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November 29, 1988

Re: Indian Point Unit No. 2
Docket No. 50-247

Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, DC 20555

SUBJECT: Response to Request for Additional Information Regarding Reactor Coolant Pump Trip Criteria (TAC 49672)

Regarding your October 14, 1986 Request for Additional Information on our response to NRC Generic Letter no. 85-12, attached is our response to the request for additional information regarding Indian Point Unit No. 2 reactor coolant pump trip criteria.

As described in our October 18, 1988 Subcooling Margin Monitor submittal (TAC 45141) and detailed in the attached response, Consolidated Edison has chosen to adopt reactor coolant system (RCS) subcooling margin as its reactor coolant pump trip criteria, taking advantage of our recent core exit thermocouple modification and its ability to display RCS subcooling. As such, the attached responses address the change in RCP trip criteria where appropiate.

If there are any questions regarding this submittal, please contact Mr. Jude Del Percio, Manager, Regulatory Affairs.

Very truly yours,

Stephen B. Bram

cc: Mr. William Russell
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A. Determination of RCP Trip Criteria

Demonstrate and justify that proposed RCP-trip setpoints are adequate for small-break LOCAs but will not cause RCP trip for other non-LOCA transients and accidents such as SGTRs. This is to include performance of safety analyses to prove the adequacy of the setpoints.

Consider using partial or staggered RCP-trip schemes.

Staff Evaluation. The licensee has selected low RCS pressure as the criterion for manual RCP trip. No information is presented regarding this selection as contrasted to alternate RCP trip criteria, with the exception that all three of the WOG trip criteria are usable at Indian Point, and the simplest of the three was selected on the basis of human factors engineering. Such information should be provided. This is particularly important in light of the difficulty associated with the inadequacy of the selected criterion.

Response.

Regarding selection of a plant-specific RCP trip parameter for IP-2, since all three alternate RCP trip parameters are essentially equally effective in providing timely indication of the need for RCP trip for a small break LOCA, the parameter selected was based on the capability to prevent RCP trip for SGTRs and NON-LOCAs and the ease with which the operator is able to obtain the necessary information.

Modifications are planned to the IP-2 Core Exit Thermocouple system (CETS) that will enhance its ability to provide qualified redundant indication for operator use and upgrade its ability to indicate RCS subcooling. Because of these planned Modifications, subcooling was selected as the criteria which will guide operators in performing manual trips of the RCP's.

The upgraded CETS will display subcooling on redundant indicators mounted on the Unit 2 control board as well as on the Accident Assessment Panel in the Central Control Room. The monitor will use qualified redundant RCS pressure inputs and core exit temperatures and calculate a subcooling value for display to the operator.

The use of RCS and Steam Generator delta pressure would require the use of two parameters and a calculation, whereas subcooling relies on a single parameter. The use of RCS pressure as the RCP trip criteria although acceptable based on our evaluation, is viewed as marginal by the NRC and is considered second to subcooling as the criteria for use by the operator.

The use of subcooling as the RCP trip criteria is also consistent with its use in the Emergency Operating Procedures (EOPs) for other than RCP trip decision points and will limit the number of different parameters used by the operator in the performance of EOP steps and evaluations, thus reducing the potential for confusion or error.

A1. Identify the instrumentation to be used to determine the RCP trip set point, including the degree of redundancy of each parameter signal needed for the criterion chosen. Establish the quality level for the instrumentation, identify the basis for the sensing instruments' design features, and identify the basis for the degree of redundancy.

Staff Evaluation. RCS pressure is provided by independent and environmentally qualified wide range pressure transmitters PT-402 and PT-403. One of these does not record full range, but this one is to be replaced to meet the required range as part of the Indian Point NUREG-0737 upgrade program.

The staff requests to be advised of the date at which the upgrade will be accomplished.

Response.

Presently both RCS pressure recorders meet the range required by the Indian Point NUREG-0737 upgrade program. RCS pressure instrument PT402 recorder was upgraded during the 1987 refueling outage and is now operable.

A2. Identify the instrumentation uncertainties for both normal and adverse containment conditions. Describe the basis for the selection of the adverse containment parameters. Address, as appropriate, local conditions, such as fluid jets or pipe whip, which might influence instrumentation reliability.

Staff Evaluation. Instrument uncertainty is provided as 90 psi (3% of span) for normal containment conditions and 390 psi (13% of span) for adverse containment conditions. The determination methodology is identified as the WOG ERGs (Emergency Response Guidelines), Rev. 1.

An adverse containment is identified as one in which containment pressure exceeds 4 psig or in which radiation level exceeds 10^5 R/hr.

RCS pressure transmitters are identified as inside containment, but outside of the crane wall so that they are not influenced by jet impingement and pipe whip.

Potential interaction of jet impingement and/or pipe whip with connections between the RCS and the transmitters or between the transmitters and the control room indicators are not mentioned. These should be briefly addressed.

Response.

The subcooling margin setpoints for manual RCP trip are as follows:

Normal containment Conditions	30° subcooled
Adverse Containment Conditions ($> 10^5$ R/hr or 4 psig)	182° subcooled

The adverse containment parameters ($> 10^5$ R/hr and 4 psig) are based on conditions in containment below which the effects of the environment on instrument uncertainty are negligible in determining overall instrument uncertainties. Due to the physical location and redundancy of both the RCS pressure and incore temperature instruments, conditions caused by pipe whip or fluid jets are not expected to have an adverse affect on the available indication of subcooling.

RCS pressure instrument connections between the RCS and the pressure transmitter are installed on RCS loops on opposite sides of the reactor vessel, run in directions 180° from each other and connect to the pressure instruments outside the crane wall. They penetrate the containment via two independent penetrations and enter two separate cable runs prior to entering the central control room (CCR). In the CCR the instrumentation is housed in independent cabinets located behind the CCR flight panel.

A3. In addressing criterion selection, provide consideration of uncertainties associated with the WOG supplied analyses values. These uncertainties are to include uncertainties in computer program results and uncertainties resulting from plant specific features not representative of the generic data group.

If a licensee or applicant determines that the WOG alternative criteria are marginal for preventing unneeded RCP trip, it is recommended that a more discriminating plant-specific procedure be developed. Licensees or applicants should take credit for all equipment (instrumentation) available to the operators for which the licensee or applicant has sufficient confidence that it will be operable during the expected conditions.

Staff Evaluation. Generic analyses with the licensed Westinghouse LOFTRAN computer code are referenced as the analysis basis for Indian Point behavior under non-LOCA conditions.

The computer program result uncertainties evaluation is based on the assumption of no changes in initial plant conditions (such as full power, pressurizer level, all Safety Injection (SI) pumps running, and all Auxiliary Feed Water (AFW) pumps running). The major contributors to uncertainty are stated to be break flow rate, SI flow rate, decay heat generation rate, and AFW flow rate. Parameteric studies are summarized in which the major uncertainties are stated to be due to the break flow model and SI flow inputs. The calculated overall uncertainty in the analyses is stated to be +20 to +100 psi.

The licensee reports "a minimum RCS pressure of 1190 psia was calculated for IP-2 using the LOFTRAN model without the improved break flow model. Applying the results of the Westinghouse uncertainty assessment described above, the expected minimum RCS pressure could be approximately 100 psi higher. Internal Con Edison calculations confirm this and, in fact, calculate a minimum RCS pressure of 1315 psia with an improved break flow model...our manual RCP trip setpoint is 1250 psig. When comparing this value with the expected minimum value of 1300 psig (1315 psia), the RCPs are not expected to be tripped using the low RCS pressure criterion at IP-2.

The staff does not understand this reasoning. The expected minimum RCS pressure could as easily be +20 psi as +100 psi if no other information were available. A further difficulty is that the calculational uncertainty is smaller than for many plants. Finally, the staff is not familiar with the calculations referenced in support of using a value at the high end of the uncertainty band. Staff assessment with the information available to the staff at this time is that the licensee selection does not meet the intent of Reference 1.

The WOG calculations are generic. The staff requires a statement concerning applicability to Indian Point Unit 2, including whether there are any plant specific differences that influence the results and, if so, an evaluation of the differences. Differences should be reflected in the uncertainty assigned to the calculations.

The licensee has not directly addressed such topics as the accuracy of the numerical solution scheme or of nodalization. Further, there is no determination of the influence of equipment or operational failures. Information pertinent to the former result from comparisons of the LOFTRAN code to operational and experimental data, and as a result should have been included in the uncertainty number. Determination of equipment or operational failures is not a necessity as long as the expected configuration of the plant is addressed since the objective of RCP trip is to provide reasonable assurance of not tripping for transients for which a trip is undesirable. It is not necessary to establish that one will never trip unnecessarily since the plant is capable of being safety controlled if an unnecessary trip does occur. Thus, the licensee submittal is adequate with respect to these items.

Response.

The Westinghouse LOFTRAN computer code was used to perform the alternate RCP trip criteria analyses. Both Steam Generator Tube Rupture (SGTR) and non-LOCA events were simulated in these analyses. LOFTRAN is a Westinghouse licensed code used for FSAR SGTR and non-LOCA analyses. The code has been validated against the January 1982 SGTR event at the Ginna plant. The results of this validation show that LOFTRAN can accurately preduct RCS pressure, RCS temperature and secondary pressures. The major source of uncertainity in the computer program results are due either to the models or the inputs to the LOFTRAN code, assuming the following initial plant conditions remain unchanged:

- 100% Power
- Best estimate RCS flow
- Best estimate SI flow
- Total AFW flow
- Best estimate decay heat
- Best estimate reactivity coeffecients
- Steam dumps operable.

The following are considered to have the most impact on the determination of the RCP trip criteria:

1. Break flow
2. SI flow
3. Decay heat
4. Auxiliary feedwater flow

Those inputs having the most effect on program conservatisms are discussed below:

a. Break Flow: The break flow model used in LOFTRAN is 30% more conservative than realistic break flow calculations validated against the Ginna SGTR. Consequently break flows used in the plant models are much higher than can be expected for double ended tube ruptures for actual plant configuration.

b. SI Flow: The SI flows inputs used represent best estimates based on all SI trains operating. a review of the calculational methodology shows that variations in these inputs for plant types evaluated have a maximum uncertainty range of -10% to +10%.

c. Decay Heat: The decay heat model used is based on the 1971 ANS 5.1 standard. This results in a 5% higher decay heat value when compared to the more recent 1979 ANS 5.1 standard. A sensitivity study for the SGTR analysis showed that a 20% decrease resulted in only 1% decrease in RCS pressure values for the first 10 minutes of the transient. RCS temperature is not affected by decay heat uncertainty since it is assumed that steam dumps are available for temperature control.

d. AFW Flow: This input is based on all AFW pumps actuating with minimum start delay and no throttling. Sensitivity studies show that SGTR analysis results are relatively unaffected by changes in AFW flow.

The effects of all these uncertainties with the models and input parameters were evaluated and it was concluded that the contributions from the break flow conservatism and the SI uncertainty dominate. The calculated overall uncertainty in the WOG analyses as a result of these considerations for IP-2 is +2 to +10°F for the minimum RCS subcooling RCP trip setpoint. Due to the minimal effects from the decay heat model and AFW input, these results include only the effects of the uncertainties due to the break flow model and SI flow inputs.

As part of the WOG Evaluation of Alternate RCP Trip Criteria, a minimum RCS subcooling of 31°F was calculated for IP-2 using the LOFTRAN model. Applying the results of the Westinghouse uncertainty assessment described above, the expected minimum RCS subcooling could be 33°F to 41°F.

For normal containment conditions, as would be expected for a design basis SGTR, our EOP manual RCP trip setpoint would be 26°F. However, in the unlikely event of the failure of the subcooling monitor the operator would be required to calculate a subcooling margin utilizing the same RCS temperatures and pressures that input the subcooling monitor and a steam table. The use of steam tables introduces potential error and is accounted for in the selected subcooling trip setpoint of 30°F as indicated in the below table.

SGTR / NON-LOCA
SUBCOOLING TRIP SETPOINT

Containment	Normal	Adverse
Subcooling Monitor	26°F	167°F
Steam Table	30°F	182°F

The use of the steam table values in the implementation of EOP's takes into account the unlikely event of a failure of the subcooling margin monitor and still meets the discrimination criteria for LOCA conditions.

B. Potential Reactor Coolant Pump Problems

B1. Assure that containment isolation, including inadvertent isolation, will not cause problems if it occurs for non-LOCA transients and accidents. Demonstrate that, if water services needed for RCP operations are terminated, they can be restored fast enough once a non-LOCA situation is confirmed to prevent seal damage or failure. Confirm that containment isolation with continued pump operation will not lead to seal or pump damage or failure.

Staff Evaluation. The licensee reports that containment isolation initiates on either a Phase A or a Phase B signal. (This is typical of Westinghouse provided nuclear power systems.) Phase A is stated to isolate only nonessential process lines, and there is no isolation pertinent to RCP seals. Phase B causes isolation of Component Cooling Water (CCW) for RCP thermal barrier and motor lube oil cooling and isolation of the Chemical Volume and Control System (CVCS) seal return line. The CVCS injection supply lines remain open.

RCP operation is stated to be permitted for up to two minutes in the absence of all RCP seal cooling before RCP trip is required. The time limit is stated to be intended to preclude subsequent seal or pump damage or failure. The licensee then continues with "Since CVCS seal injection lines remain in service, seal damage is even more remote." This is confusing since the staff normally considers seal cooling to be provided by seal injection and/or thermal barrier cooling. Please clarify. Is operation terminated within two minutes of loss of thermal barrier cooling or loss of both seal injection and thermal barrier cooling?

The licensee mentions that if there is a prolonged loss of seal cooling with the RCPs tripped, the Emergency Operating Procedures provide steps which reestablish component cooling and seal injection in a controlled manner to prevent thermal shock and potential pump or seal damage.

Isolation of seal return on Phase B rather than Phase A is unusual. Please confirm this operation and, if correct, provide the reasoning which supports this selection. In addition, please confirm that there is no influence of containment isolation on operation of other equipment, such as charging pumps, that has a significant effect on RCP seal injection.

Response.

In the event of a phase A containment isolation resulting from either manual or automatic actuation signal, "non-essential" process lines penetrating the containment will be shut off. Water services to the RCP's are considered essential and therefore not isolated. For a SGTR and the majority of events requiring phase A isolation actuation where RCP operation is desired, services to the RCP are continued.

Actuation of a containment phase B isolation, from either a manual or automatic signal, results in isolation of component cooling to the RCP's. RCP seal water supply is manually controlled and would continue to be provided by operating charging pumps as required by Indian Point EOPs. Component Cooling Water (CCW) supply to RCP thermal barrier and upper and lower bearing oil reservoirs is secured on Phase B isolations in which case the operator is instructed to secure RCP's within two minutes or a high bearing temperature condition.

Isolation of the RCP seal return valve on Phase B rather than phase A is due to a need to provide a seal water return path, and thus ensures sufficient flow through the No. 1 RCP seal to allow continued operation if necessary and feasible. The ability of the charging system to provide seal injection is maintained during phase A and phase B isolation conditions making the potential for seal damage remote. The charging pumps are operated in accordance with guidance provided in the EOP's. The seal supply system is manually controlled and not affected by the automatic isolation signals.

B2. Identify the components required to trip the RCPs, including relays, power supplies and breakers. Assure that RCP trip, when necessary, will occur. Exclude extended RCP operation in a voided system where pump head is more than 10% degraded unless analyses or tests can justify pump and pump-seal integrity when operating in voided systems. If necessary, as a result of the location of any critical component, include the effects of adverse containment conditions on RCP trip reliability. Describe the basis for the adverse containment parameters selected.

Staff Evaluation. Location of the RCP control switches in the control room is described. The licensee also states that the RCP trip components are located outside containment and are not influenced by adverse containment conditions. The staff request that information be provided pertinent to actions if the RCPs do not trip when the operator actuates the referenced controls in the control room. The staff also requests that the licensee provide information pertinent to whether high energy line breaks outside containment can have an adverse effect on the RCP trip breakers or connected wiring.

Response.

The Central Control Room (CCR) is located in the control building adjacent to the turbine building. The CCR is a completely controlled environment and is not subject to adverse affects from high energy line breaks. The RCP circuit breakers are located three levels directly below the CCR on the south end of the turbine building at the opposite end of the building from the main steam lines. The location of the RCP breakers and the large volume available in the turbine building would result in minimal increase in temperature and pressure in the area of concern. The RCP's can be secured by remote operation of their associated circuit breakers and can also be secured by opening their associated 6.9KV bus supply circuit breaker operated from the CCR. This operation will de-energize the line side of the RCP breaker and secure the RCP with its associated supply breaker still closed. Both the RCP breaker and the 6.9KV Bus supply breakers can be locally operated in the unlikely event that both breakers fail to open remotely.

C. Operator training and Procedures (RCP trip)

C1. Describe the operator training program for RCP trip. Include the general philosophy regarding the need to trip pumps versus the desire to keep pumps running. Also cover priorities for actions after engineered safety features actuation.

Assure that training and procedures provide direction for use of individual steam generators with and without operating RCPs.

Assume manual RCP trip does not occur earlier than two minutes after the RCP-trip set point is reached.

Determine the time available to the operator to trip the RCPs for the limiting cases if manual RCP trip is proposed. Best Estimate calculational procedures should be used. Most probable plant conditions should be identified and justified by the licensee, although NRC will accept conservative estimates in the absence of justifiable most probable conditions.

Justify that the time available to trip the RCPs is acceptable if it is less than the Draft ANSI Standard N660. If this is the case, then address the consequences if RCP trip is delayed. Also develop contingency procedures and make them available for the operator to use in case the RCPs are not tripped in the preferred time frame.

Staff Evaluation. The licensee has provided an overview of operator training and the topics that are covered. Reference is also made to coverage of the philosophy behind the need to trip as contrasted to the desire to keep the pumps running. The only question the staff has pertinent to this topic is "What are the specifics of this philosophy at Indian Point?"

A topic that is not discussed is what situations may exist in which the operators are instructed to operate RCPs in apparent violation of the trip criterion, or what operator action would be followed if a mistake were made and RCPs were left running when they should have been tripped. The staff requests that the licensee address these items.

Response.

Prior to the development of the WOG ERG's there was latitude that would permit operator discretion in the operation of RCP's during event conditions. Following the development of the WOG ERG's and the associated RCP trip criteria, the operator was provided with specific symptoms that are used in determining the need for RCP trip under circumstances that do not require the operator to know the exact nature of the event. The operator is instructed to perform the actions stated in the EOP's and is provided with the basis and background of the steps in the context of the procedure being performed in order that he may knowledgably perform procedure evaluations.

If a procedure step is missed, the EOP's provide additional support in the form of Function Restoration Procedures (FRP's) which the operator is required to perform on a higher priority than the EOP, Optimal Recovery Procedures (ORP's). A missed RCP trip would be identified by EOP foldout pages and/or status trees and address the situation by use of a FRP associated with loss of core cooling and guide the operator in the response to this condition.