UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 4 1980

MEMORANDUM FOR: Victor Stello, Jr., Director
Office of Inspection and Enforcement

FROM: Robert J. Budnitz, Director
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER # 86 - A GAS SCINTILLATION PROPORTIONAL COUNTER FOR MEASURING PLUTONIUM IN HUMANS AND THE ENVIRONMENT

This memorandum transmits the results of completed research on the use of a gas scintillation proportional counter for measuring plutonium in humans and the environment. This work was performed by the Battelle Pacific Northwest Laboratory (PNL) under the direction of the Environmental Effects Research Branch of the Office of Nuclear Regulatory Research (RES) in response to Research Request IE-76-3.

Gas scintillation proportional counters were originally developed for use in spacecraft for X-ray astronomy studies. The Battelle principal investigator recognized their potential application for the measurement of plutonium and other transuranic radionuclides in the human body and the environment. The increased sensitivity of GSPCs over NaI (Tl) scintillation detectors and conventional proportional counters results from the better photopeak resolution for the L-X-ray photopeaks of plutonium-239.

The first half of this project was spent in constructing prototype counters which would be uniformly responsive over the entire volume of the counter and which would give excellent energy resolution of broad beam sources of plutonium-239. Although counters using a reflector and a wave shifter produced more measurable light than those measuring the ultraviolet light directly, the direct ultraviolet light counter was chosen because the reflector and wave shifter coatings produced excessive sparking and non-uniform response. The problem of poor resolution was overcome by using converging concentric ring electrodes in the drift region and by using a spherical window and a spherical grid design.

Both the pulse height and energy resolution of the GSPC were measured over the energy range of 5.9 to 59.5 kev. The pulse height was very linear over this range, but the energy resolution did diverge slightly at higher energies. One counter was operated for more than a year with no indication of degradation in resolution or efficiency.

The GSPC was calibrated for lung counting using the Lawrence Livermore Laboratory tissue-equivalent human-torso phantom. The counter was used to measure two people who had known body burdens of plutonium-239 and americium-241. It had the same counting efficiency as the 12.5 cm diameter Phoswich detector, typically used for determining lung burdens of plutonium. Because of the naturally occurring radioactivity in the materials of which the counter was constructed, the sensitivity of the GSPC was not better than that of the Phoswich detector. Construction of a low background GSPC using extremely pure construction materials was begun, when this project ended. When completed, it will be the most sensitive counter available for measuring plutonium in vivo.

We are enclosing a copy of the final report for the project. We recommend that your staff review it and determine if you would like further research to determine the usefulness of GSPC's for measuring plutonium in the environment. The RES technical contact for this work is Dr. Judith D. Foulke (427-4358).

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