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

P. Zuloaga, M. Molina, J. Bárcena, E. Salas, M. Sánchez, H. Codée & J. Deckers

The European Commission decided in 2010 to finance a project for providing technical support for the definition and establishment of a national policy and strategy for radioactive waste management in Mexico. The Project was in the framework of the Nuclear Safety Co-operation Instrument (NSCI), a European mechanism which finances measures to support a higher level of nuclear safety, radiation protection and the application of efficient and effective safeguards of nuclear materials in third countries. Eventually, the Project was awarded to a Consortium made up by four Spanish companies, ENRESA, Empresarios Agrupados Internacional SA, Iberdrola Ingeniería SAU, Westinghouse Spain SAU, and two foreign ones, COVRA NV and Belgoprocess NV. Both ENRESA and COVRA are waste management agencies, the first responsible of these activities in Spain, the second one in the Netherlands. ENRESA acts as the leader of the Consortium.

The Project started early in 2012 and will last until March 2015. All along this period, the Mexican system for spent fuel and radioactive waste management will be scrutinized and proposals made for its upgrading according to the best international and European standards of safety and performance. A Policy and Strategy document will be proposed, as well as significant improvements for the different institutional layers, practices and elements of the Mexican system.

A total of 40 specialists are involved in the project of which 30 are Spaniards.

PROJECT OBJECTIVES. RW AND SF MANAGEMENT IN MEXICO. A POLICY AND STRATEGY FOR THE MEXICAN SYSTEM

The overall objective of the project is to provide support to the Mexican government in its efforts to ensure responsible, sound and economically efficient management of spent nuclear fuel and all radioactive waste generated at Mexican NPPs and other nuclear and radioactive installations. This will be achieved through the following specific objectives:

1. Support the development of a comprehensive National Policy Plan;
2. Support the development of a Strategy to implement this National Policy Plan, including draft legislation and institutional framework, and
3. Develop the Strategy at the level of the largest single waste generator to improve the management of the spent nuclear fuel and radioactive waste generated at Laguna Verde NPP, in compliance with the National Policy Plan.

The Mexican nuclear sector is made up of two electricity-producing nuclear reactors, 817 MWe each in the Laguna Verde Nuclear Power Plant (CNLV) in the State of Veracruz, a nuclear research centre, the Instituto Nacional de Investigaciones Nucleares (ININ), which has a TRIGA research reactor in Ocoyoacac in the State of Mexico, and approximately 600 institutional producers or users of different applications out of the nuclear fuel cycle sector. The annual generation of radioactive waste is close to 300 m^3, 90% of this quantity corresponding to the CNLV. Most irradiated nuclear fuel comes from operations of the two thermonuclear reactors of the CNLV.

The main powers of regulation and enforcement of nuclear, radiological and physical safety and safeguards correspond to the Government through the Secretary of Energy (SENER) that is responsible for

PABLO ZULOAGA
Ph.D. in Physics Engineering and Industrial Engineer. He has worked in NPP Design and Commissioning and has worked for ENRESA since 1986 as El Cabril project manager, responsible for Projects and Construction, LLW and HLW Department. At present, he is the Engineering Director of ENRESA.

MARIANO MOLINA
Industrial Engineer, Polytechnic University of Madrid. He has more than 20 years of experience in RW Management. Presently, he is the Head of the Department of International Relations of ENRESA.

J. BÁRCENA
Industrial Engineer, University Carlos III of Madrid. Since 2007, he works for Empresarios Agrupados, being responsible for several projects on RW management and decommissioning of nuclear and radioactive facilities.

EVA SALAS
Degree in Physics, University of Zaragoza. She has 13 years of experience in radioactive waste management. Currently, she works as Senior Engineer in the Waste Management and Decommissioning Unit of Iberdrola Ingeniería SAU.

MOISÉS SÁNCHEZ
Industrial Engineer, by the Polytechnic University of Madrid and Master in Business Administration by the IE Business School of Madrid. He has more than 26 years of experience in Decommissioning & Dismantling. Presently, he is W&D&D Product Manager in Westinghouse Spain.

H. CODÉE
Ph. D. Chemistry, State University Leyden and Reactor Institute Delft. He has been working in SF and RW management since 1982. Managing director of COVRA NV, the Dutch Radioactive Waste Management Agency since 1995. He has a background in chemistry and radiation protection and has been working in the area of radioactive waste management for more than 30 years. Since 1995 he is managing director of COVRA N.V.

J. DECKERS
Industrial Engineer, Master in Environmental Sanitation. He has been developing his career in radioactive waste management for more than 30 years. Presently, he is the Technical Commercial Manager of Belgoprocess NV.

Figure 1. Main facilities for Spent Fuel and Radioactive Waste Management in Mexico.

the storage, transportation and "deposit" of any nuclear fuel and radioactive waste produced in the country, regardless of their origin. SENER has issued delegations for discharging these duties onto CNLV and ININ, the first for managing its own waste, the latter for its own waste and those coming from institutional producers. The functions of regulating and supervising nuclear safety and security are carried out by the Comisión Nacional de Seguridad Nuclear y Salvaguardas (CNSNS), the Mexican nuclear safety regulatory body.

Throughout this time, the Mexican system has worked well and has provided an appreciable level of radiological safety and physical security for the country's population, both during normal operating circumstances as well as at other times when there have been incidents and accidents that have required organised and efficient actions. The aims of the current system have been reasonably achieved in most of the cases.

The point that the Project tackles is the implementation of a policy and a strategy for considering the long term aspects of safety and security, which have not yet been addressed. With this respect, the Project proposes to give priority to the following issues:

- To lay down the starting points for the immediate development of a short-term management strategy which completes the existing management framework and allows decisions to be taken on some of the issues that need urgently to be addressed, specifically with regard to the used nuclear fuel storage capacities of the Laguna Verde Power Plant;
- To lay down the starting points for developing a management strategy that enables medium and long-term technical actions to be determined and focused;
- To review, adapt and strengthen the existing allocation of responsibilities among the bodies involved in spent fuel and waste management to achieve the overall objective of ensuring safety during the entire period in which waste is harmful;
- To pave the way for the definition and establishment of a funding system for management of radioactive waste and spent nuclear fuel;
- To update existing legislation governing spent fuel and radioactive waste to align their mandates to those established in international practices and legislation.

The Project is organized around three main Tasks. Task 1 is to carry out a full assessment of the current situation of radioactive waste and spent fuel management in the country, to make a comparative evaluation with the most advanced OECD countries in this area and finally to propose a document containing a potential policy for México. Task 2 scrutinizes the main items that impact on the amelioration of the Mexican system, this comprising the potential establishment of radioactive waste management agency, the implementation of a new funding scheme, or the full development of management facilities and practices from waste production to its eventual disposal. The outcome of this Task is a document proposing a long-term national strategy for the country. Task 2 will be mainly fed by the results of Task 3 which specifically addresses the optimization of radioactive waste and spent fuel management in CNLV.

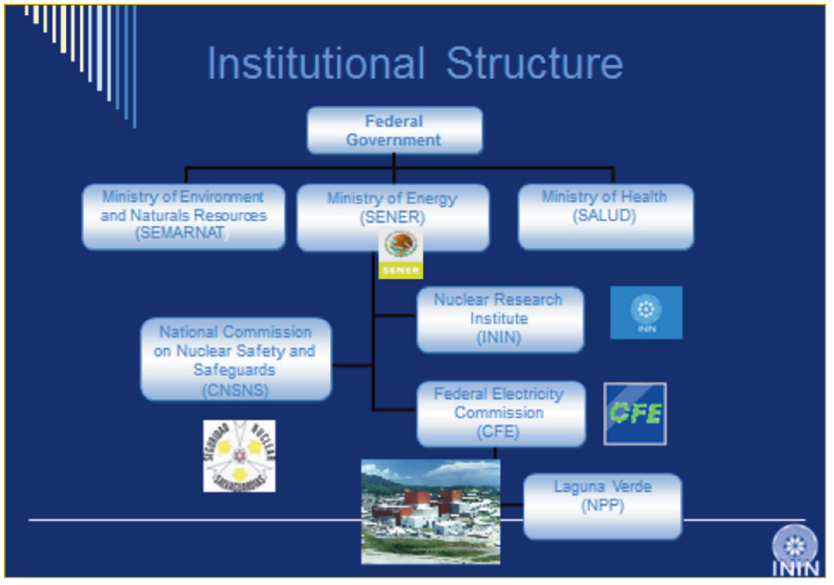

Figure 2. Institutional Framework in Mexico

AN IMPROVED INSTITUTIONAL FRAMEWORK IN MEXICO FOR SF AND RW MANAGEMENT

A relevant activity which flows from the considerations above is the design of an institutional framework that could better respond to the requirements of the proposed policy. The main international legal texts, *the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and the Council Directive 2011/70/Euratom*

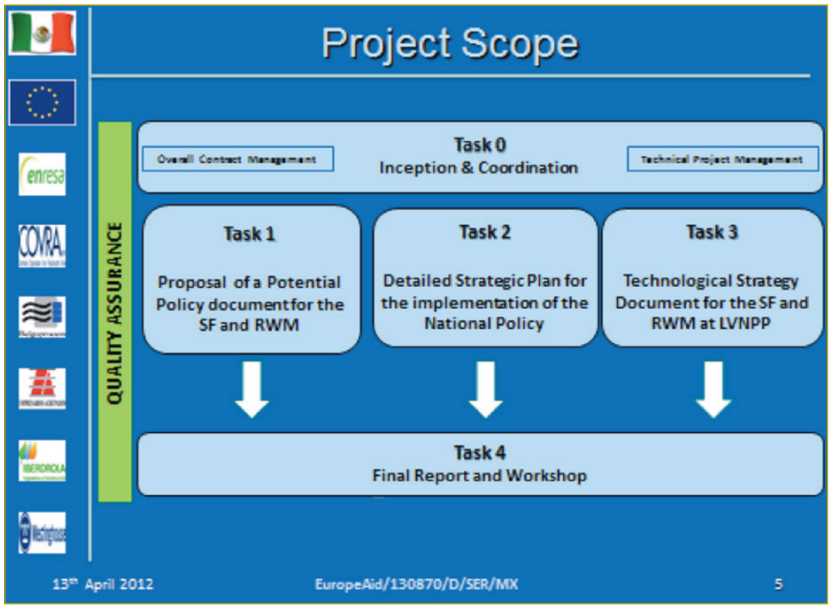

Figure 3. Scope of the Project.

of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste strongly insist on this point. An appropriate institutional framework is a fundamental requisite to achieve the long-term safety and security objectives unanimously accepted by the international community.

The Consortium has recommended the reinforcement of the country's institutional framework by means of a better and wider allocation of responsibilities among the bodies legally involved. The main findings and recommendations in this area are the following:

- The Federal Government should promote legislation to empower the State to guarantee the safe management of any SF and RW; the Government should establish a financial scheme to cope with the long term management necessities. An appropriate, stable flow of funds is a fundamental requirement for the successful implementation of any strategy;
- The independence of the CNSNS must be fully achieved, and its role in the visibility and acceptance of the proposed solutions improved;
- The primary responsibility of license holders should be legally stated and reinforced; particularly, they must provide for and maintain adequate financial resources to fulfill their long-term obligations;
- The responsibilities for long-term management of spent fuel and radioactive waste must rest on a dedicated or specialized implementing body, or National Radioactive Waste Management Agency, which will be in charge of turning into practice the long-term management objectives as stated in the National Policy and Strategy.

MAXIMIZING THE RW AND SF MANAGEMENT SYSTEM OTHER THAN THE INSTITUTIONAL FRAMEWORK

As mentioned before, CNLV and ININ currently manage the waste under their responsibility following internationally accepted practices, but independently from each other. The establishment of a national strategy is highly convenient for getting a full optimization of the minimization and management of radioactive waste in the country. This is the main goal of Task 2 of the Project.

Up to now, the main conclusions of the Consortium are focused in the maximization of existing capabilities and the implementation of additional mechanisms to improve systems and processes involved in the management activities. Among the main recommendations are the following:

- The National Inventory of radioactive waste and spent fuel should be officially established and kept updated both at the quantitative and radiological level. The new inventory should also consider potential additions in the Mexican nuclear fleet as well as the waste arising from future decommissioning of nuclear plants.
- The optimization of the sorting-out processes and the implementation of treatment models in line with the features and characteristics of the radioactive waste should facilitate minimizing its generation, thus optimizing the amount of waste packages and disposal units after their conditioning.
- The unification of the requisites and techniques for the physical, chemical and radiological characterization of the wastes will help in selecting the most appropriate conditioning processes. As a consequence, the total amount of waste will be minimized and the resulting products will have the

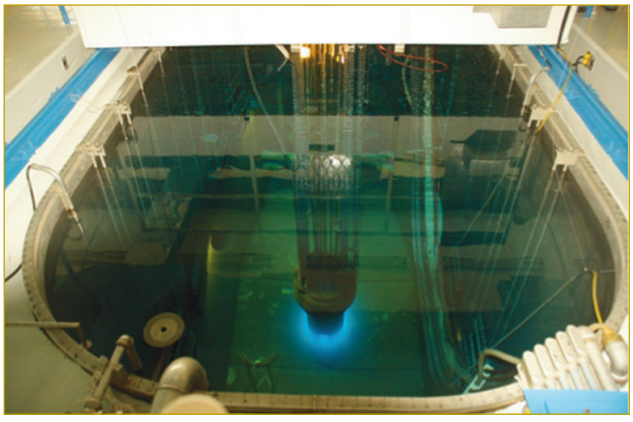

Figure 4. TRIGA reactor at ININ.

Figure 5. Treatment facilities at ININ.

required quality for its storage or disposal.

- The best envisaged option for very low level waste and low and intermediate level waste is their disposition in a single centralized facility, following the existing models of near surface repositories. The facility should also host treatment and conditioning installations and interim storage capacity. Until this facility comes into operation, the existing capacities for institutional producers at ININ should be maintained.
- A Centralized Storage Facility (CSF) or Independent Spent Fuel Installations (ISFISs) at the NPPs seems to be the best solution for the long-term storage of spent fuel depending on the size of the future nuclear power fleet. Presently, there is just the need of the scheduled ISFI at CNLV. A CSF is the best solution if further NPPs would come on line.
- The Mexican Waste Management Agency must set generic criteria and methodologies to make easier the future common management, according to the waste inventory, the new treatment processes and disposal facility.
- The Mexican policy and regulations must strive for promoting the return of disused sealed sources to the manufacturer. It is also required to improve the facilities for the storage of and treatment of orphan sources and specially to set up the strategy for its final disposal.

OPTIMIZING THE RW AND SF MANAGEMENT SYSTEM IN LAGUNA VERDE NPP

The specific assessment of CNLV, prior to proposing a detailed improvement of its practices, begun by collating and scrutinizing all available information as to better understand the current situation concerning radioactive waste and spent fuel management. There was also the intention of identifying the most relevant aspects for subsequent tasks. A comprehensive questionnaire was used for this purpose.

Following the response of the NPP, a report was issued which depicted management practices in CNLV and compared them with those internationally advised. The main conclusion was that radioactive waste management in the plant is safely carried out and in line with international standards. Further analysis detected some areas which needed to be clarified and potentially improved. A first presentation in a Project's Workshop, late in 2012, contributed to better understand CNLV conditions and to ask for additional information. A further visit to the NPP in May 2013 also helped to get a more accurate knowledge of the spent fuel and radioactive waste management installations. It also provided a direct contact with the staff responsible of these activities and better consideration of their interests and expectations.

Figure 6. Visit to Laguna Verde NPP, May 2013.

Taking all the above mentioned information as a basis, Task 3 of the Project is currently oriented to specifically assess the main management aspects, among of which there are the following:

- Different waste streams and best minimization practices;
- Best technologies for waste treatment and conditioning;
- Interim storage and waste acceptance criteria to comply with the requirements of long-term storage as defined in Task 2;
- Spent fuel storage.

Again, the assessment of these items will be focused on detecting pending issues or areas to be improved according to the Consortium experience and its applicability in Mexico.

For each of the areas listed above, a report will be drafted providing the assessment of alternative options as well as the best recommendations or improvements, all to be discussed and agreed with the Beneficiary.

Finally, all the different recommendations will be integrated in a document to become the proposal of a Strategy for the optimization of the spent fuel and radioactive waste management in CNLV. The Strategy will be aligned with the best international practices, costs optimization and the National Policy, as defined in Task 1. CNLV's Strategy is destined to be the basis for a wider National Strategy which, taking into account all radioactive waste produced in Mexico, will become the main result of the Project.

STATUS OF THE PROJECT. MAIN FINDINGS AND CONCLUSIONS

The assistance to the Mexican Authorities for improving their practices on spent fuel and radioactive waste management will continue until the first quarter of 2015. By the end of 2013, the analysis of the main elements and components of the Mexican system will be completed thus allowing the drafting of a comprehensive Strategy to be presented and discussed with the main stakeholders by the end of 2014. The new Mexican Government, in the meanwhile, has started the preparations for internally discussing the issuance of a Policy. To this end, SENER has asked the cooperation of the Consortium. This latter is presently completing some reports which address potential keystones of the future

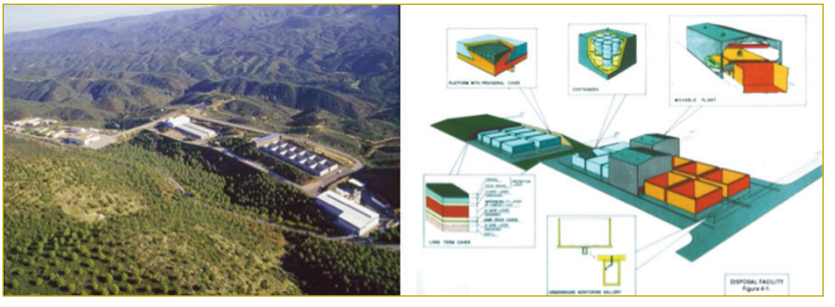

Figure 7. Spanish Disposal Concept for LILW.

Mexican institutional framework: full definition of a potential national agency for radioactive waste management, a new funding system, strategic guidelines for disposal of low and intermediate level waste and interim storage of spent fuel.

Overall, the co-operation with the Mexican authorities is proving to be a good example of how existing know-how in some European countries could be transferred to third countries as to form a sound basis for the achievement of the best internationally accepted standards. With this respect, the long experiences of countries like Spain, Belgium and the Netherlands in radioactive waste management is a high valuable asset, whose added value comes from the diversity of nuclear systems involved and the existence of sound management systems in each of them. It is to be highlighted that two national agencies (ENRESA and COVRA) with a long tradition of helping the European Commission in shaping the EU practices are being to bring this European acquis to Mexico.

The Spanish industry is playing a significant role in the Project as three Spanish engineering companies (Empresarios Agrupados Internacional SA, Iberdrola Ingeniería y Cosntrucción SAU y Westinghouse Spain SAU) are working together, covering every point in the improvement of the future technological capabilities in Mexico, as well as in the definition of the strategic directions to be followed. A key aspect of their contribution is the large stock of knowledge accumulated during the development of the main facilities and installations of the Spanish radioactive waste and spent fuel management system (Disposal center of El Cabril, C.N. José Cabrera decommissioning, disposal concepts for SF and HLW, etc.).

ACKNOWLEDGMENTS

The authors wish to express their gratitude to the Development & Co-operation Directorate-General of the European Commission responsible for the coordination and follow-up of the activities involved in the 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". Its support and understanding are of pivotal importance for the undertaking of it. It is also necessary to highlight the relevant role being played by the Mexican authorities, especially SENER and ININ, whose continuous co-operation has become crucial for the achievement of the Project's objectives.