PGE Portland General Electric Company

Charles Goodwin, Jr. Assistant Vice President

September 14, 1979

Trojan Nuclear Plant
Docket 50-344
License NPF-1

Mr. R. H. Engelken, Director
Nuclear Regulatory Commission
Region V
Suite 202, Walnut Creek Plaza
1990 N. California Blvd.
Walnut Creek, CA 94596

Dear Sir:

Attached is the PGE response to IE Bulletion 79-21 that was transmitted in your letter dated August 13, 1979. This Bulletin required a PGE evaluation of the effects of increased Containment temperature on liquid level measuring systems inside Containment.

Sincerely,

C. Goodwin Jr

C. Goodwin, Jr.
Assistant Vice President
Thermal Plant Operation and
Maintenance

CG/CJP/4kk6A25
Attachment

c: Mr. Lynn Frank, Director w/attach
State of Oregon
Department of Energy

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121 S.W. Salmon Street, Portland, Oregon 97204

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PGE RESPONSE TO IE BULLETIN 79-21

1. Review the liquid level measuring systems within Containment to determine if the signals are used to initiate safety actions or are used to provide post-accident monitoring information. Provide a description of systems that are so employed; a description of the type of reference leg shall be included, i.e., open column or sealed reference leg.

PGE Response

The only liquid level measuring systems inside Containment that are used for initiating safety actions are the steam generator narrow-range water level and the pressurizer water level. However, as indicated in attached Table 1, the only safety actions for which credit is taken in the Trojan safety analyses following a high-energy line rupture inside Containment are a reactor trip and auxiliary feedwater initiation on low-low steam generator water level; therefore, only the modification of this setpoint must be considered to accommodate the effect of reference leg heatup. The level indications listed in Table 1 all provide post-accident monitoring information to some degree, and the effect of increased ambient temperatures has been evaluated to assure that improper operator actions would not be taken as the result of possibly erroneous level indications.

Steam Generator Narrow-Range Water Level

The steam generator narrow-range level instrument is an open reference leg, condensing pot design that provides a level signal proportional to the differential pressure developed between the water column heights in the steam generator downcomer and in the reference leg. A low-low steam generator level initiates reactor trip and Auxiliary Feedwater System operation as the primary protection against a feedwater line rupture.

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Additional protective actions based on steam generator water level are a turbine trip and feedwater isolation on a high-high level and a reactor trip on low level in coincidence with steam flow/feed flow mismatch. However, no credit for these functions is taken following a high-energy line break inside Containment. Steam generator water level is used as an indicator of adequate secondary inventory for post-accident heat removal.

Pressurizer Water Level

The pressurizer water level instrument is a sealed reference leg, condensing pot design that provides a level signal proportional to the differential pressure developed between the water column heights in the pressurizer and in the reference leg. The only protective action, based on pressurizer level, is a reactor trip on high water level; however, no credit is taken for this function following a high-energy line break inside Containment. The pressurizer water level is used as an indicator of post-accident reactor coolant inventory.

Accumulators

The accumulator water level instrument is a sealed reference leg design that provides a level signal proportional to the differential pressure developed between the water column heights in the accumulator and the reference leg. The accumulator levels are used as indicators that the accumulators have discharged into the Reactor Coolant System following a large LOCA in which the system depressurizes to below accumulator pressure.

Pressurizer Relief Tank

The pressurizer relief tank level instrument is an open reference leg design that provides a level signal proportional to the differential pressure developed between the water column heights in the pressurizer relief tank and in the reference leg. The

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pressurizer relief tank level is used following an accident as an indication of discharge from the pressurizer power-operated relief valves and safety valves.

Reactor Coolant Drain Tank

The reactor coolant drain tank (RCDT) level instrument is an open reference leg design that provides a level signal proportional to the differential pressure developed between the water column heights in the tank and in the reference leg. The RCDT level instrument provides starting and stopping signals to pump the contents of the RCDT to the clean waste receiver tanks in the Auxiliary Building.

Containment Sumps

The Containment sump level instruments are magnetic float switch mechanisms. Sump level is monitored during normal operations to provide indication of water leakage inside Containment.

2. On those systems described in Item 1 above, evaluate the effect of post-accident ambient temperatures on the indicated water level to determine any change in indicated level relative to actual water level. This evaluation must include other sources of error including the effects of varying fluid pressure and flashing of reference leg to steam on the water level measurements. The results of this evaluation should be presented in a tabular form similar to Tables 1 and 2 of Enclosure 1.

PGE Response

For level measuring systems with reference legs exposed to the Containment atmosphere, high-energy line breaks inside Containment can result in heatup of the reference legs. Increased reference leg water column temperature will result in a decrease of the water column density with a consequent apparent increase

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in the indicated water level. In addition to the reference leg density change under subcooled conditions, boiling could conceivably occur in the reference leg following depressurization of a steam generator with high Containment temperature. This combination of conditions could only occur following a steam line or feedwater line rupture inside Containment. If such boiling were to occur, it could cause a major bias in indicated level for a short time period, in the extreme case indicating 100-percent level when the vessel is actually empty. A bias in indicated water level may also be introduced by changes in pressurizer or steam generator pressure, due to changes in the densities of the saturated water and steam within these vessels. While prediction of the effects of rapid depressurization requires complex calculations for each specific case, the bias which would exist at low power under quiescent conditions has been estimated by Westinghouse using a conservative simplified analysis model and assumptions that are appropriate for Trojan.

Steam Generator Narrow-Range Water Level

Credit is taken in the Trojan feed line break accident analysis for a reactor trip and auxiliary feedwater initiation on low-low steam generator water level. As far as the trip setpoint is concerned, because large steam generator pressure changes are not expected before the trip, only the reference leg heatup effects need to be considered and not the effects of system pressure changes. The calculated error in the indicated steam generator level as a function of reference leg temperature, based on calibration conditions of 1000 psia steam generator pressure and 90°F Containment ambient temperature, is summarized in Table 2.

Calculations of the combined effects of the longer-term density changes in the steam generator and its reference leg during depressurization and of reference leg heatup are summarized in attached Table 3. This table provides correction values for

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minimum and maximum allowable indicated levels to assure the actual steam generator water level remains in the allowable range during the post-accident recovery period.

Reference leg boiling is a remote possibility that could occur following a secondary high-energy line rupture. This could cause large errors in indicated level for short periods of time.

Pressurizer Water Level

No credit is taken for a pressurizer level-derived reactor trip following a high-energy line rupture inside Containment. Thus, the trip setpoint need not be revised to compensate for environmental effects.

Effects of pressurizer reference leg heatup and density changes during depressurization are summarized in attached Figure 1 and 2, illustrating the impact on post-accident monitoring. These curves are based on calibration conditions of 90°F Containment temperature and 2250 psia system pressure.

Reference leg boiling due to a combination of rapid system depressurization and reference leg heatup is a small effect for the pressurizer due to the sealed reference leg design. This effect has been previously considered in the Trojan FSAR (Section 7.2.2.3.4) and would lead to a level error of at most 1 ft, or about 2 percent of span, which is negligible for post-accident monitoring purposes.

Accumulators

The accumulators are passive devices that are discharged into the RCS if the system depressurizes below the accumulator nitrogen pressure of 600 psig. The major function of the level instrumentation is to provide assurance during operation that

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the design volume of water is available for injection into the RCS in the event of a LOCA. As far as post-accident monitoring is concerned, the accumulator levels do not provide essential information to the operator during the accident recovery and, therefor it is judged that no further analysis of the effect of reference leg heatup is necessary for these instruments.

Pressurizer Relief Tank

The pressurizer relief tank receives discharge from the pressurizer safety valves and power-operated relief valves. The water level is maintained and monitored in this tank during normal operation to provide quenching of the steam discharge. During the post-accident period, the level provides indication of the amount of relief or safety valve discharge that has occurred. Other indications such as charging system inflow and relief valve outlet piping temperature are available that provide the same information, and no inappropriate operator actions would result from an indicated level higher than the actual level in the PRT. Therefore, it is judged that no further analysis is necessary of the effect of reference leg heatup on this instrument.

Reactor Coolant Drain Tank

The RCDT receives discharge of reactor coolant from a number of sources. The level instrument controls automatic pumping of the RCDT contents to the clean waste receiver tanks outside of the Containment. The potential consequences of an erroneously high indicated RCDT level would be to pump the RCDT before the intended setpoint was reached or to continue pumping the RCDT after the setpoint intended for pump shutoff. Neither of these consequences presents a significant safety hazard, although the automatic transfer of potentially radioactive RCDT fluid out of the Containment could occur sooner than intended. A high-energy line break inside Containment that leads to the adverse environ-

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ment of concern would automatically isolate the discharge line from the RCDT. Therefore, it is judged that no further analysis is necessary of the effects of reference leg heatup on this instrument.

Containment Sumps

The sump level instruments are magnetic float switch mechanisms that have not been qualified for service in the post-LOCA Containment environment. These instruments provide indication of water leakage inside Containment during normal operation. The Containment sumps (but not the recirculation sump) are automatically pumped to the dirty waste drain tank outside Containment on a high level signal. The consequences of an erroneous level indication do not pose a significant safety hazard, since a high-energy line break inside Containment that creates the adverse environment of concern would lead to automatic isolation of the sump discharge line. Furthermore, as a followup of our review of the TMI-2 accident, we are presently developing a design change to the sump discharge system that would provide additional protection against inadvertent transfers of the sump contents. This change, to be completed prior to the Cycle 3 startup, involves installation of a radiation monitor in the sump discharge line. Therefore, it is judged that no further analysis is necessary of the effects of post-accident environment on the sump level switches.

3. Review all safety and control setpoints derived from level signals to verify that the setpoints will initiate the action required by the Plant safety analyses throughout the range of ambient temperatures encountered by the instrumentation, including accident temperatures. Provide a listing of these setpoints.

If the above reviews and evaluations require a revision of setpoints to ensure safe operation, provide a description of

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the corrective action and the date the action was completed. If any corrective action is temporary, submit a description of the proposed final corrective action and a time table for implementation.

PGE Response

The only safety action derived from a level signal, for which credit is taken following a high-energy line break inside Containment is the reactor trip and auxiliary feedwater initiation on low-low steam generator water level following a feed line break. During a high-energy line break inside Containment, both the Containment ambient temperature and ambient pressure will increase. Within a few seconds, depending on the break size, the high Containment pressure trip setpoint (5 psig) would be reached providing acceptable backup protection to the low-low steam generator level trip. In the analyses performed for the 1971 Westinghouse instrumentation environmental qualification program, in which Trojan is a participant, the high Containment pressure setpoint was reached prior to the Containment temperature reaching 280°F. A change in reference leg temperature from the calibration condition of 90°F to 280°F would result in an indicated level which is 10 percent higher than actual, as shown in the response to Question 2. Therefore, the previous low-low steam generator level trip setpoint has been raised from 5 percent to 15 percent as an interim measure to accommodate the possible effect of reference leg heatup. This change has previously been identified to you in letters dated June 26 and July 5, 1979. A combination of the revised low-low level trip setpoint and the backup protection afforded by the high Containment pressure trip ensures that the feed line break criteria stated in the Trojan FSAR continue to be met. Westinghouse is currently evaluating possible steam generator level instrument design changes to compensate for reference leg heatup. It is possible that these revised designs would permit returning the setpoint to its previous value.

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4. Review and revise, as necessary, emergency procedures to include specific information obtained from the review evaluation of Items 1, 2 and 3 to ensure that the operators are instructed on the potential for and magnitude of erroneous level signals. All tables, curves, or correction factors that would be applied to post-accident monitors should be readily available to the operator. If revisions to procedures are required, provide a completion date for the revisions and a completion date for operator training on the revisions.

PGE Response

Based on the Westinghouse and PGE reviews described above, curves showing the range of correction factors for steam generator water level indication at various Containment temperatures, up to 280°F, were developed. These curves were placed in the Trojan Control Room Operating Curves and Tables Reference Manual. In addition, the appropriate control room indicators have been marked to caution the operators regarding accuracy of the indicator at elevated Containment temperatures.

Operators have been made aware of the necessity for, and the proper use of, these correction factors.

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TABLE 1

LIQUID LEVEL MEASURING SYSTEMS INSIDE CONTAINMENT
THAT INITIATE SAFETY ACTIONS OR PAM[b] INFORMATION

Liquid Level Measuring System	Reference Leg Design	Initiates Safety Actions[a]	Provides PAM Information
1. Steam Generator Narrow-Range Water Level	Open	Yes	Yes
2. Pressurizer Water Level	Sealed	No[a]	Yes
3. Accumulators	Sealed	No	Yes
4. Pressurizer Relief Tank	Open	No	Yes
5. Reactor Coolant Drain Tank	Open	No	Yes
6. Containment Sumps[c]	N/A[d]	No	Yes

[a] Safety actions for which credit is taken following a HELB inside Containment.
[b] Post-accident monitoring.
[c] Two Containment sumps and one Containment recirculation sump.
[d] Containment sump level is measured by a float switch mechanism.

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TABLE 2

CORRECTION TO INDICATED STEAM GENERATOR WATER LEVEL FOR REFERENCE LEG HEATUP EFFECTS DUE TO POST-ACCIDENT CONTAINMENT TEMPERATURE (BEFORE REACTOR TRIP)

Maximum Containment Temperature Reached Before Reactor Trip (°F)	Correction to Steam Generator Level (% of Span)
90	0
200	4
280	10
320	13
400	20

Basis:

Level calibration pressure $\leq$ 1000 psia
Reference leg calibration temperature $\geq$ 90°F
Height of reference leg $\leq$ 1.1 x level span.

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TABLE 3

CORRECTIONS TO ALLOWABLE INDICATED STEAM GENERATOR WATER LEVEL FOR REFERENCE LEG HEATUP AND PRESSURE CHANGES FOLLOWING A HIGH-ENERGY LINE BREAK, TO ASSURE THAT TRUE LEVEL IS BETWEEN THE LEVEL TAPS

Containment Temperature (°F)	Corrections to Minimum Allowed Indicated Level (% of Span)	Corrections to Maximum Allowed Indicated Level (% of Span)
90	+1	-4
200	+6	-4
280	+11	-4
320	+14	-4
400	+21	-4

Basis:

Level calibration pressure $\leq$ 1000 psia
Reference leg calibration temperature $\geq$ 90°F
Height of reference leg $\leq$ 1.1 x level span
Pressure $\geq$ 50 psia
Pressure $\leq$ 200 psi + calibration pressure
Boiling in the reference leg is not assumed.

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Figure 1: Bias Due to Pressurizer Reference Leg Heatup

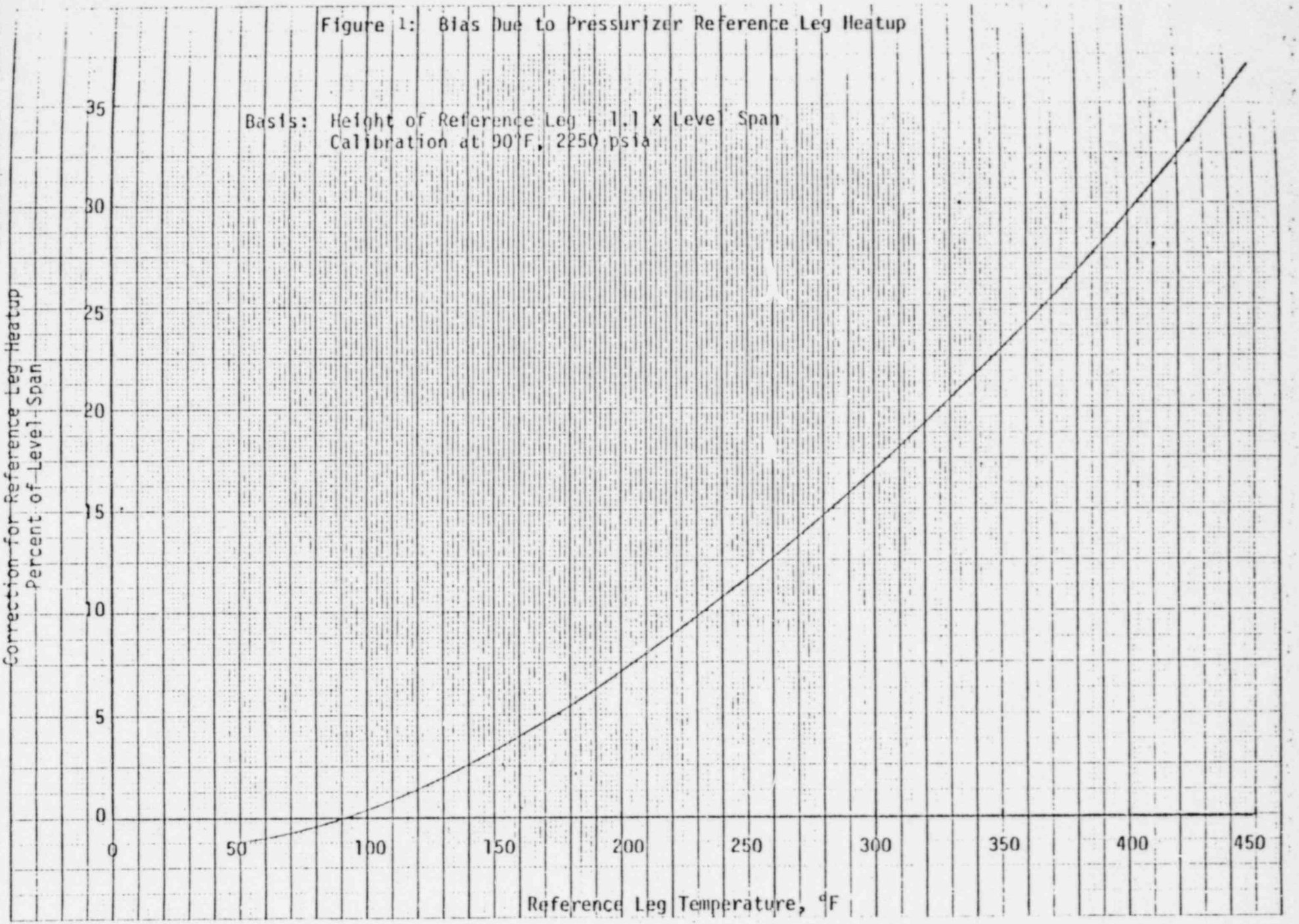

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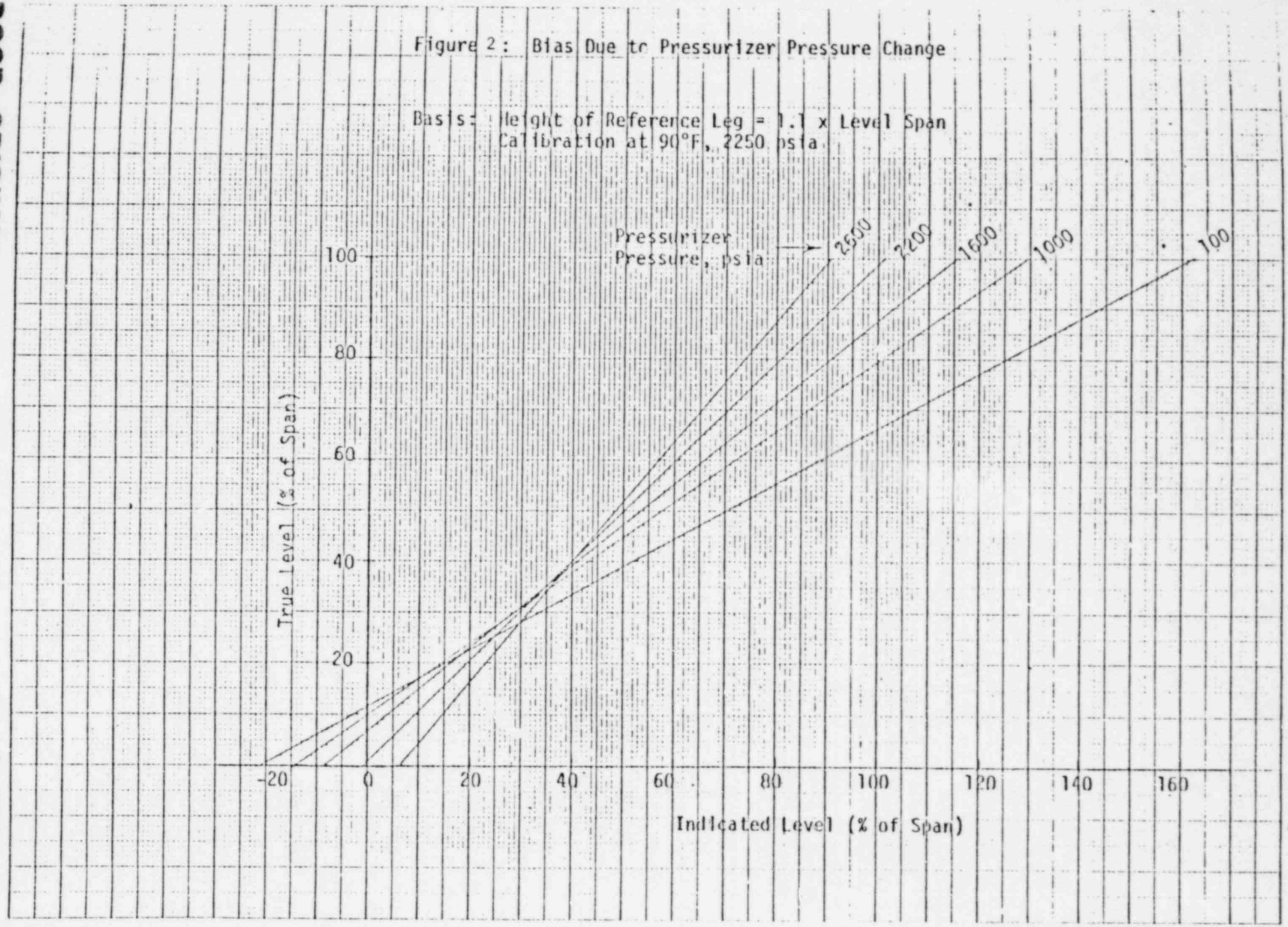
Figure 2: Bias Due to Pressurizer Pressure Change

Basis: Height of Reference Leg = 1.1 x Level Span
Calibration at 90°F, 2250 psia



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