CENTRAL FILES

Frederick W. Schneider
Vice President
Production

Public Service Electric and Gas Company 80 Park Place Newark, N.J. 07101 201/430-7373

October 5, 1979

Mr. Boyce H. Grier, Director
U.S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region 1
~~631 Park Avenue~~
King of Prussia, Pennsylvania ~~19406~~

Dear Mr. Grier:

NRC IE BULLETIN NO. 79-21
NO. 1 & 2 UNITS
SALEM GENERATING STATION

Pursuant to the subject bulletin, we hereby submit the attached response. Although the bulletin addresses our operating plant, Salem Unit No. 1, the setpoint and operating procedure revisions described in this response are also applicable to Unit No. 2 and will be implemented prior to its startup.

If you have any further questions on this matter, we will be pleased to discuss them with you.

Sincerely,

F W Schneider

Attachment

CC: Director, Office of Inspection
& Enforcement
USNRC
Washington, D.C. 20555

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SALEM NUCLEAR GENERATING STATION
NOS. 1 AND 2 UNITS
NRC BULLETIN 79-21 RESPONSE
TEMPERATURE EFFECTS ON LEVEL MEASUREMENTS

1. Steam generator levels and the pressurizer levels are utilized for protection system actuation and post accident monitoring functions. These are the only level measurements within the containment performing safety functions.

Steam Generator Narrow Range Water Level

Three instruments are provided for each steam generator. An open column reference leg is utilized in determining this measurement. The following functions are performed:

A. Initiation of turbine trip, feedwater isolation, and feedwater pump trip on high-high steam generator water level.

B. Initiation of reactor trip on low steam generator water level in coincidence with steam flow-feedwater flow mismatch.

C. Initiation of reactor trip on low-low steam generator water level.

D. Initiation of auxiliary feedwater system on low-low steam generator water level.

E. Post accident monitoring for operator action.

Pressurizer Water Level

Three instruments are provided for the pressurizer. A sealed reference leg is utilized in determining this measurement. The following functions are performed:

A. Initiation of reactor trip on high pressurizer water level.

B. Post accident monitoring for operator action.

2. The effects of reference leg heatup, varying fluid pressure and potential flashing in the reference leg have been evaluated for steam generator level and pressurizer level measurements. Calculations were made to determine the potential instrument indication errors. The calculations were

based on the instrument calibration data and design characteristics of the Salem plant. The results of our evaluation are presented in the attached Tables A through D. Correction factors are provided for reference leg heatup and varying fluid pressure only. Reference leg boiling could occur following the depressurization of the steam generator which was affected by the high energy line break. The remaining steam generators should not experience reference leg boiling in the steam generator level measurement. These instruments will provide suitable indication for operator action/post accident monitoring.

3. A review of setpoints and protection system actuation indicates that only the low-low setpoint of the steam generator level measurement results in a problem because of ambient temperature effects on the reference legs.

A review of the safety analyses for accident conditions indicates that the only high energy line rupture within the containment, for which the steam generator water level provides the primary trip function, is a feedwater line rupture. For such a case, the low-low water level trip must be actuated at a setpoint level which is above the steam generator tubes. Thus, the trip setpoints must be at or above the value that would be indicated by the instruments when the actual level is just above the steam generator tubes. Because large steam generator pressure changes are not expected before the trip, only the reference leg heatup effects need be considered, and not the effects of system pressure changes. Correction factors are required for the level setpoints to compensate for the reference leg heatup effects.

The backup trip function for the feedwater line rupture is provided by the high containment pressure signal. In addition, this signal will initiate operation of the motor driven auxiliary feedwater pumps. Therefore, revisions to the level setpoints are only required to compensate for reference leg heatup to the temperature at which the containment high pressure signal is received. A conservative upper bound for reference leg temperature would be at the peak containment temperature reached following a feedwater line break before the containment high pressure bi-stables are tripped. Steam line break results provide an upper bound for a feedwater line break due to the design characteristics of the system at Salem. Based on the results of the steam line break analysis for Salem presented in the response to FSAR Question 5.82, the containment high pressure setpoint would be reached prior to a containment temperature of 240^{0}F.

Assuming that the reference leg is at an ambient temperature of 240^{0}F (a conservative assumption), the indication error bias is 5.7% of span. The indication error bias is constant over the entire span for a particular reference leg temperature.

The existing steam generator low-low level setpoint is 5%, and will require a revision to assure that the protection system actuation is initiated in a time frame consistent with the safety analysis. A setpoint change to 11% will maintain existing safety margins. No other setpoint changes are required for the steam generator levels.

The safety analysis does not take credit for the pressurizer water level trip function following a high energy line rupture inside the containment. It should be noted that the coincident pressurizer low level-low pressure safety injection actuation was revised to delete low level as described in our response to Bulletin 79-06A.

Setpoint changes will be made prior to Unit 1 returning to service from the present refueling outage and prior to startup for Unit 2.

The setpoint change may be temporary pending the results of an engineering study of methods to eliminate the erroneous level indication through suitable design changes. Potential solutions that are being considered are insulating the reference legs, sealed measurement systems that are not susceptible to the temperatures of interest, or temperature compensation of the instruments. A timetable for implementation of other potential changes has not been established. The present corrective action of setpoint revisions is adequate for maintaining safe plant operations.

Supplemental information will be forwarded concerning this bulletin topic if any other corrective action is contemplated.

4. Post accident operating procedures which require the operator to use steam generator level and pressurizer level indication will be revised to reflect the information presented above. Cautionary statements will be included alerting the operators of the potential erroneous level indication and actions that should be taken. Correction curves will be provided for the operator's use. Procedure revisions for this item will be completed prior to Unit 1 returning to service from the present refueling outage. Operator training concerning this particular topic will be completed within one month, by November 5, 1979.

   The changes in procedures and operator training will be completed prior to startup of Unit 2.

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SALEM GENERATING STATION
NOS. 1 AND 2 UNITS
RESPONSE TO NRC BULLETIN 79-21

TABLE A

STEAM GENERATOR LEVEL INSTRUMENTATION
REFERENCE LEG HEATUP COMPENSATION

Reference Leg Ambient Temperature	Correction to Steam Generator Level % of Span
120°F	0%
200°F	3.5%
240°F	5.7%
300°F	9.6%
350°F	13.4%

Basis: Reference Leg Calibration

Temperature 120°F

Pressure 805 psia

Calculations assumed constant steam pressure with varying reference leg temperature.

Example: Containment ambient temperature is 240°F. Instrument indicates a level of 33%. Assuming reference leg has reached containment ambient temperature, the actual level in the steam generator is lower at 27.3%. Steam pressure is assumed to remain approximately the same (no large changes).

SALEM GENERATING STATION
NOS. 1 AND 2 UNITS
RESPONSE TO NRC BULLETIN 79-21

TABLE B

STEAM GENERATOR LEVEL INSTRUMENTATION

REFERENCE LEG COMPENSATION DUE TO STEAM PRESSURE

Steam Generator Pressure	Instrument Indicated Level	Actual Level
1000 psia	5.7%	5%
	32.5%	33%
	48.7%	50%
805 psia	5%	5%
	33%	33%
	50%	50%
600 psia	4.3%	5%
	33.7%	33%
	51.5%	50%
400 psia	3.7%	5%
	34.6%	33%
	53.3%	50%
200 psia	3.2%	5%
	36.0%	33%
	55.9%	50%

Basis: Reference Leg Calibration

Temperature 120°F

Pressure 805 psia

Calculations assumed constant reference leg temperature with varying steam pressure.

SALEM GENERATING STATION
NOS. 1 AND 2 UNITS
RESPONSE TO NRC BULLETIN 79-21

TABLE C

Pressurizer Level Instrumentation
Reference Leg Heatup Compensation

Reference Leg Ambient Temperature	Correction to Pressurizer Level % of Span
120°F	0%
200°F	5.3%
240°F	8.7%
300°F	14.6%
350°F	20.3%

Basis: Reference Leg Calibration

Temperature 120°F

Pressure 2250 psia

Calculations assumed constant pressure with varying reference leg temperature.

Example: Containment ambient temperature is 240°F
Instrument indicates a level of 30%.

Assuming reference leg has reached containment ambient temperature, the actual level in the pressurizer is lower at 21.3%. Pressurizer pressure is assumed to remain approximately the same (no large change).

SALEM GENERATING STATION
NOS. 1 AND 2 UNITS
RESPONSE TO NRC BULLETIN 79-21

TABLE D

Pressurizer Level Instrumentation
Reference Leg Compensation Due to Pressurizer Pressure

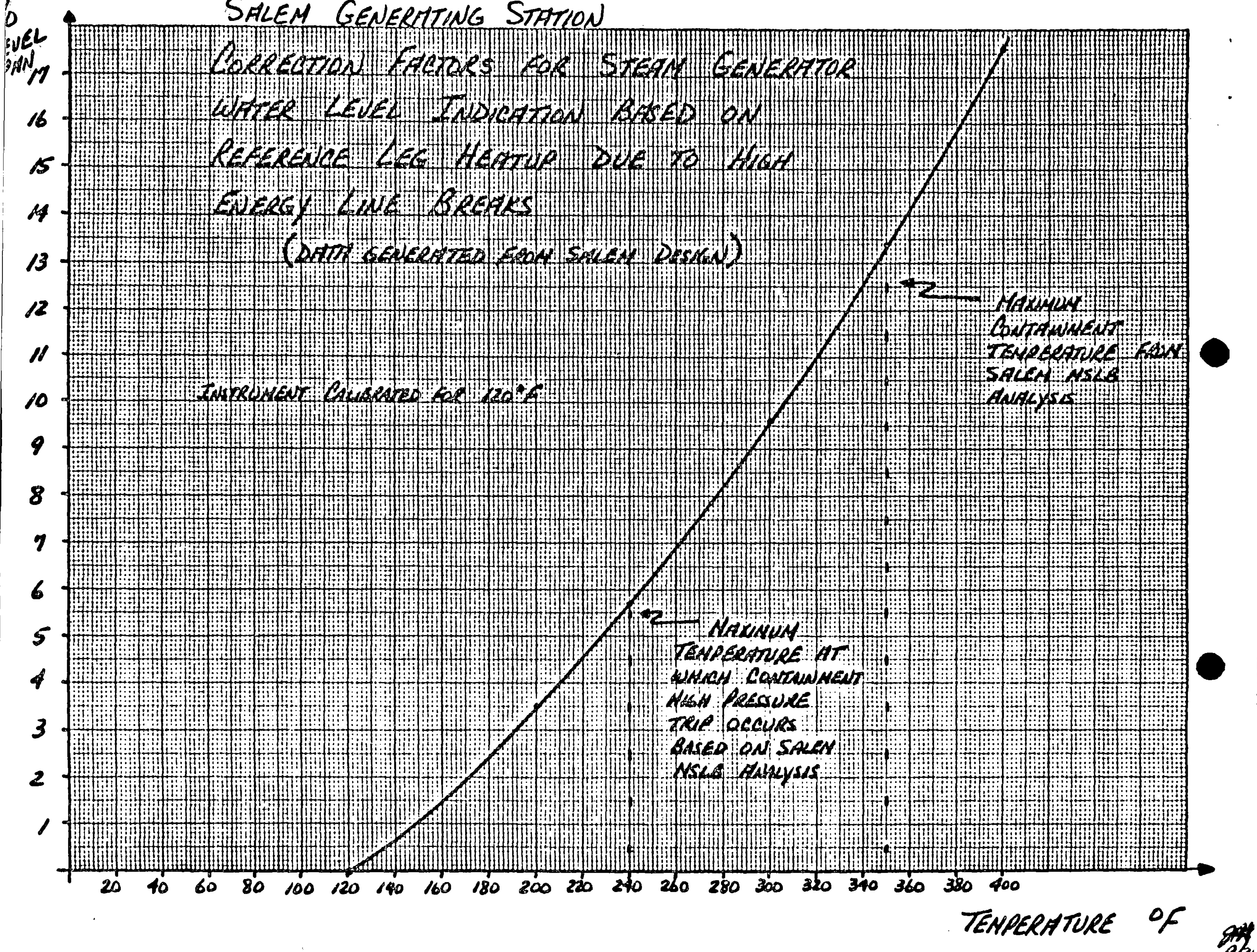
Pressurizer Pressure	Instrument Indicated Level	Actual Level
2500	21.8% 48.5%	20% 50%
2250	20% 50%	20% 50%
2000	18.6% 5 .5	20% 50%
1500	16.9% 55.0%	20% 50%
1000	16.1% 59.1%	20% 50%
500	16.2% 64.6%	20% 50%
100	18% 72.9%	20% 50%

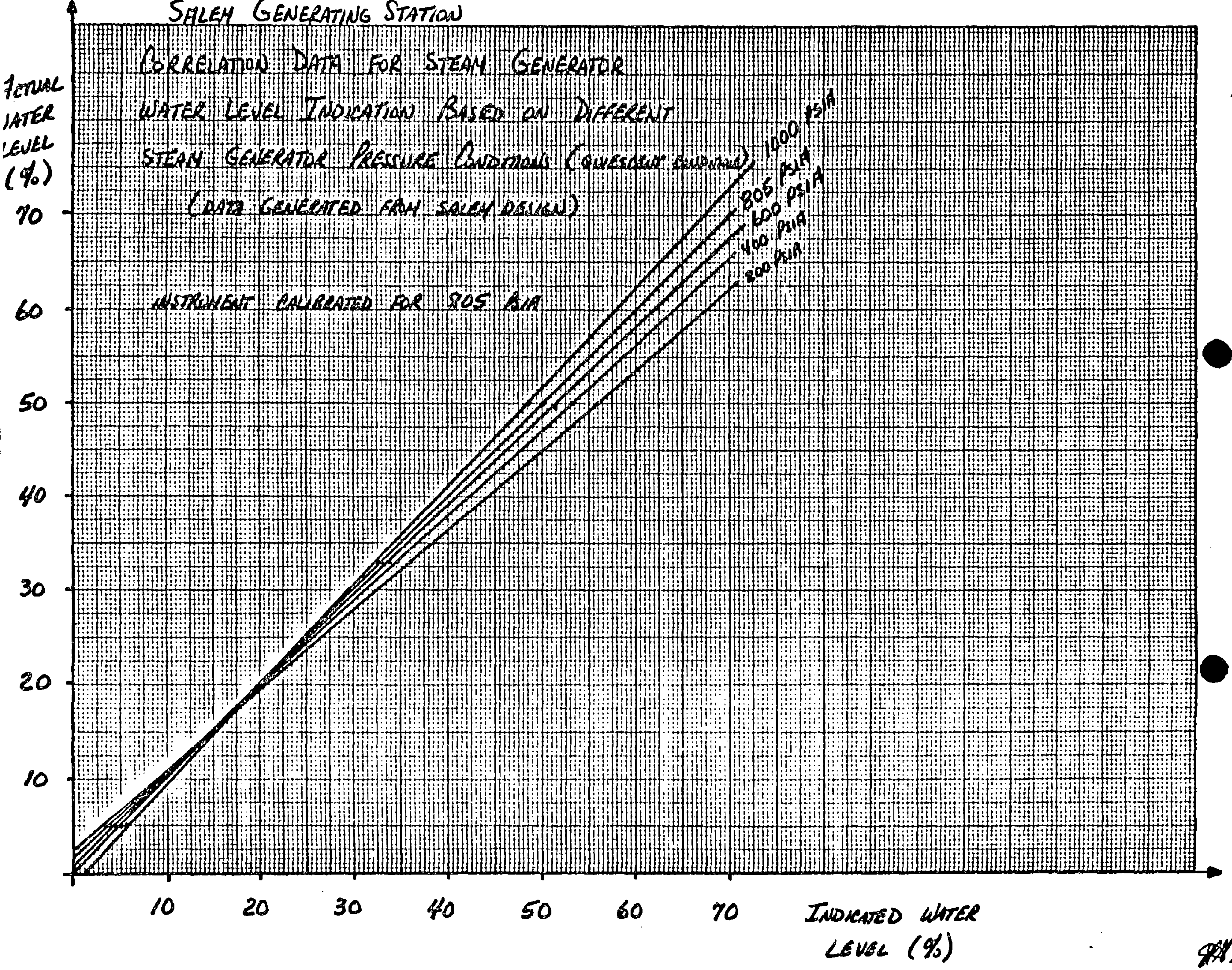
Basis: Reference Leg Calibration

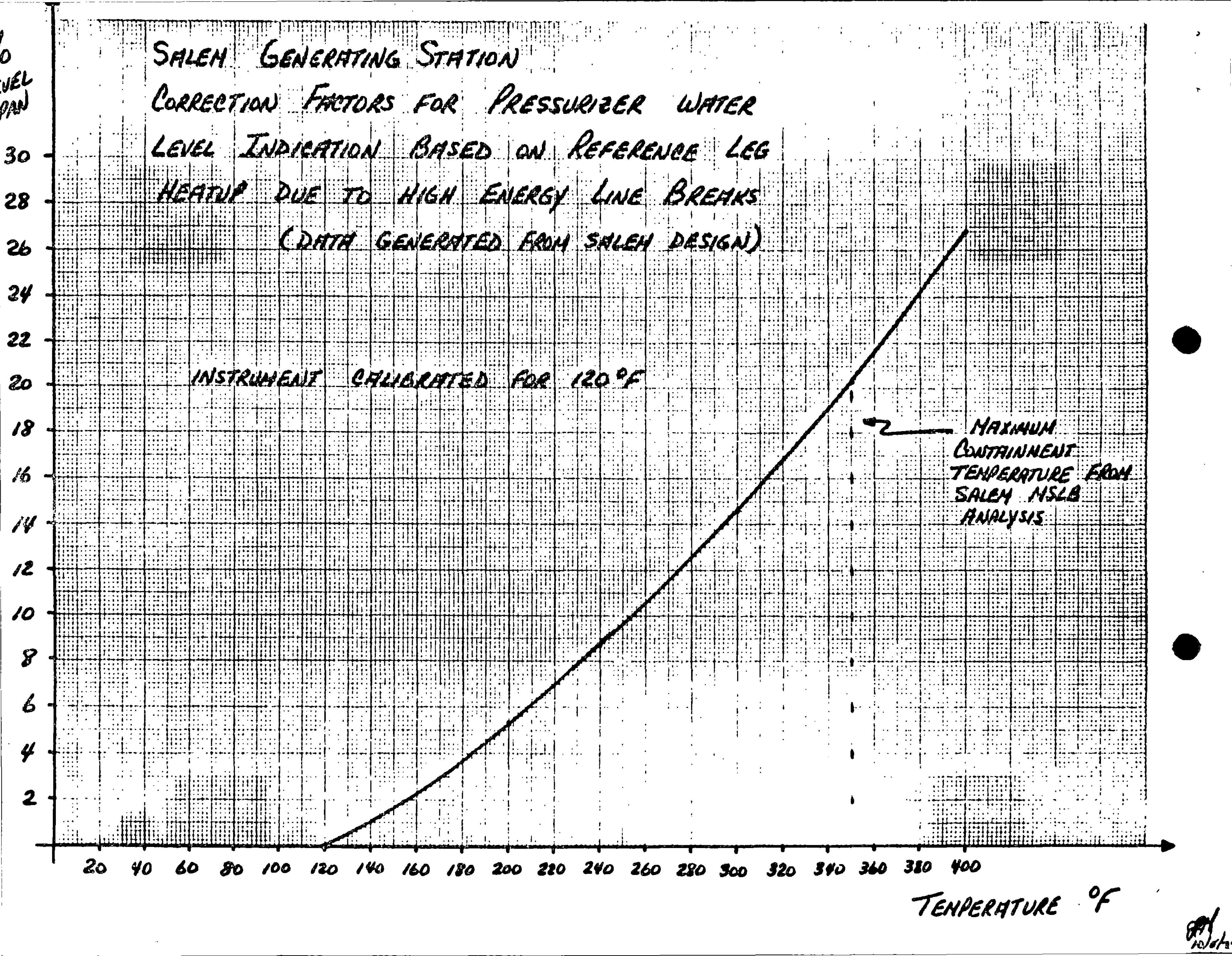
Temperature $120^{\circ}F$

Pressure 2250 psia

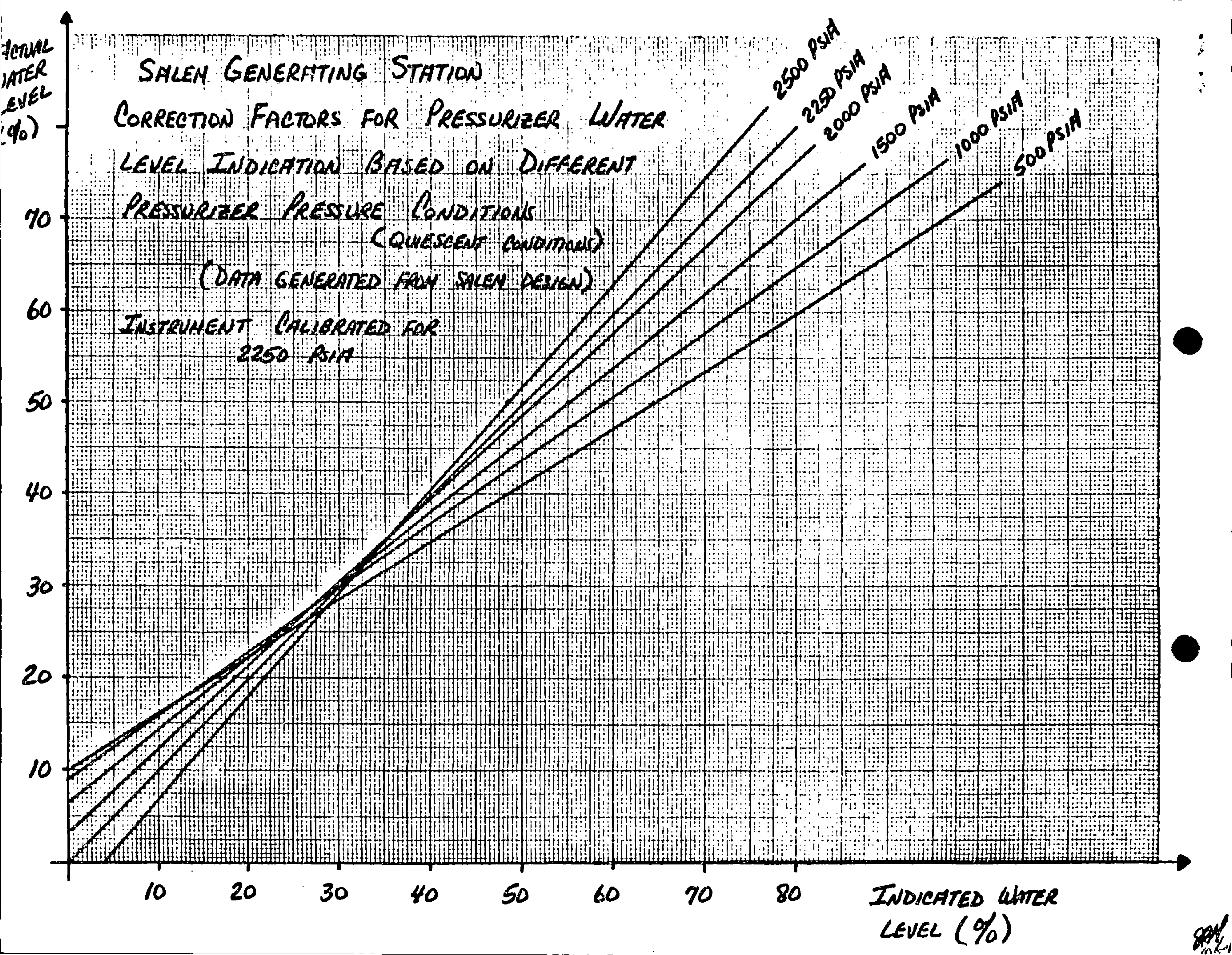
Calculations assumed constant reference leg temperature with varying pressurizer pressure.


SALEM GENERATING STATION
CORRECTION FACTORS FOR STEAM GENERATOR WATER LEVEL INDICATION BASED ON REFERENCE LEG HEATUP DUE TO HIGH ENERGY LINE BREAKS
(DATA GENERATED FROM SALEM DESIGN)
INSTRUMENT CALIBRATED FOR 120°F
MAXIMUM CONTAINMENT TEMPERATURE FROM SALEM HSLB ANALYSIS
MAXIMUM TEMPERATURE AT WHICH CONTAINMENT HIGH PRESSURE TRIP OCCURS BASED ON SALEM HSLB ANALYSIS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400
TEMPERATURE °F


SALEM GENERATING STATION
CORRELATION DATA FOR STEAM GENERATOR
WATER LEVEL INDICATION BASED ON DIFFERENT
STEAM GENERATOR PRESSURE CONDITIONS (QUIESCENT CONDITIONS)
(DATA GENERATED FROM SALEM DESIGN)
INSTRUMENT CALIBRATED FOR 805 PSIA
1000 PSIA
805 PSIA
600 PSIA
400 PSIA
200 PSIA
ACTUAL WATER LEVEL (%)
70
60
50
40
30
20
10
10
20
30
40
50
60
70
INDICATED WATER LEVEL (%)



SALEM GENERATING STATION
CORRECTION FACTORS FOR PRESSURIZER WATER LEVEL INDICATION BASED ON REFERENCE LEG HEATUP DUE TO HIGH ENERGY LINE BREAKS
(DATA GENERATED FROM SALEM DESIGN)
INSTRUMENT CALIBRATED FOR 120°F
MAXIMUM CONTAINMENT TEMPERATURE FROM SALEM HSLB ANALYSIS
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
TEMPERATURE °F


SALEM GENERATING STATION
CORRECTION FACTORS FOR PRESSURIZER WATER LEVEL INDICATION BASED ON DIFFERENT PRESSURIZER PRESSURE CONDITIONS
(QUIESCENT CONDITIONS)
(DATA GENERATED FROM SALEM DESIGN)
INSTRUMENT CALIBRATED FOR 2250 PSIA
ACTUAL WATER LEVEL (%)
INDICATED WATER LEVEL (%)
2500 PSIA
2250 PSIA
2000 PSIA
1500 PSIA
1000 PSIA
500 PSIA
10
20
30
40
50
60
70