TERA

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

October 22, 1979

Docket No. 50-336

Mr. W. G. Counsil, Vice-President
Nuclear Engineering & Operations
Northeast Nuclear Energy Company
P. O. Box 270
Hartford, Connecticut 06101

Dear Mr. Counsil:

SUBJECT: NRC REQUIREMENTS FOR AUXILIARY FEEDWATER SYSTEMS AT MILLSTONE NUCLEAR POWER STATION UNIT 2

The purpose of this letter is to advise you of our requirements for the auxiliary feedwater systems at the subject facility. These requirements were identified during the course of the NRR Bulletins and Orders Task Force review of operating reactors in light of the accident at Three Mile Island, Unit 2.

Enclosure 1 to this letter identifies each of the requirements applicable to the subject facility. These requirements are of two types, (1) generic requirements applicable to most Combustion Engineering-designed operating plants, and (2) plant-specific requirements applicable only to the subject facility. Enclosure 2 contains a generic request for additional information regarding auxiliary feedwater system flow requirements.

The designs and procedures of the subject facility should be evaluated against the applicable requirements specified in Enclosure 1 to determine the degree to which the facility currently conforms to these requirements. The results of this evaluation and an associated schedule and commitment for implementation of required changes or actions should be provided for NRC staff review within thirty days of receipt of this letter. Also, this schedule should indicate your date for submittal of information such as design changes, procedure changes or Technical Specification changes to be provided for staff review. You may also provide your response to the items in Enclosure 2 at that time.

In addition to the requirements identified in this letter, other requirements which may be applicable to the subject facility are expected to be generated by the Bulletins and Orders Task Force. Such requirements are those resulting from our review of the loss-of-feedwater event and the small break loss-of-coolant accident as described in the Combustion Engineering report CEN-114-P (Amendment 1-P)

1257 283

7911020 060

P

entitled, "Review of Small Break Transients in Combustion Engineering Nuclear Steam Supply Systems." Our specific concerns include systems reliability (other than the auxiliary feedwater system), analyses, guidelines and procedures for operators, and operator training.

We plan to identify, in separate correspondence, the requirements resulting from the additional items from the Bulletins and Orders Task Force review.

Sincerely,

Robert F Jackson/for

Darrell G. Eisenhut, Acting Director
Division of Operating Reactors
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc w/enclosures:
See next page

Northeast Nuclear Energy Company

cc:
William H. Cuddy, Esquire
Day, Berry & Howard
Counselors at Law
One Constitution Plaza
Hartford, Connecticut 06103

Waterford Public Library
Rope Ferry Road, Route 156
Waterford, Connecticut 06385

Northeast Nuclear Energy Company
ATTN: Superintendent
Millstone Plant
Post Office Box 128
Waterford, Connecticut 06385

Northeast Utilities Service Company
ATTN: Mr. James R. Himmelwright
Nuclear Engineering and Operations
P. O. Box 270
Hartford, Connecticut 06101

Anthony Z. Roisman, Esq.
Natural Resources Defense Council
917 15th Street, N.W.
Washington, D.C. 20005

Mr. John T. Shedlosky
Nuclear Regulatory Commission, Region I
Office of Inspection and Enforcement
631 Park Avenue
King of Prussia, Pennsylvania 19406

ENCLOSURE 1

X.5 (CE) MILLSTONE 2

AUXILIARY FEEDWATER SYSTEM

X.5.1 System Description

X.5.1.1 Configuration and Overall Design

The auxiliary feedwater system (AFWS) is designed to supply water to the steam generators (SG) for reactor coolant system decay heat removal when the main feedwater system is not available. It is also used for plant startups and shutdowns below the power level where the main feedwater system is not required.

The AFWS is shown in simplified form on Figure 1. The system consists of a steam turbine-driven pump having a 600 gpm capacity, and two motor-driven pumps each having a 300 gpm capacity. The steam supply to the turbine is obtained from a common line connected to lines coming from each of two steam generators. The AFWS is normally aligned as indicated on Figure 1, the motor-driven pumps supplying No. 1 SG and the turbine driven pump supplying No. 2 SG.

A condensate storage tank (CST) of 250,000 gallons capacity is the primary source of water for the AFWS, and the primary water storage tank (PWST) of 150,000 gallons capacity is the secondary source. Another back-up source consists of two 250,000 gallon fire storage water tanks. In addition, a connection to the city water supply exists which can be used to provide AFW for an extended period of time, if required.

The AFWS is manually actuated from the control room. The pumps and appropriate valves can be controlled from the control room and from the remote shutdown panel.

X.5.1.2 Component Design Classification

The pumps, motors and piping associated with the AFWS are designed to seismic Category I requirements. The CST is not designed to seismic Category I requirements; however, a seismic Category I missile barrier surrounds the CST. This barrier will contain the water in the event of a CST tank failure.

X.5.1.3 Power Sources

The motor-driven pumps are supplied from separate Class 1E emergency buses. All motor operated valves (MOVs) associated with the AFWS are powered from the 480V AC emergency buses and fail as-is.

Steam generator level instrumentation, AFWS pump breaker and valve controls are powered from their associated Class 1E emergency buses. Although the AFWS instruments and associated wiring are not Class 1E, they are powered from Class 1E emergency buses.

The steam for the turbine-driven pump is received from the main steam system via a series of valves as shown in Figure 1. Steam is introduced to the turbine via a normally closed motor operated steam admission valve, and steam flow is regulated by a turbine throttle valve in series with the admission valve.

X.5.1.4 Instrumentation and Control

X.5.1.4.1 Controls

The AFWS can be controlled from either of two control stations, one at the main control room;the other at the remote shutdown panel.

X.5.1.4.2 Information Available to the Operator

The following indications are available, except as indicated, at both control stations:

1. SG level
2. Pump turbine RPM (control room only)
3. Pump motor current (control room only)
4. MOV valve positions
5. Pump motor breaker position
6. CST level
7. PWST level (control room only)
8. Auxiliary feed flow
9. Pump discharge pressure

The following alarms annunciate at both control stations:

1. CST low level
2. SG low level

X.5.1.4.3 Initiating Signals for Automatic Operation

Not applicable since AFW is manually initiated.

X.5.1.5 Testing

The systems are tested monthly in accordance with plant Technical Specification requirements. In addition to the periodic testing, the systems are retested in the recirculation mode in accordance with the surveillance tests subsequent to performing maintenance.

The systems are tested using the recirculating lines, at which time discharge pressures and pump motor currents are monitored. In addition, valve positions are verified monthly.

The licensee uses the system routinely during startup and shutdown thus verifying valve positions.

X.5.1.6 Technical Specifications

The Limiting Condition For Operation (LCO) for the system is 48 hours upon a failure of one of the AFWS trains (e.g., a pump motor failure). If the affected AFWS train is not restored within 48 hours, the unit must be brought to a hot shutdown in the next 12 hours.

A review of the Technical Specifications indicated that these specifications cover LCOs and periodic surveillance testing consistent with current Standard Technical Specifications.

X.5.2 Reliability Evaluation Results

X.5.2.1 Dominant Failure Modes

Failure modes of the AFWS were assessed for three loss of main feedwater initiating events. The dominant failure modes for each transient type are discussed below.

- Loss of Main Feedwater (LOFW) with Offsite Power Available

The dominant failure mode of the AFWS for this transient is failure of the operator to manually actuate the system. Upon the loss of main feedwater, the licensee estimates that the operator has 15 to 45 minutes, depending on the initiating transient, to actuate the AFWS before the steam generators would boil dry. Because of this time restriction, failure to perform the required actuation prior to boiling the SG dry has been assessed to be the dominant failure mode for this transient.

- LOFW With Only Onsite AC Power Available

This transient is very similar to the transient discussed above, except that the offsite AC power system is not available. Additional failure modes related to the onsite AC power system were considered; however, these did not have a significant impact on the dominant failure mode. As such, the dominant failure mode discussed above (i.e., failure of the operator to actuate the AFWS) is also dominant for this transient.

LOFW with Only DC Power Available

For this event no AC power (onsite or offsite) is available; therefore, the AFWS is reduced to the steam-driven pump train. Failures which can fail this train include hardware failures of the pump or valves, maintenance outages, and human errors.

The dominant failure mode for this event is failure of the operator to manually open two normally closed valves (the steam admission valve and the AFW discharge valve) in the turbine-driven train within the aforementioned 15 to 45 minutes after the demand. The valves are AC motor-operated and are normally powered from offsite power or from the diesel-generators on loss of offsite AC power. Since neither of these power sources is available during this event, local manual opening of the valves is required.

X.5.2.2 Principal Dependencies

The most significant dependency found in this evaluation is the dependence on operator action to actuate the AFWS on demand.

The second significant dependency found is the dependence on AC power to actuate certain portions of the steam-driven pump train of the AFWS. This dependency is the dominant contributor to AFWS unavailability upon the total loss of AC power.

Location dependencies, such as component proximity to high energy lines, were considered but do not appear to be significant.

X.5.3 Recommendations

The short-term recommendations (both generic, denoted by GS, and plant-specific) identified in this section represent actions to improve AFW system availability that should be implemented by January 1, 1980, or as soon thereafter as is practicable. In general, they involve upgrading of Technical Specifications or establishing procedures to avoid or mitigate potential system or operator failures. The long-term recommendations (both generic, denoted by GL, and plant-specific) identified in this section involve system design evaluations and/or modifications to improve AFW system reliability and represent actions that should be implemented by January 1, 1981, or as soon thereafter as is practicable.

X.5.3.1 Short-Term

1. Recommendation GS-4 - Emergency procedures for transferring to alternate sources of AFW supply should be available to the plant operators. These procedures should include criteria to inform the operator when, and in what order, the transfer to alternate water sources should take place. The following cases should be covered by the procedures:

   - The case in which the primary water supply is not initially available. The procedures for this case should include any operator actions required to protect the AFW system pumps against self-damage before water flow is initiated; and,

- The case in which the primary water supply is being depleted. The procedure for this case should provide for transfer to the alternate water sources prior to draining of the primary water supply.

2. Recommendation GS-5 - The plant should be capable of providing the required AFW flow for at least two hours from one AFW pump train independent of any alternating current power source. If manual AFW system initiation or flow control is required following a complete loss of alternating current power, emergency procedures should be established for manually initiating and controlling the system under these conditions. Since the water for cooling of the lube oil for the turbine-driven pump bearings may be dependent on alternating current power, design or procedural changes shall be made to eliminate this dependency as soon as practicable. Until this is done, the emergency procedures should provide for an individual to be stationed at the turbine-driven pump in the event of the loss of all alternating current power to monitor pump bearing and/or lube oil temperatures. If necessary, this operator would operate the turbine-driven pump in an on-off mode until alternating current power is restored. Adequate lighting powered by direct current power sources and communications at local stations should also be provided if manual initiation and control of the AFW system is needed. (See Recommendation GL-3 for the longer-term resolution of this concern.)

3. Recommendation GS-6 - The licensee should confirm flow path availability of an AFW system flow train that has been out of service to perform periodic testing or maintenance as follows:

   - Procedures should be implemented to require an operator to determine that the AFW system valves are properly aligned and a second operator to independently verify that the valves are properly aligned.
   - The licensee should propose Technical Specifications to assure that prior to plant startup following an extended cold shutdown, a flow test would be performed to verify the normal flow path from the primary AFW system water source to the steam generators. The flow test should be conducted with AFW system valves in their normal alignment.

4. Recommendation GS-8 - The licensee should install a system to automatically initiate AFW system flow. For the short-term, this system need not be safety-grade; however, it should meet the criteria listed below, which are similar to Item 2.1.7a of NUREG-0578. For the longer term, the automatic initiation signals and circuits should be upgraded to meet safety-grade requirements as indicated in Recommendation GL-1.

   - The design should provide for the automatic initiation of the auxiliary feedwater system flow.
   - The automatic initiation signals and circuits should be designed so that a single failure will not result in the loss of auxiliary feedwater system function.

- Testability of the initiating signals and circuits should be a feature of the design.
- The initiating signals and circuits should be powered from the emergency buses.
- Manual capability to intiate the auxiliary feedwater system from the control room should be retained and should be implemented so that a single failure in the manual circuits will not result in the loss of system function.
- The alternating current motor-driven pumps and valves in the auxiliary feedwater system should be included in the automatic actuation (simultaneous and/or sequential) of the loads to the emergency buses.
- The automatic initiation signals and circuits should be designed so that their failure will not result in the loss of manual capability to intiate the AFW system from the control room.

X.5.3.2 Additional Short-Term Recommendations

The following additional short-term recommendations resulted from the staff's Lessons Learned Task Force review and the Bulletins and Orders Task Force review of AFW systems at Babcock & Wilcox-designed operating plants subsequent to our review of the AFW system designs at W- and C-E-designed operating plants. They have not been examined for specific applicability to this facility.

1. Recommendation - The licensee should provide redundant level indications and low level alarms in the control room for the AFW system's water supply to allow the operator to anticipate the need to align to backup water or transfer to an alternate water supply to prevent a low pump suction pressure condition from occurring. The low level alarm setpoint should allow at least 20 minutes for operator action, assuming that the largest capacity AFW pump is operating.

2. Recommendation - The licensee should perform a 72-hour endurance test on all AFW system pumps, if such a test or continuous period of operation has not been accomplished to date. Following the 72-hour pump run, the pumps should be shut down and cooled down and then restarted and run for one hour. Test acceptance criteria should include demonstrating that the pumps remain within design limits with respect to bearing/bearing oil temperatures and vibration and that pump room ambient conditions (temperature, humidity) do not exceed environmental qualification limits for safety-related equipment in the room.

3. Recommendation - The licensee should implement the following requirements as specified by Item 2.1.7.b on page A-32 of NUREG-0578:

   "Safety-grade indication of auxiliary feedwater flow to each steam generator should be provided in the control room.

"The auxiliary feedwater flow instrument channels should be powered from the emergency buses consistent with satisfying the emergency power diversity requirements for the auxiliary feedwater system set forth in Auxiliary Systems Branch Technical Position 10-1 of the Standard Review Plan, Section 10.4.9."

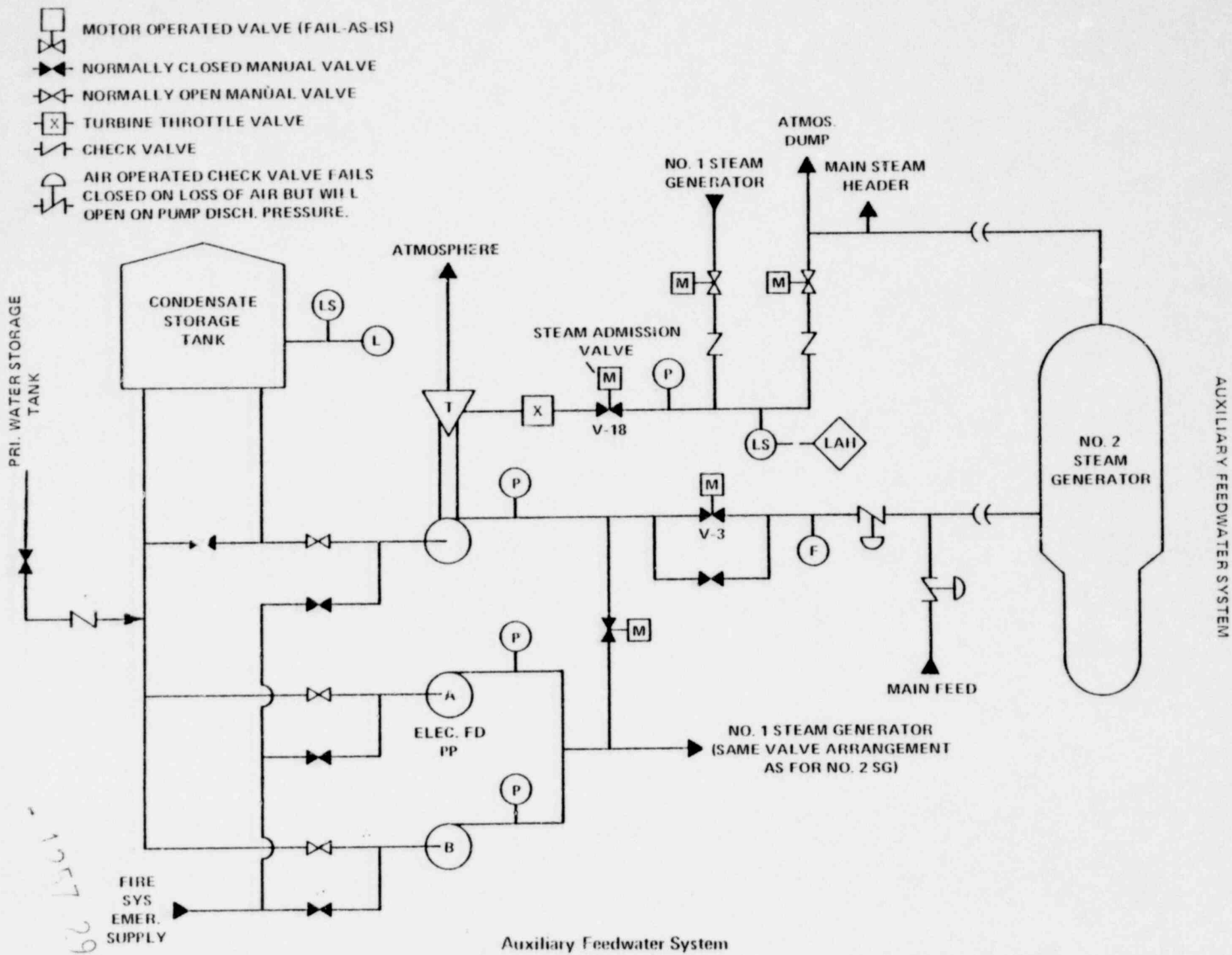
4. Recommendation - Licensees with plants which require local manual realignment of valves to conduct periodic tests on one AFW system train, and there is only one remaining AFW train available for operation should propose Technical Specifications to provide that a dedicated individual who is in communication with the control room be stationed at the manual valves. Upon instruction from the control room, this operator would realign the valves in the AFW system train from the test mode to its operational alignment.

X.5.3.3 Long-Term

Long-term recommendations for improving the system are as follows:

1. Recommendation - GL-1 - Licensees with plants having a manual starting AFW system should install a system to automatically initiate the AFW system flow. This system and associated automatic initiation signals should be designed and installed to meet safety-grade requirements. Manual AFW system start and control capability should be retained with manual start serving as backup to automatic AFW system initiation.

2. Recommendation - GL-3 - At least one AFW system pump and its associated flow path and essential instrumentation should automatically initiate AFW system flow and be capable of being independently of any alternating current power source for at least two hours. Conversion of direct power to alternating current is acceptable.



Auxiliary Feedwater System
Millstone 2
Figure 1

ENCLOSURE 2

BASIS FOR AUXILIARY FEEDWATER SYSTEM FLOW REQUIREMENTS

As a result of recent staff reviews of operating plant auxiliary feedwater systems (AFWS), the staff concludes that the design bases and criteria provided by licensees for establishing AFWS requirements for flow to the steam generator(s) to assure adequate removal of reactor decay heat are not well defined or documented.

We require that you provide the following AFWS flow design basis information as applicable to the design basis transients and accident conditions for your plant.

1. a. Identify the plant transient and accident conditions considered in establishing AFWS flow requirements, including the following events:

   1) Loss of Main Feed (LMFW)
   2) LMFW w/loss of offsite AC power
   3) LMFW w/loss of offsite and onsite AC power
   4) Plant cooldown
   5) Turbine trip with and without bypass
   6) Main steam isolation valve closure
   7) Main feed line break
   8) Main steam line break
   9) Small break LOCA
   10) Other transient or accident conditions not listed above.

   b. Describe the plant protection acceptance criteria and corresponding technical bases used for each initiating event identified above. The acceptance criteria should address plant limits such as:

   - Maximum RCS pressure (PORV or safety valve actuation)
   - Fuel temperature or damage limits (DNB, PCT, maximum fuel central temperature)
   - RCS cooling rate limit to avoid excessive coolant shrinkage
   - Minimum steam generator level to assure sufficient steam generator heat transfer surface to remove decay heat and/or cooldown the primary system.

2. Describe the analyses and assumptions and corresponding technical justification used with plant conditions considered in 1.a. above including:

   a. Maximum reactor power (including instrument error allowance) at the time of the initiating transient or accident.

   b. Time delay from initiating event to reactor trip.

   c. Plant parameter(s) which initiates AFWS flow and time delay between initiating event and introduction of AFWS flow into steam generator(s).

   d. Minimum steam generator water level when initiating event occurs.

   e. Initial steam generator water inventory and depletion rate before and after AFWS flow commences - identify reactor decay heat rate used.

   f. Maximum pressure at which steam is released from steam generator(s) and against which the AFW pump must develop sufficient head.

   g. Minimum number of steam generators that must receive AFW flow, e.g., 1 of 2, 2 of 4?

   h. RC flow condition - continued operation of RC pumps or natural circulation.

   i. Maximum AFW inlet temperature.

   j. Following a postulated steam or feed line break, time delay assumed to isolate break and direct AFW flow to intact steam generator(s). AFW pump flow capacity allowance to accomodate the time delay and maintain minimum steam generator water level. Also identify credit taken for primary system heat removal due to blowdown.

   k. Volume and maximum temperature of water in main feed lines between steam generator(s) and AFWS connection to main feed line.

   l. Operating condition of steam generator normal blowdown following initiating event.

   m. Primary and secondary system water and metal sensible heat used for cooldown and AFW flow sizing.

   n. Time at hot standby and time to cooldown RCS to RHR (or SCS) system cut in temperature to size AFW water source inventory.

3. Verify that the AFW pumps in your plant will supply the necessary flow to the steam generator(s) as determined by items 1 and 2 above considering a single failure. Identify the margin in sizing the pump flow to allow for pump recirculation flow, seal leakage and pump wear.