

**October 17, 2003**

MEMORANDUM TO: Martin J. Virgilio, Director  
Office of Nuclear Material Safety and Safeguards

FROM: Ashok C. Thadani, Director **/RA/ Ashok C. Thadani**  
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER RIL-0303, DISPOSAL OF  
RADIOACTIVE MATERIAL INTO SANITARY SEWER SYSTEMS

Background

Several instances were identified in 1984 where releases of radioactive material to sewers resulted in accumulation in sewage sludge and piping. As a result, NRC conducted special inspections of licensees where the greatest potential for radionuclide reconcentration existed to determine the extent of this problem. While these inspections did not indicate a widespread problem; they did reveal a few isolated cases wherein the sources of the reconcentrated material were composed of insoluble or readily dispersible material.

In response to a May 1994 GAO Report: "Nuclear Regulation: Action Needed to Control Radioactive Contamination at Sewage Treatment Plants" (GAO/RCED-94-133) and Congressional interest expressed in joint House/Senate hearings, the NRC and EPA coordinated a survey of radioactivity in sewage sludge and ash from sewage treatment plants, commonly referred to as publicly owned treatment works (POTWs), to determine whether the public's health and safety and the environment is being adequately protected. The objectives of the survey were to: (1) obtain national estimates of high probability occurrences of elevated levels of radioactive materials in sludge and ash at POTWs, (2) estimate the extent to which radioactive contamination comes from either NRC/Agreement State licensees or naturally occurring radioactivity, and (3) support rulemaking decisions by NRC and EPA.

The Interagency Steering Committee on Radiation Standards (ISCORS) formed a subcommittee in 1995 to coordinate efforts to address recommendations raised by the 1994 GAO Report. Subcommittee members include representatives from the NRC, EPA, Department of Energy, Department of Defense, the State of New Jersey Department of Environmental Protection, Northeast Ohio Regional Sewer District (NEORS) and Middlesex County Utilities Authority. The Subcommittee is co-chaired by the NRC and the EPA.

Research Summary

To better understand the potential issue, RES was asked to evaluate the potential for radioactive materials to concentrate in sanitary sewer systems and the significance of such concentration. The first study was undertaken to evaluate potential public doses from exposure to radionuclides in sewage sludge during its treatment and disposal. Completion of this study occurred after the Commission's 1991 approval of the revised 10 CFR Part 20 which addressed a number of improvements in the NRC's basic radiation dose requirements. Included in this revision were changes to the provision in Part 20 permitting licensees to release radioactive

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material to sanitary sewers. The final rule removed the allowance to dispose of dispersible material, with the exception of biological material. This was done in response to identified cases where insoluble radioactive material was found to have accumulated in sewage systems.

The results of this study were published in April 1992, and titled, "Evaluation of Exposure Pathways to Man from Disposal of Radioactive Materials into Sanitary Sewer Systems," (NUREG/CR-5814). NUREG/CR-5814 demonstrated that based on a worst-case scenario, the former 10 CFR Part 20 regulations were sufficient to protect the public health and safety and the environment. Although in certain scenarios, such as in the case of a sewer plant worker, the results showed that doses in excess of the public dose limit of 100 mrem per year were possible. However, in none of the scenarios was the dose to the most exposed individual in excess of 400 mrem per year. Since this study focused on the former 10 CFR Part 20 regulations in effect at the time the study was undertaken, the situation whereby readily soluble or dispersible biological material could reconcentrate in sewer systems was not addressed.

The objectives of the second study were to: 1) assess whether radioactive materials released to sanitary sewage systems undergo significant reconcentration within the POTW and 2) determine the physical and/or chemical processes that may result in their reconcentration within the POTWs. This one-year study addressed these objectives by collecting information and data from the open literature, NRC reports, EPA surveys, and interviews with licensees and staff of the POTWs that may be impacted by these discharges. While the researchers were unable to quantify the effectiveness of physical and chemical processes that lead to reconcentration, they were able to confirm that reconcentration can occur and there is evidence that radioactive material that enters the wastewater stream will be subject to such reconcentration. The findings from this study were reported in, "Reconcentration of Radioactive Material Released to Sanitary Sewers in Accordance with 10 CFR Part 20," (NUREG/CR-6829) published December 1994.

In a joint effort with the EPA, a survey of POTWs was conducted to determine the extent of radioactivity occurring in sewage sludge and ash discharges from NRC and Agreement State licensees. Questionnaires were sent to 631 POTWs and 420 questionnaires were returned. Altogether, 313 of the 420 responding POTWs provided samples (one sample of sludge and/or ash per POTW) for laboratory analysis. The report, "ISCORS Assessment of Radioactivity in Sewage Sludge: Survey Results and Analysis" is now ready for publication. This report summarizes the information collected in the survey and developed from laboratory analysis of samples from POTWs and presents the results in a tabular format categorizing classes of POTWs that participated in the survey. The survey resulted in 45 radionuclides being detected, with eight radionuclides (Be-7, Bi-214, I-131, K-40, Pb-212, Pb-214, Ra-226, and Ra-228) reported in more than 200 samples. The samples were analyzed by either the U.S. Department of Energy's Oak Ridge Institute for Science and Education in Oak Ridge, Tennessee, under contract to NRC or EPA's National Air and Radiation Environmental Laboratory in Montgomery, Alabama.

Companion reports to the Survey Results and Analysis Report will also be completed through the ISCORS Sewer Sludge Subcommittee. The remaining reports to be published include the "ISCORS Assessment of Radioactivity in Sewage Sludge: Modeling to Assess Radiation

Doses,” and “ISCORS Assessment of Radioactivity in Sewage Sludge: Recommendations on Management of Radioactive Materials in Sewage Sludge.” In the “Modeling to Assess Radiation Doses” report, dose assessments for 7 scenarios were performed: onsite resident, recreation area user, resident of nearby town, landfill neighbor, incinerator neighbor, agricultural application worker and POTW worker. These theoretical scenarios were selected to represent situations in which a worker or member of the general public might be exposed to radioactivity that could be in sludge. No dose modeling scenario showed potential significant radiation exposures to NRC regulated material. In 2 scenarios, the results demonstrated a potential for radon exposure in excess of 4 picocuries per liter, the recommended limit for radon. One of these scenarios involved an individual who was a residential user of former agricultural land on which sludge had been previously spread for 50 to 100 years. The second scenario involved a POTW employee working 40 hours per week in a poorly ventilated facility while in close proximity to large volumes of sludge.

The final report, “ISCORS Assessment of Radioactivity in Sewage Sludge: Recommendations on Management of Sewage Sludge and Ash Containing Radioactive Materials at Publicly Owned Treatment Works” is intended to provide information to POTW authorities on the possibility of concentration of radioactive materials in sewage sludge and incinerator ash and identify conditions under which they may need to take actions. Based on the results in the dose assessment report, ISCORS is developing guidance to address the issue of NORM activity such as detecting elevated levels of radioactivity in sludge or ash to assist POTW authorities in addressing potential radiation exposure from sewage and ash.

Closure

The results of earlier and recent research projects on disposal of radioactive material into sanitary sewers have not identified a need for any change to NRC’s regulations. The “Evaluation of Exposure Pathways to Man from Disposal of Radioactive materials into Sanitary Sewer Systems,” study demonstrated that based on a worst-case scenario the former 10 CFR Part 20 regulations were sufficient to protect the public health and safety and the environment. Taking into consideration that 10 CFR Part 20 no longer permits discharges of radioactive materials that are not soluble or readily dispersible biological material to sanitary sewers, the potential for reconcentration as it moves through the various treatment processed in sewage systems, outlined in NUREG/CR-6829, should be eliminated. Most recently, the “ISCORS Assessment of Radioactivity in Sewage Sludge: Survey Results and Analysis” did not identify widespread or nationwide public health concerns because no significant adverse conditions or excessive concentrations of radioactivity were observed in sludge or ash sampled. The results of the analyses revealed that samples primarily contained NORM such as radium, not under NRC’s jurisdiction. Isolated problems with regard to releases from NRC licensed facilities and involving unusual circumstances have occurred in the past and may occur again in the future. However, the work discussed here is sufficient to conclude that instances do not represent a general pattern or trend.

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ITEM NO.:            10#01

ORIGINATOR:        JONES, DSARE/RPERWMB

SUBJECT:            RESEARCH INFORMATION LETTER RIL-0303, DISPOSAL OF  
RADIOACTIVE MATERIAL INTO SANITARY SEWER SYSTEMS

DATE:                10/07/03

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