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NUCLEAR REGULATORY COMMISSION
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To Those On The Attached List

Gentlemen:

Enclosed are the minutes of the Combined Containment Review Group between FRG/BMFT and USNRC that took place on March 28-30, 1979 in Munich, Germany.

Sincerely,

H. Karwat

Professor Dr. H. Karwat

R. Cudlin

R. L. Cudlin

Enclosure: as stated

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Addressees of Letter Dated MAY 3 0 1979

T. E. Murley, NRC
L. S. Tong, NRC
S. Fabic, NRC
R. Tedesco, NRC
D. Eisenhut, NRC
G. Lainas, NRC
W. Butler, NRC
J. Kudrick, NRC
C. Grimes, NRC
H. Karwat, GRS/FRG
C. Broadus, INEL
A. Sonin, MIT
D. Norris, LLL
E. McCauley, LLL
I. Catton, UCLA
M. Plesset, ACRS
G. Mansfeld, GRS/NRC
PDR (2)

MINUTES OF COMBINED CONTAINMENT REVIEW GROUP BETWEEN
FRG/BMFT AND USNRC IN MUNICH, GERMANY

MARCH 28-30, 1979

Summary:

This was the second combined Review Group meeting covering the area of light water reactor containment research conducted in Germany and the U.S.

The agenda for the meeting was as follows:

March 28, 1979 - Munich

1. CASP — US/FRG
2. Recalculations of Battelle tests
   - COMPARE - US
   - ZOCO 6, COFLOW, CONDRU - FRG
3. Key Phenomena in Subcompartment Analysis — US

March 29, 1979 - Munich

1. Jet Formation and Interaction with Solid Structures
   - experimental results — FRG
   - BEACON simulation — US
   - BEACON applications — FRG/US
2. Pressure Suppression Studies at LLL, MIT, UCLA — US
3. Analytical Description of Key Phenomena in Pressure Suppression Containments — US/FRG

March 30, 1979 - Hamburg

GKSS Pressure Suppression Tests

. Test program description FRG

. Test facility tour and Pre Test Results FRG

The purpose of the meeting was to coordinate present and future research in the area of containment analysis and to provide for an earlier and broader information exchange among the researchers in each country.

Recommendations and conclusions of the group are provided at the end of the minutes. A list of participants is attached. A collection of materials distributed during the meeting is on file with R. Cudlin, NRC and H. Karwat, TU Munich.

Discussion:

March 28, 1979

1. CASP - Further Discussion

H. Karwat summarized the objectives and philosophy for conducting a containment standard problem. He indicated that it was their intent to pattern the standard problem after those being performed for ECCS. Specific problems are formulated in the technical review groups and proposals for the experiments are forwarded to the Ministry of Interior.

H. Karwat also gave a brief comparison of the results calculated for D-10 and ror D-15 since some participants did not feel that there would be significant differences in the short term. What the comparison showed for the short term was that the spread in participants calculations was less for D-15 than D-10, perhaps indicating that in recalculating, participants may have gained experience from comparisons of their previous results with those of others. For the long term behavior, calculated results for D-15 are closer to the data than results for D-10 as expected.

There was further discussion of the important effects of heat transfer in the test D-15. Analyses indicate that condensation on cold surfaces could be

substantial early in the transient but quickly peaked because heat transfer to the concrete was limited by conductivity. The characteristics of heat transfer to the surface coatings affect this early maximum in heat removal and represent a significant unknown in analyzing the test.

Kanzleiter (Battelle) presented a discussion of error bands associated with the test D-15. It was indicated that instrument errors were, in general, based on equipment specifications rather than calibrations of the actual instruments used in the test. Errors in blowdown mass flow rate at any point in time were in the range of 20% - 30%, however on a cumulative basis this could be mitigated by performing mass balances on the system.

H. Karwat suggested that proposed conclusions and recommendations for the CASP meeting be drafted by him and distributed to participants for comment. This was agreed to and the common conclusions will be incorporated in the CASP meeting minutes.

2. Recalculations of Battelle Tests

J. Kudrick (NRC) presented the results of calculations of Battelle Series C tests using the COMPARE code. (Handout 1). Licensing type assumptions were used in the analyses to provide conservative results. Results showed that COMPARE calculated higher blowdown compartment pressures and higher differential pressures than measured in the tests. Calculated times of maximum differential pressure were about the same as measured. Increased nodalization of compartment volumes was shown to have a secondary effect.

T. Kanzleiter (Battelle) described calculations of D-Series tests using the ZOCO-6 code (Handout 2). Values of heat transfer coefficients as a function of time for the break compartment were shown that would yield close agreement between calculated and measured pressures. Parametric studies were also done for the air compression in downstream compartments.

G. Hellings (GRS) presented results of calculations performed using the COFLOW code (Handout 3). Comparisons for C-Series tests (liquid blowdowns) indicated that use of licensing parameters resulted in overestimation of compartment pressures and that the influence of water carry-over was the dominant effect. Further studies of D-Series tests (steam blowdowns) showed that good agreement to data could be obtained by adjusting heat transfer coefficients as a function of time and orifice discharge coefficients. It was also observed that nodalization of compartments resulted in improved agreement with measured temperatures and, in the case of dead end compartments, could also influence pressures.

Comparisons to D-Series tests using the CONDRU code were presented by M. Tiltmann (GRS) (Handout 4). Using a table of heat transfer coefficients versus time that was constructed based on several D Series recalculations, it was shown that good agreement could also be obtained for the D-15 test.

March 29, 1979

1. Jet Formation and Interaction with Solid Structures

Kastner (KWU) summarized the various programs within the FRG directed at jetting phenomena (Handout 5). Battelle has tested 100mm and 145mm diameter transient discharges. KWU (RS 93) has tested 10mm to 65mm diameter discharges of saturated liquid up to 100 bar. Further tests planned by KWU (RS 93A) will involve sub-cooled blowdowns through a 40mm diameter discharge. Also planned at the HDR test facility, are liquid and steam blowdowns through a large, 450mm,diameter nozzle. In all tests, pressure distributions are measured on a flat plate located perpendicular to the discharge flow and at various distances from the nozzle.

C. Broadus (EG&G) described analytical modeling of jets using the BEACON code and comparisons of model results to Battelle and KWU data (Handout 6).

L. Slegers (KWU) provided comments on the use of BEACON/MOD 2 for jet force analysis and other reference problems. Difficulties had been encountered in running the problems, such as instabilities in the solution and physically unrealistic flow behavior. EG&G who had been supplied with the problem descriptions prior to the meeting, provided diagnostics for each problem. Generally revised modeling schemes were quite effective in eliminating the problems with the jet calculations. Also, MOD 2A has corrected some coding errors which may have been a contributing factor. Microfiche of the EG&G solutions for these problems were provided to Slegers for reference.

R. Cudlin noted that there had not been many verification calculations performed for BEACON previously but that the emphasis has shifted. The NRC/EG&G encourages the use of BEACON and will be receptive to feedback arising out of that usage. With regard to the analyses being performed by KWU and the additional sources of jet data becoming available, it appears that this might be a fruitful area to coordinate efforts on BEACON verification.

2. Pressure Suppression Studies at LLL, MIT, UCLA

R. Cudlin reviewed progress under the various NRC containment research contracts (Handout 8). Work is continuing at UCLA on basic studies of steam venting into water pools. A data base for fluid/structure interactions has been generated

by MIT and preliminary results of distorted geometry scaled tests have been analyzed. These results would indicate that simple criteria do not exist for predicting when distorted geometry scaling effects become significant. At LLL work has progressed significantly toward completion of the PELE-IC code, a coupled fluid-structure code.

Verification calculations performed to date look promising and applications calculations to MARK I and MARK II containments are being undertaken. The code is expected to be released to the Argonne Code Center in September 1979.

C. Grimes (NRC) presented the results of the hydrodynamic vertical load function error analysis for the LLL 1/5 scale air tests (Handout 9). Consideration of errors and revised pressure integration schemes still lead to the observation that the up loads measured in the 3D (90°) torus segment are higher than those in the 2D (7 1/2°) segment.

3. Analytical Description of Key Phenomena in Pressure Suppression Containments

Schwinges (GRS) described analytical models for calculating pool swell (Handout 10) and for steam chugging (Handout 11). The chugging model relies on basic physics and does not require the specification of free parameters. For direct steam-water contact condensation, the work of Engeldinger (Karlsruhe) is used to develop a heat transfer correlation. Comparisons with GKM and GKSS test data have been favorable, to date. Additional details are contained in Report GRS-A-259.

P. Schally (GRS) made a presentation on the DRASYS code, a lumped parameter, integral pressure suppression code. Various aspects of the developmental verification program were described including comparisons to Marviken and GKSS test data. The intent of the code is to analyze the degree of coupling between various dynamic phenomena in a BWR containment that normally are considered as separate effects.

March 30, 1979

GKSS Pressure Suppression Tests

The upcoming series of tests at the GKSS facility will mainly investigate steam chugging phenomena in a full scale three vent arrangement. A 15 test matrix is planned with the basic experimental parameters being (1) mass flux of steam, (2) pool temperature, and (3) wetwell airspace pressure. Extensive pressure, temperature and conductivity probe instrumentation and a video recorder system has been installed. A high speed (5000 fps) movie camera is planned to be operational by the time of the first main test. Two pretests have been completed, with a thrid scheduled for mid-April. The main tests are to begin in June, 1979

and it is anticipated that one test will be performed every six weeks. Data distribution to interested parties will be made within a short time of each test to allow some evaluation and guidance for succeeding tests. The importance of identifying a U.S. representative to receive the data and act as the principal contact was emphasized.

The test facility was toured and results of the first pretests, including videotapes, were reviewed. It was clear from these pretests that the three vents were chugging in a near synchronous mode. Aside from the need for high speed photography of the vent exits, the NRC did not have specific comments on possible instrument modifications. At the close of the meeting R. Cudlin discussed the forthcoming Seventh Water Reactor Safety Research Information Meeting in November, 1979. It was indicated that a symposium in the area of containment research was being considered and that th ıctive contribution of FRG containment experts would be desi able. This matter will be discussed internally in the FRG and H. Karwat will notify the NRC of the nature of possible participation.

Conclusions

All participants agreed that the Common Review meeting had been very beneficial. Specific conclusions and areas for further coordination were as follows:

1. NRC will designate a contact for the GKSS tests who should receive all data and will provide coordination of U.S. participation.

2. Continued close cooperation in performing calculations using the BEACON code should be an objective with special emphasis on feedback of experience.

3. NRC would like to receive results of planned jet tests at KWU and HDR.

4. There should be additional emphasis placed on evaluating and understanding existing containment test data from full size tests.

5. FRG/BMFT will provide response as to FRG participation in the 7th Water Reactor Safety Research Meeting by the end of April 1979.

SECOND COMMON REVIEW GROUP MEETING

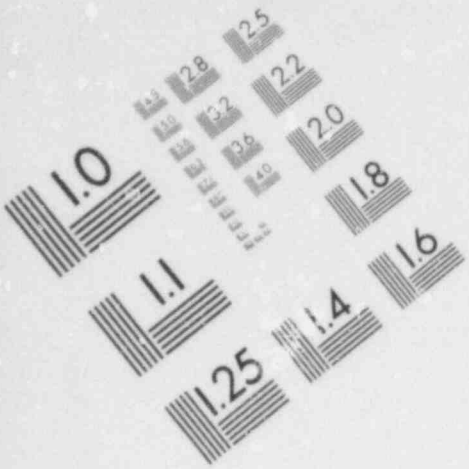
USNRC - BMFT

March 28, 1979

R. Krieg	KFK
H. Schwan	GKSS
D. Risse	GRS
G. Farber	GRS
M. Tiltmann	GRS
G. Hellings	GRS
W. Winkler	GRS
H. Jahn	GRS
K. Baumgartel	GRS
H. Karwat	T.U. Munich/GRS
G. Mansfeld	GRS/NRC
C. Grimes	NRC/DOR
J. Kudrick	NRC/DSS
R. Cudlin	NRC/RES
C. Broadus	EG&G
L. Slegers	KWU
T. Kanzleiter	Battelle Frankfurt

List of Handouts

1. COMPARE - BATTELLE Series C Test Comparisons
2. Calculations of Heat Transfer Coefficient and Orifice Discharge Coefficient for D-Series Tests
3. COFLOW Analyses of RS 50
4. CONDRU Analyses of RS 50
5. Summary of Jet Flow Tests
6. Description of Jet Modeling in BEACON
7. KWU Comments on Jet Analysis with BEACON
8. Description of NRC Supported Containment Research
9. LLL 1/5 Scale Test Program Error Analysis
10. Description of Pool Swell Model (GRS)
11. Description of Steam Chugging Model (GRS)
12. Description of DRASYS Code



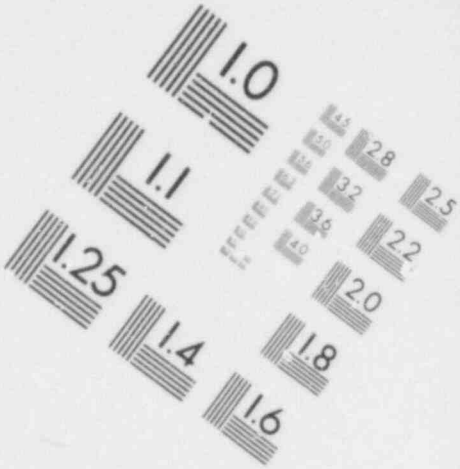


IMAGE EVALUATION TEST TARGET (MT-3)