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Subcommittee on Science, Technology and Space

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BENEFICIAL USES OF NUCLEAR FISSION WASTES

Mr. Chairman and members of the Subcommittee:

I am H. D. Sivinski of the Applied Biology and Isotope Utilization Division of the Sandia Laboratories. I welcome the opportunity to testify before this Subcommittee on the subject of Beneficial Uses of Nuclear Fission Wastes.

The fission products and transuranic wastes of the nuclear fuel cycle contain large amounts of potentially valuable metals, industrial radiation sources and specialized energy sources. Sandia Laboratories has a major role in assisting the Department of Energy in developing the technology and investigating the potential of using some of these products in processes which historically have used materials and energy sources now considered to be in short supply. If these products, now considered to be a national liability, were to be separated and utilized, they could well become a needed national asset.

The Sandia sludge irradiation program is part of a larger DOE effort to develop beneficial uses of individual isotopes. It is jointly funded by the DOE and EPA through an interagency

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agreement and addresses the potential of using gamma radiation from a fission product, cesium-137, to reduce the pathogen levels of municipal sewage sludges sufficiently to permit their use in unlimited agricultural applications. Over five million dry tons of municipal sludge are being produced each year in the U. S. and with the passage of PL 92-500, the Water Pollution Control Acts Amendments of 1972, the requirement for secondary treatment will probably double this amount by 1985. Cessation of ocean dumping is mandated to end in 1981 and other disposal options by cities are being rapidly foreclosed by stricter environmental controls, suburban development near treatment plants and landfills, public pressure and the uncertain availability of fuels for energy intensive disposal options such as hauling and/or barging to remote areas or incineration. PL 94-580, the Resource Recovery and Conservation Act of 1976, suggests land application of sludge to facilitate resource recovery and conservation of this potentially significant national agricultural resource. Such application would also contribute to the solution of the rapidly escalating sludge disposal problems faced by most metropolitan centers.

Two major problems are involved however in the agricultural use of domestic sludges. Heavy metal contaminants are taken up by plants and animals in the food chain, and control over the heavy metal pollution sources must be enforced. The second problem is the health hazard due to the pathogens (bacteria, viruses and parasite ova) in sludge. Biological inactivation of these pathogens with gamma irradiation from waste

cesium-137 is the major Sandia research and development activity in this program. Current research results indicate that a 500 kilorad dose to composted or dried raw sludges will probably be sufficient to reduce the pathogens to desired levels for general agricultural use. (The current standard for radiation sterilization of medical supplies and disposables is 2,500 kilorads). Two agribusiness uses are being researched by New Mexico State University (NMSU) using Albuquerque and Las Cruces, NM sludges. The classical use, land application for both fertilizer value and soil conditioning, is being done in greenhouse and field plots. Significant improvements in plant yields over optimal chemical fertilizer formulations are found when raw irradiated sludge is applied at equivalent nitrogen rates. Ruminant animal feed supplementation during dormant range periods is also being investigated. Sludges are rich in energy and nitrogen and can be used in lieu of the soybean or cottonseed meals normally used to balance a range animal's ration during the 2-3 month supplemental feeding program required annually.

Values for sludges used in these programs have been determined to be between \$5-60/dry ton as fertilizer and up to \$100/ton as a feed supplement. The radiation treatment cost is \$18/ton. In contrast, disposal costs average \$250/ton for trenching-in the sludge from the Blue Plains plant in the Washington, DC area and range nationally from "give away" to \$400/ton. Before we can realize the potential of irradiated sludge, the process of radiation disinfection needs to be demonstrated on a meaningful scale.

A scheme for cesium-137 utilization for this purpose is shown in Exhibit A.

The isotope is diverted to beneficial use for two half lives or 60 years, and then reintroduced into the waste disposal program. The 75 percent reduction in activity in this time interval contributes positively in decreased isotope disposal requirements.

The Sandia Irradiator for Dried Sewage Solids (SIDSS) is a pilot plant for radiation treatment of composted or dried raw sludges. It is shown schematically in Exhibit B and will treat 16 tons of material per day to a dose of 500 kilorads. It is now under construction and will be operational in the fall of this year. It will use 1 megacurie of cesium-137 from military wastes being encapsulated at the Waste Encapsulation and Storage Facility (WESF), Hanford, WA. The doubly encapsulated stainless steel source is shown in Exhibit C.

A larger 25 ton/day EPA-funded demonstration plant is planned for the Washington, DC area and will use 3 megacuries of WESF capsules. This facility will assist in the transfer of this technology to the public sector.

Successful technology transfer depends greatly on the economics of the process. A cost/benefit study of this program was done by Sandia, Battelle, and A. D. Little, Inc. The Federal Register price of \$0.10/Ci for the WESF capsule was used in the analyses and it was shown that with a 10 percent penetration of the 10 million dry tons/yr market, annual savings will approach

\$100 million. It should be emphasized that this annual economic benefit is possible now without reprocessing commercial power reactor fuels. Sufficient amounts of cesium-137 for treating 10 percent of the national sludge are available from reprocessing of military wastes. Approximately 200 MCi are at Hanford and a comparable amount is expected from Savannah River over the next 12 years.

The question of increased isotope availability and cost from commercial fuel in order to meet greater needs in this and other programs such as fruit and vegetable disinfestation was addressed in a thorough study recently completed by EXXON Nuclear Inc. Separation flow sheets were evaluated for various isotopes and a cost of \$0.08 to 0.13/Ci for cesium-137 was obtained when an isotope separation facility was designed to operate in conjunction with a commercial reprocessing plant. This study validated the basic assumption of the cost/benefit study which had shown a favorable ratio using the \$0.10/Ci price.

The use of another isotope, technetium-99, for marine biofouling and corrosion inhibition is also being investigated. Biological experiments leading to understanding of the mechanisms involved are being done in conjunction with the University of New Mexico. When completed, the information gained from this work could contribute positively to solution of both fresh water and marine cooling water problems in electrical power generation stations and to programs such as the DOE Ocean Thermal Energy Conversion (OTEC) program.

In summary the Sandia program is attacking the isotope and sludge utilization problem on many fronts. We believe we are pursuing the research areas required for a successful sludge utilization program which must be cost-effective, resource and energy conservative, socially acceptable and technically reasonable. Such results would provide another option to cities burdened by the sludge management problem. A cost reduction in waste treatment programs is possible while recycling a valuable resource for food production.

BENEFICIAL USE / SLUDGE MANAGEMENT
(Dashed lines indicate elements required)

SANDIA IRRADIATOR FOR DRIED SEWAGE SOLIDS (SIDSS)

EXHIBIT B

HANFORD WASTE ENCAPSULATION AND STORAGE FACILITY CAPSULES

	FORM	LOADING	PER CENT OF THEORETICAL DENSITY BASED ON TOTAL VOID SPACE OF CAPSULE	TEMPERATURE			
				AIR		WATER	
				CENTER LINE	SURFACE	CENTER LINE	SURFACE
CESIUM CHLORIDE	MELT-CAST	70 KCI	65	450°C	200°C	327°C	58°C

Exhibit C

	CAPSULE									
	INNER					OUTER				
	MATERIAL	WALL THICKNESS	OUTSIDE DIAMETER	TOTAL LENGTH	TOTAL CAP THICKNESS	MATERIAL	WALL THICKNESS	OUTSIDE DIAMETER	TOTAL LENGTH	TOTAL CAP THICKNESS
CESIUM CHLORIDE	316L STAINLESS STEEL (UT)	0.095 (UT)	2.250	19.725	0.400	316L STAINLESS STEEL (UT)	0.109 (UT)	2.625	20.775	0.400

NOTE: ALL DIMENSIONS ARE IN INCHES

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