PROPRIETARY

Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

June 8, 2010
U7-C-STP-NRC-100127

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket No. PROJ0772
Response to Request for Additional Information

Reference: Letter from Tekia Govan to Mark McBurnett, "Request for Additional Information Re: South Texas Project Nuclear Operating Company Topical Report (TR) WCAP-17079-P Revision 0, Supplement 3 to Bison Topical Report RPA 90-90-P-A SAFIR Control System Simulator" (TAC No. RG0012), March 12, 2010

Attached are responses to NRC staff questions included the reference. The responses to the following RAI questions complete the responses to the letter.

| | | |
|---|---|---|
| RAI-3 | RAI-15 | RAI-18 |
| RAI-19 | RAI-20 | RAI-22 |

The responses to RAI-3 and RAI-15 contain information proprietary to Westinghouse Electric Corporation. For this reason, they are supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b) (4) of Section 2.390 of the Commission's regulations.

Accordingly, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Attachments 1 through 8 contain the RAI responses, including the proprietary and non-proprietary responses to RAI-3 and RAI-15. Attachment 9 contains the request for withholding

D091

STI 32686934

of proprietary information, the affidavit, the proprietary information notice, and the copyright notice. Correspondence with respect to the copyright or proprietary aspects of this information or the supporting Westinghouse Affidavit should reference letter CAW-10-2848 and should be addressed to: B.F. Maurer, Manager, ABWR Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355. If this letter is separated from the proprietary material in RAI-3 and RAI-15, the letter is no longer proprietary.

There are no commitments in this letter.

If you have any questions, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 6/8/10

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

jet

Attachments:

1. RAI-3 (proprietary)
2. RAI-3 (non-proprietary)
3. RAI-15 (proprietary)
4. RAI-15 (non-proprietary)
5. RAI-18
6. RAI-19
7. RAI-20
8. RAI-22
9. Request for Withholding Proprietary Information

cc: w/o attachment except*
(paper copy)

Director, Office of New Reactors
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011-8064

Kathy C. Perkins, RN, MBA
Assistant Commissioner
Division for Regulatory Services
Texas Department of State Health Services
P. O. Box 149347
Austin, Texas 78714-9347

Alice Hamilton Rogers, P.E.
Inspection Unit Manager
Texas Department of State Health Services
P. O. Box 149347
Austin, Texas 78714-9347

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

*Steven P. Frantz, Esquire
A. H. Gutterman, Esquire
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Ave. NW
Washington D.C. 20004

*Tekia Govan
*Ekaterina Lenning
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852

(electronic copy)

*George F. Wunder
*Tekia Govan
*Ekaterina Lenning
Loren R. Plisco
U. S. Nuclear Regulatory Commission

Steve Winn
Joseph Kiwak
Eli Smith
Nuclear Innovation North America

Jon C. Wood, Esquire
Cox Smith Matthews

Richard Peña
Kevin Pollo
L. D. Blaylock
CPS Energy

## RAI-3

### QUESTION:

The SAFIR control system simulator appears to be best-estimate in nature based on the results of the validation provided in Supplement 3. Condition 6 in the staff's safety evaluation (SE) for BISON LTR (RPA 90-90-P-A) required conservative time-dependent boundary conditions in place of a detailed control system model. SRP 15.0.2 subsection II.1.D directs the staff to review a sample plant uncertainty determination. Please describe how the uncertainties in the SAFIR model are treated in the safety analysis method for anticipated operational occurrences (AOOs). Supplement 3 states that SAFIR is capable of modeling control systems consistent with CENPD-300-P-A. In the response please describe how Section 7.3.3 of CENPD-300-P-A is applied to safety analyses performed using SAFIR with BISON. The response should also give consideration to highly complex control systems whereby biasing particular parameters in a certain direction may not be readily apparent as "conservative." To assist the staff in its understanding of the interface of SAFIR with the reload safety analysis process, please expand the discussion provided for one of the validation cases presented in Supplement 3, or another similar case, to provide a specific example of how the uncertainties are treated.

### RESPONSE:

The purpose of referring to the CENPD-300-P-A is to clarify that the control system model will be developed in the same way as the model of any other plant system important to the transient analysis, and that SAFIR will be used to apply control system inputs to plant models in accordance with the provisions of the NRC approved methodology, for example in the Reference Safety Report (CENPD-300-P-A). Therefore, uncertainties and justification of the models will be treated in the same way as any other plant model that is input to the licensing analysis according to current licensing methodology (see answer to RAI-16, STP Letter # U7-C-STP-NRC-100095, Scott Head to Document Control Desk, 5/12/2010).

In the safety analysis method for AOOs, the model uncertainty is typically accounted for in the form of a multiplier(s) by which the SAFIR model output parameter(s) is/are multiplied by. The value of the multiplier depends on the statistical distribution function, bias and standard deviation obtained from the comparison to Separate Effect Test (SET) data.
Note: the multiplier reflecting the model uncertainty is applied to the SAFIR output parameter; input parameters are not biased in a certain direction, which may not be readily apparent as "conservative".

Uncertainties in SAFIR modeling parameters can be estimated from the comparison between SET data and SAFIR simulation of such SETs. The comparison between measurements and code predictions for the relevant modeling parameters yields either the distribution function of differences, or the mean bias and the standard deviation of the bias.

**Example:** Validation results against the plant data (SET) for the pressure controller of the [ ]$^{a,c}$ plant are shown in Figures 6-78 through 6-81 in the topical report. This model is validated such that all the input signals including a narrow range pressure in the reactor vessel, reactor power, pressure setpoint, output from speed controller and forced closure signal for bypass valves are consistent with the measurement data. Comparison of the model output parameters (BAFR, BATT and APRM-Filter) yields the following probabilistic data:

**BAFR:**
Relative difference is normally distributed with mean model bias of:
[ ]$^{a,c}$
and standard deviation:
[ ]$^{a,c}$

**BATT:**
Uncertainty in BATT is covered by the uncertainty in BAFR.

**APRM-Filter:**
Relative difference is normally distributed with the mean model bias:
[ ]$^{a,c}$
and standard deviation:
[ ]$^{a,c}$

It should be noted that the examples in the Validation and Verification (V&V) presented in supplement 3 were aimed to show the capability of SAFIR to model plant systems and comparisons were made against expected behavior and measurement data. In licensing applications conservative plant responses are modeled by altering the system response in a conservative manner, i.e. changing setpoints or the performance of critical functions in the model.

The control systems required and the complexity of these systems will be determined at the time of the application in connection to a License Amendment Request. Westinghouse will inform the NRC of a new application (for instance application of the methodology to a new plant type) and then an NRC audit would take place at the Westinghouse offices.

Currently, the NRC-approved uncertainty method A from Section 7.3.3 in CENPD-300-P-A is used in licensing applications. The corresponding conservative multiplier is added to the model to replace the output signal. SAFIR modeling uncertainties will be addressed consistent with approved methodology for AOO uncertainty evaluation.

**RAI-15**

**QUESTION:**

NUREG-0800 Section 15.0.2 Subsection II.1 requires that "[t] the submittal must identify the specific accident scenarios and plant configurations for which the codes will be used. The evaluation model documentation must be scrutable, complete, unambiguous, accurate, and reasonably self-contained."

WCAP-17079-P states that "SAFIR is capable of modeling control systems consistent with the provisions of CENPD-300-P-A" and also states "SAFIR is capable of modeling various types of transients which include, but not limited to, Load Rejection, Turbine Trip, Core Power or Pressure changes, and valve failures."

CENPD-300-P-A states in Table 1-1 that BISON is used in the Westinghouse reload methodology to analyze AOO fast transients. Section 7.4 of the same document lists the fast transients as:

- Generator Load Rejection Without Bypass
- Turbine Trip Without Bypass
- Feedwater Controller Failure - Maximum Demand
- Pressure Regulator Failure - Closed (BWR/6 only).

The material in WCAP-17079-P does not satisfy the requirements. First it addresses SAFIR and not the subject of the WCAP-17079-P – the evaluation model comprising BISON coupled with SAFIR (i.e., BISON-SAFIR). Secondly, it suggests an open-ended application rather than specifying the limits of applicability called for in the requirement.

State whether the set of transient events for which BISON-SAFIR will be used is the same as that defined in CENPD-300-P-A. If there are any additional transient events for which BISON-SAFIR is intended to be used beyond the set originally defined for BISON, and then describe in accordance with the requirement the additional transients events for which BISON-SAFIR will be used.

**RESPONSE:**

The objective of the SAFIR Licensing Topical Report is to obtain generic USNRC approval for the process to develop control system models for licensing applications. The specific transient analysis methodology has been independently submitted to the NRC for review and approval and is not considered a part of the approval of the SAFIR.

Westinghouse currently simulates the effects of control systems by conservative time-dependent boundary conditions. Conservative control system models can also be developed by using SAFIR. Please see answer to RAI-16.

The intention of WCAP-17079-P is to replace the method of modeling boundary conditions in NRC approved transient methods such as BISON, with a more flexible and robust method using SAFIR code. SAFIR will be used in conjunction with transient analysis codes approved by the NRC, such as the currently approved BISON, or with POLCA-T (once reviewed and approved by the NRC for transient analysis). The combined codes (for example BISON-SAFIR), will be used with NRC approved analysis methodologies, such as the AOO's described in chapter 5 of CENPD-300-P-A, for performing plant specific transient licensing evaluations.

The quoted statement in WCAP-17079-P, "SAFIR is capable of modeling various types of transients which include, but is not limited to, Load Rejection, Turbine Trip, Core Power or Pressure changes, and valve failures." is an incorrect statement as SAFIR does not model transients. It will be modified in the final version of the topical report to state: "SAFIR is capable of modeling time-dependent boundary conditions for various types of transients which include, but are not limited to, Load Rejection, Turbine Trip, Core Power or Pressure changes, and valve failures."

The following is an illustrative example of the application of the approved BISON methods in conjunction with the SAFIR control system methods for an ABWR plant. The transient event failure in the feedwater controller requesting maximum feedwater flow is simulated below. No CPR calculations are provided as SAFIR does not interact with BISON during hot channel analysis.

A brief description of SAFIR models used during an example transient (Feedwater Controller Failure – FWCF) and the main connections between models is presented in Figure 1. The analysis results, as calculated in BISON, shown in Figures 2 through 7, demonstrate the capability of BISON-SAFIR methods to determine a transient scenario.

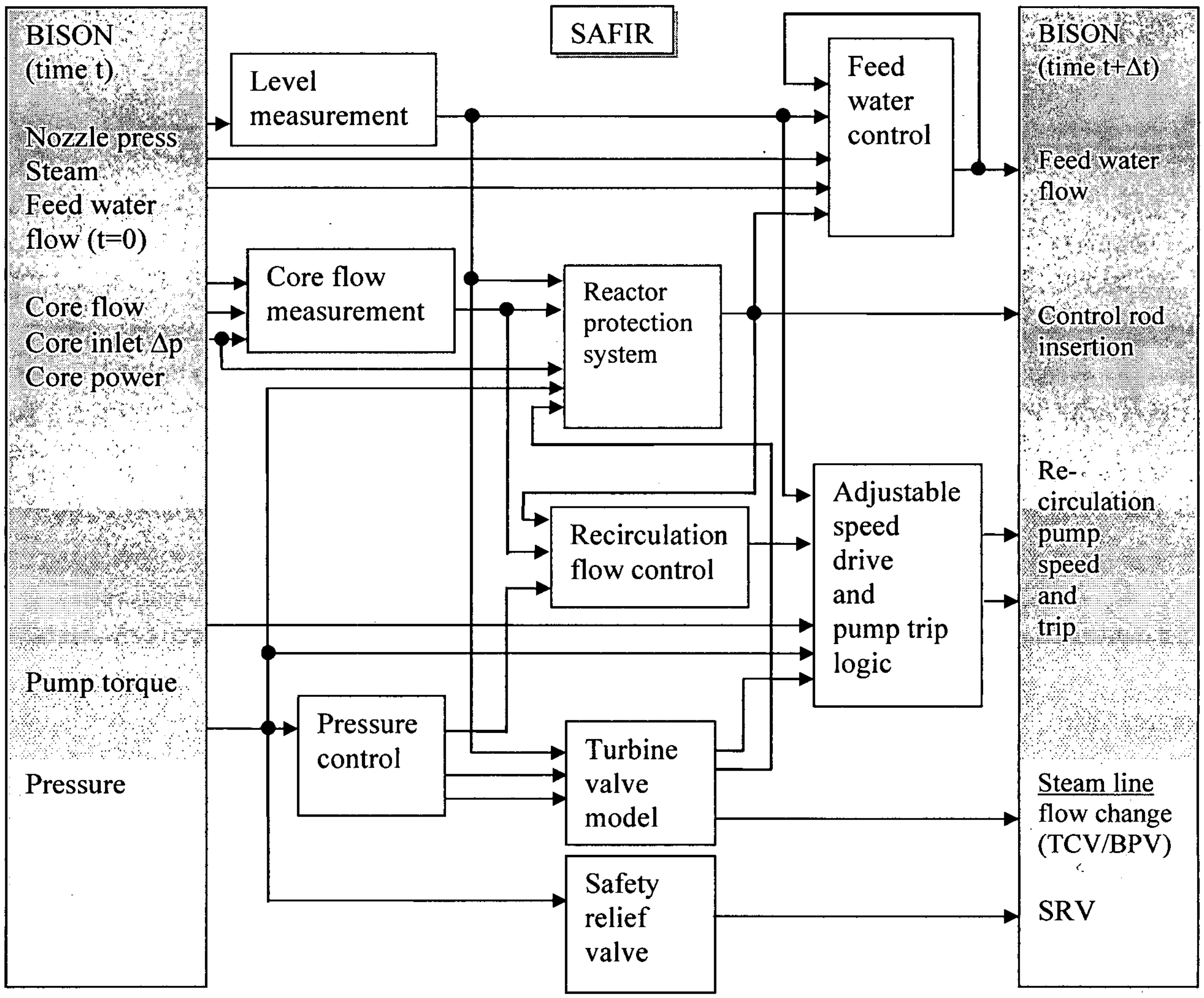



Figure 8 Brief description of ABWR model

The example case is initiated by limiting the output signal from the feedwater controller to maximum demand at time equal to 1 second, see Figure 2. The disturbance is applied to the feedwater controller (SAFIR) that calculates the feedwater flow to be used by BISON.

Figure 3 illustrates the behavior of the recirculation pump operation and flow characteristics during the transient. The SAFIR adjustable speed drive model calculates change in voltage and frequency to the pump model in BISON based on the control signal from the recirculation controller. BISON then calculates the associated pump speed based on the SAFIR input. BISON will also calculate a volumetric recirculation flow based on the pump speed, density of coolant and local pressure distribution in the RPV. For the FWCF example, the SAFIR recirculation flow controller model calculated the runback slope, transmitted a control signal to the adjustable speed drive which, within SAFIR, calculates a voltage and frequency to be used by BISON in order to calculate the pump speed, see Figure 3 for pumps 6 – 10 runback speed. For pumps 1 – 4 a pump trip is triggered by SAFIR and transmitted to the BISON pump model that effectuates the trip.

Figure 4 shows an increase in feedwater flow will also raise the water level and reduce the temperature of the coolant flow (sub-cooling) in the BISON RPV model. The combination of load demand error in the SAFIR pressure controller and decreasing core support plate pressure drop keeps reducing the recirculation pump speed to compensate for the power increase, calculated in BISON, due to change in sub-cooling. This continues until the narrow water range level measurement exceeds setpoint L8 and SAFIR logics order TSVs to close. The closure of the TSVs triggers a Boolean signal to reactor protection system that a scram setpoint (closure position of the TSVs) has been exceeded. The turbine model also senses the valve closure and corrects the flow through the TSVs, as shown in Figures 4 and 5. Figure 5 also shows the total steam flow through the BPVs and SRVs.

The RPS model within SAFIR generates a Boolean signal to activate the BISON control rod insertion model and the reactor power is reduced, as shown in Figure 6. The insertion time of the control rods is modeled within BISON and is not affected by the addition of SAFIR as the medium which determines a trip signal was exceeded.

Figure 7 demonstrates the steam dome pressure changes versus time during the transient.

a,c

Figure 2 Feedwater flow

a,c

[ ]

Figure 3 Relative recirculation pump speed and flow

a,c

[ ]

Figure 4 Narrow water level in the RPV

a,c

[ ]

Figure 5 Steam flow

a,c

[ ]

Figure 6 Relative reactor power and rod insertion

a,c

[ ]

Figure 7 Steam dome pressure

**RAI-18**

**QUESTION:**

Section 15.0 Subsection I.6.C of NUREG-0800 states that the reviewer should ensure "that the applicant has discussed the evaluation model used and any simplifications or approximations introduced to perform the analyses and identified digital computer codes used in the analysis. If the analysis uses more than one computer code, the applicant should describe the method used to connect the codes." SRP 15.0 I.6.C (i) also states that "(i) f the analysis uses more than one computer code, the applicant should describe the method used to connect the codes."

Westinghouse has stated in WCAP-17079-P that "SAFIR is a code package containing a selection of standard control components and logical functions that can be coupled for use with any transient code." Furthermore, "SAFIR is a stand-alone modeling tool for simulation of plant systems, including control systems, in conjunction with approved transient modeling codes such as BISON."

a) Describe the method used to connect BISON and SAFIR. In this regard, describe whether this new connection removed any previous functionality of BISON. Section 3.8 of WCAP-17079-P only describes input and output signals shared between the codes.

b) Originally BISON, along with the hot channel analysis code SLAVE, were approved for licensing of reload transients used in fuel reload analysis. Describe how SAFIR affects the hot channel analysis performed using BISON-SLAVE. Describe any input and output signals shared directly between SLAVE and SAFIR.

c) Demonstrate that the introduction of the SAFIR capability has not changed the previously approved performance capability of BISON-SLAVE (i.e., that an input to BISON-SAFIR that uses no SAFIR components performs identically to the same input to the previously approved BISON code).

d) ABWR systems will employ a variety of digital systems to monitor and actuate safety SSCs. These digital systems operate in a certain time domain or frequency. Does SAFIR operate in the time domain or frequency domain (given that transfer functions in the frequency domain are also listed in Table 3-2 of WCAP-17079-P)? Describe how the BISON-SAFIR time or frequency domain relationship is selected to replicate the performance of the real system. Describe testing performed under the Westinghouse Quality Assurance Program (WQAP) to demonstrate the appropriateness of this relationship.

e) WCAP-17079-P does not describe or document the use of SAFIR to model a safety system. However, such safety systems were modeled in previous submittals relating to BISON. For each ABWR safety system that is intended to be modeled using the newly integrated SAFIR capability, demonstrate that the chosen modeling method provides acceptable performance in BISON-SAFIR.

f) Section 7 of RPA 90-90-P-A provides a description of the transient time-step advancement algorithm of BISON. Describe how the calculations performed by SAFIR fit into this algorithm when the code is coupled with BISON.

g) Section 3.11 of RPA 90-90-P-A discusses the numerical solution procedure for steady-state calculations in BISON, while Section 3.7 of WCAP-17079-P describes SAFIR signal initialization. The concern exists that the steady-state solution prescribed to SAFIR at the start of the transient calculation may not be consistent with the actual BISON steady-state result. Describe whether and how the incorporation of SAFIR alters the numerical solution procedure for steady-state calculations in the combined BISON-SAFIR. In particular, demonstrate how consistent and correct steady-state values are obtained for the state variables shared between BISON and SAFIR.

h) The comments column to Table 3-1 of WCAP-17079-P indicates that the values of certain parameters (e.g., recirculation pump speed, feedwater temperature, etc.) cannot be set in steady-state. In light of the issues discussed in RAI18 (g), elaborate upon how the initial values for these parameters are established.

i) Section 3.9 of WCAP-17079 provides some limitations on the SAFIR sampling time (TS) size for simulated digital and analog systems:

- *For a digital control system the requirement on individual component sampling time shall be that of the real plant component.*

- *For an analog control system the sampling time shall not be longer than the transient code time step.*

Furthermore, in Table 3-1 of WCAP-17079, transient code (i.e., BISON) time step size is not explicitly listed as part of the BISON output signal set in the BISON-SAFIR interface.

i. SAFIR components may be used to model plant elements that are not control systems, whether of a digital or analog type (e.g., the mechanical model of turbine angular velocity as a function of steam flow rate, as described in the example of Section 6.1 in WCAP-17079). The excerpt quoted above does not cover how sampling time is determined for such systems. What limitations or guidelines govern SAFIR sampling time selection for such components?

ii. Describe in fuller detail how the SAFIR sampling time for digital and analog components is selected when the code is coupled with BISON. Does SAFIR obtain its sampling time from BISON, or is it input separately by the user? Do changes during a calculation in BISON's time-step size affect the SAFIR's sampling time, or vice-versa?

iii. Are the BISON time step size and SAFIR sampling time forced to be identical, or are they independent? If independent, describe how interface variable values are obtained, given that one code may demand the value of a variable at a point in problem time that is not necessarily defined by the other code (without means such as interpolation).

iv. Since the sampling time for simulated digital components (as described above) appears to be fixed by the design properties of the real components, does this place new constraints upon the BISON time step size in modeling ABWR digital systems with the combined BISON-SAFIR? If there are such new time step constraints, describe their impact upon BISON-SAFIR results and demonstrate that the results are not adversely affected as compared with a comparable calculation not using SAFIR.

v. In an algorithm for the solution of a system of time-discrete differential equations, the accuracy of the calculated results generally increases with decreasing time step size. Of the ABWR digital systems to be modeled using SAFIR, demonstrate that the real component sampling period (which, according to the above, must be identical to the SAFIR sampling time) is not so large as to significantly degrade the accuracy of the BISON-SAFIR solution as compared with a comparable calculation performed without SAFIR; or, if there is any loss of accuracy due to digital systems sampling time in SAFIR, justify the impact of this factor upon the validity of the coupled code's results.

j) If invalid values of input variables were to be passed through an interface between two codes, then, absent explicit error-checking at the interface, validity of the results could not be assured, and the fault would not necessarily be obvious from analysis of the results. (For example, if the value of an input signal obtained from BISON were to fall outside the range of an input table of a PROF component in SAFIR). Describe any input variable error-checking performed at the BISON-SAFIR interface to prevent this type of fault, or any input signal domain error checking performed in SAFIR that might render them inapplicable.

k) One of the requirements in Section 4.4.1.2 states "There is an input that determines the time constant for integration. This time constant may not be smaller than TS, or, or it will automatically be set equal to TS." This is an inappropriate assumption. The time constant for integral controller is an inherent property of the controller; therefore, arbitrary resetting this time to the integration time-step in non-physical/incorrect. Please elaborate.

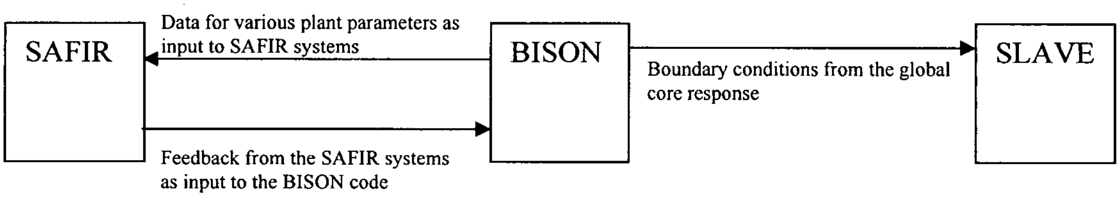
**RESPONSE:**

18 a) The connection between BISON and SAFIR does not impose any new limitations on the current functionality of BISON. The introduction of SAFIR in the BISON code extends the BISON functionality to include the modeling of advanced control system and logical systems. The BISON and SAFIR codes are compiled separately but during the BISON code installation process, SAFIR is linked together with the BISON code and a single binary executable file is created. This single executable file consists of the BISON and SAFIR code together. During run-time the connection between BISON and SAFIR is already established.

18 b) The SLAVE code is a Westinghouse method to determine transient response within a single fuel bundle. The code is typically used to predict the transient response of the hot fuel bundle and compare it to the thermal limits such as Critical Power Ratio and Linear Heat Generation Rate. The BISON code is used to simulate the global core response and consists of various types of plant systems models for simulating transients.

The hot channel analysis with SLAVE utilizes boundary conditions from the BISON determined global core response such as pressure, core pressure drop, fission power and enthalpy to determine the plant response within a single fuel bundle. The SLAVE code does not interact with SAFIR and thus no input and outputs are shared directly between SAFIR and SLAVE.

A schematic figure on how the codes interact is shown below. As can be seen in the figure, SAFIR and SLAVE do not interact directly.




18 c) SAFIR and SLAVE do not share any input or output signals directly. The SAFIR code generates the response of control systems during a transient or the initiating event itself (if it is a control system malfunction) as input to the BISON code. BISON calculates the global core response during the transient and SLAVE calculates the hot channel response using BISON global core response.

Control systems affect the core in the sense that systems feedback influences the sequence of events during the transient, but this would be the case whether the input is provided as a boundary condition or as a more flexible and robust model using SAFIR.

The parameters describing the core response such as pressure, core pressure drop, fission power and enthalpy remains unaffected by the introduction of SAFIR capabilities in the BISON context.

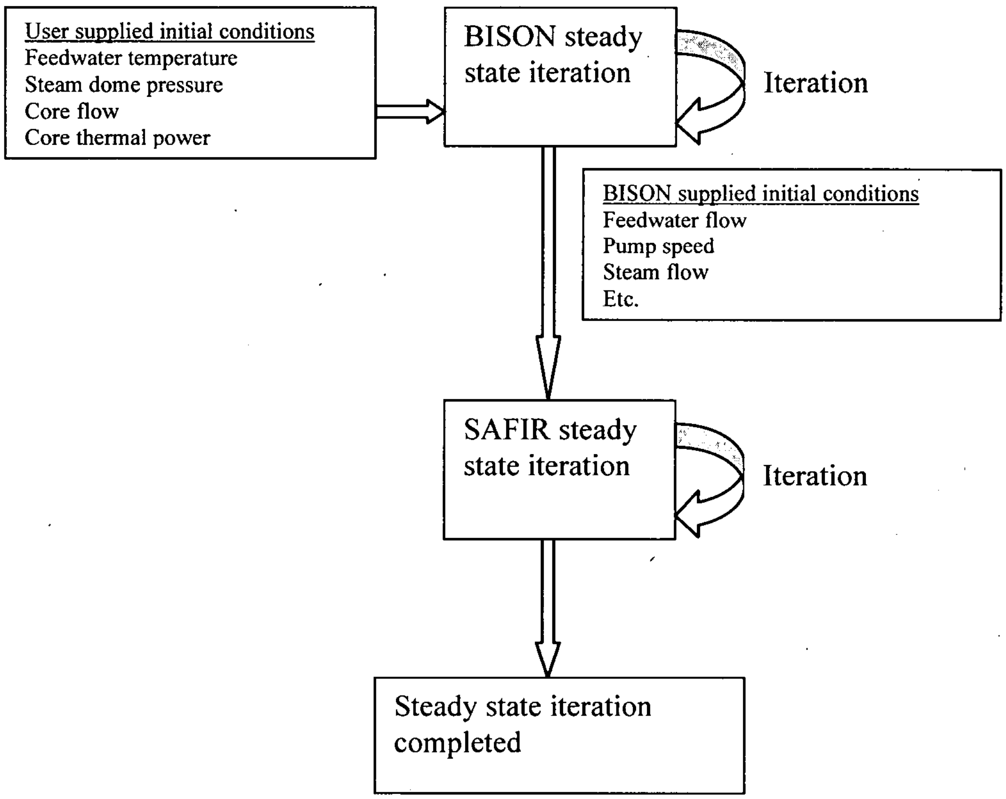
18 d) SAFIR operates only in the time domain and the implemented transforms from Table 3-2 in Supplement 3 are the discrete formulation. Laplace transformations are only provided as additional information with the intention to make it easier to recognize the desired functionality.

18 e) The introduction of SAFIR facilitates the modeling of measurement systems and trip limits that are otherwise given as input to BISON, as described in answer to RAI-20. BISON safety systems, such as the control rod insertion model, are not affected by SAFIR: see RAI-21(STP Letter # U7-C-STP-NRC-100089, Scott Head to Document Control Desk, 5/12/2010).

18 f) The BISON time-step advancement algorithm is unaffected by the introduction of SAFIR capabilities in BISON. The BISON code advances in time using the integration method as described in Section 7 of RPA 90-90-P-A. The integration scheme between BISON and SAFIR is explained in the answer to RAI-7 (STP Letter # U7-C-STP-NRC-100089, Scott Head to Document Control Desk, 5/12/2010).

18 g-h) The BISON steady state is solved using the user supplied initial conditions for feedwater temperature, reactor thermal power and steam dome pressure among other parameters. The global reactor mass balance is solved by assuming the feedwater flow equals the steam flow and by taking the initial conditions into consideration. Note that the user also has the option to supply the core inlet enthalpy as a boundary condition for the feedwater temperature. In that case, the feedwater temperature is determined by BISON by using the core inlet enthalpy and the carry-under from the steam separators. For details please refer to RPA 90-90-P-A.

The BISON steady state calculation is performed without any interaction from SAFIR. The calculation solves the global reactor mass and energy balances within BISON. After the BISON steady state iteration process is completed, the required data is transferred as input to SAFIR and SAFIR solves its own steady state using the BISON steady state parameters as boundary conditions and the user supplied initial states. The steady state process is illustrated below.




18 i)

i.)The sampling time used in modeling these types of systems is chosen so that the overall characteristic of the system is preserved, sampling times shall not be longer than the transient code time step.

ii.) Digital components are simulated by the user supplied sampling time of the real component as input to each SAFIR component. SAFIR components without an assigned sampling time will use the transient code time step size as sampling time. Simulation of analog functions may be performed either by using SAFIR components without any specified sampling time and updated at each timestep or by a sampling time shorter than the timestep specified for the transient code.

The integration scheme and the update of SAFIR components are described in the answer to RAI-7.

iii.) SAFIR uses the current state of the interface variables calculated by the transient code. To determine the values of the interface variables in between two adjacent BISON timesteps interpolation is used and the components are updated as described in the answer to RAI-7.

iv.) The use of SAFIR to generate transient boundary conditions introduces no new time step constraints upon the BISON time step size.

v.) The SAFIR code does not involve any advanced functions that restrict the time step or the sampling time due to numerical reasons. The code does not solve any equations using an iterative calculation method. The transfer functions are implemented using an explicit calculation scheme where the output is calculated using the input and the old states without iteration. Note that the code also restricts the use of time constants that are not valid for certain components. As an example, the integrator is not allowed to have an integration time constant smaller than the components sampling time. Consequently, the accuracy of the components, evaluated using time-discrete differential equations, does not depend on the real digital components sampling time.

18 j) See RAI-30. The response to RAI-30 was provided in STP Letter # U7-C-STP-NRC-100089, Scott Head to Document Control Desk, 5/12/2010.

18 k) The time constant for integration is not allowed to be smaller than the sampling time since it would be non-physical to have a integration time constant that is smaller than the update frequency of the component. Consequently, if the user supplies a time constant for the integration that is smaller than the sampling time, the SAFIR code informs the user about the discrepancy and sets the integration time constant to the minimum allowed, which is the sampling time.

**RAI-19**

**QUESTION:**

The previously approved BISON code (RPA-90-90-P-A and CENPD-292-P-A) contains the following component/system models:

- Reactor Internal Pump model,
- Steam Line model (RPA-90-90-P-A) or PARA Steam Line model (CENPD-292-P-A),
- Trip System model,
- Reactor Scram model,
- Turbine and Generator model,
- Feedwater System model, and
- Relief and Safety Valve model.

Describe which aspects of the above models are affected by the introduction of SAFIR code. Provide a summary table explaining modifications to the originally approved BISON models (similar to Table 2-1 of CENPD-292-P-A).

Where BISON-SAFIR code models for these components/systems are different from the previously approved BISON models, provide documentation of the qualification analysis, uncertainty analysis, and applicability range for the new BISON-SAFIR models, or establish that the new models yield results not significantly different from those of the approved BISON models.

**RESPONSE:**

Figure 1 of the response to RAI-15 shows a description of an ABWR model and the interaction of SAFIR with BISON. RAI-15 (Figures 3, 5 and 6) shows examples of BISON responses (recirculation pump speed, steam line flow, and control rod insertion) with SAFIR calculated boundary conditions.

SAFIR provides the boundary conditions for BISON models but does not interact with the numerical solution of any of these BISON models approved in RPA-90-90-P-A and CENPD-292-P-A. As described in RAI-15 and RAI-20, BISON calculations are done outside of SAFIR. Start and stop signals may also be generated by SAFIR and transmitted to BISON. Again BISON approved models will not be changed from the originally approved documents and are not affected by the introduction of SAFIR.

**RAI-20**

**QUESTION:**

The existing reactor protection system in the BISON code provides for modeling of reactor trip due to:

- High neutron flux,
- High steam dome pressure,
- Low core flow rate,
- High or low reactor water level, and
- Low reactor pressure.

Identify and describe the input models for any of these trips that may be modeled using the new SAFIR capability of the BISON-SAFIR code. Include a description of the signals at the BISON-SAFIR interface that are used in modeling these trips.

**RESPONSE:**

Figure 1 below shows the process by which BISON interfaces with SAFIR to model a reactor trip. This is an example intended to describe the process, but the information that is passed from BISON to SAFIR is dependant on the situation. The first box is BISON's input to the SAFIR Measurement & Detection model. Statepoints calculated in BISON for each time step are sent to SAFIR. In this example the SAFIR model is composed of a measurement, comparator, and delay components. The addition of a logic component is optional in SAFIR, and is dependent on the situation. The output from the Measurment & Detection model goes to the Reactor Protection System (RPS) model in SAFIR. The RPS model in SAFIR determines if a setpoint has been exceeded, and will provide input of either scram or no scram to BISON. This is done at each time step for BISON.

The process would not change the transient analysis performed by BISON and thus not impact any safety analysis results calculated within BISON. SAFIR would act as a logical component to determine if plant conditions exceed any boundary conditions which would trigger a reactor scram and communicate those results to BISON.

Figure 6 from RAI-15 shows the BISON control rod model response to a scram signal generated by SAFIR.

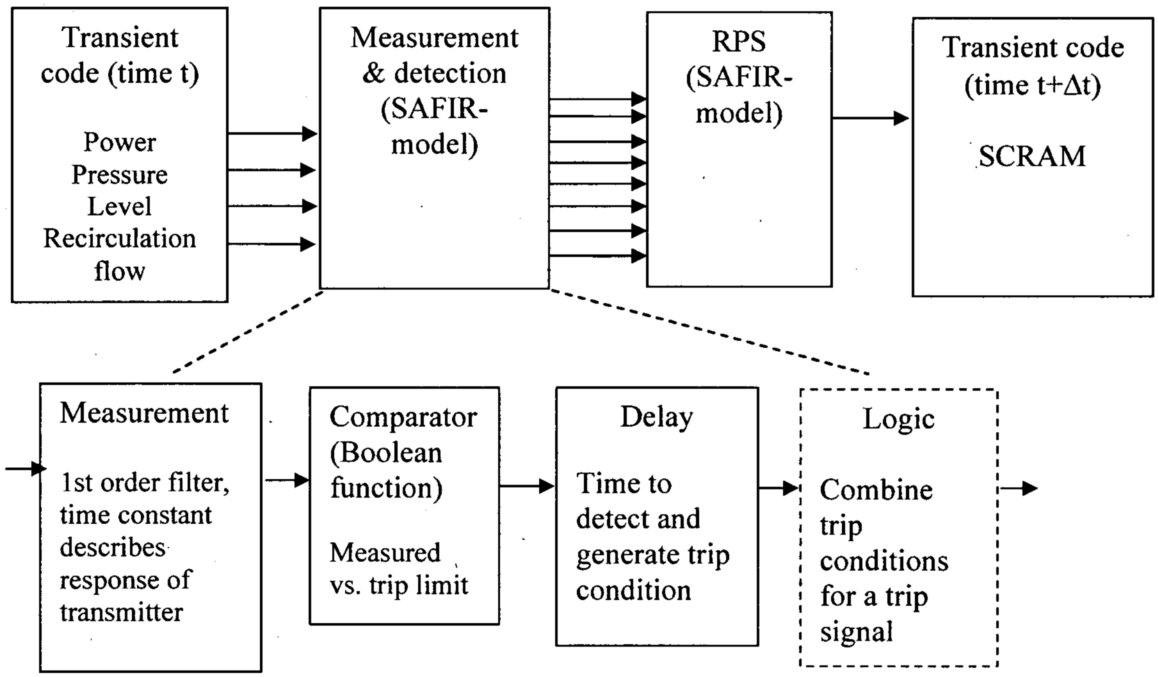



Figure 9 Signal flow during a BISON time step for trip detection

**RAI-22**

**QUESTION:**

With reference to the response to RAI-15 regarding accident events to be analyzed using BISON-SAFIR:

a) Describe the uncertainty bounds of individual physical models determined by testing to satisfy NUREG-0800 Section 15.0.2 Subsection II.4.

b) Describe the integral effects testing and demonstrate that the interactions between different physical phenomena and reactor coolant system components and subsystems modeled in BISON-SAFIR are identified and predicted correctly, in order to satisfy NUREG-0800 Section 15.0.2 Subsection II.4.

c) Describe the separate effects testing for input models of individual systems modeled for ABWR, or other equivalent testing to determine that there are no compensating errors in the integral effects testing ((b), above).

**RESPONSE:**

The control system modeling required for an application and the uncertainty bounds associated with the model will be determined in connection with a plant-specific License Amendment Request in accordance with the methodology described in the Reference Safety Report (RSR per CENPD-300-P-A). See the answers to RAI-16 and RAI-45. The response to RAI-45 was submitted in STP Letter # U7-C-STP-NRC-100089, Scott Head to DCD, 5/12/2010.

The basis for the SAFIR models will be provided in the appropriate site specific document.

CAW-10-2848

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared B. F. Maurer 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 Company LLC (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:

B. F. Maurer, Manager
ABWR Licensing

Sworn to and subscribed before me
this 4th day of June 2010

Renee' Giampole
Notary Public

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Renee Giampole, Notary Public
Penn Township, Westmoreland County
My Commission Expires September 25, 2013

(1) I am Manager, ABWR Licensing, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), 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 rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse 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 2.390 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 that 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 10 CFR Section 2.390, 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) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in, "Additional Responses to NRC Request for Additional Information for WCAP-17079, Revision 1, 'Supplement 3 to BISON Topical Report RPA 90-90-P-A SAFIR Control System Simulator'" (Proprietary) for submittal to the Commission, being transmitted by South Texas Project Nuclear Operating Company (STPNOC) letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with the NRC review of WCAP-17079, Revision 1.

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

(a) Assist customers in obtaining NRC review of the Westinghouse control system modeling topcial as applied to current BWR and ABWR plant designs.

Further this information has substantial commercial value as follows:

(a) Assist customer to obtain license changes.

(b) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

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 fuel design 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.

Further the deponent sayeth not.

**PROPRIETARY INFORMATION NOTICE**

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

**COPYRIGHT NOTICE**

The reports transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.390 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.