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ORNL**FOREIGN TRIP REPORT**

ORNL/FTR-3826

DATE: November 29, 1990**SUBJECT:** Report of Foreign Travel by Suman P. N. Singh, Group Leader,
Demonstrations and Technology Support Group, Engineering Coordination
and Analysis Section, Chemical Technology Division**TO:** A. W. Trivelpiece**FROM:** S. P. N. Singh**PURPOSE:** To provide follow-up consultations, as the International Atomic Energy Agency (IAEA) Technical Cooperation Expert to the Korea Atomic Energy Research Institute (KAERI), with their radwaste incineration technology development and related off-gas treatment program. The program includes the scale-up of their process design unit to a demonstration-scale unit and the design of their proposed commercial-scale facilities for the incineration of low-level radioactive wastes generated by the nuclear facilities in the Republic of Korea.**SITES VISITED:**

10/20-	Korea Atomic	Daeduk-Danji,	Hun-Hwee Park
11/18/90	Energy Research	Republic of	Joon-Hyung Kim
	Institute	Korea	Yong-Chil Seo
			Sung-Paol Yim
			Ki-Jung Jung

ABSTRACT: At the request of the International Atomic Energy Agency (IAEA), technical assistance was provided to the Korea Atomic Energy Research Institute (KAERI) in the field of radwaste incineration and related off-gas treatment operations. The traveler provided the requested technical consultations and, in the process, obtained an understanding of the Republic of Korea's plans for the management of the wastes from the country's nuclear power plants and research facilities.

The government of the Republic of Korea has tasked KAERI to develop the facilities for treating and disposing of the wastes from the country's nuclear facilities in an environmentally responsible manner. As a step in that direction, the Radwaste Treatment Department at KAERI is developing the technology and the plans for the incineration of burnable low-level radwaste, which comprises about 35% of the wastes generated by

the nuclear facilities. The incineration program at KAERI appears to be well planned. They have operated a 5-kg/h process design unit incinerator to gather the process data for scaling up the operation to a 30-kg/h demonstration plant. This demonstration plant is presently being built, with startup operations scheduled for January 1991. Data from the demonstration plant are proposed to be used for building a 120-kg/h commercial radwaste incineration facility.

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REPORT OF FOREIGN TRAVEL TO SOUTH KOREA BY SUMAN P. N. SINGH,
GROUP LEADER, DEMONSTRATIONS AND TECHNOLOGY SUPPORT GROUP,
ENGINEERING COORDINATION AND ANALYSIS SECTION,
CHEMICAL TECHNOLOGY DIVISION

October 19 - November 18, 1990

Suman P. N. Singh

1. STATEMENT OF PURPOSE

This trip was undertaken to provide professional assistance as the IAEA Technical Cooperation Expert to the Korea Atomic Energy Research Institute (KAERI), Daeduk-Danji, Republic of Korea. The assistance was sought in the field of radioactive waste (radwaste) incineration and related off-gas treatment systems research, development, design, and demonstration, based on the traveler's expertise and experience in waste management at the Waste Management Technology Center (WMTC) at the Oak Ridge National Laboratory (ORNL).

In addition to the professional assistance given to KAERI, the trip provided an opportunity for the traveler to exchange information concerning the nuclear waste issues, problems, and waste management solutions being developed and deployed in the United States (with particular emphasis on the Department of Energy) and the Republic of Korea.

2. BACKGROUND INFORMATION

According to Dr. Yong-Chil Seo, my host at KAERI, the government of the Republic of Korea has given KAERI the responsibility to design, build, and operate treatment facilities to manage the radioactive wastes from the country's nuclear power plants, as well as the nuclear medical and research facilities. To meet this goal, KAERI has embarked on a research, development, and demonstration program to develop the design data for the commercial-scale facilities.

As a part of the above effort, KAERI has built and operated a 5-kg/h process design unit (PDU) to incinerate low-level radioactive waste. This waste, which is also referred to as dry active waste (DAW), burnable radioactive waste, or burnable radwaste, chiefly consists of combustible (generally) nonhazardous waste materials (e.g., waste paper, rags, Tyvek clothing, and polyethylene) that have low levels of radioactive contamination. The PDU was constructed in 1987, and tests have been performed on it since 1988 to develop data for the design of the demonstration-scale plant.

Except for the changes indicated below, much of the remaining background information on the project is the same as that stated in my foreign trip report for the earlier visit to KAERI in January-February 1990.*

- o The current organizational structure of KAERI's Radioactive Waste Management Division is given in Fig. 1. The principal changes here are as follows:
 - + The Division now reports to Dr. Chang Saeng Rim instead of Dr. In-Suk Suh. Dr. Suh is now Vice-President for Fundamental Research at KAERI.
 - + The Off-Gas Treatment Systems Evaluation is now a separate group under Dr. Sung-Paai Yim. Previously, it reported to Dr. Yong-Chil Seo.
- o The Incinerator Pilot Plant Operations Group has dismantled the PDU and moved the equipment to the demonstration plant building. This building is an enclosed high-bay structure covering approximately 300 m². The demonstration plant is expected to be installed and ready for testing by January 1991. Some of the equipment for the plant is presently being fabricated.
- o The PDU tests indicated the need for an afterburner following the incinerator to ensure complete incineration of some partially combusted wastes entrained in the off-gas from the incineration chamber. Therefore, a refractory-lined afterburner will be installed in the demonstration plant between the incinerator and the off-gas cooler (heat exchanger).
- o The PDU is also proposed to be installed in the demonstration plant building to evaluate, for example, other types of incinerators such as a fluidized-bed unit.

*S. P. N. Singh, Report of Foreign Travel by Suman P. N. Singh, Program Manager, Waste Management Technology Center, Chemical Technology Division, ORNL/FTR-3526, February 20, 1990.

Fig. 1. Organization chart for KAERI's Radwaste Incineration Operations.

3. WORK ACTIVITIES

As indicated by Dr. Yong-Chil Seo, my mission principally consisted of the following tasks:

1. Provide consultations on KAERI's plans and designs for their demonstration and commercial-scale radwaste incineration and related off-gas treatment facilities.
2. Present a seminar to the KAERI staff on "Guidance for Conducting Waste Management Demonstration Projects." A copy of KAERI's announcement for the seminar is included in Appendix D.

In fulfillment of the above tasks, I had numerous consultations with the two KAERI groups responsible for the radwaste incinerator operations about the designs of the 30-kg/h demonstration unit and the proposed 120-kg/h commercial-scale radwaste incineration plant. The commercial-scale facility will dispose of the burnable radwaste from the Republic of Korea's nuclear power plants and research facilities.

In addition, as part of the mission and at the request of KAERI staff, a visit was made to Korea Electric Power Company's (KEPCO's) Kori nuclear power plant for consultations on some of Kori's waste management problems.

The topics covered in the consultations included: (1) discussion of safety concerns, (2) preparation of safety analysis documentation and environmental impact reports, (3) treatment and disposal of low-level radioactively contaminated wastes, and (4) the permitting protocols used in the United States for radioactive and hazardous waste incineration facilities.

4. CONCLUSIONS

Based on my observations and extensive discussions with various KAERI staff members (notably my hosts, Drs. Yong-Chil Seo and Joon-Hyung Kim), I have drawn the following conclusions:

- o The KAERI Radwaste Treatment Technology Department's program for technology development for radwaste management appears to be comprehensive and designed to develop indigenous processing capabilities for managing the country's nuclear wastes.
- o KAERI has completed a 2-year experimental program using their PDU to develop the engineering data for the incineration of dry active wastes (DAW). They are in the process of installing a demonstration plant to

scale up their incineration and off-gas treatment processes. This demonstration plant is sized to process up to 30 kg/h of DAW and is scheduled for testing and startup in January 1991. Data from the demonstration plant are proposed to be used for designing their 120-kg/h commercial radwaste incinerator.

- o From the English language news media, it appears that the government is experiencing difficulty in siting a suitable nuclear waste repository in the country. A site was proposed to be located on Anmyon Island in western Korea; however, strong local public opposition has caused the government to withdraw further consideration of this site. In conversations with KAERI staff members, I was told that an earlier site on the east coast of the country was similarly abandoned.
- o From the information available to me on the Republic of Korea's and KAERI's plans for radwaste management, I now conclude (based, to some extent, on the above-mentioned news reports) that the proposed plan for bringing the first commercial treatment facility on-line by 1996 is highly optimistic and may not be feasible. Achievement of this objective will require a concerted effort and cooperation by all parties involved with its implementation.
- o Greater exchange of technical information and personnel between KAERI and other waste management institutions worldwide may prove to be beneficial to KAERI in achieving their national radwaste management objectives.
- o I feel that my assignment was useful to KAERI and the staff members with whom I interacted because I was able to provide them an insight into the breadth of the waste management problems and activities being performed and pursued in the United States, particularly by the Department of Energy and its subcontractors. More importantly, I was able to provide them guidance on their radwaste incineration and related off-gas treatment systems development program and plans.
- o This visit proved to be advantageous to both DOE and ORNL because it provided an opportunity for exposure of their research, development, and demonstration efforts in managing their radioactive and hazardous wastes and because they gained an insight into the radwaste activities and plans of the Republic of Korea.
- o There appears to be considerable interest in waste management (especially radwaste management) in Korea. Because of a lack of viable alternative energy resources, the Republic of Korea is committed to building nuclear power plants to help meet the country's growing energy needs (nine nuclear power plants have been built, and five more are planned). This results in the inevitable generation of wastes that need to be treated and

disposed of in a responsible manner, thereby creating a potential market for U.S.-developed waste management technologies.

5. RECOMMENDATION

It is recommended that future technical consultations of this type be encouraged because they provide a means for ascertaining waste management activities in other countries and can serve as a possible vehicle for promoting U.S. waste management technology overseas.

APPENDIX A. ITINERARY

1990

Oct. 19-20	Travel from Knoxville, Tennessee, to Taejon, Republic of Korea
Oct. 20-21	Weekend
Oct. 22	Report at KAERI for IAEA mission, meet host, receive orientation, renew acquaintance with KAERI Radwaste Treatment Department staff, and develop schedule for mission
Oct. 22-26	Provide consultations and discuss protocols for conducting waste management technology demonstrations, in general
Oct. 27-28	Weekend
Oct. 29-31	Continue consultations on KAERI's demonstration-scale incinerator design and guidance on preparation of safety analysis and environmental impact documentation for demonstration facility
Nov. 1	Present seminar on "Guidance for Conducting Waste Management Demonstration Projects" and continue to provide consultations
Nov. 2	Discuss licensing protocols in the United States for conducting demonstration projects
Nov. 3-4	Weekend; travel to KEPCO's Kori nuclear power plant near Pusan for consultations
Nov. 5	Visit Kori plant and, jointly with KAERI staff members, provide consultations to Kori staff members on some of their waste management problems
Nov. 6	Return to Taejon from Pusan
Nov. 7-9	Review monitoring instruments requirements for the radwaste incineration demonstration facility
Nov. 10-11	Weekend
Nov. 12-16	Discuss the proposed layout of the demonstration plant and provide guidance on establishing radiation contamination zones and ingress and egress protocols
Nov. 17-18	Weekend
Nov. 18	Travel from Taejon, Republic of Korea, to Knoxville, Tennessee

APPENDIX B. INDIVIDUALS CONTACTED

Most of the technical discussions were held with KAERI staff members. The following individuals at KAERI were contacted for the indicated purposes:

Name	Title	Function or subject of discussion
KAERI		
Dr. Yong-Chil Seo	Senior Researcher, Radwaste Treatment Department	My KAERI host; coordinator for all consultations, discussions, and seminars
Dr. Sung-Paal Yim	Senior Researcher, Off-gas Treatment Systems Evaluation, Radwaste Treatment Department	Incinerator off-gas treatment systems
Dr. Joon-Hyung Kim	Head, Radwaste Treatment Technology Department	My KAERI co-host; radwaste incineration and off-gas treatment
Dr. Ki-Jung Jung	Senior Researcher, Liquid Radwaste Treatment Department	Liquid radwaste treatment R&D
Dr. Won-Jae Park	Senior Researcher, Nuclear Waste Regulation Department	U.S. environmental regulations and permitting protocols
KEPCO		
Mr. Se-Ki Whang	Manager, Radiation Management Division, Kori Nuclear Power Plant, KEPCO	Waste oil treatment and radwaste immobilization

APPENDIX C. LITERATURE ACQUIRED

1. Y.-C. Seo, I.-T. Kim, J.-H. Kim, and H.-H. Park, "Assessment of Bench-Scale Incineration Process for Treatment of Radioactive Waste," Waste Manage. 10, 233-42 (1990).
2. Y.-C. Seo, H.-C. Yang, J.-H. Kim, and H.-H. Park, "Volume Reduction Ratio and Decontamination Factor of the Bench Scale Radwaste Incineration Process," J. Korean Nucl. Soc. 21 (4) (December 1989).
3. W.-J. Park and G. G. Eichholz, "Partitioning of Organic Materials in Porous Beds Under Unsaturated Water Flow Conditions," Waste Manage., 10, 125-39 (1990).

APPENDIX D

KAERI'S ANNOUNCEMENT OF THE SEMINAR BY DR. SUMAN P. N. SINGH

수신 : 재염기술실 귀중

SEMINAR 개최 안내

당실에서 활용중인 IAEA 전문가 Dr. Singh 의 SEMINAR 를 다음과 같이 갖고자 하오니 관심 있으신 분의 많은 참석을 바랍니다.

제 목 : GUIDANCE FOR CONDUCTING WASTE MANAGEMENT DEMONSTRATION PROJECTS

발표자 : SUMAN P.N. SINGH (IAEA EXPERT)

소 속 : OAK RIDGE NATIONAL LABORATORY (OAK RIDGE, TENNESSEE, U.S.A.)

일 시 : 1990. 11. 1. 오후 3 - 4 시.

장 소 : 실증용 소각시설 (자연증발시설 옆)

- 내 용 :
- OBJECTIVES OF DEMONSTRATION PROJECTS
 - PREDEMONSTRATION ACTIVITIES
 - DEMONSTRATION TESTING
 - POST DEMONSTRATION ACTIVITIES

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