UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judge
Peter B. Bloch

In the Matter of	)	
	)	
THE CURATORS OF	)	Docket Nos. 70-00270
THE UNIVERSITY OF MISSOURI	)	30-02278-MLA
	)	
(Byproduct License	)	Re: TRUMP-S Project
No. 24-00513-32;	)	
Special Nuclear Materials	)	ASLBP No. 90-613-02-MLA
License No. SNM-247)	)	

AFFIDAVIT OF DANIEL J. OSETEK
REGARDING SAFETY OF THE TRUMP-S PROJECT

I, Daniel J. Osetek, declare as follows:

1. I am a principal engineer with the Los Alamos Technical Associates, Inc. (LATA), 6501 Americas Parkway NE, Albuquerque, NM 87110. I have been employed by LATA for approximately 1 1/2 years.

2. I received a B.S. in Physics from the New Mexico Institute of Mining and Technology in 1969 and a M.S. in Nuclear Engineering from the University of New Mexico in 1978. I have gained over twenty years of professional experience working in nuclear safety research, and I have authored or coauthored over 70 technical publications. I have been employed by the Lovelace Inhalation Toxicology Research Institute, the Los Alamos National Laboratory (LANL), and the Idaho National Engineering Laboratory (INEL). A copy of my current resume is attached (Attachment 1).

3. At Lovelace I was responsible for the daily operations of an alpha laboratory where plutonium and other actinide materials were handled in gloveboxes similar to operations in the TRUMP-S project. I participated in glovebox system designs for both the beta-gamma laboratory and the alpha laboratory. I also contributed to the development of routine operating procedures and the training of technicians in the safe handling of radioactive materials.

4. At LANL I worked in the aerosol science section and contributed to several projects related to industrial hygiene and aerosol physics. I conducted several in-place tests of HEPA filter systems for large laboratories and I developed a technique for in-place testing a two stage HEPA filter system using special equipment designed and built for this specific purpose. I was team leader for the certification of the new HEPA filter systems at the plutonium fuel fabrication facility.

5. At INEL I designed effluent monitoring systems for in-reactor tests on nuclear fuel that simulated accidents conditions. I participated in the conduct and analysis of several nuclear fuel tests in the Power Burst Facility and the Loss of Fluid Test Facility. From 1983 to 1989 I was Manager of the Fuels and Materials Unit, responsible for the supervision of scientists and engineers working on a variety of nuclear safety research projects.

6. A large part of my experience gained at INEL was related to the analysis of nuclear reactor accidents and the calculation of radionuclide release and transport. At LATA my experience has included the preparation of safety analysis reports (SARs) and the independent review of SARs for various DOE nuclear facilities. These safety analyses usually include reviews of potential accidents, the estimation of probabilities and consequences, and the calculation of potential dose effects. I am presently a member of DOE Source Term Expert's Group and a former member of several NRC technical review groups. I have contributed to reviews of NRCs accident research plans and several NUREG documents.

7. On October 31 and November 1, 1990 I visited the University of Missouri Research Reactor (MURR) and examined the Alpha Laboratory and the TRUMP-S experimental apparatus. I reviewed the operating procedures and interviewed several project personnel to gain knowledge of the operations and safety related details. I familiarized myself with the current questions and concerns surrounding the safety of the TRUMP-S project.

8. I have reviewed the "Declaration of James C. Warf and Daniel O. Hirsch", the "Declaration of TRUMP-S Review Panel" by Daniel Hirsch and James C. Warf et al., and the document titled "A Critique of the TRUMP-S Process" by James C. Warf, . I have also reviewed the "Affidavit of Dr. J. Steven Morris Regarding Errors in Petitioners Analyses", NUREG-1140 (Ref 4), and the generic NUREG-1140 analysis performed by Dr. Susan M. Langhorst to evaluate the accident involving plutonium of the type used in the TRUMP-S Project. The following paragraphs present my views on these matters and conclude that the TRUMP-S project presents acceptably low risk to the health and safety of facility personnel, the general public and the environment.

9. There are four aspects of potential concern regarding the safety of the radioactive actinide materials planned for use in the TRUMP-S project: (1) storage of the total bulk inventory at the facility, (2) transfer of the material to the Alpha Laboratory, (3) handling of the material during preparation and experimentation in the Alpha Laboratory, and (4) archive storage of small quantities of materials and contaminated equipment.

10. The bulk actinide materials are packaged in special robust double containers that are highly resistent to breakage and these packages are stored in the MURR fuel storage vault that is designed to meet special safety objectives such as fire resistance, etc. The fuel storage vault is inside containment, a safety feature specifically designed to minimize emissions in the event of an accident. These packages of actinide material are handled very seldom, greatly reducing the chances of a handling accident. The risk of a serious accident that could result in health and safety consequences outside the facility is diminishingly small. In my judgement, this risk is far below that of other routine hazards accepted by the general public in their daily activities.

11. Similarly, the risk of a serious accident during transfer of the materials from storage to the laboratory is also very low; because the quantity of material is limited (usually a fraction of the licensing limit), the transfer package is designed to survive credible accidents in transit (one of the two layers of packaging is steel), and special procedures are followed by trained personnel during the transfer operation. Each element is moved separately by trained personnel accompanied by a health physics monitor following procedures that are reviewed and approved by MURR management.

12. Archive storage includes waste material, contaminated with trace levels of depleted uranium or actinides, and reagets, reusable apparatus and equipment that contain recoverable amounts of depleted uranium or actinide material. The waste material and the depleted uranium are stored in sealed bags. Items containing recoverable amounts of actinide (up to 300 mg) are packaged in special sealed robust double containers. Both the inner and outer containers are fabricated of schedule 40 aluminum pipe with welded seams and bolted o-ring/flange covers and are backfilled with argon gas.

The archive storage vault is well designed to safely maintain these materials and protect them from damage or unauthorized handling. The risk of a serious accident involving the transfer or storage of materials in the archive storage vault is minimized by the limited quantities, the double containers, the vault design and the observance of approved written procedures in all operations.

13. The greatest risk associated with the TRUMP-S project, therefore, appears to be that of handling the actinide materials in the Alpha Laboratory. This handling risk can be separated into two parts: (1) separating the bulk materials into smaller experimental sizes, and (2) conducting experiments on these smaller quantities.

14. The risk associated with the separation process is lower than the risk associated with the experiments. During the separation process, the maximum amount of material expected to be involved is less than the licensing limits (present quantities are ~ 5 grams plutonium, ~2.4 grams americium, ~75 grams depleted uranium, and ~4.0 grams neptunium). After separation bulk materials are returned to the fuel storage vault. The separated material is less than 1 gram and usually 100 - 300 mg.

15. The physical form of the materials is also more benign at this stage. Solid single pieces or several solid chips of material are being handled, not easily dispersed powders or liquids. Further, the types of operations being conducted during separation involve low energy, that is non-mechanical non-electrical operations primarily using hand tools. No high temperatures or other risky operations are involved. Therefore it is judged that the risk dominant aspect of the TRUMP-S project is associated with the experiments themselves, and evaluation of the safety aspects of these processes is the subject of the following paragraphs.

16. Once the material to be used in a thermo-dynamic experiment has been separated from the bulk material, a maximum of 0.3 gm is used in the high temperature process in the argon glovebox and at risk of being involved in an accident. The remaining material is removed from the argon glovebox or stored safely in a sealed steel container. Little or no combustible materials are present in the vicinity of the stored actinide material.

17. The technique generally used to evaluate the safety (or risk) of specific moderate-to-high risk DOE facilities (Ref. 1) or high risk operations licensed by the NRC is to estimate the probability and consequences of credible accidents (Ref. 2). This technique uses, for example, a preliminary hazards analysis to identify possible accidents, and then more detailed analysis of the apparent high risk events is conducted if warranted. Since the TRUMP-S project involves small amounts of actinide material in low energy operations, such rigorous analysis is not warranted.

18. DOE defines a credible event as one that has a probability of occurrence of 10^{-6} per year or greater (Ref 3). When a credible accident is found by analyses to result in an unacceptable risk (usually defined as approaching certain dose/probability guidelines), additional safety features are added

to the project to reduce this estimated risk. Such added safety features may include engineered systems like extra HEPA filters, or administrative procedures like additional Health Physics (HP) surveillance. Although the TRUMP-S project does not fit in the same category with moderate-to-high risk operations such as those at large DOE laboratories, TRUMP-S already has added many additional safety features.

19. I have reviewed the experiment design and personally inspected the Alpha Laboratory, the gloveboxes and the ventilation system used to control effluents from the TRUMP-S experiments. It is my opinion that the apparatus is well designed and constructed and includes all the features expected for a system of this type and purpose and some added features beyond the minimal requirements (e.g., four banks of HEPA filters, three in-place tested, in the glovebox exhaust lines). I have reviewed the procedures used to conduct the experiments and I find these suitable and I find no cause for concern over the safety of the project.

20. Therefore, it is my judgement that the TRUMP-S project has not only complied with the safety requirements appropriate to an operation of this type, but it has exceeded the usual requirements by adding safety features and controlled procedures usually reserved for much more hazardous operations. To further support this position it is useful to compare the estimated consequences of a "worst case" accident using very conservative assumptions to the consequences estimated using more realistic assumptions.

21. The conservative approach follows that already conducted by MURR personnel using the technique described in NUREG-1140 (Ref. 4). The maximum amount of 1.0 gm, which corresponds to the experiment limit specified in the material license application, is assumed to be involved in a severe fire that prevents filtration of the effluent, prevents deposition of the effluent within the facility and prevents realistic dispersion of the effluent. A conservative release fraction of 0.001 is used, as is a conservative dispersion model with 1 m/s wind and no buoyancy. A conservative dosimetry model is used and no credit is taken for evacuation or the potential lack of individuals at the plume centerline. No plume meander is assumed and no emergency action such as fire fighting is assumed so the entire effluent is involved in the consequence analysis. The dose calculated for the maximum exposed individual at 100 m using these highly conservative assumptions is 0.034 Rem effective dose equivalent (EDE). Such highly conservative analysis is only useful for evaluating the need for rigorous emergency planning or certain project planning purposes. The stated NRC policy is "Emergency planning should be based on realistic assumptions regarding severe accidents" (Ref. 5, Issue 4, 1985, Page 6). More realistic analysis is necessary to evaluate the true risk of an

operation in instances where NRC regulations would require consideration of an emergency plan. NRC guidance for such evaluation of risk is stated in 10 CFR 30.32(i)(2):

> (2) One or more of the following factors may be used to support an evaluation submitted under paragraph (i)(1)(i) of this section:
> (i) The radioactive material is physically separated so that only a portion could be involved in an accident;
> (ii) All or part of the radioactive material is not subject to release during an accident because of the way it is stored or packaged;
> (iii) The release fraction in the respirable size range would be lower than the release fraction shown § 30.72 due to the chemical or physical form of the material;
> (iv) The solubility of the radioactive material would reduce the dose received;
> (v) Facility design or engineered safety features in the facility would cause the release fraction to be lower than shown in § 30.72;
> (vi) Operating restrictions or procedures would prevent a release fraction large as that shown in § 30.72; or
> (vii) Other factors appropriate for the specific facility.

22. A more realistic, or best-estimate (BE), analysis of a severe accident involving the TRUMP-S experiments must include the following best estimates of the relevant parameters.

1. Inventory The actinide quantity to be used in any thermodynamic experiment is 0.3 gram or less. This analysis assumes 0.3 gram of plutonium with the isotopic distribution appropriate for the TRUMP-S materials.

2. Release Fraction The fraction of actinide material that could be released in a respirable size (< 10 μm diameter aerosol particles) and remain airborne as a result of a fire can vary widely depending on accident details. The chemical form of the actinide material and the physical forces encountered during the accident influence the quantity that is released. Several references in the technical literature offer reasonable comparisons for identifying the best estimate release fraction applicable to the postulated TRUMP-S accident. There are also several references in the technical literature that offer information about actinide release but are not applicable to the TRUMP-S postulated accident. Care must be exercised to use the appropriate release fraction. The process involved in the postulated accident includes either the actinide metal before conversion or an actinide salt after conversion in the pot furnace. Thus only release fractions for burning metallic or salt contaminated combustibles are appropriate for estimating the release from a fire involving the TRUMP-S materials.

The literature data for burning metallics (Refs 6, 7, and 8) give release fraction values ranging from 2.8×10^{-6} to 5.3×10^{-4}. Certain data quoted in the literature (Ref 8 and 9) are given as fractional release rates ranging from 4.5×10^{-5} to 3.2×10^{-4} per hour. Since the fire duration is assumed to be limited to 1 hour or less, the most conservative release fraction of 5.3×10^{-4} should be used.

The literature data for salt release (Ref. 10) indicates that the release fractions depend strongly on the type of combustible material that is contaminated with the salt and involved in the burn. The largest release noted was 6.5×10^{-3} for polymethylmethacrylate or PMMA (used for glovebox windows); polychloroprene (used in rubber gloves and gasketing) gave a release fraction of 4.2×10^{-3}; and cellulose (e.g., paper towels) have release fractions of 9.5×10^{-5} to 2.9×10^{-4}. Proper application of these salt release fractions requires weighting for the appropriate partitioning of the actinide salt among the three possible combustible material types: gloves, window and cellulose. Assuming most of the salt is spilled onto combustible cellulose-type material in the glovebox and a few percent adheres to the gloves and windows, a release fraction similar to that for the burning metal can be used: 5.3×10^{-4}. Therefore, a best estimate release fraction appropriate for this analysis for either metallic or salt is 5.3×10^{-4}. This release fraction value is also consistent with the U.S. Nuclear Regulatory Commission statement in NUREG-1140 that a value of 10^{-3} is conservative since it is derived from ..."experiments designed to maximize releases."

3. <u>Filtration</u> Under normal steady state circumstances there is no effluent from the TRUMP-S argon glovebox. The atmosphere is recirculated through four HEPA filters and two gas treatment units. If the appropriate pressure differentials are not maintained between the glovebox and the laboratory, an automatic valve opens to exhaust the glovebox through four stages of HEPA filtration (3 in-place tested) and maintain confinement in the TRUMP-S experiment glovebox. Emergency procedures invoked during a fire may secure the exhaust (and intake) ventilation systems after the fire has been identified. Some filtration of fire generated smoke will occur before these systems are secured. The same procedure ensures closure of all fire doors, thus isolating the facility to minimize the ingress of air to the fire and smoke (potentially contaminated) egress. Since the fire hose connector nearest the Alpha Laboratory is inside the basement area, fire hoses can be manned without interference with the fire doors. It is expected that under these conditions some reduction in effluent will occur as a result of partial filtration or natural deposition processes that remove airborne aerosol particles inside the facility. Particle agglomeration and settling, thermophoresis and impaction or impingement will reduce the airborne quantities. The

amount of time that the aerosol particles experience these natural forces controls the degree or amount of loss (deposition). The residence time will be controlled by the distances and confinement barriers that exist between the source of the aerosol (the fire in the Alpha Laboratory) and the point of release to the environment (the nearest open door, window, or leak point at ground level). Since the aerosol must negotiate the pathway from the glovebox through ducts or the Alpha Laboratory open space, the Alpha-Laboratory door(s), the large basement room, the stairwell to the ground floor, the door to the ground level, the ground level hallways and the door, window or leak paths to the environment, a large residence time is required. Thus for small to moderate size fires, a substantial amount of aerosol and the actinide material is expected to deposit inside the building between the source and release points. This best estimate analysis conservatively assumes a 50% reduction in the effluent as a result of such partial filtration or natural deposition processes.

4. <u>Emergency Action</u> The same procedures that are used in emergency (accident) situations to secure the ventilation system are also used to control the postulated fire. Personnel are trained to fight fires and the emergency procedure instructs them to do just that. Additionally, the procedure calls for action of the Columbia Fire Department. The combination of these actions is expected to control the fire in a brief time period from a few minutes to ~1/2 hour. Limiting the duration of the burn will also limit the amount of hazardous material involved in the fire and released by the accident. If the fire requires longer to extinguish, more time is available for other emergency actions such as warnings, evacuation, or sheltering. Therefore, this best estimate analysis uses a factor of 2 reduction in the calculated consequences to account for either eventuality, a 1/2 hour fire and release period instead of a 1 hour fire and release period, or exposure to the effluent for 1/2 of the time before evacuation (or other mitigation) is enacted instead of the full exposure time.

5. <u>Plume rise</u> The assumption of no plume buoyancy in a severe facility fire is not realistic. The heat generated by the fire forces convective currents to rise, carrying any actinide release with the rising smoke plume. This buoyancy increases the dilution of the actinide material before it reaches the location of any postulated individual, and may increase the minimum distance to the nearest postulated individual. A best estimate analysis should use atmospheric dispersion models that include plume buoyancy. Therefore, this analysis will use such models as described in Figure 1 of NUREG-1140

6. <u>Wind Speed</u> Wind speeds at the facility site exceed 1 m/s 98% of the time (see Attachment 2). If winds are only 1 m/s, plume meander will reduce concentrations and/or the time of

exposure to a recipient at a fixed downwind location. The NRC Regulatory Guide 1.145 (Ref. 10) describes the use of plume meander models; and, in general, a factor of 4 reduction in estimated concentration (and dose) is calculated when plume meander is modelled. Therefore, best estimate analysis should use either a higher realistic wind speed or the plume meander assumption. This analysis uses the realistic assumption of 4.5 m/s wind speed.

23. The dose calculated for the maximum exposed individual as a result of a severe fire in the Alpha Laboratory for the more realistic case described above is significantly smaller than for the case using the numerous conservative (and unrealistic) assumptions. Using the parameters described in 1 through 6 above, an effective dose equivalent (EDE) of 2.0×10^{-5} Rem is calculated for the maximum exposed individual. Because of the plume buoyancy effect, the maximum exposure occurs at 250m. This dose is compared to 0.034 Rem for the highly conservative case that uses the NUREG-1140 assumptions. Thus, there appears to be a margin of conservatism of more than 3 orders of magnitude between the expected consequences of an assumed severe accident and those calculated using the highly conservative analysis of NUREG-1140.

24. If more conservatism is included in the best estimate analysis, and only assumptions 1, 5, and 6 are allowed (i.e., assumptions 2, 3, and 4. are excluded) the calculated dose is 1.5×10^{-4} Rem. In this case there are still more than two orders of magnitude margin of conservatism.

25. The above analysis assumes that plutonium is the actinide involved in the accident. The dose calculated for an accident involving americium is greater. Using the same assumptions 1-6 given above, except 0.3 grams of americium is substituted for the plutonium, the calculated EDE for the maximum exposed individual would be 9.4×10^{-4} Rem or about one millirem.

26. In addition to this very low consequence, the probability of such an accident also appears to be very low further reducing the estimated risk of the project. Factors affecting the probability of occurrence include:

    1. inerted glovebox reduces potential for ignition,

    2. combustible materials are essentially absent from the argon glovebox and very limited throughout the Alpha Laboratory,

    3. the laboratory is constructed primarily of concrete and fire resistant materials,

4. the only source of energy present in or near the glovebox is the pot furnace and the external thermal well which are maintained at moderate(<600° C) temperatures,

5. dry chemical and halon fire extinguishers are present in the Alpha Laboratory and personnel are trained to use them,

6. two smoke detectors are present in the laboratory and a heat sensor is located in the glovebox and each alarm locally and in the MURR control room,

7. the Columbia fire department responds rapidly to fire alarms and will likely extinguish fires before they become severe.

27. Based on this analysis showing very low consequences, and the very low probability estimated for a severe accident in the TRUMP-S Project, I believe the project presents acceptably low risk to the health and safety of facility personnel, the general public and the environment.

28. I have also examined the results of the TRUMP-S Review Panel calculations (Intervenors Exhibit 1, paragraph 75, including Table III) and find these results disagree with my own calculations. Using their assumptions of 1 gram and 3% release, I calculate a concentration at 100m of 5.3×10^{-9} Ci/m^3, which is more than 37 times lower than the value of 2.0×10^{-7} calculated by the Review Panel. Thus, the Review Panel seems to be overestimating even the concentrations that might be used for emergency planning. Similar overestimates of more realistic accident consequences distorts the true margin of conservatism that exists for the TRUMP-S Project.

29. In the "Declaration of James C. Warf and Daniel O. Hirsch" it is stated that the release of actinides at Chernobyl was 3% and, therefore, "at least a few percent" release should be assumed for the TRUMP-S accident analysis. Having worked in reactor safety for twelve years, I am very familiar with the circumstances surrounding the reactor accident at Chernobyl. The accident at Chernobyl bears no resemblance to the accident postulated for worst case analysis of the TRUMP-S project. The fire at the Chernobyl reactor was initiated by a reactivity excursion and sustained by the combination of nuclear fuel decay heat, a large volume of graphite and air ingress. Very high temperatures were attained at Chernobyl, far above any temperatures achievable in fires that can be postulated for the Alpha Laboratory. The 3% release derived from the Chernobyl data took place over a ten day period.

Good engineering practice would preclude the application of any Chernobyl data in any manner to the accident postulated for the TRUMP-S Project. The proper release fraction that should be applied to the TRUMP-S accident analysis should come from experiments that most closely simulate the conditions expected in the postulated accident. As described in the best estimate analysis above, references 5-9 provide the best source of these values.

30. The purpose of highly conservative, unrealistic analysis is to evaluate the needs for special emergency preparedness and additional safety features. Such analyses should not be used to judge the true safety (or risk) of a project. The safety of a project must be judged on the probability and more realistic consequences of credible accidents. In this regard, the best estimate analysis provided above illustrates the level of safety that should be assigned to the TRUMP-S Project, and this level appears more than adequate to this reviewer.

31. References

1. U.S. Department of Energy Order, DOE 5481.1B, Safety Analysis and Review System, September 23, 1986.

2. U.S. Nuclear Regulato[illegible]nmission, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," NUREG-1150, June 1989.

3. U.S. Department of Energy Order, AL5481.1B, Safety Analysis and Review System, January 27, 1988.

4. S.A. McGuire, "Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licenses", U. S. Nuclear Regulatory Commission final report, NUREG-1140, January 1988.

5. U.S. Nuclear Regulatory Commission, "U.S. Nuclear Regulatory Commission Policy and Planning Guidance - 1985," NUREG-0885, 1985.

6. L. C. Schwendiman et at., "Airborne Release of Particles in Overheating Incidents Involving Plutonium Metal and Compounds," Battelle Northwest Laboratory, BNWL-SA-1735, August 1968.

7. K. Stewart, "The Particulate Material Formed by Oxidation of Plutonium," <u>Progress in Nuclear Energy</u>, Pergamon Press, New York, 1963.

8. J. E. Ayer et al., "Nuclear Fuel Cycle Facility Accident Analysis handbook," NUREG-1320, May 1988.

9. J. Mishima, "Plutonium Release Studies, II. Release from Ignited, Bulk Metallic Pieces," BNWL-357, 1966.

10. M. A. Halverson and M.Y. Ballinger, "Radioactive Airborne Releases from Burning Contaminated Combustibles," PNL-5999, 1987.

Subscribed and sworn to
before me in
Bernalillo County, New Mexico
This 13th day of November, 1990

Joann S. Varner

My Commission Expires

10-27-94

Daniel J. Osetek

Daniel J. Osetek
Principal Engineer

DANIEL J. OSETEK

EDUCATION:

M.S., Nuclear Engineering, University of New Mexico - Los Alamos Branch, 1978
B.S., Physics, New Mexico Institute of Mining and Technology, 1969
Coursework at Idaho State University

TITLE: Manager, Reactor Safety Programs

EXPERIENCE:

Corporate Affiliations: LATA, 1989 - present
EG&G Idaho, 1978 - 1989
Los Alamos National Laboratory, 1974 - 1978
Lovelace Inhalation Toxicology Research Institute, 1971 - 1974

Areas of Specialization: Nuclear facility safety
Nuclear reactor safety
Severe accident phenomena evaluation
Source term analysis
In-reactor experiment design
Plutonium and fission product aerosol characterization

Years of Experience: 20

Security Clearance: DOE Q in process

Related Experience:

Mr. Osetek is a recognized expert in fission product behavior and source term analysis with a broad knowledge of current reactor safety issues, severe accident phenomena and nuclear facility safety. His technical experience includes the following.

- Safety related research, phenomenological analysis, and results reporting for several NRC and DOE Programs:
  - the Severe Fuel Damage tests in the Power Burst Facility,
  - the TMI-2 Accident Evaluation Program,
  - the OECD-LOFT fission product experiments FP-1 and FP-2,
  - design basis and severe accident source term calculations for various NRC sponsors,
  - N-Reactor source term analysis,
  - ATR safety analysis, and
  - MHTGR-NPR fuel and target safety analysis.
- Experimental Research:
  - aerosol instrumentation design, data collection, and analysis for the PBF Severe Fuel Damage Test SFD 1-4;

- fission product detection system design, operation, and data analysis for in-pile tests in PBF, LOFT, and NRU;
- effluent system design, operation, and data analysis for severe fuel damage tests in PBF and LOFT; and
- fuel and fission product behavior analysis for in-pile tests on reactivity insertion accidents, power-cooling-mismatch events, and loss-of- coolant accidents.

• Technical committee contributions:

- technical expert representing NRC to the National Research Council's review of severe accident chemical processes;
- participant in the NRC's Expert Panel Review of Source Term Uncertainties in Severe Accidents;
- member of NRC's Expert Review Team for the French PHEBUS Program, the EPRI STEP Tests, the NRU FLHT tests, and European research programs; and
- member of DOE's Source Term Experts Group for advanced reactors.

• Nuclear Safety and Environmental Reviews:

- reviewer of NRC documents on accident research and source terms: severe accident research plan, NUREG-1150, NUREG-0956, and NUREG-0772;
- review group manager for DOE-ID to evaluate Idaho National Engineering Laboratory (INEL) environmental compliance system;
- Safety Analysis reviewer for INEL, Westinghouse Hanford, and Sandia National Laboratories (SNL); and
- Manager of Safety Analysis Report preparation for SNL and Hanford Nuclear Facilities.

Mr. Osetek is manager of reactor safety programs at LATA. Currently he is participating in a DOE project to evaluate severe accident source terms for advanced Light Water Reactors and in the development of a reference manual for NRCs CONTAIN 1.1 computer code. He is managing the preparation of safety analysis reports for Sandia's Radioactive and Mixed Waste Management Facility (RMWMF) and Hanford's Buried Waste Retrieval Project. He was a principal contributor to the Preliminary Safety Evaluations (PSEs) for Hanford's Waste Receiving and Processing Facility and the Aging Waste Transfer Lines. Recently he supported the safety reviews of Hanford's Waste Vitrification Plant, the Plutonium Finishing Plant, Irradiated Fuel Storage Facility, and Buried Waste Retrieval Program. Earlier at LATA he served as a group leader for evaluation of the environmental compliance systems at INEL for DOE-ID.

With EG&G Idaho at INEL, Mr. Osetek was manager of the Fuels and Materials Research Unit. He managed the technical and administrative functions of the unit responsible for multiple projects related to nuclear reactor safety analysis, nuclear fuel testing in reactors and in hot cells, specialized instrument development, data analysis, and results reporting. Mr. Osetek represented the company in international research programs and served as technical expert for the NRC on national and international review committees concerned with severe accident research.

Earlier at EG&G Idaho Mr. Osetek was supervisor of nuclear fuel testing. he directed scientists and engineers on the design and specification of in-reactor experiments on nuclear fuel. He prepared detailed operating procedures, data acquisition and reduction plans, experiment data reports, and detailed analysis reports. Mr. Osetek also managed liaison between program planning, design engineering, reactor operations, and the physical/chemical sciences. As an EG&G project engineer Mr. Osetek managed the design, development, and upgrades of the state-of-the-art experiment monitoring and control system for in-reactor fuel and fission product behavior tests.

As a staff member at Los Alamos National Laboratory Mr. Osetek conducted aerosol research activities related to nuclear facility hygiene. He designed and developed field testing equipment and procedures for HEPA filter systems, managed air cleaning equipment qualification testing and technician training on field testing procedures, and provided engineering consultation on various aerosol projects.

At Lovelace Mr. Osetek managed the technical operation of the Alpha Exposure Complex where laboratory animals are administered lung burdens of plutonium aerosols. He trained and directed technicians in radioactive material handling, aerosol generation, sampling and data processing, electromicroscopy and decontamination activities. He also characterized alpha, beta, and gamma emitting aerosols.

PUBLICATIONS:

Mr. Osetek has over 70 technical publications concerning fuel and fission product behavior, hydrogen and aerosol generation, and reactor safety analysis.

Daniel J. Osetek (continued)

PUBLICATIONS:

A. W. Cronenberg, D. J. Osetek, R. O. Gauntt and F. E. Panisko, "Severe Accident Zircaloy Oxidation/Hydrogen Generation Behavior Noted From In-Pile Test Data," Proceedings: 17th Water Reactor Safety Information Meeting, Rockville, MD, October 1989.

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Professional Societies:

American Nuclear Society - individual contributor to public information and membership programs
Nuclear Chemistry and Technology Division of the American Chemical Society
American Association of Aerosol Science

Honors:

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1985 ANS Literary Award
1987 Idaho American Nuclear Society Outstanding Service Award

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Responsibilities/Involvement with Current Projects

1. Project Manager for CD009-00, SAR for RMWMF, 8/15/90
2. Project Manager for EG001-00, Expert technical consulting service on advanced reactor severe accident source terms, 9/30/90
3. Project Manager for EG002-00, Expert technical consulting service on NRC Severe Accident Research, 12/90.
4. Technical Reviewer and text contributor for SL066, CONTAIN Reference Manual, 12/15/90
5. Principal Investigator for WH109-00, Revise SARs on Buried Waste Retrieval and TRUSAF, 8/15/90
6. Principal Reviewer for WH112, Technical support to WHC Solid Waste Nuclear Safety, 12/30/90

Job Classification: PE III

Supervisor/Location: R. J. Kingsbury, ABO

TABLE 2.3-19

MONTHLY STABILITY CLASS FREQUENCY DISTRIBUTIONS (IN PERCENT)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: (1959-1969)

PASQUILL-TURNER STABILITY CLASS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
A	.0	.1	.1	.2	.6	1.0	1.3	1.1	.1	.2	.0	.0	.4
B	.3	1.3	2.4	3.2	6.1	9.2	11.5	10.3	6.3	4.0	.6	.6	4.7
C	5.1	6.6	6.0	9.2	16.0	18.6	21.6	21.5	13.0	9.8	5.0	5.1	11.5
D	67.1	67.5	68.5	68.2	51.2	39.0	28.5	30.0	47.3	47.3	63.1	66.1	53.6
E	18.7	14.7	14.7	12.6	15.8	17.1	17.7	19.0	18.9	23.1	20.4	18.3	17.6
F	8.7	10.0	8.2	6.5	10.2	15.1	19.4	18.0	14.4	15.6	10.9	9.9	12.2

SOURCE:

NATIONAL CLIMATIC CENTER, UNDATED, SUMMARY OF HOURLY OBSERVATIONS, COLUMBIA MISSOUR (1959-1969);
NATIONAL CLIMATIC CENTER, ASHEVILLE, NORTH CAROLINA, MAGNETIC TAPE FOR STATION NO. 13983.

EXHIBIT 1 ATTACHMENT 2

TABLE 2.3-20

JOINT WIND SPEED, WIND DIRECTION
FREQUENCY DISTRIBUTION (IN PERCENT)
BY STABILITY CLASS

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI CLASS A
DATA PERIOD: ANNUAL, (1960-1969)

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS) 2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	3.4	.0	.0	.0	.0	.0	.0	.0	3.4	4.5
NE	.0	1.7	.0	.0	.0	.0	.0	.0	.0	1.7	4.0
ENE	.0	7.8	.0	.0	.0	.0	.0	.0	.0	7.8	3.9
E	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	3.8
ESE	.0	3.4	.0	.0	.0	.0	.0	.0	.0	3.4	3.8
SE	.0	2.6	.0	.0	.0	.0	.0	.0	.0	2.6	4.3
SSE	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	4.4
S	.9	5.2	.0	.0	.0	.0	.0	.0	.0	6.0	4.0
SSW	.0	6.0	.0	.0	.0	.0	.0	.0	.0	6.0	4.6
SW	.9	4.3	.0	.0	.0	.0	.0	.0	.0	5.2	3.5
WSW	.0	6.0	.0	.0	.0	.0	.0	.0	.0	6.0	4.3
W	.9	2.6	.0	.0	.0	.0	.0	.0	.0	3.4	3.5
WNW	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	4.0
NW	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	4.2
NNW	.0	1.7	.0	.0	.0	.0	.0	.0	.0	1.7	4.5
N	.0	7.8	.0	.0	.0	.0	.0	.0	.0	7.8	4.6
CALM										27.6	
TOTAL	2.6	69.8	.0	.0	.0	.0	.0	.0	.0	100.0	3.0

NUMBER OF INVALID OBSERVATIONS = 0

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: ANNUAL, (1960-1969)

CLASS B

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS) 2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	1.3	1.0	.4	.0	.0	.0	.0	.0	2.7	5.5
NE	.1	1.2	1.1	.2	.0	.0	.0	.0	.0	2.6	5.2
ENE	.1	2.4	2.0	.6	.0	.0	.0	.0	.0	5.1	5.5
E	.1	1.9	3.0	.2	.0	.0	.0	.0	.0	5.3	5.6
ESE	.1	2.1	2.2	.4	.0	.0	.0	.0	.0	4.7	5.6
SE	.1	1.6	2.3	.5	.0	.0	.0	.0	.0	4.6	5.7
SSE	.1	1.9	3.5	1.0	.0	.0	.0	.0	.0	6.5	5.8
S	.2	3.3	6.0	1.3	.0	.0	.0	.0	.0	10.8	5.9
SSW	.1	2.5	5.0	1.1	.0	.0	.0	.0	.0	8.6	6.1
SW	.0	2.9	4.8	1.4	.0	.0	.0	.0	.0	9.2	5.9
WSW	.0	4.1	5.2	1.5	.0	.0	.0	.0	.0	10.8	5.9
W	.3	2.6	3.4	.4	.0	.0	.0	.0	.0	6.7	5.4
WNW	.1	2.5	2.4	.4	.0	.0	.0	.0	.0	5.4	5.5
NW	.1	1.8	1.9	.6	.0	.0	.0	.0	.0	4.4	5.6
NNW	.0	1.6	1.0	.3	.0	.0	.0	.0	.0	2.9	5.2
N	.4	2.1	1.8	.5	.0	.0	.0	.0	.0	4.8	5.2
CALM										4.9	
TOTAL	1.8	35.9	46.7	10.8	.0	.0	.0	.0	.0	100.0	5.4

NUMBER OF INVALID OBSERVATIONS = 0

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI CLASS C
DATA PERIOD: ANNUAL, (1960-1969)

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)									TOTAL	MEAN SPEED
	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0		
NNE	.0	.7	.7	1.6	.2	.1	.0	.0	.0	3.5	7.7
NE	.0	.9	.5	1.2	.2	.0	.0	.0	.0	2.7	7.2
ENE	.0	1.0	1.2	1.7	.3	.1	.0	.0	.0	4.3	7.5
E	.0	1.0	.9	2.3	.1	.0	.0	.0	.0	4.4	7.3
ESE	.0	1.0	.7	2.8	.2	.1	.0	.0	.0	4.8	7.6
SE	.0	1.4	1.3	2.9	.6	.1	.1	.0	.0	6.4	7.9
SSE	.0	1.0	2.0	5.0	.6	.1	.0	.0	.0	8.7	8.0
S	.0	1.9	3.5	7.4	.9	.4	.1	.1	.0	14.4	8.1
SSW	.0	1.5	2.2	5.1	.8	.2	.0	.0	.0	9.7	8.0
SW	.1	1.2	1.6	4.0	.4	.2	.0	.0	.0	7.5	8.0
WSW	.0	1.4	1.8	4.5	.8	.4	.1	.1	.0	9.0	8.3
W	.0	1.3	1.6	2.7	.3	.2	.0	.0	.0	6.2	7.6
WNW	.0	.6	1.2	2.6	.4	.2	.0	.0	.0	5.1	8.3
NW	.0	1.0	.7	2.2	.3	.1	.1	.0	.0	4.7	8.3
NNW	.0	.8	.5	1.2	.2	.1	.1	.0	.0	3.0	8.0
N	.0	1.0	1.1	2.2	.4	.1	.0	.0	.0	4.8	7.7
CALM										.7	
TOTAL	.2	17.7	21.5	49.5	6.6	2.5	.8	.4	.1	100.0	7.9

NUMBER OF INVALID OBSERVATIONS = 0

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI CLASS D
DATA PERIOD: ANNUAL, (1960-1969)

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										MEAN
	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	SPEED
NNE	.0	.3	.4	1.3	.8	.8	.3	.2	.0	4.2	11.0
NE	.0	.4	.5	1.4	.8	.6	.1	.1	.0	3.9	10.2
ENE	.0	.4	.8	1.8	.7	.7	.1	.1	.0	4.7	9.6
E	.0	.5	.8	1.7	.7	.6	.1	.1	.0	4.4	9.6
ESE	.0	.4	.9	2.1	1.3	1.1	.3	.1	.0	6.1	10.3
SE	.0	.4	.8	2.6	1.8	1.6	.5	.2	.0	7.8	11.0
SSE	.0	.4	1.0	3.1	1.9	2.1	.5	.2	.0	9.3	10.9
S	.0	.6	1.8	3.6	2.3	2.5	.6	.4	.1	11.8	10.8
SSW	.0	.4	.7	1.6	1.1	1.2	.3	.2	.0	5.5	10.8
SW	.0	.4	.5	.9	.6	.7	.2	.1	.0	3.5	10.5
WSW	.0	.4	.7	1.1	.9	1.0	.4	.3	.1	4.9	11.4
W	.0	.4	.5	1.1	.8	1.1	.3	.4	.1	4.7	11.6
WNW	.0	.4	.5	1.3	1.4	2.1	.9	.9	.4	7.9	13.1
NW	.0	.2	.4	1.4	1.4	2.3	1.3	1.3	.5	8.8	13.9
NNW	.0	.3	.4	1.0	1.0	1.5	.7	.7	.2	5.8	12.9
N	.0	.4	.7	1.6	1.1	1.3	.5	.5	.1	6.2	11.6
CALM										.4	
TOTAL	.1	6.3	11.4	27.6	18.5	21.2	7.1	5.8	1.7	100.0	11.3

NUMBER OF INVALID OBSERVATIONS = 17

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI CLASS E
DATA PERIOD: ANNUAL,(1960-1969)

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										MEAN
	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	SPEED
NNE	.0	.5	1.3	1.5	.0	.0	.0	.0	.0	3.2	7.3
NE	.0	.6	1.0	1.1	.0	.0	.0	.0	.0	2.8	7.0
ENE	.0	1.1	2.0	1.1	.0	.0	.0	.0	.0	4.2	6.7
E	.0	1.3	1.8	1.9	.0	.0	.0	.0	.0	5.0	6.9
ESE	.0	.7	2.0	3.4	.0	.0	.0	.0	.0	6.1	7.7
SE	.0	.7	2.1	5.3	.0	.0	.0	.0	.0	8.2	7.9
SSE	.0	.9	4.0	7.1	.0	.0	.0	.0	.0	12.0	7.9
S	.0	1.7	6.1	9.9	.0	.0	.0	.0	.0	17.6	7.7
SSW	.0	.9	2.9	3.7	.0	.0	.0	.0	.0	7.4	7.5
SW	.0	.6	1.4	2.4	.0	.0	.0	.0	.0	4.3	7.5
WSW	.0	.7	1.9	3.1	.0	.0	.0	.0	.0	5.7	7.6
W	.0	.9	1.9	2.4	.0	.0	.0	.0	.0	5.3	7.2
WNW	.0	.6	1.7	3.3	.0	.0	.0	.0	.0	5.5	7.8
NW	.0	.4	1.0	3.6	.0	.0	.0	.0	.0	5.1	8.2
NNW	.0	.4	.9	2.3	.0	.0	.0	.0	.0	3.6	7.8
N	.0	.7	1.4	1.8	.0	.0	.0	.0	.0	4.0	7.3
CALM										.0	
TOTAL	.0	12.8	33.3	53.9	.0	.0	.0	.0	.0	100.0	7.5

NUMBER OF INVALID OBSERVATIONS = 0

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI CLASS F
DATA PERIOD: ANNUAL, (1960-1969)

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)									TOTAL	MEAN SPEED
	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0		
NNE	.1	3.2	1.5	.0	.0	.0	.0	.0	.0	4.9	4.7
NE	.1	3.1	1.7	.0	.0	.0	.0	.0	.0	4.9	4.8
ENE	.2	4.3	2.3	.0	.0	.0	.0	.0	.0	6.8	4.8
E	.2	4.8	2.[illegible]	.0	.0	.0	.0	.0	.0	7.9	4.9
ESE	.1	2.4	2.0	.0	.0	.0	.0	.0	.0	4.5	5.1
SE	.1	2.6	1.6	.0	.0	.0	.0	.0	.0	4.3	4.9
SSE	.1	3.0	4.1	.0	.0	.0	.0	.0	.0	7.2	5.3
S	.2	6.5	5.3	.0	.0	.0	.0	.0	.0	12.0	5.1
SSW	.1	3.5	2.7	.0	.0	.0	.0	.0	.0	6.3	5.1
SW	.1	3.6	2.3	.0	.0	.0	.0	.0	.0	6.0	4.9
WSW	.1	3.4	2.4	.0	.0	.0	.0	.0	.0	5.9	4.9
W	.2	3.5	2.4	.0	.0	.0	.0	.0	.0	6.1	4.9
WNW	.0	3.0	1.9	.0	.0	.0	.0	.0	.0	5.0	4.9
NW	.1	2.0	1.5	.0	.0	.0	.0	.0	.0	3.6	4.8
NNW	.1	1.9	1.0	.0	.0	.0	.0	.0	.0	3.0	4.6
N	.0	3.7	2.1	.0	.0	.0	.0	.0	.0	5.8	4.9
CALM										5.9	
TOTAL	1.7	54.6	37.8	.0	.0	.0	.0	.0	.0	100.0	4.6

NUMBER OF INVALID OBSERVATIONS = 0