Contribution ID: **172** Type: **Poster**

DECOMMISSIONING OF L-54M REACTOR: PRELIMINARY TOPSOIL CHARACTERISATION OF REACTOR SITE AND SURROUNDINGS

Thursday, 26 May 2016 15:00 (3 hours)

Abstract: Scientific research cannot disregard environmental and public safety. The majority of worldwide nuclear power plants will undergo permanent shutdown over the next 10 years. This is also the case of L 54M, a homogeneous fuel thermal research reactor commissioned by Politecnico di Milano to Atomic International in 1958. It was used for research purposes in the fields of nuclear reactor physics and control, radiochemistry and for materials irradiation. It was shut down in 1979 and subsequently put under Safe Storage. In order to restore the reactor site to the status of "unrestricted re-use", also known as "greenfield"status, several operations have to be managed.
The subject of this work is the radiological characterization of the topsoil of the CeSNEF site, with the aim of assessing that no external radionuclide release occurred during the operational life of the plant. Standardised methods were employed in order to obtain representative and reliable results. Suitable sample pre-treatment procedures were applied. Gamma and beta spectrometric analyses were carried out. 137Cs and 90Sr were considered as representative radionuclides which could have been originated from reactor operations.

1. INTRODUCTION

The topsoil radiological characterization of the reactor Impacted zone is a preliminary step to final decommissioning. It aims at evaluating the radioactivity inventory in the area before the plant dismantling. The present work is based on the guidelines of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) [1] and the Environmental Radiation Survey and Site Execution Manual (EURSSEM) [2]. They provide a complete guidance on radiological, environmental and facility surveys. They are based on the best available practices for demonstrating compliance with dose or risk-based regulations of radioactively (or potentially) contaminated sites. Depending on the type of the matrix and on the future use of the material to be analysed, clearance levels were established by the Italian Competent Authorities [3]. The key radionuclides of concern when dealing with potential nuclear facility external contamination are: 3H, 14C, 40K, 54Mn, 55Fe, 60Co, 63Ni, 90Sr, 137Cs, 152Eu, 226Ra, 235U, 238U, 232Th, 241Am. Among these, 40K and the progenies of 238U and 232Th are naturally occurring radionuclides in environmental samples.

2. METHODS

The area surrounding the CeSNEF site was radiologically defined as Impacted zone of Class 3 [1]. For this area a uniform distribution sampling was chosen, together with a spot-like sampling in the not-Impacted zone [1,2]. The number of samples has to guarantee statistical significance with a standard level of confidence (usually 95%) [1,2,4]. The initial number of samples was set to 30, but supplementary samples will be collected if the statistic constrains are not respected. Georeferenced topsoil samples were collected following a standardised procedure [5]. Before analysis, proper sample preparation was necessary in order to obtain a homogeneous matrix. 250 mL plastic cylindrical beakers were filled with dried (110°C for 24 h) and sieved (up to 2 mm) samples for the HPGe (ORTEC GEM) gamma spectrometry measurement [5,6]. Furthermore, proper radiochemical preliminary operations were needed in order to evaluate the 90Sr specific activity [7,8]. An ultra-low background Perkin Elmer Quantulus liquid scintillator was employed as a Čerenkov beta counter to measure the 90Y specific activity.

3. RESULTS

Preliminary results are reported in Table 1.

Table 1. 137Cs and 90Sr specific activity [Bq□g-1] in preliminary samples, where DL is the detection limit [9].

Sample	10	11	12	13	14	15	16	17	18
137Cs	1.9E-1± 2.5E-3	8.4E-2± 1.6E-3	1.2E-1± 2.1E-3	1.1E-1± 1.9E-3	2.1E-1± 2.7E-3	2.0E-1± 2.5E-3	1.1E-1± 1.9E-3	1.7E-1± 2.5E-3	1.8E-1± 2.5E-3
90Sr	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL

1. CONCLUSIONS The preliminary results show that no contamination was spread outside the reactor building. The radioactive levels of the contaminants are comparable with the average values of the region, which were considerably affected by the Chernobyl accident. REFERENCES [1]NRC, EPA, DoE, DoD, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), 2000. [2]CND (FP6), Environmental Radiation Survey and Site Execution Manual (EURSSEM), 2010. [3]EC, RP 122 - Recommendation on Practical use of concepts of clearance and exemption: Part I, 2000. [4]ISO 11932 - 1996. [5]ISO 18589-2 - 2007. [6]ISO 18589-3 - 2007. [7]ISO 18589-5 - 2009. [8]Eichrom Technologies, Inc., Strontium 89,90 in Water (SRW01), Analytical Procedures, 2003. [9]ISO 11929-1 - 2010.

Country or International Organization

Politecnico di Milano (Italy)

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 Forms A and B via the official channels

YES

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Session Classification: Young Professional Session - Poster

Track Classification: Young Generation