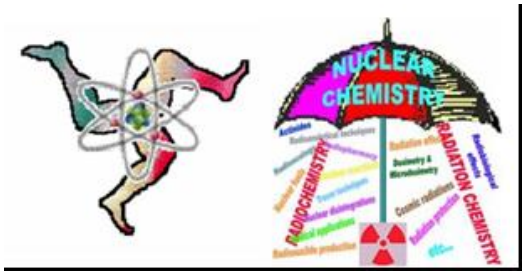

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TENORM accumulation and management in refineries

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Naturally occurring radionuclides are present at varying concentrations in the Earth's crust and can be concentrated by processes associated with various industrial activities, such as the ones involved in the recovery of oil and gas. This "enhanced"NORM (Naturally Occurring Radioactive Material) are also known as TENORM (Technologically Enhanced NORM) and their presence in the upstream oil sector is a widely known phenomenon, that occurs because of the large quantities of production water usually present in the plants, that can carry up to the surface the radium-226 and radium-228 salts that form in the reservoir. In production plant therefore there might be presence of large amounts of TENORM in the form of sludge, scale, mud, etc, with varying activity concentration and usually large presence of radium-226 and radium-228.

In the downstream oil sector, nevertheless, water percentage upon the total product (watercut) is usually very low, thus lacking the main reason of NORM presence in components for upstream sector.

In this work, it is presented eni's 4-step plan for the evaluation of TENORM presence in refineries, its characterization and the management of the risk coming from its presence.

The first step of the plan is a preliminary survey in various refineries, to detect the presence of radiometric anomalies on components caused by TENORM, comprising the collection of samples of different matrixes, potentially contaminated by natural radionuclides. Dose rate values higher than environmental background were detected in some areas of the plants, i.e. the mud treatment area, the water storage tank, desalters, the cocking heater, the crude storage tank.
Samples collected from these points showed increased concentrations of natural radionuclide, especially lead-210 concentration up to 15000 Bq/kg, to be compared to radium-226 activity concentration not exceeding 200 Bq/kg.

Since TENORM are present at all, it was necessary to evaluate the exposure of the workers of the plant and to check that it is compliant to Italian Legislation dose limit, equal to 1 mSv/annum. To perform the dose assessment, working activities are divided into 2 main categories, ordinary activities that include plant surveillance and parameters registration, and extra-ordinary maintenance such as components cleaning, maintenance and decommissioning.

Next stage is the workers training, based on a general radioactivity induction and information about the risk of the specific site. Eni also introduced contaminated components labelling with dedicated signals.

Finally, all the waste coming from these plants should be adequately sampled and characterized, to assure best disposal solution depending of their radiometric content.

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