MEXICO

A. National Framework for management of radioactive waste and spent fuel

A.1 Overview of National Policy

In order to protect people and environment from the hazards of ionising radiation, the Mexican Government established a policy, in the early development of nuclear and radioactive applications in the country, which has not been modified up to now. As part of this policy, there is a law and a series of regulations in matter of radioactive waste management.

It is important to mention that Mexican legislation does not consider spent fuel as radioactive waste so it has not been established if it has to be reprocessed or not; it is just stored under secure conditions.

A.2 National Regulatory Bodies

The Ministry of Energy (SENER), as part of the Federal Executive, is in charge of the regulation and enforcement of nuclear, radiological, security and safeguards. It is responsible for proposing legal rules and policies regarding to the storage, transportation and deposit of nuclear fuel and radioactive wastes, as well as setting up a national strategy in this matter.

In order to supervise the process of the spent fuel and radioactive waste management in the country, the Ministry of Energy delegates the regulations functions to the National Commission of Nuclear Safety and Safeguards (CNSNS), which is the national regulatory body in nuclear radiological, security and safeguards field and its main responsibilities are regulating, licencing and supervising the nuclear and radioactive facilities in the safe use of nuclear and radioactive materials, until their storage or dispose.

A.3 National Implementation Bodies

In the country there are two main bodies responsible of the management of spent fuel and radioactive wastes, the Federal Electricity Commission (CFE) and the National Institute of Nuclear Research (ININ).

The Federal Electricity Commission operates the Laguna Verde Nuclear Power Plant and is in charge for the treatment, conditioning and storage of radioactive wastes and spent fuel, produced during the operation of its two nuclear reactors.

The National Institute of Nuclear Research is responsible for treatment and interim storage of radioactive waste from its facilities and for the collection, treatment, transportation and storage of wastes generated by the industrial and medical use. Also, it is in charge of the safekeeping of all the wastes from accidents and remediation activities carried out in the past.

B. National legal and regulatory framework

B.1 Primary Legislations and General Regulations

To guarantee the safety use of nuclear and radioactive material, there is the Regulatory Law of Constitutional Article 27 in nuclear matters, which regulates exploration, exploitation and benefit from radioactive minerals, use of nuclear energy, research in nuclear field and spent fuel and radioactive waste management. In its Article 50, establishes that the main power of regulation and enforcement in nuclear matter is the Ministry of Energy,

The General Regulations of Radiological Safety (RGSR) is the code that establishes the criteria and basic requirements in radiological safety. This regulation defines radioactive wastes and classifies radioactive waste management facilities; sets up that processing, conditioning and disposal of radioactive wastes have to be authorized by CNSNS, as well as storage of disused sealed sources; and requires to licensees a plan to dispose radioactive wastes from decommissioning of radioactive facilities.

B.2 Rules Governing Specific Activities or Facilities

As part of the regulatory framework, there is the Mexican Official Norms (NOM) of nuclear series (NUCL) which are compulsory in all national territory and regulate in detail, different requirements included in RGSR. The Norms related to radioactive waste are shown in table 1.

Table 1. Mexican Official Norms

Number	Title
NOM-004-NUCL-2013	Radioactive Waste Classification
NOM-008-NUCL-2011	Radioactive Contamination Control
NOM-018-NUCL-1995	Methods to Determine Activity Concentration and Total Activity in Radioactive Waste Packages
NOM-019-NUCL-1995	Requirements for the Near Surface Disposal of Low-level Radioactive Waste Packages
NOM-020-NUCL-1995	Requirements for Radioactive Waste Incineration Facilities
NOM-021-NUCL-1996	Lixiviation Test for Solid Radioactive Wastes
NOM-022/1-NUCL-1996	Requirements for Low-level Radioactive Waste Disposal near surface. Part 1. Siting
NOM-022/2-NUCL-1996	Requirements for Low-level Radioactive Waste Disposal near surface. Part 1. Design
NOM-022/3-NUCL-1996	Requirements for Low-level Radioactive Waste Disposal near surface. Part 1. Construction, Operation, Closure, Post-Closure and Institutional Control.
NOM-028-NUCL-2009	Radioactive Waste Management in Radioactive Facilities where Open Sources are used.
NOM-035-NUCL-2013	Levels to Classify a Solid Waste as Radioactive Waste
NOM-036-NUCL-2001	Requirements for a Treatment and Conditioning Radioactive Waste Facilities
NOM-039-NUCL-2011	Specifications for Exemption of Ionizing Radioactive Source and the Practices which use them
NOM-041-NUCL-2013	Annual Incorporation Levels and Discharge Concentrations

C. Radioactive waste management, decommissioning and spent fuel strategy and current practices & technologies

C.1 Strategy and Practices on Spent Fuel Management

The spent fuel generated by the two boiling water reactors (BWR-5) of Laguna Verde Nuclear Power Plant (LVNPP) is actually stored in two pools, one for each unit. In both pools were installed high-density racks to increase their capacity, and remain unchanged.

C.2 Strategy and Practices on Radioactive Waste Management

The radioactive materials from medical, industrial and research uses, including disused sources, are classified, treated and conditioned in the radioactive waste treatment plant (PATRADER) and then transported to the radioactive waste storage facility (CADER), both facilities operated by ININ.

The low-level radioactive wastes (according the national classification system) that come from the operation of the two power units of LVNPP, are classified, treated, conditioned and stored in the dry solid radioactive waste storage (DDRSS) and the temporary storage in site (ATS), which are located in side the NNP. On the other hand, the intermediate-level radioactive wastes are stored in the two pools of spent fuel storage.

Finally, the radioactive wastes from remediation measurements of a melted source accident and the uranium mining tails from operation and closure of the uranium and molybdenum extracts plat, are disposed in the repositories "La Piedrera" and "Peña Blanca", respectively.

C.3 Current Issues at National Level

Nowadays, the main issues related to spent fuel and radioactive waste management that Mexico face are the lack of proper national policy in order to provide and strengthen the technical and financial autonomy of the regulatory body; lack of comprehensive regulations and updating of the legal framework on radioactive waste management, as well as lack of efficient funding for it; establish the construction of a repository for low-level and intermediate-level radioactive wastes and determine an appropriate management of Natural Occurring Radioactive Material (NORM).

C.4 Financing of Radioactive Waste Management and Spent Fuel Management

Related to radioactive wastes from LVNPP operations, CFE is responsible for financing their management through funds from the Government, to cover all spends. There is also an internal fund to cover future expenses for decommissioning and associated management of wastes. However, no funding mechanisms have been detected to ensure the necessary financial resources to cover full costs of future decommissioning, spent fuel or radioactive waste management of LVNPP.

ININ, as current operator of radioactive waste management, has established fees to be paid by the generator, to cover transportation, characterization, conditioning and storage of wastes, and receive some funds from the Government as well.

D. Radioactive Waste Classification, Quantities (Inventory) of Waste and Spent Fuel

The national classification system is established in NOM-004-NUCL-2013 "Radioactive waste classification", based on American classification system. In this regulation, radioactive wastes are classified according to concentration, activity, half-life and origin of the wastes, in:

- Low-level waste
  - Class A. Radioactive waste that within a period of 100 years constitute a level of risk that is acceptable for population and environment.
  - Class B. Radioactive waste that within a period of 300 years constitute a level of risk that is acceptable for population and environment.
  - Class C. Radioactive waste that within a period of 500 years constitute a level of risk that is acceptable for population and environment.
- Intermediate-level waste. Radioactive waste whose risk remains above acceptable levels for more than 500 years.
- High-level waste. Radioactive wastes arising from reprocessing of spent nuclear fuel and spent nuclear fuel itself, once the Government declares it as waste.
- Mixed waste. Radioactive waste mixed with other hazardous materials.
- Uranium and thorium tailings. Radioactive waste arising from ore processing in a mill to extract metal content.

By the end of 2013, there were 27752 m^3 of conditioned low-level wastes; 205 m^3 of conditioned intermediate-level wastes and 103 m^3 of conditioned mixed wastes, all of these stored. About spent fuel, at the beginning of 2013, there were 570.13 tU stored from one research reactor and two units of the LVNPP. The amount of NORM from remediation activities is 41574 m^3, which is located in a near surface disposal.

Table 2. Radioactive waste in storage

Route Waste Class	Processed (type) / Unprocessed	Total Current Volume (m^3)	Estimated disposal Volume (m^3)	Distribution (%)							Planned Disposal Route
				RO	FFE	RP	NA	DF	DC/RE	ND	
Total	Unconditioned	-	-	-	-	-	-	-	-	-	Not determined
	Conditioned	28060.5	-	17	-	-	83	-	-	-	
LLW	Unconditioned	-	-	-	-	-		-	-	-	Not determined
	Conditioned	27855.5	-	16	-	-	84	-	-	-	
ILW	Unconditioned	-	-	-	-	-	-	-	-	-	Not determined
	Conditioned	205	-	100	-	-	-	-	-	-	

Waste origin type codes:
RO – reactor operations
FFE – fuel fabrication & enrichment
RP – reprocessing
NA – nuclear applications
DF– defence

DC/RE – decommissioning & remediation
ND – Undetermined

Table 3. Radioactive waste disposed

Waste Class	Processed (not)	Total Volume (m^3)	Distribution (%)							Disposal Route Used
			RO	FFE	RP	NA	DF	DC/RE	ND	
Total of all classes	NO	41574	-	-	-	-	-	41574	-	NSD
LILW	NO	41574	-	-	-	-	-	41574	-	NSD
HLW	NO	0.0	-	-	-	-	-	-	-	-

(Note: Abbreviations as in Table 1)

Table 4. Spent fuel in storage (tU)

Type	Current amount (NPP)	Current amount (Research Reactors)
Total spent fuel storage	570	0.129
Wet storage (AR)	570	0.129
Wet storage (AFR)	-	-
Dry storage (AR)	-	-
Dry storage (AFR)	-	-
Total spent fuel held in storage for other countries (amounts also included above)	-	-

AR = "at reactor site", including fuel pools at NPP
AFR = "away from reactor site"

E. The Capacities and Status of Processing, Storage and Disposal Facilities for Waste and Spent Fuel

In Mexico, all the existing facilities are just to store radioactive waste and spent fuel; there are two pools where the spent fuel from LVNPP is stored as well as intermediate-level wastes from the operation of both reactors. Additionally, it is under planning to build a dry storage facility for spent fuel, inside the NPP.

For low-level wastes from medical, industrial and research uses, there are one treatment facility and one storage facility; in the case of radioactive wastes generated in LVNPP, there are two facilities to treat and store them.

One of the two existing disposal facilities is under operation, where uranium tailings coming from remediation activities were disposed; the other facility in which was disposed material from an accident with a cobalt-60 source, is now closed.

Table 5. Summary of management facilities of spent fuel and radioactive waste

Type	Planned	Construction	Commissioning	In Operation	Shut-down	Decommissioning	Total
Spent fuel	1	0	0	2	0	0	3

storage							
Spent fuel reprocessing And recycling	-	-	-	-	-	-	-
Spent fuel conditioning	-	-	-	-	-	-	-

Type	Planned	Construction	Commissioning	In Operation	Shut-down	Decommissioning	Total
Spent fuel disposal	-	-	-	-	-	-	-
Waste processing:	0	0	0	2	0	0	2
LILW processing	0	0	0	2	0	0	2
HLW processing	0	0	0	0	0	0	0
Waste storage:	0	0	0	3	0	0	3
LILW storage	0	0	0	3	0	0	3
HLW storage	0	0	0	0	0	0	0
Waste disposal	0	0	0	1	1	0	2
LILW disposal	0	0	0	1	1	0	2
HLW	0	0	0	0	0	0	0

Table 6. Summary of major sources of waste

Type	Planned	Construction	Commissioning	Operation	Shut-down	Decommissioning	Total
Research reactors	0	0	0	1	0	0	1
Nuclear power reactors	0	0	0	2	0	0	2

Note: "Planned" means it has been identified in a national report, strategy, or formal plan. It includes: Planned, Under Study-Assessment, Siting-Design phases

F. Trends and future prospects (volumes of waste and spent fuel arising, waste and spent fuel management facilities)

According to the future prospects carried out by the European Commission project "Co-operation in the development of a policy and strategy for the management of spent nuclear fuel (including provisions for its safe interim storage) and radioactive waste in Mexico", there are two scenarios to take into account. The first scenario is, the existing two reactors with 30 and extended 60 years of operation, and the second scenario is, the existing two reactors and two more reactors (1400 MWe/unit) built by 2016 with 30 and 60 years of operation. In Table 7, it is shown the amount of spent fuel and radioactive waste for both scenarios.

Table 7. Projected amounts of spent fuel and radioactive waste

Wastes	2010 (m^3)	30 op. year (m^3)	60 op. year (m^3)
Scenario 1			
LLW	24487	29160	38572
ILW	205	205	205
NORM	41574	41574	41574
Spent fuel (FA)	3168	5668	11084
Scenario 2			
LLW	24487	43357	49495
ILW	205	205	205
NORM	41574	41574	41574
Spent fuel (FA)	3168	14314	17884

Sources of data, assumptions (especially for future waste forecasts) and references

Data sources quoted in the report

European Commission Project MX4.01/10 "Co-operation in the development of a policy and strategy for the management of spent nuclear fuel (including provisions for its safe interim storage) and radioactive waste in Mexico"

1. Task 2. Estrategia nacional para la gestión de residuos radiactivos y el combustible gastado.
2. Subtask 2.5. Waste control system: Characterization, classification and record keeping.
3. Subtask 3.1. Technical report on analysis on the current situation of spent nuclear fuel and radioactive waste management at Laguna Verde NPP.
4. Subtask 3.6. Technical report on Spent Nuclear Fuel Options for storage.

References

1. Regulatory Law of Constitutional Article 27 in Nuclear Matters. 4th February 1985.
2. General Regulations of Radiological Safety, 22nd November 1988.
3. European Commission Project MX4.01/10 "Co-operation in the development of a policy and strategy for the management of spent nuclear fuel (including provisions for its safe interim storage) and radioactive waste in Mexico"