

INTERIM REPORT

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Prepared for
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

INTERIM REPORT

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NRC Research and Technical
Assistance Report

7912170337

November 30, 1979

Mr. Richard Sherry
U. S. Nuclear Regulatory Commission
Fuel Behavior Research Branch
Division of Reactor Safety Research
MS 1130SS
Washington, DC 20555

Dear Rick,

Enclosed are status reports for the month of October for the core melt and separate effects program. I have also enclosed a copy of the telegram from H. J. Teague to Lloyd Nelson. As you know, the single drop experiment has been selected as one of two experiments chosen for the international joint interpretation exercise.

I. Steam Explosions

The small scale experiments are continuing in two areas: (1) Completion of scoping experiments with high temperature melts ($ZrO_2 \sim 3500K$); (2) Start of theory checking experiments. Explosions were triggered for ZrO_2 - water systems although the conversion ratio was lower than iron-oxide melts. The reason is being attributed to non-condensable gases hampering the explosion. The first series of theory checking experiments are to begin in November with laser heated iron-oxide melts. Initial experiments are to be conducted for trigger characterization and laser operation.

The open geometry thermite Corium-E test series will resume in November. Four tests are planned. The melt delivery problem encountered in July-September appears to be solved. A detonator generated hole is formed in the bottom of the melt generator to allow the melt to pour into the water.

The site for the FITS experiments is complete and awaiting delivery of the chamber. Melt delivery experiments done this month demonstrated that the air-piston two-piece crucible system can deliver the melt. Alumina-iron thermite is being used for these development tests as well as the stressed glass crucible tests.

Analysis this month has been focusing on the explosion ("propagation") phase of the interaction and structural response. The small scale scoping experiment (specifically

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test-11-2-1) using FeO_x has been modelled using a fragmentation mechanism based on local mixing of fuel and coolant and local pressurization fragmenting the melt. The idea originally was advanced by Bankoff but the model was developed here. It shows good agreement with experimental data. Structural analysis of the vessel and containment response is continuing. SL-1 data are being gathered to understand this accident which was driven by a steam explosion. Also structural response calculations on the full scale reactor vessel and containment is continuing.

II. Core-Concrete Interactions

CORCON development activities during October were directed primarily toward debugging of the initial version of CORCON. A number of modelling and programming errors and omissions were discovered, mostly in those portions of the code that were written and assembled in great haste during September. The smaller items have been corrected. Efforts to correct the remaining items are underway.

Additional activities during the month included writing the LWR Quarterly Report for July through September 1979 and the monthly report for September, and preparation of a presentation to be given at the Seventh WRSR meeting, November 5-9, 1979.

III. Separate Effects Tests for TRAP Code Development

Vapor Pressure Experiments

A series of transpiration experiments has been performed investigating the transport of CsI. These experiments (at 770C) used as carrier gas, a) dry nitrogen, b) nitrogen saturated (at room temperature) with water vapor, c) dry forming gas (a 2% H_2 -98% N_2 mixture), and d) forming gas saturated with water vapor. These gas mixtures had no effect on the transpiration of CsI vapor; the conclusion is that there are no chemical interactions of water and/or hydrogen with CsI vapor at 770C. The vapor pressure of CsI at 770C is calculated to be $(2.5 \pm 0.2) \times 10^2$ Newton/m² (1.9 ± 0.1 torr) as compared to 2.4×10^2 Newton/m obtained by the interpolation of data reported in the Handbook of Chemistry and Physics.

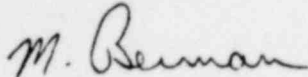
In addition at 770C no interaction is apparent between either CsI vapor or liquid and the stainless steel collection tube.

Fission Product Chemistry Experiments

Conceptual design for several modules in the Fission Product Reaction Facility is essentially complete - the water reservoir, boiler, fission product generation state, Raman chamber and the condenser. Detailed drawings for the water reservoir and boiler have also been completed.

In the light scattering chamber for Raman spectroscopy, several techniques will be tried to keep species vapor from depositing on the quartz windows: 1) Provide a small gas flow inward from the windows. 2) Establish a radial temperature gradient and thus a thermophoretic force on the vapor to keep it from diffusing outward. 3) Cover the quartz windows with quartz cover glass which can be changed during the test.

Sincerely,



M. Berman, Supvr.
Reactor Safety Studies
Division 4441

Enclosure

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FROM H J TEAGUE, UKAEA SRD/WIGSHAW LANE CULCHETH
WARRINGTON CHESHIRE ENGLAND

2 NOVEMBER 1979

I HAVE NOW RECEIVED A CONSIDERABLE NUMBER OF REPLIES TO MY
TELEX OF 8 AUGUST 1979 REQUESTING PROPOSALS FOR EXPERIMENTS
THAT COULD FORM THE SUBJECT OF A JOINT INTERPRETATION EXERCISE.
I AM VERY GRATEFUL TO ALL WHO REPLIED AND FOLLOWED UP WITH
SUPPLEMENTARY INFORMATION AS APPROPRIATE. IT HAS BEEN
DIFFICULT TO FIND EXPERIMENTS WHICH SATISFY ALL DESIRABLE
CHARACTERISTICS BUT I WOULD LIKE TO PROPOSE THE FOLLOWING
AS CANDIDATE FOR INTERPRETATION:

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(1) SINGLE DROP EXPERIMENT. OFFERED BY LLOUD NELSON OF
SANDIA. MATERIALS THERMITE-GENERATED IRON OXIDE DROPPED
THROUGH AIR INTO WATER. DROP SIZE APPROXIMATELY
3 MM FALLING INTO 600 ML PYREX BEAKER. WELL CHARACTERISED
EXPERIMENTAL PARAMETERS INCLUDING TRIGGERING PULSE AND
EXTENSIVE RECORDS OF INTERACTION PRESSURE PULSE. RECORD OF
BUBBLE DIAMETER ENABLES THERMAL TO MECHANICAL CONVERSION TO
BE ESTIMATED.

(2) MULTIPLE DROP (PROPAGATING) INTERACTION. OFFERED BY
C H ROBINSON OF WINFRITH. TWO WELL DOCUMENTED EXPERIMENTS CARRIED
OUT IN THE THERMIR RIG ARE AVAILABLE USING MOLTEN TIN AND
ALUMINIUM RESPECTIVELY. IN EACH CASE A DISTRIBUTION OF COARSELY
DISPERSED MATERIAL OVER A LENGTH OF ABOUT 350 MM RESTING ON
A FALSE BASE IN A VESSEL 580 MM X 84 MM X 560 MM FILLED WITH
WATER AT 85 DEGS C WAS PRODUCED. THE INTERACTION WAS TRIGGERED,
HIGH SPEED FILM IS AVAILABLE AT 60000 FPS FOR ALUMINIUM AND

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4000 FPS FOR TIN. THERE ARE RECORDS FROM A DISTRIBUTION OF
10 PRESSURE TRANSDUCERS. I PROPOSE USING THE RESULTS FROM THE
ALUMINIUM EXPERIMENT WHICH PRODUCED A HIGHER PEAK PRESSURE AND
WAS FILMED AT A HIGHER FRAMING RATE.

IT SEEMS TO ME THAT THESE EXPERIMENTS ARE QUITE CLOSELY IN LINE
WITH THE SUGGESTION MADE AT GRENOBLE LAST YEAR. THEY SHOULD
GIVE SCOPE FOR TESTING CONCEPTS RELATING TO SINGLE DROP
DISRUPTION AND TO PROAGATION PROCESSES WHICH TYFIFY THE
TWO MAIN TEOTETICAL SCHOOLS OF THOUGHT. IT WOULD BE BETTER IF
THE SAME MATERIALS WERE EMPLOUED IN EACH EXPERIMENT BUT
UNFORTUNATELY THIS OPTION WAS NOT AVAILABLE AMONGST THE
MATERIAL OFFERED.

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YOU WILL REMEMBER THAT AT THE BOURNEMOUTH MEETING IT WAS
ENVISAGED THAT AN APPROPRIATE TIME TO START THE JOINT EXERCISE
WOULD BE THE SPRING OF 1980 AND THERE SEEMS TO BE NO REASON
WHY WE SHOULD NOT ADHERE TO THIS TIMESCALE. I WOULD BE
GRATEFUL FOR REACTIONS TO THIS PROPOSAL. I WOULD SUGGEST THAT
ANYONE WISHING TO PARTICIPATE SHOULD NOTIFY ME AND ARRANGEMENTS
WOULD BE MADE FOR ALL THE EXPERIMENTAL DATA TO BE TRANSMITTED
TO HIM. IF THE CSNI DECIDE TO SPONSOR THIS ACTIVITY PRESUMABLY
IT WOULD BE DESIRABLE TO HAVE AT LEAST A PRELIMINARY REPORT ON
PROGRESS AVAILABLE FOR THE PLENARY MEETING LATE IN 1980S.
PERHAPS DR STEPHENS COULD ADVISE ON THIS POINT.

IF I DO NOT HEAR ANY OBJECTIONS TO THIS PROPOSAL WITHIN THE
NEXT WEEK I INTEND TO PREPARE A SHORT NOTE EMBODYING THIS
MATERIAL TO BE OFFERED TO THE CSNI AT ITS NOVEMBER MEETING.

WITH BEST WISHES AND MANY THANKS FOR YOUR COOPERATION.

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CORRECTION TO PARA 2 UNDER HEADING (2) - LINE

5 - WORD 3 - SHOULD READ THEORETICAL

TOD ~~XXXXX~~ 1008/6

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