Central file

WISCONSIN PUBLIC SERVICE CORPORATION

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September 17, 1979

Mr. J. G. Keppler, Regional Director
Office of Inspection & Enforcement
Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Dear Mr. Keppler:

Docket 50-305
Operating Licnese DPR-43
IE Bulletin 79-21, Temperature Effects on Level Measurement

The above referenced bulletin concerning temperature effects on level instrumentation within containment has been received and reviewed. The following addresses the items of concern in the referenced bulletin.

Item I

There are three liquid level measuring systems within containment; Pressurizer Water Level, Steam Generator (S/G) narrow and wide range levels. The S/G narrow range level instruments provide a reactor protection function and all three systems may be used for post-accident indication. None of the systems are used for safeguards/SI actuation. All three systems employ a sealed reference leg. The attachment to this letter provides a more detailed description of these systems and these functions.

Item 2

The effects of post-accident ambient temperatures on indicated water levels are being evaluated. Information and appropriate equations and procedures have just recently been received from Westinghouse, so specific calculations for the Kewaunee level instruments described above are not completed. Our evaluation will include other sources of error as described in Item 2 of the bulletin. We expect to complete our analyses within 30 days and appropriate action as suggested in Item 4 of the bulletin will be taken as necessary.

Item 3

Safety and control setpoints for the above mentioned level instruments have been reviewed. The only protection system setpoint affected is the S/G narrow range low-low level reactor trip setpoint. The trip setting for this instrument has been raised by conservation calculation to ensure that the low-low level reactor trip will take place above the required Technical Specification value, thus assuring the validity of assumptions used in the safety analysis. A listing of the safety and control setpoints for each of the above mentioned instruments are given in the attachment.

Very truly yours,

E. R. Mathews

E. R. Mathews, Vice President
Power Supply & Engineering

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ATTACHMENT

Steam Generator Narrow Range Water Level

Description of Steam Generator Water Level Instrumentation is provided in the Kewaunee Final Safety Analysis Report Section 7, the appropriate pages have been attached for your conveniance. The narrow range instrumentation consists of 3 sets of level indication per Steam Generator. These instruments contain a sealed reference leg. S/G narrow range instrumentation provides the following functions.

1. Turbine trip and FW isolation on hi-hi S/G water level.

   This is not of any consequence since the increase in reference leg temperature is in the conservative direction for this trip.

2. Reactor trip on lo-lo S/G water level.

   The reactor trip setting has been raised a conservative amount to insure a trip occurs prior to the value used in safety analysis. It should be noted that it takes a finite time for the reference leg temperature to come to equilibrium with an increased containment temperature. The trip function would have occurred long before this increased reference leg temperature.

3. Reactor trip on low S/G level coincident with steam-flow-feed flow mismatch.

   This is an anticipatory trip, no credit is given in Safety Analysis.

4. Auxiliary FW pump initiation of low-low steam generator water level.

   The same setting change as for item 2 above applies for this function.

5. Operator Indication

   The relative error associated with this indication will be analyzed and appropriate action will be taken.

Steam Generator Wide Range Water Level

The sole function of this instrumentation is to provide operator indication. The relative error associated with this indication will be analyzed and appropriate action will be taken.

Pressurizer Water Level

A description of the Pressurizer Water Level instrumentation is provided in the Kewaunee FSAR, section 7; the appropriate pages have been attached for your convenience. The pressurizer level instrumentation provides the following functions:

1. A reactor trip on high water level.

This is of no consequence because any increase in reference leg temperature would change this trip in the conservative direction.

2. Operator Indication.

Significant discussion has occurred with this instrumentation post TMI. The relative error associated with this indication due to increased containment temperature will be analyzed and appropriate action will be taken.

Pressurizer Level

Three pressurizer level channels are used for reactor trip (2/3 high level) ~~*and safety injection (1/3 low level coincident with low pressure).~~ Isolated signals from these channels are used for level control, increasing or decreasing the pressurizer water level as required. A failure in the level control system could fill or empty the pressurizer at a slow rate (on the order of half an hour or more). (See Figure 7.2-11 (a)).

The design of the pressurizer water level instrumentation is a slight modification of the usual tank level arrangement using differential pressure between an upper and a lower tap. (See Figure 7.2-11 (b)). The modification consists of the use of a sealed reference leg instead of the conventional open column of water.

*Design change to eliminate Pressurizer Level from Safety Injection Signal completed in May, 1979.

*Design change to eliminate Pressurizer Level from Safety Injection Signal

Experience has shown that hydrogen gas can accumulate in the upper part of the condensate pot on conventional open reference-leg systems in pressurizer level service. At Reactor Coolant System (RCS) operating pressures, high concentrations of dissolved hydrogen in the reference-leg water are possible. On sudden depressurization accidents, it has been hypothesized that rapid effervescence of the dissolved hydrogen could blow water out of the reference leg and cause a large level error, measuring higher than actual level. To eliminate the possibility of such effects, a bellows is used in a pot at the top of the reference legs to prevent dissolving of hydrogen gas into the reference-leg water.

The reference-leg operating temperature will remain at the local ambient temperature. This temperature will vary somewhat over the length of the reference leg piping under normal operating conditions but will not exceed approximately 140°F. During a blowdown to atmospheric pressure, any reference leg boil-off will be confined to the condensate-steam interface in the condensate pot at the top of the temperature barrier leg, with only negligible effects on the accuracy of the level sensors. Flashing or effervescence within the reference leg itself will not occur. Therefore, the instrumentation provided will sense low pressurizer level.

3 The pressurizer level sealed reference-leg design has had successful operation of over 1-1/2 years at the Ginna Nuclear Plant and over 1/2 year at the Point Beach Nuclear Plant. Supplier tests were run to confirm less than 1 second time response.

Calibration of the sealed reference-leg system is done in place after installation by application of known pressure to the low pressure side of the transmitter and measurement of the height of the reference column. The effects of static pressure variations are predictable. The largest effect is due to the density change in the saturated fluid in the pressurizer itself. The effect is typical of level measurements in all tanks with two-phase fluid and is not peculiar to the sealed reference-leg technique. In the sealed reference leg, there is a slight compression of the fill water with increasing pressure, but this is taken up by the flexible bellows. A leak of the fill water in the sealed reference-leg can be detected by comparison of redundant channel readings on line and by physical inspection of the reference-leg off line with the channel out of service. Leaks of the reference-leg to atmosphere will be immediately detectable by off-scale indications of the level on the control board. Further detection of leakage is provided by the plant computer alarms for deviation between redundant channels.

If an assumed break is at the top of the pressurizer instrument line, the affected pressure channel would be subjected to containment pressure and initiate a partial reactor trip on low pressure. If the break is on a level instrument line, the affected sealed reference-leg will indicate high water level because of the resulting pressure imbalance, and this will generate a partial reactor trip. In either case, the resulting action is in the "safe" direction, producing a trip of the affected channel bistable. 3

A break in a non-instrument line will not effect the capability of either the pressure or level instruments to function properly in their calibrated range, as noted. Regardless of the particular line severed there is sufficient redundancy of both pressure and level instrumentation to initiate a reactor trip on low pressure (2/4) or high water level (2/3) and for safety injection on co-incidence of low water level and low pressure(1/3 pairs).

Furthermore, core DNB protection is provided by the ΔT overtemperature reactor trip. The ΔT overtemperature trip setpoint will be adjusted downward (safe direction) as the system pressure decreases (reference page 7.2-39.

3 A typical depressurization incident caused by opening a line at the top of the pressurizer would be an accidental opening of a relief valve. Studies of this hypothetical accident occuring under full power assuming conservative conditions and maximum instrument errors reveals that the event results in a rapidly decreasing reactor coolant system pressure causing a slight increase in pressurizer water level as the overpressure is released. Reactor trip occurs on overtemperature ΔT as the DNBR goes down with the pressure. (If the low pressure trip set point is high enough it will trip the reactor before the ΔT overtemperature trip). Following trip both T_{avg} and the pressure continue to decrease rapidly. Eventually the pressure decreases to the saturation point of the hot leg, at which point boiling in the hot leg causes the water level in the pressurizer to rise again. Throughout the transient, the core remains covered and DNB does not occur. Depending on plant design and/or setpoints, the time scale of events is typically up to one minute to reach reactor trip and 5 minutes to reach saturation pressure in the hot leg.

High Level

A reactor trip on pressurizer high level is provided to prevent filling the pressurizer in the event of a rapid thermal expansion of the reactor coolant. A rapid change from high rates of steam-relief to water-relief could be damaging to the safety valves, relief piping, and pressure relief tank. However, a level control failure cannot actuate the safety valves because the high pressure reactor trip is set below the safety valve set pressure. With the slow rate of charging available, overshoot in pressure before the trip is effective is much less than the difference between reactor trip and safety valve set pressures. Therefore, a control failure does not require protection system action. In addition, alarms occur in ample time for corrective manual action.

Low Level

For control failures which tend to empty the pressurizer, one-out-of-three logic for safety injection actuation on low level coincident with low pressure ensures that the protection system can withstand an independent failure in another channel. In addition, alarms occur in ample time for corrective manual action.

Steam Generator Water Level; Feedwater Flow

Before describing control and protection interaction for these channels, it is beneficial to review the protection system basis for this instrumentation. (See Figure 7.2-12).

The basic function of the reactor protection circuits associated with low steam generator water level and low feedwater flow is to preserve the steam generator heat sink for removal of long-term residual heat. Should a complete loss of feedwater occur with no protective action, the steam generators would boil dry and cause an overtemperature-overpressure excursion in the Reactor Coolant System. Reactor trips on temperature, pressure, and pressurizer water level will trip the unit before there is any damage to the core or Reactor Coolant System. Redundant auxiliary feedwater pumps are provided to remove and thus prevent residual heat, after trip, from causing thermal expansion and discharge of the reactor coolant through the pressurizer relief valves. Reactor trips act before the steam generators are dry to reduce the required capacity and starting time requirements of these pumps and to minimize the thermal transient on the Reactor Coolant System and steam generators. Independent trip circuits are provided for each steam generator for the following reasons:

1) Should severe mechanical damage occur to the feedwater line to one steam generator, it is difficult to ensure the functional integrity of level and flow instrumentation for that unit. For instance, a major pipe break between the feedwater flow element and the steam generator would cause high flow through the flow element. The rapid depressurization of the steam generator would drastically affect the relation between downcomer water level and steam generator water inventory.

2) It is desirable to minimize thermal transients on a steam generator for credible loss-of-feedwater accidents. It should be noted that controller malfunctions caused by a protection system failure affect only one steam generator.

A spurious high signal from the feedwater flow channel being used for control would cause a reduction in feedwater flow and prevent that channel from tripping. A reactor trip on low-low water level, independent of indicated feedwater flow, will ensure a reactor trip if needed.

A spurious low steam flow signal would have the same effect as a high feedwater signal, discussed above.

A spurious high water level signal from the protection channel used for control will tend to close the feedwater valve. This level channel is independent of the level and flow channels, used for reactor trip on low flow coincident with low level.

1) A rapid increase in the level signal will completely stop feedwater flow and lead to an actuation of a reactor trip on low feedwater flow coincident with low level.

2) A slow drift in the level signal may not actuate a low feedwater signal. Since the level decrease is slow, the operator has time to respond to low level alarms. Since only one steam generator is affected, automatic protection is not mandatory and reactor trip on two out of three low-low level is acceptable.