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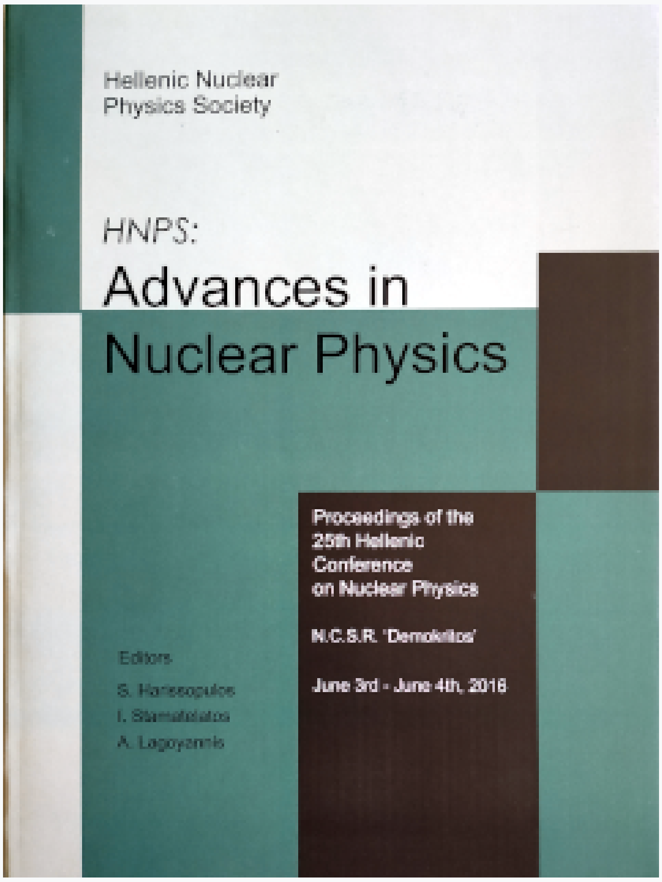

Activities and prospects of the Radioactive Materials Management Laboratory at the NCSR “Demokritos”

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Activities and prospects of the Radioactive Materials Management Laboratory at the NCSR "Demokritos"

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Abstract: The Radioactive Materials Management Laboratory (RMML) was established in July 2013. The RMML is the sole laboratory in the country that holds the know-how in all the fields of radioactive waste management and decommissioning of nuclear facilities.The challenge for the Laboratory is the prospect of development of the Centralized Infrastructure of the country for Radioactive Waste at the NCSR D.

Keywords: interim storage, disposal, radioactive waste management, decommissioning

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INTRODUCTION

The Radioactive Materials Management Laboratory (RMML) of the Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety (INRASTES) was established in July 2013. RMML is the sole laboratory in the country which holds the know-how in all fields related to the management of radioactive waste and decommissioning of nuclear facilities. The challenge for the Laboratory is: (i) the prospect the radioactive waste management facility of the NCSRD, to be upgraded and become the Centralized Infrastructure in the country, contributing crucially to protection of the public health; (ii) further development of expertise and skills in radioactive waste management and decommissioning of nuclear facilities by training specialized staff to meet development and operational needs of the Centralized Infrastructure.

Radioactive waste in Greece originates from medicine, research and industry, including waste from the past operation and the future decommissioning of GRR-1; waste with Naturally Occurring Radioactive Materials (NORM) results from some industrial activities like mining and mineral processing. The majority of radioactive wastes in Greece are Low Level Waste, while there is a small amount of Intermediate Level Waste, like irradiated parts from the reactor core, the control rods of GRR-1 and some sealed sources which cannot be exported for recycling.

The goal of the radioactive waste management is the protectionof human health and environment without leaving unnecessary burdens for future generations.The way to achieve this goal is thecontainment of radionuclidesby using a system of barriers: (i)inside interim storage facilitieswith security system, until decay/ clearance or pending disposal, the storage span cannot be more than 100 years; (ii)inside specific underground constructions (disposal facilities),where the radionuclides will decayin a time span of some hundreds to some hundreds of thousands of years.

For safe and effective management of radioactive waste (Joint Convention IAEA, COUNCIL DIRECTIVE 2011/70/EURATOM), an integrated approach is required. This means that the whole process from generation to disposal needs to take place in such a way that the management at each stage is compatible with the subsequent stages. Radioactive waste may undergo several stages depending on the type of waste and the strategy for its management: (1) Pre-treatment is the initial step that occurs just after waste generation that may involve collection, segregation/ classification, chemical adjustment decontamination and cutting/ disassembling; (2) Treatment involves changing of the characteristics of the waste by volume reduction, radionuclide removal or change of composition; (3) Conditioning involves transforming radioactive waste into a form that is suitable for handling, transport, storage and disposal. This might involve immobilization of radioactive waste, placing waste into containers; (4) Storage of radioactive waste may take place at any stage in the radioactive waste management process and aims to isolate the radioactive waste and help protect the environment; (5) Retrieval involves recovering waste packages from storage either for inspection, for disposal or for further treatment/conditioning and storage in new facilities; (6) Disposal occurs when packages of radioactive waste are deposited in a disposal facility, with no intention of retrieval.

The current activities of RMML towards upgrading of the facility of the NCSR “D” in order to meet the criteria and become the Centralized Infrastructure for radioactive waste management in the country are described briefly below.

Radioactive Waste Management Facility Security System

The design of a security detection system was based on the IAEANuclear Security Series No. 11, 2009. A system of 8 infrared high resolution cameras will be installed for monitoring the fencing of the facility locally as well as over a network. Also, infrared beams placed all around, inside the fence,will provide an audible alarm as well as a notification over a network (remote alarm) in case of breach. Magnetic contacts will be put at the three entrances of the new interim storage facilityas well as infrared detectorsinside the two departments.In case of violation the guard, who will monitor the facility through his computer screen, will be notified via the network.Additionally, the system includes a network interface printed circuit board, which gives the possibility to the guard to have the information about the breach point on his computer screen. Video recording and storage in hard disk 1TB is also provided. Furthermore, a controlled access system will be installed. The possibility of extension of the system to fully cover future needs is also foreseen.

Optimization of Radiation Protection

The Radiation Protection Program (RPP) for the radioactive waste management facility is beingupdated and the new version will be ready soon for submission to the Radiation Protection Officer. The main changes in the new version of RPPare: (1) the revised organization chart with description of responsibilities; (2) specifications of the new instruments and gauges; (3) the dose rate mapping and classification of the working areasby laying down daily rules in each area for radiation safety [1]. Dose rate measurements for gamma and neutron radiation were carried out in the whole region of the facilityby using the gauges which purchased via the Siemens project.

The specifications of a local HEPA ventilation system which will be used over the working bench or over the open hood cabinet, where the disassembling of radioactive devices is performed, were determined.

Radiological Characterization of Radioactive Waste and Verification of Clearance

The efficiencies of the two gamma spectrometry systems (based on 3X3 NaI(Tl) and 1.5X1.5 LaBr3(Ce) scintillation detectors) of the RMML were evaluated for point, area and volume source geometries by simulations performed with the MCNP code. The models were validated by using standard sources of the same geometry [2].

Moreover, the management option for cementation of the total amount of the VLLW resin for pavement construction inside the restricted area of the radioactive waste management facility was examined. The clearance verification methodology for the cemented waste form was developed [3, 4]. By this way 95 drums with resin waste could be cleared and removed from the interim storage facility of NCSR "Demokritos". Evaluated detector efficiencies for point and volume source which represent parallelepiped cement block, as well as experimental data for point sources are presented in Fig. 1.

Elaboration of the Safety Analysis Report

A programme of IAEA support for development of safety case for LLW and radioactive sources storage facility in NCSRD was prepared. The support provided will be arranged through one of Greece's regional, or interregional projects through the Technical Cooperation Department. The duration of the programme is 3-months. The greek specialists will be informed by international experts about the required documents and data, the specific components of a safety case and how it is developed and reviewed. Furthermore, the greek

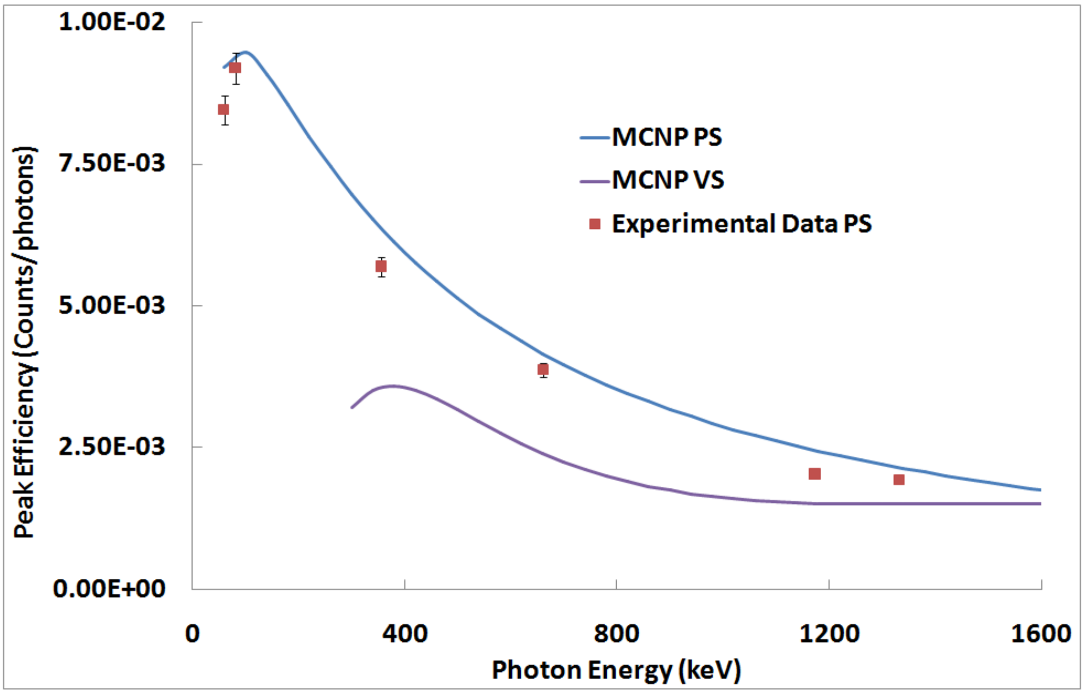

FIG. 1. Evaluated detector efficiencies for point and volume source which represent parallelepiped cement block and experimental data for point sources

specialists will be trained on IAEA software (SAFRAN) relevant to development of the safety assessment and will be assisted in development of the first draft of the safety case. The result of the programme will be the draft safety case for submission to the regulatory authority. Furthermore, greek specialists will have built the capacity to conduct such work independently in the future. Greek specialists from NCSRD as well as from the EEAE will participate in the programme and one safety expert from the System Reliability and Industrial Safety Laboratory of INRASTE will cooperate in the programme to support the greek team.

Planning and Costing the Decommissioning of Nuclear Infrastructures

The Laboratory participated in the coordinating team and chaired the Open-pool research reactors working group of the phase I of the IAEA DACCORD(Data Analysis and Collection for Costing of Research Reactor Decommissioning) project which was completed in December 2015. The DACCORD project was launched in 2012 for the analysis of the main cost elements, sincethe published data for decommissioning of research reactors tend to provide overall costs only. The work was undertaken by three main working groups: (1) TRIGA-type research reactors; (2) Pool-in-tank research reactors of Soviet design and (3) Open-pool research reactors. Each working group undertook a detailed cost analysis for different reactors of the relevant type.The participants provided detailed inventory and cost related information for the costing cases studied by the group, including the development of a complete cost file using CERREX-D(Cost Estimation for Research Reactors in Excel, Version D) which the structure was based on the International Structure for Decommissioning Costing (ISDC) of Nuclear Installations,OECD Radioactive Waste Management 2012. During the DACCORD Phase I the costing of the GRR-1 decommissioning was based on the composition and radiological status of the facility [5]. The assumption was the removal of all activated and contaminated parts without demolition of the reactor building thatwill be used in the nuclear sector. In August 2016 the phase II of the DACCORD project launched for collection and analysis of decommissioning and characterization plans as well as waste management approaches.The sensitivity and probabilistic analysis began in phase I, will be deepened. The Laboratory participate in the coordinating team of the DACCORD phase II and co-chair with the Centre de Cadarache, CEA the working group “collecting and analysis of information data from decommissioning and characterization plans and waste management approaches”.

Contribution to the International Discussion about Disposal Solutions for Countries Without Nuclear Power Plans

Greece, like many other countries without a nuclear power program and with low amounts of radioactive waste, needs convincing solutions for the safe and affordable disposal of the radioactive waste. The available solutions are high cost large disposal facilities, near surface and in deep geological layers that are appropriate for countries with a nuclear power programme. Even if the spent fuel is returned to the manufacturer and the production rate of radioactive waste is much lower than in countries with extended nuclear program, the radioactive waste from operation and future decommissioning of the research reactors and other small facilities as well as the radioactive sources that cannot be exported are not negligible. Usually a large part of the waste can be cleared as non-radioactive waste after storage or decontamination. The amount of remaining radioactive waste is not negligible, a partof that could be disposed at near-surface facility (LLW) while another partshould be disposed in deeper geological layers (ILW). The alternatives (see Fig. 2) for the safe disposal of radioactive waste for countries generating small amounts were presented attheEuropean Research Reactors Conference in Berlin [6]and will be also presented at the International Conference on the Safety of Radioactive Waste Management in Vienna [7].

Provision of Specialized Scientific Services

At present, the main financial source for upgrading the facility is the revenue from services. The Laboratory offers specialized scientific services to the Industry, hospitals and individuals. These services concern the withdrawal of spent/ disused radioactive sources and

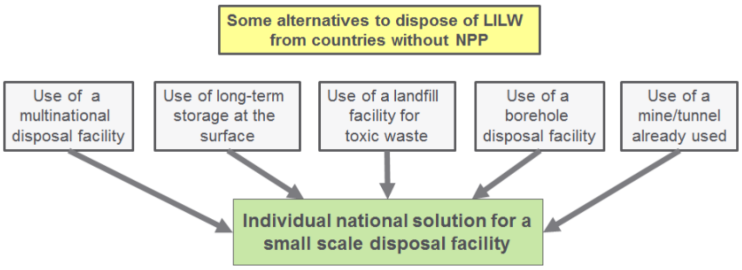

Fig 2.Alternatives for safe disposal of radioactive waste in countries without NPP

devices. The management options for the sources and devices are the export to a recycling facility, storage for decay or storage until future disposal.

The devices are dismantled for volume reduction and the parts which contain the radioactive sources are collected and characterized by determining the radiological condition and the characteristics of the source. Then, the sources are packaged in appropriate containers for interim storage, or for export to a recycling facility/ disposal facility in the country of origin. The dismantling procedures are carried out under a radiation protection program which is in accordance with the national and European regulations [8].

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