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February 2, 1967

MEMORANDUM

To : Dr. David Okrent, Subcommittee Chairman

FROM : ^{Signed R. H. F.} R. F. Fraley, Executive Secretary
ACRS

Subject: MINUTES OF SUBCOMMITTEE MEETING ON REACTOR SAFETY RESEARCH
ON DECEMBER 14, 1966

Attached for your review and comment are draft minutes of the subject meeting.

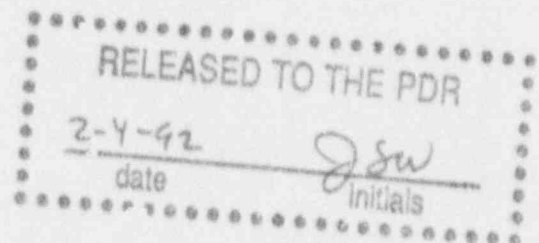
The slides and discussion by R. F. Rose and G. B. Brockatt have been provided as requested at the meeting and are attached. Slide material used by the other contractors has been requested and will be forwarded when received.

Copies of the attached have also been forwarded to the remaining Committee Members for information and/or comment as appropriate.

Attachment:

Minutes of Reactor Safety Research Substa. Mtng. on Dec. 14, 1966 in Washington, D. C., Draft #1, dtd 2/2/67, with attachments.

CC: Remaining ACRS Members w/attachments.



ACRS Job 429 Box 3 Shelf 11913
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Draft #1

KFF:bmd

2/2/67

MEETING OF

REACTOR SAFETY RESEARCH SUBCOMMITTEE

DECEMBER 14, 1966

WASHINGTON, D. C.

Purpose: This meeting was held to discuss areas of reactor safety research related to:

- (a) Loss-of-coolant accidents
- (b) Reactivity accidents
- (c) Primary system integrity

Attendees:

ACRS

D. O'Brien
E. O. Monson
A. A. O'Kelly
J. M. Hendrix
R. F. Fraley, Staff

Div. of Safety Standards

Arne B. Holt
J. Di Nunno
G. A. Arlotte
R. H. Bryan

ACRS

William L. R. Rice

Reactor Licensing

S. Levine

Idaho Operations Office

Swing A. Pettier
R. E. Swanson

Battelle (Columbus)

R. J. Eiber
A. R. Duffy
O. L. Morrison
S. J. Basham

EDRS

M. Shaw
J. A. Lieberman
E. Henshaw
Edward Gilbert
F. Hamaker
S. A. Sawicki
Andrew J. Freesecky
R. Horton

Battelle Northwest

R. T. Allen
G. J. Rogers
P. H. Hutton
J. C. Spenser

General Electric

S. R. Vandenberg
H. H. Klapfer

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Attendees (Cont'd)

Phillips Petroleum

H. E. Saunders
F. Schroeder
S. O. Johnson
J. C. Hanley
R. F. Ross
I. R. Wilson
W. Byer

Introduction: Mr. Lieberman noted that an office has been set up within Phillips Petroleum Company to coordinate activities related to safety research efforts for water reactors. The objective of the program is to develop a better understanding of accident initiation, response and consequences. An accident sequence diagram is being developed for accidents with and without engineered safeguards. The analytical effort associated with LOFT, CSE and BML work is directed toward a better understanding of each step in the sequence. The nuclear safety progress reports are now being published more frequently (e.g., OENL report is bi-monthly rather than semi-annually) to provide more current summary type information regarding program progress.

Additional activities which have been started or planned include:

- (a) The reactor pressure vessel safety research program proposed by PVRC improve analytical techniques.
- (b) An effort to design containment structures to withstand seismic forces.
- (c) A Task Force on emergency core cooling and core melt-through.
- (d) Large core dynamics (not yet implemented).
- (e) Participation in the CEEST meeting related to graphite and fission product retention.

Nine discussion papers are being prepared by OENL related to reactor safety research items (see memo from M. Shaw to R. F. Fraley dated October 28, 1966). A report by Holmes and Harver regarding operating and safety experience at nuclear power reactors will be available shortly. (Advanced copies were provided to the Reactor Safety Research Subcommittee on January 11, 1967.)

The LOFT program is currently being reviewed to determine if greater emphasis should be placed on emergency core cooling.

Mr. Lieberman noted that blowdown tests to date, conducted in support of LOFT, have demonstrated that most conventional wiring will "not stand-up" under the high-temperature, high-humidity conditions that exist after a blowdown. Most of the wiring failed after approximately one hour in the hot, humid environment although it would last indefinitely under either condition alone.

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Mr. Dikorne noted that this information is being evaluated for application to licensed reactor facilities.

Work is continuing on effluent control techniques.

Presentation and Discussion

G. B. Brookhatt, Phillips Petroleum Company discussed the results of the LOFT Semiscale Blowdown Program. A copy of the slides used during this presentation and a summary of the presentation is attached.

R. P. Rose discussed the LOFT Blowdown and Core Heatup Analysis. A copy of the slides used during this presentation and a summary of the presentation is attached.

S. R. Vandenberg discussed the GE Pipe Rupture Studies. An outline of the activities in this program is attached.

The PAPA code has been developed for stress analysis of a panel and plate grid which can be applied to pipe fittings of various configurations.

Work is continuing to develop an analytical method to predict crack growth rates. Tests with a 6" schedule 80 carbon steel pipe at 70° F and 1000 psi are being run in support of this effort.

A reliability evaluation procedure is being developed which can be used to establish a level of system reliability based on length of time in service, etc. It involves the Indirect Method to:

- (1) Identify failure mechanisms.
- (2) Obtain the distribution equation for failure mechanisms vs. years of service.
- (3) Establish uncertainty for each parameter.
- (4) For each cause arrive at the uncertainty distribution.

There was considerable discussion over the implication of this technique that failures will occur. Mr. Shaw maintained that we want to establish a zero probability of failure. The GE representatives noted that this technique does not produce a zero probability of failure but does identify the areas where the greatest gains can be made by inspection, quality control, etc., in building more reliable systems.

A. A. Duffy (MHI) discussed the work Battelle is doing to investigate the brittle fracture situation. The fracture mode, pattern, rate, etc., have been evaluated in full scale model tests related to gas transmission pipelines. Equations have been developed for the critical arrangement for initiation of a running crack. One significant discovery of this effort is that there is a temperature range (60 - 130° F) below the Drop Weight Tear Test (DWTT) transition temperature where cracks propagate by ductile initiation and then run by brittle fracture, below this range cracks initiate and run by brittle propagation, above the DWTT

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cracks initiate and run by ductile propagation. This work is being continued as part of the safety research program for application to pipe sizes and materials used in nuclear plants.

A relationship is being developed for cracks only partially through a wall as well as for cracks completely through the wall. A correlation for irregular cracks is also being developed.

The program to develop a sonic monitor to detect crack propagation is continuing.

S. O. Johnson described the work being done in the SPHER program related to reactivity transients. Additional work is needed to verify analytical techniques for large core kinetics. Mr. Johnson noted that one mechanical effect has been uncovered which has not previously been considered. This is the effect of thermal expansion during the transient. The C. G. moves upward as the fuel expands with a resulting downward force of 120 lb. for a 5 lb. fuel element. This could generate a downward force of 300,000 lb. on a large core grid plate. Additional tests are planned in the Super Kulis facility to investigate this effect.

Very rapid and large pressure pulses (5-8000 psi) have occurred when fuel pins have been failed in capsule experiments. This occurred when the fuel was dispersed in the water with a rapid increase in heat transfer area. Additional tests are planned in the Power Burst Facility to investigate the effects of flow, pressure and temperature on the value of the pressure pulses.

Attachments:

1. Slides used in the December 14, 1966 Presentation to the ACES, Results From LOFT Semiscale Blowdown Program, Presented by G. B. Brockett - Phillips Petroleum Company.
2. Slides used in the December 14, 1966 Presentation to the ACES, LOFT Blowdown and Core Startup Analyses Presented by R. P. Rose - Phillips Petroleum Company.
3. GEAP-5192, Section I, Introduction.

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