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SUMMARY
NUCLEAR SAFETY PROGRAM - MISSION 8

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SUMMARY

Classification Canceled and Changed to

NUCLEAR SAFETY PROGRAM - MISSION 8

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By

N. R. MILLER

Process Evaluation and Control
Research and Engineering

By Authority of CG PR-2,

AS Lewis, 4-21-94.

By Jessie Maley, 5-16-94.

Verified By J E Savely 6-16-94

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SUMMARY

NUCLEAR SAFETY PROGRAM - MISSION 8

The Nuclear Safety Mission consists of seven programs of broad integrated experimental and analytical studies designed to answer long-standing nuclear safety questions and thus assist in providing safeguards against nuclear accidents. It will provide data leading to the technical bases for controlling the consequences of postulated nuclear incidents. Safety standards in the area of nuclear and radiological control are tending towards increased restrictions. As this trend continues it will be necessary for Richland facilities to either show compliance or modify facilities for compliance with new standards.

Long-Term Potential Incentives

The long-term benefits of the program are:

- o By substituting facts for pessimistic estimates of maximum severity (limiting cases) this program will reduce excessive conservatism in hazards evaluations of Richland nuclear facilities. Thus, the program results are expected to show that the Richland reactors are safer than has been indicated in previous evaluations. This could permit releasing more land for commercial use or for farming.
- o Methods for further reducing the consequences of accidents in Richland nuclear facilities will be disclosed.
- o Very significant economies in the treatment and disposal of liquid wastes might be made possible.
- o Future planning of land utilization, being based upon more factual information, can be done with more confidence.
- o The service life of the Richland production reactors may be extended.
- o Economical and practical means of conforming to the intent of AEC power reactor safety criteria will be found.

Progress During the Year

Significant progress was made during the year in obtaining a better understanding of the nuclear safety characteristics of the Richland

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facilities. Also, considerable work was done which will produce results in the coming few years. The program results are highlighted as follows:

1. Metal-water reaction rates for full-sized metallic fuels and cladding following postulated reactor loss-of-cooling accidents are being investigated in tests now underway. A facility is being equipped to permit extension of these tests to irradiated fuel pieces heated to uranium melting.
2. Uranium-aluminum reactions occurring during fuel heatup at rates postulated for coolant loss accidents are now better understood as a result of tests with full-sized, irradiated, aluminum clad fuel. These tests confirmed the low fission product release fraction previously determined at temperatures below uranium melting with zirconium clad fuels.
3. Newly available data were incorporated in calculations of post-accident fuel temperature transients. The results allow better present definition of these transients and pin-point those parameters for which experimental verification is needed to further reduce uncertainties.
4. An initial break-through phenomena was discovered in tests to determine the capability of soil to remove radio cesium and radio strontium from liquid wastes. Promising means for mitigating this effect by pre-treatment were identified in preliminary studies.
5. The rate of release of airborne particles from heated bare plutonium was measured. It was found that these rates would be reduced by 1-2 orders of magnitude by covering the ignited metal with magnesium-oxide sand. Tests, still in progress, show that releases from plutonium oxide-oxalate are greater than from bare plutonium.

Future Plans and Program Appraisal

Major technical efforts will be applied to:

1. Determining fission product releases from irradiated zircaloy and aluminum clad fuel heated to uranium melting. Parameters controlling the metal-water and metal-metal reactions will be defined.
2. Quantitatively verifying key parameters controlling fuel temperature transients following coolant loss.
3. Obtaining a better understanding of the behavior of fission gases released from overheated fuel cores and means for preventing release to atmosphere.

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4. Determining the joint probability for occurrence of limiting - case meteorological parameters at the reactor sites. Information will be derived from a facility scheduled for installation at a reactor site in FY-1968.
5. Finding feasible means for eliminating the early break-through of cesium and strontium when liquid wastes are handled by ground disposal.
6. Extending the studies of particle releases to other plutonium compounds and to determining the effects of combustible materials mixed with the compounds.
7. Obtaining a better understanding of the seismic characteristics of the Richland site.

The scope of this mission assumes continued funding support by Process Technology and DRD-04 funding for many areas of technology, including basic criticality studies, environmental safety, chemical safety and radiological protection.

Facility modifications and/or additions cannot now be firmly estimated. However, it is anticipated that, as the technical bases are developed, capital expenditures will be necessary to provide the desirable nuclear safety improvements.

Milestones

Initiate metal-water and fission product release tests where irradiated fuel elements are heated to uranium melting.	December, 1967
Experimentally determine the radiative heat transfer from zircaloy-clad fuels to the reactor core at temperatures up to about 1100 C.	June, 1968
Measure seismic vibration response of Richland facilities.	June, 1968
Characterize particulates and aerosols arising from fires involving plutonium compounds and contaminated combustibles.	July, 1968
Establish technical feasibility of fission gas control.	July, 1969
Define fractional release rates of fission products and particle characteristics including fission products released from molten fuel.	July, 1969

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Define the effects of terrain on the dispersion and path of gaseous releases from the reactor sites.

January, 1970

Define long-range criteria for radioactive liquid waste handling.

June, 1971

Complete the definition of the consequences of reactor loss-of-cooling accidents including the effects of metal-water and metal-metal reactions, fission product release from fuel and removal by engineered safeguards, using realistic quantitatively established meteorological variables.

June, 1972

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