Westinghouse Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

AW-96-966

May 13, 1996

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: T. R. QUAY

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: WESTINGHOUSE RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION ON THE AP600

Dear Mr. Quay:

The application for withholding is submitted by Westinghouse Electric Corporation ("Westinghouse") pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary material for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10CFR Section 2.790, Affidavit AW-96-966 accompanies this application for withholding setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-96-966 and should be addressed to the undersigned.

Very truly yours,

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

/nja

cc: Kevin Bohrer NRC 12H5

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AW-96-966

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

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COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Brian A. McIntyre, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

Sworn to and subscribed
before me this 15 day
of May, 1996

Notary Public

Notarial Seal
Rose Marie Payne, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Nov. 4, 1996
Member, Pennsylvania Association of Notaries

2770A

(1) I am Manager, Advanced Plant Safety And Licensing, in the Advanced Technology Business Area, of the Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Energy Systems Business Unit.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Energy Systems Business Unit in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) Enclosed is Letter NSD-NRC-96-4721, May 13, 1996 being transmitted by Westinghouse Electric Corporation (W) letter and Application for Withholding Proprietary Information from Public Disclosure, Brian A. McIntyre (W), to Mr. T. R. Quay, Office of NRR. The proprietary information as submitted for use by Westinghouse Electric Corporation is in response to questions concerning the AP600 plant and the associated design certification application and is expected to be applicable in other licensee submittals in response to certain NRC requirements for justification of licensing advanced nuclear power plant designs.

This information is part of that which will enable Westinghouse to:

(a) Demonstrate the design and safety of the AP600 Passive Safety Systems.

(b) Establish applicable verification testing methods.

(c) Design Advanced Nuclear Power Plants that meet NRC requirements.

(d) Establish technical and licensing approaches for the AP600 that will ultimately result in a certified design.

(e) Assist customers in obtaining NRC approval for future plants.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for advanced plant licenses.

(b) Westinghouse can sell support and defense of the technology to its customers in the licensing process.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar advanced nuclear power designs and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for developing analytical methods and receiving NRC approval for those methods.

Further the deponent sayeth not.

ENCLOSURE 2

NSD-NRC-96-4721

CONTAINS NON-PROPRIETARY MATERIAL

Question 410.263

Branch Technical Position ASB 10-2 provides design guidance to meet GDC 4 on dynamic effects associated with possible water hammers in the feedwater piping. Specifically, the feedwater system should be designed to (a) prevent or delay water draining from the feedring following a drop in steam generator water level, (b) minimize the volume of feedwater piping external to the steam generator which could pocket steam using the shortest horizontal run (less than 7 feet), (c) perform tests acceptable to NRC to verify that unacceptable feedwater hammer will not occur and provide the procedures for these tests for approval, and (d) implement pipe refill flow limits where practical. Address the AP600 feedwater system design against these guidelines.

Response:

As indicated in SSAR section 10.4, Revision 6, the Startup Feedwater system and the condensate and feedwater systems include many features to minimize the potential for unacceptable water hammers in the feedwater piping. These features are further delineated in SSAR subsection 3B.2.3, Revision 7. These features include:

(a) The design of the feedwater system includes a number of features specifically intended to minimize water hammers. For example, the startup feedwater system is entirely separate from the main feedwater system, including its entry point into the steam generators. This allows the system flowrates and pipe sizes to be more consistent with their intended function than if startup feed flows were directed through main feed headers and feedrings. In addition, the main feedring itself is designed to minimize the potential for water hammer. The spray tubes are located on the top of the feedring so that the feedring does not drain when steam generator levels drop below the feedring level. The thermal sleeve is welded which also prevents drainage when steam generator levels fall.

(b) The main feedwater line is continuously sloped upward to the steam generator nozzle. The horizontal run from the steam generator to the feedwater elbow is minimized.

(c) Tests have been performed on many Westinghouse feedring type steam generators in the United States. These tests verify the effectiveness of Westinghouse feedring designs like that described above for AP600 in preventing water hammer. Westinghouse does not consider that further design testing is required.

(d) Pipe flow limits, especially on startup feed, are not required for AP600 because the startup feed path is separate from the main feed path, including its entry into the steam generator. In addition, unlike other PWRs, AP600 has no auxiliary feedwater system and associated lines and operations.

In addition, Chapter 14 of the SSAR will include a preoperational test to verify unacceptable dynamic effects do not occur for expected operating conditions.

SSAR Revision:

None

Question 440.269

Re: WCAP-14234 (LOFTRAN CAD)

Will LOFTRAN be used for long-term transient calculations? Has it or will it be compared and assessed to long-term data? Please explain.

Response:

The majority of the AP600 non-LOCA analyses reported in the SSAR consider short-term events having durations that are generally less than 1000 seconds (often, much less than 1000 seconds). However, the following SSAR events that are analyzed using LOFTRAN consider substantially longer time periods ranging from 20,000 to 36,000 seconds:

SSAR Section	Description
15.2.6	Loss of ac Power to the Plant Auxiliaries
15.2.7	Loss of Normal Feedwater Flow
15.2.8	Feedwater System Pipe Break
15.5.1	Inadvertent Operation of the Core Makeup Tanks During Power Operations
15.5.2	Chemical and Volume Control System Malfunction That Increases Reactor Coolant Inventory
15.6.3	Steam Generator Tube Rupture (LOFTTR2 version of LOFTRAN used)

Individual LOFTRAN models for the key AP600 passive features that affect these events (the CMTs and PRHR heat exchangers) have been verified by comparison with component test data. The overall predictions of the integrated LOFTRAN computer code have been verified via comparison with data collected at the SPES-1 and SPES-2 test facilities. The details of the LOFTRAN code verification for the AP600 program are found in Reference 440.269-1. The verification documented in Reference 440.269-1 confirms the ability of LOFTRAN to analyze the AP600 for the range of conditions encountered during the transients indicated above.

Reference:

440.269-1 Scherder, W. et al., "AP600 LOFTRAN-AP and LOFTTR2-AP Final Verification and Validation Report," WCAP-14307 (Proprietary), June 1995.

SSAR Revision: NONE

Question 440.271

Re: WCAP-14234 (LOFTRAN CAD)

Page 1-5. It is stated that LOFTRAN uses a saturated node and a two region node for LOFTTR2. From Table 2-2 it is shown that LOFTRAN-AP will be used for feedwater and steam line breaks. Why not use LOFTTR2-AP that could calculate superheated steam effects for these transients? Please explain how a saturated node for the steam generator will be able to calculate superheating of steam when the steam generator tubes are uncovered?

Response:

LOFTTR2-AP does not contain the models used to calculate superheated steam effects for the feedwater and steam line breaks. The absence of these models from the advanced plant version of the steam generator tube rupture analysis code is consistent with these models also not being included in the LOFTTR2 computer code, which is used for steam generator tube rupture analysis of operating plants. Just as LOFTRAN is employed to perform the superheat predictions for operating plants, LOFTRAN-AP is the code used for the advanced plants.

Superheated Steam Model

The LOFTRAN code includes a model for heat transfer which may occur in the uncovered steam generator tube region. If activated, the model adds a calculation of the uncovered region heat transfer [ ]^{a,c}. The model being used for the LOFTRAN-AP superheat calculations is the same as that used for Westinghouse operating plants and has previously been reviewed and approved by the NRC (References 440.271-1 and 440.271-2).

This model uses a variable noding scheme in the calculation of the uncovered region heat transfer. The "variable noding" reflects the capability of the coding to evaluate the general conditions of the uncovered tube region and determine an appropriate number of nodes to be used in the subsequent calculations. The noding scheme is applied to both the primary and secondary sections in the uncovered tube region. Each steam generator is treated independently to determine its particular noding scheme and heat transfer in the uncovered tube region.

The major assumptions used in this model are described below:

- A constant primary tube temperature is assumed throughout the uncovered tube region. This is applied [ ]^{a,c}. Additionally, this is applied [ ]^{a,c}.
- The heat transfer coefficient used in the uncovered tube region is based on the [ ]^{a,c} (Reference 440.271-3). The heat transfer calculation is based on the wall surface temperature and the steam bulk temperature. The heat transfer coefficient (U) is calculated by the following expression:

a,c

[ ]

- No credit is taken for either a primary film heat transfer resistance or a tube metal heat transfer resistance. Therefore, the wall surface temperature is assumed to be equal to the primary fluid temperature. This provides a conservatively high heat transfer calculation for prediction of the steam superheat.

- All heat transfer to the steam in the uncovered tube region is [ ]^{a,c}. Condensation and/or recirculation of superheated steam is assumed [ ]^{a,c}. Heat transfer to uncovered tube regions in isolated, intact steam generators (i.e., no steam flow) is not calculated since there is no mass/energy release.

The heat transfer calculation to determine the outlet temperature of an individual node in the superheat region is based on the following expressions:

a,c

[ ]

These expressions can be arranged into two equations with unknowns of [ ]^{a,c}. Solving these simultaneous equations for the steam temperature exiting the node provides the following equation:

[ ]^{a,c}

With a conservative assumption that [ ]^{a,c} this equation reduces to:

[ ]^{a,c}

An iteration routine is used in each node to determine the outlet steam temperature. The convergence criterion used is based [ ]^{a,c}. The convergence criterion is [ ]^{a,c}. The outlet temperature of one node is used as the inlet temperature of the next node.

References

440.272-1 D. S. Love and M. P. Osborne, "Mass and Energy Releases Following a Steam Line Rupture; Supplement 1 - Calculations of Steam Superheat in Mass/Energy Releases Following a Steam Line Rupture," WCAP-8822-S1-P-A (Proprietary), September 1986.

440.272-2 J. C. Butler and P. A. Linn, "Mass and Energy Releases Following a Steam Line Rupture; Supplement 2 - Impact of Steam Superheat in Mass/Energy Releases Following a Steam Line Rupture for Dry and Subatmospheric Containment Designs," WCAP-8822-S2-P-A (Proprietary), September 1986.

440.271-3 [ ]^{a,c}

SSAR Revision: NONE

Question 440.275

Re: WCAP-14234 (LOFTRAN CAD)

Are the degradation of heat transfer options for the steam generator on page 6 (1-6) going to be assessed against integral effects data for the steam generators? Since this is not a first principles approach to heat transfer degradation, please provide some assessments.

Response:

The heat transfer degradation models discussed on page 1-6 will not be assessed against integral effects data for the steam generators. The application of these specific steam generator heat transfer models is not limited to the AP600. These same basic LOFTRAN models are routinely applied to safety analyses for operating plants, with a relatively limited amount of plant specific steam generator geometry input being required. The results of these analyses for operating plants have been accepted by the NRC for licensing purposes.

In the safety analyses, when the option is selected to directly input the secondary side water volume below which the tubes start to uncover, the intent is to assume a value that produces a conservative response (either early or late tube uncovery) for the transient of interest. The volume to uncover the tubes that is assumed for this code option is bounding and is not based on any complex supporting analysis.

In contrast, the other models discussed on page 1-6 require the application of results from a much more sophisticated steam generator model. Specifically, for one LOFTRAN option, the NOTRUMP computer code (Reference 440.275-1) is used to predict an overall steam generator heat transfer coefficient as a direct function of steam generator water mass. Another available option uses the NOTRUMP code to define a conservative steam generator riser quality that is consistent with the onset of degradation in steam generator heat transfer. This quality is input to LOFTRAN and then used in conjunction with an available correlation that calculates steam generator riser quality and then reduces heat transfer once the input quality is exceeded.

Except for the user option that directly inputs the total steam generator heat transfer coefficients as a function of steam generator water mass, the LOFTRAN code reduces steam generator heat transfer linearly with water volume, once the tube bundle is predicted to uncover. This assumption is consistent with the loss in heat transfer area as the tube bundle gradually uncovers.

Reference:

440.275-1 Meyer, P. E., "NOTRUMP - A Nodal Transient Small Break and General Network Code," WCAP-10079-P-A (Proprietary) and WCAP-10080-A (Nonproprietary), August 1985.

SSAR Revision: NONE

Question 440.307

Re: WCAP-14234 (LOFTRAN CAD)

Please demonstrate that any lagging or smoothing performed in LOFTRAN or its various components is time step independent.

Response:

There is no lagging or smoothing performed in LOFTRAN or its various components. That is, no artificial constraint is placed on the predicted magnitude of change for a parameter during a time step, or series of time steps. Such approaches are sometimes used to promote code convergence and stability, but have not been used in LOFTRAN.

SSAR Revision: NONE

Question 440.310

Re: WCAP-14234 (LOFTRAN CAD)

Page 3-9. Please provide the details of how the head vent choked flow model is incorporated into the pressure solution to LOFTRAN? Is the choked flow solution one time step behind pressure? Also, please provide justification for the stability of the approach.

Response:

The reactor vessel head vent model is implemented explicitly with respect to the RCS. A converged solution is found for the main RCS loop. Using the head vent conditions at the current time step, the model calculates the relief rate. The flow is then subtracted from the RCS. Thus, the choked flow solution is one time step behind the pressure. No iterations are performed between the RCS and the head vent flow calculations because the rate of change of RCS pressure and the impact on the calculated flow is considered to be negligible for all applications of this model. Therefore, this efficient approach to incorporating the head vent model is stable. For example, the maximum rate of depressurization during cases where the head vent model is used is approximately -0.6 psi/sec upon opening the head vent valve. The rate at which the head vent flow decreases during this same time period is approximately -0.00125 (lbm/sec)/sec.

SSAR Revision: None

Question 952.96

Re: Valve Testing Roadmap

Provide a commitment to submit a narrative of an ADS valve testing "roadmap". The road map is to include additional information on the testing to be performed outside of design certification was requested by the staff to assess the adequacy of the test plans.

Response: Revision 1

Within design certification a number of tests were performed to verify our capability to predict ADS system performance. These included the ADS system "single effects tests" at VAPORE, as well as, " integral system tests" at SPES and OSU which included scaled ADS systems. Valves for these tests were selected to simulate ADS valve performance but were not used to select or qualify any particular valve.

The design of the ADS valves, as captured by text in the SSAR, is specified as "generic," with the specific valves to be determined later. For completeness, the system P&ID shows the current valve configuration based upon tests and design selections made outside design certification. Inputs to safety analyses have assumed conservative values for valve resistance and valve opening time. The design of the ADS stages 1/2/3 provide for staggering the opening of the upstream and downstream ADS valves. The upstream ADS valves (in each of the three stages) are designated ADS isolation valves, and these valves are sequenced to open before the downstream valves. The downstream ADS valves are designated ADS control valves, and these valves are sequenced to open after the upstream isolation valves are fully open. With this arrangement, the blowdown is controlled by the downstream valve, thus the term ADS control valve. The upstream isolation valves will open with no flow. The downstream control valves will be designed and qualified to open against full reactor coolant system pressure, temperature, and resultant blowdown flow rate. The upstream isolation valve will be designed and qualified to open against reactor coolant system pressure and temperature without blowdown flow rate. To provide margin in the ADS stages 1/2/3 design, the upstream isolation valves will also be designed to open against full RCS pressure, temperature, and resultant blowdown flow rates.

ADS Valve Testing and Analysis

There will be a number of additional tests and analyses performed during the development, manufacture, installation, and operation of the ADS valves. These tests and analyses include:

- Testing to support ADS stage 1/2/3 valve type selection and to support valve qualification testing
- Valve qualification testing
- Production testing
- Pre-operational testing
- In-service testing

Each of these tests is further discussed below.

ADS Stage 1/2/3 Valve Type Selection Testing

For this testing, full sized prototypic Stage 1/2/3 ADS valves were installed in an ADS valve package piping simulation. Different valve designs were tested for the ADS Stage 2 and 3 function to provide a basis for performance comparisons. Testing was performed over a range of flow conditions that bound the actual ADS operation.

The overall objective of this testing was to characterize gate and globe valve performance in this application as an aid to the final selection of a specific valve type. This information is not required for design certification. Data obtained on valve performance included the measurement of valve operator mechanical and electrical performance; that is, the required thrust to unseat, open, close, and seat the valves. The valve seats and disks were visually examined after test runs to observe and document valve wear/damage.

These tests will also provide input to the valve specification including fluid conditions, flow, temperature/pressure, differential pressure conditions, and IST conditions. They will also provide input to the valve qualification testing to determine the limiting test conditions (flow, fluid, temperature/pressure, and differential pressure).

As discussed above, the upstream valve in each ADS path is designated as an ADS isolation valve. The functional requirements for this valve specify it to be a very leak-tight valve to prevent operational and safety complications arising from an RCS pressure boundary leak. Although the valves are designed to open against differential pressures up to the maximum RCS operating pressure (i.e., 2485 psig) at blowdown conditions, their design basis safety requirement is to open with no flow and high differential pressure.

The upstream valve in each ADS path is designated as an ADS isolation valve. Based on the results of the ADS test program conducted outside of design certification, the valve type best suited to meet the requirements for the ADS isolation valves is a gate valve. Three types of gate valves were tested. All three types of gate valves tested exhibited superior leak-tightness. In addition, due to design modifications on these valves, bonnet pressurization was not observed. Thermal binding effects were observed on the wedge gate valves although not of a magnitude to prevent opening of the valve under design conditions.

The downstream valve in each ADS path is designated as an ADS control valve. The functional requirements for this valve specify it to provide a controlled blowdown from the pressurizer at a sufficient flow to meet the ADS venting requirements. The safety-related function of the ADS first stage control valve is to open against differential pressures up to the maximum RCS operating pressure (i.e., 2485 psig) at blowdown conditions. The valve is also designed to be used by the operator to manually depressurize the RCS in some beyond design basis events. However, this function is not considered safety-related.

Based on the results of the ADS test program, the valve type best suited to meet the requirements for the ADS first stage control valve is a globe valve. Furthermore, the globe valve opening characteristics should be such that the valve does not exhibit significant tensile loads upon opening. Simply stated, the peak operating loads for the valve during blowdown conditions should not exceed the opening loads at static conditions. The globe valve tested as a first stage control valve was a 4 inch body-guided plug globe valve with control valve trim.

The safety-related function of the ADS second and third stage control valves is to open against differential pressures up to the maximum RCS pressure they are required to open against during ADS. This has been specified to be 1200 psig for the second stage ADS valves and 500 psig for the third stage ADS valves. These values are based on the safety analysis results for an inadvertent ADS. However, the valve motor operators will be designed to open against full RCS operating pressure (i.e., 2485 psig) to provide sufficient ADS reliability while considering the possibility of the failure of the first stage ADS valves to open.

In summary, the valve type best suited to meet the requirements for the ADS first, second and third stage control valve is a globe isolation valve. Furthermore, the globe valve opening characteristics should be such that the valve does not exhibit tensile loads upon opening as described above. The globe valves tested as second and third stage ADS control valves included the 8-inch gate valves described earlier, an 8-inch globe valve with a full body guided disk-piston, and an 8-inch globe valve with dual seats and a balanced cage guided trim package. The 8 inch globe valve with full body guided disk-piston performed well under blowdown conditions and provided sufficient leak-tightness for the ADS valve application.

The configuration shown on the system P&ID includes gate valves for isolation for four stages, globe valves for control for stages 1/2/3 and squib valves for control for stage 4.

Valve Qualification Testing

Valve qualification will occur after vendor selection and is a three step process of analytical qualification, functional testing of the valve/operator assembly, and IEEE qualification of the operator.

Analytical Qualification

Prior to qualification testing, vendors will perform analytical qualification calculations to confirm that their designs are acceptable for the ADS application. These calculations include:

- An ASME Code Class 1 design report to verify valve integrity under the design conditions in the equipment specification to include specified nozzle loads and design transients
- A seismic analysis to verify operability for the specified seismic accelerations at the maximum operating load
- A weak link analysis to provide the maximum loads the valve components can withstand for both test and operating conditions
- Operator sizing calculations using both the manufacturer's and EPRI's methodology (when applicable)

Functional Testing

Based on acceptable analytical qualification, valves will be manufactured for functional testing. The valve/actuator assembly to be tested will be identical to that used in the plant with respect to configuration, materials, and dimensions. Prior to assembly, each test valve will be dimensionally inspected. Critical dimensions will be recorded

with any special features that are critical to operation. Testing is performed with instrumentation to measure stem thrust, torque, switch actuation, travel, motor speed, motor temperature, accelerations and fluid temperature, pressure, differential pressure and opening/closing times. The test conditions will be determined with input from the type selection testing discussed above.

IEEE Qualification

The operator will require separate qualification based on IEEE-382 which will include cyclic aging, vibration aging, seismic testing, and environmental aging to include LOCA/HELB.

Supplemental testing may be required to address separate issues related to the electric actuators, such as, effects of operating time on motor temperature and speed, motor temperature effect on motor output torque, and motor speed effect on torque capability.

Production Testing

An ITAAC Type test will be performed as necessary for each type of valve selected to confirm that the valves of each type can be procured to perform as required. Each valve will be subjected to production testing to include a hydrostatic shell test of the body/bonnet, hydrostatic disc test, leakage tests on the seat, backseat and packing, and a functional test. The hydrostatic test will be consistent with the ASME Code, Section III, NB-6000. The functional test is performed at nominal and reduced voltage without flow but with the valve closed and at the design pressure differential at room temperature. Finally, a cyclic test is performed for a number of cycles with no pressure or flow.

Pre-Operational Testing

Static baseline testing will be performed prior to startup to verify that the valve is set up and functioning correctly. Following the static test, the stage 1, 2, and 3 valves will be subjected to individual valve tests with low flow and with design differential pressure (initial). Finally, a blowdown test will be performed on the first AP600 from an elevated RCS pressure and temperature which will actuate ADS Stages 1, 2, and 3. Stage 4 will be flow tested. These tests will be described in Chapter 14 of the SSAR.

In-service Testing

The ASME code requires valve exercise tests be performed on safety-related valves on a quarterly schedule. In addition, in Generic Letter 96-xx the NRC requires safety-related power operated valves be tested to verify their capability to perform their safety-related function. These valve operability tests are to be performed at operating conditions (differential pressure and flow) as near as practicable to the conditions expected during the valves' performance of their safety-related missions. These tests are excepted to be performed once every five years or every 3 refueling outages consistent with Generic Letter 96-xx. The ability to do meaningful operability tests is an important functional requirement for the ADS valves. The COL applicant is responsible to specify and perform specific tests for specific valves.

An in-service stroke time test will be performed at the required interval at zero differential pressure, ambient temperature. Periodically, during a refueling outage, a flow/differential pressure test will be performed at low flow, a pressure differential between 400 and 1200 psi, and a temperature of 300 degrees. The squib valves currently specified for the fourth stage, would not be subject to these tests but will have unique IST requirements (such as periodically actuating their charges outside the ADS valves).

Periodically, verification testing will be performed on valve set-up and operator capabilities in accordance with GL-89-10, and GL-96-xx as specified by COL applicant. This would require a flow test be performed on these valves during a refueling shutdown prior to depressurizing the RCS below 300-400 psig. A simple exercise test of a globe isolation valve with low differential pressure and no flow will provide a meaningful test of the operability of the ADS control valves. Therefore, the AP600 Inservice Test Plan as documented in the SSAR will reflect the simplified IST approach.

In summary, to meet the requirements for inservice testing as described in SSAR Section 3.9.6, the following IST commitments for the ADS valves are:

ADS Isolation Valves

- Exercise test periodically as specified by COL applicant. These test are conducted at-power with no flow and no differential pressure across the valve.
- Operability test periodically as specified by the COL applicant. These tests are conducted at full RCS pressure with no flow and high differential pressure.

ADS Control Valves

- Exercise test periodically as specified by the COL applicant. These tests are conducted at-power with no flow but with the potential for a differential pressure across the valve.
- Operability test periodically as specified by the COL applicant. These tests are conducted during shutdown operation with no flow and low differential pressure. There are no RCS pressure requirements for these tests.

A one-inch solenoid operated test valve is provided with each ADS valve package. This valve is provided to equalize the pressure across the ADS gate isolation valves prior to exercise testing of the valve. This practice has been shown to be effective in reducing wear on the gate valves that may develop from repeated exercise tests. It is not required to equalize the pressure across the ADS globe valves for exercise testing. The globe valves will not experience significant wear during exercise testing.

Post-maintenance testing of the operator and valve will be required whenever changes are made that may affect the required operating loads or operator output.

Valve Design Control

Design control is not a part of testing. However, it is required to establish the linkage among the designed valves, the tested valves, the production valves and the installed valves. Production valves will be purchased to the same equipment specification requirements as the tested valves. Dimensional inspection of critical parts will be performed and recorded to verify that they are within required tolerances. The critical dimensions will be determined based on a review of the test results and design configuration by the valve manufacturer and Westinghouse.

Any modifications to the original design must be reviewed, evaluated, and approved by Westinghouse prior to implementation by the manufacturer.

SSAR Revision: NONE.

The preoperational testing of the ADS valves will be included in Chapter 14, Initial Test Program of the SSAR.

Question 952.97

Provide a commitment to submit inspections, tests, and analysis criteria (ITAAC) consistent with the ADS valve testing "roadmap".

Response:

As indicated in the ADS valve "roadmap" contained in the response to RAI 952.96, appropriate requirements will be included in the inspection, test and analysis and acceptance criteria (ITAAC) for ADS valves. These requirements will include valve stroking and flow differential pressure tests. They will also include system configuration tests.

SSAR Revision:

None

Question 952.99

Provide a check valve qualification test or analysis program that details the conditions under which the check valve will be required to operate and the basis by which to conclude that the check valve will operate reliably under these conditions

Response:

The check valves in the passive core cooling system (PXS) that are safety related and required to open or close under low differential pressure are the containment recirculation check valves and the IRWST injection check valves. The current design includes squib valves in series with the check valves which eliminate the closing differential pressure. Since check valves are characteristically simple in design, their operation is not affected by seismic accelerations or the maximum applied nozzle loads. These valves are designed such that if structural integrity is maintained, the valve operability is maintained. In addition to design considerations, the check valves undergo in-shop hydrostatic tests, in-shop seat leakage tests, and periodic in-situ valve testing and inspection. SSAR sections 5.2.4 and 6.6 provide descriptions of valve inservice inspection criteria. SSAR section 3.9.3.2.2 (Valve Operability) provides a description of the approach for maintaining check valve operability. SSAR section 3.9.6.2.2 (Valve Testing) provides a description of the in-situ testing for check valves. Table 3.9-16 provides a listing of the specific inservice tests for each of these PXS check valves.

SSAR Revision: None