Contribution ID: **4** Type: **not specified**

Source Term Estimates for the Environmental Impact Analyze of the European Spallation Source Facility_____

Monday, 28 April 2014 18:03 (9 minutes)

As other accelerator based facilities, the European Spallation Source (ESS) facility will not be a totally isolated system. It will interact with the environment. One can distinguish four types of radiological impacts: i) releases of activated air, ii) discharges of activated water, iii) activation of soil and groundwater, iv) stray radiation in the environment. The Swedish legislation requires a demonstration that the sum of the doses resulting from the exposure of any member of the public to ionizing radiation dose does not exceed the specified limit.A radiological assessment has been produced to provide that demonstration [1]. This evaluation was based upon the actual status of the ESS design as given in the Ref. [2].

This paper reports the source term estimates for the radiological assessment of the dose that would arise: i) from the routine discharge of gaseous and aqueous radioactive waste for ESS facility as well as from ii) the groundwater activation around the linac tunnel and of the beam dump and the target station monolith foundations. Additionally, estimates of the stray radiation effects were done by coupling the results of the deep penetration calculations with analytical formula [3].

The source term for atmospheric releases was separated into two distinct release operations: i) on-line emissions, and ii) emissions resulting from processing. On-line emissions through the stack into the atmosphere were derived from both accelerator tunnel (AT) and target station (TS). For the tunnel the source term was derived from the activation calculations of the air [4] and conservative assumptions upon the ventilation rate. As the Helium cooling loop of the target is a closed circuit the single release source from the target station accounted was the leakage rate of the loop. The main contributions to atmospheric releases arising from processing operations are on-site cementation of tritiated water and the hot cell operations such the cut of the target shaft. The assessment shows that the major contribution to the source term (H-3, Be-7, C-11, N-13, O-15, Ar-41, P-32, P-33, S-35) comes from the linac tunnel. The most important nuclide released from the target station is I-125 while the “post processing” source term given mainly by tungsten dust has negligible effects.

The source term for the migration of activated-groundwater towards the ESS site border (distance 300 m) is driven mainly by H-3 and other radionuclides produced by spallation in the earth around the linac tunnel. Derivation was based on calculations assuming a linac beam loss of 1 W/m, and standard shielding (60 - 80 cm of concrete). The activation of the groundwater underneath the beam dump shielding and the target station was also assessed. As resulted from the bulk shielding calculations for both linac and target station the dose rates on the top of the shields are at the level of 1 microSv/h. Based on this result roughly derivation of the “skyshine” dose from the emitting surface of the shield in a distance corresponding to the site border or more, may be easily achieved. However, more rigorous calculations have to be performed to derive the levels of neutrons escaping outwards through holes or thin parts of the shields.

1. D. Ene, Evaluation of the Environmental impact of the ESS facility, ESS Internal Report, 2013
2. S. Peggs, ESS Technical Design Report, 2013
3. A. H. Sullivan, A Guide to Radiation and Radioactivity and Radioactivity Leveles Near High Energy Particle Accelerators, Nuclear Technology Publishing, England, 1992
4. D. Ene Radioprotection studies for ESS superconducting Linac, Progress in Nuclear Science and Technology, Vol. 2, pp.382-388, 2011

Summary

Radiological studies were performed for the European Spallation Source Facility in order to determine radiological impact to the environment.

Primary author: ENE, Daniela (European Spallation Source, ESS-AB, Sweden)

Presenter: ENE, Daniela (European Spallation Source, ESS-AB, Sweden)

Session Classification: Poster Session and Reception