CHARACTERISTICS OF OUTAGE RADIATION FIELDS AROUND VARIOUS REACTOR COMPONENTS

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Activity monitoring surveys, consisting of gamma spectroscopy and dose rate measurements, of various CANDU station components such as the reactor face, feeder cabinet, steam generators and moderator heat exchangers are often performed during shutdown in order to trend the transport of activity around the primary heat transport and moderator systems.

Recently, the increased dose expenditure for work such as feeder inspection and replacement in the reactor vault has also spurred interest in improved characterization of the reactor face fields to facilitate better ALARA decision making and hence a reduction in future dose expenditures. At present, planning for reactor face work is hampered by insufficient understanding of the relative contribution of the various components to the overall dose.

In addition to the increased dose expenditure for work at the reactor face, maintenance work associated with horizontal flux detectors and liquid injection systems has also resulted in elevated dose expenditures. For instance at Darlington, radiation fields in the vicinity of horizontal flux detectors (HFD) and Liquid Injection Shutdown System (LISS) nozzle bellows are trending upwards with present contact fields being in the range 16-70 rem/h and working distance fields being in the range 100-500 mrem/h.

This paper presents findings based on work currently being funded by the CANDU Owners Group. Measurements were performed at Ontario Power Generation's Pickering and Darlington nuclear stations. Specifically, the following are addressed:

- Characteristics of Reactor Vault Fields
- Characteristics of Steam Generator Fields
- Characteristics of Moderator Heat Exchanger Fields

Measurements in the reactor vault were performed at the reactor face, along the length of end fittings, along the length of feeders, at the bleed condenser and at the HFD and LISS nozzle bellows. Steam generator fields were characterized at various elevations above the tube sheet, with and without the primary/secondary side waters being drained. Spectroscopy measurements utilized both germanium and cadmium-zinc-telluride detectors.

Spectroscopy measurement results were interpreted to estimate both the percent contributions of various radionuclides to the radiation fields as well as the radionuclide activities associated with the various components. The ultimate objective is to integrate the individual characteristics of various reactor vault components into an overall model capable of predicting dose rates at any location in front of the reactor face.