

**DISMANTLING AND REHABILITATION PROGRAMME OF NUCLEAR AND
RADIOACTIVE FACILITIES AT THE SPANISH RESEARCH CENTRE
(CIEMAT)**



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Abstract. Ciemat was gradually proceeding to the decommissioning of its more than 60 historical facilities. At present, a general decommissioning programme has been established that includes, to a different extent, all radioactive and nuclear facilities and their areas of influence, particularly those related to the front-end and back-end of the nuclear fuel cycle, hot cells and three experimental reactors. The purpose of the programme is to manage a model of a research centre integrating, on one side, a set of radioactive and conventional facilities and laboratories, and, on the other, a small area temporarily classified as a nuclear facility dedicated to the radioactive wastes management and providing an interim storage for materials under safeguards. The largest part of the radioactive wastes produced will be sent to El Cabril, a near surface disposal facility for low and intermediate level wastes, and the rest will be temporarily stored at Ciemat. This paper presents the main features of the programme and the lessons learned in its execution so far.

INTRODUCTION

After fifty years of activity in this field, Ciemat, in line with other world-wide research centres, was gradually proceeding to the decommissioning and rehabilitation of its more than 60 historical facilities. The current six years (2000-2006) decommissioning programme, the so called Pimic Project [1,2], includes the main nuclear and radioactive facilities of the centre related to the nuclear fuel cycle. At present, these facilities are classified in three groups: facilities already decommissioned, in safe shutdown for decommissioning and in operation.

The largest part of the radioactive wastes generated (393.000 kg) will be sent for final disposal to El Cabril, a low and intermediate levels wastes disposal facility of Enresa, the national organization responsible for the management of radioactive wastes in Spain. The rest (21.000 kg), that are not allowed to be stored in El Cabril, because of their α content, will be temporarily put in storage at Ciemat. Enresa and other companies with proven experience in dismantling are collaborating in the programme.

At the end of the programme, Ciemat will be reclassified from its current radiological classification as "a unique nuclear installation" to a centre formed by a small area classified as nuclear facility and a set of independent radioactive installations. The regulated nuclear area will be temporarily used as radioactive wastes management and an interim storage for materials under safeguards. The rest of the buildings and grounds of the site will be decommissioned for unrestricted use. This paper presents the main features of the Pimic project and the progress made so far.

HISTORICAL DEVELOPMENT OF THE CENTRE. PHASES OF ACTIVITY

Located at the University City of Madrid, the Centre for Energy, Environment and Technology Research (Ciemat), former Junta de Energía Nuclear (JEN), was created in 1951 as a public research organism with the objective of promoting the development and peaceful use of the nuclear energy in Spain. In a surface of about 20 Ha, 71 buildings in a built-up area of 71.000 m², Ciemat has 1.218 employees, 480 of them scientists and technicians and 738 auxiliary workers.

Ciemat has been recently transferred to the new Ministry of Science and Technology, being the Ministry of Economy through the General Directorate for Energy, Politics and Mines (DGPEYM), the responsible for authorisations and licensing of nuclear and radioactive installations, once the favourable report of the Spanish Regulatory Body (CSN). Since its foundation, Ciemat has known several phases of development:

- Period 1951-1984.

A total of 59 installations, 12 nuclear (NI) and 47 radioactive (RI) were constructed, covering most of the nuclear field. In 1980, after some grouping, the whole centre was classified by DGPEYM as "unique nuclear facility", formed by 14 NI and 38 RI.

- Period 1985-1995.

During this period, 3 NI and 19 RI, mainly dedicated to the front-end of the fuel cycle, were decommissioned and those facilities devoted to the back-end of nuclear fuel cycle were shutdown. In 1992, a general dismantling plan was initiated. In 1993, there were 6 NI in safe shutdown for decommissioning and 17 RI, in operation.

- Period 1996 - 1999.

Decommissioning is progressing. The centre had 4 NI and 2 RI in dismantling phase and 19 RI in operation, two of them were new facilities.

CURRENT SITUATION OF THE MAIN FACILITIES, BUILDINGS AND ITS ZONES OF INFLUENCE

A map of Ciemat is shown in Fig.1, where the position of buildings and the main installations is indicated, together with the rehabilitation and dismantling zones, contaminated grounds and buried tanks.

- NI-01 Reactor JEN - 1:

JEN-1 was a typical MTR 3 MW mainly fuelled with 20 % enriched U-235. It was shutdown in 1984. From its 165 spent fuel elements, roughly 40 were reprocessed and the remainder sent outside of the country. From 1997 to 2001, the facility was used to evaluate underwater metal cutting, decontamination and melting techniques [3,4,5]. Present dismantling activities will cover: the demolition of the reactor pool (concrete and metal surfaces, internals); the removal of all radioactive components still stored in the reactor hall; cleanup systems; auxiliary equipment; buried tanks (450 m³) and finally the ventilation stack. The reactor hall will be employed as an auxiliary installation in support of the general decommissioning programme.

- NI-03. Manufacturing plant of fuel elements for research reactors:

The facility consisted in a rectangular hall divided in three zones devoted to handle fissionable materials and manufacture the typical MTR sandwich plates fuel elements. In 1989, all fuel elements and components existing in the installation were evacuated. It remains for dismantling: ventilation and drain systems, diverse components and machinery, like rigs, glove boxes, a bridge crane, shielded packages, ovens, rolling mills, shearing machine, etc.

- NI-04. Metallurgical hot cells:

The hot cells were constructed in 1976. Different prototypes of fuel elements irradiated in JEN-1 and in Zorita Spanish NPP were analysed. Later, the facility was used for reactor material analysis. In 1998, a first dismantling phase of the facility was completed. Presently, it is being redesigned as a radioactive installation.

- NI-07. Plant for storage of radioactive liquid wastes:

Built in the seventies, the NI-07 had stored the radioactive liquid wastes generated in the reprocessing of the JEN-1 irradiated fuels. After 1990, the facility was shutdown. At present, there is a residual volume of wastes of about 30 litre and a total activity of 1,5 Ci. Ventilation, auxiliary systems and radiological survey remain activated.

- RI-16. Conditioning of radioactive liquid wastes:

It was built in 1975 for handling and managing the low and intermediate liquid wastes produced in Ciemat. In 1993, the facility was shutdown and the existing liquid sent for final storage to El Cabril. At present, only a remainder of 900 litre (65.000 MBq) of radioactive liquids remains in the facility. After dismantling, the facility will be employed as an auxiliary installation.

- RI-18. Reprocessing plant for MTR irradiated fuel:

Set up in 1967, the plant ran until 1971. It contains a hall of 350 m², 6 m height, divided in three modules. Dismantling work will cover: a hot cell, a chain of several glove boxes and two cells for plutonium storage and radioactive liquid storage. At present, there are 145 litre (213.000 MBq) in the installation. Auxiliary systems and radiological survey are in operation. In 1970, a contamination incident affected a surface of 215 m² around the facility. A fraction of leaked liquid flowed to Manzanares and Tagus rivers. Crops from the affected areas were transported to Ciemat for analysis and storage.

- Old installations for treatment of uranium ores and concentration process:

Old facilities (Buildings 20, 21, 22 and 65) were dismantled in 1991. During the rehabilitation of the buildings for conventional use (1998), some slowly contaminated surfaces with an estimated volume of 36,4 m³ were identified. The decontamination of the buildings is being carried out. The destination of wastes is not defined yet.

- Contaminated grounds and buried tanks:

Two old disposal lands of wastes, originated from uranium ores processing, were in addition contaminated by crops from RI-18 incident (1970); two other small surfaces have also been identified. Furthermore, several buried tanks exist containing water, sludge, mineral ores, etc. An amount of 247.000 kg of land, slowly contaminated, has been estimated; its destination or restoration is not yet defined.

RADIOLOGICAL CHARACTERISATION OF THE CENTRE. EXPECTED RADIONUCLIDES

During the period 1992 and 2001, more than 140 borings were practised. The radiological results can be grouped as follows:

- 150 - 17.000 Bq/g: Adjacent zone of RI-18
- 1 - 150 Bq/g: Crops from Manzanares bank river (RI-18 incident 1970)

- 0.1 - 1 Bq/g: Old disposal affected by uranium ores wastes
- < 0,1 Bq/g: Rest of the centre.

At present, a systematic radiological study of the centre is just being made. For that, the site has been divided in 27 zones. Analysis of each zone, including facilities and buildings, buried tanks and grounds, is complemented by a historical review based on documents, files and interview of old workers, when necessary. Furthermore, a new campaign of borings is engaged. It will provide a more complete database estimating the type and amount of wastes to be handled in compliance with the radiological clearance levels.

To define dismantling actuation and characterise the wastes generated, a special Unit has been created with the collaboration of different laboratories of Ciemat. It is foreseen that a total of 3.200 radiological samples will be analysed. The expected radionuclides, type of emitter and nature of wastes and samples are given in Table 1.

DECONTAMINATION AND DISMANTLING PLAN

Basically, two main lines of actuation are defined. They are centred in both, the complete dismantling of the shutdown facilities and the rehabilitation of zones with residual contamination. For carrying out that, the *Rehabilitation* and *Dismantling* subprojects have been organised [1,2]. Modernisation of the centre conventional part is also considered. *Auxiliary facilities* as temporary areas for the produced wastes conditioning will be also set up.

The general decommissioning project is being performed by Ciemat with close co-operation of Enresa. A quality assurance programme including respective functions, responsibilities and interfaces has been established, particularly in radiation protection and emergencies. Radiological protection of the workers, the public and the environment is assured and a committee ad-hoc has been created to apply the ALARA principle. The preparation of dismantling and waste management actions will be optimised according to the safety regulations for the workers and the environment. The collaboration of subcontracted companies is foreseen. A duration of 7 years from 2000 to 2006 and a budget of 43 Meuros are contemplated. The general schedule of activities is shown in Table 2.

The complete plan has been presented to the Spanish Regulatory Body for approval. Apart from organization and quality assurance, it includes an estimation of the radioactive source term; types, volume and generation rate of wastes and wastes management; together with their handling, treating, conditioning, storing and disposing procedures. Committees have been created to inform periodically Ciemat employees, the media and the public.

RADIOLOGICAL SURVEY OF THE WORKERS AND ENVIRONMENTAL IMPACT STUDY

A safety and environmental study including possible accidents scenarios is being carried out. It is based on the Ciemat radiological and environment survey network. In this regard, a continuous external and internal dosimetry survey of the about 20 persons directly related to the Pimic project is made [6]. The radiation protection service restricts the collected dose for workers to 1 mSv/person x a week. Along the total decommissioning programme, a total of 150 analyses for internal dosimetry control were estimated. They include whole body counter, urine, faecal and nose smear method analysis, in which the presence of radionuclides, like Cs, Co, I, U, Pu, Am, C-14, H-3 and Sr-90 will be studied. Collective and individual dose received up to now are largely below of the admitted limits.

For radiological survey, there is a measurement system covering the Ciemat site, Madrid city and surrounding region [7]. At Ciemat, it exists a local station and a set of 25 surface dosimeters. The station is made for a continuous survey of atmospheric particles and gases. Along the year 2001, it provided values of: $< 8,33 \cdot 10^{-5}$ Bq/m³ for total α ; $8,4 \cdot 10^{-5}$ Bq/m³ for total β ; $< 2,16 \cdot 10^{-2}$ Bq/m³ for Tritium; the dosimeters provided a range or values of 0,34-4,72 mSv. In the area of Madrid a regular

monitoring is made on water cleaning stations, air quality, surface water, sediment, soils, foods, plants and biologic organisms, etc, particularly on the banks of the Manzanares and Jarama rivers. Not significant values have been obtained in the last years. Natural background measured in Ciemat is comprised in the interval of 1,0-1,6 mSv/year.

WASTE MANAGEMENT

Firstly, wastes arising from the Pimic project should be characterised in order to determine their radioactive or conventional class, and secondly, their destination, either for definitive disposal in El Cabril or interim storage at Ciemat. In fact, those wastes of low and intermediate level that are not admitted in El Cabril will be temporarily stored at Ciemat.

Criteria for segregating waste

The limits for admission in El Cabril are given in Table 3. Moreover, the exemption levels for radionuclides in solid material will be based on the IAEA recommendations for specific activity and surface contamination [8]. An group of expert to define the radiological limits to be applied has been created among CSN, Enresa and Ciemat.

Volume and destination of waste

Table 4 shows the type, amount, origin and destination of radioactive waste generated in both rehabilitation and dismantling activities. Approximately, 414 tons of radioactive waste will be generated; a major part of them, 393 tons, will be sent to El Cabril for final destination and the remainder (21 tons) will be temporary stored at Ciemat. For this purpose, a limited zone of the centre (Fig. 2) will be redesigned (Building 55). In addition to radioactive waste, exemptible and conventional waste are expected; an estimation gives 155 tons for the former and 5.320 tons for the latter. Furthermore, the management of radioactive material still existing in the centre, such as radioactive sources, lightning rods, ionisation chamber of smoke detectors, minor amounts of uranium and thorium, etc. is foreseen.

FINAL REMARKS

At present, most of requested documents (quality assurance procedures, safety and environment studies, etc) and licensing ones have been submitted to the Spanish Authorities for approval. Also, radiological characterisation of installations and zones has been finished (NIs-01-03-04-07) or is underway (RIs-13-16-18). Regarding decontamination activities, they are progressing adequately in the Buildings 13, 20, 21, 26, 30, 31, 33, 36, 55 and 65 and in NI-03; being completed in NI-04. On the other hand, dismantling actions are expected to begin in 2004 (Table 2), when the licensing permissions are allowed. In conclusion, the Pimic project is progressing according the schedule. By the end of it, most of the Ciemat radioactive source term will have been considerably reduced and the decommissioning wastes evacuated outside the centre for final disposal, only a remainder will be stored temporarily in Ciemat.

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