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## THE LOSS OF KNOWLEDGE IN NUCLEAR SAFETY AND RADIATION PROTECTION DURING THE SPANISH NUCLEAR MORATORIUM

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The life of a nuclear power plant includes seven phases: site selection and characterization, design and construction, commissioning, operation, decommissioning, dismantling and long term spent fuel management, comprising about 100 years and at least three generations of workers. Each one of these phases requires specific knowledge and experience, which has to be managed along the life of the nuclear energy deployment in any country. When such deployment is interrupted and later on resumed, as in Spain, the knowledge and experience gained during the first phase could only be effectively transferred to the new phase if a proper knowledge management was implemented, which was nor normally the case in the early days. The knowledge gained is certainly in the files and archives for everybody to read, but it can only be read effectively by those who have participated in creating the knowledge. The experience is lost with the people.

The Spanish nuclear power programme started in the decade of the 60's. By early 1980, seven plants were in operation and seven more under different stages of construction. There was a great deal of optimism, the participation of the domestic industry was encouraged and growing, and there was research and development in the national research laboratories and the universities. The industry provided heavy and all type of components, fuel fabrication was also national, the whole fuel cycle was given attention, architect-engineering and servicing companies were also created. A regulatory organization was born, legislation was enacted and nuclear activities were under proper regulatory control. Nevertheless, in 1983 the Authorities decided to stop all this progress, the construction authorization for five of the seven plants was cancelled, a moratorium on the construction of new plants was enacted and the fuel cycle was declared open. This created a great impact on the new industry, nuclear activities declined in all senses, and pessimism on nuclear started to grow. A new more independent regulatory organization was created. At present, there are seven nuclear power plants in operation and two are been dismantled. Future prospect for new plants are very dim at the moment.

As nuclear power should not be completely discarded, it is of interest to evaluate the knowledge and experience lost, in both the industry and the regulatory body, to see whether or not it could be recuperated and to establish conditions for a potential nuclear renewal. The knowledge and experience gained during the three first phases: site selection and characterization, design and construction and commissioning, are practically lost and difficult to recuperate. The last phases: operation, decommissioning, dismantling and long term spent fuel management are on-going activities.

Site selection and characterization was very active in the 60's and 70's. Many applications for site permits were filed. Individual site studies were performed as well as studies performed by the regulatory authority on the potential nuclear capacity of some river basins and coastal regions. Practically all participants in such studies are retired and the experience gained is lost. The analysis of external events for probabilistic safety studies has brought back some valuable experience, but it only refers to existing sites. Finding new sites for a new substantial renewal of nuclear power will be a difficult job for the utilities. This activity will have to commence anew.

Design and construction is a major endeavour. Spain is termed as a qualified importer, in the sense that the domestic industry participates in the design and construction of the imported plants. Only the first unit was a turn-key contract. The participation of the Spanish industry, mainly in the balance of plant, structures and ancillary systems was intense. Quality assurance and quality control were the responsibility of the plant owner. The regulatory organization also developed a great deal of experience in regulating design and construction and in verifying compliance with regulations, that were also growing. The last construction activities ended in 1986. Since that time, the activities of the regulatory body and national industry were limited to implement modifications in the domestic plants. The new regulatory authority has yet to issue the first construction authorization. A new built will not profit much from the old experience.

Commissioning is the phase when the interchange of knowledge between the supplier and the utility is more intense and under the supervision of the regulatory authority. The utility has been preparing during the four or five previous years the new operating personnel. A number of pre-nuclear and nuclear tests, up to the final acceptance test, are performed in collaboration between the experienced provider and the new operating team. The last activity of this type took place in Spain in 1986-87. The original people who participated in the transfer of such knowledge are now out of operation and replaced by new operating personnel who have not seen that previous experience. The same applies to the regulatory body. Future deployment of nuclear energy may encounter difficulties in finding experts on that matter on both sides, the supplier and the receiver of the plant, as well as on the regulatory body.

As the last phases are on-going activities, it is of interest to create methodology and procedures to manage knowledge acquired in operation, decommissioning, dismantling and spent fuel management. The Spanish utilities and the national radioactive waste company are creating procedures to secure such knowledge and experience following the IAEA recommendations. The regulatory authority has recently issued an Instruction to maintain knowledge and experience on radiation protection matters. More Instructions may follow.