

PRELIMINARY

# NRC Research and Technical Assistance Report

Accession No. \_\_\_\_\_

Contract Program or Project Title: FLECHT SEASET

Subject of this Document: November Monthly Status Report

Type of Document: Monthly Status Report

Author(s), Affiliation and Address: H.W. MASSIE, JR. Project Engineer  
Westinghouse Electric Corporation  
P.O. Box 355, Pittsburgh, PA. 15230

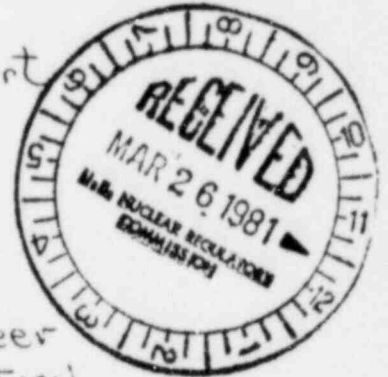
Contract No.: NRC-04-77-1a7

Date of Document: November 1980

Date Transmitted to NRC: 3-24-81

NRC Individual and NRC Office or Division to Whom Inquiries Should be Addressed:

L.H. SULLIVAN  
Reactor Safety Research



This document was prepared primarily for preliminary or internal use. It has not received full NRC review and approval. Since there may be substantive changes, this document should not be considered final.

This Document may be made Publicly Available:

A handwritten signature in cursive script, appearing to read "H.W. Massie, Jr.".

Signature  
(NRC Program or Project Sponsor or  
Authorized Contractor Official)

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

PRELIMINARY

## NRC Research and Technical Assistance Report

8104010790



Westinghouse  
Electric Corporation

Water Reactor  
Divisions

Box 355  
Pittsburgh Pennsylvania 15230

February 9, 1981

(FSS-81-347)

## NRC Research and Technical Assistance Report

Dr. K. H. Sun  
EPRI PMG Member, FLECHT-SEASET Program  
Safety and Analysis Department  
Nuclear Power Division  
Electric Power Research Institute  
3412 Hillview Avenue  
P. O. Box 10412  
Palo Alto, CA 94303

Dr. L. Harold Sullivan  
NRC PMG Member, FLECHT-SEASET Program  
Separate Effects Research Branch  
Division of Reactor Safety Research  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Subject: FLECHT-SEASET PROGRAM  
Informal Monthly Progress Report for November, 1980  
Contract: NRC 04-77-127, EPRI No. RP959-1

Gentlemen:

Attached is an informal progress report for the month of November, 1980, for FLECHT-SEASET.

Yours truly,

WESTINGHOUSE ELECTRIC CORPORATION

H. W. Massie, Jr.  
Acting PMG Member  
Technology Development

HWM/sm

Attachment

Dr. K. H. Sun, 12L, 12A  
Dr. Harold Sullivan, 1L, 1A

cc: Mr. Andrew L. M. Hon (NRC)

(See attached list for additional distribution)

## NRC Research and Technical Assistance Report

FLECHT-SEASET PROGRAM  
CONTRACT NRC-04-77-127  
PROGRESS LETTER

Dr. T. E. Murley, Director  
Div. of Reactor Safety Research  
Nuclear Regulatory Commission  
Washington, D. C. 20555

Mr. R. F. Fraley, Executive Secretary  
ACRS  
Nuclear Regulatory Commission  
Washington, D. C. 20555

Mr. P. Litteneker  
Idaho Operations Office  
P. O. Box 2108  
Idaho Falls, Idaho 83401

Mr. L. Leach, Manager  
Semiscale Program  
INEL  
550 Second Street  
Idaho Falls, Idaho 83401

Mr. G. Sozzi  
General Electric Company  
175 Curtner Avenue  
San Jose, California 95125

Mr. John Blaisdell  
Combustion Engineering, Inc.  
Nuclear Power Department  
P. O. Box 500  
Windsor, Connecticut 06095

Dr. B. Bingham  
Babcock & Wilcox Company  
P. O. Box 1206  
Lynchburg, Virginia 24505

Mr. C. L. Mohr  
Pacific Northwest Laboratory  
Richland, Washington 99352

Mr. P. R. Davis  
Intermountain Technology  
P. O. Box 1604  
Idaho Falls, Idaho 83401

Dr. L. S. Tong, Assistant Dir. for  
Water Reactor Safety Research  
Division of Reactor Safety Research  
Nuclear Regulatory Commission  
Washington, D. C. 20555

Dr. P. A. Lottes  
Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, Illinois 60439

Dr. J. A. Dearien, Manager  
Code Verification & Applications Program  
EG&G Idaho, Inc.  
P. O. Box 1625  
Idaho Falls, Idaho 83401

Dr. Peter Griffith  
Dept. of Mechanical Engineering  
MIT  
Cambridge, Massachusetts 02139

Dr. D. C. Groeneveld  
Chalk River Nuclear Laboratories  
Chalk River  
Ontario, Canada K0J1J0

Dr. D. A. Powers  
Core Performance Branch  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Professor W. Y. Chon  
Dept. of Engineering Science  
Aerospace Engineering & Nuclear Engineering  
State University of New York  
Buffalo, New York 14214

Mr. Wayne Hodges  
Nuclear Regulatory Commission-RSB  
Washington, D. C. 20555

Mr. E. L. Halman, Director  
Division of Contracts  
Nuclear Regulatory Commission  
Washington, D. C. 20555

Dr. W. V. Johnston  
Core Performance Branch  
Nuclear Regulatory Commission-NRR  
Washington, D. C. 20555

DISTRIBUTION

- Continued -

Dr. James F. Jackson (MS-671)  
Deputy Associate Director  
NRC Programs  
Los Alamos Scientific Laboratory  
P. O. Box 1663  
Los Alamos, New Mexico 87545

Mr. R. Jensen  
Intermountain Technology  
P. O. Box 1604  
Idaho Falls, Idaho 83401

Dr. P. North, Manager  
Code Development & Analysis Program  
EG&G Idaho, Inc.  
P. O. Box 1625  
Idaho Falls, Idaho 83401

Mr. James White, Manager  
PWR BDHT Program  
Oak Ridge National Laboratory  
P. O. Box Y  
Oak Ridge, Tennessee 37830

Mr. W. Kayser  
Exxon Nuclear  
2101 Horn Rapids Road  
Richland, Washington 99352

Mr. Don Ogden  
EG&G Idaho, Inc.  
550 Second Street  
Idaho Falls, Idaho 83401

Mr. L. Phillips  
Core Performance Branch  
Nuclear Regulatory Commission-NRR  
Washington, D.C. 20555

Mr. Joel S. Gilbert (Group Q-9)  
Los Alamos Scientific Laboratory  
P. O. Box 1663  
Mail Stop 553  
Los Alamos, New Mexico 87545

Professor R. A. Seban  
Dept. of Mechanical Engineering  
University of California  
Berkeley, California 94720

Professor I. Catton  
Dept. of Chemical, Nuclear, and Thermal Engr.  
University of California  
Los Angeles, California 90024

Mr. G. F. Brockett  
Intermountain Technologies, Inc.  
P. O. Box 1604  
Idaho Falls, Idaho 83401

Dr. G. E. Dix  
Nuclear Energy Division, M/C 583  
General Electric Company  
175 Curtner Avenue  
San Jose, California 95125

Mr. K. V. Moore  
Energy Incorporated  
P. O. Box 736  
Idaho Falls, Idaho 83401

Mr. T. Charlton  
EG&G Idaho, Inc.  
P. O. Box 1625  
Idaho Falls, Idaho 83401

Dr. S. Fabric  
Nuclear Regulatory Commission-RSR  
Washington, D. C. 20555

Mr. H. Balukjian  
Core Performance Branch  
Nuclear Regulatory Commission-NRR  
Washington, D. C. 20555

## LEGAL NOTICE

THIS REPORT WAS PREPARED AS AN ACCOUNT OF WORK SPONSORED BY THE U.S. NUCLEAR REGULATORY COMMISSION, THE ELECTRIC POWER RESEARCH INSTITUTE, INC., AND THE WESTINGHOUSE ELECTRIC CORPORATION. NEITHER THE UNITED STATES GOVERNMENT NOR ANY AGENCY THEREOF, NOR THE INSTITUTE OR MEMBERS THEREOF, NOR THE WESTINGHOUSE ELECTRIC CORPORATION, NOR ANY OF THEIR EMPLOYEES, MAKES ANY WARRANTY, EXPRESS OR IMPLIED, OR ASSUMES ANY LEGAL LIABILITY OR RESPONSIBILITY FOR ANY THIRD PARTY'S USE OR THE RESULTS OF SUCH USE OF ANY INFORMATION, APPARATUS, PRODUCT, OR PROCESS DISCLOSED IN THIS REPORT OR REPRESENTS THAT ITS USE BY SUCH THIRD PARTY WOULD NOT INFRINGE PRIVATELY OWNED RIGHTS.

FLECHT-SEASET PROGRAM  
INFORMAL MONTHLY PROGRESS REPORT  
NOVEMBER, 1980

PROJECT MANAGEMENT -- H. W. Massie, Jr.

After loading of the fifth bundle into the 21 Rod Bundle test facility, two heater rods developed low isolation resistance during shakedown testing. The bundle was removed from the facility; the two heater rods, which had blockage sleeves attached, were replaced with spare heater rods; the bundle was reinstalled into the facility; and, a satisfactory isolation resistance measurement was obtained. Diagnosis of the two heater rods removed from the bundle illustrated that the problem was caused by welding the blockage sleeves onto the heater rods. The QC for the welding process was tightened and bundle build procedures were modified to avoid future problems.

TESTING PLANNING AND ANALYSIS -- L. E. Hochreiter/M. Y. Young

Unblocked Bundle Task (Task 3.2.1)

Work was completed in generating data for inclusion into the data report, however, approximately 800 of the required 1300 data plots still need to be reproduced.

Steam cooling data from the unblocked bundle has been re-analyzed using the COBRA-IV-I computer code. A new steam cooling correlation was developed based on COBRA calculated vapor temperatures. The new correlation gave better heat transfer than the Dittus-Bolter correlation, but the calculated Nusselt number was lower than the previous correlation which was based on a rod-centered subchannel energy balance. This has resulted in some additional program effort.

A draft data evaluation report for the unblocked bundle is being prepared and is expected to be completed by the end of November. A model to predict the onset of the dispersed flow regime was prepared in the draft report. The model was based on calculated flow conditions and a mathematical expression for the critical void fraction, above which dispersed flow is assumed to exist, was also developed. The mass and energy balance section of the report is being revised to broaden this section of the report and to make it more inclusive.

21-Rod Bundle Task (Task 3.2.2)

The data summary package for bundle #4 with all rods blocked, non-coplanar distribution, and short concentric sleeves, was issued to EPRI, NRC, and their respective consultants. This package includes quick-look results and data on microfiche output for 8 hydraulic characteristics tests, 4 steam cooling tests, and 15 reflood tests. Data and heat transfer comparisons of bundle #4 and the unblocked bundle were completed. Analysis of the results of date shows a distinct effect of the non-coplanar blockage distribution on heat transfer. Only a slight improvement in heat transfer (relative to unblocked bundle) is observed immediately downstream of a blockage sleeve; however, significant heat transfer improvement is observed on the adjacent rod even upstream of its blockage sleeve. This result signifies the "snaking" of flow through the blockage.

The fourth bundle was removed from the test facility and it was found that the fillers at the 6' elevation (in the blockage zone) bowed slightly into the bundle, and that the pin connecting the fillers broke in the grid span downstream at the blockage zone. This behavior is attributed to the thermal stress induced by the high temperature testing. Although there has been some distortion in all 4 bundles, it has been shown that the bundle distortion effect is secondary to the flow blockage effect through repeat tests.

Modifications to the DATAR and secondary heat transfer codes and FLOTS data reduction code were completed for utilization in bundle #5 data reduction and analysis. Bundle #5 has long, non-concentric blockage sleeves on all rods distributed in a non-coplanar manner. A bad heater rod was discovered in bundle #5 after the bundle was installed in the test facility and during the preliminary shakedown tests. The bundle was subsequently removed from the housing and two heater rods were replaced with spare rods. Both rods were found to have a hole in the cladding at the location where the blockage sleeve was "welded" to the rod. The bundle was reinstalled in the facility and testing is expected to begin in December.

A methodology to calculate enhancement factors in blocked bundle has been developed based on Hall and Duffey's approach. This method is based on a steady state, isothermal, and single phase steam flow. The effects of flow rate change and non-isothermal process are under study.

#### 163-Blocked Bundle Task (Task 3.2.3)

The instrumentation for the heater rods outside the 2 blockage islands in the 163-rod bundle was established.

A plan or approach on how to select the blockage sleeve for the 163-blocked bundle was developed and sent to the PMG for review.

Flow calculations for the cases with short and long sleeve (reference and higher strain) utilizing COBRA code are in progress. The results will help choose a sleeve shape to be used in the large bundle tests.

#### Systems Effects Tests (Task 3.2.7)

Upper plenum internals fabrication for the Air/Water flooding test to be conducted at EG&G are about 80% completed. An aluminum ground plate with the same configuration as the actual nickel ground plate is being fabricated for these tests. In addition, W is also fabricating the upper plenum column guides which are tack-welded to the upper core plate. Air/Water loop construction at EG&G is in progress.

Fabrication of the loop piping for the natural circulation and reflood tests are completed except for the downcomer. Late delivery of the downcomer has caused an additional two weeks delay in assembling the loop piping.

The natural circulation and reflux test matrix was revised. A description for each test is being written.

Final revisions were made to the loop instrumentation drawings for both the natural circulation and reflood tests.

A letter was sent to the PMG with Westinghouse recommendations for tests recommended in PKL Bundle #2.

TEST ENGINEERING/TEST OPERATIONS -- C. E. Conway/C. E. Fuchs

21 Rod Bundle (Task 3.2.2)

Bundle #4 testing was completed 11/1/80. A new housing was installed along with bundle #5. Heater rod resistance checks after the bundle and housing were hydro tested revealed that rod 3D had a low isolation resistance. A decision was made to remove the bundle and replace the defective rod. In order to remove rod 3D, rod 3E also had to be removed. The sleeve attachment weld beads on both rods were ground off for removal. It was discovered that both rods had pin hole leaks in these areas. Both rods were subsequently replaced with spares, a minor weld procedure change was made and more isolation resistance checks were made during re-installation to insure the integrity of the replacement rods as well as the remaining rods. The bundle was reinstalled in the housing and testing was initiated on 11/24/80. The turn-around for this took 1.5 weeks.

163 Rod Blocked Bundle (Task 3.2.3)

Due to a change in bundle geometry, this facility has been redesignated 163 Rod Blocked from 161 Rod Blocked.

Successful hydro of the housing was completed. The downcomer was received and is currently being installed.

Systems Effects (Task 3.2.7)

The SCR Power Control System wiring has been completed. All SCR cabinets and control console have been interconnected. The fabrication of the intermediate patch panels have begun. The loop wiring lists are presently being finalized.

All piping with the exception of two spools were received as of 11/19/80. The downcomer support stand was completed and installation of the downcomer is underway. Drawings of the secondary piping and superheater line have been completed and material and fabrication are being ordered.