



PROJECT AND BUDGET PROPOSAL FOR NRC WORK

DATE OF PROPOSAL

8/5/83

☐ NEW☐ REVISION NO.

PROJECT TITLE

Molten Fuel - Concrete Interactions (CORCON)

FIN NUMBER

A-1019

NRC OFFICE

Nuclear Regulatory Research

NRC S&R NUMBER

60190201

DOE CONTRACTOR

Sandia National Laboratories

CONTRACTOR ACCOUNT
NUMBER DE-AC04-
76DP00789

SITE

Albuquerque, NM 87185

DOE S&R NUMBER

401001060

COGNIZANT PERSONNEL

ORGANIZATION

FIS PHONE NUMBER

PERIOD OF PERFORMANCE

NRC PROJECT MANAGER

S. B. Burson

DAE/CSRB

427-4562

STARTING DATE

10/01/77

OTHER NRC TECHNICAL STAFF

COMPLETION DATE

9/30/85

DOE PROJECT MANAGER

R. N. Holton

ALQ/ERT

846-5208

CONTRACTOR-PROJECT MANAGER

A.W. Snyder

6400

844-8203

D.A. Dahlgren

6440

844-1407

PRINCIPAL INVESTIGATOR(S)

M. Berman

6441

844-1545

R. K. Cole

6441

844-1534

D. P. Kelly

6441

846-0086

STAFF YEARS OF EFFORT (Round to nearest tenth of a year)

FY 83

FY 84

FY 85

FY

FY

Direct Scientific/Technical

2.1

1.7

3.0

Other Direct (Graded)

TOTAL DIRECT STAFF YEARS

2.1

1.7

3.0

COST PROPOSAL

Direct Salaries

227

192

374

Material and Services (Excluding ADP)

112

54

104

ADP Support

30

50

60

Subcontractors

50

Travel Expenses

Foreign

1

1

2

Domestic

2

3

4

Indirect Labor Costs

Other (Specify)

General and Administrative (%)

TOTAL OPERATING COST

CAPITAL EQUIPMENT

FIN CHARGED

TOTAL PROJECT COST

422

300

544

FY

OCTOBER

NOVEMBER

DECEMBER

JANUARY

FEBRUARY

MARCH

MONTHLY FORECAST
EXPENSE

APRIL

MAY

JUNE

JULY

AUGUST

SEPTEMBER

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PDR FOIA
ALVAREZ85-110 PDR

PROJECT AND BUDGET PROPOSAL FOR NRC WORK

37010
DATE
8/5/83

PROJECT TITLE

Molten Fuel-Concrete Interactions (CORCON)

DOE PROPOSING ORGANIZATION

Sandia National Laboratories

FORECAST MILESTONE CHART - SCHEDULE TO START - - COMPLETED (SHOWN IN QUARTER YEAR)
PROVIDE ESTIMATED DOLLAR COST FOR EACH TASK FOR EACH FISCAL YEAR

TASK		FY 83				FY 84				FY 85				FY 86			
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CORCON-MOD1 Assessment	SCHEDULE																
	COST																
CORCON-MOD2 Development	SCHEDULE																
	COST																
CORCON-MOD2 Assessment	SCHEDULE																
	COST																
	SCHEDULE																
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	COST																
TOTAL ESTIMATED PROJECT COST		422				300				544							

APPROVAL AUTHORITY-SIGNATURE

DATE

M. Berman

D. A. Dahlgren

0155

A. W. Snyder

E. H. Beckner

6441

6440

6400

6000

1. Objective of Proposed Work

A variety of physical, thermal, and chemical phenomena associated with the interactions between molten LWR core materials and concrete are likely to be significant in the understanding of hypothetical fuel-melt accidents. The objectives of the Molten-Fuel/Concrete Interactions study are to characterize these phenomena and to develop models for their prediction. Previous work in this program led to the development and release of the CORCON-MOD1 computer code. The proposed work involves the completion and release of an improved version of the code. The principal improvements are (1) addition of models for phenomena such as crust formation and freezing, to extend the time period for the which the code is applicable, (2) replacement or improvement of several models found during assessment of MOD1 either to be inadequate or to cause calculational problems, and (3) reduced computer core requirements combined with improved readability and internal documentation.

Molten-Fuel/Concrete Interactions must be considered by severe accident systems codes, and we will continue to cooperate with groups developing such codes. This will include assistance both in coupling CORCON itself into codes which require its full detail, and in developing a "stripped" version for use in the MELCOR PRA code.

2. Summary of Prior Efforts

During FY83, further distribution was made of the public release version of the CORCON code (CORCON-MOD1). User support was provided including a second memo to users containing corrections for a few additional code "bugs" which have been identified, and additional user guidelines based on accumulated experience. We also provided planning information to the group which will develop MELCOR, including a report summarizing both the phenomenology and the models recommended for inclusion in the first version of that code.

Much of the work has been completed on an improved version of the code (CORCON-MOD2). We replaced the package which evaluates the viscosity of oxidic mixtures (an important variable in the evaluation of heat transfer) when code assessment activities identified it as a source of difficulties, and significantly improved several other packages. Models have been incorporated for crust formation and freezing, and initial work done on models for (benign) interactions with an overlying coolant.

A wide range of assessment and sensitivity studies have been performed for CORCON-MOD1, the results of which have provided significant input on MOD2 development. These tests have included model sensitivity tests which concentrated on heat transfer models, transport properties, and material properties. In addition, numerical stability was examined along with a series of input/initial conditions tests.

3. Work To Be Performed and Expected Results

FY84

During FY84, work will include support of the released (MOD1) version of the CORCON code, development and release of an improved (MOD2) version, and further code assessment. The specific tasks to be addressed are:

- 1) Provide ongoing support and guidance for the users of CORCON-MOD1. Prepare and distribute correction data memos on an "as-needed" basis.
- 2) Complete initial phenomenological models needed to characterize the transition from a fully-liquid stratified pool to a frozen, or partially frozen regime. Include the interactions between a high-temperature solid and concrete, if possible.
- 3) Complete models necessary for CORCON-MOD2 to treat the behavior of a system including an overlying coolant layer.
- 4) Develop models for radiative heat transfer from the pool surface which include the opacity effects of suspended aerosols in the atmosphere.
- 5) Improve the liquid-liquid interfacial heat-transfer correlation and test the improved system against available experimental data.
- 6) Distribute CORCON-MOD2 to a limited number of selected users to provide field testing and refinement feedback.
- 7) Prepare a draft users manual for CORCON-MOD2 to be available before the initial distribution of the code.
- 8) Extend and improve the library of materials properties, especially those believed to be inadequate. Thoroughly document the models used.
- 9) Continue sensitivity tests and expand code assessment. Increase analysis of experimental data to test the models, advance code validation, and provide guidance for the experimental program.

- 10) Identify existing experimental or industrial facilities where chemical and thermal conditions may be found which are similar to those expected to exist under severe-accident circumstances, apply the CORCON code, and compare the CORCON predictions with data obtained from such facilities.

FY85

During FY85, we propose to complete the documentation and assessment of the CORCON-MOD2 code. If sufficient, experimental data become available to warrant it, some modifications to the code might be made to reflect this new knowledge. It does not seem likely that work on a major new (MOD3) version will be (or should be) undertaken until some of the underlying uncertainties in phenomenology are resolved. However, development of a "stripped" version which could be used in PRA codes might be considered. Such an effort would also provide insight into which of the detailed models in the full CORCON code could be simplified without significant loss.

4. Description Of Any Follow-On Efforts

The possibility of (or need for) any follow-on efforts will be greatly affected by developments in the licensing area. The straightforward, modular structure of the CORCON code would make it relatively easy to modify to consider other fuel-melt-accident concerns. These might include studies of alternate core-retention concepts, advanced designs, and interactions with soils.

5. Relationship To Other Projects

The proposed program is a continuation of the current "Molten Fuel Concrete Interaction Study" (189A No. A-1019). This project is closely allied with the "Core Melt Technology" program, which is a source of experimental data and phenomenology. It shares many elements with the "Molten-Core Coolant Interactions Program," which is addressing steam explosions, steam generation rates, and the phenomena associated with coolant layers above melts. It is connected with the "Containment Analysis," "Combustible Gas in Containment," and "Hydrogen Program" projects in that fuel-concrete interactions provide significant source terms for the phenomena considered in these programs. There is also a close relationship with the "Severe Accident Research Program," which will require a molten-fuel/concrete interactions model for inclusion in the new PRA code MELCOR.

6. Reporting Schedule

FY83 Reports

1. Light Water Reactor Safety Research Program Semiannual Report, April-September 1982, NUREG/CR-2726, SAND82-1137.
2. Light Water Reactor Safety Research Program Semiannual Report, October 1982-March 1983, to be published.
3. D. P. Kelly, Results of CORCON Sensitivity Studies, to be published.

FY84 Reports

1. Semiannual Research Progress Reports (two).
2. R. K. Cole, Jr., et al., CORCON-MOD2 User's Manual.

No more than 30 copies of any interim report will be furnished to the NRC Project Monitor.

W. L. Garner, Supervisor, Technical Writing Division, Sandia National Laboratories, Albuquerque, has been designed as the authorizing official for publications for NRC Form 426.

7. Subcontractor Information

No work is expected to be subcontracted, other than programming assistance.

8. New Capital Equipment

No capital equipment is involved.

9. Special Facilities Involved

None.

10. Conflict of Interest

No significant contractual or organizational relationships of Sandia National Laboratories, its employees, or anticipated subcontractors and/or consultants exist with industries regulated by NRC and suppliers thereof that might give rise to an apparent or actual conflict of interest.