

# Demonstrating Safety through Environmental Monitoring around Nuclear Installations in Pakistan

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## BACKGROUND

- ◆ Nuclear installations during normal operation may release small amounts of radioactivity into the environment in the form of gaseous or liquid effluents.
- ◆ The released radionuclides travel into various environmental components and may become part of human food chain. It is therefore important to assess the concentration of these radionuclides in environmental media in order to ensure the safety of the public and environment.
- ◆ According to PNRA regulations on radiation protection, the licensees are required to submit environmental monitoring program to regulator for approval before issuance of operating license and responsible to carry out environmental monitoring in accordance with this program during operation of Nuclear Installations.
- ◆ PNRA as a national regulator verifies the licensee commitment to the compliance of regulatory requirements through periodic inspections, review of licensee reports and independent Environmental Monitoring studies.

- ◆ Gross Alpha/beta counting system, a low background gas flow proportional counter was used to determine gross activity concentration of alpha and beta emitters.
- ◆ Liquid Scintillation Analyzer (LSA) was used to determine Tritium in water samples.
- ◆ For the identification of gamma emitting radionuclides and the measurement of their activities, HPGe (High Purity Germanium) based Gamma Spectrometry System was used.



Fig.02. (From L to R) Gamma Spectrometry System, Gross Alpha beta Counting System, Liquid Scintillation Analyzer

## SAMPLE COLLECTION AND PROCESSING

- ◆ Environmental monitoring was carried out at three sites, first site (Site-I) containing four NPPs operating units, second site (Site-II) containing three NPPs operating units and third site (Site-III) containing two research reactors.
- ◆ More than 500 samples of various environmental media such as soil, water, air, food etc. were collected from on-site and off-site locations around each site during the period 2016 - 2021.
- ◆ All samples were collected and processed in accordance with the IAEA Technical Report Series No. 295 and 486.



Fig.01. Sample Collection and Processing Activities

## RADIOMETRIC ANALYSIS OF SAMPLES

- ◆ Analysis of samples was performed for identification and quantification of potential alpha, beta and gamma emitting radionuclides associated with the operation of the facilities.
- ◆ Gross alpha/beta counting system was used as a screening tool to determine whether radionuclide specific analysis to further characterize the samples is required or not.

## RESULTS AND DISCUSSION

- ◆ Analysis results revealed the presence of minor trace levels of Cesium ( $^{137}\text{Cs}$ ) in few soil samples. Graphical representation of average activity concentration of  $^{137}\text{Cs}$  in Soil samples is presented in Fig. 03.
- ◆ Tritium ( $^3\text{H}$ ) was detected in few water samples. However, activity concentration values are far below the guidance level of 10,000 Bq/l specified in Regulations on Radiation Protection- PAK/904 (Rev. 01).
- ◆ Gross alpha and gross beta activity concentration values in water samples are well below the WHO recommended screening criterion of 0.5 Bq/l for gross alpha and 1 Bq/l for gross beta in drinking Water samples. Graphical representation of average activity concentration of  $^3\text{H}$ , Gross Alpha and Gross Beta in water samples is presented in Fig. 03.
- ◆ The analysis results of anthropogenic radionuclides in remaining environmental media (air, vegetation, food etc.) are less than Minimum Detectable Activity (MDA).

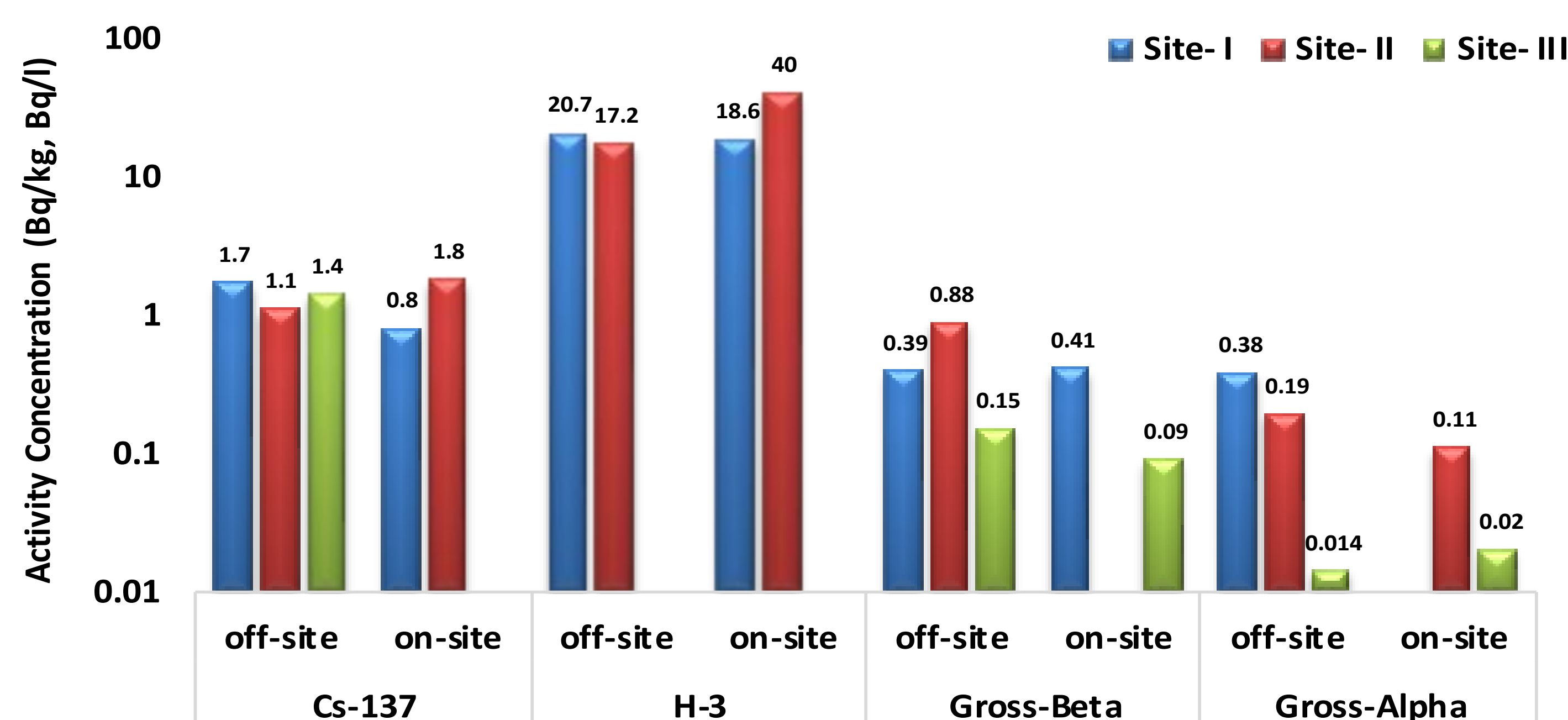


Fig. 03. Graphical Representation of Average Activity Concentration (Bq/kg or Bq/l) of  $^{137}\text{Cs}$  in soil samples and  $^3\text{H}$ , Gross Alpha and Gross Beta in Water Samples

## CONCLUSIONS

- It is concluded from the Environmental Monitoring study that:
- ◆ Operation of the nuclear facilities do not pose any radiological risk to the environment and public residing in the vicinity of sites.
  - ◆ Environmental protection is ensured during operation of Nuclear Installations in Pakistan.