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IMPROVED METHOD FOR MEASURING THE EFFECTIVENESS OF RADIATION FIELD CONTROL TECHNIQUES

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Objectives: To develop a cost-effective and improved technique to evaluate the effectiveness of radiation field control techniques.

Dose rate (DR) measurements are commonly used to assess the efficiency of operating procedures (chemistry control, shutdown procedure, additive injection to the coolant) and design options to limit deposition of corrosion products. Although DR measurements are easy and cheap to perform, they are subject to many inaccuracies and have limited validity. Inaccuracies arise from activity in the water, how much water is in the circuits, background dose rates, wall thickness of pipes and the density effect of water at temperature. Previously, direct in-situ spectrometry measurements were developed with the so called EMECC device. These techniques proved very precise and provide good information about corrosion product behavior, if the necessary precautions are taken. However, they are complex and costly. The proposed methodology therefore relies on a few gamma ray measurements reinforced by dose rate measurements done with and without collimation. It allows a large number of surveys and provides very reliable results.

This methodology has been successfully used by CEA and EdF to prepare maintenance jobs such as SG replacement, and is integrated in "PANTHERE V1" software. This software enables to calculate DRs and associated uncertainties whatever the complexity of geometry and sources distribution, and reciprocally, to determine sources from DRs measurements (collimated or not) with automatic minimization of uncertainties.

Comments: The essence of the proposed method is as follows:
(1) Gamma ray spectrometry measurements of the deposited activity are carried out in-situ at a limited number of selected locations.
(2) The reasonable assumption is made that the nuclides' spectrum does not have large variations for a given portion of the circuit. This was verified by about 1,500 gamma ray measurements.
(3) Dose rate measurements were carried out using a collimated detector in order to minimize the contribution from the background.
(4) Dose rate factors [(mSv./h)/(GBq/m^2)] were calculated for the main nuclides, taking

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geometry into account.
(5) The amount of deposited activity was then determined.

It was found that there was very good agreement between the calculated dose rate derived from the measured deposited activities and the dose rate factors (DRF) on the one hand and the measured collimated dose rates on the other. More over the calculated deposited activities derived from collimated dose rates and DRFs were in good agreement for the main contributors (Co-60 and Co-58).

Remarks: The correct assessment of the extent of success with various radiation field control techniques is essential. The currently used dose rate measurement technique is very simple but suffers from many uncertainties that can be large. The technique of directly measuring dose rate sources in-situ using gamma ray spectroscopy can be very accurate but is more expensive and difficult to perform.

The proposed method combines both techniques and enables a fair estimation of deposited activities on the pipes and components of the circuits. The knowledge of the sources is thought to be much more indicative than the dose rates to assess the effectiveness of radiation field control techniques. Both the uncertainties and the cost are reduced by this technique.

References: Brissaud,.A., and S.Anthoni, "Improved Methods to Evaluate the Effectiveness of Radiation Field Control Techniques," Proceedings, EPRI Radiation Field Control and Chemical Decontamination Seminar, Tampa, Florida, November 1995, available from EPRI Distribution Center, P.O. Box 23205, Pleasant Hill, CA 94523, Phone: (501)934-4212.

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