UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 29 1984

Professor Richard Wilson
Physics Department
Harvard University
Cambridge, MA 02138

Dear Professor Wilson:

Enclosed are the following reports on the NRC safety research program:

(1) "Comments on the NRC Safety Research Program Budget for Fiscal Years 1986 and 1987"

(2) NUREG-0963, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Years 1984 and 1985"

(3) NUREG-1039, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Year 1985"

(4) NUREG-1080, "Long Range Research Plan, FY 1985-FY 1989."

Sincerely,

Christopher P Ryder

Christopher P. Ryder
Accident Source Term Program Office
Office of Nuclear Regulatory Commission

Enclosures: As stated

Summary 9.d.1 25.j.

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July 2, 1984

Mr. John Telford
U.S. Nuclear Regulatory Commission
Containment Systems Research
7915 Eastern Avenue
Silver Springs, Maryland 20910

Dear Mr. Telford:

I am enclosing a summary of the calculational results performed at Brookhaven in support of the CLWG Standard Problem 4 (BWR Mark I).

A detailed report describing the BNL contributions to the CLWG is in preparation and will be published late this fiscal year. Comparisons of BNL results with that of BCL and SNL are reported in the Appendix D of the Consensus Report. A copy of the report has been sent to you under separate cover.

Very truly yours,

Kenneth R Perkins

Kenneth R. Perkins
Accident Analysis Group

KRP:tr
Encl.

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# SUMMARY OF BNL RESULTS FOR STANDARD PROBLEM 4

(BWR Mark I)

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The BWR Mark I containment loads were calculated using the MARCH 1.1B code with concrete decomposition calculated separately with CORCON Mod 1 and input as gas generation "events." A summary of the Mark I sensitivity study is given in Table 1. Based on these results the following conclusions can be made:

Concrete Composition:

1. Much higher containment temperatures and pressures are generated with limestone than with basalt.

2. Calculations with basalt concrete are very sensitive to free water in the concrete.

Corium Disposition:

1. Spreading of the debris over the entire drywell floor leads to much more rapid gas generation and correspondingly higher containment pressures but the debris is also cooled more rapidly.

2. If the debris is confined within the pedestal wall, it stays hot (or heats up if it is cool) and maintains an aggressive attack on the concrete.

Corium Temperature:

1. The containment pressure and temperature is very sensitive to the initial temperature of the debris.

An estimate of the uncertainty range for Case 1 is included in Table 2. Note that Case 1 is, itself, an extreme case (maximum temperature, maximum $H_2$ generation, and maximum spreading) and should not be confused with a best-estimate. Thus, the "high estimate" corresponds to a limiting case of a limiting case and has an extremely low probability of occurrence.

Table 1 Summary of BWR Mark I Standard Problem Results

| Case Number | 1 | 1a | 1e | 2 | 3 | 3a | 4 |
|---|---|---|---|---|---|---|---|
| Corium Spread (m) | 5 | | | 3 | 5 | | 3 |
| Debris Temperature (°F) | 4130 | | | 2700 | 4130 | | 2700 |
| Concrete Type | L | | | L | B | | B |
| Free $H_2O$ (%) | 3 | 6 | | 3 | 4 | 8 | 4 |
| Steel in Corium (lb) | 140K | | | 140K | 140K | | 140K |
| Upward Radiation to Structures | No | No | Yes | No | No | No | No |
| RESULTS | | | | | | | |
| Peak Pressure (psia) | 145* | 154* | 87 | 88* | 108* | 142* | 65* |
| Peak Temperatures (°F) | | | | | | | |
| Drywell Atmosphere | 660 | 700 | 460 | 500* | 400 | 450 | 280* |
| Drywell Liner | 360 | 380 | 210 | 300* | 270* | 310* | 240* |
| Wetwell Atmosphere | 286* | 270* | 460 | 200* | 220* | 227* | 220* |
| Wetwell Liner | 175* | 159* | 139 | 138 | 142* | 143* | 143* |

*Temperature or pressure is still rising after five hours

Table 2 Uncertainty in the High Temperature Limiting Case with Limestone

| | High Estimate* | Low Estimate* |
|---|---|---|
| Pressure Loading | 164** | 87 |
| Temperature Loading (°F) (Drywell Atmosphere) | 700+ | 460+ |

*Within five hours of vessel failure.

**Note that this pressure exceeds the predicted ultimate capacity and is included.

+Thermal radiation will raise local temperatures considerably above this value (to 1000°F or more).