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MEMORANDUM FOR: Edward F. Hawkins, Section Leader
Low-Level Waste Licensing Branch
Division of Waste Management

FROM: Stanley M. Neuder
Low-Level Waste Licensing Branch
Division of Waste Management

Kitty S. Dragonette
Low-Level Waste Licensing Branch
Division of Waste Management

SUBJECT: HEALTH PHYSICS INTERNAL DOSIMETRY SYMPOSIUM

Enclosed please find trip report for the Joint Chapter Symposium of the Health Physics Society that we attended in Harrisburg, Pennsylvania. Most of the presentations emphasized various aspects of theoretical, and experimental findings in internal dosimetry. A detailed summary of the presentations is included.

Original Signed By

Stanley M. Neuder
Low-Level Waste Licensing Branch
Division of Waste Management

Original Signed By

Kitty S. Dragonette
Low-Level Waste Licensing Branch
Division of Waste Management

Enclosure:
As stated

OFFICE	WMLL	WMLL					
SURNAME	SMNeuder:db	KSDragonette					
DATE	7/27/82	7/27/82					

SYMPOSIUM OVERVIEW

The theme of the Health Physics Society Symposium was internal dosimetry. Drs. Ken Skrable (U. of Lowell) and Keith Eckerman (ORNL) discussed the theoretical approaches to calculating internal dose based on recent revisions published by the International Commission on Radiological Protection (ICRP). Dr. Niel Wald (U. Pitt) discussed cytogenetic assays as population monitors of radiation and chemical exposures. Dr. Evelyn Watson (Oak Ridge Associated Universities) presented an overview of radiopharmaceutical applications in nuclear medicine. Dr. Jerry Rosen (U. Pitt) presented case histories of internal dose from accidental ingestion, inhalation and skin punctures. Dr. Ed Lessard (BNL) presented results of studies of inhabitants of the Marshall Islands following weapons testing in 1954. The symposium ended with a review and current status at Three Mile Island and was followed by tours of the power plant and EPA environmental monitoring facilities.

Except for copies of Dr. Skrable's viewgraphs, no reprints or summaries were made available to attendees. Dr. Skrable's viewgraphs were not accompanied by text and are therefore of limited use for NRC internal distribution. However, I am including a detailed summary for all interested NRC staff.

DETAILS OF PRESENTATIONS

Drs. Skrable and Eckerman discussed the different approaches to calculating internal dose. Specifically highlighted were the methods of ICRP-2 compartment models, investigation levels (IL) and annual limits of intake (ALI) of ICRP-26 and, intake retention functions and metabolic models of ICRP-30.

Calculational methodology of intake retention functions for the respiratory tract, pulmonary region, lymph, and GI tract was demonstrated. Also discussed was information derivable from bioassays, as for example, estimating intake and evaluation of fit (with theory) from N-bioassay measurements. General conclusions were that (a) improved internal dose models are needed to better interpret bioassay data, (b) additional in-vivo data is needed to be factored into theoretical models, (c) standard man data should be re-evaluated, (d) efforts of modelers, radiobiologists and nuclear medicine researchers should be organized to design experiments to obtain better human metabolic data and to interpret experimental data, and (e) bioassay measurements should be related to legal limits.

Dr. Wald discussed the use of chromosome aberration scoring in human peripheral blood lymphocytes as a monitor for radiation and chemically-induced cytogenetic toxicity. At the microscopic level cytogenetic effects might be evident as alterations in chromosome numbers or in chromosome aberrations (e.g., dicentrics, fragments, breaks, etc.). At

the molecular level, evidence is manifested via various types of DNA damage and morphologically altered chromosomes. The use of cytogenetic aberration scoring of human blood cells is a sensitive means of detecting biological changes produced by radiation exposures of smaller magnitude than can be detected by any other practical tests. Induced aberrations can be detected in populations in which sufficient cells are scored following radiation exposure at low multiples of the natural environmental background. For example, at an average exposure of 100 mrem, the detection of a statistically significant increase in dicentric frequency requires the scoring of 10^6-10^7 cells. However, at the rate of 100 cells scored per 7 man-hours, cost-benefit analysis should precede any cytogenetic screening for epidemeological investigations. Cytogenetic techniques in epidemeological populations exposed to low doses over long periods must also consider age as well as sample size. Age-related effects, which include effects due to cumulative natural radiation background exposure, medical diagnostics exposures, increased cytogenetic radiosensitivity, chemical and virus exposures, etc., are all comparable to the low-level exposures being assessed.

Dr. Watson discussed various aspects of nuclear medicine including: the use of radioactive materials for diagnosis and treatment of patients and the study of human diseases, type and number of radiopharmaceuticals used (12 million administration in 1979) people at risk (workers, patients, patients' families and the general public), physicians licensed to administer (10,000 in U.S.) and, the growth of nuclear medicine in the early 70's and at the present time. Also mentioned were the types of accidents most frequently encountered (faulty preparation of solutions, millicurie instead of microcurie amounts, wrong radionuclides, administration to pregnant women, etc.), and the use of the MIRD methods, ICRP-2 and ICRP-30 for calculating internal radiation dose.

Dr. Rosen presented several cases of accidental (occupational) internal contaminations resulting from ingestion, inhalation and puncture wounds. Isotopes involved were americium, cobalt-60, and uranium. Estimates of internal dose were made from in-vivo measurements, e.g., whole-body counting following inhalation or ingestion. Theoretical dose models were found to be insufficiently precise because standard data is not precise, e.g., dose derived from measurements differ from theoretical predictions by more than a factor of 10. The speaker believes that there is not enough information present in the "real" world to improve models and would therefore like to make optimum use of any future, accidentally contaminated people to study metabolic processes.

Dr. Lessard: The above-ground nuclear weapon test BRAVO of March 1, 1954 strongly affected the Marshall Islands atolls of Rongelap and Utirik because of sudden, unexpected shifts in the wind patterns. The high levels of radioactivity made it necessary to relocate the inhabitants of these atolls two days later. Utirik inhabitants returned 3 months later while Rongelap inhabitants returned 27 months later. The following

population data was presented: body-burden histories, calculated activity ingestion rate patterns (post return), external exposure data, and estimates of internal committed dose equivalants (CDE). The relationship between body burden and declining continuous intake was shown. The implications of these studies are that (a) the dietary intake of CS-137 was the major component contributing to the CDE for the years after the fallout, (b) for persons whose diet included fish, Zn-65 was a major component of the CDE during the first years post return, (c) the relative impact of each nuclide on the CDE was dependent upon the time interval between initial contamination and rehabitation, and (d) the internal CDE exceeded the external dose equivalent during the rehabitation period.

TMI Status: Discussions covered TMI Unit-2 physical conditions, radiological conditions, building decontamination and future projects. The internal physical status in the reactor building was described as follows: rusted steel surfaces due to water sprays, charred scaffolding and singed log books perhaps due to a hydrogen burn, melted plastics (e.g., telephones partially melted) perhaps due to a sodium hydroxide caustic spray, panel glass discoloration perhaps due to radiation, 6-8 inches of water at the 282-ft (basement) level, and high humidity with 80-degree temperature producing a terrarium effect. Lighting is retained only at the 347-ft elevation with 8 closed-circut TVs in place. Radiation levels at the 305-ft (entry) elevation are 200-600 mrem/hr gamma and 200-1000 mrad/hr beta. Sources of this radiation are surface contaminations plated-out on the floor, walls, and ceiling, contaminated water at the basement level, and contaminated reactor primary coolant. Hot spots exist in floor drains and air-flow systems, which will present a decontamination problem in the future clean-up. Surface contamination is mostly Cs-137 (80 precent of plated materials) and some Sr-90 but little Co-60. Beta fields are due mostly to Cs-137. Contaminated water previously in the containment building (at 150 mCi/ml, mostly Cs-137) was processed in 50,000 gal batches using a demineralizing system and ion-exchange resins (Epicor-2), and stored in 500,000 gal tanks with concentrations reduced to 10^{-5} mCi/ml. Decontamination experiments were performed using high pressure water spray on walls. Varying pressure, water temperature and flow rates were tried on selected surfaces. A twenty-percent reduction in the average surface exposure rate was observed. Up to eighty percent reduction was observed for stainless steel surfaces. The problem with quantifying surface decontamination is that it is difficult to determine the various sources of the radiation which cause the elevated readings at any one point in the building. In other words, it is possible to decontaminate a small surface but still obtain little change in radiation levels measured at that surface. Future projects include repairing the polar crane needed to lift the reactor head, removing the missile shield to observe the core condition (at least 2 of 8 insertion rods do not move at all), and processing approximately 88,000 gal of reactor coolant system water.