ASPECTS OF SUPERVISION OF THE CLEARANCE OF NUCLEAR FUEL PRODUCTION SITES IN THE HANAU AREA

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Abstract. Five nuclear fuel production facilities in the Hanau area are shut down and have to be dismantled. The activities and the licenses for these activities are carried out and issued step by step. In charge of the licensing authorities, TÜV Süddeutschland evaluated clearance limits as far as they were not given by law and carried out the on-site supervision. This includes independent measurements, the control of a safe clearance strategy and the solution of the specific problems that arise by the characteristics of nuclear fuel. These problems were solved, mainly by specific gamma spectrometric measuring and evaluation techniques, such as adapted in situ spectrometry and a conveyor belt device. At the end of this process is a green field or a site with buildings which can be re-used for purposes not subject to the atomic law.

INTRODUCTION

There are five nuclear fuel production facilities that were operated in the Hanau area near Frankfurt, Germany. Due to technological reasons on the one hand and governmental decisions to phase out nuclear energy on the other hand, it has been decided to shut down the facilities.

The green-field option was chosen by the applicants for three of these facilities, whereas the buildings of the other two facilities are to be used for other purposes after decontamination.

Following the German Atomic Act [1] and the Radiation Protection Ordinance [2], decommissioning and clearance of residual material, buildings and sites are subject to licensing procedures, including public hearings. In general the licenses have been issued step by step.

METHODS

General procedure

In accordance with the licensing authority, decommissioning started by dismantling the production lines step by step after removing the nuclear fuel from the site. At the end of this process the buildings are empty. Only structural elements and ventilation systems remain. The dismantling of ventilation systems will proceed after decontaminating building structures, so that radiation protection conditions are provided as long as possible. The same strategy has to be pursued for radiation monitoring systems. Finally, clearance measurements have to be carried out and buildings pulled down, if projected.

As for contamination in the soil, e.g. Thorium, no clearance limits are given by the general regulations. The determination of clearance limits must be given by the licensing authority, which puts experts in charge of evaluating such limits according to general rules as in this case to the 10μSv/a concept [3].

Licensing Process

The experience in the German decommissioning projects has shown that step by step licensing is advantageous in many aspects [4, 5] - even more so than with the construction of nuclear power

plants. Difficult steps can be planned based on the experience from previous work. The knowledge of the radiological state and the general data background of the site are constantly growing. This licensing process allows changes without having to modify the license.

On-site supervision

In general all activities on-site are supervised by an independent inspection organization such as TÜV Süddeutschland in charge of the licensing authority. On-site supervision and evaluation have to establish compliance of activities with documents evaluated during the licensing procedure. The on-site supervision usually includes independent radiation measurements by TÜV-Süddeutschland.

Clearance measurements and their strategies

In the final phase of decommissioning nuclear fuel facilities, clearance measurements are of essential importance. Their quality makes sure that the amount of waste is reasonable and the sites and materials released meet the requirements for a safe clearance.

Taking into account the regulations of the radiation protection ordinance [2] and the technical standards such as DIN 25457 [6] and DIN 25462 [7], specific strategies are required due to the characteristics of the fuel formerly processed, which are as follows:

- Natural background radiation is present in all mineral material to a different extent. Screening measurements for identifying radioactivity, which may have penetrated structure material, e. g. direct surface measurements, will fail due to the very small ranges of Beta and Alpha emitters in material and due to the background radiation e. g. by natural Thorium;
- Uranium and Thorium isotopes and their decay products, TRU and fission products (from reprocessed Uranium) occur, as well as different amounts of enrichment of U-235 (less than 3.5% up to high enriched material);
- U-235, the Gamma emitter, which is easiest to detect, emits at 185 keV. At this Gamma energy there is a superposition with Ra-226 of natural origin. Therefore it is difficult to reduce the effect of the background radiation in areas where contamination is low; and
- Due to low Gamma energy of 185 keV only layers of a certain thickness can be monitored for hidden U-235 by Gamma spectrometry.

As an independent expert in charge of supervising the applicant's activities on-site TÜV Süddeutschland is required to provide different measurement strategies if possible [8, 9, 10, 11]. This means that TÜV-Süddeutschland has to analyse the applicant's measurements before defining its own methods and measurements.

To solve the specific requirements mentioned above the following procedures have proved to be reliable:

- Investigations with respect to clearance measurement strategies have recently been carried out by TÜV-Süddeutschland taking into account the typical conditions of the different nuclear facilities [12]. All aspects have been covered: suitable measuring methods, sampling frequencies, averaging areas and masses, and the influence of the variation of the radionuclides.
- As the applicants preferred classical strategies of clearance measurements - surface contamination measurements, sampling and evaluation at the laboratory – in-situ gamma spectrometry is used more and more today. Application of in-situ gamma spectrometry for clearance measurements has been investigated into and demonstrated by TÜV-Süddeutschland [13, 14].
- Due to the amount of material for disposal [3] during remediation at one of the sites, measurement and evaluation is done automatically using a conveyor belt device equipped with four Germanium detectors. In this case the independent supervision by TÜV-Süddeutschland is carried out through sampling and immediate measurement in connection with online checks of the electronically based evaluation of the applicant's measurements.

- For reducing the background effect, correlation analyses have been carried out for the different materials in the planning phase. Then the role of natural background radiation was subject to determining and evaluation of clearance values as well [3]. In all cases the measurements and their evaluation take place using only one radionuclide composition which is defined before for all materials of the plant. There are procedures in the applicant's operation manual to prove compliance case by case. Monitoring the actual radionuclide composition is a part of the supervision by TÜV-Süddeutschland as well.
- Special attention must be paid to sewer systems and hidden contamination behind liners or within roof layers. Experience shows that these problems can only be solved case by case. With the license allowing a certain scope for decision, the concept of on-site supervision provides appropriate solutions.

CONCLUSION

Issuing licenses for decommissioning and clearance of nuclear fuel production sites in several steps, as done in the Hanau area, proved to be useful.

Put in charge for the on-site supervision of five nuclear fuel production sites by the licensing authorities, TÜV-Süddeutschland proved that decommissioning could be safely carried out with a reasonable amount of radioactive waste to be disposed of. The specific clearance problems arising from the characteristics of nuclear fuel could be solved, mainly by specific gamma spectrometric measuring and evaluation techniques, such as adapted in situ spectrometry and a conveyor belt device.

At the end of this process there is a completely cleared site, in some cases with buildings that can be re-used for purposes not subject to the atomic law.

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