Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

FPL

August 13, 2008

L-2008-186
10 CFR 50.90

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

RE: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Increase in Refueling Water Tank Level
LIC-109 Acceptance Review Additional Information

On June 30, 2008 FPL submitted a request for an amendment to the renewed Facility Operating License DPR-67 for St. Lucie Unit 1 and NPF-16 for St. Lucie Unit 2 that would modify Technical Specifications (TS) requirements related to Refueling Water Tank (RWT) minimum contained volume of borated water.

As a result of the LAR submittals and the subsequent NRC Staff's LIC-109 acceptance review, the NRC Staff requested supplementary information. This correspondence provides the FPL finalized responses to the NRC Staff's request for supplementary information received July 24, 2008.

The No Significant Hazards Analyses submitted with FPL letter L-2008-125 remains bounding.

In accordance with 10 CFR 50.91(b)(1), a copy of the proposed amendment was forwarded to the State Designee for the State of Florida.

Please contact Ken Frehafer at 772-467-7748 if there are any questions about this submittal.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on the 13th day of August 2008.

Very truly yours,

Gordon L. Johnston
Site Vice President
St. Lucie Plant

GLJ/KWF

Attachments

cc: Mr. William A. Passetti, Florida Department of Health

A001
NRR

The license amendment requests (LARs) propose to amend Facility Operating Licenses DPR-67 for St. Lucie Unit 1 and NPF-16 for St. Lucie Unit 2 to Increase the Refueling Water Tank (RWT) level. To support the Nuclear Regulatory Commission (NRC) assessment of the acceptability of the LARs in regard to the proposed changes, please provide the responses to the following items:

NRC Question 1:

Calculation methodology: Provide documentation (including sample calculations) of the methodology used for establishing the limiting RWT minimum water level and corresponding volume acceptable values for the As-Found and As-Left settings as measured in periodic surveillance testing. Indicate the related Analytical Limits and other limiting design values (and the sources of these values) for the RWT minimum water level and corresponding volume.

FPL Response to Question 1:

There are two separate RWT level monitoring instrumentation systems. The Recirculation Actuation System (RAS) level instrumentation is used to determine RWT level, provides local indication in the control room, and is used to verify that the Technical Specification requirements for RWT minimum contained volume of borated water, are being met. In addition to the RAS instrumentation, RWT HIGH/LOW level alarms are also available to the control room Operators. These alarms provide no safety related functions and are not relied upon by the control room Operators for RWT TS level compliance.

The calculations used for establishing the limiting RWT minimum water volume/level while containing conservatisms, are solely mechanical engineering calculations. The level calculations are not instrumentation and control calculations, and do not address the uncertainty associated with the RWT level instrumentation.

The Recirculation Actuation System (RAS) level instrumentation is used to determine RWT level. The uncertainty associated with the RAS RWT level channel indication is determined in calculations PSL-1FJI-08-002 (Unit 1) and PSL-2FJI-08-001 (Unit 2). These calculations are provided in Attachments 2 and 3, respectively. These calculations are performed in accordance with Florida Power and Light (FPL) Instrumentation and Control Standard IC-3.17, "Instrument Setpoint Methodology for Nuclear Power Plants".

Regulatory Guide (RG) 1.105, Setpoints for Safety-Related Instrumentation, describes a method acceptable to the NRC staff for complying with the NRC's regulations for ensuring that setpoints for safety-related instrumentation are initially within and remain within the Technical Specification limits, and endorses ANSI/ISA Standard ISA-67.04-1994, Part 1.

St. Lucie Units 1 and 2 are not specifically committed to RG 1.105. However, Standard IC-3.17 has been written to conform to ISA-67.04-1994, Part 1, and is also consistent with the recommended practice of ISA-67.04-1994, Part 2.

The methodology used for the development and application of RWT level instrument uncertainties is based on the Square Root-Sum of the Squares (SRSS) methodology. The methodology accounts for random, independent (x, y), random, dependent (w + u) and non-random/bias (v, t) elements differently in determining the Total Loop Uncertainty as follows:

$TLU = \pm[x^2 + y^2 + (w + u)^2]^{1/2} + v - t.$

The calculations form the basis for the ± tolerances established in the plant surveillance procedures for Engineered Safeguards System Loop Instrumentation Calibration for Refueling Water Storage Tank Level. Surveillances are performed to meet the requirements of TS ESFAS Table 4.3-2. The ± tolerances in these procedures provide guidance for acceptable "As Found" and "As Left" settings for the associated instrumentation channel.

As Found data found outside of the acceptable tolerances are flagged as unacceptable and subsequently adjusted back into tolerance. As Left data is recorded to document any adjustments to the instrument loop relative to its As Found condition.

In addition to the RAS RWT instrumentation described above, RWT HIGH/LOW level alarms are also available to the control room Operators. These alarms provide no safety related functions and are not relied upon by the control room Operators for RWT TS level compliance. The alarms, however give the control room Operators an early warning indication of RWT level trending high or low. Once the RWT level alarm is actuated the alarm response procedures (1-ARP-01-R23 & 2-ARP-01-S29) instruct the Operators to confirm levels by using the RAS RWT level indicators and to take the appropriate action if needed. The RWT low level alarm is set conservatively above the RWT minimum required level accounting for the uncertainty associated with the instrument alarm setpoint.

The Instrument Uncertainty calculations performed for the RWT HIGH/LOW alarm instrumentation (LIS-07-3 & LIS-07-1), also utilize FPL Standard IC-3.17, and are provided in Attachments 4 and 5 for Units 1 and 2, respectively.

NRC Question 2:

Measures to Ensure Operability: Describe the measures to be taken to ensure that the associated instrument channel is capable of performing its specified safety functions in accordance with applicable design requirements and associated analyses. Include in your discussion information on the controls you employ to ensure the as-left setting after completion of periodic surveillance is consistent with your methodology. Also, discuss the plant corrective action processes (including plant procedures) for restoring channels to operable status when channels are determined to be "inoperable" or "operable but degraded." If the controls are located in a document other than TS (e.g. plant test procedure), describe how it is ensured that the controls will be implemented.

FPL Response to Question 2:

The St. Lucie Unit 1 and Unit 2 Technical Specifications (TS) specify the operability requirements for the RAS RWT level instrumentation. The TSs also specify the Surveillance Requirements (SRs) that are to be performed to demonstrate that the instrumentation is operable. Performing the specified SRs ensure that the associated instrument channels are capable of performing their specified safety functions in accordance with applicable design requirements and associated analyses. TS SR 4.3.2.1.1 for Unit 1 and TS SR 4.3.2.1 for Unit 2, Functional Unit 5, Containment Sump Recirculation, requires the performance of a shiftly (12 hours) channel check, a monthly (31 days) channel functional test, and a channel calibration every refueling (18 months). The level indications used to verify RWT level are associated with the RAS channels. The instrumentation TSs do not specify a setpoint or allowable values for the RAS RWT level associated with the required minimum contained volume of borated water in the RWT, because there is no required automatic action (trip or equipment actuation) or alarm function for the RAS instrumentation associated with this plant condition.

NAP- 403 "Conduct of Maintenance" and QI-12-PR/PSL-7 "Calibration of Installed Plant Instrumentation and Control Equipment St. Lucie Plant" provide direction to maintenance personnel in the performance of maintenance activities. Calibration sheets, where appropriate, are completed with "As-Found" and "As-Left" calibration data, as well as measurement and test equipment (M&TE) usage.

A supervisor is required to review all surveillance data and determine if the data comply with the acceptance criteria. All TS and equipment operability concerns are promptly communicated to Operations. Nonconformances are documented in the CR system

Performance of the SRs and the associated implementing procedures ensure that the RWT level instrumentation is capable of performing its required functions.

Per plant procedures, any TS equipment found to be inoperable shall be declared out-of-service and entered into the Equipment Out-of-Service log. The equipment shall not be declared back in service until appropriate testing has been performed and documented, assuring the operability of the RWT level instrumentation.

Should the number of Operable channels be less than that required by TSs, LCO 3.3.2.1 Action Statement 13 would apply. Entry into TS Action Statements is tracked via the plant's Action Tracking database. Equipment return to service is controlled in accordance with the plant's Conduct of Operations. The Shift Manager shall authorize the return of Technical Specification, safety related, and risk significant equipment or systems to operable status provided, among others, that the component or system is capable of performing its design function, and required surveillance testing is satisfactorily completed.

RWT level instrumentation for the HIGH/LOW alarms are calibrated on an 18 month interval as part of the preventive maintenance program. The LOW alarm setpoint will be set at 33 feet which corresponds to the TS limit, and also accounts for instrument uncertainty.

TS SR 4.1.2.8.a.2 and TS SR 4.5.4.a.1 specifies that the RWT shall be demonstrated OPERABLE at least once per 7 days by verifying the water level in the tank (Unit 1)/verifying the contained borated water volume in the tank (Unit 2). In compliance with these TSs, plant Operators perform RWT level checks, utilizing instruments LIS-07-2A thru 2D, on a weekly basis in accordance with Operations Surveillance Procedure 1/2-OSP-100.01. The RWT level readings will be compared to a value of 33 feet, which corresponds to the TS limit, and also accounts for instrument uncertainty. The control room RWT level indicating functions of RAS are safety related and facilitate monitoring of RWT level to verify compliance with TS requirements for the RWT.

Sample Calculations

PSL-1FJI-08-002 Rev 0 (14 pages)
PSL-2FJI-08-001 Rev 0 (10 pages)
PSL-1FJI-92-009 Rev 1 (15 pages)
PSL-2FJI-92-008 Rev 2 (25 pages)

CALCULATION COVER SHEET

CALCULATION NUMBER: PSL-1FJI-08-002 **REV.** 0

TITLE: Unit 1 Refueling Water Tank Level LIS-07-2A, -2B, -2C and -2D Indication and High-High Alarm Uncertainty

0	Initial Issue	[redacted]	6/16/08	[redacted]	6/18/08	[redacted]	7/16/08
No	Description	By	Date	Chkd	Date	Appr	Date

REVISIONS

LIST OF EFFECTIVE PAGES

CALCULATION NUMBER: PSL-1FJI-08-002 REV. 0

TITLE: Unit 1 Refueling Water Tank Level LIS-07-2A, -2B, -2C and -2D Indication and High-High Alarm Uncertainty

Page	Section	Rev.	Page	Section	Rev.
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ii	List of Effective Pages	0			
iii	Table of Contents	0			
1	1.0	0			
2	2.0	0			
3	3.0 – 3.2	0			
4	4.0 – 4.12	0			
5	4.13	0			
6	4.14	0			
7	4.15	0			
8	4.16	0			
9	5.1 – 5.4	0			
10	5.5 – 5.6	0			
11	6.0	0			

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CALCULATION NUMBER: PSL-1FJI-08-002 REV. 0

TITLE: Unit 1 Refueling Water Tank Level LIS-07-2A, -2B, -2C and -2D Indication and High-High Alarm Uncertainty

SECTION	TITLE	PAGE
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1.0 PURPOSE / SCOPE

The purpose of this calculation is to determine the uncertainty associated with Refueling Water Tank (RWT) level indication as provided by RTGB 106 indicating switches LIS-07-2A, LIS-07-2B, LIS-07-2C, and LIS-07-2D.

In addition this calculation will determine the uncertainty of the RWT High-High level alarm, RTGB 106, window S-19, provided by LIS-07-2B and LIS-07-2B (see Reference 2.8).

This calculation is prepared in support of the Technical Specification proposed license amendment request (LAR) per PSL-ENG-SENJ-08-009, Rev. 0, which proposes to increase the minimum contained volume of borated water in the refueling water tank to 477, 360 gallons (32.5 ft), and PC/M 04096, Attachment 4.10, Section 2.0, Affected Calculations, to revise calculation PSL-1FJI-92-008 to reflect Versatile-to-OTEK indicator replacement. By Engineering Management decision, an independent calculation has been prepared for the above referenced loop functions rather than a revision to PSL-1FJI-92-008. PSL-1FJI-92-008 does not currently address the loop functions of RWT level Control Room indication and High-High level alarm. The segmented bargraph display of these indicators is considered an Operator Aid and is not part of the scope of this calculation.

The scope of Revision 0 is the Normal Loop Uncertainties (NLU) of the RWT level indicated value for the purpose of Operations Department maintaining level in accordance with station procedures and as prescribed in the Technical Specifications, and the NLU associated with the RWT High-High level alarm.

2.0 REFERENCES

2.1	FPL Standard IC-3.17, Rev. 7, Instrument Setpoint Methodology
2.2	St. Lucie Unit 1 Technical Specification, through Amendment 204 (3/4.1.2.7, 3/4.1.2.8, and 3/4.5.4. and Table 4.3.2)
2.3	PSL-ENG-SENJ-08-009, Rev. 0, License Amendment Request (LAR) to Increase the Minimum Contained Volume of Borated Water in the Refueling Water Tank
2.4	CWD Drawing 8770-B-327, Sheet 293, Rev. 21
2.5	CWD Drawing 8770-B-327, Sheet 294, Rev. 21
2.6	CWD Drawing 8770-B-327, Sheet 295, Rev. 18
2.7	CWD Drawing 8770-B-327, Sheet 296, Rev. 28
2.8	CWD Drawing 8770-B-327, Sheet 361, Rev. 11
2.9	Not Used
2.10	Not Used
2.11	PC/M 04091, Revision 0, Supplement 0, Unit 1 Versatile Indicator Replacement Project
2.12	CRN 04201-14598 (LIS-07-2A)
2.13	CRN 04201-14599 (LIS-07-2B)
2.14	CRN 04201-14600 (LIS-07-2C)
2.15	CRN 04201-14601 (LIS-07-2D
2.16	Procedure 1400190, Rev. 34, I&C Department Surveillance/Testing Schedule
2.17	Procedure 1-1400153H, Rev 13, Refueling Water Storage Tank Level Calibration
2.18	Calculation PSL-BFJI-92-003, Rev. 2, St. Lucie Units 1 & 2 Environmental Parameters for Instrument Uncertainty Analysis
2.19	Calculation PSL-1FJI-92-011, Rev. 2, PSL 1 Refueling Water Tank Level RAS Bistable Setpoint (L-07-2)
2.20	Total Equipment Database (TEDB) as of 6/9/08
2.21	Not Used
2.22	Technical Manual 8770-9821, Revision 6, Sigma/Versatile Indicators and Indicating Controllers
2.23	Drawing 8770-4544, Revision 3, Refueling Water Tank General Plan
2.24	IMP-77.02, Revision 11, OTEK Indicator Setup and Calibration
2.25	CR 2008-19846, Tracking CR for calculation integration into implementing design change for LAR (see Reference 2.3)
2.26	CR 2008-19850, Tracking CR for verifying assumptions on to-be-installed OTEK indicators (Replacement for Versatiles)

3.0 METHODOLOGY

The methodology used by this calculation for the development and application of uncertainties is based on the Square Root-Sum of the Squares (SRSS) methodology outlined in detail in Reference 2.1. The methodology accounts for random, independent (x, y), random, dependent (w + u) and non-random/bias (v, t) elements differently in determining the Normal Loop Uncertainty as follows:

$NLU = \pm[x^2 + y^2 + (w + u)^{1/2}]^{1/2} + v - t$

3.1 Elements of Uncertainty

Primary elements of uncertainty are identified in Reference 2.1. The terminology, abbreviations and uncertainty terms from Reference 2.1 to be addressed in this calculation, and that apply to these loops, are:

A	-	Device Reference Accuracy
DB	-	Deadband
D	-	Drift
HU	-	Humidity Effect
L	-	Linearity
M	-	Measuring & Test Equipment Uncertainty
PS	-	Power Supply Effect
REP	-	Repeatability
RES	-	Resolution
ST	-	Setting Tolerance (Calibration Tolerance)
Tn	-	Normal Environment Temperature Effect
SP	-	Nominal Setpoint
PL	-	Process Limit
NLU	-	Normal Loop Uncertainty

Any additional uncertainty terms introduced by vendor specifications will be addressed in Table 1.

Aggregate module (individual device) uncertainties will be denoted by the term e_x where "x" is a unique numeric identifier.

3.2 Setpoint Evaluation

The PL is the process parameter to be protected by the setpoint, in this case RWT overflow. A Limiting Setpoint ($SP_{LIMITING}$) will be determined in the manner:

$SP_{LIMITING} = PL - NLU$ (for an increasing process)

The existing calibration setpoint (SP_{CAL}) will be evaluated relative to $SP_{LIMITING}$ to determine if positive margin exists in the manner:

$Margin = SP_{LIMITING} - SP_{CAL}$

A positive Margin indicates that the existing setpoint adequately accounts for instrument uncertainty with regard to protecting against an overflow condition.

4.0 ASSUMPTIONS/BASES

4.1 The lower edge of the overflow nozzle has been determined to be at Elevation 38 ft (Reference 2.19). For the purpose of this calculation, 38.00 ft is taken as the PL for the High-High alarm.

4.2 The level transmitters (LT-07-2A, -2B, -2C and -2D) are located outdoors, and the remainder of the loops are located in the Control Room, therefore accident uncertainties are not applicable.

4.3 From Reference 2.19, errors associated with the resistors in the loop have been determined to be negligible relative to the magnitude of other uncertainties.

4.4 For initial and intermediate computations conventional rounding will be used and the final NLU values will be rounded conservatively to the degree of resolution of the digital display.

4.5 Uncertainties associated with the level transmitters have already been determined in Reference 2.19. For the purpose of this calculation, the transmitter uncertainty, denoted by e_1, will be carried forward into this calculation as verified input.

4.6 The transmitters and loops are calibrated for a process range of 0 ft to 50 ft for a 4 to 20 mAdc signal (References 2.17, 2.19, and 2.20). Transmitters LT-07-2A, -2B, -2C, and -2D provide an input signal to the Recirculation Actuation Signal (RAS) bistables, and level transmitter uncertainty is developed in calculation PSL-1FJI-92-008 (Reference 2.19).

4.7 OTEK Indicating Switch setting tolerances are assumed to be per the guidelines of Reference 2.24.

4.8 The Indicating Switch calibrations are currently within Reference 2.17, which is performed on a Refueling Cycle interval (Reference 2.16 and Reference 2.2 Table 4.3-2, for the RAS circuit). For the purpose of Drift determination, the total calibration interval is assumed to be 18 months + 25% Technical Specification Interval over-ride, or 24 months.

4.9 The M&TE used to calibrate the digital display & relay is assumed to be at least as accurate as the rated accuracy of the device. For the installed Versatiles M&TE error term is based on typical DMM accuracies rather than bounding value (±0.01% Span, typical, for DMMs, based on OE).

4.10 Hardware Error terms for which no vendor specifications are published are assumed to be negligible or not applicable unless otherwise noted.

4.11 For an inside diameter of 50 ft (Reference 2.23), the RWT volume-to-height relationship is:

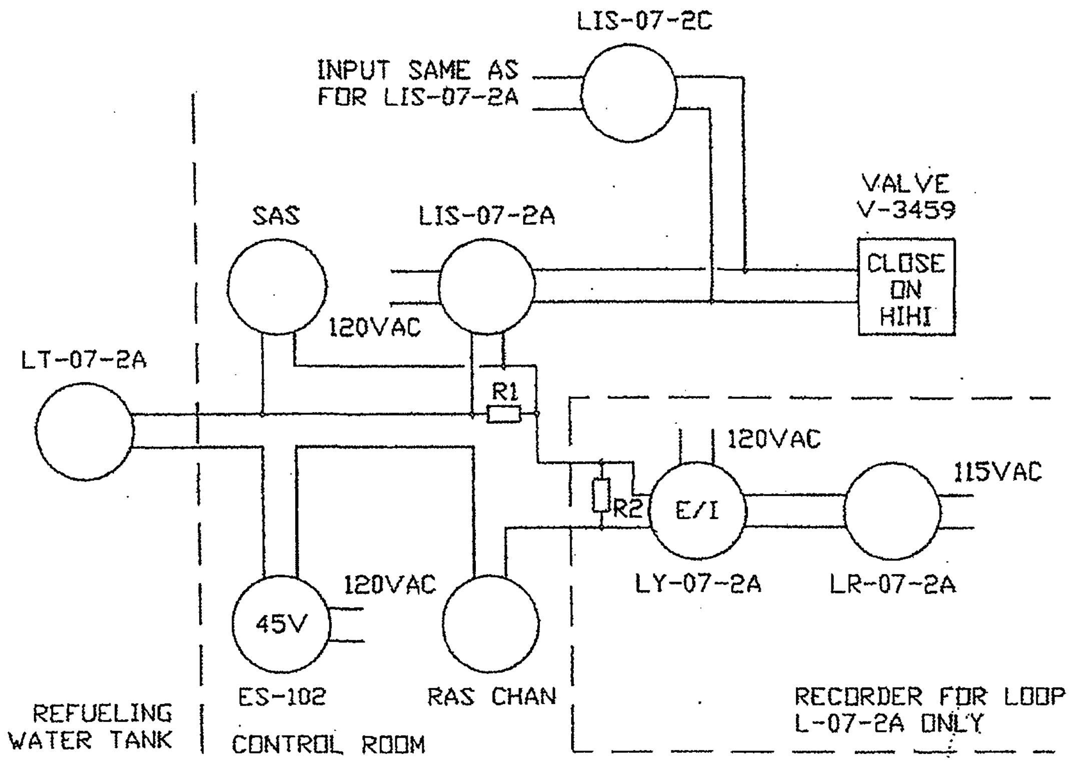
$V/ft = (50)^2 \times \pi / 4$

$V/ft = 1963.5\ ft^3 / ft$, in gallons at 7.4805 gallons per cubic ft:

V/ft = 14, 688 gallons/ft elevation

4.12 **UNVERIFIED ASSUMPTION (tracking CR 2008-19850)** OTEK setting tolerance (ST) is assumed equal to ±0.2% Span (±0.03 mAdc, ±0.1 ft), digital display resolution is assumed to XX • X, and procedurally specified MTE accuracy, when installed by the applicable (Reference 2.12 to 2.15) OTEK CRNs.

4.13 As excerpted from Reference 2.19, the following depicts the loop diagram for the RWT level indicating loops, L-07-2A and L-07-2C. The two loops are essentially the same, changing only in the measurement channel suffix. Loop L-07-2A also provides input to a RWT level recorder in the control room.

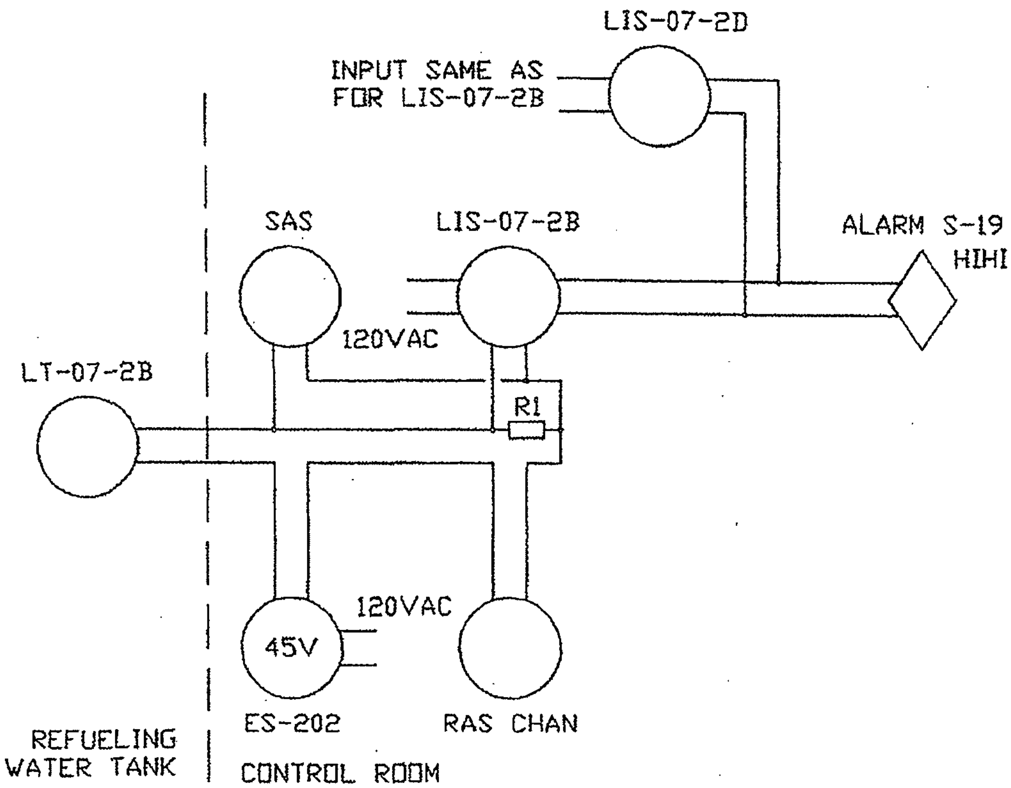


R_1 is a 250Ω ±0.1% resistor
R_2 is a 250Ω ±0.1% resistor

Figure 5.1a: Loops L-07-2A and L-07-2C

(Excerpt from calculation PSL-1FJI-92-011, Rev. 2)

4.14 As excerpted from Reference 2.19, the following depicts the loop diagram for the RWT level indicating loops, L-07-2B and L-07-2D. The two loops are essentially the same, changing only in the measurement channel suffix.



R_1 is a 262Ω ±0.1% resistor

Figure 5.1b: Loops L-07-2B and L-07-2D
(Excerpt from calculation PSL-1FJI-92-011, Rev. 2)

4.15 Versatile Indicating Switch Inputs Table 1

Parameter	Input/Computation	Reference
Mfg/Model Number	Versatile 2000-21D	2.20
Range/Span	Range: 0 to 50 ft Span: 50 ft	2.20
Location	Control Room RTGB 106	2.20
Environment (Normal)	Temperature Setting: 75 °F nominal T_{MAX} = 80 °F for uncertainty calculations Humidity: 60% RH nominal (conservatively specified) Radiation: Negligible	2.18
Minimum Calibration Temperature	68 °F	2.18
Calibration Interval	Maximum 24 months (18 months + 25%)	Assumption 4.8
Digital Indication Accuracy (A)	0.1% Span + 1 digit A = ±[0.1 + 0.2] % Span A = ±0.3% Span	2.22
Alarm Setpoint Accuracy (REP)	REP = 0.1% Span + 1 digit = A; independently programmed	2.22
Resolution (RES)	1 Digit; Display set, and fixed, for XX•X ft RES = ±0.1 ft RES = ±0.2% Span	2.17; 2.22
Linearity (L)	Assumed negligible or N/A	Assumption 4.10
Temperature Effect (Tn)	±0.02% /°C; ΔT = [80-68] = 12 °F, or [26.67 – 20] = 6.67 °C Tn = ±[(0.02/°C) x 6.67 °C] % Span Tn = ±0.133 % Span	2.22
Line Voltage Effect (PS)	±0.25% per 10% line change. By engineering judgment, for a regulated power source and allowing for a 1% line swing: PS = ±0.025 % Span	2.1, 2.22
Frequency Effect	Assumed negligible or N/A (no specification quoted by the vendor)	Assumption 4.10
Humidity Effect (HU)	Assumed negligible or N/A (no specification quoted by the vendor)	Assumption 4.10
Drift (D)	Not initially specified by vendor. Assumed 0.1% Span + 1 digit; assumed for 24 months (see note 1) D = ±0.3% Span	2.1; 2.11 Assumption 4.8
Measuring & Test Equipment (M)	M&TE ≤ A (M&TE ≤±0.2% Span); but based on OE for DMMs: M = ±0.01% Span, typical, for DMMs	Assumption 4.9
Digital Display Setting Tolerance (ST)	ST = ±0.1 ft; by inspection: ST = ±0.2% Span	2.17
Relay Setting Tolerance (ST)	ST = ±0.06 mAdc, by inspection: ST = ±0.4% Span	2.17
Deadband (DB)	Not specified by vendor; assumed not applicable based on decreasing level trending to TS Low. For relay, not an error term. DB = N/A	Assumption 4.10

Note 1: For this application, the D specification is sourced from the Tech Manual rather than PC/M 04091

4.16 OTEK Indicating Switch Inputs Table 2

Parameter	Input/Computation	Reference
Mfg/Model Number	OTEK HI-Q2000	2.11
Range/Span	Range: 0 to 50 ft Span: 50 ft	2.18, 2.20
Location (pending installation)	Control Room RTGB 106	2.18, 2.20
Environment (Normal)	Temperature Setting: 75 °F nominal T_{MAX} = 80 °F for uncertainty calculations Humidity: 60% RH nominal (conservatively specified) Radiation: Negligible	2.18
Minimum Calibration Temperature	68 °F	2.18
Calibration Interval	Maximum 24 months (18 months + 25%)	Assumption 4.8
Digital Indication Accuracy (A)	±0.01% Full Scale (FS) or ±0.01% Span	2.11
Resolution (RES)	1 Digit; Display set for XX•X ft; by inspection: RES = ±0.2% Span	2.12; 2.13; 2.14; 2.15
Linearity (L)	±0.01% FS or ±0.01% Span (See Note 1)	2.11
Repeatability (REP)	±0.01% FS or ±0.01% Span (See Note 1)	2.11
Temperature Effect (Tn)	±0.002% FS/ °F (See Note 2); ΔT = [80-68] = 12 °F Tn = ±[(0.002/ °F) x 12 °F] % Span Tn = ±0.024 % Span	2.11
Line Voltage Effect (PS)	±0.0003% FS, 90 to 140 VAC. Assumed negligible by inspection	2.1, 2.11
Frequency Effect	+0.00047% FS 47 to 440 Hz; negligible by inspection	2.1, 2.11
Humidity Effect (HU)	Not specified by vendor. Assumed negligible for a controlled environment	2.1, 2.11
Drift (D)	< ±0.2% FS over 24 months D = ±0.2% Span	2.11
Measuring & Test Equipment (M)	M = ±0.01% Span	Assumption 4.9
Digital Display Setting Tolerance (ST)	ST = ±0.2% Span	2.23; Assumption 4.7
Relay Setting Tolerance (ST)	ST = ±0.2% Span (0.032 mAdc, conservatively rounded to 0.03 based on OE for other OTEK relays)	2.23; Assumption 4.7
Deadband (DB)	±0.01% FS, assumed not applicable based on decreasing level trending to TS Low. For relay, not an error term. DB = N/A	2.1; 2.11

Note 1: For conservatism and convenience, uncertainty determinants L and REP are assumed applicable, in addition to A, to the digital display and alarm function.
Note 2: PC/M 04091, Attachment 4.9 gives Tn as an implied bias (+) function per °F; however for the purposes of this calculation and consistent with the methodology of Reference 2.1, the specification is assumed to be bi-directional (±) and random.

5.0 CALCULATION

5.1 Transmitter Uncertainty (e_1)

From Section 5.2.3 of calculation PSL-1FJI-92-011 (Reference 2.19) and where e_1 is the module uncertainty of the transmitter:

$e_1 = \pm [A^2 + D^2 + M^2 + ST^2 + Tn^2]^{1/2}$ % span; substituting:

$e_1 = \pm [0.25^2 + 0.25^2 + 0.35^2 + 0.25^2 + 0.36^2]^{1/2}$ % span

$e_1 = \pm 0.663$ % span

5.2 Versatile Indicating Switch Uncertainty (e_2)

Initially, the uncertainties for the alarm output are the same as for the digital display, except for ST, where the alarm ST, as currently calibrated, is bounding for the display ST, and for RES, which is not an error determinant for the alarm function; but for convenience and conservatism e_2 will be developed using RES to be typical for both module functions. For convenience and conservatism, the bounding alarm ST and display RES will be used for e_2, typical for both module functions.

From Table 1 of this Attachment and where e_2 is the module uncertainty of the indicator's digital display and alarm functions:

$e_2 = \pm [A^2 + D^2 + M^2 + ST^2 + Tn^2 + RES^2 + PS^2]^{1/2}$ % Span, substituting:

$e_2 = \pm [0.3^2 + 0.3^2 + 0.01^2 + 0.4^2 + 0.133^2 + 0.2^2 + 0.025^2]^{1/2}$ % Span

$e_2 = \pm 0.631$ % Span

5.3 Versatile Indicating Switch Normal Loop Uncertainty (NLU)

$NLU = \pm [e_1^2 + e_2^2]^{1/2}$, substituting:

$NLU = \pm [0.663^2 + 0.631^2]^{1/2}$ % Span

$NLU = \pm 0.915$ % Span

$NLU = \pm [0.915 / 100 \times 50]$ ft

$NLU = \pm 0.458$ ft, rounded to reflect readability to the least digit:

$NLU = \pm 0.5$ ft

5.4 OTEK Indicating Switch Uncertainty (e_3)

From Table 2 of this Attachment and where e_3 is the module uncertainty (pending installation, see References 2.12 through 2.15) of the indicator's digital display function:

Initially, the uncertainties for the alarm output are the same as for the digital display, except for RES which is not an error determinant for the alarm function; but for convenience and conservatism e_3 will be developed using RES to be typical for both module functions.

$e_3 = \pm [A^2 + D^2 + M^2 + ST^2 + Tn^2 + REP^2 + L^2 + RES^2]^{1/2}$ % span, substituting:

$e_3 = \pm [0.01^2 + 0.2^2 + 0.01^2 + 0.2^2 + 0.024^2 + 0.01^2 + 0.01^2 + 0.2^2]^{1/2}$ % Span

$e_3 = \pm 0.348$ % Span

5.5 OTEK Indicating Switch Normal Loop Uncertainty (NLU)

$NLU = \pm [e_1{}^2 + e_3{}^2]^{1/2}$, substituting:

$NLU = \pm [0.663^2 + 0.348^2]^{1/2}$ % Span

$NLU = \pm 0.749$ % Span

$NLU = \pm [0.749 / 100 \times 50]$ ft

$NLU = \pm 0.374$ ft, rounded to reflect readability to the least digit (XX • X):

$NLU = \pm 0.4$ ft

For OTEK display resolution of XX • XX (if desired), NLU is rounded to:

$NLU = \pm 0.37$ ft

5.6 High-High Alarm Setpoint Evaluation

Versatile Channel

Per Assumption 4.1, the lower edge of the overflow nozzle is at elevation 38 ft (assumed 38.00 ft for computation purposes), defined here as the Process Limit for determining the limiting setpoint (without any margin) and evaluating the existing calibration setpoint (SP_{CAL}). Then, for an increasing setpoint, initially:

Limiting Setpoint ($SP_{LIMITING}$) = PL – NLU, substituting:

$SP_{LIMITING} = [38.00 - 0.5]$ ft

$SP_{LIMITING} = 37.5$ ft

Margin = $SP_{LIMITING}$ - SP_{CAL}, substituting:

Margin = $[37.5 - 37.75]$ ft

Margin = (-) 0.25 ft

The calculated margin for the Versatile indicator channels High-High alarm is negative, by ~ 3 inches, noting that this result is a 2σ value.

OTEK Channel (pending installation –see References 2.12 through 2.15)

Note: For conservatism, the setpoint uncertainty is based on the XX • X digital display resolution NLU results

Similarly:

Limiting Setpoint ($SP_{LIMITING}$) = PL – NLU, substituting:

$SP_{LIMITING} = [38.00 - 0.4]$ ft

$SP_{LIMITING} = 37.6$ ft

Margin = $SP_{LIMITING}$ - SP_{CAL}, substituting:

Margin = $[37.6 - 37.75]$ ft

Margin = (-) 0.15 ft

The calculated margin for the Versatile indicatc. channels High-High alarm is negative, by ~ 1.8 inches, noting that this result is a 2σ value.

6.0 RESULTS

For the purpose of evaluating the RWT level with respect to Technical Specification minimum inventory, the uncertainties associated with the digital display of the current Versatile and pending OTEK Indicating Switches LIS-07-2A, LIS-07-2B, LIS-07-2C, and LIS-07-2D are:

Versatile Indicators (existing)

Indication

For the purpose of evaluating the RWT level with respect to Technical Specification minimum inventory, the uncertainty associated with the digital display of Versatile Indicating Switch LIS-07-2A, LIS-07-2B, LIS-07-2C, and LIS-07-2D is ± 0.5 ft or ± 6 inches or ± 7,344 gallons.

High-High Alarm

For the purpose of evaluating the RWT level with respect to High-High level alarm, the uncertainty associated with the alarm relay of Versatile Indicating Switches LIS-07-2B and LIS-07-2D ± 0.5 ft or ± 6 inches or ± 7,344 gallons. With the lower edge of the overflow nozzle as a process limit, the margin from the process limit to the calibration setpoint, accounting for uncertainties, is negative. Therefore the High-High Alarm will warn of imminent or occurring overflow conditions, but may not provide sufficient time for remedial action to prevent an overflow. For overflow protection, the High level alarm from LIS-07-3 (37.5 ft ± 0.24 ft – see calculation PSL-1FJI-92-009, Section 6.1) will need to be relied upon.

Otek Indicators (pending installation –see References 2.12 through 2.15)

Indication

For the purpose of evaluating the RWT level with respect to Technical Specification minimum inventory, the uncertainty associated with the digital display of the OTEK Indicating Switch LIS-07-2A, LIS-07-2B, LIS-07-2C, and LIS-07-2D is:

For a display resolution of XX • X: ± 0.4 ft or ± 4.8 inches or ± 5,875 gallons.

For a display resolution of XX • XX: ± 0.37 ft or ± 4.44 inches or ± 5,435 gallons.

High-High Alarm

Note: For conservatism, the setpoint uncertainty is based on the XX • X digital display resolution NLU results

For the purpose of evaluating the RWT level with respect to High-High level alarm, the uncertainty associated with the alarm relay of OTEK Indicating Switches LIS-07-2B and LIS-07-2D is ± 0.4 ft or ± 4.8 inches or ± 5,875 gallons, an improvement of 0.1 ft relative to the Versatiles. With the lower edge of the overflow nozzle as a process limit, the margin from the process limit to the calibration setpoint, accounting for uncertainties, is negative. Therefore the High-High Alarm will warn of imminent or occurring overflow conditions, but may not provide sufficient time for remedial action to prevent an overflow. For overflow protection, the High level alarm from LIS-07-3 (37.5 ft ± 0.24 ft – see calculation PSL-1FJI-92-009, Section 6.1) will need to be relied upon.

CALCULATION COVER SHEET

CALCULATION NUMBER: PSL-2FJI-08-001 **REV.** 0

TITLE: Unit 2 Refueling Water Tank Level LIS-07-2A, -2B, -2C and -2D Indication and High-High Alarm Uncertainty

0	Initial Issue	[redacted]	6/16/08	[redacted]	6/17/08	[redacted]	6/17/08
No.	Description	By	Date	Chkd	Date	Appr	Date
REVISIONS							

LIST OF EFFECTIVE PAGES

CALCULATION NUMBER: PSL-2FJI-08-001 REV. 0

TITLE: Unit 2 Refueling Water Tank Level LIS-07-2A, -2B, -2C and -2D Indication and High-High Alarm Uncertainty

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ii	List of Effective Pages	0			
iii	Table of Contents	0			
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2	2.0	0			
3	3.0 – 3.2	0			
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7	6.0	0			

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TITLE: Unit 2 Refueling Water Tank Level LIS-07-2A, -2B, -2C and -2D Indication and High-High Alarm Uncertainty

SECTION	TITLE	PAGE
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1.0 PURPOSE / SCOPE

The purpose of this calculation is to determine the uncertainty associated with Refueling Water Tank (RWT) level indication as provided by RTGB 206 indicating switches LIS-07-2A, LIS-07-2B, LIS-07-2C, and LIS-07-2D.

In addition this calculation will determine the uncertainty of the RWT High-High level alarm, RTGB 206, window S-19, provided by LIS-07-2C (see Reference 2.8).

This calculation is prepared in support of the Technical Specification proposed license amendment request (LAR) per PSL-ENG-SENJ-08-009, Rev. 0, which proposes to increase the minimum contained volume of borated water in the refueling water tank to 477, 360 gallons (32.5 ft), and PC/M 04096, Attachment 4.10, Section 2.0, Affected Calculations, to revise calculation PSL-2FJI-92-008 to reflect Versatile-to-OTEK indicator replacement. By Engineering Management decision, an independent calculation has been prepared for the above referenced loop functions rather than a revision to PSL-2FJI-92-008. PSL-2FJI-92-008 does not currently address the loop functions of RWT level Control Room indication and High-High level alarm. The segmented bargraph display of these indicators is considered an Operator Aid and is not part of the scope of this calculation.

The scope of Revision 0 is the Normal Loop Uncertainties (NLU) of the RWT level indicated value for the purpose of Operations Department maintaining level in accordance with station procedures and as prescribed in the Technical Specifications and the NLU associated with the RWT High-High level alarm.

2.0 REFERENCES

2.1	FPL Standard IC-3.17, Rev. 7, Instrument Setpoint Methodology
2.2	St. Lucie Unit 2 Technical Specification, through Amendment 151,(Section 3.1.2.7, 3.1.2.8, 3.5.4, and Table 3.3.4)
2.3	PSL-ENG-SENJ-08-009, Rev. 0, License Amendment Request (LAR) to Increase the Minimum Contained Volume of Borated Water in the Refueling Water Tank
2.4	CWD Drawing 2998-B-327, Sheet 293, Rev. 15
2.5	CWD Drawing 2998-B-327, Sheet 294, Rev. 18
2.6	CWD Drawing 2998-B-327, Sheet 295, Rev. 13
2.7	CWD Drawing 2998-B-327, Sheet 296, Rev. 23
2.8	CWD Drawing 2998-B-327, Sheet 361, Rev. 10
2.9	CWD Drawing 2998-B-327, Sheet 1192, Rev. 4
2.10	CWD Drawing 2998-B-327, Sheet 648, Rev. 4
2.11	PC/M 04096, Revision 0, Supplement 0, Versatile Indicator Replacement Project
2.12	CRN 04201-13515 (LIS-07-2A)
2.13	CRN 04201-13518 (LIS-07-2B)
2.14	CRN 04201-13462 (LIS-07-2C)
2.15	CRN 04201-13516 (LIS-07-2D)
2.16	Procedure 1400190, Rev. 34, I&C Department Surveillance/Testing Schedule
2.17	Procedure 2-1400153G, Rev 11A, Engineered Safeguards System Loop Instrumentation Calibration for Refueling Water Storage Tank Level
2.18	Calculation PSL-BFJI-92-003, Rev. 2, St. Lucie Units 1 & 2 Environmental Parameters for Instrument Uncertainty Analysis
2.19	Calculation PSL-2FJI-92-008, Rev. 1, PSL 2 Refueling Water Tank Level Setpoint Loops L-07-1 and L-07-2A, B, C, & D
2.20	Total Equipment Database (TEDB) as of 6/9/08
2.21	Calculation NSSS-022, Revision 1, RWT Level
2.22	CR 2008-19846, Tracking CR for calculation integration into implementing design change for LAR (see Reference 2.3)

3.0 METHODOLOGY

The methodology used by this calculation for the development and application of uncertainties is based on the Square Root-Sum of the Squares (SRSS) methodology outlined in detail in Reference 2.1. The methodology accounts for random, independent (x, y), random, dependent (w + u) and non-random/bias (v, t) elements differently in determining the Normal Loop Uncertainty as follows:

$$NLU = \pm[x^2 + y^2 + (w + u)^{1/2}]^{1/2} + v - t$$

3.1 Elements of Uncertainty

Primary elements of uncertainty are identified in Reference 2.1. The terminology, abbreviations and uncertainty terms from Reference 2.1 to be addressed in this calculation, and that apply to these loops, are:

A	-	Device Reference Accuracy
DB	-	Deadband
D	-	Drift
HU	-	Humidity Effect
L	-	Linearity
M	-	Measuring & Test Equipment Uncertainty
PS	-	Power Supply Effect
REP	-	Repeatability
RES	-	Resolution
ST	-	Setting Tolerance (Calibration Tolerance)
Tn	-	Normal Environment Temperature Effect
SP	-	Nominal Setpoint
PL	-	Process Limit
NLU	-	Normal Loop Uncertainty

Any additional uncertainty terms introduced by vendor specifications will be addressed in Table 1.

Aggregate module (individual device) uncertainties will be denoted by the term e_x where "x" is a unique numeric identifier.

3.2 Setpoint Evaluation

The PL is the process parameter to be protected by the setpoint, in this case RWT overflow. A Limiting Setpoint ($SP_{LIMITING}$) will be determined in the manner:

$$SP_{LIMITING} = PL - NLU \text{ (for an increasing process)}$$

The existing calibration setpoint (SP_{CAL}) will be evaluated relative to $SP_{LIMITING}$ to determine if positive margin exists in the manner:

$$Margin = SP_{LIMITING} - SP_{CAL}$$

A positive Margin indicates that the existing setpoint adequately accounts for instrument uncertainty with regard to protecting against an overflow condition.

4.0 ASSUMPTIONS/BASES

4.1 The lower edge of the overflow nozzle has been determined to be at Elevation 38 ft (Reference 2.19). For the purpose of this calculation, 38.00 ft is taken as the PL for the High-High alarm.

4.2 The level transmitters (LT-07-2A, -2B, -2C and -2D) are located outdoors, and the remainder of the loops are located in the Control Room, therefore accident uncertainties are not applicable.

4.3 From Reference 2.19, errors associated with the resistors in the loop have been determined to be negligible relative to the magnitude of other uncertainties.

4.4 For initial and intermediate computations conventional rounding will be used and the final NLU values will be rounded conservatively to the degree of resolution of the digital display.

4.5 Uncertainties associated with the level transmitters have already been determined in Reference 2.19. For the purpose of this calculation, the transmitter uncertainty, denoted by e_1, will be carried forward into this calculation as verified input.

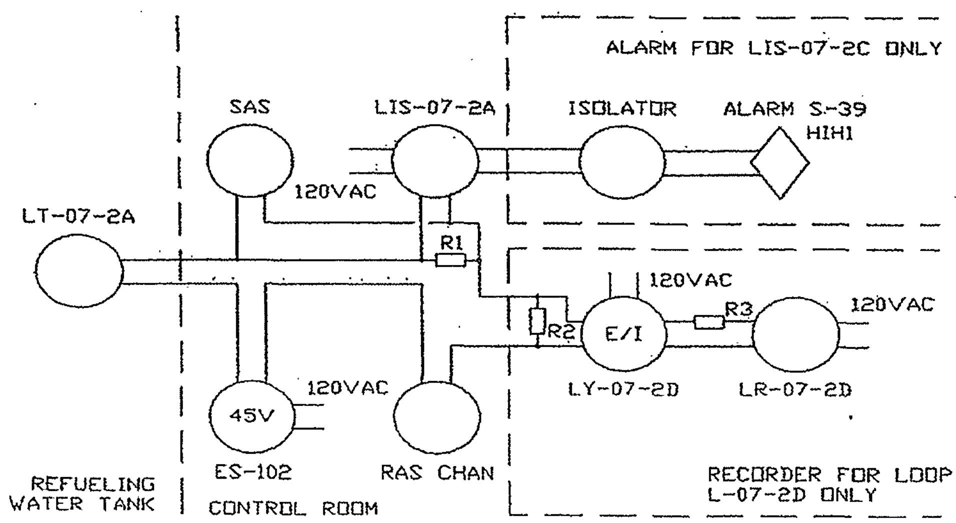
4.6 The transmitters and loops are calibrated for a process range of 0 ft to 50 ft for a 4 to 20 mAdc signal (References 2.17, 2.19, and 2.20). Transmitters LT-07-2A, -2B, -2C, and -2D provide an input signal to the Recirculation Actuation Signal (RAS) bistables, and level transmitter uncertainty is developed in calculation PSL-2FJI-92-008 (Reference 2.19).

4.7 The RWT relative volume-to-height is ~ 14,688 gallons/foot (Reference 2.21).

4.8 The Indicating Switch calibrations are currently within Reference 2.17, which is performed on a Refueling Cycle interval (Reference 2.16 and Reference 2.2 Table 4.3-2, for the RAS circuit). For the purpose of Drift determination, the total calibration interval is assumed to be 18 months + 25% Technical Specification Interval over-ride, or 24 months.

4.9 The M&TE used to calibrate the digital display & relay is assumed to be at least as accurate as the rated accuracy of the indicating switch.

4.10 The following depicts the loop diagram for the RWT level indicating loops, L-07-2. The four loops are essentially the same, changing only in the measurement channel suffix. However, LIS-07-2C also provides a contact output which feeds a control room annunciator. Loop L-07-2D also provides input to a RWT level recorder in the control room.



R_1 is a 250Ω ±0.1% resistor
R_2 is a 250Ω ±1% resistor
R_3 is a 50Ω ±0.01% resistor

4.11 Indicating Switch Inputs Table 1

Parameter	Input/Computation	Reference
Mfg/Model Number	OTEK HI-Q2000	2.20
Range/Span	Range: 0 to 50 ft Span: 50 ft	2.20
Location	Control Room RTGB 206	2.20
Environment (Normal)	Temperature Range: 75 ±5 °F T_{MAX} = 80 °F for uncertainty calculations Humidity: 60% RH (conservatively specified) Radiation: Negligible	2.18
Minimum Calibration Temperature	68 °F	2.17, 2.18
Calibration Interval	Maximum 24 months (18 months + 25%)	Assumption 4.8
Digital Indication Accuracy (A)	±0.01% Full Scale (FS) or ±0.01% Span	2.11
Resolution (RES)	1 Digit; Display set for XX•XX ft; by inspection: RES = ±0.02% Span	2.12; 2.13, 2.14, 2.15, 2.17
Linearity (L)	±0.01% FS or ±0.01% Span (See Note 1)	2.11
Repeatability (REP)	±0.01% FS or ±0.01% Span (See Note 1)	2.11
Temperature Effect (Tn)	±0.002% FS/°F (See Note 2); ΔT = [80-68] = 12 °F Tn = ±[(0.002/°F) x 12 °F] % Span Tn = ±0.024 % Span	2.11
Line Voltage Effect (PS)	±0.0003% FS, 90 to 140 VAC. Assumed negligible by inspection	2.1, 2.11
Frequency Effect	+0.00047% FS 47 to 440 Hz; negligible by inspection	2.1, 2.11
Humidity Effect (HU)	Not specified by vendor. Assumed negligible for a controlled environment	2.1, 2.11
Drift (D)	< ±0.2% FS over 24 months D = ±0.2% Span	2.11
Measuring & Test Equipment (M)	M = ±0.01% Span	Assumption 4.9
Digital Display Setting Tolerance (ST)	ST = ±0.1 ft, by inspection: ST = ±0.2% Span	2.17
Relay Setting Tolerance (ST)	ST = ±0.03 mAdc, by inspection: ST= ±0.2% Span (0.032 mAdc, conservatively rounded)	2.17
Deadband (DB)	±0.01% FS, assumed not applicable based on decreasing Process. For relay, not an error term. DB = N/A	2.11

Note 1: For conservatism and convenience, uncertainty determinants L and REP are assumed applicable, in addition to A, to the digital display and alarm function.
Note 2: PC/M 04096, Attachment 4.9 gives Tn as an implied bias (+) function per °F; however for the purposes of this calculation and consistent with the methodology of Reference 2.1, the specification is assumed to be bi-directional (±) and random.

5.0 CALCULATION

5.1 Transmitter Uncertainty

From Section 5.5 of calculation PSL-2FJI-92-008 (Reference 2.19) and where e_1 is the module uncertainty of the transmitter:

$e_1 = \pm [A^2 + D^2 + M^2 + ST^2 + Tn^2]^{1/2}$ % span; substituting:

$e_1 = \pm [0.125^2 + 0.125^2 + 0.125^2 + 0.177^2 + 0.18^2]^{1/2}$ ft

$e_1 = \pm 0.333$ ft or ± 0.665 % span

5.2 Indicating Switch Uncertainty

From Table 1 of this Attachment and where e_2 is the module uncertainty of the indicator's digital display function:

$e_2 = \pm [A^2 + D^2 + M^2 + ST^2 + Tn^2 + REP^2 + L^2 + RES^2]^{1/2}$ % span, substituting:

$e_2 = \pm [0.01^2 + 0.2^2 + 0.01^2 + 0.2^2 + 0.024^2 + 0.01^2 + 0.01^2 + 0.02^2]^{1/2}$ % span

$e_2 = \pm 0.285$ % span

From Table 1 of this Attachment and where e_3 is the module uncertainty of the indicator's alarm relay function:

Initially, RES is not applicable for the relay and the remaining terms from e_2 are the same for e_3, substituting:

$e_3 = \pm [0.01^2 + 0.2^2 + 0.01^2 + 0.2^2 + 0.024^2 + 0.01^2 + 0.01^2]^{1/2}$ % span

$e_3 = \pm 0.285$ % span

Therefore e_2 is typical for both the digital display function and the relay alarm function.

5.3 Normal Loop Uncertainty

$NLU = \pm [e_1^2 + e_2^2]^{1/2}$, substituting:

$NLU = \pm [0.665^2 + 0.285^2]^{1/2}$ % span

$NLU = \pm 0.723$ % span

$NLU = \pm [0.723 / 100 \times 50]$ ft

$NLU = \pm 0.37$ ft

5.4 Setpoint Evaluation

Per Assumption 4.1, the lower edge of the overflow nozzle is at elevation 38 ft (assumed 38.00 ft for computation purposes), defined here as the Process Limit for determining the limiting setpoint (without any margin) and evaluating the existing calibration setpoint (SP_{CAL}). Then, for an increasing setpoint, initially:

Limiting Setpoint ($SP_{LIMITING}$) = PL – NLU, substituting:

$SP_{LIMITING} = [38.00 - 0.37]$ ft

$SP_{LIMITING} = 37.63$ ft

Margin = $SP_{LIMITING}$ - SP_{CAL}, substituting:

Margin = [37.63 – 37.75] ft

Margin = (-) 0.12 ft

The calculated margin is slightly negative, by ~ 1.4 inch, noting that this result is a 2σ value.

6.0 RESULTS

For the purpose of evaluating the RWT level with respect to Technical Specification minimum inventory, the uncertainty associated with the digital display of the OTEK Indicating Switch LIS-07-2A, LIS-07-2B, LIS-07-2C, LIS-07-2D is ± 0.37 ft or ± 4.44 inches or ± 5,435 gallons.

For the purpose of evaluating the RWT level with respect to High-High level alarm, the uncertainty associated with the alarm relay of OTEK Indicating Switch LIS-07-2C is ± 0.37 ft or ± 4.44 inches or ± 5,435 gallons. With the lower edge of the overflow nozzle as a process limit, the margin from the process limit to the calibration setpoint, accounting for uncertainties, is negative. Therefore the High-High Alarm will warn of imminent or occurring overflow conditions, but may not provide sufficient time for remedial action to prevent an overflow. For overflow protection, the High level alarm from LIS-01-1 (37.5 ft ± 0.0.28 ft – see calculation PSL-2FJI-92-008, Section 5.3.1) will need to be relied upon.

CALCULATION COVER SHEET

CALCULATION NUMBER: PSL-1FJI-92-009 REV. 1

TITLE: PSL 1 REFUELING WATER TANK LEVEL SETPOINT (L-07-3)

Purpose of Revision 1:
To evaluate the impact of an administrative RWT level of 32.5 feet based on Engineering Evaluation PSL-ENG-SEMS-05-022, Rev. 0, Response to NRC Request for Additional Information Regarding Bulletin 2003-01 Responses, on the acceptability of the RWT level instrumentation (loop L-07-3) setpoint for the Technical Specification (TS) minimum RWT level.

The changes to the setpoint calculations have been developed to support an Engineering Evaluation for Refueling Water Tank (RWT) License Amendment Request (LAR) to raise the RWT Technical Specification level to provide for additional post-accident sump level margin for St. Lucie Unit 1 and the resulting UFSAR updates. The changes establish proposed administrative limits due to the implementation of the containment sump modifications under PC/Ms 06138 and 06139.

1	Revision 1, Incorporate Revised Administrative Level Limit per PSL-ENG-SEMS-05-022	[redacted] [redacted]	6-24-08	[redacted] [redacted]	7/14/08	[redacted] [redacted]	7-14-08
0	Initial Issue		10/1/92		10/1/92		1/26/93
No.	Description	By	Date	Chkd	Date	Appr	Date
REVISIONS							

LIST OF EFFECTIVE PAGES

CALCULATION NUMBER: PSL-1FJI-92-009 REV. 1

TITLE: PSL 2 REFUELING WATER TANK LEVEL SETPOINT (L-07-3)

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1-2	Attachment 1	0			
1	Attachment 2	0			

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ATTACHMENT	TITLE	NUMBER OF PAGES
1	Vendor Instrument Data Sheets and catalog cut from Reference 2.15	2
2	Walkdown Notes	1

1.0 PURPOSE / SCOPE

1.1 Purpose

The purpose of this calculation is to determine the acceptability of the Refueling Water Tank (RWT) level instrumentation (loop L-07-3) setpoint for the Technical Specification (TS) minimum RWT level.

1.2 Scope

The scope of this calculation is limited to the evaluation of uncertainties associated with the low level alarm function.

Changes from previous revision

- Revised the assumptions and bases to incorporate the results of revised Calculation NSSS-004.
- Provided recommendations for a new low level alarm setpoint incoporating the results of Revised Calculation NSSS-004 to support the LAR.
- All attachments to Revision 1 of this calculation are valid for Revision 2, therefore no changes in the attachments are required.
- Updated all affected references

1.3 Loop Description

The subject level loop (L-07-3) provides control room alarm of "RWT LEVEL – HIGH/LOW". The low level is indicative of level approaching the TS minimum operating level and the high level is the first alarm given for level approaching overflow.

2.0 REFERENCES

2.1 FPL Standard IC-3.17, Rev. 7, Instrument Setpoint Methodology

2.2 St. Lucie Unit 1 Technical Specification, Amend. 204 (Sect. 3.1.2.7, 3.1.2.8 and 3.5.4)

2.3 St. Lucie Unit 1 FSAR, Amendment 22, Section 6.3.2.2.4, and 7.3

2.4 St. Lucie I&C Procedures for Calibration of Installed Plant Instruments:
1400065, Rev. 42C, Maintenance and Calibration

2.5 Instrument Arrangement Drawing, 8770-G-229 Sh 1, Rev. 15

2.6 Control & Wiring Diagram, 8770-B-327

Sheet 296 Rev. 28	Containment Pressure, Temp. & Refueling Tank Water Level
Sheet 362 Rev. 13	Engineered Safeguards Annunciator 'R' Sht. 1 RTGB-106

2.7 Ebasco Sketches SK-2998-M-531A/8770-M-28A and SK-8770-M-28, RWT Levels – PSL 1 & 2

2.8 Calculation:
NSSS-004, Rev. 3, RWT Volume for Post LOCA Heat Removal

2.9 Piping Handbook, 6th Edition, Mohinder L. Mayyar

2.10 Instrument Installation Detail, 8770-B-231 Sheet 7-5, Rev. 3 and Sheet 30-18, Rev. 3

2.11 FPL Calculation PSL-BFJI-92-003, Rev 1, St. Lucie Units 1 & 2
Environmental Parameters for Instrument Uncertainty Analysis

2.12 Ebasco Calculation IC.0004, Rev 4, Safety Injection Tank Level Instrumentation

2.13 ITT Barton Instruction Manual, 8770-6480, Rev 2, Differential Pressure Ind. Switches

2.14 Engineering Evaluation PSL-ENG-SEMS-05-022, Rev. 0, Response to NRC Request for Additional Information Regarding Bulletin 2003-01 Responses

2.15 TEDB, Total Equipment Data Base

3.0 METHODOLOGY

3.1 The setpoints will be determined from data give in the FSAR, TS, and other design documents. The setpoints will then be evaluated for acceptability considering instrument uncertainties.

3.2 The methodology employed by this calculation for the application of uncertainties is based on the Square-Root-Sum-of-the-Squares (SRSS) methodology outlined by Reference 2.1. The methodology accounts for random-independent (x, y), random-dependent (w, u) and non-random/bias (v, t) elements differently in determining the total loop uncertainty (TLU), as follows:

$$TLU = (x^2 + y^2 + (w + u)^2)^{1/2} + v - t$$

The level instrumentation provided by this loop is utilized to provide alarms to verify compliance with the TS requirements and impending overflow conditions. The normal loop uncertainties will be determined, as applicable. This instrument loop is non-nuclear safety related and Seismic Category I (for pressure boundary integrity) and is not required for safe-shutdown of the plant.

Potential elements or device uncertainty and terminology are as follows:

Elements of Uncertainty

* A - Device reference accuracy
CSE - Chemical Spray Effect (accident only)
C - Calibration Tolerance (combination of M and ST)
* DB - Deadband
* D - Drift
*H - Hysteresis (typically included in reference accuracy)
*HU - Humidity Effects (includes accident or seismic effects)
IR - Insulation Resistance (accident only)
*L - Linearity (typically included in reference accuracy)
M - Measuring and Test Equipment (M&TE) uncertainty
PC - Process Considerations
*PS - Power Supply Effects
*Ra - Radiation Effects (accident)

3.0 METHODOLOGY (continued)

3.2 Elements of Uncertainty (continued)

*	Rn	-	Radiation Effects (normal)
*	REP	-	Repeatability (typically included in reference accuracy)
*	S	-	Seismic Effect
*	SPE	-	Static Pressure Effect
	ST	-	Setting Tolerance (typically equal to reference accuracy)
*	RES	-	Readability or resolution
*	Ta	-	Temperature Effects (accident)
*	Tn	-	Temperature Effects (normal)

Note: * designates instrument uncertainties typically provided by the vendor.

Terminology/Abbreviations

SP	-	Nominal Set Point
OL	-	Operating Limit
PL	-	Process Limit
SL	-	Safety Limit
NLU	-	Normal Loop Uncertainty
TLU	-	Total Loop Uncertainty

4.0 ASSUMPTIONS/BASES

4.1 Calculation NSSS-004, RWT contained volume for Post LOCA Heat Removal, identifies a minimum RWT contained volume of 477,360 gallons available for Post LOCA, ECCS and CSS based on the RWT administrative level of 32.5 feet. (References 2.8 and 2.14). For the purpose of this calculation, it is assumed that the proposed RWT administrative level of 32.5' will be equal to the new TS value.

4.2 The level indicating switch is calibrated at 37' 6" (HIGH) (Ref. 2.15) and a proposed (LOW) setpoint is in Section 5.3.3). The high setpoint provides the first alarm of impending overflow conditions and the low alarm provides indication of approaching TS level.

4.3 The level indicating switch is located outdoors (Reference 2.15) and is not exposed to any abnormal environmental conditions; therefore, chemical spray effect, insulation resistance, accident temperature, and accident radiation are not applicable.

4.4 As concluded in Reference 2.11, the calibration temperature of the differential pressure switch is 68°F. The differential between the maximum temperature and the assumed calibration temperature is 25°F.

4.5 The indicating switch is calibrated for a range of 0 to 40'. The indicating switch's elevation of approximately 48½" above the bottom of the tank is calibrated out per Section 6.2. (Reference 2.10) The switch's elevation was determined from the installation detail (Reference 2.10) and was verified by a walkdown documented via Attachment 2.

4.6 The fluid in the RWT is water with a minimum boron concentration of 1720 pm (Reference 2.2). The specific gravity of water at 68°F is 1.00 and boric acid is 1.435 at 15°C (Reference 2.12, Paragraph 5.6). The specific gravity of the RWT fluid is a combination of the water and boric acid specific gravities (Reference 2.12, Paragraph 7.4) and is equal to

$$\frac{(100-0.9840) * (1.000) + (0.9840) * (1.435)}{100} = 1.0043 \text{ @68°F}$$

This specific gravity applied to the actual tank level is the level measured by the differential pressure switch, i.e. 39' (maximum tank level) is measured as 39' * 1.0043 or 39.17'. The actual tank level is 0.17' less than measured for a bias of -0.43%. This bias is a shift in the measured level and is to be applied during differential pressure switch calibration. Therefore, it will not be considered as an uncertainty.

CALCULATION NUMBER: PSL-1FJI-92-009 REVISION: 0

5.0 CALCULATION

5.1 Loop Diagram

The following depicts the loop block diagram for the RWT level indicating switch, L-07-3.

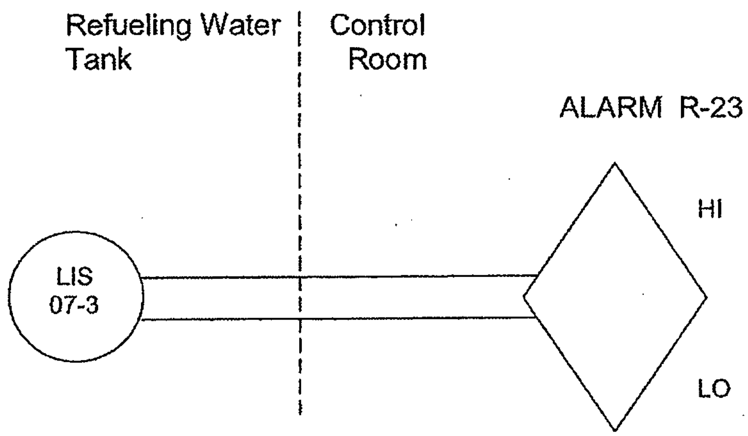

Figure 5.1: Loop L-07-3

5.2 Setpoint Determination of Minimum RWT Level

5.2.1 The function of the minimum RWT level setpoint is to provide an alarm that the RWT level is approaching TS minimum level for operating modes.

5.2.2 The level alarm is determined / affected by the following instrument:

LIS-07-3	ITT / Barton 288A	Ref. 2.15 (TEDB)

The calibrated span of the level indicating switch is 0 to 40 ft. (Ref. 2.15)

5.2.3 The instrument uncertainties are shown in Attachment 1. All the uncertainties are itemized below:

UNCERT	DESCRIPTION / VALUE
A	The accuracy specified for this instrument is for the indicator. There is no accuracy for the switching action.
CSE	N/A (Paragraph 4.3)
DB	DB is assumed to be included in A for the indictor. Deadband is not applicable to the switching action. The switch has a fixed reset.
D	The drift of the indicating switch is not specified by the vendor and assumed to be equal to the repeatability. D = ± 0.2% span (span = full scale for this instrument)
H	N/A for the switch
HU	This uncertainty is not specified by the vendor. (Attachment 1) It is assumed that the humidity affects are negligible as this instrument is a mechanical device which is not normally affected by changes in humidity.
IR	N/A (Paragraph 4.3)
L	N/A for the switch
M	Reference 2.4 requires M&TE with accuracies equal to or better than the equipment being calibrated. For conservatism, the repeatability of the calibrated instrument will be used for all M&TE used for calibration. The LIS requires a pressure gauge for the input and a meter to check the output contact continuity. Only the pressure gauge has an uncertainty associated with it. M = ± 0.2 % span

5.2 Setpoint Determination of Minimum RWT Level

5.2.3 (continued)

UNCERT		DESCRIPTION / VALUE
PC	(1)	Process considerations include expansion /contraction of the tank due to temperature variations. The thermal expansion coefficient for carbon steel is 7.8×10^{-6}" / °F/ linear foot (Reference 2.9, Table A3.3). For the normal temperature differential of 25°F (Paragraph 4.4), the expected circumferential expansion for the 50' diameter tank would be

$$T_{diff} * T_{coeff} * \pi * DIA = 25 * 7.8 \times 10^{-6} * 157 = 0.03'$$

Adding this to the circumference results in a diameter of

$$DIA = \frac{(D_{old} * \pi) + 0.03}{\pi} = 50.01'$$

This is the thermally expanded diameter considering worst cases. The volume varies with the square of the tank radius, so the volume difference is given by

$$VOL_{diff} = \frac{VOL_1 - VOL_2}{VOL_1} = \frac{DIA^2 - D_{old}^2}{D_{old}^2} = 0.04\%$$

PC (2) The level of water in the RWT will fluctuate with the temperature of the water due to density changes. Level is directly proportional to specific gravity assuming the other two dimensions of the volume are constant.

Differential pressure types of level measuring devices are subject to uncertainties due to differences in water volume because of temperature related density variations. The differential pressure switch measures the water level relative to standard temperature and pressure (STP) regardless of variations of temperature. Therefore, as the temperature and water level rises, the dferrential pressure switch signal does not change since the weight of the water has not changed.

The volume of water required by TS is based upon pounds of water expressed as gallons. So in this case, it is desirable to measure the water level relative to a constant temperature. Therefore, the uncertainties due to temperature related density variations are not applicable.

5.2 Setpoint Determination of Minimum RWT Level

5.2.3 (continued)

UNCERT	DESCRIPTION / VALUE
PS	N/A (Attachment 1)
Ra	N/A (Paragraph 4.3)
Rn	Normal radiation effects are assumed to be included in reference accuracy and drift.
REP	REP = ± 0.2% span
S	The level switch seismic effect is unstated by the vendor. (Attachment 1) This instrument is not required to be seismically qualified other than for pressure boundary integrity; therefore, this uncertainty is not applicable.
SPE	The RWT is vented to the atmosphere (Reference 2.7); therefore, there is no static pressure.
ST	Generally equal to the repeatability for the level switch. However, ST = ± 0.5 % span
Ta	N/A (Paragraph 4.3)
Tn	The vendor does not specify any temperature uncertainty but does state that the instrument is temperature compensated. It is assumed that this results in no temperature related uncertainty.

5.2.4 The uncertainty equation for the setpoint, considering only the applicable normal uncertainties, is

$$NLU = (PC^2 + REP^2 + D^2 + M^2 + ST^2)^{1/2}$$

$$NLU = ((0.04)^2 + (0.2)^2 + (0.2)^2 + (0.2)^2 + (0.5)^2)^{1/2}$$

NLU = ± 0.61% span = ± 0.24' = ± 2 -15/16"

5.2.5 There are no seismic or accident uncertainties which are applicable; therefore, TLU = NLU.

5.3 Evaluation of Low Setpoint

5.3.1 The administrative limit of 32.5' level (Ref. 2.14) translates to 477,360 gallons, based on 14,688 gals / ft height, (Ref. 2.8). This value is based upon the values determined in Mech Calc NSSS-004 (Ref. 2.8).

5.3.2 The existing low level setpoint of 28' 3" (equivalent to 415,000 gallons) was evaluated under Revision 0 of this calculation, based on the current TS value of 401,800 gallons. It provides a margin of 10,500 gallons, or 8.5" level. With the admininistrative limit of 32.5' level the TS value is to be increased accordingly.

5.3.3 A proposed low level setpoint is established as follows:

A low level setpoint (without margin) is equal to 477,360 gals (32.5' * 14,688 gals / ft height (Ref. 2.12) + 0.24' (3,525 gals) uncertainty (Section 5.2.4), or 32.74' or 480,885 gallons.

With 0.26' (3819 gals), or 3.14" margin (assumed to round off)

Low level setpoint = 32.74' + 0.26' = 33' or 484,704 gallons

The proposed low level setpoint of 33' is acceptable because the setpoint, including uncertainties, is greater than the TS minimum operating level of 477, 360 gals (Assumptions/Bases Section 4.1), with a margin of 3819 gals.

6.0 Results

6.1 The following table shows the setpoints and the normal loop uncertainties.

Instrument	Setpoint	NLU
LIS-07-3 High[1]	37' 6"	± 0.6% span ± 0.24' ± 2-15/16"
LIS-07-3 Low[2]	33'	± 0.6% span ± 0.24' ± 2-15/16"

Note 1: The high setpoint data is provided for information. The setpoint is carried over from Rev. 0 of this calculaton and is not changed by Rev. 1. The NLU determined for the low setpoint is applied to the high setpoint.

Note 2: This Low setpoint is proposed to support the LAR. A design change will be required to implement a setpoint change.

6.2 The following table shows the calibration data for the RWT level instrumentation.

Refueling Water Tank Level Instrumentation Calibration Data		
Input % span	**LIS-07-3**[1] Input (in wc)	**LIS-07-3** Indication (ft)
0	-48.7	0
25	71.8	10
50	192.3	20
75	312.8	30
100	433.4	40
Setpoint	397.7[3] 403.2[2]	33' (low)[3] 37' 6" (high)[2]
Setting Tolerance	± 0.5% span ± 2.4" wc	± 0.5% span ± 2.4"

Note1: The calibration inputs are based on the 48½" differential pressure switch offset (Paragraph 4.5) and the minimum specific gravity of the solution (Paragraph 4.6).

Note 2: The high setpoint data is provided for information. The setpoint is from Reference 2.15.

Note 3: This Low setpoint is proposed to support the LAR. A design change will be required to implement a setpoint change.

6.3 The proposed setpoint for the TS minimum operating RWT level meets the new administrative level of 32.5 feet.

CALCULATION COVER SHEET

CALCULATION NUMBER: PSL-2FJI-92-008 REV. 2

TITLE: PSL 2 REFUELING WATER TANK LEVEL SETPOINT LOOPS L-07-1 AND L-07-2A, B, C, & D

Purpose of Revision 2:
To evaluate the impact of a proposed administrative RWT level of 32.5 feet based on Engineering Evaluation PSL-ENG-SEMS-05-022, Rev. 0, Response to NRC Request for Additional Information Regarding Bulletin 2003-01 Responses, on the acceptability of the RWT level instrumentation setpoints for the Technical Specification (TS) minimum level and the overflow high level alarm (loop L-07-1), and the input signal to the Engineered Safety Functions Actuation System (ESFAS) Recirculation Actuation System (RAS) (loops L-07-2A, 2B, 2C, & 2D).

The changes to the setpoint calculations have been developed to support an Engineering Evaluation for Refueling Water Tank (RWT) License Amendment Request (LAR) to raise the RWT Technical Specification level to provide for additional post-accident sump level margin for St. Lucie Units 1 and 2 and the resulting UFSAR updates. The changes establish proposed administrative limits due to the implementation of the containment sump modifications under PC/Ms 06138 and 06139.

2	Revision 2 - Incorporate Revised Administrative Level Limit per PSL-ENG-SEMS-05-022	[redacted]	6-24-08	[redacted]	7/14/08	[redacted]	7-14-08
1	Clarifications and Typo Corrections		4/16/93		4/16/93		10/5/93
0	Initial Issue		9/10/92		9/10/92		11/18/92
No.	Description	By	Date	Chkd	Date	Appr	Date
REVISIONS							

LIST OF EFFECTIVE PAGES

CALCULATION NUMBER: PSL-2FJI-92-008 REV. 2

TITLE: PSL 2 REFUELING WATER TANK LEVEL SETPOINT LOOPS L-07-1 AND L-07-2A, B, C, & D

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20	5.0	2			
21	6.0	2			
22	6.0	2			
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1	Attachment 4				

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TITLE: PSL 2 REFUELING WATER TANK LEVEL SETPOINT LOOPS L-07-1 AND L-07-2A, B, C, & D

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--	List of Effective Pages	ii
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ATTACHMENT	TITLE	NUMBER OF PAGES
1	Vendor Instrument Data Sheets	5
2	Shand & Jurs Models 92020 & 99050 Vendor Instrument Data Sheets	2
3	Shand & Jurs Vendor Information	4
4	Telecon between B.A. Woodruff (FPL) And G. Garrity (Consolidated Controls)	1

1.0 PURPOSE / SCOPE

The purpose of this calculation is to determine the acceptability of the Refueling Water Tank (RWT) level instrumentation setpoints for the Technical Specification (TS) minimum level and the overflow high level alarm (loop L-07-1), and the input signal to the Engineered Safety Functions Actuation System (ESFAS) Recirculation Actuation System (RAS) (loops L-07-2A, 2B, 2C, & 2D).

The scope of this calculation is limited to the evaluation of uncertainties associated with the TS minimum operating level alarm function, the high level alarm, and the RAS setpoint.

RWT Level Loops Description:

Level indicating switch LIS -07-1 has a low and a high setpoint, both of which provide a control room alarm: "RWT LEVEL HI/LO". Additionally, the high setpoint closes block valve LCV-07-12, refueling water return to RWT.

The Technical Specifications (Reference 2.2) identify the RWT as a source of borated water. The TS also identify the minimum water volumes for the RWT. The low setpoint provides an alarm that the minimum RWT volume is being approached.

Level loops L-07-2A, 2B, 2C, & 2D provide control room indication and input to RAS. The RAS is actuated on 2-out-of-4 low RWT level signals, and automatically transfers suction from the RWT to the containment sump and stops the low pressure safety injection (LPSI) pumps. The level signal to RAS is a safety related function necessary for the Engineered Safety Features Actuation System (ESFAS). The loops also provide a signal to SAS. Additionally, LIS-07-2C provides a non-safety related high-high alarm to the control room: "RWT LEVEL HI-HI".

The control room level indicating functions (LIS-07-2A, 2B, 2C, & 2D) are safety related and facilitate monitoring for RWT level to verify compliance with Technical Specification (TS) requirements. These indicators also function for post accident monitoring as a RG 1.97 Type D, Category 2 variable (Reference 2.15). The control room level recording function (L-07-2D) is non-nuclear safety related and also is provided for post accident monitoring as a RG 1.97 Type D, Category 2 variable. The control room high-high alarms (L-07-1 & 2C) are to warn the operator of potentially excessive RWT level conditions and are non-nuclear safety related functions.

Revision 1

This revision incorporates various clarifications and also corrects typos in the results section.

Revision 2

- Revised the assumptions and bases to incorporate the results of revised Calculation NSSS-022.
- Provided recommendations for a new low level alarm setpoint incorporating the results of Revised Calculation NSSS-022 to support the LAR.
- Revised discussion on RAS to incorporate the impact of the revised Calculation NSSS-022 on RWT volumes.
- All attachments to Revision 1 of this calculation are valid for Revision 2. Therefore, no changes in the attachments are required.
- Updated all affected references

2.0 REFERENCES

2.1 FPL Standard IC-3.17, Rev. 7, Instrument Setpoint Methodology

2.2 St. Lucie Unit 2 Technical Specification, Amend. 151 (Sect. 3.1.2.7, 3.1.2.8, 3.5.4 and Table 3.3.4)

2.3 St. Lucie Unit 2 FSAR, Amendment 17, Section 6.3.2.2.4, 7.3

2.4 Instrument List, 2998-B-270C, Rev. 30

2.5 Setpoint List, 2998-B-470, Rev. 14

2.6 St. Lucie I&C Procedures for Calibration of Installed Plant Instruments:
2-IMP-69.02, Rev. 10, ESFAS – Monthly Channel Functional Test
2-1400153G, Rev 11A, ESFAS RWT Loop Instrument Calibration

2.7 Miscellaneous Instrument Arrangement, 2998-G-229, Rev. 15

2.8 Control & Wiring Diagram, 2998-B-327
Sheet 293 Rev. 15 Sheet 294 Rev. 18
Sheet 295 Rev. 13 Sheet 296 Rev. 23
Sheet 361 Rev. 10, "S" Annunciator
Sheet 1010 Rev. 13, Instr Buses & Inverters
Sheet 1009 Rev. 13 Sheet 1192 Rev. 4

2.9 EMDRAC 2998-4614, Rev. 3, RWT General Arrangement

2.10 Ebasco Sketches SK-2998-M-531A/8770-M-28A and SK-8770-M-28, RWT Levels – PSL 1 & 2

2.11 Mechanical Frontfit Calculation:
NSSS-022, Rev. 2, RWT Level

2.12 Electrical Box Details, 2998-B-404, Sheet 14, Rev. 15

2.13 Piping Handbook, 6th Edition, Mohinder L. Mayyar

2.14 Instrument Installation Detail, 2998-B-231 Sheet L19, Rev. 4 and Sheet S8, Rev. 3

2.15 Ebasco Letter P-SL-90-0375, dated April 9, 1990, RG 1.97 Rev. 3 Parameter Summary Sheets

2.16 Instruction Manual 2998-15662, Rev. 8, ESFAS Operating and Maintenance

2.17 FPL Calculation PSL-BFJI-92-003, Rev. 1, St. Lucie Units 1 & 2 Environmental Parameters for Instrument Uncertainty Analysis.

2.18 Ebasco Calculation IC-0004, Rev. 4, Safety Injection Tank Level

2.19 Consolidated Controls, Inc. Engineering Report # ER 7228, Rev. 0, Bistable Test Program

2.20 Engineering Evaluation PSL-ENG-SEMS-05-022, Rev. 0, Response to NRC Request for Additional Information Regarding Bulletin 2003-01 Responses

2.21 TEDB; Total Equipment Database

2.22 Post Accident Containment Level, NSSS-023, Rev. 7

2.23 FPL Calculation PSL-2FJM-96-008, Rev. 1, Impact of Vortex Formation in RWT

3.0 METHODOLOGY

3.1 The setpoints will be determined from data given in the FSAR, TS, and other design documents. The setpoints will then be evaluated for acceptability considering applicable instrument uncertainties.

3.2 The methodology employed by this calculation for the application of uncertainties is based on the Square-Root-Sum-of-the-Squares (SRSS) methodology outlined by Reference 2.1. The methodology accounts for random-independent (x, y), random-dependent (w, u) and non-random/bias (v, t) elements differently in determining the total loop uncertainty (TLU), as follows:

$$TLU = (x^2 + y^2 + (w + u)^2)^{1/2} + v - t$$

The level instrumentation provided for the RWTs is utilized to provide indication and alarm to verify compliance with the TS requirements (L-07-1) and to provide an input signal to the ESFAS RAS (L-07-2A, 2B, 2C & 2D). Both the normal and total loop uncertainties will be determined, as applicable.

Potential elements or device uncertainty and terminology are as follows:

Elements of Uncertainty

*	A	-	Device reference accuracy
	CSE	-	Chemical Spray Effect (accident only)
*	DB	-	Deadband
*	D	-	Drift
*	H	-	Hysteresis (typically included in reference accuracy)
*	HU	-	Humidity Effects (includes accident or seismic effects)
	IR	-	Insulation Resistance (accident only)
*	L	-	Linearity (typically included in reference accuracy)
	M	-	Measuring and Test Equipment (M&TE) uncertainty
	PC	-	Process Considerations
*	PS	-	Power Supply Effects
*	Ra	-	Radiation Effects (accident)
*	Rn	-	Radiation Effects (normal)
*	REP	-	Repeatability (typically included in reference accuracy)

*	S	-	Seismic Effect
*	SPE	-	Static Pressure Effect
	ST	-	Setting Tolerance (typically equal to reference accuracy)
*	RES	-	Readability or resolution
*	Ta	-	Temperature Effects (accident)
*	Tn	-	Temperature Effects (normal)

Note: * designates instrument uncertainties typically provided by the vendor.

Terminology/Abbreviations

SP	-	Nominal Set Point
OL	-	Operating Limit
PL	-	Process Limit
SL	-	Safety Limit
NLU	-	Normal Loop Uncertainty
TLU	-	Total Loop Uncertainty

4.0 ASSUMPTIONS/BASES

4.1 Calculation NSSS-022, RWT Level, identifies a minimum RWT contained volume of 477,360 gallons available for Post LOCA, ECCS and CSS based on the RWT administrative level 32.5 feet level. (Reference 2.11). St. Lucie Unit 2 TS identifies an RAS setpoint of 5.67' with allowable values between 4.62' and 6.24' (Reference 2.2). For the purpose of this calculation, it is assumed that the proposed RWT administrative level of 32.5' will be equal to the new TS value. RAS setpoint addressed below.

4.2 FSAR Section 6.3.2.2.4 (Reference 2.3) states that the high setpoint is 6" below the RWT overflow nozzle (37'6" tank height for 7,350 gallons less than the spillover capacity). The lower edge of the overflow nozzle is at elevation 38' (Reference 2.10). This is in agreement with the TEDB (Reference 2.21) high setpoint value for LIS-07-1.

The basis of the high setpoint is to close the valve before overflowing the tank, and provide operations time to respond to the alarm before the tank overflows.

4.3 FSAR Section 6.3.2.2.4 (Reference 2.3) states that the TS requirement accounts for the unusable volume at the bottom of the tank up to a point 6" above the suction nozzle, and a 5% margin for instrument error for the TS minimum RWT level instruments.

4.4 The RAS bi-stable is calibrated at 5.81 mA $\pm$ 0.25% span. (Reference 2.6). For a 50' span, 5.81 mA converts to 5.67' (4-20mA loop with a 0-50' range, Reference 2.4)

4.5 The RWTs for Unit 1 and Unit 2 are identical except as noted on specific drawings. (Reference 2.10)

4.6 The tank has a capacity of 14,688 gallons per foot height. (Reference 2.11)

4.7 The Engineering Evaluation PSL-ENG-SEMS-05-022 shows a minimum RWT level of 32' 6" and TEDB (Ref. 2.21) shows a high level setpoint of 37' 6" for LIS-07-1. (References 2.20 and 2.21)

4.8 LIS-07-1 is made up of two components: Shand & Jurs Model 92020 level gauge and Shand & Jurs Model 99050 level gauge limit switch assembly. (Attachment 2 and Reference 2.21)

4.9 The level indicating switch (LIS-07-1) and transmitters (LT-07-2A, 2B, 2C, & 2D) are located outdoors (Reference 2.4) and the remainder of the loops' instruments are located in the control room (References 2.8 and 2.4); therefore, chemical spray effect, insulation resistance, accident temperature, and normal/accident radiation are not applicable.

4.10 As concluded in Reference 2.17, the calibration temperature of the transmitter is 68°F. The differential between the maximum normal temperature and the assumed calibration temperature is 25°F.

4.11 The M&TE used to calibrate LIS-07-1 is a standard tape measure (Reference 2.6) which can be read to 1/16 inch.

4.12 The transmitter (LT-07-2A,B,C,D) is calibrated for a range of 0 to 50' relative to the bottom of the tank. The transmitters' elevation of 27.5" above the bottom of the tank is calibrated out (Reference 2.6 and 2.14)

4.13 The resistors in the loop are located in control room cabinets which have a maximum temperature rise of 22°F (12°C) (Reference 2.17). These resistors have a maximum power dissipation of from 20 to 200 milliwatts. This power dissipation level results in a minimal temperature rise of the resistors. With a typical resistor temperature coefficient of $\pm$ 20ppm / °C (Attachment 1), the temperature uncertainty would be $\pm$ 0.02%. This amount of uncertainty is insignificant considering that it is more than an order of magnitude less than other loop uncertainties.

4.14 The fluid in the RWT is water with a minimum boron concentration of 1720 pm (Reference 2.2). The specific gravity of solid boric acid is 1.435 (Reference 2.18, Paragraph 5.6). The specific gravity of the RWT fluid is a combination of the water and boric acid specific gravities (Reference 2.18, Paragraph 7.4) and is equal to

$$\frac{(100-0.9840) * (1.000) + (0.9840) * (1.435)}{100} = 1.0043 \text{ @68°F}$$

This specific gravity applied to the actual tank level is the level measured by the differential pressure transmitter, i.e. 39' (maximum tank level) is measured as 39' * 1.0043 or 39.17'. The actual tank level is 0.17' less than measured for a bias of -0.43%. This bias is a shift in the measured level and is to be applied during transmitter calibration. Therefore, it will not be considered as an uncertainty.

This bias is applicable to float type instruments, but can be easily offset by calibration. The specific gravity of the measured fluid determines the level that the float will be submerged. This submergence level is not dependent upon the height of the fluid being measure; that is, it is a fixed offset.

The maximum boron concentration is specified by Reference 2.2, Section 3.1.2.8, as 2100 ppm. Reference 2.18, Paragraph 7.4, identifies the relationship for percent weight of boric acid which can be used in the above equation. 2100 ppm equals 1.20% wt BA.

$$\frac{(100-1.2014) * (1.000) + (1.2014) * (1.435)}{100} = 1.0052 \text{ @68°F}$$

The maximum uncertainty due to the fluctuation of boron concentration is the difference between the two calculated specific gravities:

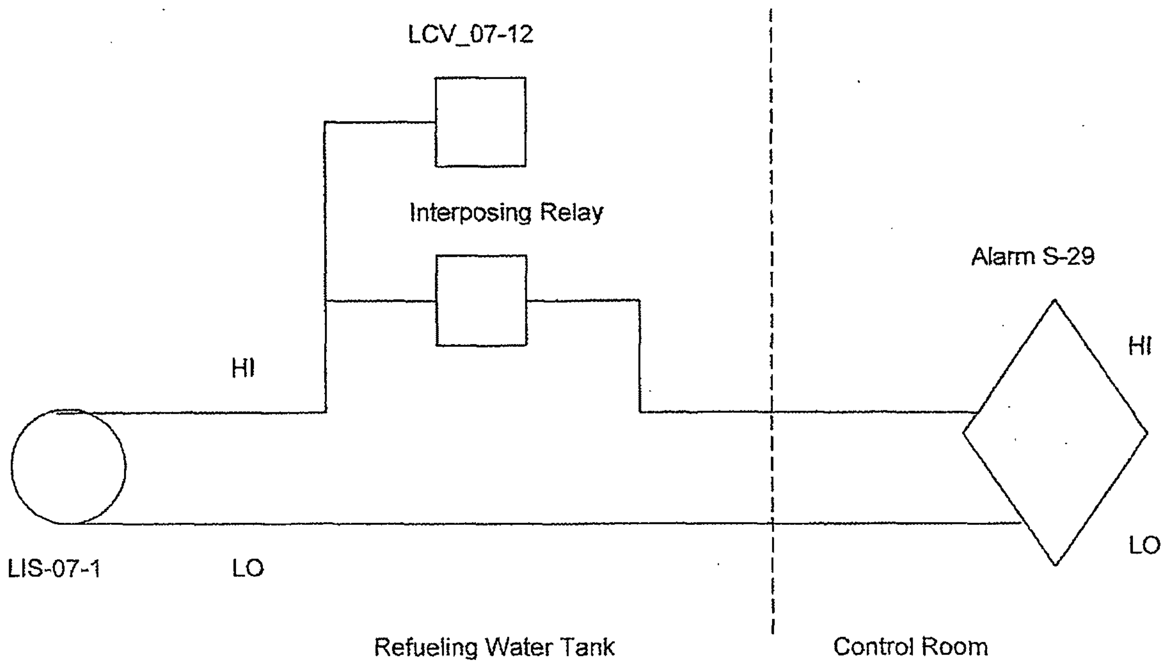
$$\frac{1.0052 - 1.0043}{1.0043} = 0.09\%$$

This uncertainty is relative to the height of the water and is a negative bias (actual water level is less than indicated). For the float type instruments, this uncertainty is insignificant in that it only applies to the small portion of the float which is submerged. For differential pressure instruments, converting the uncertainty to units of percent span for the elevation of the loops' setpoint results in an even smaller percentage value (0.01% @ 5.7') which is insignificant relative to the other uncertainties since it is greater than one order-of-magnitude less than the largest loop uncertainty value. (Reference 2.1)

5.0 CALCULATION

5.1 Loop Diagram for L-07-1

The following depicts the loop block diagram for the RWT level indicating switch, LIS-07-1.



5.2 TS Low Level Setpoint Determination

5.2.1 Setpoint determination

Paragraph 4.6 states the linear height capacity of the tank and Paragraph 4.1 minimum RWT contained volume of 477,360 gallons available for Post LOCA, ECCS and CSS based on the RWT administrative level of 32.5 feet. The elevation for the minimum contained volume is determined by:

$$\frac{477{,}360 \text{ gallons}}{14{,}688 \text{ gallons / foot}} = 32.5 \text{ feet or } 32' \, 6''$$

This elevation assumes 5% instrument error identified in the FSAR (Paragraph 4.3).

The existing low level setpoint of 28' 6" (equivalent to 418,670 gallons) was evaluated under Revision 1 of this calculation, based on the current TS value of 417,100 gallons. It provided a margin of 1570 gallons. The administrative limit of 32.5' level is being revised and TS value is to be increased accordingly (Section 4.1).

A recommended low level setpoint is 33', which is 6" higher than the minimum contained volume. This provides adequate margin, and includes a 5% instrument error allowance for conservatism, which is justified under Section 5.2.2 below.

5.2.2 Uncertainty determination

For this setpoint to be fully acceptable, the instrumentation uncertainty must be within 5% (Paragraph 4.4) plus 0.29 % (1" / 28' 6" additional margin) for a total uncertainty not to exceed 5.3% of the setpoint value.

The instrument uncertainties are shown in Attachment 2. The additional uncertainties are itemized below:

UNCERT		DESCRIPTION / VALUE
CSE		N/A (Paragraph 4.9)
IR		N/A (Paragraph 4.9)
M		The M&TE used for calibration consists of a tape measure which conservatively has an uncertainty of ¼ inch. (Paragraph 4.11)
PC	(1)	Process considerations include expansion/contraction of the tank due to temperature variations. The thermal expansion coefficient

for carbon steel is 7.8×10^{-6} "/°F/ linear foot (Reference 2.13, Table A3.3). For the normal temperature differential expansion for the 50' diameter tank would be

$T_{diff} * T_{coeff} * CIR = 25 * 7.8 \times 10^{-6} * 157 = 0.03'$

Adding this to the circumference results in

$$DIA = \frac{(D_{old} * \pi) + 0.03}{\pi} = 50.01'$$

This is the thermally expanded diameter considering worst cases. The volume varies with the square of the tank radius, so the volume difference is given by

$$VOL_{diff} = \frac{VOL_1 - VOL_2}{VOL_1} = \frac{DIA^2 - D_{old}^2}{D_{old}^2} = 0.04\%$$

This volume difference is insignificant.

PC (2) Assuming the float type level instrument was calibrated at the midpoint of the expected temperature range, the water in the RWT will expand as the temperature rises with a consequent change in measured level. The same holds true for a falling temperature with the water compressing as the temperature falls. Reference 2.13, Table C1.1 states that the specific volume for water changes from 0.01613 ft^3/lb at 100°F to 0.01602 ft^3/lb at 32°F. The percentage volume change can be determined by comparing these two values:

$$VOL_{diff} = \frac{0.01613 - 0.01602}{0.01602} = 0.69\%$$

For conservatism, it can be assumed that the calibration was performed at the midpoint so that the volume difference can be expressed as an uncertainty. This percent volume needs to be converted to units of inches. This is done by conservatively determining the uncertainty at a point just above the high setpoint.

PC2 = ± 0.35 % of span = ± 0.35 % * 40'

PC2 = ± 0.14' = ± 1.7"

UNCERT	DESCRIPTION / VALUE
ST	Equal to the SRSS of the reference accuracy for both the switch and indicator / drive unit. $ST = \pm (0.0625^2 + 2^2)^{1/2} = \pm 2"$
Tn	The vendor did not specify an uncertainty for temperature. However, the temperature effects major contributor is the thermal expansion of the 316 SS tape (Attachment 3). The thermal expansion coefficient (T_{coeff}) for 316 SS is 8.9 x 10^{-6} "/°F/ linear foot (Reference 2.13, Table A3.3). The temperature differential (T_{diff}) is 25°F (Paragraph 4.10). The expected expansion for the maximum length of tape (two times the height of the tank, L_{max} = 78') would be $Tn = \pm T_{diff} * T_{coeff} * L_{max} = \pm 25 * 8.9 \times 10^{-6} * 78$ $Tn = \pm 0.21"$

5.2.3 The uncertainty equation for the switch portion of the instrument, considering only the applicable uncertainties, is

$$NLU = \pm (A^2_{92020} + Tn^2_{92020} + A^2_{99050} + M^2 + PC2^2 + ST^2)^{1/2}$$

$$NLU = \pm (0.0625^2 + 0.21^2 + 2^2 + 0.25^2 + 1.7^2 + 2^2)^{1/2}$$

$$NLU = \pm 3.32" = \pm 3\ 5/16" = \pm 0.28'$$

This uncertainty can be expressed as a percent of setpoint by dividing it by the setpoint.

$$NLU = \pm \frac{0.28'}{33'} = \pm 0.85 \text{ \% of set point or } +/- 0.28'/50' = +/- 0.56\% \text{ of span}$$

This uncertainty is well within the ± 5% of setpoint instrument error identified in Paragraph 4.3 and within the ± 5.3% instrument error identified above, and is acceptable.

5.3 High Level Setpoint Determination

5.3.1 The function of the high level setpoint is to close the block valve and provide an alarm of a possible overflow condition (Ref. 2.3).

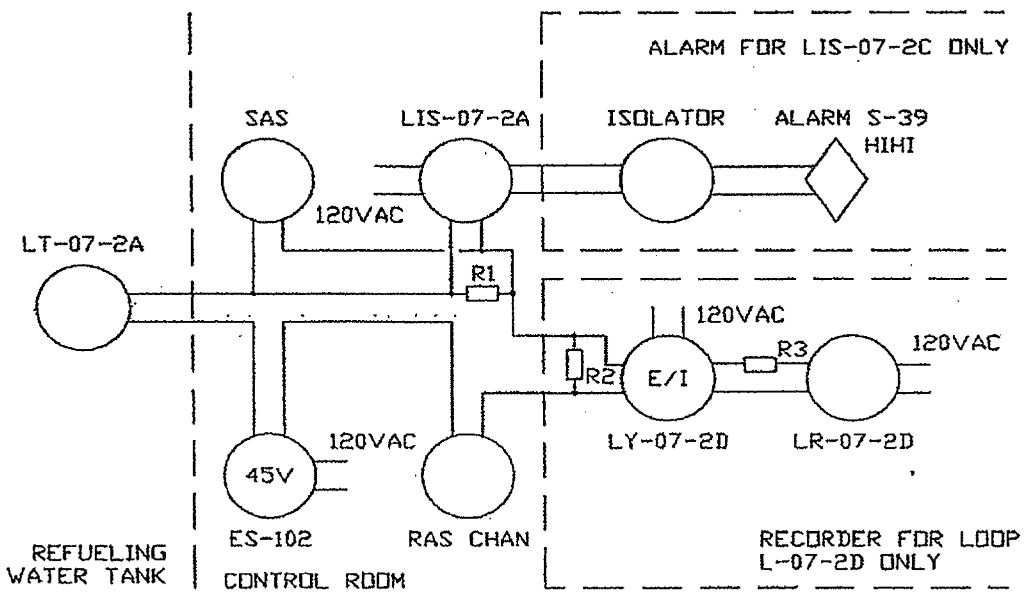
The NLU determined in Section 5.2.3 is also applicable to the high setpoint for this instrument since all loop components are the same and all uncertainties are relative to span.

NLU = ± 3.3" = ± 3 5/16"

The uncertainty of ± 3 5/16" is approximately one half of the level at which overflow can begin (6" below overflow nozzle). This results in a reduction of operator response time of over 24 minutes (UFSAR Chapter 6) to approximately 12 minutes. This response time is considered acceptable, particularly considering that overflow is allowed for in the design.

5.4 Loop Diagram for L-07-2

The following depicts the loop diagram for the RWT level indicating loops, L-07-2. The four loops are essentially the same, changing only in the measurement channel suffix. However, LIS-07-2C also provides a contact output which feeds a control room annunciator. Loop L-07-2D also provides input to a RWT level recorder in the control room.



R_1 is a 250Ω ±0.1% resistor
R_2 is a 250Ω ±1% resistor
R_3 is a 50Ω ±0.01% resistor

5.5 Setpoint Determination of RAS Input

5.5.1 The function of the RAS setpoint is to allow switchover of Safety Injection suction from the RWT to the containment sump.

5.5.2 The RAS input is determined/affected by three instruments:

LT-07-2A/B/C/D	Rosemount 1153DB5	(Ref 2.21)
ES-102/202/302/402	Lambda LCS-2-4	(Ref 2.21)
RAS Bistable (BA105/205/305/405)	CCI 6N220	(Ref 2.21)

Calculation PSL-2FJM-96-008, Rev. 1, "Impact of Vortex Formation in RWT" lists the minimum allowed submergence as 2.12 feet above the centerline of the discharge nozzle. Since the centerline of the discharge line is at 30-3/4", the additional 2.12 feet indicates a lower process limit of 4.68'. Applying Total Loop Uncertainty (TLU) of 0.5' or 6" from Section 5.5.5 and an additional 1.0 % or 0.5' for conservatism results in a RAS setpoint value of 5.68'. Therefore, the TS listed value of RAS setpoint at 5.67' is reasonably applied.

5.5.3 The instrument uncertainties are shown in Attachment 1. All the uncertainties are itemized below:

UNCERT	DESCRIPTION / VALUE
A	The calibrated span of the transmitter is 0 to 50 ft. (Reference 2.21) $A_{LT} = \pm 0.25\% * 50' = \pm 0.125'$ As shown in Attachment 4, the accuracy for the bistable is stated by the vendor to be $A_{RAS} = \pm 0.1\% * 50' = \pm 0.05'$
CSE	N/A (Paragraph 4.9)
DB	DB_{LT} included in A_{LT} Deadband is not applicable to the bistable.
D	The transmitter drift will not be adjusted for the shorter time period between calibrations than the vendor specified value. $D_{LT} = \pm 0.2\% * 750$ in WC $= \pm 1.5$ in WC $= \pm 0.125'$ The drift of the bistable is not specified by the vendor and assumed to be equal to the reference accuracy. The monthly functional test (Reference 2.6) minimizes the amount of drift experienced. $D_{RAS} = A_{RAS} = \pm 0.1\% * 50' = 0.05'$
H	H_{LT} included in A_{LT} Hysteresis is not applicable to the bistable
HU	N/A (Attachment 1)
IR	N/A (Paragraph 4.9)

UNCERT		DESCRIPTION / VALUE
L		L_{LT} included in A_{LT} L_{RAS} is assumed to be included in A_{RAS}
M		Reference 2.6 requires M&TE with accuracies equal to or better than the equipment being calibrated. For conservatism, the reference accuracy of the calibrated instrument will be used for all M&TE used to calibrate that instrument. The LT requires a pressure gauge for the input and a meter for the current output ($M_{LT\text{-}in}$ and $M_{LT\text{-}out}$): $MLT = \pm (M_{LT\text{-}in}{}^2 + M_{LT\text{-}out}{}^2)^{1/2} = \pm 0.177'$ The calibration procedure (Reference 2.6) allows a setting tolerance of ± 0.25% span. Therefore the M&TE uncertainty should be equal to the setting tolerance. $\pm M_{RAS} = \pm ST_{RAS} = \pm 0.125'$
PC	(1)	Process considerations include expansion/contraction of the tank due to temperature variations. This is discussed in Section 5.2.2. Since the value determined in that Section has greater than an order-of-magnitude difference with other uncertainties for this loop, this process consideration is considered insignificant.
PC	(2)	The level of water in the RWT will fluctuate with the temperature of the water due to density changes. Level is directly proportional to specific gravity assuming the other two dimensions of the volume are constant. Differential pressure types of level measuring devices are subject to uncertainties due to differences in water volume because of temperature related density variations. The level transmitter measures the water level relative to standard temperature and pressure (STP) regardless of variations of temperature. Therefore, as the temperature and water level rises, the transmitter signal does not change since the weight of the water has not changed. The volume of water required by TS is based upon pounds of water expressed as gallons. So in this case, it is desirable to measure the water level relative to a constant temperature. Therefore, the uncertainties due to temperature related density variations are not applicable.
PS		The power supply (ES-102 for Channel MA) is regulated to ± 0.01% + 1mV. This amount of regulation, combined with the power supply uncertainty of the bistable, is insignificant when considering the order of magnitude of uncertainties (Reference 2.1).

The emergency Safeguards cabinets are fed from the instrument bus which is regulated to ± 1% (Ref. 2.8). This amount of regulation, combined with the power supply uncertainty of the bistable, is insignificant when considering the order of magnitude of uncertainties (Reference 2.1).

UNCERT	DESCRIPTION / VALUE
Ra	N/A (Paragraph 4.9)
Rn	Normal radiation effects are not applicable as the instruments are not exposed to any elevated radiation levels.
REP	REP_{LT} included in A_{LT} The repeatability of the bistable is not specified by the vendor and assumed to be included in the reference accuracy. REP_{RAS} is assumed to be included in A_{RAS}
S	The transmitter seismic effect is as stated in Attachment 1. The bistable is an electronic device which is not sensitive to seismic events, and is assumed to have no seismic uncertainty. $S_{LT} = \pm 0.5\% * URL = \pm 0.5\% * 750" = \pm 3.75" = \pm 0.31'$
SPE	The RWT is an open air tank (Reference 2.10); therefore, there is no static pressure.
ST	Equal to the reference accuracy for the transmitter. $ST_{LT} = A_{LT} = \pm 0.125'$ The calibration procedure (Reference 2.6) allows a setting tolerance of ± 0.25 % span. $ST_{RAS} = \pm 0.25\ \%\ span = \pm 0.125'$
Ta	N/A (Paragraph 4.9)
Tn	Based on Paragraph 4.10 $Tn_{LT} = \pm (0.75\% \ URL + 0.5\% \ span) / 100°F$ * difference between calibration temperature and min / max temperature. $Tn_{LT} = \pm (0.75\% * 62.5' + 0.5\% * 50') / 100°F * 25°F = \pm 0.18'$ The bistable is located in the ESFAS cabinets in the control room (Reference 2.8) which is a controlled environment with an expected temperature rise of 22°F (12°C) (Paragraph 2.17). As shown by the CCI test (Reference 2.19), the maximum deviation was 0.15% of span for a 10°C rise. Therefore, $Tn_{RAS} = \pm 0.15\% * \frac{12°C}{10°C} * 50' = \pm 0.09'$

5.5 Setpoint Determination of RAS Input

5.5.4 The uncertainty equation for the RAS output portion of the loop, considering only the applicable normal uncertainties, is

$$NLU = \pm (A^2_{LT} + D^2_{LT} + M^2_{LT} + ST^2_{LT} + Tn^2_{LT} + A^2_{RAS} + D^2_{RAS} + M^2_{RAS} + ST^2_{RAS} + Tn^2_{RAS})^{1/2}$$

$$NLU = \pm ((0.125)^2 + (0.125)^2 + (0.125)^2 + (0.177)^2 + (0.18)^2 + (0.05)^2 + (0.05)^2 + (0.125)^2 + (0.125)^2 + (0.09)^2)^{1/2}$$

NLU = ± 0.39'

NLU = ± 4 11/16"

5.5.5 The uncertainty equation for the RAS output portion of the loop, considering only the applicable accident uncertainties, is

$$TLU = \pm (A^2_{LT} + S^2_{LT} + D^2_{LT} + M^2_{LT} + ST^2_{LT} + Tn^2_{LT} + A^2_{RAS} + D^2_{RAS} + M^2_{RAS} + ST^2_{RAS} + Tn^2_{RAS})^{1/2}$$

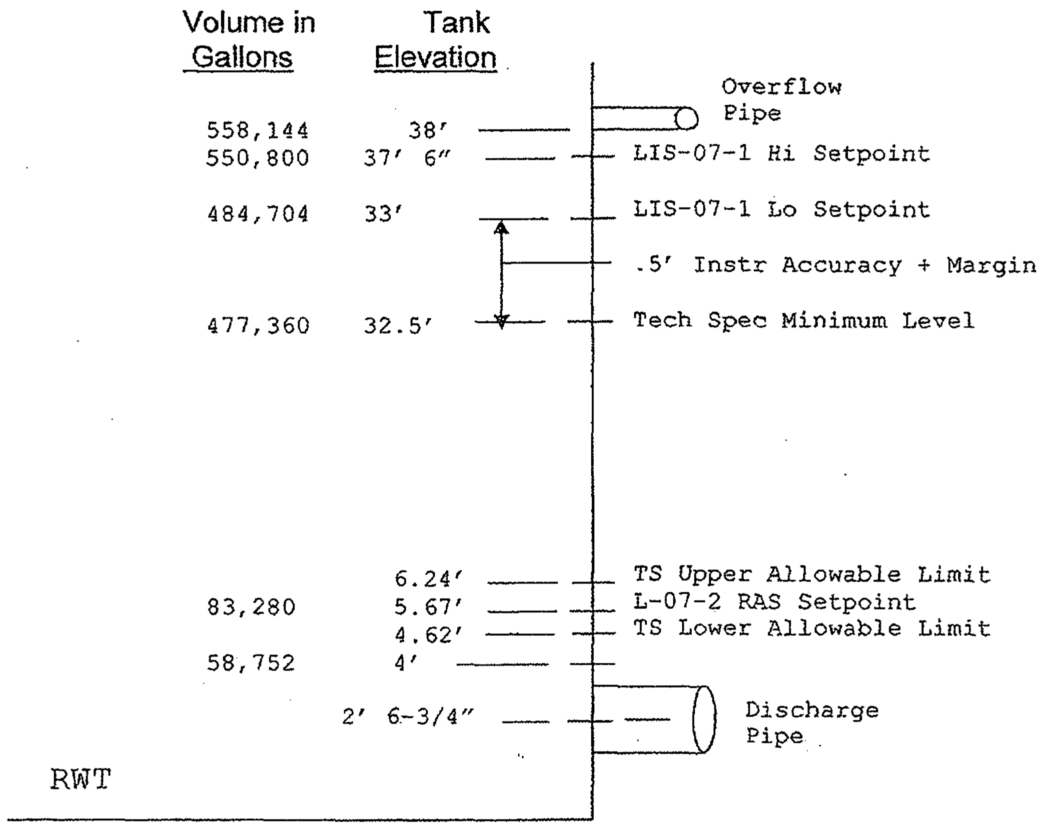
$$TLU = \pm ((0.125)^2 + (0.31)^2 + (0.125)^2 + (0.177)^2 + (0.125)^2 + (0.18)^2 + (0.05)^2 + (0.05)^2 + (0.125)^2 + (0.125)^2 + (0.09)^2)^{1/2}$$

TLU = ± 0.50'

TLU = ± 6"

5.6 Evaluation of Design Inputs

5.6.1 The figure below shows the approximate relationship of the various volumes and setpoints for the RWT.



5.6.2 The recommended new low level setpoint of 33' is equal to 484,704 gallons (33" * 14,688 gals/ft height).

The RAS setpoint is acceptable if the setpoint minus the loop uncertainty and minus the transfer allowance is above the suction pipe and if the setpoint plus the uncertainty still allows 386,735 gallons to be transferred, considering the TS minimum level requirements.

RAS transfer allowance = 9,765 gals

The transfer allowance assumes one half of the RWT full flow, less one LPSI pump for the full 90 seconds of closing valves, [(17,520-4500) * 1.5 min] / 2 = 9,765 gals. This is conservative as the flow will actually be decreasing as the valves close and the recirculation valves open. This assumption is consistent with the methodology used in Unit 2 Calculation NSSS-023 (Ref. 2.22).

The normal loop uncertainty downward is -0.39' and the transfer allowance is 9,765 gallons or 0.66' (9,765 gals /14,688 gals/ft).

Therefore, 5.67' - 0.39' - 0.66' = 4.62' or 4' -7 1/2"

This is above the suction pipe considering the normal loop uncertainty.

The total loop uncertainty downward is -0.5' and the transfer allowance is 9,765 gallons or 0.66' (9,765 gals /14,688 gals/ft).

Therefore, 5.67' - 0.5' - 0.66' = 4.51' or 4' - 6"

This is above the suction pipe considering the total loop uncertainty.

The TS low level RWT requirement is for 477, 360 gallons to be available in the RWT (Paragraph 4.1). This level minus the RAS setpoint plus the setpoint uncertainty (both NLU and TLU) must be greater or equal to 386,735 gallons.

477,360 – 83,280 - (0.39' * 14,688 gals) = 388,352 gallons

477,360 – 83,280 - (0.5' * 14,688 gals) = 386,735 gallons

The above values are greater or equal to 386,735 gallons, considering both normal and total uncertainties for the RAS setpoint. Therefore, the current RAS setpoint is considered adequate.

6.0 RESULTS

6.1 The following table shows the setpoints and both the normal and total loop uncertainties.

Instrument	Setpoint	NLU	TLU
LIS-07-1 Lo[1]	33' [1]	± 3 5/16"	± 3 5/16"
LIS-07-3 Hi	37' 6"	± 3 5/16"	± 3 5/16"
LIS-07-2 RAS BA105/205/305/405	5.67'	± 4 11/16"	± 6"

Note 1: This Low setpoint is proposed to support the LAR. A design change will be required to implement a setpoint change.

6.2 The following table shows the calibration data for the RWT level instrumentation.

Refueling Water Tank Level Instrumentation Calibration Data			
Input % span	**LIS-07-1** (ft)	**LT-07-2A,B,C,D** Input (in wc)	**LT to RAS** Output (mA)
0	0	-27.6	4.00
25	12.5	123.0	8.00
50	25.0	273.7	12.00
75	37.5	424.3	16.00
100	50.0	575.0	20.00
Setpoint	33.0 (low) [1] 37.5 (high)	40.7	5.81
Setting Tolerance	± 0.33% span ± 2"	± 0.25% span ± 1.5" wc	± 0.25% span ± 0.04 mA

Note 1: This Low setpoint is proposed to support the LAR. A design change will be required to implement a setpoint change.

6.3 The current setpoint for the RAS RWT level meets the design requirements and TS requirements.

6.4 The proposed setpoint for the TS minimum operating RWT level meets the design requirements and administrative low limit of 32.5 feet.

6.5 The current setpoint for the high RWT level meets the design requirements.