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Title

ENEA fast internal contamination methodology for nuclear emergency

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Text

The Fukushima Dai-ichi accident stresses the necessity of organized and tested procedures for conducting large scale individual monitoring of internally contaminated public in a nuclear emergency. For the issue the implementation of a mobile whole body and thyroid counter (WBC-TC), able both to distinguish each emission line of the main interesting gamma radionuclides (^{131}I , ^{132}Te - ^{132}I , ^{137}Cs and ^{134}Cs , ^{103}Ru , ^{60}Co) and to acquire useful data in a very short time, can represent the best solution. The ENEA Radiation Protection Institute has recently acquired a trans-SPEC-DX-100 detector with the purpose to develop, in a nuclear emergency situation, a procedure for fast internal monitoring. The instrument is equipped with a variable length tripod, whereon it can be mounted with a customized support tilted for WBC-TC measurements. Efficiency calibrations were performed by means of an adult BOMAB phantom, placed both sit on a chair and laid on a stretcher, and of three neck phantoms (5 y.o., 10 y.o. and adult); in all cases, no collimation was used in order to maximize the efficiency. The detector performance was determined in an emergency tent arranged in open field by the 7th NBC defense Regiment “Cremona” of the Italian Army by means of a set of 10 volunteers acquisition. Detection limit (DL) values in Bq have been evaluated using ISO 28218, instead “DL committed effective dose” in mSv (i.e. the dose corresponding to an in vivo amount equal to a DL) have been evaluated assuming an acute inhalation intake 5 days before measurement by means of the MONDAL3 software.

The system in WBC configuration showed (acquisitions of 3 min counts) DL values equal to 3200, 4500 and 4600 Bq respectively for ^{60}Co , ^{134}Cs and ^{137}Cs . This results in “DL committed effective doses”, respectively, equal to 0.76, 0.10 and 0.07 mSv. The system in adult T configuration (acquisitions of 100 s counts) showed a DL value for ^{131}I equal to 120 Bq, resulting in a “DL committed effective dose” equal to 0.01 mSv and a “DL committed equivalent dose” to thyroid equal to 0.27 mSv.

Considering that the evaluated “DL committed doses” are lower than the annual limit of effective dose for public exposure reported on Council Directive 2013/59/Euratom (1 mSv), the described instrument has a significant sensitivity to be used for fast internally monitoring in nuclear emergency response. Performing the 3 min measurements, a large amount of individuals (up to 250) can be monitored daily. Furthermore the system can be used as a valid tool to evaluate nuclear dangers in a malevolent event involving a gamma emitter dirty bomb.

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