D. CARLSON 10-7-85

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

September 27, 1985
ADC-85-P698

Mr. T. Sweitzer
Fuel Facility Safeguards Licensing Branch
Division of Safeguards, 881-SS
Office of Nuclear Material Safety and Safeguards
US Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Sweitzer:

SUBJECT: CONSEQUENCES OF SABOTAGE OF NONPOWER REACTORS (A7153-4)

Enclosed are six copies of Los Alamos National Laboratory proposal entitled "Consequences of Sabotage of Nonpower Reactors." This is a revised proposal that reflects the meeting between you and T. F. Bott on October 10, 1984. If you have any questions on the technical aspects of this proposal, please contact the Principal Investigator, W. D. Zerwekh at FTS 843-0505. For information of a programmatic nature, please contact the Program Manager, Harold Sullivan at FTS 843-9820.

Sincerely,

Allen L. Jennings
Associate Director/Controller

ke

Enc: a/s

cy: R. W. Barber, DOE
C. A. Beckwith, NRC
R. L. Holton, AL (2)
H. E. Valencia, LAAO, MS A316
J. F. Jackson, ADES, MS A145
J. E. Boudreau, ES-NP, MS F671
L. A. Garvey, BUD, MS B244
G. J. Garcia, Q-DO, MS E561
L. H. Sullivan, Q-DO/RS, MS K552
E. R. Nance, Q-6, MS K557
W. D. Zerwekh, Q-6, MS K557
CRM-4, MS A150 (2)

B/39

NRC FORM 189 (3-81)

US NUCLEAR REGULATORY COMMISSION

PROJECT AND BUDGET PROPOSAL FOR NRC WORK

DATE OF PROPOSAL: 9-19-85

☐ NEW ☒ REVISION NO. 0

PROJECT TITLE: Consequences of Sabotage at Nonpower Reactors

FIN NUMBER: A 7153-5

NRC B&R NUMBER: 50-19-02-00

NRC OFFICE: NMSS

DOE CONTRACTOR: Los Alamos National Laboratory

CONTRACTOR ACCOUNT NUMBER: R21W

SITE: Los Alamos, New Mexico

DOE B&R NUMBER: 40-10-01-05-0

COGNIZANT PERSONNEL	ORGANIZATION	FTS PHONE NUMBER
NRC PROJECT MANAGER: T. Sweitzer	NMSS	427-4750
OTHER NRC TECHNICAL STAFF		
DOE PROJECT MANAGER		
CONTRACTOR-PROJECT MANAGER: L. H. Sullivan	Q-DO/RS	843-9821
PRINCIPAL INVESTIGATOR(S): W. D. Zerwekh	Q-6	843-0505

PERIOD OF PERFORMANCE

STARTING DATE: 10-1-85

COMPLETION DATE: 9-30-86

STAFF YEARS OF EFFORT (Round to nearest tenth of a year)	FY 85	FY 86	FY	FY	FY
Direct Scientific/Technical	1.3	0.9			
Other Direct (Graded)	0.3	0.2			
TOTAL DIRECT STAFF YEARS	1.6	1.1			
COST PROPOSAL					
Direct Salaries	88.0	66.1			
Material and Services (Excluding ADP)	19.4	20.3			
ADP Support	10.0	23.0			
Subcontracts	50.0	30.0			
Travel Expenses — Foreign / Domestic	10.0	12.0			
Indirect Labor Costs	92.6	73.6			
Other (Specify)					
General and Administrative (%)					
TOTAL OPERATING COST	270.0	225.0			
CAPITAL EQUIPMENT FIN CHARGED					
TOTAL PROJECT COST	270.0	225.0			

MONTHLY FORECAST EXPENSE

OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
25	25	25	25	20	20
APRIL	**MAY**	**JUNE**	**JULY**	**AUGUST**	**SEPTEMBER**
20	20	15	10	10	10

NRC FORM 189 (9-81) U.S. NUCLEAR REGULATORY COMMISSION

PROJECT AND BUDGET PROPOSAL FOR NRC WORK

FIN NUMBER: A 7153-5

DATE: 9-19-85

TITLE: Consequences of Sabotage at Nonpower Reactors

DOE PROPOSING ORGANIZATION: Los Alamos National Laboratory

FORECAST MILESTONE CHART Sched. loc to Start - △ - Completed (Shown in Quarter Year)
PROVIDE ESTIMATED DOLLAR COST FOR EACH TASK FOR EACH FISCAL YEAR

TASK		FY 85 1st	FY 85 2nd	FY 85 3rd	FY 85 4th	FY 86 1st	FY 86 2nd	FY 86 3rd	FY 86 4th	FY 1st	FY 2nd	FY 3rd	FY 4th	FY 1st	FY 2nd	FY 3rd	FY 4th
Analysis of Individual Reactors	SCHEDULE			△				▲									
	COST						210 k										
Final Report	SCHEDULE							▲									
	COST						15 k										
	SCHEDULE																
	COST																
	SCHEDULE																
	COST																
	SCHEDULE																
	COST																
TOTAL ESTIMATED PROJECT COST							225 k										

PROJECT DESCRIPTION (Provide narrative descriptions of the following topics in the order listed. Attach on plain paper to this NRC Form 189. If an item is not applicable, so state.)

1. OBJECTIVE OF PROPOSED WORK
2. SUMMARY OF PRIOR EFFORTS
3. WORK TO BE PERFORMED AND EXPECTED RESULTS
4. DESCRIPTION OF ANY FOLLOW-ON EFFORTS
5. RELATIONSHIP TO OTHER PROJECTS
6. REPORTING SCHEDULE
7. SUBCONTRACTOR INFORMATION
8. LIST NEW CAPITAL EQUIPMENT REQUIRED
9. DESCRIBE SPECIAL FACILITIES REQUIRED
10. CONFLICT OF INTEREST INFORMATION

SEE NRC MANUAL CHAPTER 1102 FOR ADDITIONAL INFORMATION

APPROVAL AUTHORITY-SIGNATURE: John R. Gilat

DATE: 9/24/85

1. Objective of Proposed Work

a. Background

In 1979, the Los Alamos Scientific Laboratory conducted a study of the consequences of sabotage of nonpower reactors (NPRs). It was concluded that, within the constraints of this study, only one NPR has any potential for the release of significant amounts of fission product materials in the event of sabotage. Because of terrorist activities in other parts of the world, concerns of the Advisory Committee on Reactor Safeguards about manipulation of reactor control systems, and concerns of a public interest group about the effects of incendiary devices on reactor components, it was decided that this information should be supplemented with further technical information.

b. Objective

The objective of this work is to provide the Nuclear Regulatory Commission (NRC) with technical information on the effects of malicious manipulation of reactor controls, blast effects from various quantities and types of explosives, and the use of incendiary devices on NPRs to confirm an adequate margin of public safety.

2. Summary of Prior Efforts

Existing information in available sources, such as the NRC docket files, augmented by site-specific information provided by NRC staff and site visits has been gathered to provide the basis for calculating the radiological consequences for the NPRs listed in Table I.

TABLE I

REACTORS VISITED IN FY 1985

Facility	Docket No.	Power Level	Reactor Type
National Bureau of Standards	50-184	20 MW	Tank
University of Missouri	50-186	10 MW	Tank
Georgia Institute of Technology	50-160	5 MW	Tank
Massachusetts Institute of Technology (MITR)	50-20	5 MW	Tank
Rhode Island Atomic Energy Commission (RIAEC)	50-193	2 MW	Pool

Mathematical models have been developed and used to perform the following.

a. Calculate the radiological release resulting from a total core meltdown, partial core meltdown, core disintegration and/or crushing, or other means that could damage the fuel in the reactor core severely. Because the key consideration is the fission product release associated with such incidents, the effects of using low-enriched uranium vs high-enriched uranium on the fission product release has been evaluated.

b. Determine, as a function of distance from the reactor, the total radiation dose (rem) to the whole body and the radiation dose (rem) to the thyroid and indentify any facility for which these could exceed regulatory standards. The list of assumptions used in the calculations has been submitted to and reviewed by the NRC Division of Nuclear Material Safety and Safeguards (NMSS).

Analyses of the first three reactors in Table I will be completed, and the report on these will be delivered before the end of FY 1985. These three reactors were used as lead reactors to develop the methodology to be used for all remaining reactors.

The analyses established the doses expected for a worst-case sabotage event and developed a set of scenarios that bracket the possible range of sabotage actions, identifying the equipment and systems that must be attacked to cause the release. These scenarios oulined the quantity and placement of explosives and all other discrete actions required to achieve the release.

The analyses included models for internal building transport phenomena and atmospheric dispersion so that the entire sequence of events, from initial attack to dose reception, is described clearly.

3. Work to be Performed and Expected Results

During FY 1986 Los Alamos will perform the following:

a. Work required

Task 1. Complete analyses for the last two reactors in Table I.

Task 2. Issue an addendum report covering the analyses of these two reactors. The form of this report will be similar to and compatible with the report covering the first three reactors.

Task 3. Make site visits to the reactors in Table II to gather information necessary for analysis.

Task 4. Complete analyses and prepare reports as in item 2 above for the reactors in Table II.

Task 5. Issue a final report incorporating analyses for all nine reactors in Table I and II.

The tentative schedule for these is as follows.

Task	Target Completion Date
a. Analyses of MITR and RIAEC	December 1985
b. Report on MITR and RIAEC	December 1985
c. Site Visits (Table II)	
(1) Union Carbide and Michigan	December 1985
(2) SUNY Buffalo and UVAR	March 1986
d. Reactor Analyses and Reports	
(1) Union Carbide and Michigan	March 1986
(2) SUNY Buffalo and UVAR	June 1986
(3) Final Report	August 1986

TABLE II

LIST OF REACTORS TO BE VISITED IN FY 1986

Facility	Docket No.	Power Level	Reactor Type
Union Carbide	50-54	5 MW	Pool
Buffalo Materials Research Center	50-57	2 MW	Pool
University of Michigan Ford Reactor	50-2	2 MW	Pool
Univ. of Virginia Reactor (UVAR)	50-62	2 MW	Pool

b. Meetings and Travel

Site visits for two analysts to the four reactors in Table II will be required. Two meetings with NRC sponsors in Washington, DC, for two people also will be required in FY 1986. Los Alamos representatives will meet with the NMSS project manager (PM) two to four times a year. These meetings may be held during Washington visits or during site visits.

c. NRC Furnished Material

NRC will furnish only reactor documentation that cannot be obtained by Los Alamos from the open literature or from the Los Alamos files accumulated during license renewal activities.

4. Description of Follow-On Efforts

There are no follow-on efforts anticipated as a result of this study. However, the ability to extend the analysis technique to additional reactors at the request of NMSS will be retained by Los Alamos.

5. Relationship to Other Projects

None

6. Report Schedule

a. Monthly Letter Status Report

Los Alamos will submit a letter status report each month that summarizes the work performed during the previous month, personnel time expenditures during the previous month, and costs generated against the work effort. Any changes to cost projections or schedules will be indicated. The letter report will be prepared by the 20th of each month. In all monthly reports there will be a breakdown of (1) manpower costs; (2) costs incurred for direct salaries, material and services, ADP support, subcontracts, travel, general, and administrative and other related items; and (3) current obligation status information for the project.

The report shall be distributed as follows.

T. Sweitzer, SG, NMSS - one copy

Office of Director, NMSS (Attn: Program Support) - one copy

b. Interim Reports

Three draft iterim reports shall be furnished to the NMSS PM, one for each of the analyses required in Sec. 3. After review by appropriate NRC personnel, the PM will provide comments on the draft report to Los Alamos National Laboratory within 60 days of receipt of each report. A revised interim report shall be submitted if deemed necessary by the NMSS PM.

c. Final Report

Los Alamos shall furnish two copies of a draft final report to the NMSS PM by June 30, 1986. The format of these documents shall be as specified for formal technical reports in NRC Manual Chapter 1102 and will provide

1. the on-site and off-site fission product release and dosage calculations associated with the sabotage scenarios identified by the analyses,
2. the quantities of explosives or a description of acts necessary to cause a limiting case incident,
3. the placement of explosives in relation to the reactor,
4. a description of unauthorized manipulation of reactor controls and fuel to cause a limiting case incident,
5. the resulting consequences, and
6. appropriate alternative measures that can be implemented to mitigate a significant event (for example, reactor facility modifications, administrative procedures, and so on).

After review by appropriate NRC personnel, the PM will provide comments on the draft report to Los Alamos within 60 days or receipt of the report.

The performing organization shall revise the draft report based on the PM's comments and submit one camera-ready copy of the final report to the Document Managment Branch, Technical Information and Document Control, NRC, to be published as a NUREG/CR series report and a duplicate to the NMSS PM.

All draft reports, as well as final reports, shall be screened for Classified Information and appropriately marked in accordance with "NRC Classification Guide for Information Dealing with the Release and Dispersion of Radioactive Material (NRC-RDRM-1)" (September 1982) and NRC Manual Chapter 1102.

7. Subcontractor Information

Los Alamos will use Intermountain Technologies Inc. (ITI) to assist in performing thermal hydraulic analysis in Tasks 1 and 4. ITI personnel are very familiar with using the TRAC (Transient Reactor Analysis Code) computer code and have provided this service for us on other NRC contracts.

8. New Capital Equipment Required

None

9. Special Facilities Required

None

10. Conflict of Interest Information

None

11. Quality Assurance

All reports, plans, charts, graphs, schedules, and so on furnished under the terms of this statement of work are to be subject to internal review and shall reflect acceptance by an authorized management individual before submittal to NRC.