

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

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1

Three Basic Axioms

- The book of knowledge is there for everybody to read, but it only can be read by those who have participated in the writing.
- Knowledge becomes lost when it is not put into practice.
- Too much information may produce biblioclasms, that is the desire to burn the books

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2

The Spanish Nuclear Development Government and Regulator

- **1951. Creation of the Nuclear Energy Board.**

- **1964. Promulgation of the Law on Nuclear Energy**
 1967. Third Party Liability
 1972. Basic Requirements for Nuclear Installations
 1987 Radiation Protection

- **1982 the Nuclear Safety Council was created as a separate independent regulatory organization.**

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3

Table I. The Spanish nuclear power plants indicating the year they received the site, construction and operation licences

NAME	TYPE	POWER (Mwe)	SITE (year)	CONS. (year)	OPER. (year)	STATUS
1 st Generation						
José Cabrera	W-PWR-1L	160	1963	1964	1968	Decomm.
Garoña	GE-BWR/4	460	1963	1966	1971	Operating
Vandellós I	F-GCR	500	1967	1968	1972	Dismantled
2 nd Generation						
Almaraz I	W-PWR-3 L	930	1971	1973	1982	Operating
Almaraz II	W-PWR-3 L	930	1971	1973	1984	Operating
Lemóniz I	W-PWR-3 L	930	1972	1974	-	Cancelled
Lemóniz II	W-PWR-3 L	930	1972	1974	-	Cancelled
Ascó I	W-PWR-3 L	930	1972	1974	1985	Operating
Ascó II	W-PWR-3 L	930	1972	1975	1986	Operating
Cofrentes	GE-BWR/6	975	1972	1975	1985	Operating
3 rd Generation						
Valdecaballeros I	GE-BWR/6	975	1975	1979	-	Cancelled
Valdecaballeros II	GE-BWR/6	975	1975	1979	-	Cancelled
Vandellós II	W-PWR-3 L	930	1976	1981	1988	Operating
Trillo I	KWU-PWR-3L	1030	1975	1971	1988	Operating
Trillo II	KWU-PWR-3L	1030	1975	1980	-	Cancelled

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4

The Moratorium (1983)

- Cancellation of the construction of five units (4,84 Gwe). Prohibition to build new NPPs
- Declaration that the fuel cycle should be open
- Transformation of the old Nuclear Energy Board into a research centre for energy, environment and technology
- Cancellation of research reactors and hot cells
- Transformation of the old Institute for Nuclear Studies into the a new Institute for Energy Studies

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5

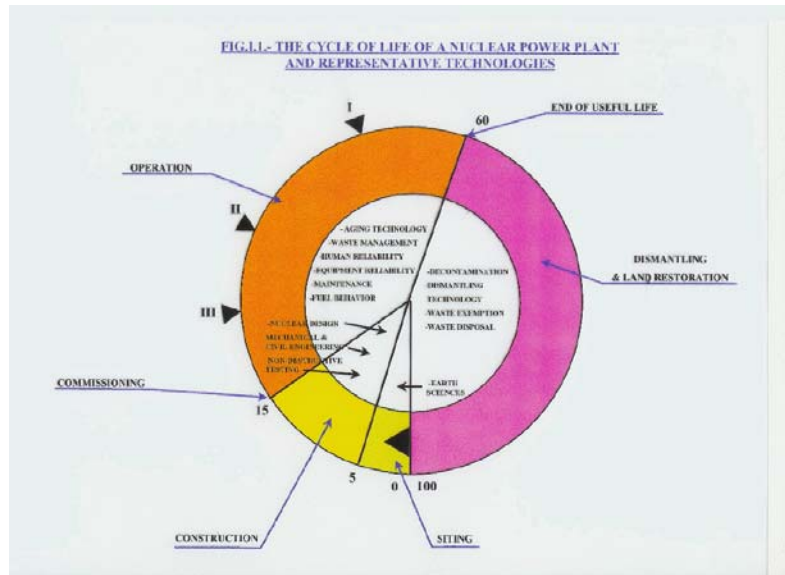
The Moratorium Consequences

- Nuclear activities were reduced to the operation of nine power plants
- Architect-engineers reduced their nuclear personnel
- The national constructor of heavy equipment, ENSA, diversified its production
- The fuel manufacturing company, ENUSA, limited its expected production
- The interest for nuclear education declined considerably

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6



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7

Knowledge Lost in Site Selection and Characterization

- Site selection and characterization very active in Spain in the 60's and 70's.
- Last site permit granted in 1976 (31 years ago)
- No detail regulations have been issued. IAEA standards can be of help
- Most experts in the utilities and the regulatory organization missing
- Need to transfer and absorb explicit knowledge
- PSA external events have been of help

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8

Knowledge Lost in Design and Construction

- Difficult to keep the title of qualified importer
- Last construction license granted in 1986 (28 years ago)
- No detail regulations issued on design and construction. IAEA regulations could be of help
- New designs include advanced safety features and safety/security integrated requirements
- Many deviations and circumstances found during construction demanding experience
- Most experts in the utilities and the regulatory organization retired or missing
- Need to absorb tacit and explicit knowledge
- No participation in the NEA driven Design Evaluation Multinational Programme

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9

Knowledge Lost in Testing and Commissioning

- Testing and commissioning is the phase when the interchange of knowledge is more intense
- Last testing and commissioning performed in 1987 (20 years ago)
- During commissioning many situations of interest are found requiring analysis, interpretations and corrections
- No detail regulations issued on testing and commissioning
- Most experts in the vendors, utilities and the regulatory organization are retired
- Need to capture explicit and implicit knowledge

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10

Summary

- Requirements for site selection and characterization have changed and most of the knowledge and experience gained has been lost.
- The construction time has a paramount importance in the economics; this requires a detail design and well defined regulatory requirements.
- Intense transfer of knowledge takes place during commissioning between the reactor provider, the utility and the regulatory organization. A large part of the experience gained has been lost.
- Programmes for transferring tacit and explicit knowledge are necessary for siting, design and construction and commissioning.