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

SEP 8 1980

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

FROM: Thomas E. Murley, Acting Director
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER #104 - THE BIOACCUMULATION FACTOR FOR PHOSPHORUS-32 IN EDIBLE FISH TISSUE

This memorandum transmits the results of completed research to evaluate the bioaccumulation factor for phosphorus-32 in fish as requested in RR-IE-77-1, which stated that this was needed in order to decide whether liquid effluents from power plants should be analyzed for P-32 concentration. This work was performed by the Environmental Resources Center of the Georgia Institute of Technology under the direction of the Environmental Effects Research Branch of the Office of Nuclear Regulatory Research (RES). The final report entitled, "The Bioaccumulation Factor for Phosphorus-32 in Edible Fish Tissue," NUREG/CR-1336, has been transmitted to your staff.

The available information on measured phosphorus concentrations in fish muscle and on measured phosphorus concentrations in large rivers and estuaries was reviewed. Using the geometric mean phosphorus concentrations of 2 mg/g wet weight in fish muscle and 0.03 mg/l dissolved in water, a stable phosphorus bioaccumulation factor of 70,000 was calculated.

However, this calculated value does not take into account the multiple pathways by which phosphorus passes from water into fish or the effect of radioactive decay. Thus, it was necessary to evaluate the effective turnover rate for phosphorus-32 in fish muscle; i.e., the biological turnover rate (λ_b) and the radioactive decay constant (λ_r).

In order to do this the principal investigator developed a model of the phosphorus balance in fish. This required determination of the daily turnover rate and the daily growth rate, which in turn required data on food and water intake and fecal, urinary, and body surface excretion. It was then necessary to convert the whole body turnover rate to the value for fish muscle.

Under steady-state conditions the ratio of the radioisotope bioaccumulation factor to the stable element bioaccumulation factor is also equal to the ratio of the biological turnover rate to the sum of the biological turnover rate and the radioactive decay constant. Using the value of 70,000 for the stable phosphorus bioaccumulation factor and the value of 0.04 for the ratio of the biological turnover rate to the effective turnover rate, the principal investigator calculated a generic P-32 bioaccumulation factor in fish muscle of 3000. This value is consistent with measurements made on P-32 in fish in the Columbia River over extended periods.

In summary, we recommend that the value of 3000 be used for the bioaccumulation factor for phosphorus-32 in edible fish tissue. The Office of Nuclear Reactor Regulation has requested further experimental studies to check values used in the phosphorus balance model, to evaluate possible effects on bioaccumulation of various physico-chemical forms of phosphorus in water, and to examine turnover mechanisms for phosphorus in fish that may be alternatives to ingestion. If you have any questions with regard to this report or the continuing studies, please contact Dr. Judith D. Foulke (427-4358).

Thomas E. Murley, Acting Director
Office of Nuclear Regulatory Research