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Analysis of External Radiation Exposure for Security Officers in NORM Storage Facilities in a Tin Industry in Indonesia

ANALYSIS OF EXTERNAL RADIATION EXPOSURE FOR SECURITY OFFICERS IN NORM STORAGE FACILITIES IN A TIN INDUSTRY IN INDONESIA

W.P.D. BETA
Indonesia Nuclear Energy Regulatory Agency (BAPETEN),
Jakarta, Indonesia
Email: putradaeng29@gmail.com; d.beta@bapeten.go.id

D.DARSINO
Indonesia Nuclear Energy Regulatory Agency (BAPETEN)
Jakarta, Indonesia

Synopsis:
In IAEA SF-1 and GSR Part 3 stated 'facilities and activities'as a general term encompassing any human activity that may cause people to be exposed to radiation risks arising from naturally occurring or artificial sources. That is why external radiation from NORM (Naturally Occurring Radioactive Material) is subject for investigation of this research. In Indonesia regulation, that is article 4 of Act No. 10 of 1997 Nuclear Energy stated that the regulatory body, (the BAPETEN), does the task via regulation, licensing, and inspection. The objectives of it are for the safety, security and welfare of the workers, public and preservation of the environment. Also it is based on GR No. 33 of 2007 on Radiation Safety and Security of Radioactive Sources and BCR No.1 of 2017 on Implementation of Inspection in controlling nuclear energy utilisation, Article 88 stated that BAPETEN coordinates with government agencies related to the implementation of inspection to producers of Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) through inspection activities.

In a simple way, NORM is radioactive material that form naturally and or because of technologically intervention that make them higher in concentrations. Indonesia differentiates between NORM and TENORM. But in the paper, authors do not make them differentiation. BAPETEN issued licensing for NORM storages for period of 5 years. Licensee has to ensure the safety of the workers, public and the environment during the period of the licence.

NORM is still having economic value. NORM can be reprocessed to obtain its rare earth substances. Rare earth substances can be useful in semiconductor industries, and others.

External radiation exposure of NORM to the workers and security officers has not been addressed properly. Because there are lack of supporting data related to radiation dose. The purposes of the paper are to analyse and present the external radiation exposure received by security officers in doing their job to secure NORM storage facilities in a tin industry in Indonesia. Given the assumptions that the security officers do their job 24 hours, 7 days a week with 3 shifts. The security surveillance buildings are located onsite of the facilities, tens of meters distance from NORM. But there were lots of NORM spills around. There are 2 (two) NORM storage facilities of interest. One facility is for monazite (12 tonnes) and ilmenite (2 tonnes) storage (Facility A). Another one is for tin slag (38 tonnes) storage (Facility B). The system of storage is open dumping in a large area location, with the size of 200 meters x 200 meters of each facility. The facilities were surrounded by 3 meters height of steel fence.

Methods used in the paper were observation in inspection activity and primary data analysis from direct measurements with calibrated gamma survey meters in NORM storage facilities. Authors conducted inspection

and measurement in the location, including in security officers positions and their base at the facilities. Data analysis will be presented in form of mapping of radiation survey, dose calculations based on the mapping and dwelling time of the officers in the sites, tables and documentation photos.

The measurement of dose rate for Facility A, given to the range value of 5.56 - 41.6 microSievert/hour. The value of 41.6 microSievert/hour was measured at the monazite surface. While the value of 15 microSievert/hour was measured at ilmenite surface. At ground surface measured in the range value of 13.1 - 25.6 microSievert/hour, while 9 microSievert/hour was measured at the position of the officer inside the surveillance building. The value of 5.56 microSievert/hour was measured at the fence door.

The measurement of dose rate for Facility B, given to the range value of 1.5 –9.7 microSievert/hour. The value of 9.7 microSievert/hour was measured at the tin slag surface. At ground surface measured in 5.1 microSievert/hour, and 3.7 microSievert/hour was measured at 1 meter above the ground. While 1.5 microSievert/hour was measured at the position of the officer inside the surveillance building. The value of 0.8 microSievert/hour was measured at the fence door.

Authors use conservative assumption that security officers spend most of their time of duty in the surveillance buildings within 24 hours, 7 days a week with 3 shifts, one personnel per shift, 365 days per year. While the time for security patrol and breaks were ignored, because they were insignificant.

Results were found that security officers in Facility A receive higher total external radiation exposure, which was 78.84 milliSievert/year in total or 26.28 milliSievert/year/personnel. While in Facility B, they receive 13.14 milliSievert/year in total or 4.38 milliSievert/year/personnel. These radiation doses were calculated based on instantaneous measurement results at the time inspection activity.

Authors assume that security officers are radiation workers for planned exposure situation. Because, it is based on paragraph 3.4 of IAEA GSR Part 3, the requirements for planned exposure situations apply to include in NORM storage facilities; therefore, 20 milliSievert/year dose limits were applied to them.

To conclude, the management of facilities has to take immediate radiation protection action to reduce external radiation dose from NORM exposure, especially for security officers who work in Facility A in the first priority, such as relocate security surveillance buildings to lowest dose rate area with RPO's assistance, equipped them with personal radiation monitors, monitoring radiation regularly, scheduling the officers wisely, and adding more personnel. In suggestion of the research, based on this case, BAPETEN need to include consideration of radiation protection for the external radiation exposure from NORM/TENORM in the regulation.

Keywords: NORM, external radiation exposure, security officers, tin industry, Indonesia

Primary author: Mr BETA, Werdi Putra Daeng (Nuclear Energy Regulatory Agency (BAPETEN), Indonesia)

Co-author: Mr DARSINO, Darsino (Nuclear Energy Regulatory Agency (BAPETEN), Indonesia)

Presenter: Mr BETA, Werdi Putra Daeng (Nuclear Energy Regulatory Agency (BAPETEN), Indonesia)

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