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NRC Technical Support

Report of Foreign Travel of T. S. Kress to France

Foreign Trip Report

T. S. Kress

April 8, 1983

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INTERIM REPORT

OAK RIDGE NATIONAL LABORATORY

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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-1479

DATE: April 8, 1983

SUBJECT: Report of Foreign Travel of T. S. Kress, NRC/DAE Program Manager
at ORNL, Engineering Technology Division

TO: Herman Postma

FROM: T. S. Kress

PURPOSE: To participate in and represent NRC at two OECD/CSNI meetings:
(1) The Group of Experts on Nuclear Aerosols, and (2) The Group
of Experts on Source Terms.

SITES VISITED: 3/21-25/83 CSNI Paris, France J. Royen

ABSTRACT: At the request of the USNRC, the traveler attended the final
meeting of the CSNI-sponsored Group of Experts on Nuclear Aero-
sols. This final meeting was for the purpose of completing a
supplement to their State-of-the-Art Report on Nuclear Aerosols
in Reactor Safety. The traveler also attended the inaugural
meeting of a new CSNI group, The Group of Experts on Source
Terms, to establish its charter and make plans for its future
activities.

REPORT OF FOREIGN TRAVEL OF

T. S. KRESS

Manager

NRC/DAE Programs at ORNL

PURPOSE

This foreign travel had two purposes. The first was to participate in the sixth and final meeting of the OECD/CSNI-sponsored Group of Experts on Nuclear Aerosols. This final meeting was for the purpose of completing a supplement to the previously issued State-of-the-Art Report on Nuclear Aerosols in Reactor Safety. The second purpose was to attend and represent NRC at the inaugural meeting of a new OECD/CSNI-sponsored group - The Group of Experts on Source Terms. This meeting of the new group was to determine its charter and to lay out plans for its future activities.

Meeting of the Group of Experts on Nuclear Aerosols (3/21-23)

A list of attendees at this meeting (and the countries they represented) is given in Appendix A. The agenda is reproduced in Appendix B.

The Group of Experts on Nuclear Aerosols (GRENA) had previously issued (June 1979) an excellent state-of-the-art report* on nuclear aerosols in reactor safety under the chairmanship of M. Silberberg of the USNRC. However, this original report emphasized LMFBRs and only touched lightly on LWRs. Consequently, after the increased awareness and research brought about by TMI-2, the group decided to produce a supplement to the original report that would focus on aerosol issues related to LWRs. It is emphasized here that this supplement is not intended to be a "source term" report but is rather to assess the aerosol aspects as they influence the source term.

The purpose of this last meeting of GRENA was to reach final agreement on the content and text of the supplemental report and to prioritize activities that could be recommended to the new group being formed to address the broader issues of source terms in general. A draft of the report, in relatively final form, was to be developed for presentation to the Principal Working Group-4 by the first week in June 1983.

A listing of the chapter headings, as they were established prior to this meeting, is given in Appendix C. It was decided at this meeting to delete Chapter VI from the report for two good reasons: (1) a lead author with the appropriate qualifications was not identified and (2) it was believed that this particular subject matter was the realm of another working group and not that of GRENA.

**Nuclear Aerosols in Reactor Safety*, CSNI/SOAR No. 1 (June 1979).

There was a proposal to replace this chapter with one dealing with suppression pools that could be based on a good contribution to the group by Harry Morewitz (EPRI consultant). The group decided not to devote a whole chapter to this subject and that the Morewitz contribution would be condensed for inclusion as part of Chapter III.

Substantial differences in style and grammar among the chapters would be assuaged by allowing the chairman to choose a technical editor, with a good command of English, to edit the document.

Extensive and animated discussions were held by the group regarding the details of the text. I believe I effectively represented the views of the USNRC and made substantive technical contributions during these discussions that will be reflected in the final draft.

As a final action before disbanding, the GRENA developed, both for Chapter IX and for presentation to the new source term group, a set of prioritized topics recommended for further research and analysis. These are listed below in priority order:

Topics Suggested for Further Experimental Research

1. Aerosol transport in the containment.
2. Aerosol transport in the primary circuit.
3. Effects of hydrogen combustion on the physicochemical form of the fission products.
4. Validation of the basic phenomenological models for gravitational agglomeration, turbulent deposition, thermophoretic deposition, diffusiophoretic deposition.
5. Solubility, hygroscopic, and other chemical properties of mixed aerosols containing fission product iodine, cesium, and tellurium.
6. Compaction and spherification of LWR agglomerates due to condensing and evaporating of water and/or fission product vapors.

Topics Suggested for Further Analysis

1. An international comparison of aerosol codes for standard problems.
2. Interfacing of thermal hydraulics, chemical kinetics, and aerosol codes.
3. An aerosol code sensitivity analysis including sensitivity to thermal hydraulic uncertainties, relative timing of releases from various sources, and containment failure.
4. Condensation of steam onto aerosols.

Meeting of the Group of Experts on the Source Term (3/24-25)

This was the inaugural meeting of the Group of Experts on the Source Term (GEST) as established by the CSNI Principal Working Group-4. (There

are five principal working groups related to severe accidents: (1) Operating Experience and Human Factors, (2) Transients and Breaks, (3) Primary Circuit Integrity, (4) Source Terms and Environmental Consequences, and (5) Risk Assessment.) GREST is one of three "groups of experts" established by Principal Working Group-4: Group of Experts on Air Cleaning and Containment Atmospheric Control Systems Under Accident Conditions (GENAC), Group of Experts on Accident Consequences (GRECA), and GREST.

The terms of reference for GREST, as defined by Principal Working Group-4 at their October 18-19, 1982, meeting are:

- "i. To provide advice to the Principal Working Group, and to other expert groups, on source term matters.
- ii. To meet periodically to review further developments in source term technology, and to make recommendations as appropriate for
 - additional supplements to the current state-of-the-art report on nuclear aerosols in reactor safety, including recommendations for work needing to be initiated;
 - specialists meetings.
- iii. To act as a steering group for the international best estimate source term code comparison exercise proposed by the Senior Group of Experts on Severe Accidents.

It was further agreed (by PWG-4 and CSNI) that the scope of the group's activities should cover all types of facilities within the nuclear fuel cycle and that the source term was to be understood in this context as the amounts and forms of all contributions to the radioactivity released, including gases and vapors as well as aerosols. The impact of containment sprays and suppression pools on the source term is included within the groups remit, but other aspects of air cleaning, including equipment integrity, are excluded. Also excluded are topics related to the source term, but which are within the subject areas of other Principal Working Groups, e.g., thermal hydraulics, containment failure times and modes" (emphasis by author).

A list of attendees at this meeting was not available in time to include in this report. However, it included most of the attendees at the GRENA meeting along with new participants so that the total countries represented were Australia, Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom, and the United States.

As the initial item of business for GREST, F. Abbey (UKAEA) was elected Chairman of the group, J. Fermandjian (CEA), Vice-Chairman; and K. O. Johansson (Studsvik-Sweden), Technical Secretary.

In determining the most immediate tasks facing the new group, it was decided that we should first address specific requests already received from other groups as discussed below.

Request from GENAC

A request was received from GENAC for information they need to assess the capability of air cleaning systems to deal with severe accidents. They requested that GREST provide (1) source term information related to

power reactors for LOCA (no fuel melt and core melt), (2) source term information related to fuel cycle facilities, and (3) radiological information related to power plants and fuel cycle facilities.

It was decided to divide the responsibilities for responding to these into subgroups with leaders for each. The task leader selected for Item (1) was J. Femandjian (CEA) with assistance from Messrs. Leclair (Belgium), Schock (FRG), and Soda (Japan/JAERI).

For Item (2), D. Booth (UK/NII) agreed to take an initial look only to assess what could be done and where the information sources might be with respect to this item; it was believed that the USNRC could be of some help and that the Barnwell plant might be a source of information. GREST requested that the NRC reply to this.

For Item (3), it was believed that the most GREST could do here would be to identify the important nuclides. A task leader was not assigned.

Request from Senior Group of Experts on Severe Accidents

The Senior Group of Experts recommended that one of GREST's first topics of review be the influence of steam explosions and hydrogen deflagration on the form and disposition of the fission products in severe LWR accidents.

It was believed by GREST that little was known about this, but that we would try to produce a paper (of speculative nature but based on sound physical principles) that would assess the problem. D. Torgerson (Canada) agreed to lead this activity with assistance from J. Van de Vate and C. Andriessse (both of Netherlands).

There was a request to the USNRC to see if they could provide assistance on this (through Sandia) on the likelihood and severity of such events.

International Code Comparison Exercise

The senior Group of Experts on Severe Accidents made a recommendation to Principal Working Group-4 that it would be useful to undertake an international comparison effort on best estimate codes predicting the removal of fission products from the containment atmosphere and release to the environment. They indicated that the exercise should include a range of containment concepts and that it should be timed to coincide with projected completion of major items of source term research now in progress (which would seem to place it perhaps in late 1984).

GREST would like some firm view of whether or not the USNRC would be willing to participate in such an exercise. They suggested a letter from D. Ross (USNRC) to F. Abbey (Chairman of GREST) expressing NRC's views on this.

Specialists' Meeting

The now defunct GRENA had previously recommended to CSNI that they sponsor another specialists' meeting on nuclear aerosol, similar to the highly successful one held in Gatlinburg, Tennessee, in April 1980, co-hosted by USNRC and Oak Ridge National Laboratory. The CSNI accepted this recommendation in principle and directed that GREST be responsible for it and put together an appropriate program to offer CSNI as a proposal. F. Abbey and R. Schikarski were appointed by GREST to develop this proposed program to be presented to CSNI in June. The group unanimously accepted an offer from KfK (Karlsruhe) to host the meeting in September 1984, consecutively in time with the ANS Thermal Reactor Safety Meeting also to be held in Germany. The group also tentatively agreed to make the meeting a workshop (as opposed to a technical conference) and to focus on the topic "Interfacing Between Thermal Hydraulics and Aerosol Behavior." As an action item, each representative of GREST is to send his views on this proposed meeting to F. Abbey within two weeks, along with suggested topics to be included in the workshop (the author of this report has already done this). In addition, it was requested that the USNRC give Abbey some indication as to whether they would support attendance and participation in this meeting.

Other Activities

An ad hoc meeting being held in Oak Ridge on April 24-25, 1983, on iodine chemistry was suggested as an activity that GREST might desire to promote and sponsor on an annual basis. The group directed D. Torgerson to make such a proposal at the Oak Ridge meeting to solicit their views.

In terms of continuing activities of GREST, the group decided that they should concentrate on the three general areas below:

1. Fission Product Chemistry
2. Release from Fuel (including core/concrete)
3. Behavior in Primary System and Containment

There was some discussion as to whether thermal hydraulics per se fit within the third item above. The author argued that it is not a good idea (perhaps impossible) to separate the aerosol behavior from the thermal hydraulics and that they must be considered together. The author even proposed a list of ten phenomenological areas relative to Item (3) in which the thermal hydraulics is an integral part and which might be good topics for GREST to address. The author received as an action item to produce a paper assigning priorities to this list.

The final item of business for GREST was to establish a date for the next meeting. It was agreed this would be October 17-21, to coincide with the October 12-14 water chemistry conference in Bournemouth, UK, so that delegates could attend both meetings if they so choose.

Summary of Action Items Requested of USNRC

There were a number of questions that could not be answered directly by the author as a technical representative for NRC as these tended to be of a policy nature. Consequently, it was requested that the USNRC respond to these by way of a letter (or phone call) to F. Abbey, Chairman of GREST:

1. How does NRC view the proposed International Code Comparison Exercise? Would they participate in and support it and, if so, who would be the U.S. contact? GREST would like an indication of USNRC's views on the type of containments and the accident scenarios to be considered.

2. Would NRC support attendance and participation in the proposed Specialists Meeting in conjunction with the Thermal Reactor Safety Meeting in September 1984?

3. Can NRC provide assistance to GREST in soliciting information (e.g., from Barnwell) that would be helpful if GREST undertakes a study of reprocessing plant source terms?

4. Can NRC support the study on the effects of H₂ detonation and/or steam explosions on the form and disposition of fission products in the containment? It was suggested, for example, that Sandia could provide information on the likelihood and severity of such events.

APPENDIX A

List of Attendees at the Meeting of the
Group of Experts on Nuclear Aerosols

Country	Name	Organization
Australia	F. May	AAEC
Canada	D. Torgerson	AEC
France	J. Femandjian J. Royens	CEA CNSI
Federal Republic of Germany	R. Schikarski W. Schock	KfK KfK
Netherlands	C. Andriesse J. Van de Vate	KEMA Petten
Sweden	D. Mecham	Studsvik
United Kingdom	F. Abbey D. Booth C. Clements I. Dunbar	AEA NII Harwell AEA
United States	T. Kress	ORNL

APPENDIX B

Agenda for the Meeting of the Group of Experts
on Nuclear Aerosols

ORGANISATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT

NUCLEAR ENERGY AGENCY

SEN/SIN(83)5

RESTRICTED

Paris, draft.: 20th January 1983

dist.: 25th January, 1983

Or. Engl.

NOTIFICATION OF MEETING

STEERING COMMITTEE FOR NUCLEAR ENERGY

COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS

Group of Experts on Nuclear Aerosols in Reactor Safety

I. The sixth (and last) Meeting of the Group will be held from 21st to 23rd March 1983 at the Château de la Muette, 2 rue André-Pascal, F-75016 Paris, France. It will begin at 9.30 a.m. on the first day; notices identifying the Meeting room will be posted at the entrances to the OECD buildings.

II. The following agenda is proposed for the Meeting:

1. Opening remarks by the Secretariat; reports on the first Meeting of Principal Working Group No. 4 [SEN/SIN(82)527], and the tenth Meeting of CSNI.
2. Review of proposed agenda [SEN/SIN(83)57]; adoption of agenda.
3. Approval of the summary record of the previous meeting [SEN/SIN(82)767].
4. Discussion of the final draft of the report to CSNI on nuclear aerosols in reactor safety [to be distributed later].
5. Publication of the report on nuclear aerosols in reactor safety: distribution of tasks, schedule.
6. Other matters.

III. It would be helpful if the names and addresses of the designated experts could be communicated to the Secretariat as soon as possible (if you have not already done so).

IV. Background documentation will be distributed to the participants as soon as it becomes available.

V. Suggestions for additional agenda items, or for modifications to the proposed agenda, should be made to the Secretariat as soon as possible (attn: Dr. J. Royen).

APPENDIX C

Supplemental Report Chapter Headings

- I. Introduction and Objectives
 - II. Nuclear Aerosol Formation and Characterization
 - III. Aerosol Processes
 - IV. Computer Modeling of Aerosol Behavior
 - V. Comparison of Computer Modeling with Aerosol Experiments
 - VI. The Influence of Aerosols on Containment Integrity
 - VII. Impact of Uncertainties About Nuclear Aerosols
 - VIII. Conclusions on the State of the Art
 - IX. Topics Suggested for Further Research and Analysis
- APPENDIX A. Input and Output of Codes

APPENDIX D

Itinerary of Trip

March 19, 1983	.....	Leave Oak Ridge, Tennessee
March 20, 1983	.....	Arrive Paris, France
March 21-23, 1983	.....	CSNI/GRENA Meeting
March 24-25, 1983	.....	CSNI/GREST Meeting
March 26, 1983	.....	Return to Oak Ridge, Tennessee

APPENDIX E

Bibliography of Literature Acquired

- M. Bustraan et. al., De Bronterm Bij Ernstige Reactorongevallen. Een Kritische Evaluatie Van Nieuwere Inzichten,* Opdracht No. 0652, Stichting Energieonderzoek Centrum Nederland, Petten, May 1982 (Restricted Distribution).

*Written in Dutch. The present author (who does not read or speak Dutch) translates this title as, "The Source Term for Severe Reactor Accidents. A Critical Evaluation Based on Current Knowledge."

DISTRIBUTION

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3. Director, Division of Safeguards and Security, DOE-Wash.
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- 6-7. Director, Division of International Programs, NRC-Wash.
- 8-9. Division of Technical Information and Document Control, NRC-Wash.
10. J. A. Lenhard, DOE-ORO
11. J. S. Denton, DOE-ORO
12. Herman Postma
13. T. S. Kress
14. IETA Program Manager, Lawrence Livermore Laboratory, Mail Stop
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15. R. B. Minogue, NRC-Wash.
16. D. Ross, NRC-Wash.
17. O. E. Bassett, NRC-Wash.
18. C. N. Kelber, NRC-Wash.
19. M. Silberberg, NRC-Wash.
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