March 4, 1997

Mr. Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Analysis
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
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Pittsburgh, PA 15230

SUBJECT: FOLLOWON QUESTIONS REGARDING THE AP600 INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA (ITAAC)

Dear Mr. Liparulo:

As a result of its review of the June 1992 application for design certification of the AP600, the staff has determined that it needs additional information. Specifically, the enclosure to this letter contains requests for additional information concerning the AP600 ITAAC.

You have requested that portions of the information submitted in the June 1992, application for design certification be exempt from mandatory public disclosure. While the staff has not completed its review of your request in accordance with the requirements of 10 CFR 2.790, that portion of the submitted information is being withheld from public disclosure pending the staff's final determination. The staff concludes that these followon questions do not contain those portions of the information for which exemption is sought. However, the staff will withhold this letter from public disclosure for 30 calendar days from the date of this letter to allow Westinghouse the opportunity to verify the staff's conclusions. If, after that time, you do not request that all or portions of the information in the enclosures be withheld from public disclosure in accordance with 10 CFR 2.790, this letter will be placed in the NRC Public Document Room.

If you have any questions regarding this matter, you may contact me at (301) 415-1132.

Sincerely,
original signed by:
Joseph M. Sebrosky, Project Manager
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Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosure: As stated

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Docket No. 52-003
AP600

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Followon Questions on the AP600 Certified Design Materials (CDM)

Civil/Structural and Piping Areas (Questions 640.1 thru 640.20)

General Comments

640.1 It is our understanding that the certified design material (Tier 1 material) should be a subset of the Tier 2 information. Therefore, the content of Tier 1 material should be consistent with what is in the Tier 2 material. However, a number of inconsistencies were identified between the Tier 1 and Tier 2 materials (see specific comments below). In addition, cross references need also to be provided in the certified design material document.

640.2 During the staff's review of the ABWR standard design, the staff, GE and industry representatives including NEI expended a significant effort developing ITAAC and Tier 1 format that were mutually agreeable. CE followed a similar approach and completed the ITAAC for the System 80+ standard plant design with minimal differences. The approach that Westinghouse is taking reopens many issues that were mutually resolved with the industry and will result in a significant waste of effort and resources for the staff and Westinghouse.

640.3 As required by 10 CFR 52.97(b)(1), the "ITAAC are to be necessary and sufficient to provide reasonable assurance that the facility has been constructed and will be operated in conformity with the license, ..., the Commission's rules and regulations." From its review of Revision 2 of the AP600 Certified Design Material (CDM), the staff found that the level of detail of the material provided in the civil/structural and piping areas is far below that necessary for the staff to use as a basis for making any safety determination.

Specific Comments

Section 3.3 - Nuclear Island Buildings

640.4 In order to ensure that the ITAAC can be effectively implemented, the design description needs to be expanded to include (a) the scope, (b) description of all safety related structures, (c) design codes, (d) design loads, and (e) figures to show the configuration of the nuclear island structures including the foundation mat.

640.5 Figures to be provided should include the floor plan at each elevation and cross-sections of structures including key dimensions such as dimension of the foundation mat, thickness of floors and major walls, thickness of foundation mat, embedment depth, etc.

640.6 From the review of Item 1 (nuclear island structures) of Table 3.3-4 (ITAAC), the staff is unable to determine what the design commitments are, what structures are to be inspected and/or tested, and what the acceptance criteria are. Westinghouse should use the ITAAC for either GE ABWR or ABB/CE System 80+ as an example and redevelop the AP600 ITAAC for all seismic Category I structures and structural elements including the nuclear island foundation mat.

640.7 In order to ensure that the nuclear island structures as constructed can withstand the structural design basis loads, Westinghouse should commit in the ITAAC that a structural analysis will be performed which reconciles the as-built data with the structural design basis loads specified in the design description.

640.8 ITAAC should be provided to ensure that the containment vessel and containment penetrations are designed and constructed to ASME Code, Section III, and an analysis report does exist to conclude that the as- built containment vessel and penetrations are able to withstand the design basis loads defined in the design description.

640.9 A commitment needs to be made in the ITAAC that the containment vessel and penetrations will maintain the leakage rate less than the maximum allowable leakage rate as required by regulations.

640.10 Figures should be provided to show the configuration of the fire water tank. In addition, the ITAAC should commit to perform tests to ensure there is no leakage of water from either the PCS tank or the fire water tank, and to identify any deflection of roof structures during and after the first fill of tank water.

640.11 ITAAC should be provided for the spent fuel pool structure and fuel racks.

640.12 ITAAC should also be provided for the construction sequence of the seismic Category I structures including the nuclear island foundation mat, embedded exterior walls, shield building roof structures, etc.

Section 5.0 - Site Parameters

640.13 The third sentence of Page 5.0-1, "For cases where a site characteristic .... does not exceed the capacity of the design," does not belong to the certified design material and should be deleted.

640.14 The maximum ground water level and maximum flood level at plant elevation of 100 ft (design grade elevation) as stated in this table are inconsistent with those stated in SSAR Section 2.4 (Revision 8) which stated that the ground water level and flood level are up to the plant elevation. Also, SSAR Section 3.4 (Revision 8) stated that the high water interface is at two feet below the grade elevation. Furthermore, SSAR Table 2-1 (Revision 10) stated that the flood level and ground water level are less than the plant elevation of 100 ft. Clarification for these inconsistencies is needed.

640.15 For the tornado wind, the maximum pressure drop in addition to the maximum wind speed should be provided in this table.

640.16 For the soil bearing strength, the minimum static soil bearing capacity instead of the average bearing reaction due to dead load and the maximum static bearing reaction should be provided.

640.17 For the soil shear wave velocity, the phrase, "or acceptable comparison of floor response spectra to the certified design based on site-specific soil-structure interaction analyses," should not belong to the certified design material and should be deleted from this table.

640.18 For the safe shutdown earthquake, (1) the design ground response spectra as shown in SSAR Figures 3.7.1-1 and 3.7.1-2 should be provided in this section, and (2) the phrase, "SSE free field ground acceleration of 0.3g with Regulatory Guide 1.60 response spectra," should be replaced by, "SSE free field ground acceleration of 0.3g with modified Regulatory Guide 1.60 response spectra."

Design of Safety Related Piping Systems

640.19 In Revision 2 to the AP600 Certified Design Material, the Design Description and ITAAC for piping have been eliminated and placed in the respective system-based design description and ITAAC. The staff's review of the proposed changes finds that the relocation of the certified piping design (Tier 1) commitments and ITAAC to the specific system is not acceptable. Through this change, many

technical and policy issues that have been resolved in the previous reviews of the evolutionary plant applications have now been reopened. The following summarizes some of the more significant issues that need to be resolved as a result of the change.

Elimination of the piping design description reopens the policy issue related to level of detail needed for design certification as it pertains to piping system design. The level of detail issue is discussed at length in SECY-90-377 and in the staff requirements memorandum dated February 15, 1991. In resolving this issue, the staff proposed in SECY-92-053 the use of Design Acceptance Criteria (DAC) for piping design. Therein, the staff stated that the DAC are a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies in making a final safety determination to support design certification. DAC would have to be sufficiently detailed to provide an adequate basis for the staff to make a final safety determination regarding piping design. The staff further stated that it would specify DAC in the design certification rule (DCR) that would enable the staff to make a final safety determination on all piping issues. The DCR would contain a description of the methodologies, design processes, and acceptance criteria that will be used to complete the design details and verify that the requirements for piping design have been properly implemented.

For ABWR and System 80+, the staff ensured that the piping DAC were sufficiently specified in the Tier 1 design description. The details of the Tier 1 commitments were described in the SSAR as Tier 2* commitments. However, the fundamental design commitments for piping design were included in the Tier 1 design description. Some of the fundamental design commitments for piping included (1) designing the piping to the ASME Boiler and Pressure Vessel Code, Section III to ensure pressure boundary integrity, (2) designing the piping to ensure its functional capability, (3) minimizing the effects of erosion-corrosion, (4) ensuring that equipment nozzle loads are met, (5) benchmarking the piping computer code, (6) ensuring that high-energy line breaks and environmental effects are adequately considered, (7) ensuring that proper materials are used to prevent brittle fracture and reduce the possibility of cracking during service, and (8) ensuring that adequate clearances are provided during construction.

All of the above fundamental piping design commitments and more were eliminated in Revision 2 of the AP600 CDM. In order for the staff to reach a final safety determination on the adequacy of the AP600 piping design, these commitments need to be included as Tier 1 commitments.

To minimize staff resources required to review the AP600 CDM report as presently formatted, and Westinghouse resources required

to respond to many potential Requests for Additional Information on each applicable system in Section 2.0, the staff believes that the AP600 CDM report should be revised to add a "Piping Design" subsection in Section 3.0 "Non-System Based Design Description and ITAAC." This new subsection should be similar to the "Piping Design" subsections in the two evolutionary plant CDMs.

640.20 In Revision 2 of the AP600 CDM, the section which was included in the evolutionary plant CDMs under, "General Provisions, Verification for Basic Configuration for Systems," has been eliminated and placed under system-based ITAAC. The staff's review of this change finds the relocation of this information into system-based ITAAC is acceptable. However, in relocating this information to ITAAC, the intent of the verification appears to have been unacceptably changed as noted below.

The verification of the seismic qualification of mechanical and electrical equipment was intended to be an inspection of the type tests, analyses, or combination of type test and analyses to ensure that the as-built equipment including associated anchorages is qualified to withstand design basis dynamic loads without a loss of its safety function. In other words, the ITAAC should be an inspection; not the type tests and analyses themselves. The type tests and analyses are performed by the equipment vendor at the test location—not on site—using certain anchorages. The ITAAC should be an inspection of the as-installed equipment to ensure that the installed configuration including anchorages is similar to the configuration tested or analyzed by the vendor.

The same comment noted above for equipment seismic qualification also applies to the relocation of the verification of basic configuration for MOVs. The tests or type tests of MOVs is not the ITAAC. Rather, the ITAAC should be an inspection of the tests or type tests for the MOV to ensure that the as-installed MOV has been qualified for the intended function. The inspection should verify that a test report exists that demonstrates that the as-installed MOV is qualified to perform its safety function under design basis differential pressure, system pressure, fluid temperature, ambient temperature, minimum voltage, and minimum and/or maximum stroke times.

To ensure adequate welding, the ITAAC may be the NDE inspection required by the ASME Boiler and Pressure Vessel Code, Section III because this is an inspection of the as-installed ASME Code components. In this case, the acceptance criteria should be the ASME Code, Section III acceptance criteria for pressure boundary welds — not a report.

The AP600 CDM should be revised to address all of the above staff comments in each applicable system in Section 2.0.

Reactor Systems Branch Comments (Questions 640.21 through 640.36)

SSAR 14.3

640.21 Page 14.3-1, sixth para- it is stated that "The Certified Design Material design descriptions delineate the principal design bases and principal design characteristics that are referenced in the design certification rule." The design description (DD)in the November 7, 1996 submittal is a duplicate of the Design Commitment given in the ITAAC table. Westinghouse is not following their own committed approach given in the SSAR by the present form of the Design Description.

640.22 Page 14.3-4, first para-The seven factors we used for determining what information is significant to safety in the ABWR and System 80 + Design Description (DD) review are replaced by four factors. These four factors do not meet the intent of the seven factors we approved for ABWR and System 80+.

(a) "Whether the feature of function is necessary to satisfy the NRC's regulations in Parts 20, 50, 52 73 and 100." This should be added.

(b) "Whether the feature or function represents an important assumption or insight from the probabilistic risk assessment." This should be added.

(c) "Whether the feature or function is important in preventing or mitigating severe accidents." This should be added.

(d) "Whether the feature or function in question has had a significant impact on the safety or operation of the plant." This should be added.

(e) "Whether the feature or function in question is typically the subject of a provision in the Technical Specifications." This should be added.

640.23 Page 14.3-5, third para-There is one exception to the rule. This pertains to nuclear fuel, and rod cluster control assemblies. These components should be described in the certified design descriptions due to their importance to safety and the desire to control their overall design throughout the lifetime of a plant that references AP600 standard plant design.

640.24 Page 14.3-6, third para-There should be a discussion of the detailed review and verification of the input parameters and

assumptions used for the various analyses such as flooding analyses, overpressure protection, containment analyses, core cooling analyses etc. (refer to the similar write-up given for ABWR and System 80+).

640.25 Page 14.3-6, last para-Design Description entries for safety - related systems are significantly different than the entries given in the SRP. W should justify the deviations from the SRP.

GENERAL COMMENTS

640.26 Since the RTNSS issue is not resolved, it is difficult to finalize the ITAAC for the following systems:

(a) Normal RHR
(b) Diesel Generators
(c) CVCS
(d) Start-up Feedwater System

640.27 Westinghouse should provide information in tabular form, in Section 14.3 of the SSAR that cross references the important design information and parameters of the following analyses to their treatment in Tier 1.

(a) flooding analyses
(b) overpressure protection
(c) containment analyses
(d) core cooling analyses
(e) fire protection
(f) transient and accident analyses
(g) ATWS
(h) Steam Generator Tube Rupture
(i) radiological analyses
(j) USIs/GSIs
(k) TMI-2 Action items

640.28 Listing of instruments with their tag numbers in a table is not sufficient. Minimum set of instruments should be shown in the figure to show the functional arrangement. The overall locations of the instruments are essential for the function. The instruments' exact locations need not be shown in the diagram. Typically in the P&ID, the instruments are shown without showing the exact place where they are installed.

640.29 We understand that numerical criteria given in the ITAAC are different from the numbers given in the SSAR. The numbers in Tier 2 and Tier 1 should be consistent. If they are different, there should be an analysis or outline of the analysis in Tier 2 justifying the deviation.

640.30 It is important to state in the beginning of the DD whether the system is a safety grade System or a Defense-in Depth System or a non-safety related System. This statement will dictate the content of the DD using the graded approach. We understand that some systems will be a combination of safety and non-safety. But still it is possible to portray a system. We used this approach in the review of Evolutionary plants and found it useful.

DEFINITIONS

640.31 In the draft AP600 TIER 1 material submitted on June 28, 1996 a definition of "Defense-in-depth Systems" was given. Why this definition is not included in the November 7, 1996 submittal?

640.32 Add "Division (for mechanical systems or component)."

GENERAL PROVISIONS

640.33 Add "Maximum Reactor Core Thermal Power."

2.1 REACTOR

640.34 Submit the Design Description for Nuclear Fuel System and Control Rod Drive System (System 80 + DCD may be referred for an acceptable submittal). Even though "ITAAC" will not be required for these systems, a basic configuration inspection will be required. Tier 2* documentation for these systems should be submitted for staff review.

640.35 Digital Metal Impact Monitoring System described in SSAR Section 4.4.6.4 which is used for monitoring loose parts in the reactor should be in the ITAAC.

2.2.3 Passive Core Cooling System

640.36 Since ITP will be significantly used for verification of ITAAC, resolution of our comments on ITP are essential for completion of the ITAAC review.

Instrumentation and Controls Branch Comments (Questions 640.37 through 640.45)

640.37 The certified design material (CDM) and the inspection, tests, analyses and acceptance criteria (ITAAC) for the AP600 I&C systems should provide information on the design process and implementation, with appropriate tests, inspection and acceptance criteria, based on supporting information in SSAR Chapter 7 and Section 14.3. The material should include information on the design controls, development, and qualification processes for I&C hardware, software, and other design features.

640.38 The CDM should address the hardware and software development process to be used in the design, testing, and installation of I&C equipment and should also include the description of the design process to be followed for hardware and software development, design commitments, the inspections, tests, and analysis to be performed to verify that the design is consistent with the commitments, and acceptance criteria against which the design will be judged.

The commitment in the ITAAC should reflect the elements, activities, and documentation required of the various phases of the life cycle as shown in Figure 1 of SRP Section 14.3.5.

640.39 Provide criteria in the CDM and SSAR to guide the design process throughout the digital I&C systems life cycle stages. The ITAAC should provide the acceptance criteria for verifying the design through the stages while the SSAR adds the set of guidelines and standards that will provide more detailed criteria for the development of the design. The ITAAC for software and hardware for the I&C systems should verify the design stages within the overall design process as specified in the WCAP-13383, Revision 1:

(a) Design requirement phase
(b) Definition phase
(c) Development phase
(d) Test phase (integration, verification, and validation)

In addition to the four phases listed above, the staff believes that two more phases should be added:

(e) Installation phase
(f) Operation and maintenance phase.

The ITAAC for software development should include, but not be limited to the following elements:

* software quality assurance plan (SQA)
* software management plan (SMP)
* software configuration management plan (CMP)
* software development plan (SDP)
* verification & validation plan (V&VP)
* software safety plan (SSP)
* software operation and maintenance plan (SOMP)

640.40 The CDM should address the development and qualification process for I&C equipment. The discussion should include:

(a) design processes and acceptance criteria to be used for safety-related systems using programmable microprocessor-based control equipment,

(b) a program to assess and mitigate the effects of electromagnetic interference on I&C equipment,

(c) a program to establish setpoints for safety-related instrument channels,

(d) a program to qualify safety-related I&C equipment for in-service environmental conditions, including mild environmental conditions with the potential for local hot spots due to abnormal conditions.

(e) a program to verify the conformance of the safety-related I&C systems in accordance with guidance provided in IEEE standards 279 and 603.

(f) a program to verify the independence between redundant divisions. In addition to separation requirements, the isolation aspects should be also addressed.

640.41 The CDM should include an Instrumentation and Control Systems Architecture Block Diagram similar to Figure 7.1-1 in the SSAR.

640.42 In addition to the PMS and DAS, the I&C CDM and ITAAC should include the following I&C systems:

PLS - Plant Control System
DDS - Data Display and Processing System
OCS - Operations and Control Centers System
IIS - Incore Instrumentation System
SMS - Special Monitoring System

640.43 The CDM and ITAAC should include the communication system that verifies the communication between the main control room and the local control stations, and the remote shutdown station and the local control stations.

640.44 In the CDM for PMS, the description of the logic and control should have more detail when addressing automatic decision-making and trip logic functions, and manual initiation functions associated with the safety actions of the safety-related systems.

640.45 The CDM and ITAAC for the DAS should follow the commercial grade item dedication program as defined in the WCAP-13383 Revision 1. The DAS CDM should address defense-in-depth considerations for protection against common mode failures in the PMS.

Quality Assurance and Maintenance Branch Comments (Questions 640.46 and 640.47)

Based on the preliminary staff's review of Section 3.0, "Non-System Based Design Descriptions and ITAAC" of the AP600 Certified Design Material, Westinghouse is requested to provide the following information:

640.46 Subsection 3.4, "Initial Test Program:" While the staff agrees that "ITAAC aimed at verification of the initial test program are not necessary," the initial test program design description needs to summarize, in comprehensive detail, the fundamental initial test program objectives, phases, and organizational elements as described in SSAR Chapter 14.2 (Subsections 14.2.1, "Summary of Test Program Objectives" through 14.2.3, "Test Specifications and Test Procedures").

640.47 Design Reliability Assurance Program (D-RAP): The Certified Design Material information for the AP600 should contain a high level commitment to a D-RAP for use in the detailed design and equipment specification of risk-significant SSCs prior to fuel load. The D-RAP design description should describe the scope, purpose, objectives and essential elements of the D-RAP, including, (a) a commitment for a process to evaluate, prioritized and list SSCs based on their risk-significance, (b) a commitment that the process used to determine dominant failure modes will consider industry experience, analytical models, and applicable requirements, and (c) a commitment that for risk-significant SSCs, the key assumptions and risk insights will consider operations, maintenance, and monitoring activities.

EP and Radiation Protection Branch Comments (Questions 640.48 and 640.49)

640.48 There is no ITAAC on the configuration and thickness of shield walls. Such an ITAAC is needed to validate the SSAR calculations of 1 or plant radiation dose rates. It was expected that such an ITAAC would exist, possibly in the building ITAAC (section 3.3). One way of accomplishing the ITAAC would be to have a set of drawings that show the walls and their thickness.

640.49 There was no ITAAC on ventilation flow rates. Such an ITAAC is needed to validate the SSAR calculations of inplant concentrations of airborne radioactivity.

Electrical Engineering Branch Comments

640.50 Section 3.3.4.c) states that the separation is maintained between Class 1E divisions and between Class 1E divisions and non-Class 1E

cables in accordance with the fire areas as identified in Table 3.3.2. ITAAC Table 3.3-4 Section 4.c) also refers to fire areas for the cable separation. Inspection of the as built will be done in general plant areas for 12 in. vertical separation and 6 in. horizontal separation for open cable trays. The following areas need to be clarified:

a) Why are you referring to fire areas? It is not for fire protection review.

b) SAR Section 8.3.2.4.2, Rev. 8 states that within general plant areas (limited hazard areas), the minimum vertical separation is 12 inches and the horizontal separation is 6 inches for open cable trays with low voltage power cables for sizes < 2/0 AWG.

Miscellaneous Comments

640.51 Scope of Design - Chapter 1 of the SSAR and the CDM do not show what the boundary is for the AP600 design scope (even Figure 1.2-2 is unclear). In order to meet the requirements of 10 CFR 52.47(b)(1), Westinghouse needs to identify the structures and systems that are wholly or partially outside (or inside) the scope of the design to be certified and specify the boundary of the certified design scope (see SRP 14.3, page 30 for guidance). For example, it appears that the following structures are in the AP600 scope:

Nuclear Island (Containment, Shield, and Aux. buildings)
Turbine building
Annex building
Diesel generator building
Radwaste building
Are the outer walls of these buildings considered the boundary??

640.52 Interface requirements - Section 8 of the SSAR and 4.0 of the CDM are unacceptable. In order to meet 10 CFR 52.47(a)(vii) & (ix), Westinghouse needs to specifically identify the structures and systems that are wholly or partially outside the design scope and specify the interface requirements for those systems. Also, Westinghouse needs to describe the method to be used to verify the interface requirements in order to meet 52.47(a)(viii). Refer to 4.0 of ABWR ITAAC to see how GE did this and SRP 14.3-30.

640.53 ITAAC - In conclusion, Westinghouse needs to identify all structures and systems that are wholly or partially in the AP600 design scope in Tier 1 ITAAC, regardless of safety significance. Each system needs at least one page in the ITAAC book (see example from ABWR) and more detail can be provided in Tier 2 as necessary.

640.54 Basic configuration - It appears that some verification capability was lost in the CDM because the term "Basic Configuration" was replaced with "Functional Arrangement" (such as design descriptions that do not become verified commitments and verification against design drawings - "Bridge Concept").