

RADIOACTIVE WASTE MANAGEMENT PROGRAMMES IN OECD/NEA MEMBER COUNTRIES

MEXICO [2005]

NATIONAL NUCLEAR ENERGY CONTEXT

Commercial utilisation of nuclear power in Mexico started in 1990 and by 2002 there were two nuclear power units connected to the electricity grid. In 2002 they generated 9.7 TWh of electricity, 5.5% of the total electricity generated in that year.

Also in 2002, the spent fuel storage capacity was 984 tonnes heavy metal (HM), and the amount of spent fuel arising in that year was 20 tonnes HM.

The Energy Programme for 2001-2006, issued by the Federal Government in 2001, emphasises the use of nuclear power with high standards of safety and reliability consistent with the international standards of the industry. Also, it includes the analysis of the implications of introducing new, fourth generation reactor designs in the long term and, in particular, of reprocessing the spent nuclear fuel from the reactors in operation.

Under the Mexican Constitution, and associated *Nuclear Law*, nuclear energy can be used only for peaceful purposes. These purposes include the following activities:

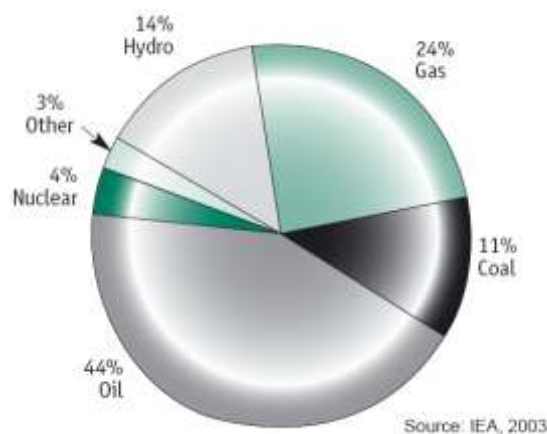
- Energy production and associated activities.
- Mining and milling of radioactive minerals.
- Nuclear fuel production and associated activities.
- Reprocessing nuclear fuel.
- Transport, storage and disposal of spent nuclear fuel and waste reprocessing.

The only body entitled to generate electricity from nuclear sources is the *Comisión Federal de Electricidad* (CFE) a government-owned electric utility. Public sector bodies, universities, institutes and research centres are entitled to use nuclear reactors only for non-energy purposes.

The National Energy Plan of 1990 called for an electricity production capacity from nuclear power on the order of 3.0 GWe and 6.9 GWe by 2010. However, due to changes in the national economic situation and public opinion, the future expansion of nuclear power in Mexico is now uncertain. The current production capacity from nuclear power is around 1.4 GWe and no new nuclear power facility is under construction or planned in the near future.

All exploration and mining activities associated with the nuclear fuel-cycle have been halted since the mid-1970s and there are no plans to restart them. A fuel-fabrication pilot plant at the National Institute for Nuclear Research (ININ) was in operation in the 1990's and produced four fuel assemblies for the Laguna Verde nuclear power plant (NPP), unit two. This facility is likely to be decommissioned due to economic reasons.

Breakdown of electricity sources (in %)



SOURCES, TYPES AND QUANTITIES OF WASTE

Radioactive waste classification

Radioactive waste in Mexico is classified depending upon activity levels and the half-lives of the radionuclides present in the following categories:

- Low-level radioactive waste (LLW) (which is subdivided into classes A, B and C).
- Intermediate-level radioactive waste (ILW).
- High-level radioactive waste (HLW).

- Mixed waste.
- Uranium and thorium tailings.

The above classification takes into account the characteristics that can influence the waste disposal arrangements, as follows:

1. Concentrations of long-lived radionuclides, and any short-lived precursors, that constitute a potential hazard for long times after institutional control, the waste form and storage methods are able to ensure safety.
2. Concentrations of short-lived radionuclides where requirements such as institutional control, waste form, and storage methods are effective for ensuring safety.
3. Mixtures of chemical, biological and radiological components that represent both toxic and radiological hazards to the population and the environment.

Description of classification

Subclasses A, B and C, are based on the activity concentrations and half-lives of the radionuclides present in the radioactive waste, in accordance with the Mexican Official Standard NOM-004-NUCL-1994 "Radioactive Waste Classification".

Low-level radioactive waste – class A

Radioactive waste that within a period of 100 years constitutes a level of risk that is acceptable for the population and environment. Engineered barriers are required to warrant its integrity for at least 100 years.

Low-level radioactive waste – class B

Radioactive waste that within a period of 300 years constitutes a level of risk that is acceptable for the population and environment. Engineered barriers and the waste matrix of the package are required to provide stability of the waste and warrant its integrity for at least 300 years.

Mexico's accumulated radioactive waste

Waste type	Total quantities as of April 2003 (in m ³)
LLW class A	23 808 *
– class B	396
– class C	0
ILW	7
HLW	140
Mixed waste	0
Uranium and thorium tailings	40 625 **

* Includes radioactive waste disposed in La Piedrera disposal facility (20 858 m³) and radioactive waste stored in LV NPP (2 913.07 m³) site and the radioactive waste storage centre (CADER) (37.4 m³).

** Radioactive waste disposal in Peña Blanca disposal facility.

Low-level radioactive waste – class C

Radioactive waste that within a period of 500 years constitutes a level of risk that is acceptable for the population and environment. Engineered barriers are required to warrant their integrity for at least 500 and the waste matrix or the package that provide stability are required to warrant their integrity for at least 300 years.

Intermediate-level radioactive waste

Radioactive waste whose risk remains above acceptable levels for more than 500 years, so that a geological repository constitutes the disposal option.

High-level radioactive waste

This waste is classified according to its origin, and includes those radioactive wastes arising from reprocessing of spent nuclear fuel, and the spent nuclear fuel itself once it is declared as waste. A geological repository constitutes the disposal option.

Mixed radioactive waste

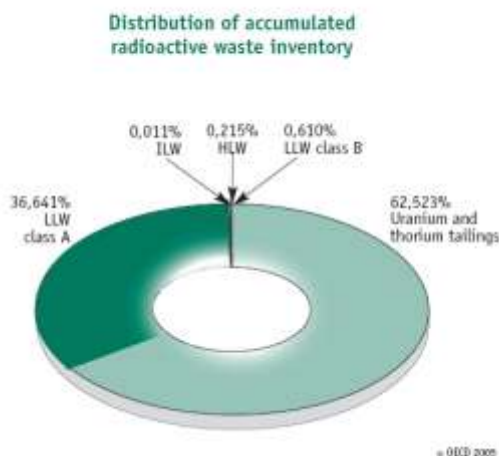
Radioactive waste that contains radioactive material and other hazardous materials.

Uranium and thorium tailings

Radioactive waste arising from ore-processing in a mill to extract the metal content.

Quantities of waste

The radioactive waste produced up to April 2003, and the breakdown by waste category, are shown respectively in the following table and the figure below.



Nuclear power plants

The total amount of waste arising from the operation of the Laguna Verde NPP as of April 2003 comprised 2 913 m³ of LLW, 7 m³ of ILW and 140 m³ of HLW (spent fuel). The annual average production is approximately 369 drums (200 litre) and 15 high-integrity containers of LLW, and an average of 100 spent fuel assemblies from each refuelling.

Fuel cycle

A uranium-milling experimental plant, located in Villa Aldama, Chihuahua and already decommissioned, was in operation at the end of the 1960s. Approximately 65 000 tonnes (40 625 m³) of uranium tailings were generated, and were disposed in Peña Blanca, Chihuahua. This disposal facility is currently closed. The fuel-fabrication pilot plant at ININ generated during its period of operation approximately 4 m³ of LLW.

Hospitals, industry and research

90% of solid radioactive waste generated from sources other than nuclear power production comes from research activities and 10% from medical applications. The same percentages apply to the generation of liquid radioactive wastes. Moreover, 95% of discarded or spent radioactive sources arise from industrial applications, and 5% from medicine and research.

RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

Waste management policies

Small amounts of radioactive waste are generated from nuclear activities other than nuclear power. These wastes constitute approximately 5% of the total national waste generation and there are no plans to expand these nuclear activities in the short term.

Currently, radioactive waste is temporarily stored in authorised facilities. There are neither arrangements for its disposal nor any decommissioning plan of nuclear facilities. Studies are underway to assess the techniques for waste volume reduction. Also, different designs for disposal facilities are being evaluated together with preliminary studies of disposal sites and investigation of associated social, political and economic factors.

An interim solution for the spent nuclear fuel, considering the current situation of Mexico's nuclear programme, was to modify the current spent fuel pool design in order to provide sufficient storage capacity for the operating lifetime of the reactors, until a decision on the future of the nuclear programme was reached.

The spent fuel arising from the operation of the Triga Mark III research reactor is being stored in the reactor pool.

Programmes and projects

Overview of the conditioning, storage and final disposal programme

Radioactive wastes arising from medical, industrial and research activities are treated and conditioned at the ININ radioactive waste treatment facility using compaction and spent source immobilisation techniques, and stored temporarily at the radioactive waste storage centre (CADER) also operated by the ININ.

The Laguna Verde NPP classifies its radioactive wastes as dry wastes (paper, clothes, gloves, etc.) and solidified wastes (sludges, spent resins, etc.). Dry wastes are treated, compacted and placed in drums (200 litres). The other wastes are solidified in a cement or bitumen matrix, except the resins which are stored without any treatment in high integrity containers. These wastes are temporarily stored at the plant, under CFE control, in specially prepared areas in two storage facilities, one for dry wastes and the other for solidified radioactive wastes and high integrity containers. As mentioned spent fuel is temporarily stored in the pools inside each of the two reactor buildings.

Existing plants and storage and disposal sites

The ININ radioactive waste treatment facility is designed to process annually 200 m^3 of solid wastes and 200 m^3 of liquid wastes, by a precipitation process. It can also deal with 240 m^3 per year of waste by way of dilution and decay, and with immobilisation of 300 spent radioactive sources.

The CADER is composed of three buildings for interim waste storage. The first with a capacity of 3 664 drums (200 litres) is 75.4% full and the second is used only for storage of spent radioactive sources. The third with capacity for 1 046 drums (200 litres) is 91.6% full. There are also $1\,418 \text{ m}^3$ of radioactive wastes in trenches at this facility, which come from past activities, including the decommissioning of some

pilot fuel-cycle plants. These wastes will be recovered for disposal when a disposal site is eventually selected.

The Laguna Verde NPP has two interim storage facilities, one for dry wastes with a capacity of 9 424 drums (200 litres) DDRSS, and another, ATS, for solidified and wet wastes with a capacity of 4 452 drums and 300 high integrity containers. By April 2003, the DDRSS and the ATS were at 71.4% and 55.7% of their respective capacities. The annual average rate of radioactive waste generation is 370 drums of dry wastes and 15 high integrity containers for wet wastes (the solidification process was suspended in 2001). The remaining capacity of the DDRSS is about 2 300 drums. At the current rate of waste generation it is estimated that the ATS will be full in five years, the construction of a new ATS storage module and the introduction of supercompaction for dry wastes are being considered as future options.

The LLW from activities other than power production may be disposed in the same facility as that intended for radioactive waste produced by the Laguna Verde NPP.

RESEARCH AND DEVELOPMENT

Future development of technological concepts

The ININ is studying the migration, dispersion and leaching techniques, the treatment of radioactive wastes by incineration, as well as the treatment of organic radioactive wastes. To date there are no research or studies underway in Mexico for the development of new technology for the treatment of wastes.

DECOMMISSIONING AND DISMANTLING POLICIES AND PROJECTS

The National Commission for Nuclear Safety and Safeguards (CNSNS), as the regulatory body, requires the licensee of the Laguna Verde NPP (CFE) to establish and follow a strategy for the decommissioning of both units of the plant at the end of their operating life. This should provide enough financial resources for decommissioning, therefore CFE has established a policy of funding. The licensee has selected the option of deferred dismantling with interim safe storage of the shutdown plant, the so-called SAFSTOR option, as the most suitable for decommissioning the plant. The CFE policy requires a review of the funds at least once every five years, in order to assure that they will be sufficient for their purpose.

As part of the licence renewal process for the TRIGA Mark III research reactor, the CNSNS requires enough financial resources for decommissioning the facility to be available five years before the end of its operating life.

TRANSPORT

Mexico has adopted the International Atomic Energy Agency recommendations on “Regulations for the Safe Transport of Radioactive Material”, as amended in 1990.

The transport of radioactive waste in Mexico is mainly carried to convey the waste from industry, medicine and research to the ININ radioactive waste treatment facility, where it is processed and conditioned before being stored in the CADER. Up to date, no radioactive waste from the Laguna Verde NPP has been moved off-site.

The ININ is responsible for this transport. It is carried out by road, in special vehicles, in compliance with the above-mentioned regulations. 97 m³ of radioactive wastes are transported annually along with 95 conditioned spent radioactive sources.

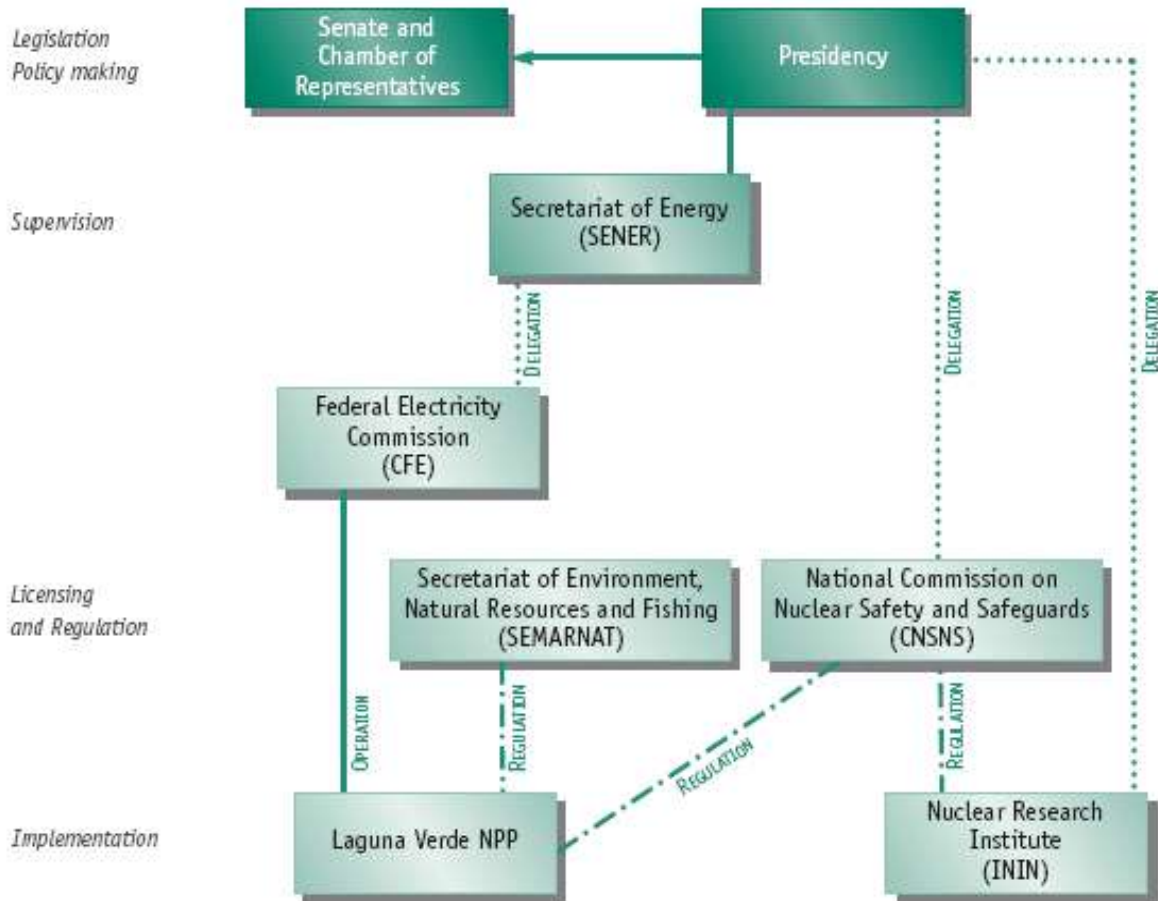
COMPETENT AUTHORITIES

The Secretariat of Energy (SENER) is responsible for the storage, transport and disposal of nuclear fuels and radioactive wastes, regardless of their origin. These responsibilities have been delegated to the CFE, in the case of the radioactive wastes from the NPP operation, and to the ININ, in the case of the radioactive waste from other sources. Depending upon future policy developments, these responsibilities could be transferred to other private or public bodies.

In any case, the National Commission for Nuclear Safety and Safeguards (CNSNS) will keep its current responsibility for licensing current and future installations, and for carrying out inspections and audits. CNSNS is also empowered to take any measures necessary to verify compliance with the regulations in force.

The Secretariat of the Environment and Natural Resources (SEMARNAT) is responsible for regulating the non-radiological environmental aspects of waste management.

Main bodies involved in radioactive waste management in Mexico



FINANCING

The CFE is responsible for financing the management of radioactive waste from NPP operations. The industry, medicine and research, for treatment, conditioning, and provisional storage of the radioactive waste generated should pay a fee, established by the ININ. However, the adequate fee has not been established yet within the framework of the radioactive waste management programme to be defined so, for the time being, the government provides funding.

Several spent fuel disposal options are being studied, and funds are kept in order to provide the necessary resources. Financing of this fund is assured by means of a levy on electricity sales.

PUBLIC INFORMATION

For more information and contact, the relevant authorities and organisations are listed below.

Government

National Commission for Nuclear Safety and Safeguards

Dr. Barragán 779, Col Narvarte 03020 México D. F.

Website: www.cnsns.gob.mx

The competent body authorised to inform the public about activities related to radioactive waste is:

Social Communication Unit

Secretariat of Energy

Av. Insurgentes Sur No. 552 1er piso

Col. Roma Sur O6769, México D.F.

Responsible: Lic. Cybele Díaz

E-mail: Cybele.Diaz.Energia@rtm.net.mx

Visitor centre

Research

National Institute for Nuclear Research

Km. 36.5 Carretera México-Toluca

Ocoyoacac 52045 Estado de México

Website: www.inin.mx

Industry

Laguna Verde nuclear power plant has an information centre for visitors. Through this centre the utility provides information to the public regarding nuclear energy and LVNPP.

Laguna Verde Nuclear Power Plant

Km. 44.5 Carretera Cardel-Nautla

Laguna Verde, Veracruz

C.P. 91476, México

Website: www.cfe.gob.mx