INTERIM REPORT

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Responsible NRC Individual and NRC Office or Division:

G. S. Lewis, Systems Performance Branch, SAFER:RES

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NRC FIN No. B0425

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INTERIM REPORT

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July 14, 1980

Mr. G. S. Lewis, Project Manager
Systems Performance Branch
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Mail Stop 1130SS
Washington, D. C. 20555

Dear Mr. Lewis:

In accordance with your instructions, I am transmitting herewith a brief report for the month of June 1980 on the "Definition of Parameters for Major Accidents at Waste Solidification and Spent Fuel Storage Facilities" program.

Very truly yours,

E. J. Frederick
Manager of Regulatory Programs
Chemical Technology Division

EJF:msb

Enclosure

cc: D. E. Ferguson
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PROGRESS REPORT FOR JUNE 1980

PROJECT TITLE: Definition of Parameters for Major Accidents at Waste Solidification and Spent Fuel Storage Facilities

189 No.: B0425

BUDGET ACTIVITY No.: DOE 41 88 55 02 5

PERSON IN CHARGE: E. J. Frederick

PRINCIPAL INVESTIGATORS: H. W. Godbee, E. L. Compere

FY 1980 BUDGET: $119,175 ($90,000 FY 1980 funds and $29,175 FY 1979 carry-over funds)

TECHNICAL PERSON POWER: June - 235 hours

COSTS: June - $14,013
FY 1980 - $101,937
Total to Date - $177,762
Estimated Cost to Completion - $42,238

ACCOMPLISHMENTS:

Major efforts during the current month focused on preparing for the first contractors' work session which was held at ORNL on June 18, 1980 and fulfilling the commitments made during the meeting. The general purpose of these sessions is to maintain liaison between the LASL, PNL, and ORNL participants and ensure that each is dealing with the same parameters and have an adequate understanding of the input data needed by the LASL material transport codes.

An annotated preliminary outline (attached) for the Source Book of Physico-chemical and Some Representative Engineering Parameters and Properties for Evaluating Accidents in Selected Fuel Cycle Facilities was completed and sent to the other program participants and NRC for review and comment.

ORNL and PNL are currently checking the completeness of the outline by using it as a guide in developing data input on two separate accidents for the LASL analytical program. This exercise will be the subject of a second contractors' work session in mid July.

The preparation of criteria for fire and explosion accident paramters is in progress.

Annotated Preliminary Layout

of a

Source Book of Physicochemical

and Some Representative Engineering Parameters

and Properties for Evaluating Accidents in

Selected Fuel Cycle Facilities

ABSTRACT

1. SUMMARY

2. BACKGROUND

2.1 Purpose

The purpose of this book is to provide characteristics of processes, materials, and systems containing them; to define major potential accidents in nuclear fuel cycle facilities; and to provide input to transport codes which estimate the extent to which released materials may be transported to the environment.

2.2 Need

Methods are needed to realistically compare the safety impacts of various design options and criteria for nuclear fuel cycle facilities available for licensing. A reference methodology will permit comparisons to have a common basis.

2.3 Scope

Facilities under consideration include mixed oxide fuel fabrication facilities, spent fuel storage pools, defense high-level waste solidification facilities, and the proposed Hot Experimental Facility. One or more representative facilities of each type will be used. Potential major accidents include (where relevant): criticality excursions, fires, explosions, equipment failures, spills (dynamic and static), and tornadoes.

3. PREACCIDENT PARAMETERS

3.1 Description of Facilities Considered

The description of process and process equipment, contents, and ventilation systems will be included. This provides the essential characteristics of each type of facility and process subject to the accidents to be considered. This will include description and dimensions of involved vessels, equipment and components and a statement of relevant temperatures, pressures, composition and quantity of contents, and flow or movement. This will also include the inventory at risk with appropriate identification of species, nuclides or other groupings, energy content parameters for process contents, identification of process pressure boundaries, and a description of relevant parts of the ventilation system, dimensions, equipment, layout, and normal flows.

4. EVENT DEFINING PARAMETERS

The following apply to each facility and to the respective accidents to be considered.

4.1 Rationale for Accidents Considered

Breach of pressure boundary, barrier, or other restraints (or alteration of chemical or physical form) as a consequence of an accident can result in release of contents and subsequent mobilization. Mechanisms of release and mobilization will be identified. The course of the accident until mass and energy release is abated will be given or calculated. Effects of engineered safety systems will be included where appropriate. Event-defining (or controlling) parameters for each phase of given accident types will be identified.

5. CONTROLLING PARAMETERS

The significant parameters depend on the category of accidents considered. The following listings generally apply.

5.1 Energetics (Kinetics and Thermodynamics)

- Energy release rate - within process boundaries and to ventilation systems. Needed properties or attributes include: heats of combustion, heats of vaporization, heat capacities, heats and free energies of potential reactions, and other physicochemical properties. Internal heat generation by fissioning or radioactive decay may be significant. Air requirements for combustion may be needed.

- Temperature rise rate - in many cases this is derived from other considerations but could be input. In fire accidents this could be limited by air availability.

5.2 Dynamics

The normal flow dynamics are perturbed by the accident. The parameters may be input or may be computed as a function of the time history of the accident.

- Mass release rate (to ventilation system) - this is taken as being gaseous material (accompanied by aerosol) and could be vapor or reactive substances: identify rates for relevant species.

- Pressure rate - the pressure rate may be computed from other data or provided as an arbitrary input if appropriate to a particular accident.

- Aerosol (material) dynamics - this is a major source input that will depend on the mobilization mechanisms involved. The following items at least will be needed:

  (a) material composition - and associated radioactivity;
  (b) size distribution
  (c) rate of mobilization and entry into system during the course of the accident; and
  (d) material behavior - changes in the above during the course of the accident.

Material to this point should permit source term evaluation and provide appropriate input to near-field transport calculation.

5.3 Transport Parameters [LASL]

The near-field and far-field calculations at the chosen level will include parameters related to the following categories:

- gas dynamics,
- convective material transport,
- heat transfer,
- filtration device performance,
- aerosol removal or addition,
- engineered safety systems, and
- effects on structure and/or ducts.

6. IMPORTANT PHYSICOCHEMICAL PROPERTIES OF MATERIALS

6.1 Criticality

6.2 Equipment Failures

6.3 Explosion

6.4 Fires

6.5 Spills (Dynamic and Static)

6.6 Tornadoes

7. CONCLUSIONS AND RECOMMENDATIONS

8. ACKNOWLEDGMENTS

9. REFERENCES

10. GLOSSARY

APPENDICES