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DMB

February 9, 1984

Mr. James G. Keppler
Regional Administrator
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: Byron Station Units 1 and 2
Braidwood Station Units 1 and 2
Response to IE Bulletin 79-21
"Temperature Effects on Level Measurements"
NRC Docket Nos. 50-454/455 and 50-456/457

References (a): August 13, 1979 letter from J. G. Keppler to B. Lee

(b): January 26, 1982 letter from T. R. Tramm to H. R. Denton

Dear Mr. Keppler:

Reference (a) addressed water level measurement errors for operating reactors. Reference (b) committed us to address water level measurement error at Byron Station Units 1 and 2.

The attachment to this letter is the analysis performed which provides information concerning the adequacy of the present steam generator low level setpoints.

The analysis utilized the containment pressure safeguards actuation setpoint as a backup to the steam generator low level trip for auxiliary feedwater initiation. Westinghouse incorporated this analysis into the statistical setpoint study.

FSAR Section 14.2.8 addresses the containment high pressure safety injection in the accident analysis for feedwater system pipe break.

We believe that this submittal adequately addresses Byron Station SER Item 7.2.2.3.

IE 11
1/1

To the best of my knowledge and belief the statements contained in the Attachment are true and correct. In some respects these statements are not based on my personal knowledge but upon information furnished by other Commonwealth Edison employees, consultants or contractors. Such information has been reviewed in accordance with Company practice and I believe it to be reliable.

Please address questions regarding this matter to this office.

Respectfully,

P. L. Barnes

P. L. Barnes
Nuclear Licensing Administrator

cc: Document Control Desk
RIII Resident Inspector - BY/BW

SUBSCRIBED and SWORN to
before me this 9th day
of February, 1984
Rosalie A. Piexta
Notary Public

8126N

Byron/Braidwood

STEAM GENERATOR REFERENCE LEG

The potential for steam generator level bias was originally addressed by Westinghouse. Westinghouse postulated that a high-energy line break, specifically a feedwater line break, could result in a heatup of the steam generator level measurement reference leg. An increase reference leg water column temperature would result in a decrease of the water column density with a consequent increase in the indicated steam generator water level. This bias could delay or prevent reactor trip and auxiliary feedwater initiation which are based on low-low steam generator water level.

The loss of feedwater accident is protected by a reactor trip on low-low steam generator level. Steamline breaks and LOCA's are protected by other reactor trips and safety injection signals. The low-low steam generator level trip setpoint was normally set at 37.5% (Unit 1) and 17% (Unit 2) of the narrow range level instrument span. As a result of the Westinghouse concern, a review of the potential inaccuracies was performed at Zion Station and concluded that a maximum of 4.5% inaccuracy could exist exclusive of heat induced bias.

Westinghouse generically estimated the worst bias that might exist for the low-low steam generator level due to reference leg heatup would be 10% for temperatures up to 280°F. Above 280°F, reactor trip and auxiliary feedwater actuation would occur on a high containment pressure signal.

By utilizing the present containment trip setpoint of 5 psig, the maximum temperature reached prior to unit trip is 160°F. This corresponds to a 2.55% temperature induced bias, rather than the 10% generically determined by Westinghouse. Based on the above values, the steam generator low-low trip setpoint can be 37.5% without affecting plant safety.

ATTACHMENT

A. TERMS

P_T - Total Pressure in Containment

P_S - Partial Pressure of Steam

P_a - Partial Pressure of Air

T - Temperature of Containment

V - Volume

P - Pressure

R' - Number of Air Molecules in Containment

B. Assumptions (and Justification)

1. Perfect Gas Law Applies $PV=R'T$
2. Law of Partial Pressure Applies $P_T=P_S=P_a$
3. Initial Conditions: $T_{range}=65-120°F$
   Assume $T_i=90°F$

   $P_{range}=-.1$ to $+.3$ psig
   Assume=0 psig=14.7psia

   $P_S=0.69$ psia

   $P_a=14.01$ psia
4. Saturation Conditions (Liquid and Vapor phases present Simultaneously).
5. Localized heating effects are minimized due to the routing of the four referrence legs. (However, the four taps are located within the same 90° quadrant.)

6. Equilibrium conditions with respect to pressure (pressure can be considered to be in equilibrium almost instantaneously because pressure fronts move with sonic velocity).

7. Temperature equilibrium is reached slower than pressure (trip will be initiated prior to containment temperature reaching equilibrium conditions and calculation is conservative).

8. Containment high pressure trip setpoint = 5 psig

= 19.7 psia

9. a. No air being added $\left[\frac{P_a V_a}{T_a}\right]_i = \left[\frac{P_a V_a}{T_a}\right]_f$

b. Volume is Constant $\left[\frac{P_a}{T_a}\right]_i = \left[\frac{P_a}{T_a}\right]_f$

10. Bias Formula

$$E = \frac{H_L}{H} = \frac{\rho_{L,\,CAL} - \rho_L}{\rho_{f,\,CAL} - \rho_{g,\,CAL}}$$

Where:

E = Level error due to reference leg heat up as a fraction of level span.

H = Level span = Vertical distance between narrow range taps on S. G. (233").

H_L= Height of reference leg = maximum vertical distance from lower tap to water level in condensing POT on upper tap. (233")

ρ_L, CAL = Water density at containment temperature and S. G. pressure for which the level indication was calibrated (90°F, 62.12#/FT^3)

ρ_L = Water density in reference leg at time of interest.

ρ_f, CAL - ρ_g, CAL = Difference between saturated water density and dry saturated steam density at the S. G. pressure for which the level indication system was calibrated. An upper bound pressure must be assured.

11. Calibration temperature = 90°F
Calibration pressure (@ 50% power) = 1055 psia (S. G. Secondary pressure)

C. Calculations

1a. Maximum temperature (Containment at 90°F)

$$\left[\frac{P_a}{T_a}\right]_i = \left[\frac{P_a}{T_a}\right]_f$$

$$\frac{P_{a,i}}{T_{a,i}} \times T_{a,f} = P_{a,f}$$

$$P_{a,f} = \frac{(x + 460)}{550} \times 14.01 \text{ psia}$$

1b. $T = 180°F$

$$P_{a,f} = \frac{(180 + 460)}{550} \times 14.01 = 16.30 \text{ psia}$$

$P_S = 7.51$ psia

$P_T = 23.81$ psia

1c. $T = 140$

$$P_{a,f} = \frac{(140 + 460)}{550} \times 14.01 \text{ psia} = 15.28 \text{ psia}$$

$P_S = 2.89$

$P_T = 18.17$ psia

1d. $T = 150$

$$P_{a,f} = \frac{(150 + 460)}{550} \times 14.01 \text{ psia} = 15.53 \text{ psia}$$

$P_S = 3.71$

$P_T = 19.24$

1e. $T = 160$

$$P_{a,f} = \frac{(160 + 460)}{550} \times 14.01 \text{ psia}$$
$$= 15.53 \text{ psia}$$

$P_S = 4.749$ psia

$P_T = 20.53$

160°F gives a conservation value of 20.53 psia, which is over the containment high pressure trip setpoint.

2. Reference Leg

$$E = \frac{H_L}{H} = \frac{\rho_{L\,CAL} - \rho_L}{\rho_{f,\,CAL} - \rho_{g,CAL}}$$

$\rho_{L,CAL}$ @ 90°F = 62.12 #/FT^3

ρ_L @ 160°F = 61.01 #/FT^3

$$\rho_{f,\,CAL} - \rho_{g,CAL} = \frac{1}{\overline{V}_f} - \frac{1}{\overline{V}_{g,CAL}} \text{ @ 1050 psia}$$

$$= \frac{1}{.0218} - \frac{1}{.4239} = 45.87156 - 2.3590$$
$$= 43.51 \text{ \#/FT}^3$$

$$\frac{H_L}{H} = \frac{233}{233} = 1.00$$

$$E = 1 \frac{(62.12 - 61.01)}{43.51}$$

$= 2.55\%$

3. Setpoint Conservatism

Instrument Error =	4.5%	(Zion Information)
Temperature induced error =	2.55%	
	7.05%	

Based on the Accident Analysis on page 15.2-19 of the SAR, which assumed a reactor trip at -10% of low low level setpoint, it can be seen that:

$$\begin{array}{r} 10\% \\ -\ 7.05\% \\ \hline 2.95\% \end{array}$$ is the conservatism in the setpoints presently being used.

I. SAR References

15. Accident Analysis

page 15.0 - 33 Limiting trip point assumed in analysis 32.3%-low SG level
87.4%-Hi SG level

page 15.2 - 19 Feedwater System line break section 15.2.8.2i Reactor trip is assumed to be initiated when the low-low level trip setpoint minus 10% of the narrow range span in the faulted SG is reached.

16. Technical Specifications

Page 16.2-6 U1 SG low-low level ≥ 37% Trip ≥ 36% Allowable

U2 SG low-low level ≥ 16% Trip ≥ 15% Allowable

II. Precautions, Limitations & Setpoints Document

Revised by CAW-4194 (CBW-3420) of March 17, 1982.

Section 1A1c - SG Control system level ±5% (page 1)

*Section 1B2G - SG Low-low level 40.8% Unit 1
17.0% Unit 2

*Section 1B2H - SG Hi-Hi level 82.4% Unit 1
78.1% Unit 2

Section SG level Control 66% Unit 1 (Page 32)
50% Unit 2 (Page 33)

*Change with March 17, 1982 letter

III. Setpoint Study WCA 9640 November, 1979

Section 3.3.12 - Low-low SG level Trips 37%-Unit 1
17%-Unit 2

Section 3.3.13 - Hi-hi SG level Trips 82%-Unit 1
78%-Unit 2