POLICY ISSUE
(Notation Vote)

January 31, 1992

SECY-92-037

For: The Commissioners

From: James M. Taylor
Executive Director for Operations

Subject: NEED FOR NRC-SPONSORED CONFIRMATORY INTEGRAL SYSTEM TESTING OF THE WESTINGHOUSE AP600 DESIGN

Category: This paper covers a major policy issue regarding confirmatory testing plans of NRC for the Westinghouse AP600 advanced passive reactor, and the need for a new thermal-hydraulic integral test facility in the U.S.

Purpose:

1. To inform the Commission of the staff's plans to obtain confirmatory experimental data with which to independently assess the integral performance of the passive safety features with the reactor coolant system in the AP600 design.

2. To inform the Commission of the advantages and disadvantages of the various options available for conducting integral systems tests.

3. To request guidance, as appropriate, from the Commission on a number of policy issues associated with integral system testing.

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NOTE: TO BE MADE PUBLICLY AVAILABLE IMMEDIATELY

Summary: The staff has conducted a preliminary evaluation of the expected performance of the AP600 reactor. This evaluation has led us to conclude that while passive safety system philosophy is to depressurize the plant to low pressure, there are several events in which the passive safety systems will be called upon to perform while the primary system pressure is still high. For this reason, we have determined that thermal-hydraulic performance data is needed from both a high pressure, full height, integral system test facility, as well as a low pressure facility, in order to properly validate the NRC staff's computer codes over the range of conditions expected in AP600 and confirm no unexpected systems interactions adversely affect the thermal-hydraulic performance.

We have examined several options for obtaining this data.

For the low pressure data, cooperative research with Westinghouse initially appeared to be the most attractive, cost-effective option. However, there were numerous concerns regarding conflict of interest as well as schedular concerns due to limited availability of the facility. While it is possible that some or all of these difficulties could have eventually been resolved, we decided it was most prudent to construct and operate our own small scale, low pressure facility separately from the facility Westinghouse is building.

For the high pressure data, given the existing constraints on costs and schedules, the modification of an existing foreign facility is concluded to be an attractive option for obtaining high pressure data. The staff is currently evaluating whether a modified facility will adequately simulate the AP600 performance. However, the staff has also concluded that Westinghouse will be required to obtain high pressure test data for code validation or otherwise modify the AP600 design to reduce the reliance on the passive system performance at high pressure. If Westinghouse chooses the latter, then the need for high pressure testing is greatly diminished, and the staff's plans will need to be reevaluated. If Westinghouse chooses the former, we believe that cooperatively funded testing with the NRC would be an attractive option for them. Until such matters are clarified, the staff intends to pursue discussions to utilize a foreign test facility (ROSA-IV in Japan) and make the minimum resource commitments necessary to retain this facility as an option.

There are several key policy questions which arise from this matter for which Commission guidance is sought.

a. Constructing and operating a new test facility, or even experiencing unplanned delays using an existing foreign facility, could result in the staff obtaining confirmatory test data after the certification date. The staff believes that conducting confirmatory research subsequent to certification is acceptable, since it is confirming the safety margin used by the staff in their regulatory decisions. Does the Commission agree?

b. Is it acceptable to and what are the policy implications of conducting major research programs on advanced U.S. designs in a foreign country?

c. If confirmatory research subsequent to certification is acceptable, the staff's preference is to design, construct, and perform tests in a new facility built in the U.S. Net additional funding needed for such a facility is estimated to be $18-20M over about 3 years. Does the Commission concur in the staff's preferred option, and can the Commission obtain the necessary additional funds to construct a new facility?

d. An NRC commitment to use the foreign facility being considered by the staff for AP600 testing will have to be made by early March, at the latest, or the option to use the facility could be delayed for several months to a year. If resolution of the testing issue with Westinghouse is not decided by early March, the staff intends to make the minimum resource commitments necessary to proceed with testing at this foreign facility. Estimated funding at risk, should an alternative testing program be decided later, is 2-3 million dollars. Does the Commission concur with this approach?

e. The staff believes that if cooperative testing with Westinghouse is concluded to be the most cost effective way of obtaining the data the staff needs for code validation, then the benefits to the agency are sufficient to justify negotiating such arrangements with Westinghouse. In carrying out the negotiations, we would attempt to minimize the specific conflict of interest issues so that the Commission can consider waiving the conflict of interest restrictions of Section 170A of the Atomic Energy Act. Does the Commission agree?

Background:

Over the past several years, the staff has begun reviewing the designs of advanced passive reactors being developed by both Westinghouse and the General Electric Company. In 1989, the Office of Nuclear Regulatory Research began a program to examine the AP600 design and evaluate the extent to which current thermal-hydraulic computer codes, in particular RELAP5, had been adequately validated for analyzing AP600 performance. The study concluded that no new basic thermal-hydraulic phenomena were expected to be exhibited by the plant as a result of including the new passive safety system components or the new primary loop geometry. However, the NRC has a limited database for validating current thermal-hydraulic models over the range of operating conditions that could be experienced in these plants. The NRC also lacks experimental data on the performance of these new passive safety systems incorporated into new primary loop geometries in an integral loop configuration. Thus, the extent of NRC's validation of its analytical codes for the advanced designs is considered substantially less than it is for currently operating reactors. Although current analysis models, validated with existing integral systems data and data from passive system component (separate effects) tests being run by Westinghouse will certainly improve the level of confidence in the ability of the analysis codes to predict AP600 behavior, questions remain regarding the potential for unpredicted systems interactions. The staff has concluded that integral testing specifically designed to represent the AP600 reactor system would provide the experimental database needed to resolve these questions. Therefore, the staff proposes to go forward in carrying out a confirmatory research program of testing integral system behavior of the AP600 design. The NRR user need letter requesting thermal-hydraulic testing of the Westinghouse AP600 design is provided in Enclosure (1).

Discussion:

The basic safety approach used by Westinghouse in designing the AP600 reactor is to rely on passive, gravity driven safety systems rather than the active, pumped systems relied upon in the current plants. The successful operation of most of these passive safety systems is designed to occur at low primary system pressure. Therefore, a major element of this safety approach is to rapidly depressurize the primary system for all events which could actuate a safety injection signal due to a significant loss of coolant.

Westinghouse has concluded that because the greatest challenges and uncertainties associated with passive safety system performance occur at low pressure, their integral systems testing program need only address the low pressure portion of transients and accidents, rather than include the initial high pressure portion as well. However, the staff review of anticipated AP600 behavior for transients and accidents normally postulated for licensing review indicates there are several events for which the passive safety systems would be called upon to operate while the primary system is still at relatively high pressure. While Westinghouse acknowledges this, they believe that the most important integral system thermal-hydraulic behavior that needs to be tested is at low pressure. Hence, they believe that the high pressure portion of these transients and accidents can be adequately handled solely by analysis using computer codes validated only with component separate effects data.

Over the past 20 years, the staff has gained substantial experience and insights into the relative benefits of integral system testing using high pressure, full height facilities. These benefits and insights are described in more detail in Enclosure (2). Also, our preliminary evaluation of the AP600 performance during the high pressure portion of these transients and accidents indicates there are a number of scenarios in which uncertainties in the thermal-hydraulic performance could produce potentially adverse behavior and consequences. Enclosure (3) provides a detailed discussion of this evaluation. For these reasons, the staff has tentatively concluded that high pressure, full height integral systems test data are needed from Westinghouse to support the AP600 application. A companion Commission Paper prepared by the Office of Nuclear Reactor Regulation discusses this subject in detail. (SECY-92-030)

However, the staff has also indicated that if Westinghouse were to modify their design, in particular by adding a reliable, high pressure safety injection system to supplement the passive systems, and thus reduce the extent to which passive systems performance was relied upon to properly operate during high pressure scenarios, then high pressure, full height integral systems testing data would probably not be needed from Westinghouse.

Some time ago, the staff concluded that, in addition to whatever testing would be required of Westinghouse to support the AP600 design, experience has shown that the staff needed to perform its own integral system testing of the AP600 design (see Enclosure 1) in order to validate its computer codes used for independently assessing and auditing the plant's performance. Working in close coordination with NRR, RES began to examine various options for conducting integral system testing of the AP600 design. We concluded that testing under both high and low pressure conditions, to adequately span the range of conditions over which the passive safety systems are expected to operate, was needed.

Low Pressure Testing

The staff examined two options for obtaining low pressure integral system performance data. One was to participate cooperatively with Westinghouse on the construction and operation of their low pressure integral test facility being built at Oregon State University (OSU). Our evaluation concluded that Westinghouse would most likely have to run the tests that were required for AP600 certification. If we waited for Westinghouse to complete its testing program, we could not guarantee that the test facility would be available in sufficient time for the NRC to conduct its own tests in order to meet current certification schedules. Second, we understand that Portland General Electric, the owners of the Trojan plant, are contributing $50K per year to the OSU facility, in return for the ability to reconfigure the facility to more closely approximate the Trojan design and use it for operator training once the AP600 testing is done. Hence, we would lose the ability to utilize the facility in the longer term, should it be needed.

Lastly, we were unsure if in this case the overall benefits to NRC of cooperative research with Westinghouse on this facility could justify a waiver of conflict of interest restrictions. Based on the questionable ability to justify a waiver of conflict of interest restrictions, the limited availability of the facility, and the relatively low costs of building and operating our own facility, we decided it was prudent to go forward and build and operate our own small scale, low pressure facility.

Therefore, we are currently soliciting bids for the design, construction, and operation of a small-scale, low pressure loop that simulates the AP600 design. Details of such a loop have not yet been developed, but the staff expects it to be similar in scale (1:9 linear scale) to the small-scale, low pressure loop configured to the B&W geometry currently operated under NRC sponsorship at the University of Maryland. The staff estimates the cost for design, construction, and testing to be about $2 million over 2-3 years. The FY 1992-1996 Five Year Plan includes resources for this loop, and the Senior Contract Review Board approved FY 1993-1996 funding for its design, construction, and testing. An announcement in the Commerce Business Daily was issued on January 23, 1992. The staff plans to keep the Commission informed if any difficulties arise concerning this test facility.

High Pressure, Full Height Testing

The staff has examined several options for conducting high pressure, full height integral system testing of the Westinghouse AP600 design. These are (1) use an existing shut down U.S. facility, (2) modify and use a foreign facility, and (3) design and construct a new facility in the U.S. Benefits and drawbacks of each of these options are as follows:

1. Use an Existing Shut Down U.S. Facility

There are two facilities in the U.S. that are currently shut down but could potentially be reactivated and reconfigured to approximate the AP600 design. These are the Semiscale Facility at the Idaho National Engineering Laboratory (INEL) and the MIST Facility at Babcock and Wilcox's Alliance Research Center in Alliance, Ohio. We rejected the MIST facility because it was configured to the B&W lowered-loop design and would require almost all new components in order to potentially simulate the AP600. Moreover, Westinghouse would most likely be unwilling to provide proprietary design data to B&W necessary to design and run such a facility. We also rejected it for the same reason we rejected the use of the Semiscale facility, namely that its area scaling was too small.

While the Semiscale facility was configured to a Westinghouse 4-loop design, it too would require significant modification to simulate AP600. In particular, one of its two loops simulated 3 of the loops of a 4 loop plant. Thus, its two loops are not volumetrically symmetric and would not adequately represent the AP600 two-loop design unless one entire loop was replaced. However, most important is the concern that while Semiscale was a full height facility, it was volume scaled at about 1:1700. This meant that the vessel and piping were all of very small diameter and, for relatively slow transients and accidents (i.e., most non-large break LOCA events), surface heat loss and stored metal heat produced significant scale distortions and consequent behavior that was atypical of large reactors. In addition, the small piping diameters sometimes did not allow prototypical flow patterns to be established, further distorting the behavior of the facility compared to a reactor.

For these reasons, the use of Semiscale was rejected.

2. Modify and Use a Foreign Facility

As previously discussed, for relatively slow, non-large break LOCA events, facility scale must be sufficiently large so that distortions in phenomena arising from scale distortions are, to the maximum extent, minimized or eliminated. Since there were no available facilities of sufficiently large scale in the U.S., we considered two foreign facilities, ROSA-IV/large scale test facility (LSTF) in Japan and Bethsy in France.

ROSA-IV:

ROSA-IV/LSTF is a full pressure, full height integral system loop that simulates a Westinghouse 4-loop plant and would simulate AP600 at a volume scale of about 1:30. We have initiated discussions with the Japan Atomic Energy Research Institute (JAERI) which owns and operates the facility. JAERI has indicated it could be modified and made available to us for use. Based on these discussions, we initiated an analysis program last summer to evaluate the fidelity that the ROSA IV facility, appropriately modified, could achieve in simulating expected AP600 performance.

Preliminary results indicate that ROSA-IV may do a reasonably acceptable job in simulating AP600. Some events and parameters will be simulated well, while other events and parameters may not be simulated very well. Unfortunately, the degree of fidelity is a very subjective judgment and thus must be considered along with numerous other factors when deciding the acceptability of such a facility. Our current plans are to review the analyses being performed for us by EG&G, Idaho. Following this review, we intend to make a determination whether or not ROSA-IV is considered adequate for simulating AP600 performance. If it is judged adequate, then we could in the near future begin discussions with JAERI regarding costs, modifications needed, and schedules.

Bethsy:

Bethsy is a full height, full pressure integral system loop located in France that simulates a French PWR and would simulate AP600 at a volume scale of about 1:70. The smaller scale makes it less attractive than the ROSA-IV option, and our only discussions with the French have been an inquiry into its availability. We understand it could be made available by 1994.

Benefits and Drawbacks

The major benefits of utilizing a foreign facility are cost and schedule. JAERI has indicated that if a decision is made soon (i.e., before the beginning of their fiscal year in April, 1992) then they could include AP600 testing in their facility planning and budgeting, and begin the necessary modifications this summer, with testing commencing perhaps as early as CY 1993. We do not have any firm estimates on cost yet. For planning purposes, we have estimated that costs could run as much as $5 million over a 3-year period, and the FY 1992-1996 Five Year Plan includes $5 million for this facility. Note that this funding would not go to JAERI, but would go directly to the contractors fabricating the facility hardware modifications.

With regard to Bethsy, we would expect costs to be similar to or less than the ROSA-IV/LSTF estimates because much of the costs are related to needed hardware modifications. The French indicated that Bethsy could be made available in 1994. Thus, we might expect to begin obtaining data in early 1995.

A final potential benefit of utilizing a foreign facility is that the countries that own these facilities are interested in keeping them operational. Therefore, charges to conduct NRC tests may be lower than expected due to the benefit the country would receive by maintaining the facility operational.

There are several significant drawbacks to utilizing foreign facilities such as ROSA-IV or Bethsy. First, because a major benefit of utilizing an existing facility derives from the cost savings associated with not having to construct an entire new loop or test facility, some compromises must be made. For example, ROSA-IV does not have the single hot leg-two cold legs per loop configuration of AP600, but rather has a single hot leg-single cold leg configuration of the current operating plants designed by Westinghouse.

Since AP600 has two core makeup tanks (CMTs), with each one having its cold leg equalization line connected to a different cold leg in a single loop, neither ROSA-IV nor Bethsy could model the two CMTs unless significant modifications are made to include two cold legs per loop. Thus, concerns with loop to loop interactions or instabilities could not be observed in these facilities. Initial discussions with JAERI indicate such modifications are possible, but at additional cost to the NRC. Also, our analyses show that the ROSA-IV hot leg piping is not properly scaled to AP600 and can result in less mass loss through the ADS than predicted for AP600. In general, the degree of simulation fidelity will be reduced because of geometric differences in the existing ROSA-IV test facility configuration compared to the AP600 design. The significance of these facility compromises is being evaluated in the EG&G, Idaho analyses.

Another drawback is that while utilizing foreign facilities will still involve U.S. scientists and engineers in the analysis of the data and in some aspects of the design of facility modifications, U.S. engineers and technicians will not be involved in its construction or operation. Moreover, U.S. funds might now be spent overseas rather than in the U.S. unless the facility modifications could be fabricated in the U.S. and then shipped to the facility, and if the host country did not charge the NRC for testing. Accessibility of the facility to the NRC and its contractors will also be greatly reduced due to its foreign location. Thus, the benefits of close participation in the design, construction, and operation of a facility between the NRC and the facility contractor is greatly diminished.

Finally, testing advanced reactor designs overseas will directly export U.S. technology out of the U.S. Westinghouse has already expressed concern that because both France and Japan are working on their own passive, advanced reactors, asking either of them to test the AP600 design will given them direct access to proprietary Westinghouse design information. Although appropriate contract restrictions can be drafted, it is not certain that this would fully alleviate Westinghouse's concerns. Thus, the degree to which proprietary data concerns can affect our ability to use foreign facilities is not presently known.

3. Design and Construct a New Facility in the U.S.

The third option that the staff considered was to design, construct, and operate a new facility in the U.S. This option has several obvious advantages. First, the facility could be optimally scaled to some of the fixed factors associated with the contractor's facilities, such as available electric power supply for decay heat simulation. Second, components could be accurately scaled and simulated, and the primary system configuration could be built to accurately represent that of the AP600, so phenomena (such as loop to loop instabilities) that could not be investigated in the foreign facilities without major modifications could be investigated in a new facility. As a result, we would expect that a new facility would yield improved simulation fidelity of AP600 compared to modified foreign facilities. However, the extent of this improvement is not known to us at this time.

Another important consideration is that by building and operating a new facility in the U.S., we would utilize U.S. technicians, engineers, and scientists, and all funds would remain the U.S. Accessibility of the facility to the NRC and its contractors would be greatly enhanced as well and would result in the NRC and its contractors gaining important "hands-on" experience not available with a foreign facility. Most importantly, U.S. technology would not be exported overseas.

There are of course two principal drawbacks to building and operating a new facility in the U.S.; cost and schedule. It is expected that the time required to design and construct a new facility is approximately 2 years, and testing would take an additional 1 to 2 years. Therefore, there is a significant likelihood that validated codes for use by the staff to independently analyze the AP600 performance would not be available prior to certification. However, the principal responsibility for obtaining the test data necessary to answer essential safety questions and support licensing decisions rests with Westinghouse. While it is desirable for the NRC to have some confirmatory research data of its own before issuing the FDA, since this data could be used to improve the level of validation of NRC codes, we do not consider it necessary that all NRC confirmatory research be completed before certification. This is because the NRC's codes are used to confirm margins used by the staff in its regulatory positions and acceptance criteria for the design.

Costs for a new facility are also estimated to be substantially higher than the estimated costs for utilizing an existing foreign facility. We have received two very preliminary estimates of the costs to design, construct, and run an approximately 1:50 scale high pressure full height integral test loop configured in the AP600 geometry. These were from the Energy Technology Engineering Center (ETEC) in Canoga Park, California, and from EG&G, Idaho, at INEL.

Both estimates however, were substantially above the $5M identified in the FY 92-96 Five Year Plan for integral system testing and are described in more detail in the following discussion of the ETEC and EG&G, Idaho, proposals. Thus, if the NRC were to build a new facility, substantial additional funding would be needed.

<u>ETEC Proposal</u>

ETEC is run for the DOE by the Rocketdyne Division of Rockwell International and it has the status of a National Laboratory with regard to contracting. ETEC approached the staff in December, 1991, described to us their facilities and capabilities to conduct integral thermal hydraulic system testing, and requested the opportunity to put together a very preliminary proposal to conduct such testing for us on the AP600 design. On January 20, 1992, members of the staff travelled to ETEC, received information on their proposal, and visited their facilities.

ETEC concluded that they could design and construct an approximately 1:50 scale integral system loop that simulates AP600 for approximately $15M, and that design and construction would take about 2 years. This estimate did not include computer analyses needed to support the design or the testing program nor did it include the costs to run a testing program. If such analysis and testing costs are included, we estimate a complete integral system test program would cost on the order of $25M over a 3-4 year period. This option would utilize ETEC to construct and operate the facility, and another laboratory, most likely INEL, to conduct the necessary design and testing analyses. The advantages of the ETEC proposal are that the facility site has sufficient electrical power available for the decay heat simulation, an existing test stand could be used for mounting the loop, and a pressurized hot water supply is available for secondary feedwater simulation. ETEC also has substantial experience in conducting large scale thermal-hydraulic testing for naval reactors.

<u>INEL Proposal</u>: INEL provided us with a preliminary estimate to design, construct and operate an integral systems test facility simulating AP600 at approximately 1:50 scale for about $22 million, which is similar to the preliminary ETEC proposal.

Our experience with funding previous systems test facilities indicates that as we proceed with design of a facility, many unforseen factors will have a tendency to push costs up. Therefore, more detailed, realistic estimates are likely to come out somewhat higher. Estimates in the range of $25M-$30M are probably reasonable.

<u>Evaluation of Options</u>: The options previously described assume two things: the first is that Westinghouse will choose not to install a reliable, pumped, high pressure safety injection system, and thus the need for high pressure, full height testing remains valid. The second, is that they did not assume cooperation between the NRC and Westinghouse to perform integral system testing.

If Westinghouse chooses to obtain the required integral system data, it is unclear at this time how they would propose to obtain it. There also appears to be a number of reasons from a cost and schedule standpoint for both the NRC and Westinghouse to cooperatively pursue high pressure, full height integral systems test data. If both organizations have a legitimate need for such data, then a cooperative program should be possible. Until such decisions are made, the staff intends to continue pursuing the ROSA-IV option. If Westinghouse chooses to obtain integral systems data, and indicates a desire to obtain it through a cooperatively funded program with the NRC, then we plan to work with OGC to develop a procedure by which a cooperative program can be established.

If cooperative testing ultimately becomes the desired course of action, then obviously Westinghouse, and possibly the Department of Energy would make financial contributions to the testing program, and the ultimate testing program option selected would depend on available funds and ability to produce appropriate data on needed schedules.

In our evaluation of the options, we assumed that the NRC pursues integral testing independently. Insights from this evaluation are provided below.

As previously noted, the two principal factors of the evaluation are cost and schedule. Since the staff identified the need for integral system testing only within the last year, the FY1992-1996 Five Year Plan does not include sufficient funds (i.e., $25M - $30M) to design, construct, and operate a new facility. We are also assuming, subject to Commission endorsement, that confirmatory testing beyond certification is acceptable. Obviously, if sufficient funding were available and confirmatory (post-certification) testing was acceptable, then building a new facility is our preferred option. As part of our evaluation, we briefly examined the impact of reprogramming existing research funds to pay for a new integral facility. Our conclusion is that, with very little exceptions, our current ongoing research programs are of high priority and are either responding to user office requests, Commission requirements requiring rulemakings, etc. Thus, we believe that any reprogramming of funds would most likely result in unacceptable reductions to or elimination altogether of certain programs.

Modifying a foreign facility appears, on balance, to be an attractive option for NRC at this time for schedule as well as budgeting reasons. The needed funds are already adequately budgeted and therefore a request for additional funding is not needed. Because the facilities are built, they can be modified and should be ready to start testing within about a year of initiating the program. Hence, use of a foreign facility has the highest likelihood of obtaining data on an early schedule.

If the choice is to use a foreign facility, our preference at this time is to pursue testing in ROSA-IV rather than Bethsy, primarily because we are farther along in our evaluation of ROSA-IV, and it is, by volume, twice as large as Bethsy.

ACRS Review:

On November 6, 1991, the staff briefed the AP600 and SBWR Subcommittees of the ACRS on SECY 91-273 and on the RES plans for confirmatory AP600 integral systems testing of the type (i.e., ROSA-IV and the low pressure integral testing) discussed in this paper. The full ACRS committee was also briefed on November 7, 1991. The ACRS Thermal-Hydraulic Phenomena Subcommittee was briefed on the staff's AP600 integral system testing plan on December 17, 1991, and the full committee was again briefed on January 9, 1992. For these latter two meetings, the staff presentations emphasized the need for high pressure, full height integral facility tests.

The ACRS letter that responds to the November 6 and 7, 1991, briefings is provided as Enclosure (4) and the staff's response is provided in enclosure (5). However, based on the December 17, 1991, and January 9, 1992, briefings, the Committee decided not to write an additional letter at this time on either the need for Westinghouse to produce high-pressure, full-height integral system data, or on the staff's plans for confirmatory integral system testing. From the comments made at the January 9, 1992, full committee meeting, a number of the Committee members did not appear to object to the staff's stated need for high pressure, full height integral system data. However, one member did state that he believed the ROSA-IV facility would be unacceptable for AP600 testing. Since EG&G has not submitted their report on this matter, and the staff has not completed its review of the EG&G, Idaho evaluation, we have not reached a definite conclusion on the ROSA-IV matter. We plan to continue to keep the ACRS fully informed and interact with them on our progress in this matter.

Conclusion:

The issue of whether and how best to obtain data from a high pressure, full height integral system test facility is an extremely complex issue that depends on several key decisions being made on the part of both NRC and Westinghouse before a clear cut research approach can be formulated. In particular, guidance on a number of policy issues needs to be provided by the Commission to the staff. These are identified in the recommendations that follow.

Recommendation:

1. That the Commission note the staff's plans to conduct independent, confirmatory testing of the AP600 performance under low pressure conditions using a small scale, low pressure facility.

2. That the Commission note that until it is

established (a) whether Westinghouse plans to modify the AP600 system design to reduce reliance on the passive systems during the high pressure portions of transients, and (b) if they do choose to obtain integral systems data, whether or not they desire to do it cooperatively, the staff plans to pursue the ROSA-IV testing option.

3. That the Commission provide guidance to the staff as the Commission deems appropriate on the five policy issues discussed previously and listed below:

   a. Constructing and operating a new test facility, or even experiencing unplanned delays using an existing foreign facility, could result in the staff obtaining confirmatory test data after the certification date. The staff believes that conducting confirmatory research subsequent to certification is acceptable, since it is confirming the safety margin used by the staff in their regulatory decisions. Does the Commission agree?

   b. Is it acceptable to and what are the policy implications of conducting major research programs on advanced U.S. designs in a foreign country?

   c. If confirmatory research subsequent to certification is acceptable. The staff's preference is to design, construct, and perform tests as a new facility built in the U.S. Net additional funding needed for such a facility is estimated to be $18-20M over about 3 years. Does the Commission concur in the staff's preferred option, and can the Commission obtain the necessary additional funds to construct a new facility?

   d. An NRC commitment to use the foreign facility being considered by the staff for AP600 testing will have to be made by early March, at the latest, or the option to use the facility could be delayed for several months to a year. If resolution of the testing issue with Westinghouse is not decided by then, the staff intends to make the minimum resource commitments necessary to proceed with testing at this foreign facility. Estimated funding at risk, should an alternative testing program be decided later, is 2-3 million dollars. Does the Commission agree?

e. The staff believes that if cooperative testing with Westinghouse is concluded to be the most cost effective way of obtaining the data the staff needs for code validation, then the benefits to the agency are sufficient to justify negotiating such arrangements with Westinghouse. In carrying out the negotiations, we would attempt to minimize the specific conflict of interest issues so that the Commission can consider waiving the conflict of interest restrictions of Section 170A of the Atomic Energy Act. Does the Commission concur with the staff's conclusion?

<u>Note:</u> That the staff will keep the Commission and ACRS fully informed of progress on this issue and any further key policy, legal, and technical issues as they arise.

<u>Coordination:</u> The Office of General Counsel has no legal objections to this paper.

James M. Taylor
Executive Director
for Operations

Enclosures:
See next page

1. Memorandum TMurley to EBeckjord dated November 15, 1991
2. NRC Sponsored Integral Systems Testing and Its Benefits
3. Basis for NRC Confirmatory Testing
4. ACRS Letter
5. Staff Response to the ACRS Letter

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Wednesday, February 19, 1992.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Tuesday, February 11, 1992, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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ENCLOSURE 1

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

November 15, 1991

MEMORANDUM FOR: Eric S. Beckjord, Director
Office of Nuclear Regulatory Research

FROM: Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

SUBJECT: RESEARCH USER NEED FOR CONFIRMATORY THERMAL-HYDRAULIC TESTING OF WESTINGHOUSE AP-600 DESIGN

NRR has completed a preliminary assessment of the Westinghouse test program planned to support Design Certification of AP-600. This assessment has identified a number of concerns related to uncertainties in thermal-hydraulic performance which we believe should be resolved by the vendor through enhancements and modifications in the planned test program. Details of our concerns are identified in SECY 91-273 which was developed jointly with your staff. Largely, the concerns center on the issue that Westinghouse has planned no testing to study systems behavior and systems interactions at high and intermediate pressures. The numerous interconnections between safety system components, such as the CMTs and the primary system or the multiple stages of the ADS connected to the pressurizer, provide the potential for significant fluid flow redistribution during RCS depressurization and safety injection in ways that can affect the overall performance of the passive safety systems.

We believe that these concerns could be well addressed through a testing program conducted at an appropriately scaled full-height, full-pressure integral experimental facility. NRR intends to work with the vendor to resolve our concerns, including the possibility of Westinghouse conducting such a test program to support their Design Certification submittal for AP-600.

In support of our Design Certification review of AP-600, we believe that the NRC should have an independent capability for acquiring confirmatory integral systems test data. Development of an independent confirmatory testing capability for the AP-600 has several advantages for the staff. First, it allows the staff to develop an independent experience base and database for assessing the safety performance of the advanced passive plant designs. This will allow the staff to investigate performance issues related to audit code validation which may not have been addressed by the vendor. Such testing capability also provides the ability to conduct follow-up investigations on performance issues which arise later in the design review process. This experience will be of significant benefit in aiding the staff's assessment of the vendor testing programs. In addition, it allows us to gain insights into the design and operation of large scale thermal-hydraulic test programs directed to study passive system performance.

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A. Levin, DST/NRR
49-20890

To meet the above objectives, NRR requests that RES develop experimental programs to study both high pressure and low pressure integral system behavior of AP-600. This will allow for generation of data for analytical model development and validation over the entire pressure range the plant could experience during postulated transients or accidents.

In the high pressure regime, we request that a large-scale, full pressure, full-height integral facility be utilized for testing of passive system response and interactions over a wide range of transients. Important performance issues which should be investigated in such a facility include:

CMT performance at high pressures (interactions with primary system, accumulators, condensation and pressure oscillations)

Initial stages of ADS operation (flow split through ADS valves, interactions with PRHR heat exchanger)

High pressure interactions between safety and non-safety systems, effects of control systems

Simulation of containment feedback

Beyond design basis events (multiple failure scenarios)

We believe that it is the responsibility of the vendor to provide appropriate systems data to demonstrate acceptable safety systems performance for transients and accidents up to the plant design basis. Therefore, for an NRC-sponsored confirmatory program, the test facility may not need to simulate the AP-600 plant in detail; rather, key safety systems and aspects of the system configuration should be represented. This will allow parametric studies of systems behavior and phenomenological issues over a range of conditions up to and beyond design basis. However, such testing would not need to provide conclusive demonstration and validation of compliance with design basis criteria.

In addition to the large scale, full pressure facility addressed above, it is also advantageous to have integral facilities at more than one scale and with different capabilities. For example, a full-height, full-pressure facility could investigate the high pressure interactions of fluid flow and heat transfer that may occur before the automatic depressurization system is activated and during the initial stages of depressurization. A separate reduced-height, reduced-pressure facility could be used to study the low pressure system interactions during the latter parts of the depressurization. Some overlap between the facilities' capabilities is also valuable, for the purposes of performing counterpart tests in the two facilities. Such tests would allow investigation of key phenomena at different scales, and would aid in validating phenomenological models used in systems analysis codes.

While use of a high pressure full height integrated facility allows investigation of significant safety systems interactions while at pressure, some large unknowns exist in safety system performance for late stage accident events when the system will be operating at low pressure in natural circulation. In this situation, primary inventory lost through the break or ADS will be replenished by water from the IRWST and/or containment sump. The makeup rate under these conditions will be dependent on pressure balances in the system, small hydrostatic heads, and complex interactions between system components. Phenomena and processes that will be prevalent during this time frame include:

Small gravity-driven flows and two-phase pressure losses,

Single and two-phase natural circulation in the primary loops and possibly in the various loops formed by the pressure equalization lines

Condensation heat transfer in the containment and primary system

Counter-current flow

As part of your confirmatory test program, we also request study of these low pressure regime issues, which will allow the staff to reduce uncertainties that may exist in our current thermal-hydraulic computer codes, and improve the ability to conduct audit analyses in predicting the safety behavior of these new designs.

We would like to meet with RES staff in the near future to discuss in detail projected schedules for responding to this user need. The Reactor Systems Branch, Division of Systems Technology, will have the technical lead responsibilities in NRR for this work.

T. Murley

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

ENCLOSURE 2

NRC SPONSORED INTEGRAL SYSTEMS TESTING AND ITS BENEFITS

Integral systems data are needed when legitimate technical issues arise that cannot be effectively resolved by component or separate effects testing, or by analysis. In the past, the use of substantial conservatisms in the analysis models, put there not only by the NRC staff but by the industry as well, were usually considered sufficient to compensate for lack of both integral and component performance data. The original Emergency Core Cooling System (ECCS) evaluation model requirements specified in Appendix K to 10 CFR 50 (part of the "ECCS Rule") are a prime example of this approach. However, even though the use of conservative features in analysis models allowed plants to be licensed, it was still necessary to quantify these conservative margins. The extensive ECCS research program conducted by the NRC and the industry following the promulgation of 10 CFR 50.46 and Appendix K to 10 CFR 50 (the "ECCS Rule") was conducted for just this purpose.

A key element of the ECCS research program was integral system testing. To study the performance of the ECC systems in an integral manner with the primary and secondary reactor coolant systems, the NRC constructed and ran the SEMISCALE facility at the Idaho National Engineering Laboratory for nearly 20 years, modifying it several times to look at design features of different PWR vendors and at different accidents other than the large break loss-of-coolant accident.

The LOFT program provided similar data as SEMISCALE on PWR accident behavior, but on a much larger scale, and utilized a nuclear core instead of electrical heaters. The LOFT test program included four large-break LOCA tests, seven small-break LOCA tests, two ATWS tests, two loss-of-feedwater tests, and one SGTR test, plus a variety of other simulated transients. The data from these tests were used to validate NRC computer codes.

For BWRs, GE and the NRC ran the Two Loop Test Apparatus (TLTA) and Full Length Integral System Test (FIST) Facility cooperatively.

Following the accident at TMI-2, the staff concluded that an insufficient data base existed to assure that both the NRC's and the industry's codes would acceptably predict small break loss of coolant accident (SBLOCA) behavior in Babcock and Wilcox-designed plants. Because the staff believed that both staff and industry codes required validation against integral systems data on SBLOCA behavior, a cooperative program was established among the NRC, the Babcock and Wilcox (B&W) Owner's Group, and the B&W company. This program involved constructing and operating a full-pressure, full-height integral systems test facility at B&W's Alliance Research Center in Alliance, Ohio. This loop was called the Multiloop Integral Systems Test (MIST) Facility. In addition, the staff also constructed and operated a small-scale low-pressure loop that simulated the B&W design at the University of Maryland. This facility was relatively inexpensive to construct and operate, could run tests very quickly and inexpensively, and was based on a different scaling rational that complemented the full-height, full-pressure MIST facility.

In addition, the NRC has participated in international cooperative programs using foreign integral test facilities. These have included the 2D/3D program investigating LBLOCA in the Upper Plenum Test Facility (Germany), Cylindrical Core Test Facility (Japan) and Slab Core Test Facility (Japan). They have also included other integral test facilities in Germany (PKL for SBLOCA and LBLOCA), France (BETHSY for SBLOCA, GTR and other transients) and Japan (ROSA-IV for SBLOCA, SGTR, and other transients).

As a result of running these integral testing facilities over the past 20 years, we believe that great insights on systems performance, thermal-hydraulic behavior, and analytical modeling were gained not only by the NRC and its contractors, but by the U.S. industry and the world nuclear community as well. Almost every test that was run in these facilities demonstrated areas where code models were deficient and resulted in code model improvements being made.

In addition to the very substantial improvements that were made in the analysis codes that predict reactor accidents, the operation of these loops produced the less tangible but very important benefit of improved public confidence in the NRC staff and nuclear industry regarding our understanding of reactor accident behavior.

ENCLOSURE 3

TECHNICAL CONCERNS SUPPORTING NEED FOR INTEGRAL SYSTEMS TESTING

The staff has reviewed the Anticipated Operational Occurrences and Postulated Accidents normally considered in the design basis of PWRs (and as identified in Chapter 15 of the staff's Standard Review Plan) with regard to their applicability to the AP600 design. In addition, we have considered whether there are any applicable anticipated operational occurrences or postulated accidents that would actuate the passive safety systems while the primary system was still at relatively high pressure. Our evaluation, although not complete since we did not have the benefit of thermal-hydraulic analyses to support our findings, concluded that there are at least four accidents which have the potential to actuate a safety injection, or "s" signal, and hence open the CMT discharge valve. These are the large break loss of coolant accident (LBLOCA), the small break loss of coolant accident (SBLOCA), the steam generator tube rupture (SGTR) and the steam line break (SLB).

The LBLOCA will very rapidly depressurize the primary system, and the accumulator injection is expected to pressurize the cold leg and downcomer sufficiently to prevent CMT discharge until accumulator discharge is complete and the primary pressure is down in the range of 250 psi. Hence, for the LBLOCA, ADS operation is not important, and CMT discharge will not occur until the primary system is at low pressure. Therefore, the low pressure test facility proposed by Westinghouse will probably be sufficient to provide integral systems data on passive safety system performance for the LBLOCA. It is also expected to provide sufficient integral systems data on passive safety system performance during the long term portion of other transients and accidents after the ADS has depressurized the primary system.

For the remaining three events, the SBLOCA, SGTR, and SLB, a safety injection signal will actuate on either low pressurizer pressure or level and open the CMT discharge valve while the primary system is still at substantial pressure.

For each of these events, the rate at which the CMT water discharges into the primary system will determine when each stage of the four-stage ADS will actuate, and thus determines the rate and timing of primary system depressurization. The SBLOCA and SGTR both involve loss of primary system coolant, and any pressure imbalances could result in a loss of CMT coolant injection. Because the AP600 does not have an active high pressure safety injection system, the design requires that coolant pumps be automatically tripped in the event of the SBLOCA. Failure or delay in tripping these pumps could result in preventing CMT discharge into the primary system while at the same time accelerating the coolant loss out the break by pump action. Vendor analysis codes were never adequately validated for the case of a SBLOCA with the coolant pump running.

While the AP600 plant is neither designed nor expected to actuate the ADS for a single SGTR event, a multiple SGTR event could conceivably actuate the ADS leading to a situation in which the primary system is depressurized while the secondary loop with the faulted steam generator remains at pressure, and backleakage of unborated water through the ruptured tubes into the primary system occurs.

While Westinghouse claims that borated water from the CMT will provide sufficient shutdown margin to overcome any reactivity addition from the unborated water, backleakage of hot secondary water into a unpressurized primary system could produce flashing of the secondary coolant and pressurization of the cold leg sufficient to interrupt CMT flow. Finally, for the SLB, which is the most severe primary system overcooling event the staff postulates for PWRs, the rapid overcooling will shrink the primary coolant and drop the level and pressure in the pressurizer, possibly actuating an "s" signal and starting the CMT to discharge. Since there is no loss of primary coolant, core cooling is not jeopardized, but overall behavior and control system response is unknown.

The primary concern associated with the above examples is that there are a number of systems that will actuate and interact during these types of events. From TMI-2, we have learned that operators don't sit idly by during accidents, as may be assumed in a stylized safety analysis. Rather, we expect they will actively intervene in the event. Likewise, control and protection systems will actuate, as well as non-safety systems. Unknown system interactions can lead to unforseen symptoms, and unknown accident symptoms can lead operators to misdiagnose an event and make wrong decisions (as was painfully learned from TMI-2).

These concerns, and others described in NRR's Commission Paper on the need for integral system testing for the AP600 design, have led the staff to conclude that integral systems data from an experimental facility that is full pressure and full height and configured to sufficiently simulate the AP600 design are necessary in order to adequately validate both the staff's and the AP600 applicant's codes.

Full pressure is required to address events which call on the CMT to actuate while the primary system is still at relatively high pressures. While low pressure facilities can shed some light on expected high pressure phenomena, we do not believe they are, by themselves, sufficient, but rather complementary to high pressure facilities. Full height is needed in order to accurately simulate the pressure driving heads that determine CMT drain rates and PRHR natural circulation flows. Full height also preserves coolant transit time in the loop equal to that in the prototype reactor. In summary, full pressure, full height facilities which are based on power-to-volume scaling minimize scaling distortions compared to other concepts (e.g., lower pressure, less than full height). This conclusion is confirmed by previous scaling analyses on SEMISCALE and MIST that concluded they needed to be power-to-volume scaled and full pressure and full height.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

November 14, 1991

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: NRC STAFF RECOMMENDATIONS FOR REVIEWING, MONITORING, AND APPROVING VENDORS' TEST PROGRAMS TO SUPPORT THE DESIGN CERTIFICATION OF PASSIVE LIGHT WATER REACTORS AS DESCRIBED IN SECY-91-273

During the 379th meeting of the Advisory Committee on Reactor Safeguards, November 7-8, 1991, we discussed the NRC staff's recommendations for reviewing, monitoring, and approving test programs to support the design certification of passive light water reactors (LWRs) as described in SECY-91-273. The Committee had previously been briefed on the major design features of the passive LWRs by the vendors. An enclosure to SECY-91-273 provides an initial assessment of the planned testing program for the Westinghouse AP-600 passive plant. Our Advanced Boiling Water Reactors and Advanced Pressurized Water Reactors Subcommittees held a joint meeting on November 6, 1991, to discuss this matter. During these meetings, we had the benefit of discussions with representatives of the NRC staff and comments by the Westinghouse Electric Corporation on its planned test program for the AP-600 passive LWR. We also had the benefit of the document referenced.

The staff also discussed two SECY papers that are in preparation; one will describe the need for large-scale, full-pressure, integral systems testing for the Westinghouse AP-600, and the other will provide an initial assessment of the planned testing program for the General Electric Simplified Boiling Water Reactor (SBWR). We plan to comment on these SECY papers when they become available.

Our overall conclusion is that the staff is developing a comprehensive program for reviewing, monitoring, and approving vendors' test programs to support the design certification of passive LWRs. Our specific comments are as follows:

1. The staff's intent to initiate an early formal relationship with the vendors to provide review and oversight of their test programs in advance of receipt of their applications for design certification should be fully implemented. This staff

initiative is of considerable importance if the present schedules for design certification of passive LWRs are to be maintained.

2. The staff's program may go beyond what is needed to support the design certification of passive LWRs. Accordingly, we plan to closely follow implementation of items 4 and 5 of the staff's proposed formal review procedure, which state respectively that, "The NRC may require the vendors to perform additional tests beyond those originally approved, if information from other tests or analyses indicates that previous testing and analyses are not adequate to satisfy the 10 CFR 52.47 requirements," and "The NRC may identify additional confirmatory testing to be done at NRC's expense in the vendor's facilities, beyond the testing required for design certification."

3. Although the SECY paper identifies the staff's concerns, there is little to indicate what would be required to allay these concerns or to provide answers to related questions. Before beginning a test program, the staff should spend additional effort to define not only its concerns, but also to identify what information must be obtained in order to allay those concerns and allow licensing action to proceed. Unless this is done, there is little assurance that the results of the test programs will be useful or used.

4. At the time of our meetings, SECY-91-273 had not been released to the public. This hindered our review since Westinghouse was not aware of the staff's concerns relative to its planned test program for the AP-600 plant. The present policy of delaying the issuance of SECY papers relating to the design certification of advanced reactors until the final Staff Requirements Memorandum is made available should be reconsidered. A change in this policy would facilitate the review process of future SECY papers.

5. Staff representatives informed us that the staff is evaluating the need to construct its own test facilities to model the AP-600 plant. We were told that one of the justifications for the NRC constructing its own facilities is a concern that sharing test facilities with Westinghouse to obtain independent data might represent a "conflict of interest." This matter should be reviewed in light of past examples of successful NRC/industry cooperative efforts in reactor safety testing and the expense and potential schedule impacts.

6. Consideration should be given to testing the thermal hydraulic aspects of ATWS scenarios for the AP-600 plant, including the performance of safety and automatic depressurization system

valves and the passive containment heat removal system under ATWS conditions.

7. Consideration should be given to the capabilities of the containment system relative to molten core spreading and core-concrete interaction, steam explosions, hydrogen detonation, direct containment heating, direct attack of molten core on containment structures, and extremely high level temperatures that could occur in certain accident scenarios. The SECY paper describes, under the heading of Severe Accident Performance Tests, a set of investigations of the above listed phenomena that could provide information about containment loading during severe accidents. Further, the SECY paper contains the statement, "The staff recommends that the testing and evaluations detailed above be performed." However, staff representatives told us that this statement was not correct and that the staff does not intend to recommend these tests.

8. The SECY paper being prepared for the SBWR testing program should include consideration of the performance requirements for the primary containment isolation valves associated with the Reactor Water Cleanup/Shutdown Cooling System. These valves should be selected and tested on the basis of their critical need to interrupt large pipe-break flows in a highly reliable manner. If isolation is not achieved, it is necessary to show that the passive core cooling water supplies inside of containment do not drain through a break outside of containment.

We are concerned about the issue of human factors in the review of advanced LWR instrumentation and control systems. The staff should begin developing "General Human Factors Criteria," analogous to the "General Design Criteria" contained in Appendix A of 10 CFR Part 50, as a means to prescribe NRC requirements in this area. Some rules are needed for this important area that are understood by both the staff and ~~the advanced LWR vendors.~~

10. The staff believes that a full-height, high-pressure integral facility simulating the AP-600 plant is needed for confirmatory research and for validation of its computer codes. The staff is concerned about interactions between different aspects of the various passive safety systems as well as operator actions to recover from a plant upset. ~~The staff was not prepared to defend its view.~~ At this time, we are not convinced that such a facility is needed. We will comment further when the staff completes the development of its basis for such a facility.

We wish to be kept informed as the staff implements the program described in SECY-91-273, and plan to review the related SECY papers that the staff has in preparation when they become available.

Sincerely,

David A. Ward
Chairman

Reference:

SECY-91-273, Memorandum dated August 27, 1991 for the Commissioners from James M. Taylor, Executive Director for Operations, Subject: Review of Vendors' Test Program to Support the Design Certification of Passive Light Water Reactors (Predecisional)

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

DEC 31 1991

Mr. David A. Ward, Chairman
Advisory Committee on Reactor Safeguards
Washington, DC 20555

Dear Mr. Ward:

I am responding in part to your letter of November 14, 1991, to Chairman Selin regarding the staff's recommendations for reviewing, monitoring, and approving vendors' test programs to support the design certification of passive light water reactors (LWRs) as described in SECY-91-273. The Office of the Secretary is addressing item 4 of your letter. You indicated the Committee's wish to be kept informed on the staff's activities associated with passive reactor testing programs, encouraged early interaction with the vendors, and provided a number of comments on related issues.

The staff appreciates the Committee's comments on SECY-91-273 and on the staff's presentations on November 6 and 7. We will keep the ACRS fully informed both as we review the vendors' test programs, including issuing the two forthcoming SECY papers on AP600 integral testing and the simplified boiling water reactor (SBWR), and as we develop plans for NRC-sponsored confirmatory testing.

The staff is also working to define more precisely the scope of both required and confirmatory testing and associated analyses necessary to resolve its concerns and provide answers to questions.

The staff is consulting with the Office of the General Counsel to resolve the issue of conflict of interest regarding cooperative research. We will consider performing cooperative research if we can do so without compromising our independence in reviewing the vendors' testing.

We understand that some confusion has arisen with regard to severe accident issues, and would like to clarify the staff's position and activities in this area. While severe accidents remain outside of the traditional design basis for the passive LWRs, the staff believes that plant performance under severe accident conditions must be assessed and the probability of a large release of radioactivity outside the containment should be acceptably low. Section IV of Enclosure 2 to SECY-91-273 discusses severe accident issues, focusing on four specific topics: debris coolability, hydrogen generation and control, containment performance, and fuel-coolant interactions. As was explained to the Committee at the meeting, the staff's position is stated clearly in the opening paragraph of Section IV: "In view of the unique features of the plant design, it <u>may</u> be appropriate to require testing of components or systems that will be involved in severe accident mitigation or accident management. No specific vendor-sponsored testing related to severe accident performance has been identified <u>at this time</u> for AP600. The staff will be evaluating the applicability of current industry-sponsored research to the AP600 design, as well as determining where additional vendor-sponsored testing is appropriate." (Emphasis added.)

In the area of debris coolability, the staff is following the progress of the industry- and NRC-cosponsored MACE program, and the NRC WETCOR program. The specific applicability of the data acquired from these experiments must be assessed with respect to the unique aspects of the AP600 design. The issue of containment performance in severe accidents is also being addressed, to some extent, as part of Westinghouse's passive containment cooling system test program. However, we do not yet have a detailed test plan for this program, and therefore, cannot evaluate the ability of the test program to generate data for assessment of containment performance under severe accident conditions. The staff also recommended to the Commission in SECY-91-273 that Westinghouse assess severe accident challenges of the types noted above.

While the staff recommended that these evaluations be performed, the specific approaches to the evaluations in all four severe accident areas are the responsibility of the vendor. We intend to meet with the vendor to gain an understanding of the testing and analyses to be performed and how results from existing industry-sponsored programs will be used to address severe accident issues. After these assessments are complete, the staff will review the results and determine whether additional vendor-sponsored testing is necessary to resolve outstanding issues. The degree of NRC involvement, if any, in additional testing will also be evaluated.

The Committee also recommended development of "General Human Factors Criteria." The treatment of human factors issues was outside the scope of SECY-91-273. However, in SECY-91-272, the staff informed the Commission of its approach to considering human factors and the role of the operator in the review of advanced instrumentation and control systems for future evolutionary and passive plant designs. The staff discussed specifically the need to define the role of the operator before designing the control room man-machine interface, and to test human performance in a control room prototype as necessary to demonstrate that the design is acceptable.

The staff has also recognized the need to provide guidance to assist both the staff in reviewing and the LWR vendors in designing the human factors aspects of the proposed advanced instrumentation and control systems of future plants. Therefore, the staff is conducting a program to revise and update Section 18.0, "Human Factors Engineering," of the "Standard Review Plan" (NUREG-0800) to incorporate this new guidance. In addition, assuming adoption of the design acceptance criteria approach for certification of advanced reactor designs, the staff plans to develop design acceptance criteria in the human factors area as part of its safety determination for certification of the evolutionary plant designs.

As the staff prepares additional Commission papers on subjects identified in your letter, we will consider the Committee's concerns regarding necessary testing and design criteria. We will also discuss with the ACRS the issues of SBWR testing and AP600-related integral testing in the near future, and we hope to address the Committee's concerns and questions in those areas at that time.

The staff will continue to consult closely with the ACRS as it proceeds with design certification-related activities for the advanced passive LWRs. Should the committee have any additional questions on these issues,the staff will be pleased to provide further information.

Sincerely,

Original Signed By:
James M. Taylor
James M. Taylor
Executive Director
for Operations

EDITED BY: J. Main
DATED: 12/2/91

cc: The Chairman
Commissioner Rogers
Commissioner Curtiss
Commissioner Remick
Commissioner de Planque
SECY