.

Regulatory Controls Over Nuclear Installations

In 1963 the Nuclear Installations (Licensing and Security) Act was promulgated; in this legislation the AEB was charged with the responsibility for regulating nuclear safety.

Licensing Branch of the AEB

In 1968 the Licensing Division of the AEB was set up to implement the licensing process; its name was changed to the "Licensing Branch" in the 1970s.

At the time that the Licensing Branch was set up it was recognized that in the long term it would have to become completely independent of the AEB to properly fulfil its intended regulatory function.

In the late 1970s the Licensing Branch, recognizing the potential seriousness of the occupational radiation exposures in the uranium producing gold mines investigated the feasibility of implementing formal controls over the radiation hazards arising from the exploitation of uranium bearing ores in the gold mines.

For various reasons including the lack of specific legislation to cover such a situation, the Licensing Branch was unable to pursue the matter to a satisfactory conclusion and it was not until 1990 that formal controls over radiation hazards in uranium producing mines commenced.

Nuclear Energy Act (1982)

In 1982 the Nuclear Energy Act (No. 92 of 1982) was passed into law and this established the Atomic Energy Corporation (AEC) and repealed the previous Acts defining the functions of the erstwhile AEB.

In addition, the AEB's Nuclear Safety Advisory Committee was disbanded and in its place the new Act created and defined the powers and functions of the Council for Nuclear Safety (CNS).

Under the 1982 Act the AEC remained the nuclear safety regulator, with the Licensing Branch of the AEC performing the technical regulatory work. The CNS was granted the powers to veto licence proposals which the AEC was obliged to submit to it.

Nuclear Energy Amendment Act (No 56 of 1988)

In 1988 the Council for Nuclear Safety was established as a completely independent regulatory body and finally acquired the degree of independence from the AEC which had been envisaged since the early 1970s.

This was achieved through the Nuclear Energy Amendment Act (No 56 of 1988). The new Council for Nuclear Safety at that time included a "Council" of up to 13 members, an Executive Officer and his staff of managers and technical experts.

All members of the "Council" and the Executive Officer are appointed by the Minister of Mineral and Energy Affairs.

Members of the Council may not be licensees or employees of licensees.

The Nuclear Energy Act (Act No 131 of 1993)

The Nuclear Energy Act (Act No 131 of 1993) replaced the 1982 Nuclear Energy Act and came into force in March 1994.

The main provisions of the new act which covers all aspects of the nuclear fuel cycle are briefly summarized below:

(1) to provide for the continued existence of the AEC and the CNS as separate and independent organizations;

(2) to determine the objects, powers and functions of the AEC and the CNS;

(3) to provide for the implementation of the Nuclear Non Proliferation Treaty and Safeguards Agreement;

(4) to regulate the licensing of certain nuclear activities by the CNS;

(5) to ensure control over uranium and thorium resources;

(6) to exercise control over the discarding of radioactive waste.

D.4. LEGAL IMPLICATIONS OF THE ACT FOR MINING AND MINERALS PROCESSING ACTIVITIES

The Act is an extensive and complex document; those sections of direct relevance to mining and minerals processing facilities exploiting radioactive ores (including uranium producers) are briefly summarized below.

Both the CNS and the AEC exercise regulatory functions in separate areas applicable to the mining and processing of radioactive materials containing uranium or thorium and their decay products.

Powers and Responsibilities of the AEC

The AEC has a number of powers defined in the Act of direct relevance to uranium producers:

The AEC has powers to:

(a) control the discarding of radioactive waste, discard radioactive waste and operate waste disposal facilities;

The AEC operates a waste disposal facility licensed by the CNS. Any proposal to discard radioactive waste at some other site (for example on a mine) would require the prior approval of the AEC and the site would have to be licensed by the CNS.

(b) exercise control over source material.

Source material is defined in Government Notice 740 of 16 April 1994 and with reference to uranium and thorium states:

"Any substance containing:

- uranium expressed as a conversion to uranium oxide, above:

  (1) 0.05% of the mass of the substance: and

(2) a mass of 3 kilograms: or

- thorium, expressed as a conversion to thorium oxide, above:

(1) 0.05% of the mass of the substance: and

(2) a mass of 3 kilograms."

The Act also states that:

No person shall (except with the Minister's written authority):

- be in possession of any source material,
- acquire, use or dispose of source material,
- import or export source material,
- process, enrich or reprocess any source material.

With regard to "possession" it should be noted that in the case of possession resulting from "lawful prospecting, reclamation or mining operations" written authorization is not required from the Minister.

The Act also requires that the presence of source material must be reported to the Minister in writing within 30 days of its discovery. The Act also gives the Minister extensive powers regarding the acquisition of source material by the government.

Control over uranium and thorium as "source material" is primarily concerned with control over these materials as important strategic resources. Since the notice refers to "any substance..."; source material could include ores, ore concentrates, process materials, wastes and all mineral products above the specified levels. Therefore uranium producers would have to obtain the relevant authorizations from the Minister applicable to source material.

Responsibilities of the CNS

The CNS regulates and exercises control over radiation safety within the complete nuclear fuel cycle and in those activities involving radioactive ores, through powers set down in the Nuclear Energy Act (Act No 131 of 1993).

The CNS is not legally empowered to make decisions regarding the authorization of new nuclear facilities or mining ventures involving radioactive ores. Its remit is strictly limited to safeguarding persons against nuclear damage once the decision to proceed with a project has been taken.

New mining operations involving uranium production would require authorization under the relevant legislation administered by the Department of Mineral and Energy Affairs and its departments e.g. Government Mining Engineer and the Mining Commissioners.

Mission of the CNS

It is the mission of the Council for Nuclear Safety to safeguard persons and their property against the risk of nuclear damage arising from the production or exploitation of nuclear energy and associated radioactive materials in the Republic of South Africa.

The licensing philosophy of the CNS is based on risk and in particular to ensure that the risk of nuclear damage resulting from activities involving radioactive materials is consistent with the requirements of health and safety.

Fundamental safety standards have been established by the CNS which define the limits consistent with health and safety and for the purposes of demonstrating compliance with those limits a system of radiation dose limitation has been derived from the fundamental safety standards.

To this end the CNS must regulate and exercise control over the construction and use of nuclear installations, or the possession or use of, or carrying out any activity involving, radioactive material and which is capable of causing nuclear damage, and these activities include the discarding of radioactive waste.

The CNS exercises its regulatory function primarily through the issue of nuclear licences; in addition it has discretionary powers regarding the issue of licences.

D.5. CNS LEGAL POWERS AND THE NUCLEAR ENERGY ACT (ACT NO 131 OF 1993)

The objects of the CNS are, with a view to the safeguarding of persons against nuclear damage, to regulate and exercise control through the issue of nuclear licences or the exercise of the discretion contemplated in section 51 (1) of the Act over:

(a) the construction or use of a nuclear installation;

(b) the use, possession, production, storage, processing, enriching, reprocessing, conveyance or disposal of radioactive material;

(c) the discarding of radioactive waste, and

(d) storage of irradiated nuclear fuel;

(e) the carrying out of any other activity involving radioactive material and which is capable of causing nuclear damage.

Section 50 of the Act allows the CNS to direct the applicant for a licence to provide information in support of the application.

Since 1990 the CNS has issued 45 licences to various mining and minerals processing facilities exploiting materials containing uranium and thorium; a summary is given in Appendix 2.

Nuclear Damage

Nuclear damage means any injury to or death or any sickness or disease of a person, or other damage to or any loss of use of property, which arises out of or results from, or is attributable to, the ionizing radiations associated with radioactive material or with the generation of nuclear energy.

Nuclear damage can take many forms including:

(a) loss of use of land or property or business;

(b) deterministic and stochastic effects;

(c) psychological trauma and anxiety.

Liability in respect of Nuclear Damage

Under Section 61 of the Act the licensee's liability in respect of nuclear damage is absolute and unlimited: claims for compensation may be lodged up to 30 years after the initiating event.

Responsibility During Transport

Under Section 61 (2) of the Act radioactive materials during transport are deemed to be under the control of the licensee and he alone is liable for any nuclear damage that occurs during transport.

Financial Security

Under Section 59 of the Act the Minister may require the applicant to provide financial security in respect of the applicants obligations under Section 61 (liability for nuclear damage).

The amount and manner of the security is determined by the Minister and the Minister of Finance. For large mines including uranium producers, the normal amount requested is 250 000 rands.

The amount requested does not define the limit of a licensee's financial liability for nuclear damage should possible claims exceed this amount

Nuclear Licence

This is a legal document issued by the CNS which lays down the conditions a licensee has to comply with to ensure compliance with the fundamental safety standards during operation of the facility.

Where the CNS refuses to issue a licence it must do so in writing stating the reasons.

Radioactive Waste

This means any radioactive material which is intended to be discarded as waste material.

Radioactive Material

This is defined in the Act as "any substance consisting of, or containing, any radioactive nuclide, whether natural or artificial."

The quantitative definition of radioactive material is not given in the Act itself, however, it can be defined by the Minister through what is termed a "Government Notice" published in the Government Gazette.

In Government Notice 848 of 23 April 1994 the Minister in terms of Sections 2 (f) of the Act has determined that:

"0.2 becquerels per gram as the level of the specific activity of each radioactive nuclide in radioactive material below which the provisions of the act do not apply."

Radioactive materials below this level therefore fall completely outside the scope of the Act.

Declarations in Terms of Section 51 (1) of the Act

The issue of a nuclear licence may not be appropriate in the case of many facilities handling small quantities of low specific activity radioactive materials. Therefore the Act gives the CNS discretionary powers regarding the issue of a nuclear licence.

Under Section 51 () b (i) if:

"the specific activity and the total activity of the radioactive material or the radiation dose which persons may accumulate, is below the levels determined under Section 2 (e) and the CNS has declared in writing that in its opinion the risk of nuclear damage associated with the performance of the activity in question will not exceed limits laid down by the CNS for the safeguarding of persons."

In terms of Section 2 (e) of the Act, paragraph 1 of Government Notice 848 of 23 April 1994, states:

(a) 100 becquerels per gram as the level of the specific activity of radioactive material,

(b) 10 000 becquerels as the level of the total activity of radioactive material involved over a period of one year, and

(c) one millisievert as the radiation dose (per annum).

Therefore above these levels the CNS must issue a licence, however, below these levels the issue of a licence is at the discretion of the CNS.

Licence Conditions

In terms of Section 54 (1) (a): "a nuclear licence shall be subject to such conditions as the CNS may deem necessary or desirable for the purpose of the safeguarding of persons against nuclear damage ..."

In terms of Section 54 (1) (b): "the CNS may at any time amend any condition contemplated in paragraph (a) imposed by it".

The Council is therefore empowered under the Act to impose any conditions which it may deem necessary in the interests of health and safety.

The Act itself does not define conditions as these will be site or activity specific and vary from licensee to licensee: the CNS decides on the licence conditions and these are dependent on the results of licensee specific quantitative risk assessments.

In the case of licences issued to mining and minerals processing facilities since 1990 the CNS has progressively modified and added conditions to make them more specific to each facility. This is an evolving process with the aim in the longer term for each licence to contain conditions specific to a licensed site or activity.

Failure of a licensee to comply with the licence conditions could lead to prosecution.

The Council has the power to revoke a nuclear licence, thereby curtailing a licensees operation.

Inspectors

Under Section 67 of the Act the CNS may appoint inspectors: inspectors appointed by the Council have wide powers, including the power to enter premises, remove articles and obtain information.

Licence Fees

Section 56 specifies that the licensee pay such fees as the CNS may from time to time determine.

Inspection of Documents

Under Section 58 the CNS is required to keep records and maps of each licensed site available for inspection by the public.

Display of the Licence

Section 57 requires that the licence must be displayed prominently on the licensed site.

Nuclear Accidents

Section 62 requires that the licensee must report such accidents to the CNS forthwith. The specific requirements are set down in the nuclear licence and licence documents.

Appeal to the Minister and the Supreme Court

Under Section 65 persons may appeal to the minister on certain matters e.g. CNS refusal to grant a licence or in connection with licence conditions.

The Minister can confirm, set aside, vary or substitute the CNS decision in the above matters.

Under Section 66 any person aggrieved by the Minister's decision may appeal to the Supreme Court.

D.6. THE NUCLEAR LICENCE AND ITS CONDITIONS

The Issue of a Licence

In law it is the responsibility of the users of radioactive materials to determine whether they need to apply for a nuclear licence.

The potential licensee e.g. uranium producer, must make an application in writing to the CNS for a licence and provide financial security normally in the amount of R 250 000.

The CNS then draws up and issues a licence, which sets down the conditions under which the facility is allowed to operate.

Licences Issued to Mining and Minerals Processing Facilities

The licence conditions will vary according to the amounts and concentrations of radioactive material involved and the potential radiation hazards associated with the facility.

Initially a new licensee would receive a licence with generic conditions, with the long term aim being the development of site specific licence conditions appropriate to the level of radiation hazard revealed by the required hazard assessments at the facility in question.

Licence Structure

The present structure of the initial generic licence issued to mining and minerals processing facilities incorporates two parts.

Part 1 refers to the licence conditions of which there are presently (1994) ten sections, these refer to:

1.1. Scope of the Licence

1.2. Hazard Assessments: e.g. Exposure of Employees, Visitors, Public

1.3. Operational Limitations: e.g. Specific operations, Demolition, Maintenance activities

1.4. Operational Radiation Protection: Control of Hazards and Dose Limitation; Workforce and the Public

1.5. Radioactive Waste Management Programme

1.6. Transportation of Radioactive Materials

1.7. Physical Security over Radioactive Materials

1.8. Occurrences, Occurrence Reporting and Emergency Plans

1.9. Quality Management Requirements

1.10. The Licence Schedule.

Part 2 of the licence contains a document control table and index for the listing of current license documents and any other documents drawn up by the licensee or CNS applicable to a specific licence condition.

As new or updated documents are added to the licence these are referenced in Part 2 of the licence and over a period of time the generic licence will gradually develop into a mine specific licence.

Licence Change Requests

These are initiated by the licensee and refer to changes and revisions to parts of the licence e.g. a request to the CNS to revise a previous document referenced in the licence.

Licence Variations

Major changes to the licence may require that the whole of the original licence be varied and the new variation issued to the licensee.

Licence Documents and License Guides

These are issued by the CNS to provide more specific details on the compliance requirements for a particular licence condition.

ANNEX

Mining and Minerals Processing Activities in South Africa
Summary of Legislation and Regulatory Organizations

Mining activities in South Africa are subject to many different items of legislation administered by a number of government departments and statutory organizations: a uranium producing mine would be required to comply with a wide range of legislation during the course of its operation.

The following list is a summary of the most important national legislation and the responsible organizations.

Department of Mineral and Energy Affairs

Minerals Act 50 of 1991

Atomic Energy Corporation of South Africa

Nuclear Energy Act No 131 of 1993

Council for Nuclear Safety

Nuclear Energy Act No 131 of 1993

Department of Water Affairs

The Water Act No 54 of 1956

Department of National Health and Population Development

Hazardous Substances Act No 15 of 1973
Occupational Diseases in Mines and Works Act No 78 of 1973
Atmospheric Pollution Prevention Act No 45 of 1965
Atmospheric Pollution Prevention Act No 17 of 1973
Health Act No 63 of 1977

Department of Environmental Affairs

The Environment Conservation Act No. 100 of 1982.

Minor Legislation

In addition to the legislation listed above there are numerous other minor pieces of legislation that are applicable to mining activities; for example, in addition to most of the main Acts listed above, the Acts given below are also applicable to slimes dams operations.

Mines and Works Act No 27 of 1956
Soil Conservation Act No 76 of 1969
Physical Planning Act No 88 of 1967
Agricultural Resources Act No 43 of 1983
Agricultural Pests Act No 36 of 1983
Weeds Act No 42 of 1937

Environmental Management Programme Reports (EMPR's) for Prospecting and Mining.

The following document has been issued to assist mines in drawing up an EMPR:

The Aide-memoire for the Preparation of Environmental Management Programme Reports (EMPR's) for Prospecting and Mining.

The Aide-memoire is issued by the Department of Mineral and Energy Affairs as a guideline to mine operators to assist them in complying with the requirements of the Minerals Act, 1991, which

requires in the case of new projects that each mine owner submit and obtain approval for an environmental management programme (EMP) before new mining operations may commence.

Purpose

To assist applicants for, and holders of, prospecting permits or mining authorizations to draw up EMPR's in accordance with an established approach acceptable to the involved regulatory authorities and to secure their approval of the report.

Aims

The EMPR must meet the following objectives:

(1) The environmental requirements and directives under the Minerals Act, No 50 of 1991, and its regulations.

(2) To provide a single document that will satisfy the various authorities concerned with the regulation of the environmental impacts of mining.

(3) To give reasons on the need for and overall benefits, of the proposed project.

(4) To describe the relevant baseline environmental conditions at and around the proposed site.

(5) To describe the prospecting and mining method and associated activities so that an assessment can be made of any significant impacts that the project is likely to have on the environment during and after mining.

(6) To describe how negative environmental impacts will be managed and the positive aspects of the project maximized.

(7) To set out the environmental management criteria that will be used during the life of the project so that the stated and agreed land capability and closure objectives can be achieved and a closure certificate can be issued.

(8) To indicate that resources will be made available to implement the EMP as set out in the Aide-memoire.

The EMPR and the EMP should be seen as site specific and the requirements of the Aide-memoire are applied as appropriate in a site specific manner.

The EMPR is to be seen as a dynamic document which may require updating during the life of the project.

The approved EMP is legally binding on the mine owners and must be complied with if a closure certificate is required at a later date.

At the discretion of the Regional Director an applicant may be exempted from the requirement to submit an EMPR.

Legislative requirements administered by the CNS and the AEC are additional to those listed in the Aide-memoire.

The CNS has issued licences to control activities in the following areas:

(1) generation of nuclear power e.g. the Koeberg nuclear power plant

(2) uranium enrichment, fuel fabrication, isotope production and waste disposal e.g. the Atomic Energy Corporation

(3) facilities calcining uranium e.g. the Nuclear Fuels Corporation (Nufcor)

(4) mining and minerals processing facilities producing uranium as a by-product e.g. gold and copper mines

(5) mining and minerals processing facilities handling radioactive materials containing uranium or thorium and their decay products e.g. gold mines, mineral sands operations, monazite mines

(6) "small users" of uranium and thorium e.g. laboratories

(7) other mining related facilities handling radioactive materials containing uranium or thorium and their decay products associated with the mining industry e.g phosphoric acid plants, scrap yards, smelters, refurbishers and waste recycling facilities

(8) the rehabilitation of land contaminated with radioactive materials containing uranium or thorium and their decay products.

In addition the CNS acts as the national competent authority for any purpose in connection with the IAEA's Regulations for the Safe Transport of Radioactive Materials.

E. REGULATIONS IN THE UNITED STATES OF AMERICA RELATED TO URANIUM DEPOSIT DEVELOPMENT AND PRODUCTION

E.1. INTRODUCTION

Regulation of uranium deposit development and production in the United States is the product of laws that are passed at the Federal (national), State, or local level. Laws governing uranium mining and milling are intended to protect the health and safety of the work force and the public, and the environment from unacceptable and irreversible impacts. In addition, organizations that want to explore, develop the uranium deposits, and operate production facilities benefit from having their rights protected and from having a clear understanding of what their requirements will be at the various stages of the process. These laws have been passed over the years in response to the public perception of the hazards associated with uranium mining and milling. In some cases, the laws were passed because of problems in other types of mineral deposits development and other industries, and uranium development and production was included.

From these laws, government agencies assigned to enforce them are primarily responsible to develop standards, regulations, and codes of practice and to assure compliance with the laws. Regulations and standards are typically drafted by the regulating agency and then undergo a public review process. Most of the technical criteria of regulations are developed by the regulating agency and the impacts of the various degrees of restrictions on mining and milling activities are the subject of public meetings and in some cases, administrative hearings. For laws aimed at protection of the environment, standards are generally set by the US Environmental Protection Agency (EPA). In the case of uranium milling, for example, the regulations were developed by the US Nuclear Regulatory Commission (NRC) after the EPA set the generally applicable environmental standards.

To provide additional guidance to the uranium mine and mill operators, regulatory guidance documents are developed. These range from regulatory guides or guidebooks that receive internal agency review and public comment before they are put into place, to technical positions that generally

receive little or no review before they are made available as a method or approach that is acceptable to the regulatory agency. Regulatory guidance documents, technical position papers and policy issuances, however, do not take the place of the regulations. They serve as methods and procedures that the regulatory agency has found acceptable, but the mine and mill operators may propose alternatives that will also meet the regulations.

E.2. FEDERAL LEGISLATION OF MINERAL RIGHTS

There are very few Federal laws that address mineral ownership and protection of mineral rights, except where the minerals occur on Federal or Native American lands. Mineral ownership in the United States may belong to the surface property owner, or mineral rights may be owned separately. Often, surface land owners have sold their mineral rights for development by another enterprise. If they are owned separately, the mineral rights owner has a right to explore and develop these minerals, but he is required to compensate the surface land owner for disturbance of the surface or interference with the surface land owner's use of the land. In the case of Federal or Native American lands, the laws and regulations are aimed at assuring that public lands are protected, and that other uses of the land by the public are not unduly impacted. Public lands in the United States may be used for such things as minerals extraction, timber, agriculture, and recreation. For lands and minerals held privately, laws governing mineral rights are under the purview of the States. Local governments (counties, districts, cities) generally control land use and zoning.

E.3. FEDERAL LEGISLATION OF NUCLEAR MATERIALS AND OPERATIONS

Over the last 40 years, the US Government has passed numerous laws that affect uranium mining and milling. Some of the laws were specifically directed at uranium mining and milling and in other cases these activities were incorporated under broad laws that affect virtually every organization, industry and individual in the United States. The laws that most directly affect uranium mining and milling would include the Atomic Energy Act of 1954 (AEA), as amended, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), the National Environmental Policy Act (NEPA), the Clean Air Act (CAA), and the Clean Water Act (CWA). Earlier laws, such as the General Mining Law of 1872, the National Park Service Law of 1916, and the Leasing Law of 1920, were passed to set up procedures for addressing such issues as the leasing of Federal lands, payment of royalties, and access to and control of mining claims on public lands.

Basic Federal oversight of nuclear-related activities originated with Atomic Energy Act of 1954, as amended. The AEA was originally enacted to allow commercial exploitation of nuclear materials for peaceful uses. Up until that time, all activities related to nuclear material were restricted to national defense. In the ensuing years, the Act has been amended numerous times to consider the changing aspects of nuclear activities in the United States. Exploration for uranium and conventional mining (both underground and open pit) are not addressed by the Act. The US Congress determined that those activities should remain under the jurisdiction of the States. Uranium exploration and mining must, however, comply with Federal laws regarding such things as environmental protection and non-radiological health and safety, as discussed below. Control and regulation of all activities related to the nuclear fuel cycle and the generation of electric power by nuclear energy continues, however, to be the prerogative of the Federal Government. The Act does address uranium recovery activities such as milling and heap leach operations, in terms of controlling the operations to assure worker and public protection from radiation, safeguarding of nuclear materials, radioactive waste management, and protecting the environment. The AEA also encompasses in situ leach mining of uranium.

In 1969, the NEPA was passed which mandated that for all major Federal actions, the impact on the environment must be assessed before the action was taken; this was the beginning of the environmental impact statement procedures, which apply to all uranium mining and milling activities.

In 1978, Congress passed UMTRCA in recognition that uranium mill tailings posed a potential health and environmental risk. This Act, which actually amended the AEA, resulted in the development of environmental standards, specified that uranium mill tailings be remediated and ownership turned over to the Federal government or the State in which they reside, at their option, for long-term surveillance and monitoring.

The Clean Water and Clean Air Acts are much broader and intended to address protection over the entire scope of human activities that might degrade the nation's air and water. These laws, although not directly addressing uranium mining and milling, have a significant impact. They directed that environmental standards be established for a broad range of constituents that are considered hazardous or toxic, including nuclear materials, that may be discharged to air or water.

Other Federal laws that may impact uranium exploration and deposit development are those that govern use of public and Native American lands and their mineral deposits. These include lands that are managed by the Federal government, national forests, national parks, and lands reserved or allotted to the various indian tribes.

The last category of Federal laws are those associated with general worker safety and welfare that are generic to all exploration, mining, and milling activities. These include laws on occupational safety, mine safety, and labor laws. This category will not be discussed here, except the occupational safety regulations that address radon daughter exposures.

E.4. FEDERAL REGULATIONS

Federal regulations are derived from the above Federal laws and are contained in the "Code of Federal Regulations" (CFR). For example, those parts of the AEA that apply to uranium mining and milling are found in Title 10 of the CFR. These codes address all Federal regulations. Those that will apply at some point in exploration and development of uranium mining and milling are Title 10, "Energy", Title 30, "Mineral Resources", Title 40, "Protection of the Environment", and Title 49, "Transportation". Others that may apply, depending on where the uranium deposit is located, are Title 25, "Indians", Title 36, "Parks, Forests, and Public Property", and Title 43, "Public Lands: Interior".

Under Title 10, the regulations that apply to uranium mining and milling are those found in Parts 20, "Standards for protection against radiation", 40, "Domestic licensing of source material", and 51 "Environmental protection regulations for domestic licensing and related regulatory functions". The purpose of Part 20 of Title 10 of the Code of Federal Regulations (10 CFR 20) is to control the possession, use, and transfer of licensed radioactive material in such a manner that the total dose to an individual does not exceed established standards. The regulations in 10 CFR 40 establish procedures and criteria for issuance of licences to receive title to, receive, possess, use, transfer or deliver source and by-product material, and establish and provide for the terms and conditions of these licences. Uranium is defined as a source material and mill tailings are defined as byproduct material. Environmental protection regulations are contained in 10 CFR 51.

Under Title 30, the regulations that apply the most directly are in Part 57. This part addresses radon daughter exposures in underground mines. Other parts of this title apply to uranium mining in that they address generally applicable regulations for any kind of mining.

Title 40 regulations address environmental protection standards for any activity that falls under the jurisdiction of Federal laws. These regulations are the result of the NEPA, CAA, CWA, and others. The primary regulations that relate to uranium mining and milling include Parts 61, "National emission standards for hazardous air pollutants", 122, "EPA administered permit programmes: The national pollutant discharge elimination system", 144, "Underground injection control programme", 146, "Underground injection control programme: Criteria and standards", 192, "Health and environmental protection standards for uranium and thorium mill tailings", and 440, "Subchapter N-

Effluent guidelines and standards: Ore mining dressing point source category". The requirements in Part 61 that apply to uranium mining address limits to emissions to air from operating mills and radon emanation from mill tailings piles. Part 122 limits effluents to receiving waters and requires a permitting procedure to discharge any liquids. In Parts 144 and 146, the regulations limit injections of pollutants to ground waters, set standards for the pollutants, and requires permits for such operations. Of note, in situ leach mining for uranium is considered underground injection for the purposes of these regulations, permits are required. Required permits are normally issued by state authorities, consistent with the Environment Protection Agency's Underground Injection Control (UIC) Program. Part 192 contains the environmental protection standards that resulted from the passage of UMTRCA. These standards were incorporated into 10 CFR 40, discussed above. Part 440 addresses effluent guidelines and standards that must be met during underground ore mining.

Title 49, "Transportation", has some application to uranium mining and milling in that it establishes requirements for transporting uranium ore, mill tailings, and uranium oxide. The regulations address the radiological survey, vehicle, packaging, placarding, and methods of hauling requirements for transporting these materials over public roads.

Title 25, 36, and 43 may only apply if the uranium deposits are on public or Native American lands. These regulations contain requirements on permitting, payment of royalties, protection of lands, fish and wildlife, and cultural resources.

E.5. STATE REGULATIONS

Exploration and mining for mineral resources on private and State lands is under the jurisdiction of the state in which the deposit is located. This is also true for conventional uranium mining. The AEA, however, allows States to assume responsibility for regulating certain nuclear materials-related activities, including uranium recovery facilities. A State can apply to become an "Agreement State" under provisions of the AEA. In this capacity, the State regulates uranium recovery activities once they have demonstrated to the Nuclear Regulatory Commission that State requirements are compatible with Federal requirements and that the State has provided adequate staff to administer the regulatory programme. The States of Colorado, Texas, Washington, and Illinois currently have Agreement State status for regulating uranium recovery facilities. Since the state regulations must be compatible with federal regulations they will not be reiterated here.

States can also assume responsibility for certain Federal requirements administered by the Environmental Protection Agency (EPA). The requirements are in the areas of underground injection control, surface and ground-water standards, and control of effluents. The procedures for a State assuming these responsibilities are similar to the Agreement State process discussed above.

The State regulations, other than those discussed above for Agreement States, that apply to uranium mining and milling may vary significantly from State to State. Also, many States have passed laws similar to the Federal laws discussed above, particularly in the area of environmental protection. In several instances, States have adopted environmental protection regulations that are even more stringent than Federal regulations. Therefore, for simplicity and to provide some representative examples, State regulations will be discussed in only general terms.

State regulations are generally more broadly-based, applying to all types of mineral resource exploration, development, and production. State regulations will typically address such areas as permitting of exploration, bonding requirements, surveys, and reporting requirements. These regulations also typically contain rules to be complied with such as worker protection, mine construction requirements, well drilling, abandonment procedures, waste management requirements, and codes for building structures, roads, etc. Unless they are an Agreement State, regulations do not normally address uranium specifically. The exception is radon monitoring requirements in underground mines, regardless of the mineral being extracted.

E.6. LOCAL REGULATIONS

Local government bodies may include counties, cities, and special districts, such as soil conservation and flood control districts. They may be empowered to establish laws and regulations that could impact uranium mining and milling within their legal boundaries. As with State regulations discussed above, there is a wide variety of requirements from one local government to the next.

Local regulations that may affect uranium mining and milling might include such areas as use and maintenance of local roads, codes of practice for design and construction of structures, consumptive use of water, sanitary waste requirements, housing requirements for the work force, local taxes, and fees. In general, local government bodies may impose conditions that are more stringent than state or federal requirements if they can show good reason. They typically cannot impose less stringent requirements, however. They may also be able, under certain circumstances, to impose requirements on conditions that are local in nature and not likely to cause effects beyond their jurisdictional boundaries. Special districts may also apply requirements directly related to their areas of jurisdiction, such as soil conservation practices, restrictions on fluid extractions from, and injections into, regulated aquifers, and contamination of land and/or groundwater from mining and milling activities.

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[3] For all documents identified as Regulatory Guides, copies may be purchased by writing: Superintendent of Documents, US Government Printing Office, Post Office Box 37802, Washington, D.C. 20013-7082, USA

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APPENDIX II — CONSIDERATIONS AND CONCERNS OF A PROPONENT

The clear definition of laws and regulations is necessary to provide a framework under which uranium related activities of exploration, project development, mining, production and facilities decommissioning may take place. Some of the questions and concerns that must be considered before a company elects to undertake a uranium related programme within a country are given below. While the concerns may apply to all types of mining activities, many of the questions may involve additional, or special considerations when uranium is the target commodity. These questions may help identify whether the existing legislations are adequate to meet the requirements for these activities.

Basic Considerations

Are the legislative requirements for operation clear? Who administers them, and how are disputes, defaults, etc. to be determined?

Exploration

Can I explore?

Do I have exclusive rights to explore in a particular area? What must I do to safeguard these rights? For how long do I hold them?

Do I have exclusive rights to develop any discoveries? What must I do to safeguard these rights? For how long do I hold them?

What exploration methods can I employ? Are further approvals needed for particular exploration methods (e.g. underground exploration)?

What licences, permits, etc. are required before commencing exploration? How, and from whom are they obtained?

What safety provisions must be made for my workers? Who is responsible for these provisions?

What requirements must be followed to protect the environment? Who is responsible for ensuring that these are carried out?

What rehabilitation must be carried out after exploration? How soon after completion of exploration must rehabilitation be completed?

Are there financial bonds, etc. that must be lodged before commencing exploration? When and under what conditions can these be refunded?

What reports must be made during exploration, and at cessation? Are these reports confidential?

Development

Do I retain exclusive rights to my discovery? For how long, and under what conditions?

If my rights are not exclusive, who may share them, how much must be shared, and under what conditions?

Are my rights transferrable to others? If so to whom and under what conditions?

What commitments to production must I make?

Construction

Am I assured of the right to operate after commitment to construction? For how long and under what conditions?

Can I import materials and equipment which might be required for construction?

What licences, permits, etc. are required before commencing construction? How, and from whom are they obtained?

What construction standards, building codes, etc. must be complied with?

What provisions must be made for accommodation, etc. of workers and their families?

What requirements are there for construction of waste management systems?

Operation

What licences, permits, etc. are required before commencing operation? How, and from whom are they obtained?

Are there any limits on the rate of production? Must minimum production levels be maintained?

What health and safety requirements must be put in place? Who is responsible for their provision?

What health and safety standards and limits must be met? How are such standards determined, and by whom?

What procedures must be adopted for protection of the environment? What limits are there on discharge of wastes? What monitoring must be undertaken? Who is responsible for remedial actions in the case of environmental damage, and what standards of remediation must be achieved?

What requirements are there for reporting of activities, production, sales, incidents and accidents, etc.?

What is the procedure for payment of royalties, etc.? At what time do they become due?

Closure

Can I relinquish my lease?

Must plant and equipment be demolished, or must they be left in place for future mining?

What rehabilitation standards must be met, how are such standards determined?

How is compliance with rehabilitation standards to be determined?

What responsibility must I take for integrity of the site (including disposed wastes)? How long does this responsibility continue? Who is responsible for repair of unforeseen deficiencies in rehabilitation?

What procedures are must be followed to terminate my responsibilities for the site, and claim any remaining bond monies?

GLOSSARY

ALARA. An acronym for 'as low as reasonably achievable', a concept meaning that the design and use of **nuclear facilities**, and in the practices associated with them, should be such as to ensure that **exposures** are kept as low as reasonably practicable, with technical, economic and social factors being taken into account.

aquifer. Porous water-bearing formation (bed or stratum) of permeable rock, sand, or gravel capable of yielding significant quantities of water.

assessment, safety. An analysis to predict the performance of an overall system and its impact, where the performance measure is radiological impact or some other global measure of impact on safety.

audit. A documented activity undertaken to determine by investigation, examination and evaluation of objective evidence that there is adequate adherence to established procedures, instructions, specifications, codes, **standards**, administrative or operational programme requirements, and other applicable documents.

authorization. The granting of a **regulatory body** of written permission for an operator to perform specified activities. An **authorization** may be more informal or temporary than a **licence**.

biota. The animal and plant life of a region.

bore. See **drill**.

borehole; drillhole. A cylindrical excavation, made by a rotary drilling device. **Boreholes** are drilled during exploration for and delineation of uranium deposits as well as for evaluating the physical and chemical site characterization for siting waste sites.

bulk samples. Large samples of a few hundredweight or more taken at regular though widely spaced intervals.

closeout. In the context of uranium mill tailings impoundments, the operational, regulatory and administrative actions required to place a tailings compoundment into long term conditions such that little or no future surveillance and maintenance are required. The same concept may apply to mining debris piles, heap and in situ leaching piles, and mines.

closure (permanent). The term **closure** refers to the status of or an action directed at a **disposal** facility at the end of its operating life. A **disposal** facility is placed into permanent closure usually after completion of waste emplacement, by covering for a near surface disposal facility, by backfilling and/or sealing of a geological repository and the passages leading to it, and termination and completion of activities in any associated structures.

codes of pratice. A designation for legislation enacted by the Commonwealth of Australia.

commissioning. The process during which the facility's components and systems, having been constructed, are made operational and verified to be in accordance with design specifications and have met the required performance criteria. Commissioning may include both non-radioactive and radioactive testing.

confinement. In radioactive waste **disposal**, the isolation of radioactive material in such a way that it is not dispersed into the environment in an unacceptable manner.

containment. Refers to methods or physical structures that prevent the dispersion of **radionuclides**.

contamination, radioactive. The presence of a radioactive substance or substances in or on a material or in the human body or other place where they are undesirable or could be harmful.

decommissioning. Actions taken at the end of the useful life of a **nuclear facility** in retiring it from service with adequate regard for the health and safety of workers and members of the public and protection of the environment. The ultimate goal of decommissioning is unrestricted release or use of the site. The time period to achieve this goal may range from a few to several hundred years. Subject to the legal and regulatory requirements of a Member State, a **nuclear facility** or its remaining parts may also be considered decommissioned of it is incorporated into a new or existing facility, or even if the site in which it is located is still under regulatory or institutional control. This definition does not apply to nuclear facilities used for mining and milling of radioactive materials (**closeout**) or for the **disposal** of radioactive waste (**closure**).

decontamination. The removal or reduction of radioactive **contamination** by physical and/or chemical process with the objective of reducing the residual radioactivity level in or on materials, persons or the environment. (See also **contamination**).

deposit. Mineral deposit or ore deposit is used to designate a natural occurrence of a useful mineral, or an ore, in sufficient extent and degree of concentration to invite exploitation.

development. To open up an orebody as by sinking shafts and driving drifts or developing wells (in in situ leach mines), as well as installing the requisite equipment.

development drilling. Drilling done to determine more precisely size, grade, and configuration of an ore deposit subsequently to the time the determination is made that the deposit can be commercially developed.

dismantling. The disassembly and removal of any structure, system or component during **decommissioning**. Dismantling may be performed immediately after permanent retirement of a **nuclear facility** or may be deferred.

disposal. The emplacement of waste in an approved, specified facility (e.g. near surface or geological repository) without the intention of retrieval. **Disposal** may also include the approved direct discharge of **effluents** (e.g. liquid and gaseous wastes) into the environment with subsequent **dispersion**.

disposal well. Well used to dispose of liquid wastes.

dose limits. See **limit**.

drill. Equivalent **bore**. To make a circular hole with a drill or cutting tool.

drillhole. Synomym for **borehole**.

effluent. A waste liquid, solid, or gas, in its natural state or partially or completely treated, that discharges into the environment.

enriched uranium. Uranium in which the ^{235}U isotope concentration has been increased to greater than the 0.711 percent ^{235}U (by weight) present in natural uranium.

environmental impact. The expected effects of the project upon the environment.

environmental impact statement. A statement of the expected effects of the project upon the environment, the conditions (if any) that should be observed to avoid or satisfactorily manage

any potentially adverse effects of the project and the economic social and other consequences of carrying the project into effect.

exploration. The search for minerals or ore by geological and geophysical surveys, as well as by drilling or surface or underground headings, drifts or tunnels.

exploration drilling. Drilling done in search of new mineral deposits, on extensions of known ore deposits, or at the location of a discovery up to the time when the company decides that sufficient ore reserves are present to justify commercial exploitation.

exposure.

(a) Irradiation of people or materials. Exposure can either be external exposure from sources outside the body or internal exposure from sources inside the body. The exposure can be either normal or potential exposure; occupational, medical or public exposure; and, in intervention situations, temporary, or chronic exposure. [See IAEA Safety Series No. 76 and **ICRP** publication 60 for a more technical interpretation of exposure.]

(b) A term used in radiation protection both in a specifically defined quantitative sense and in a general sense.

Quantity:
The **exposure,** X, is the quotient of dQ by dm where the value of dQ is the absolute value of the total charge in the ions of one sign produced in air when all the electrons and/or positrons liberated by photons in air of mass dm are completely stopped in air.

$$X = \frac{dQ}{dm}$$

Unit: $C \cdot kg^{-1}$.

In practice, the former special unit röntgen (R) is still sometimes used:

$$1\ R = 2.58 \times 10^{-4}\ C \cdot kg^{-1} \text{ (exactly)}.$$

General:
Irradiation of persons or materials. Exposure of persons to **ionizing radiation** may be either:

(1) external exposure, irradiation by sources outside the body, or
(2) internal exposure, irradiation by sources inside the body.

The term occupational exposure refers to exposure of a worker received or committed during a period of work.

groundwater. That part of **subsurface water** that is in the saturated zone, including underground streams. The term excludes water of hydration. **Groundwater** can be brought to the surface by pumping.

guide. See **Safety Guides**.

heap leach solutions. The separation, or dissolving-out, from mined rock of the soluble uranium constituents by the natural action of percolating a prepared chemical solution through mounded (heaped) rock material. The mounded material usually contains low grade mineralized materials and/or waste rock produced from open pit or underground mines. The solutions are collected after percolation is completed and processed to recover the valued components.

heap leaching. In mining and milling, the process whereby leach liquid percolates through a pile of mined ore placed on an impervious base in such a way that the leachate can be collected for recovery of the metal values.

ICRP (International Commission on Radiological Protection). An independent international group of experts, founded in 1928, which provides guidance on principles and criteria in the field of **radiation protection**. The recommendations of the **ICRP** are not legally binding, but are generally followed by countries in establishing national regulatory requirements.

ion exchange. Reversible exchange of ions contained in a crystal for different ions in solution without destruction of crystal structure of disturbance of electrical neutrality. The process is accomplished by diffusion and occurs typically in crystals possessing one or two dimensional channelways where ions are relatively weakly bonded. Also occurs in resins consisting of three dimensional hydrocarbon networks to which are attached many ionizable groups. Method used for recovering uranium from leaching solutions.

ionizing radiation. Electromagnetic radiation (e.g. X ray or gamma ray photons) or corpuscular radiation capable of producing ionization in its passage through matter.

in situ leaching.

(1) In mining and **milling**, the process whereby leach liquid percolates through or is injected into the **ore** body in such a way that the leachate can be collected for recovery of the metal values.

(2) The in-place mining of a mineral without removing over-burden or ore, by installing a well and mining directly from the natural deposit thereby exposed to the injection and recovery of a fluid that causes the leaching, dissolution, or extraction of the mineral.

law. A rule established by authority, society or custom.

legislation.

(a) the process of making laws.
(b) laws collectively.

licence. A formal, legally prescribed document issued to the applicant (i.e. **operating organization**) by the **regulatory body** to perform specified activities related to the siting, design, construction, **commissioning**, operation, **decommissioning** of a **nuclear facility, closure** of a **disposal** facility, **closeout** of a mining and mill tailings site, or institutional control. (See also **authorization**.)

licensee. The holder of a **licence** issued by the **regulatory body** to perform specific activities related to the siting, design, construction, **commissioning**, operation, **decommissioning** of a **nuclear facility, closure** of a **disposal** facility, **closeout** of a **mining** and mill **tailings** site, or institutional control. The applicant becomes the **licensee** after it receives a **licence** issued by the **regulatory body.**

limit. The value of a quantity which must not be exceeded.

Limits in radiation protection are as follows:

(1) Primary limits: Values of dose equivalent and/or effective dose equivalent applying to an individual. In the case of a member of the public the limit is taken to apply to the average dose in the critical group.

(2) Secondary limits: Values of the dose equivalent indices (deep and shallow), in the case of external **exposure**, or of annual limits on intake, in the case of internal **exposure**, which can be used to obtain an indirect assessment of compliance with primary limits.

(3) Derived limits: Values of quantities related to the primary or secondary limits by a defined model such that if the derived limits are not exceeded, it is most unlikely that the primary limits will be exceeded.

(4) Authorized limits: Limits of any quantity specified by the competent authority for a given radiation practice or source. These are generally lower than the primary, secondary or derived limits. (Adapted from Basic **Safety Standards**).

(5) Operational (radiation) limits: Limits of any quantity specified by the management for a given radiation practice or source. These are equal to or lower than the authorized limits.

liquid discharge. See **effluent.**

milling of uranium. The processing of uranium from ore mined by conventional methods, such as underground or open pit methods, to separate the uranium from the undesired material in the ore.

mineral. A naturally occurring inorganic solid substance with a characteristic chemical composition.

mineral lease. See **mining lease**.

mineral right. The ownership of the minerals under a given surface, with the right to enter thereon, mine, and remove them. It may be separated from the surface ownership, but, if not so separated by distinct conveyance, the latter includes it.

mineralized. Mineral bearing, where a mineral is defined as a homogeneous naturally occurring inorganic phase.

mining. Process of obtaining useful minerals from the earth's crust, including both underground excavations and surface workings.

mining lease. A legal contract for the right to work a mine and extract the mineral or other valuable deposits from it under prescribed conditions of time, price, rental, or royalties. Also called **mineral lease**.

natural background. The normal abundance or background of a specific area.

natural radiation exposure. Exposure of persons resulting from natural radioactive substances inside the body and from sources of external **radiation** including cosmic rays and sources of terrestrial origin, i.e. **radionuclides** naturally present in the crust of the earth and in air.

nuclear facility. A facility and its associated land, buildings and equipment in which radioactive materials are produced, processed, used, handled, stored or disposed of, on such a scale that consideration of safety is required.

occupational exposure. See **exposure**.

open pit mine; opencast mine; opencut mine; strip mine.
(1) A mine working or excavation open to the surface.
(2) A form of operation designed to extract minerals that lie near the surface. Waste, or overburden, is first removed, and the mineral is broken and loaded.

operating organization. The organization authorized by the **regulatory body** to operate a **nuclear facility**.

operational limits. See **limit**.

ore. A **mineral** or **rock** containing an element and/or compound in a quantity and of a quality so as to make **mining** and extraction of the element and/or compound economically or otherwise viable.

permit. A document giving permission to act in a specified way.

pilot plant. A small-scale mill in which representative tonnages of ore can be tested under conditions which foreshadow (or initiate) those of the full-scale operation proposed for a given ore.

plume. The spatial distribution of a release of airborne or waterborne material as it disperses in the environment.

porosity. The ratio of the aggregate volume of interstices in **rock**, soil or other porous media to its total volume.

porous medium. Material that contains pores or cracks through which water or gas can flow.

post-closure. Pertaining to the period of time following the final shaft sealing and surface facility **decommissioning** of a **nuclear facility**. Some type of surveillance or control will likely be maintained in this period, particularly for near surface disposal facilities such as a **tailings impoundment**.

processing radioactive ore. See **milling of uranium**.

production. That which is produced or made; any tangible result of industrial or other labor. The yield or output of a mine, metallurgical plant, or quarry.

prospect. To search for minerals or oil by looking for surface indications, by drilling boreholes, or both.

quality assurance. All those planned and systematic actions necessary to provide adequate confidence that an item, process or service will satisfy given requirements for quality, for example, those specified in the **licence**.

quality control. Action which provides means to control and measure the characteristics of an item, process, facility or person in accordance with **quality assurance** requirements.

radiation. Equivalent to **ionizing radiation**.

radiation dose. A term denoting the quantity of radiation energy absorbed by a medium. Sometimes shortened to dose.

radiation protection or radiological protection. Measures associated with limitation of the harmful effects of **ionizing radiation** on people, such as limitation of external **exposure** to such radiation, limitation of incorporation of **radionuclides** as well as the prophylactic limitation of injury resulting from either of these. (See also **ALARA**.) [See IAEA Safety Series No. 76 for additional information.]

radiation protection officer. A technically competent person designated by the management to supervise the application of radiation protection regulations and to provide advice on all relevant aspects of radiation protection. Equivalent to production safety officer (RSO).

radiation source. Substance or apparatus producing or capable of producing **ionizing radiation**.

radioactivity. Property of certain nuclides to undergo spontaneous disintegration in which energy is liberated, generally resulting in the formation of new nuclides. The process is accompanied by the emission of one or more types of radiation, such as alpha particles, beta particles and gamma rays.

radionuclide. A nucleus (of an atom) that possesses properties of spontaneous disintegration (**radioactivity**). Nuclei are distinguished by their mass and atomic number.

radiotoxicity. The ability of **radionuclide** to produce injury, by virtue of its emitted radiation, when incorporated into the body.

radon. Chemically inert radioactive gaseous element formed from the decay of radium or **thorium** (which is then called **thoron**). A potential health hazard.

reclamation. Process of restoring surface environment to acceptable pre-existing conditions. Includes surface contouring, equipment removal, well plugging, revegetation, etc.

records. A set of documents, including instrument charts, certificates, log books, computer printouts and magnetic tapes kept at each **nuclear facility** and organized in such a way that they provide a complete and objective past and present representation of facility operations and activities including all phases from design through **closure** and **decommissioning** (if the facility has been decommissioned). Records are an essential part of **quality assurance**.

regulatory body. An authority or a system of authorities designated by the government of a country or state as having legal authority for conducting the licensing process, for issuing **licences** and thereby for regulating the siting, design, construction, **commissioning**, operation, **closure**, **closeout**, **decommissioning** and, if required, subsequent institutional control of the **nuclear facilities** (e.g. near surface repository) or specific aspects thereof. This authority could be a body (existing or to be established) in the field of nuclear related health and safety, mining safety or environmental protection vested and empowered with such legal authority.

remedial action. Action taken to reduce a **radiation dose** that might otherwise be received in an intervention situation involving chronic **exposure**, when a specified action level is exceeded. Examples are: (a) Actions which include **decontamination**, waste removal and environmental restoration of a site during **decommissioning** and/or **closeout** efforts. (b) Actions taken beyond stabilization of **tailings impoundments** to allow for other uses of the area or to restore the area to near pristine condition.

residues. All solids and associated liquids resulting from ore mining and milling to recover uranium and other minerals.

restoration. The returning of all affected **groundwater** to its premining quality for its premining use by employing the best practical technology.

risk. The following alternative definitions may be relevant in the field of radioactive waste management:

- In general, risk is the probability or likelihood of a specified event occurring within a specified period or in specified conditions.

- In the **safety assessment** of radioactive waste repositories, risk may be used as a measure of safety. In this context it is defined as the product of the probability that an individual is exposed to a particular radiation **dose** and the probability of a health effect arising from that dose.

rock. In geology, any mass of **mineral** matter, whether consolidated or not, which forms part of the Earth's crust. Rocks may consist of only one **mineral** species, in which case they are called monomineralic, but they usually consist of several **mineral** species.

Safety Fundamentals (IAEA Safety Series). A category of IAEA publications that comprise basic objectives, concepts and principles to ensure safety.

Safety Guides (IAEA Safety Series). A category of IAEA publications that supplement **Safety Standards** by giving recommendations relative to the fulfillment of basic requirements and principles on the basis of international experience.

Safety Practices (IAEA Safety Series). A category of IAEA publications that provide practical examples and detailed methods regarding procedures and techniques which can be used for the application of **Safety Standards** or **Safety Guides**.

Safety report. A document required from the **operating organization** by the **regulatory body** containing information concerning a **nuclear facility** (e.g. a waste repository), the site characteristics, design, operational procedures, etc., together with a safety analysis and details of any provisions needed to restrict **risk** to personnel and the public.

Safety Standards (IAEA Safety Series). A category of IAEA publications that establish, for particular activities or specific application areas, basic **requirements** which in the light of experience and the current state of technology must be satisfied to ensure safety.

shutdown. Permanent or temporary termination of a process or operation. (See also **closeout; closure**.)

site characterization. Detailed surface and subsurface investigations and activities to candidate **nuclear facility** sites to obtain information to determine the suitability of and to evaluate long term performance of a waste **disposal** facility at the site.

slimes, mill tailings. That fraction of a ground **ore** or **tailings** slurry consisting of very fine particles, usually less than 30–40 μm and typically with much material below 10 μm particle size. The solid particles will settle only slowly in an aqueous system (in a gravitational force field) and the removal of interstitial water and development of shear strength within the settled solids can be achieved only with difficulty.

solvent extraction. A method of separation in which a generally aqueous solution is mixed with an immiscible solvent to transfer one or more components into the solvent. Method used to recover uranium from leach solutions.

source material. Uranium or thorium ores containing 0.05 percent uranium or thorium regulated under the Atomic Energy Act. In general, this includes all materials containing radioactive isotopes in concentrations greater than natural and the by-product (tailings) from the formation of these concentrated materials (US usage).

standard. See **Safety Standards**.

statutes. (a) A written law passed by a legislative body.
(b) A rule of a corporation, founder, etc. intended to be permanent.

stockpile. A supply of material stored for future use.

subsurface water. All water in both saturated and unsaturated zones beneath the land surface.

surety. A type of bond to ensure that funds are available for a specific activity, in this case, dismantling, reclamation, restoration, and remediation of uranium-concentrate production sites. In the event the company goes bankrupt, the bonding company pays the responsible regulatory body or the appropriate government the amount of the bond. It is the responsibility of the responsible regulatory body or the appropriate government to ensure that the amount is adequate for the remediation activities.

surface water. Water which fails to penetrate into the soil and flows along the surface of the ground, eventually entering a lake, a river or the sea.

tailings.

(a) The remaining portion of a metal-bearing ore consisting of finely ground rock and process liquid after some or all of the metal, such as uranium, has been extracted.

(b) Heap leach residues, which result from treatment of **ore** by **heap leaching**.

tailings impoundment. A structure in which the **tailings** and tailings solution are deposited, including all its elements such as embankment walls, liners and cover layers.

tailings pile. A **deposit** of **tailings** material.

tailings seepage. Seepage of liquid from a **tailings impoundment**.

thorium. A radioactive element of atomic number 90; naturally occurring thorium has one main isotope thorium 232. The absorption of a neutron by a thorium atom can result in the creation of the fissile material uranium 233.

thoron. The isotope ^{220}Rn of the element of atomic number 86. A potential health hazard.

transportation. Operations and conditions associated with and involved in the movement of radioactive material by any mode on land, water or in the air. The terms transport and shipping are also used.

trial mining. A research and development activity carried out to test and select methodology for use in a full scale commercial mine.

underground. Situated, done or operating beneath the surface of the ground; therefore, tunneled.

underground exploration. (a) The driving of advance exploring headings and up-and-down boring to establish the continuity and thickness of coal seams or other mineral deposits. (b) Extensions of a known ore deposit may be probed along its strike or dip in which shafts, drifts, or crosscuts may be driven. A study of the habits of known ore shoots is a desirable preliminary to underground exploration.

underground water. See **groundwater**.

uranium. A heavy, naturally radioactive, metallic element (atomic number 92). Its two principally occurring isotopes are uranium-235 and uranium-238. Uranium-235 is indispensable to the nuclear industry because it is the only isotope existing in nature to any appreciable extent that is fissionable by thermal neutrons. Uranium-238 is also important because it absorbs neutrons

to produce a radioactive isotope that subsequently decays to the isotope plutonium-239, which also is fissionable by thermal neutrons.

uranium concentrate. A yellow or brown powder produced from naturally occurring uranium minerals as a result of milling uranium ore or processing uranium-bearing solutions. Synonymous with yellow cake, U_3O_8, or uranium oxide.

uranium ore. Rock containing uranium mineralization in concentrations that can be mined economically, (typically 1 to 4 pounds of U_3O_8 per tonne or 0.05 to 0.20 percent U_3O_8) or higher, depending on the present or projected uranium price.

uranium oxide. May be described as uranium concentrate or yellow cake, normally referred to as U_3O_8. Term may also be used to designate UO_2 used in fuel.

uranium reserves. Estimated quantities of uranium in known mineral deposits of such size, grade, and configuration that the uranium could be recovered at or below a specified production cost with currently proven mining and processing technology and under current law and regulations. Reserves are based on direct radiometric and chemical measurements of drill holes and other types of sampling of the deposits. Mineral grades and thickness, spatial relationships, depths below the surface, mining and reclamation methods, distances to milling facilities and amenability of ores to processing are considered in the evaluation. The amount of uranium in ore that could be exploited within the chosen forward-cost levels are estimated in accordance with conventional engineering practices.

ventilation. The provision of an adequate flow of fresh air at all points within an underground mine.

waste, radioactive. For legal and regulatory purposes, radioactive waste may be defined as material that contains or is contaminated with radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body, and for which no use is foreseen. (It should be recognized that this definition is purely for regulatory purposes, and that material with activity concentrations equal to or less than clearance levels is radioactive from a physical viewpoint — although the associated radiological hazards are negligible.)

waste characterization. The determination of the physical, chemical and radiological properties of the waste to establish the need for further adjustment, treatment, conditioning, or its suitability for further handling, **processing**, storage or **disposal.**

waste, decommissioning. Radioactive waste from **decommissioning** activities.

waste management, radioactive. All activities, administrative and operational, that are involved in the handling, pretreatment, treatment, conditioning, transportation, storage and disposal of waste from a nuclear facility.

waste rock. Rock generated by mining activities which does not have a sufficient uranium or thorium content to be useful as **ore.**

water table. (a) The upper surface of the **groundwater.**
(b) The upper surface of a zone of **groundwater** saturation.

wellfield. The area of an **in situ leach** operation that encompasses the array of injection and extraction wells and interconnected piping employed in the leaching process.

working conditions. Conditions under which workers are occupationally exposed to **ionizing radiation.**

(1) Working Condition A: condition where the annual **exposures** might exceed three-tenths of the dose equivalent **limits**.

(2) Working Condition B: conditions where it is most unlikely that the annual exposures will exceed three-tenths of the dose equivalent limits.

working level (WL). A unit for potential alpha energy concentration (i.e. the sum of the total energy per unit volume of air carried by alpha particles emitted during the complete decay of each atom and its progeny in a unit volume of air) resulting from the presence of radon daughters or thoron daughters equal to emission of 1.3×10^5 MeV of alpha energy per litre of air. In SI units the WL corresponds to 2.1×10^{-5} $J \cdot m^{-3}$.

yellow cake.

(a) Sludge of uranium oxide concentrate formed during the final step of the milling process.

(b) Applied to certain uranium concentrates produced by mills. It is the final precipitate formed in the milling process. Usually considered to be ammonium diuranate, $(NH_4)_2U_2O_7$, or sodium diuranate, $Na_2U_2O_7$, but the composition is variable,and depends on the precipitating conditions.

(c) A common form of triuranium octoxide, U_3O_8, is yellow cake, which is the powder obtained by evaporating an ammonia solution of the oxide.

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Kraemer, G.	Compagnie Générale des Matières Nucléaires, COGEMA, France
Marino, J.M.	Compagnie Générale des Matières Nucléaires, COGEMA, France
McCabe, R.	Atomic Energy Control Board, Canada
Stegnar, P.	International Atomic Energy Agency
Tauchid, M.	International Atomic Energy Agency
Underhill, D.H.	International Atomic Energy Agency
Webb, G.A.	International Atomic Energy Agency

Consultants Meetings

Vienna, Austria, 27-30 April 1992, 19-21 July 1993, 8-10 March 1994
21-25 November 1994