Uranium Mining Environmental Restoration Project in the Republic of Argentina

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URANIUM MINING ENVIRONMENTAL RESTORATION PROJECT IN THE REPUBLIC OF ARGENTINA

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SUMMARY

The Argentine National Atomic Energy Commission (CNEA) was preparing to restart mining operations at its Sierra Pintada uranium deposit in Mendoza province, in the central-west region of the country. The mine has been shut since 1997 and should be up and running by October 2003. The local Chamber of Commerce (Cámara de Comercio, Industria y Agropecuaria de San Rafael) joins the opposition against the reopening of the Sierra Pintada uranium mine, since the mine would have severe impacts on the regional economy.

Argentina's atomic energy commission CNEA pushed ahead with administrative procedures to enable it to reopen the. The CNEA will present an environmental impact study (EIS) for the project.

Ongoing negotiations were aimed at resolving the question of environmental legacies resulting from previous operations at the mine.

On July 27, 2004, Argentina's atomic energy commission (CNEA) has handed over to Mendoza provincial authorities the environmental impact study (EIS) to revive the Sierra Pintada uranium mine, located in Mendoza's San Rafael district. CNEA wants Sierra Pintada, which has a capacity of 120t/y, to produce close to 2,500t of uranium over 20 years. The 1800-page document was prepared by the Technical University of Avellaneda.

The Federal Court of San Rafael has ordered the prohibition of all activities associated with the re-opening of the Sierra Pintada uranium mine. The decision was taken at the request of, an organization comprising about 40 local NGOs, and having repeatedly spoken out against the reopening of the mine before the environmental liabilities of nearly 20 years of uranium mining have not been cleaned up.

The mine could then be reopened in mid-2007. For resumption of mining, in addition, a new license has to be obtained from the nuclear authority Auctorial Regulatory Nuclear (ARN).

CNEA has scheduled the beginning of the reclamation of the Sierra Pintada uranium mine for mid-2006. CNEA maintains, however, that the requested complete reclamation of the old workings is not possible, since most backfilling could only be done after the final closure of the mine. For the reclamation work, approval of the provincial government is required.

Frightened by the possible contamination of the Diamante River and the environment, hundreds of inhabitants marched on June 2, 2006, through the downtown streets of San Rafael to demand that the Sierra Pintada uranium mine should not be reopened nor any other uranium mine should be permitted.

On October 16 - 20, 2006, a public hearing will be held on the reopening of the Sierra Pintada uranium mine. Provided the Provincial Government issues a declaration of
environmental impact, the reclamation of the environmental liabilities from former mining at the site could start by the end of the year. The reclamation work would take two years; CNEA had a total budget of $17 million for it.

The CNEA had opened an information centre at San Rafael to inform the public on the proposed reopening of the Sierra Pintada uranium mine.

The public hearing scheduled on Nov. 2, 2006, for discussion of CNEA's Environmental Impact Study for the reclamation of the abandoned Sierra Pintada uranium mine was suspended upon receipt of a notification issued by the Fourth Civilian Court of San Rafael at the request of the environmental organization.

A powerful coalition of vineyards, organic farmers and local businesses is up in arms, warning residents that their water, air and soil are at risk of being poisoned and their livelihoods, export markets, tourist industry and health could be ruined. The issue is so explosive that for now, there is no official talk of restarting the Sierra Pintada mine complex. A public hearing was scheduled for February 17, 2007, to discuss the National Atomic Energy Commission's (CNEA) plan to clean up uranium waste that has been left at the site since operations halted a decade ago. Opponents say the plan, presented to the provincial government a year ago, is flawed and merely "environmental window dressing". The group coalition said waters in the Tigre stream, which flows through the mine and into the Diamond River that supplies semi-arid San Rafael with drinking water, contain up to 75 micrograms of uranium per litre - which they said was more than twice the levels permitted in the US, Canada and Australia. The CNEA says the water is naturally high in uranium and independent studies have proved there is no contamination.

The wine producers of the San Rafael river basin fear that the reopening of a uranium mine in the Sierra Pintada area endangers the prestige that their wine has in the exporting market, mainly American and European. In an attempt to measure the real impact of the uranium, they summoned specialists of the National University of La Plata (UNLP) to analyze water, grape juice, and products of the region.

The World Bank is interested in financing the restart of the Sierra Pintada uranium mine, provided that a solution is found for the reclamation of the former operations.

At the request of a member of the oppositional organization, a federal judge ordered that no works preparing production may be performed at the Sierra Pintada uranium mine. The judge summoned a hearing on June 26, 2007.

A report prepared by the Nuclear Regulatory Authority (ARN) found that concentrations of natural uranium and radium in Río Diamante were below national and international guideline values during the monitoring period 1998-2007, despite the impacts of the inactive San Rafael uranium mine site.

CNEA expected to begin the works to repair the effluent ponds at the former Sierra Pintada uranium mine. This is a prerequisite for future resumption of the mine operation.

The Federal Chamber of Appeals of the province of Mendoza ordered the CNEA to abstain from reopening the San Rafael uranium mine (that is inactive since 1995), because it is potentially harmful for the environment.
I. INTRODUCTION

Back in the 1950’s, Argentina set up a uranium mining and extraction industry to supply nuclear fuel to its nuclear power generating plants and medical and research facilities. In the 1980’s and 1990’s, when the global market price of uranium lowered its domestic production cost and some of the ores became exhausted, most of the facilities were closed down or put on hold. As the extraction of uranium from its ores requires a concentration factor of several orders of magnitude, the approximate 2,500 tons of uranium produced left behind a legacy of over 6.7 million tons of mining and processing residue, ‘tailings’ in the technical jargon. These tailings pose a potential source of radiation hazard to the population and the environment. Indeed, two of the defunct facilities are located in the immediate proximity to urban population centers.

The National Atomic Energy Commission of Argentina (CNEA) is in charged of the preparation and implementation of a project for environmental restoration of all the sites associated with uranium mining and processing (PRAMU). The objective of the PRAMU, a three-phase project, is to achieve the environmental restoration as comprehensively as possible in terms of economic and technical feasibility. In order to address public concerns, this Project involves active public participation in decision making, as well as institutional strengthening of the implementing agency.

For any one of the sites slated for restoration under this Project, a site specific Environmental Assessment (EA) has to be carried out in accordance with Argentine national and provincial requirements.

Each of these sites needs first to be characterized to identify the types of contaminants, their extant and potential environmental impacts and possible contaminant pathways. Based on internationally accepted best practices and standards, effective solutions for the management of the tailings and site restoration would be then developed.

The accompanying Program-wide EA provides the framework for subsequent individual site EA’s. The nature of this type of project in Argentina, combined with the heightened public concern about radiological risks, has induced active public participation as a means for decision making.

This report provides an overview of Argentina’s nuclear industry and the uranium mining sector, describing the PRAMU’s master plan and also summarizes the legal framework at national and provincial level that is pertinent to environmental management and restoration activities of the sector and on the public consultation processes that accompanied the EA preparation.

Finally, the report contains a brief about a legal case in which a group of residents of San Rafael, Province of Mendoza, involved in different activities, companies and organizations, began important movements against the reopening of the Manufacturing Complex San Rafael (or Sierra Pintada mines).
II. ARGENTINA’S URANIUM MINING SECTOR: EVOLUTION, CURRENT STATUS AND ASSOCIATED ENVIRONMENTAL ISSUES AND POLICIES

The operation of uranium ores started in the 1950’s with the development of mining projects in different Provinces. Uraniferous ores occur in stratiform sandy deposits and in veins in granites, along the eastern flank and foothills of the Andes Range. Due to a combination of adverse economic factors (competition and low price on the international market and high domestic production costs), most of the mines and mineral processing facilities are now either closed or operating on a maintenance basis only. Today, there are only two major deposits that, under favorable international market conditions, are capable of producing uranium ore. The Sierra Pintada deposit (San Rafael, Mendoza Province) has 9,200 tons of mineral reserves (today in stand-by) and the Cerro Solo deposit (Chubut Province) containing about 5,200 tons of uranium reserves. Consequently, about 100 tons of uranium concentrates are purchased annually on the international market and only a small quantity is still supplied domestically.

Argentina has two nuclear power plants (Atucha I and Embalse) and a third (Atucha II)\(^1\) under construction and put on hold. The reactors use natural uranium as fuel and heavy water as moderator and cooler. With an installed generation capacity of 940 MWe, the annual fuel consumption is about 150 tons of uranium\(^6\). Presently, nuclear power provides about 11.5% of the country’s total power.

During the 1980’s, the production infrastructure of the nuclear fuel cycle was completed with the construction of UO\(_2\) manufacturing (the raw material for nuclear fuel), heavy water production plants, as well as facilities for the manufacturing of fuel elements for research and power reactors. Argentina has also developed, through private - and state - owned facilities, a well-established experience in the production of radioisotopes for medical and industrial uses, for both domestic consumption and export.

Overview of the Environmental Problems Associated with Argentina’s Uranium Sector\(^2\)

Until the early 1990’s, Argentina’s uranium extraction industry evolved in a radiological regulatory frame with some gaps in the environmental standards (the environmental protection chapter of the mining Code was set up in 1995). This activity resulted in environmentally harmful accumulation of solid and liquid waste associated with the uranium mining and processing sites. Mining took place primarily in hard rock open pits, generating waste piles of sterile overburden or low-grade (marginal) ore. Milling and leaching of the ores required installation of buildings and mechanical equipment and the construction of large leaching pads. These processes generated liquid wastes containing acids, metals and residual uranium compounds, as well as heap-leach residues\(^3\) (for brevity, all referred to in this report as ‘tailings’). The primary contaminants associated with the uranium industry are radionuclides, heavy metals and anions and acid effluents.

\(^1\) Once the third nuclear plant becomes operational, the installed generation capacity would increase to 1640 MWe, corresponding to an annual consumption of 300 tons of uranium.

\(^2\) Information based on the National Joint Convention on the Safety of Spent fuel management and on the safety of radioactive waste management.

\(^3\) A fine-grained, sand-like material from which the maximum possible quantity of uranium has been extracted by acidic solutions.
Radionuclides. Milling tailings, while relatively low in concentration of long half-life radionuclides, still contain several types of contaminants that pose health risks to the workers and, through dispersion, to the public at large. The most important radioactive components of mine tailings are primarily radium 226, which decays to produce radon 222 and thorium 230. Their exposure pathways include diffusion of radon gas via the air, where it can be inhaled or ingested when blown in particulate form and mobilization by water through leaching of the tailings and their dispersed dust particles. This may disperse radioactive and other hazardous materials to surface and/or ground water. Finally, many of the radioactive decay products in the tailings produce gamma radiation, which poses a health hazard to recipients in the immediate vicinity.

To counter adverse effects such as concern about long-term public health and access to natural resources, the environmental assessment project is developing appropriate containment and stabilization measures for each contaminated site, to reduce direct radiation and to protect the tailings from erosion and atmospheric and/or aqueous dispersion. The measures that are being adopted are based on risk analysis, availability of resources and cost-benefit considerations. They will ensure that (i) the release of contaminants to the environment is as low as reasonable

III. THE STRUCTURE OF ARGENTINA’S NUCLEAR SECTOR

When established in 1950, CNEA was designed as an autonomous Federal entity, responsible for the development and management of Argentina’s nuclear field. Under its present charter, CNEA is ordained to act both in the public and private domains in all matters pertaining to the scientific, technical, industrial, commercial, administrative and financial aspects of Argentina’s nuclear sector.

CNEA has been active in fundamental and applied research, uranium ore exploration, mining and production, nuclear energy generation, nuclear medicine and ionizing radiation applications, management of radioactive waste and radiological protection. Whereas CNEA was left in charge of many of its original functions, a new operating company NUCLEOELECTRICA ARGENTINA S.A. (NA-SA) and a regulatory agency NUCLEAR REGULATORY AUTHORITY (ARN) were established.

The ARN, an autonomous entity reporting to the Federal Government, by virtue of the National Act on Activities in the Nuclear Sphere, N° 24.804, is the State's national technical agency responsible for controlling and regulating all areas of nuclear activity in respect of radiological and nuclear safety.

To fulfill some of its functions (e.g. heavy water production, UO₂ production, fuel elements manufacturing, nuclear engineering projects, etc.), CNEA has also established subsidiary companies that are open to private capital. Presently, CNEA has retained its responsibility for overall management and disposal of all types of radioactive waste and dismantling of nuclear and radioactive facilities and its mandate is evolving towards research, development and education in the nuclear field. NA-SA, a Federal corporation slated for privatization, operates Argentina’s nuclear power plants.

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4 Autoridad Regulatoria Nuclear
5 National Act on Activities in the Nuclear Sphere, Act N° 24.804
IV. THE URANIUM MINING ENVIRONMENTAL RESTORATION PROJECT\textsuperscript{6}

The Project will be carried out in three phases\textsuperscript{7}:

\textit{Phase I}

Restoration of top priority site (Malargüe): implementation of the actions subject to \textit{DIA}\textsuperscript{8} from the Mendoza Province authorities and \textit{ARN} requirements.

Engineering studies, EIA’s and public consultation process addressing two additional key sites (Córdoba and Los Gigantes)

The long-term monitoring after site closure has been successfully completed.

Developments of engineering solutions for the other sites.

Institutional strengthening of the \textit{CNEA}, through Institutional environmental capacity building and training for a public consultation process.

Establishing the Project’s Environmental Unit (\textit{UGAMU})

Establishing \textit{CNEA} Environmental Management Unit (\textit{UGA}) for Uranium Mining.

Introducing an Environmental Information and Management System

Establishment of a Project Implementation Unit (\textit{UEP})

\textit{Phase II}

Conduct analysis and lessons learned in the preceding stage to ensure optimization of resources. This is to include an evaluation of improvements in the environmental quality as a result of the completed restoration activities and assessment of public perceptions concerning the risks associated with the restored Malargüe site.

\textit{Subject to respective DIA’s, implement environmental restoration works at the Córdoba and Los Gigantes sites.}

Prepare studies for the remaining sites.

Continue the institutional strengthening of the \textit{CNEA} through Support to \textit{UGAMU} and \textit{SIGAMU}

Further support to the Project Implementation Unit (\textit{UEP})

\textit{Phase III}

Restoration of the remaining sites.

\textbf{THE PRAMU PROJECT (PHASES I AND II)}

The current Project comprises Phase I and Phase II of the \textit{PRAMU} and entails the following:

\textit{Phase I}

\footnote{6 Information based on the National Joint Convention on the Safety of Spent fuel management and on the safety of radioactive waste management.}
\footnote{7 \textit{CNEA} environmental policy regarding uranium mining is posted on the \textit{PRAMU} web site.}
\footnote{8 The term \textit{DIA} (Declaración de Impacto Ambiental) in the Argentine context is interchangeable with EIA (Environmental Impact Assessment) in the international context.}
Implementation of restoration works at the Malargüe site into a green space, including the relocation of over 700,000 tons of tailings and soils, to prevent further groundwater contamination and formation of harmful dust and abate radiation and radon emanation.

Preparation of studies for the restoration of two sites in the Córdoba Province, including public consultation process, EIA, the preparation of engineering plans and designs for the removal of about 57,600 tons of tailings, soils and equipment from the Córdoba City site and site restoration into a green space.

**Phase II**

Restoration of the Los Gigantes site, including the closeout and decontamination of the mine area and concentration plant, stabilization of 4,000,000 tons of mining waste and tailings’ dumps and other mitigation measures to prevent soil, groundwater and air contamination.

Upon completion of preliminary site studies, a DIA and a public consultation process, the subsequent steps towards the implementation of each of the individual Project phases would entail selection of a mitigation plan, engineering design, authorization by the applicable regulatory agencies, contracting and execution and finally, long-term monitoring.

Following preliminary site studies, the first step towards authorization of the Malargüe Project required the preparation of a DIA that contains the devised restoration plan, assessment of its environmental impact and demonstration of its compliance with site-specific regulatory standards.

CNEA’s engineering restoration plans for the Malargüe site have been approved by ARN and by the Mendoza Province and some preliminary restoration work has already been carried out at the site. Similar plans were under development for the closing of the Córdoba manufacturing plant and the Los Gigantes mine.

Table 1 summarizes the waste quantities at the PRAMU sites, the current sites status and, to the degree available, the respective environmental restoration scope. For site locations.
Table 1. The PRAMU Sites: Waste Quantities, Current Status and Restoration Plans

<table>
<thead>
<tr>
<th>SITE PROVINCE</th>
<th>FACILITY TYPE</th>
<th>WASTE QUANTITIES AND DESTINATION</th>
<th>STATUS AND RESTORATION SCOPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MALARGÜE</td>
<td>Processing</td>
<td>~700-t milling tailings.</td>
<td>Relocate within the site, cap and divert drainage to depress groundwater level. Once restored as green space, relinquish title to provincial authorities.</td>
</tr>
<tr>
<td>Mendoza</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAN RAFAEL</td>
<td>Processing</td>
<td>1,895-t milling tailings.</td>
<td>Under study to assess scaled-down operation vs. closing. Once restored, relinquish title to provincial authorities.</td>
</tr>
<tr>
<td>Mendoza</td>
<td></td>
<td>21,936-t sterile residues.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>376-t marginal ore.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35-t low-grade ore.</td>
<td></td>
</tr>
<tr>
<td>HUEMUL</td>
<td>Mine</td>
<td>31.2-t sterile residues,</td>
<td>After operation ceased in 1974, CNEA implemented closure procedures; needs to be re-evaluated.</td>
</tr>
<tr>
<td>Mendoza</td>
<td></td>
<td>4.0-t marginal ore.</td>
<td></td>
</tr>
<tr>
<td>CÓRDOBA</td>
<td>Processing, manufacture of UO₂</td>
<td>57.6-t milling tailings.</td>
<td>Unspecified amount of manufacturing equipment. Plant and tailings to be relocated outside the densely populated urban area; designated as a green space.</td>
</tr>
<tr>
<td>Córdoba</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOS GIGANTES</td>
<td>Mine</td>
<td>2,400-t heap-leach tailings.</td>
<td>While in an unpopulated area, its up-basin location from tourist areas is of particular concern. A possible repository for Córdoba’s tailings.</td>
</tr>
<tr>
<td>Córdoba</td>
<td></td>
<td>1,000-t sterile residues.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>600-t marginal ore.</td>
<td></td>
</tr>
<tr>
<td>PICHÍNAN</td>
<td>Processing</td>
<td>145-t milling tailings.</td>
<td>Closed since 1980, requires only minor management works. Needs to be reevaluated.</td>
</tr>
<tr>
<td>Chubut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TONCO</td>
<td>Processing</td>
<td>57.6-t milling tailings.</td>
<td>Unspecified amount of manufacturing equipment. Plant and tailings to be relocated outside the densely populated urban area; designated as a green space.</td>
</tr>
<tr>
<td>Salta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA ESTELA</td>
<td>Mine</td>
<td>70-t milling tailings</td>
<td>Following cessation of operations in 1990, restoration of mine and tailings by operator was approved by ARN.</td>
</tr>
<tr>
<td>San Luis</td>
<td></td>
<td>1,140-t sterile residues.</td>
<td></td>
</tr>
<tr>
<td>LOS COLORADOS</td>
<td>Mine</td>
<td>135-t milling tailings</td>
<td>Following cessation of operations in 1996, restoration of mine and tailings by operator was approved by ARN.</td>
</tr>
<tr>
<td>La Rioja</td>
<td></td>
<td>1,000-t sterile residues.</td>
<td></td>
</tr>
</tbody>
</table>

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V. THE CONSULTATIVE PROCESS

Consultation within the framework of project preparation has been carried out mainly in relation to the development of this EA, dealing with the objectives and planning of the PRAMU. A first draft of the EA was distributed to Project-entity and individuals stakeholders, including representatives of municipal, provincial and national legislatures and governmental authorities, universities and NGO’s. The initiative for the establishment of a project-wide “dialogue group” started with the participation of national level NGO’s19, as well as institutions directly involved in the project, including the ARN.

VI. THE LEGAL AND INSTITUTIONAL FRAMEWORK

The pertinent legislation and regulatory framework applicable to the operation and management of Argentina’s nuclear sector is summarized in the following.

*Federal vs. Provincial Jurisdictions.*

Argentina’s environmental legislation started evolving with the introduction of the constitutional reform in 1994. The recent evolution of both the Federal and local environmental legislation reflects a growing societal concern with environmental quality.

The Republic of Argentina is a Federal system, where the national Government coexists side by side with autonomous provincial governments. Article 41 of the Federal Constitution (i) guarantees the rights of the citizenry to a healthy environment, balanced with the needs for human development. (ii) Empowers the Federal Government to establish the minimum standards for environmental protection and (iii) gives the provinces powers to complement the national requirements, but not to modify them.

In the nuclear sector, Article 41 is promulgated in the National Nuclear Activity Law (No. 24.804 of 1994) that assigns the Federal Government the lead role on policy, R&D, regulation and funding *vis a vis* CNEA and ARN. Decree No. 1540/94 practically separates between the implementing agency and the regulatory agency, by creating Argentina’s Nuclear Regulatory Authority (*ARN*) and assigning it the authority to “issue regulatory standards in reference to radiological and nuclear safety”.

Law No. 25.018, Plan for Managing Nuclear Waste, specifies *CNEA*’s obligations to (i) manage the residues derived from the mining of uranium and those that result from abandoned mineral deposits or closed out milling facilities and (ii) recover sites impacted by uranium mining. This law also stipulates that *CNEA* has to coordinate its activities with the local authorities.

Argentina’s regulatory structure is characterized by concurrent authorities. According to the Federal Constitution, the environmental protection of a given domain is the responsibility of the jurisdiction that owns the title to that domain. Consequently, the provincial governments are empowered to set up complementary environmental standards, as long as they are no less stringent than the Federal standards.

Relevant environmental legislation is mainly at the provincial level, with the most comprehensive regulations having been established in the Province of Mendoza. The responsibility for the environment is at the level of Minister and the law provides for a process of EIA, resulting in a formal for specific projects. The legislation also provides for public hearings as part of the evaluation process.
Córdoba and all the other Provinces that host uranium production sites have broadly similar legislation, under the Federal Mining Code and its provincial complementary standards, but without the formal provisions for public hearings.

**Mining and Mining Regulation**

The mining sector in Argentina is subjected to the authority of the Office of Mining, within the ministry of Production. Decree No. 214/02 defines its responsibilities to include, among others, setting up mining policy and managing the nation’s mining activities; promoting the introduction of innovative technologies and the establishment and management of a central database of geological and mining information.

Argentina’s nuclear regulatory approach, is performance-based. However, the environmental section of Argentina’s Mining Code also incorporates oversight of nuclear activities by a concurring (i.e., Provincial) authority.

There are no specific Argentine standards or guidelines for restoration, stabilization and control of inactive uranium mining sites. The radiological impacts of such sites and their mitigation are subject to the basic standard on radiological protection (AR 10.1.1). This law applies to all sources of radiation as well as all phases of the production of nuclear fuels and also to contamination resulting from past practices. Overall, the Argentine approach is consistent with ICRP recommendations and in line with approaches in a number of other countries.

**VII. ENVIRONMENTAL ASSESSMENT OF THE MALARGÜE PROJECT SITE**

**GENERAL BACKGROUND**

**Objective and Scope**

The mitigation of the Malargüe site is to include relocating the tailings to a higher (and better drained) ground within the site, provision of surface drainage to divert runoff away and underground drainage to depress the extremely shallow phreatic aquifer, sealing the substrate designated to accept the relocated tailings and capping the relocated tailings with low-permeability, natural material. Finally, the site is to be decontaminated, leveled and replanted, then subjected to institutional control to enforce limited access.

**VIII. IMPACTS – ESTIMATES OF THE PRESENT RISKS**

In the absence of physical hazards at the site, the two major risk sources to humans are the inhalation of radon 222 and its decay products and exposure to gamma radiation.

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9 Under this approach, the operating organization of a nuclear facility bears the ultimate responsibility for ensuring the safety of the facility at each and every stage. The only role assigned to the regulatory authority is that of critically reviewing the operators’ safety specifications.

10 AR 10.1.1. “Basic Radiation Safety Standard”. In accordance with the provisions of article 16, section a) of Act 24,804, the ARN shall have power to establish regulations relating to radiation and nuclear safety, physical protection and nuclear materials use control, the licensing and control of nuclear facilities, international safeguards and transport of nuclear materials with regard to its radiation and nuclear safety and physical protection aspects.

11 International Committee on Radiological Protection
**Projection of the Radiological Risk**

Two cases are presented to demonstrate the risk of contacting cancer as a result of radon inhalation and exposure to gamma radiation. In the first case, a hypothetical resident living permanently on the top of the tailings (with no shielding) for 7,000 hrs of annual exposure would receive a combined dose of 157 mSv/year. According to published life expectancy reduction models, this will shorten his life expectancy by almost 10 years. In the second case, living on the perimeter of the site will result in a combined dose of 6.8 mSv/year, which would shorten his life expectancy by about ½ year. However, the amount of radiation projected for individuals who pass through the site frequently or just visit it occasionally (e.g., 1,000 hrs/yr. of radiation exposure) is well within the international standards.

It is concluded that the radioactive residues at the CFM would pose a radiological risk to a hypothetical group that would choose to live at the site’s perimeter, but not to occasional visitors. On the other hand, the radiological effect on the town’s population is insignificant.

**IX. THE MALARGÜE SITE PUBLIC CONSULTATION PROCESS**

CNEA has some experience in public consultation, as a result of the Malargüe site EIA development process and its concurrence by the Mendoza Province authorities. During the preparation of the restoration plans, numerous conferences, discussions and workshops with individuals and groups took place. Different options to deal with the tailings were discussed in a public hearing. In addition, as required for EIA approval under the legislation of Mendoza Province (Law No. 5961 and a derived regulation), two public hearings were held to discuss engineering concepts and detailed planning of engineering works and monitoring.

**X. PROJECT PERFORMANCE VERIFICATION AND LONG TERM MONITORING**

The proposed repository is a standard design utilized for mill tailings in the U.S. and other countries in the last two decades. While considered state-of-the-art, the long-term performance of such repositories has not yet been established. This explains the need for the long term monitoring plan proposed under the Project. During an estimated period of 20-years, the performance of the system and its components will be verified, by monitoring fluctuations in the level of the phreatic aquifer, the hydrochemistry of ground water and surface water, the emanation levels of radon gas and emerging gamma radiation.

Modifications will be introduced, as necessary, to address system malfunctions. In the longer-term, a monitoring plan will be implemented that would address the physical conditions at the site as well as control the water and air in the site’s sphere of influence.

**XI. POST-Closure MONITORING**

As stated above, post-closure monitoring for an estimated period of twenty years is required to verify the performance of the Project’s design. The monitoring will be carried out by the **UEP of CNEA**.
Simultaneously, the ARN and provincial authorities would be involved as well in the verification plan. All field and laboratory measurements will be executed under a Quality Assurance Program.

The Complejo Fabril Córdoba (CFC) site covers 9.2 Ha in the Alta Córdoba suburb of the city and was initially established for chromium production during World War II. In 1952 the facility was converted to an experimental uranium leaching plant processing various types of domestic ores. From 1963 to 1976 the plant also processed uranium pre-concentrate for further extraction. At a later stage, uranium purification (in 1976) and uranium dioxide conversion (in 1982) have been introduced with annual installed capacity of 150 tons, to provide uranium fuel for Argentina’s two nuclear power reactors and for research reactors. The production process entails dissolution of uranium di-uranate or U3O8, purification, evaporation, precipitation as ammonium uranyl carbonate, concentration to UO2, homogenization, storage in drums and treatment of the effluents.

Proposed Restoration Measures

The available data suggest that rather than only relocating the tailings, an integral remedial solution for the whole site should be prepared and CNEA has been ordered by the ARN to restore the whole Córdoba site. An agreement has been reached between CNEA and the Córdoba Province and the City of Córdoba to move the existing Dioxitek plant and production equipment to another site and to restore the site into a green space. The plant transfer is scheduled to take place in the near future, following which tailings’ removal and site restoration could begin.

Considering the low levels of radioactivity monitored at and around the site, the radiological benefits to be gained from removal of the contaminated materials are small. However, one of the major benefits of the site’s restoration will come from the release of the land in the heart of the city, together with the impacts on the value of adjoining land and property of converting an industrial site into public open space.

No detailed implementation plans for the restoration have yet been finalized. The PRAMU will launch a wide public consultation process to identify an acceptable set of site restoration measures. The selection of a site for the disposal of the materials has so far been proven as the major issue. The Province of Córdoba has passed legislation prohibiting the creation of any new “nuclear sites”, including sites for the disposal of the Córdoba tailings. A technically acceptable solution has been explored, involving the incorporation of the tailings and unredeemable debris from the dismantled facilities into the restoration of the Los Gigantes mine site (see below). It is estimated that 27 daily trips of a 15-ton capacity truck for 7-8 months would be required to complete the transfer. However, transportation of the materials would be difficult because of the distance (100Km) and the need to pass through several municipalities.

XII. THE LOS GIGANTES SITE

The closed Los Gigantes mine is located at 1700 meters a.s.l., in the largely unpopulated rocky mountainous Sierra Grande area (Córdoba Province), about 30 km upstream of the city of Villa Carlos Paz.
Contamination Sources

Mining and milling waste. 1.6 million tones of mining waste and marginal grade mineral, as well as 2.4 million tons of heap-leach residues are deposited at the site. Due to intensive weathering, combined with earlier exposure to sulfuric acid, the residues are rapidly disintegrating to sand.

Restoration Approaches

Since the site is so remote from population centers, the main concern is with its potential impact on spreading contamination downstream by eroded waste rock or polluted run-off from the site. CNEA is considering tailings’ stabilization strategies such as reinforcing and enlarging the principal dike such that it would become an impoundment for Cordoba’s relocated tailings and the building of small dikes in streams to capture sediment in tailing areas. While the contamination sources are presently basically contained, the primary goal of the restoration works will be to maintain in the longer-term leaching and off-site tailings’ transport to a minimum. Wind could carry some material a short distance. However, the greater concern is surface water runoff and leaching into groundwater. Calculations are ongoing to estimate potential human intake of dissolved contaminants via surface water, as well as studies to characterize the hydrogeology and the aquifers’ potential as a future source of drinking water.

The logic behind stabilization at Los Gigantes, instead of more complex engineering solutions, is lack of local population. The geomorphology, altitude, climate and paucity of arable soil imply that permanent settlement near the mine is highly unlikely. However, engineering plans will take into consideration the long-term performance objectives – a minimum of 200 years – to be achieved by the restoration works. Currently, CNEA is also actively researching and testing methods of removing contaminants from the effluents collected in the main dam.

Environmental Assessment of the Córdoba Province Projects

The CFC and Los Gigantes, the two sites for which planning and environmental assessments will be carried out under this project are both in Córdoba Province and therefore subject to the same broad regulatory requirements. The sites are quite separate physically and are different in character. However, there is a potential linkage between them since the mine site at Los Gigantes has been identified as a possible final repository for the tailings that are to be removed from the CFC at Córdoba City. Consequently, the environmental processes for both sites will be carried out more or less in tandem.

There is a considerable amount of background information and data already available for both sites, held by CNEA and by other Provincial and local agencies.

XIII. LEGAL PRECEDENT

Sierra Pintada Uranium District, Mendoza

“Asociación Multisectorial del Sur en defensa del desarrollo sustentable vs. C.N.E.A” Multisectorial Association of the South in defense of the sustainability development vs. CNEA”
XIV CONCLUSIONS

Strategic environmental assessment (SEA) is evolving as a mechanism that attempts to assess systematically the environmental impacts of decisions made at, what is conventionally called, levels of strategic decisions. Evidence is emerging in different countries on specific SEA approaches including institutional frameworks, assessment and review mechanisms, and results achieved in specific case applications. Experience is as yet too limited to conclude how effective such systems are but is nevertheless instructive on particular issues implicated in the development and implementation of SEA. Many governments and environmental assessment (EA) administrators are currently showing great concern regarding the potential environmental consequences of decisions made at policy, planning, and programmatic levels.

A comprehensive review of existing SEA practical approaches was undertaken with the purpose of understanding the existing status of SEA and identifying key practical issues raised by practitioners in different countries. Such practical issues reflect the strengths and weaknesses experienced with the adoption of particular approaches. This article highlights and reflects on some of the most fundamental; technical procedure, policy, legal and institutional framework.

The legal case pointed out in this report reflects strengths and weaknesses. On one hand, a serious technical work and on the other hand the lack of credibility because of doubts, public concerns, lack of information and uncertainties. The community must not feel alone in experimenting with public hearing, in time they will come to understand that other nations have accepted and embraced similar changes following the nuclear energy as a safety option, which contributes with sustainability. The strength of a society and sustainability lies in freedom of information and truth, which is what an unbiased government, justice and media will have to provide seriously and timely.

In conclusion, an effective SEA implies a commitment in a variety of capacities and technical knowledge. Public consultation is a key component of the communication policy, setting in motion a decision making process based on the participation of any sector, institution or individual that can contribute to different aspects of an Environmental Restoration Project or of an Environmental Assessment.

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