ENCLOSURE 2 TO NL-12-097

IP-CALC-EG-00217, "EMERGENCY DIESEL GENERATOR STORAGE TANK LEVEL SETPOINTS," REV. 5

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286

☐ ANO-1 ☐ ANO-2 ☐ GGNS ☐ IP-2 ☒ IP-3 ☐ PLP
☐ JAF ☐ PNPS ☐ RBS ☐ VY ☐ W3
☐ NP-GGNS-3 ☐ NP-RBS-3

CALCULATION COVER PAGE	(1) **EC #** 32406	(2) **Page 1 of** 74
(3) Design Basis Calc. ☒ YES ☐ NO	(4) ☐ CALCULATION ☒ EC Markup	
(5) **Calculation No: IP3-CALC-EG-00217**		(6) **Revision: 5**
(7) **Title: Emergency Diesel Generator Storage Tank Level Setpoints**		(8) **Editorial** ☐ YES ☒ NO
(9) **System(s): EDG (Fuel Oil)**	(10) **Review Org (Department): Design I&C**	

(11) **Safety Class:**

☒ **Safety / Quality Related**
☐ **Augmented Quality Program**
☐ **Non-Safety Related**

(12) **Component/Equipment/Structure Type/Number:**

LC-1204S LI-1133	LC-1207S
LC-1205S LI-1134	LC-1208S
LC-1206S LI-1135	LC-1209S

(13) **Document Type: Calc**	EDG-31-FO-STNK	EDG-31-FO-DTNK
(14) **Keywords (Description/Topical Codes):**	EDG-32-FO-STNK	EDG-32-FO-DTNK
EDG, Fuel Oil, Level Switches	EDG-33-FO-STNK	EDG-33-FO-DTNK
Level Indication, Day tank		

REVIEWS

(15) Name/Signature/Date	(16) Name/Signature/Date	(17) Name/Signature/Date
Bruce Shepard	**Robert Schimpf** 14 FEB '12	**John Hill**
Responsible Engineer	☒ **Design Verifier** ☒ **Reviewer** ☐ Comments Attached	**Supervisor/Approval** ☐ Comments Attached
Bruce Shepard 2/14/12		

ATTACHMENT 9.3 CALCULATION REFERENCE SHEET

CALCULATION REFERENCE SHEET	*CALCULATION NO:* **IP3-CALC-EG-00217** REVISION: **5**

I. EC Markups Incorporated (N/A to NP calculations)

1. NONE
2.
3.
4.

II. Relationships:	Sht	Rev	Input Doc	Output Doc	Impact Y/N	Tracking No.
1. IP-CALC-11-00058		1	☒	☐		
2. IP-CALC-11-00011		0	☐	☐		
3. IP-RPT-09-00014		1	☐	☒	N	
4. 3-SOP-EL-009			☐	☒	Y	
5. 3-SOP-EL-001			☐	☒	Y	
6. ESOMS (log readings)			☐	☒	Y	
7. 3-PT-R160A/B/C			☐	☒	Y	

III. CROSS REFERENCES:

1. NONE
2.
3.
4.
5.

IV. SOFTWARE USED:

Title: NONE Version/Release:_____ Disk/CD No._____

V. DISK/CDS INCLUDED:

Title: NONE Version/Release_____ Disk/CD No._____

VI. OTHER CHANGES:

NONE

ATTACHMENT 9.4 RECORD OF REVISION

Sheet 1 of 1

Revision	Record of Revision
4	SUPERSEDES IP3-CALC-EG-00217 REV 3
5	SUPERSEDES IP3-CALC-EG-00217 REV 4 Removes the various EDG loading scenarios & usage calculations and adds reference to Mechanical EDG fuel oil usage calculation. General revision of all sections of the calculation.

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1.0 PURPOSE

1.1. This calculation identifies the Channel uncertainty and the appropriate settings for the EDG Underground Fuel Oil Storage Tank (FOST) Level Switches (LS), (LC-1204S, LC-1205S & LC-1206S). The switches provide:

- LOW - Alarm function and
- LOW-LOW - Stop the fuel oil transfer pumps at low-low oil level to protect them from effects of vortexing or inadequate NPSH.

1.2 This calculation identifies the uncertainty for EDG Underground Fuel Oil Storage Tank Level Indicators (LI-1133, LI-1134 & LI-1135) and the dipstick readings (level indication by sounding tank). Table 1 (attached) identifies Tank slope effect on Setpoint, volume, and sounding tube measurements.

1.3. This calculation uses EDG Day Tank level switches (LC-1207S, LC-1208S & LC-1209S) actuation points to document storage considerations.

NOTE: Revision 5 is a major revision. Therefore it is not practical to identify each line change. This revision supersedes Revision 4 which is available from records for comparing any changes and previous calculation results.

2.0 ASSUMPTIONS

2.1 The displacer trip level sheets from Magnetrol have 100°F as the lowest temperature listed, although certification lists temperature range as 35°F-110°F. Tanks are underground, and temperature variations are assumed to be minimal. Extrapolation down to 30°F is based on data points at 100°F and 200°F. Function with respect to process temperature is assumed to be linear over this range (see attachment 4.2). The 30°F temperature is considered conservative based on Attachment 4.10 & 4.14. Additionally, it is considered conservative to evaluate the uncertainty associated with temperature effect (TE) based on a postulated nominal calibration temperature of 70 °F with temperature excursions between 30°F and 110°F or ±40 °F. This span is considered conservative based on the specified span of 35°F to 110°F (see attachments 4.2, 4.10 & 4.14).

2.2 Oil displaced by equipment/hardware installed inside the tank is considered negligible.

2.3 It is assumed conservative to interpolate values by Lagrange's Interpolation formula using a minimum of six known values about the unknown. The values for volume and inches in Table 1 were interpolated using this methodology, based upon Ref. 3.2. Values used in this calculation which are not in the table were linearly interpolated from adjacent table values.

2.4 The effects of normal vibration (or a minor seismic event that does not cause an unusual event) on the level switches is assumed to be dampened out by the fluid surrounding the displacers and; therefore seismic effects (SE) are considered to be negligible. For post-accident operability considerations, it is noted that a design basis accident coincident with a design basis earthquake is not postulated. It is assumed that following a SSE seismic event the setpoint of the Magnetrol switches and Uehling indicator readings cannot be warranted until the instrumentation has been functionally evaluated and subjected to a calibration check. Additionally, it is assumed that Magnetrol switch contacts may chatter causing a false alarm or pump start/stop signal during, but not following, a SSE.

2.5 For a displacer type level switch, based upon Engineering Judgment, it is assumed the As-Left-Tolerance will be ≤ 2.4 x RA (Where RA is the reference accuracy of the device).

2.6 This calculation uses fuel oil specific gravity of 0.83 for all settings, unless stated otherwise.

2.7 Fuel specific gravity is maintained between 0.83 and 0.89 (see attachment 4.5). Volume required in tank has previously been calculated in gallons (Ref. 3.10 & 3.21) at lowest density (0.83 specific gravity) to maximize required volume. The evaluation in Ref. 3.10 identifies that as specific gravity increases the required volume for operation at any specific load decreases. Review of the adjusted low (net) heat values in BTUs per gallon and BTUs per LB for the range of allowed fuel density indicates that as the density is increased, BTUs per gallon increases, and the required volume for any specific load would decrease.

2.8 The conversion from gallons to inches in Table 1 is not based on volume measurements. The conversion basis is found in Calculation 200 (Ref. 3.2). Tank tilt has negligible effect on volume measurements.

2.9 Inch values of calculations will be rounded-off to 5/100th (0.05) of an inch.

2.10 Final gallon values of calculations will be rounded-off to whole gallons.

2.11 This calculation assumes normal plant operating conditions (non-seismic/non-harsh environment).

2.12 Magnetrol displacer (float) calculations are from the available manufacturer information (Magnetrol installation drawing, see attachment 4.2). Actual performance of displacers versus design settings was field verified (see attachment 4.15).

2.13 The Level Indicators LI-1133, LI-1134 & LI-1135 (manometer/bubbler) are calibrated for a liquid specific gravity (SG) of 0.86 based on attachment 4.12. It should be noted that SG less then 0.86 is acceptable since the read indication would be lower then the actual tank level and more than required (Indication would be conservative). Additionally, it should be noted that SG above 0.86 is considered conservative due to the increase in BTU/gallon (see reference 3.21) and indicator SG allowance. NOTE: Presently the Operations Graphs TC-25B & D show a correction factor for SG change (see Attachment 4.12).

2.14 Tank coating reduces usable tank volume by less than 20 gallons, based upon engineering judgment, since:
- tank coating was identified to reduce total tank volume by ~25 gallons (ref. 3.2),
- <82% of the tank heads coating material is in the usable volume area, and heads are less than 24% of the total surface area of the tank,
- <40% of the cylinder tank coating material is in the usable volume area [107.5" diameter cylinder portion of tank, ¼ of surface area is below 15.7" elevation (and floor is twice as thick), and ¼ is above the 91.5" elevation], 76% of the total surface area of the tank,
- <58% of the total tank coating material is in the usable volume area.

3.0 REFERENCES

3.1 ISA-RP67.04, Part II, "Methodologies for the Determination of setpoints for Nuclear Safety-Related Instrumentation", dated September 1994.

3.2 IP3-TS-200 calculation "Diesel Generator Fuel Oil Storage Tanks Capacity Calculation", dated 1/19/90, (Including Margin Rev. 0A dated 10/01/1999).

3.3 EN-IC-S-010-MULTI, Instrument Loop Accuracy and Setpoint Calculation Methodology.

3.4 Technical Specification 3.8.1 "AC Sources – Operating".

3.5 Technical Specification 3.8.3 "Diesel Fuel Oil and Starting Air".

3.6 Final Safety Analysis Report (FSAR),

3.7 Drawings:

(1) 9321-F-20303, "Flow Diagram Fuel Oil to Diesel Generators".

(2) IP3V-0353-0002 (FP 9321-05-2990), "Fuel Oil Storage Tank (7700 GAL)".

(3) IP3V-0186-0043 & IP3V-0186-0046 (FP 9321-05-20324 sheets 1 & 2), "Outline Model VITX-5D, 3X6JLC 4 Stage".

3.8 EN-DC-126, Revision 4, Engineering Calculation Process

3.9 EN-DC-115, Revision 12, Engineering Change Process

3.10 IP-CALC-11-00058, Revision 1, IP3 Emergency Diesel Generator (EDG) Fuel Oil Consumption Licensing Basis Calculation.

3.11 Preventive Maintenance Procedure "Diesel Generator Fuel Oil Storage Tank NO. 31 Level Indicator", IC-PM-LI-1133, 1134 & 1135.

3.12 Modification MMP 94-3-132, "EDG Fuel Oil Tank Level Indicator LI-1133, LI-1134, LI-1135 Replacement, "dated 10/21/94.

3.13 Alarm Response Procedures, 3-ARP-011, "Panel SHF - Electrical", Rev. 34.

3.14 WR No. 94-03803-3 "DG F.O. Storage Tank 31 Level", dated 8/8/94. Implements IP3 SCR-94-010, 8/9/94, Change Low & Low-Low settings on level switch (LC-1204S)

3.15 WR No. 94-03803-14 "DG F.O. Storage Tank 32 Level", dated 11/30/94. Implements IP3 SCR-94-026, 10/28/94, Change Low & Low-Low settings on level switch (LC-1205S)

3.16 WR No. 94-03803-11 "DG F.O. Storage Tank 33 Level", dated 11/15/94. Implements IP3 SCR-94-027, 10/28/94, Change Low & Low-Low settings on level switch (LC-1206S)

3.17 IP-3 Calculation 204 "Diesel Generator Fuel Oil Consumption," dated 2/6/90.

3.18 System Operating Procedures, 3-SOP-EL-009 "Filling the Diesel FOST's" Rev. 20.

3.19 Plant Equipment Database in Asset Suite (IAS)

3.20 Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants, REG GUIDE 1.108, 1977

3.21 IP-CALC-11-00011, Revision 0, Evaluation of Emergency Diesel Generator (EDG) Fuel Oil Usages Accounting for Issues identified During the IP3 2010 NRC CDBI.

3.22 0-CY-1810 Rev. 11, Diesel Fuel Oil Monitoring, Chemistry Procedure

3.23 IP-RPT-09-00014, Rev. 1, Critical Submergence Evaluation Related to Surface Vortices in Nuclear Safety and Augmented Quality Tanks/Pumps at IPEC

4.0 ATTACHMENTS

4.1 DELETED

4.2 Magnetrol Drawing D-1257 (FP 9321-05-7214 Rev. 0, 1/22/70) "Magnetrol Installation Dimensions Model A-153-F-TDM & A-153-F-E.P.-TDM"

4.3 Gould Pumps Bowl Engineering Data, Document # 22.13, October 1, 1986, "Minimum Submergence Required for Vortex Suppression".

4.4 Telephone Discussion Documentation form, 6/5/91, A. Cerwin to T. Fricke.

4.5 Telephone Discussion Documentation form, 11/10/93, F. Granitto to D. Wilson.

4.6 DELETED

4.7 DELETED

4.8 DELETED

4.9 DELETED

4.10 U.S. Environmental Protection Agency (EPA), 1995, *Review of Mathematical Modeling for Evaluating Soil Vapor Extraction Systems,* Office of Research and Development, Washington, D.C. EPA/540/R-95-513 – Figure 1. "Average Shallow Ground Water Temperature in the United States"

4.11 DELETED

4.12 IP3-RPT-EDG-01632, "Operation Graphs, TC-25A through TC-25D Diesel Generator Fuel Oil Storage Tanks Slope and Specific Gravity Compensation, "dated 10/21/95.

4.13 FAX MESSAGE, from A.E. Vazquez of Uehling, to R.F. Jones of MDM Engineering, "Certificate of Calibration" dated 12/18/95.

4.14 Specification for "Liquid Level Switches", No. 9321-05-252-20, Revision 2, Pages 3, 4 & 5, dated 9/19/95.

4.15 Telecopy Transmittal Sheet IP3, To R. JONES (I&C), From M. Pactong (Mech Eng), dated 12/1/95.

5.0 LOOP FUNCTION

5.1 General

There are 3 EDG Underground Fuel Oil Storage Tanks (FOST). Each tank has three level indication/monitoring devices or capabilities. Functions considered within the scope of this calculation are; LOW & LOW-LOW tank level switch (Displacer Type), tank level indicator (Manometer/Bubble type) and level indicator (Dipstick). The instrumentation is further described below:

5.2 Level Switches (LC-1204S, LC-1205S, & LC-1206S)

Each EDG Underground Storage Tank has one Magnetrol Level Switch (LS), with separate actions for one control circuit and one alarm circuit on each Magnetrol LS. Each LS has two (2) setpoints which actuate on decreasing tank level. The low (LOW) level setting on each tank actuates a CCR alarm; alerting operators that action to replenish the storage tank volume is required. Level switch actuation at the low-low (LOW-LOW) level stops the Underground Fuel Oil Storage Tank transfer pump to provide protection from vortexing or inadequate NPSH. The LOW and LOW-LOW LS setpoints for each tank envelope the volume of fuel oil required for specified EDG operation.

The LS's are Magnetrol model A-153-FTDM (Reference 3.19). They use 2 Karbate displacers that operate two DPDT micro-switches. The specified service is #2 diesel fuel oil, atmospheric pressure, at 35° - 110°F; specific gravity 0.84 to 0.89. They have tag numbers of LC-1204S, LC-1205S & LC-1206S for tanks 31, 32 & 33 respectively. There is one device in each tank. Each device controls two circuits. Each circuit operates from an independent micro-switch. One switch is in the control circuitry for the pump motor, the other actuates a CCR alarm. See Attachments 4.2 and 4.14.

5.3 Level Indicators (LI-1133, LI-1134 & LI-1135)

The Level Indicators (LI's) provide the following functions:

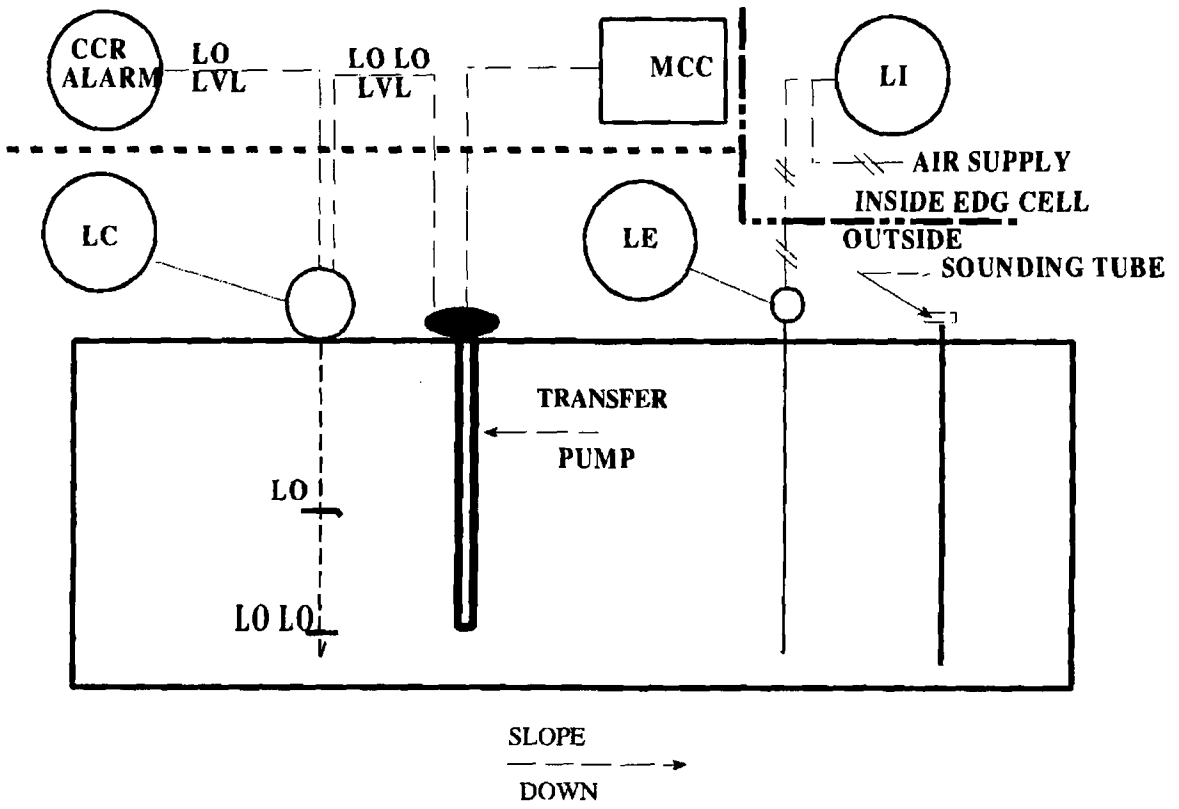
(1) Indication of tank level,
(2) Provide an indication of tank leakage (In-Leakage, Out-Leakage) and
(3) Following an event, which requires EDG operation, the indicators provide indication of tank level approaching the FOST transfer pump STOP setpoint.

The LI's are located in the cell for each EDG and provide FOST tank level readout. The LI's are Uehling Instrument Co. model 55R173 (Reference 3.19). They consist of a manometer (with readout), a pneumatic hand pump (for air supply), and a dip tube (process interface bubbler). When the hand pump is operated a flow of air passes through tubing to the dip tube; when air bubbles escape from the submerged open end, the air pressure in the tube equalizes to the hydrostatic head of the tank fuel oil. As the tank fuel oil head varies, the air pressure in the dip tube changes correspondingly. The air pressure is indicated on the manometer in inches and equivalent gallons. The manometer and hand pump are located in each EDG cell. The dip tube is located in each underground storage tank. The manometer fill fluid is Diazene-42. The specified service is #2 diesel fuel oil, atmospheric pressure at 35° - 110°F; specific gravity 0.86. They have tag numbers of LI-1133, LI-1134 & LI-1135 for tanks 31, 32 & 33 respectively. There is one device in each tank. Operations Graph TC-25B and TC-25D show the relationship between level in inches and gallons.

5.4 Dipstick

Each EDG FOST has a specific location for sounding the tank with a Dipstick, the sounding tube. The Dipstick is stored near the sounding tubes for the underground storage tanks. The Dipstick has markings in inches. Manual measurements are made at the sounding tube location for each tank. The specified service is for the EDG fuel oil (#2 diesel) storage tanks. No tag number is associated with the Dipstick. There is one Dipstick for the three EDG tanks. Operations Graph TC-25A and TC-25C show the relationship between level in inches and gallons for each tank. Additionally the relationship between Sounding tube measurement and each tank volume was documented in IP3-RPT-EDG-01632, and is shown in Table 1 of this calculation.

6.0 BLOCK DIAGRAM



See Reference 3.7(2) for tank dimensions and specific device locations

DEVICE	EDG TK 31	EDG TK 32	EDG TK 33	NOTE:
LC SWITCH	LC-1204S	LC-1205S	LC-12O6S	e_1 for LOW-LOW & e_2 for LOW LVL
LI INDICATOR	LI-1133	LI-1134	LI-1135	$e_{6\&7}$ for LOW-LOW & $e_{4\&5}$ for LOW LVL
LE ELEMENT	YES	YES	YES	N/A
SOUND TUBE	YES	YES	YES	e_3 (for DIPSTICK)

FIGURE 1 LOOP DIAGRAM TYPICAL

7.0 UNCERTAINTY EQUATIONS

$$CU = \pm(PM^2 + PE^2 + e_1^2 + e_2^2 + \ldots + e_n^2 + IRE^2)^{1/2} \pm B \quad \text{Where,}$$
$$e = \pm(RA^2 + DR^2 + TE^2 + RE^2 + SE^2 + HE^2 + PS^2 + ALT^2 + SP^2 + MTE^2)^{1/2} \pm B$$

7.1 Uncertainty terms taken to be either negligible or not applicable (not included elsewhere in the evaluation) are:

- PE - There is no primary element, therefore, PE is not applicable
- IRE - Mild environment & switches are OFF-ON not analog, therefore, IRE is not applicable
- B - No process or module bias identified, therefore, relative to the magnitude of known uncertainties, any bias that may be inherent in the loops is considered to be negligible (The effects of slope are accounted for in scaling for each tank)
- RE - Non-radiological environment, therefore, RE is not applicable
- SE - Per assumption 2.11 Seismic Error (SE) is not applicable
- HE - Humidity changes are within the operating range of the devices and are considered to be negligible
- PS - The switch is an OFF-ON device not analog and is not affected by power supply changes
- SP - The tanks are at atmospheric pressure, therefore, any static pressure effect is negligible

7.2 Uncertainty Allowances to Address

(1) PM - Process Measurement Effect
(2) e_n - Equipment Uncertainties
(3) ALT or CT - Calibration Uncertainties
(4) Other Uncertainties

7.2.1 Process Measurement effects (PM)

Fuel oil may be supplied at various SGs of 0.83 to 0.89 (Ref. 3.22). The Chemistry Supervisor at IP3, responsible for the fuel oil monitoring data, indicated that the average SG of existing fuel oil is 0.84 SG and does not vary significantly when new fuel is added to the storage tanks (See Attachment 4.5). Chemistry testing identified the following EDG FOST density values based upon field testing, which are numerically equivalent to SG values

11/18/11 – 31 EDG FOST – 0.8482 grams/ml = SG of 0.8482
11/18/11 – 32 EDG FOST – 0.8449 grams/ml = SG of 0.8449
11/18/11 – 33 EDG FOST – 0.8482 grams/ml = SG of 0.8482

Ref. 3.10 identified Btu/LB, Btu/Gal, and required fuel gallons calculated at various SG between 0.83 & 0.89. As EDG FOST SG increases (Ref. 3.10 & 3.21); the volume of the fuel oil required for EDG operation decreases. Review of this information indicates an uncorrected indicator elevation is equivalent in work (for low net heat value, Ref. 3.10) within 0.05% for any of the allowed SG readings (0.83 to 0.89), based upon:

[0.83 x Btu/LB(@0.83 SG)/Btu/Gal(@0.83 SG)]/[0.89 x Btu/LB(@0.89 SG)/Btu/Gal(@0.89 SG)] = 1 ±0.001
[0.83 x 18762 / 125987.6] / [0.8348 x 18736.9 / 126572.5] = 1.000 = 100.02%
[0.83 x 18762 / 125987.6] / [0.8448 x 18686.2 / 127754.5] = 1.000 = 100.03%

[0.83 x 18762 / 125987.6] / [0.8550 x 18635.4 / 128936.5] = 1.000 = 100.02%
[0.83 x 18762 / 125987.6] / [0.8654 x 18584.7 / 130118.5] = 1.000 = 100.04%
[0.83 x 18762 / 125987.6] / [0.8762 x 18523.8 / 131300.5] = 1.000 = 99.99%
[0.83 x 18762 / 125987.6] / [0.8871 x 18462.9 / 132581] = 1.001 = 100.05%
[0.83 x 18762 / 125987.6] / [0.890 x 18447.2 / 132884.4] = 1.000 = 100.04%

∴ Corrected gallon value = (0.830/current SG) x Actual gallon required

- Magnetrol Switch

This calculation uses fuel oil specific gravity (0.83 SG) for both the low-low and low magnetrol switch action. Any density changes resulting from the effects of temperature variations are included in the temperature effects (TE) for the Magnetrol level switches. Therefore, net adverse effect of PM on the Magnetrol Switches is negligible, (See Attachment 4.5 and Assumption 2.7). At higher densities, both low-low and low magnetrol switch action would be slightly lower.

$PM_{SG\text{-}LL}$ = (1/8" / 0.1 [SG change]) x 0.06 [SG change] = 0.075"
$PM_{SG\text{-}L}$ = (1" / 0.1 [SG change]) x 0.06 [SG change] = 0.6"

- Dipstick

PM for sounding (internal 3" stilling pipe to within 2" of bottom) the tank is attributed to, process turbulence (if pump is running or tank is being filled) and or uncertainty in identification of wet to dry interface due to wicking on the dipstick. This PM value cannot be calculated, therefore, a value of ±0.50" will be used in the evaluation. This value is considered conservative enough to include Readability error of approximately 1/4 of 1/16th of an inch or 0.0156".

- Uehling indicators

Historically, the required fuel volume was calculated at a SG of 0.83 to maximize the required gallons value. The Uehling indicators are calibrated for a SG of 0.86. Density changes due to temperature increases or decreases will result in an increase/ decrease (respectively) in the actual tank level. However, the level indication, because it is based on head pressure, will remain almost unchanged and will therefore reflect the effective level relative to EDG run time. This is due to the increase in BTU/gallon (or Lbs of fuel/gallon). The effect of density changes due to temperature changes on the fuel available for EDG running time requirements are considered to be negligible.

For the required level indication, the actual gallon value is sufficient to provide the fuel inventory required to meet the EDG running time requirements, regardless of SG value. If the SG is less than 0.86, the uncorrected read elevation, and gallons, would be less than actual height and gallon value. If the SG is greater than 0.86, then the uncorrected read elevation, and gallons, is more than actual height and gallon value. If the SG >0.86, then the potential difference in SG from the calibrated 0.86 value will impact the total net heat value of unusable fuel oil below the switch actuation point, see sect. 7.2.1.2.

7.2.1.1 Uehling Indicators - Process impact for fuel oil SG (SG_e)

The impact per ±0.01 of SG changes is approximately 1.16% change in elevation reading (and resultant gallons), or a total of approximately +/-3.5% of reading for allowed SG span of 0.83 to 0.89. PM for indicator includes readability.

SG_e = 100 (0.87 - 0.85 / 0.86) = 2.32% for a 0.02 SG change at any specific value
SG_e = 2.32% / 2 = ±1.16% for a ±0.01 SG change (The SGe has linear impact on gallons)

Operators use graphs TC-25B or TC-25D to convert the indicated EDG tank level to gallons. The graphs identify the SG correction calculation to be used for a corrected tank level to achieve the ±50 gallon accuracy identified in IP3-RPT-EDG-01632.

Corrected inch value = (0.860/current SG) x Actual inch reading from LI

7.2.1.2 Indication SG error at low-low switch setpoint evaluation ($SG_{ie\ l\text{-}l}$)

At the low-low switch setpoint (17.1") the process error is small, both for level and gallons required. For a nominal setpoint (from Section 12.1) of 17.1", the LI is 20.17" (Low value for Tank 33, Tank 31 & 32 would be approximately 1" lower - See Table 1 for slope correction). From REF 3.12 the indicator does not measure level below 6" from the tank bottom. Therefore, measured head (mh) @ LI:

mh = (20.17" - 6.0") = 14.17" (See Table 1)
$SG_{ie\ l\text{-}l}$ = Indication Error = SG_e x mh
$SG_{ie\ l\text{-}l}$ = ± 1.16% x (0.03/0.01) x 14.17" = ±0.492" [for ±0.03 SG]

The following is the potential impact on required indicated gallons due to SG >0.86
$SG_{ie\ l\text{-}l}$ = ±0.492" = ±0.5" [rounded, max. $SG_{ie\ l\text{-}l}$ change, or ±36, round to 40, gallons required]

7.2.1.3 Indication SG error at Low switch setpoint evaluation ($SG_{ie\ l}$)

From REF 3.12 the indicator does not measure level below 6" from the tank bottom. For a nominal switch setpoint of 87.0" the LI is 89.27" for tank 31 & 32, 90.07" for tank 33 (See Table 1 for slope correction). Therefore, measured head @ LI (mh) = (90.07" - 6.0") = 84.07"

$SG_{ie\ l}$ = Indication Error = SG_e x mh
$SG_{ie\ l}$ = Indication Error = ± 1.16% x 84.07" = ±0.975" [per ±0.01 SG, ±2.93" max. change ±0.03 SG]

7.2.1.4 Bounding indication SG error evaluation

For bounding level at top of tank (108") @ LI (mh) = (108" - 6.0") = 102"
Bounding Indication Error = ± 1.16% x 102" = ±1.18" [per ±0.01 SG, ±3.5" max. change ±0.03 SG]

Therefore, indication could be 3.5" lower than actual when the tank is full of fuel oil @ 0.83 SG, or 3.5" higher than actual when the tank is full of fuel oil @ 0.89 SG.

7.2.2 Other Dipstick Uncertainties (Indicator Readability)

Readability effect (Approximately 1/4 of 1/16th of an inch, the smallest marking) for the Dipstick is included in the PM value (See Section 7.2.1).

7.2.3 Uehling Indicator PM for indicator readability, for use in this Calculation

Readability effect for the manometer (Approximately 1/4 of 1/4 of an inch) is included in the PM value for the Uehling indicators (See Section 8.1.8). For conservatism a value of 1.25 x RA will be used to envelope readability error of .0625" and any unidentified PM uncertainties (pump running turbulence, etc.).

RA = level at the indicator ± 1/8" (see Section 8.1.1)
PM = ± 0.16"

8.0 MODULE UNCERTAINTY

8.1 Level Switch (LC-1204S, LC-1205S & LC-1206S) -Magnetrol model A-153-FTDM (Reference 3.19

& See Attachment 4.2) (e_1) for LOW-LOW level (17.1" pump protection level) & (e_2) for LOW level (87" or 87.5" for low level alarm)

Level Indicator, Dipstick (e_3)

Level Indicator (LI-1133, LI-1134 & LI-1135) -Uehling model 55R173 (tank 31 & 32 @ 87.5" level - e_4), (tank 33 @ 87" level - e_5), (tank 31 & 32 @ 17.1" level - e_6) & (tank 33 @ 17.1" level - e_7)

8.1.1 Reference Accuracy (RA)

- Magnetrol Switch

  Magnetrol specifies an accuracy of ±1/4" for the actuation diaphragm and switch (See attachment 4.4)

- Dipstick

  Based on Engineering Judgment, an accuracy value of ±1/16" is applied for this device (the smallest marking).

- Uehling indicators

  Uehling specifies an accuracy of ±1/8" of level measurement (See attachment 4.13)

8.1.2 Drift (DR)

Past performance Data is not available and vendors do not provide a drift factor for these devices. Based on Engineering Judgment, for devices of this type, it is assumed that drift is accounted for in (RA). Therefore, a value of 0.0 will be used for DR in this evaluation.

8.1.3 Temperature Effect (TE)

- Magnetrol

  Each EDG FOST tank is located underground, with the switch housing flange approx. 38" above the tank cylinder. The temperature of the fuel oil (density, viscosity) affects the displacer point of action. Normal environment of the EDG underground FOST tank location is 35°F - 110°F [use 70°F +/-40°F] (See Attachment 4.2).

  The Magnetrol installation drawings show the switch settings at temperature from 100° to 300°F. Compensation to 30°F is by extrapolating the 100° and 200° values. Values are approximately 0.5" per 100°F.

  TE = ± (40°F) X 0.5" /100°F (See Assumption 2.1)
  TE = ± 0.2"

- Dipstick

  For the Dipstick indicator the TE is not applicable

- Uehling

  For the Uehling indicators the TE is not applicable (See attachment 4.13)

8.1.4 Measurement and Test Equipment uncertainty (MTE)

- Magnetrol switches

MTE_1: Tape measure (or Dipstick), accuracy ±1/16"
MTE_2: When taking measurements, an error due to flex in the tape measure or flex in the cable can occur. Therefore, an error of ±1/2" is a conservative estimate. Due to this conservative estimate indicator Readability is not evaluated as a separate uncertainty.

$$MTE = \pm (MTE_1^2 + MTE_2^2)^{1/2}"$$
$$MTE = \pm (0.0625^2 + 0.5^2)^{1/2}"$$
$$MTE = \pm 0.5"$$

- Dipstick

MTE for the dipstick is not applicable

- Uehling Indicators

Calibration is not required; therefore, MTE for the Uehling indicators is not applicable (See attachment 4.13)

8.1.5 As-Left Tolerance = (ALT) NOTE: ALT is equal to Calibration Tolerance (CT).

- Magnetrol switches

The As-Left Tolerance is the technician precision in setting the tolerance of a device during installation or verification. The instrument surveillance procedure for these switches does not presently require measuring or resetting of the displacers.

Since no specific instrument calibration procedure is approved for LC-1204S, LC-1205S or LC-1206S, the As-Left tolerance will be evaluated based on Assumption 2.5.

$$ALT = \pm 2.4 \times (RA)$$
$$ALT = \pm 2.4 \times (0.25")$$
$$ALT = \pm 0.60"$$

- Dipstick

ALT for the Dipstick is not applicable

- Uehling indicators

Calibration is not required; therefore, ALT/CT for the Uehling indicators is not applicable (See attachment 4.13)

8.2 Magnetrol Level Switch Uncertainty (e_1) & (e_2), and As-Found Tolerance (AFT)

8.2.1 LOW-LOW Level Switch (Lower Displacer) uncertainty (e_1)

$$e_1 = \pm (RA^2 + DR^2 + TE^2 + MTE^2 + ALT^2)^{1/2}$$
$$e_1 = \pm (0.25^2 + 0.0^2 + 0.20^2 + 0.50^2 + 0.60^2)^{1/2}$$
$$e_1 = \pm 0.84"$$

8.2.2 LOW Level Switch (Upper Displacer) uncertainty (e_2)

The value of e_2 is based on the uncertainty associated with the LOW-LOW Level displacer, which is similar to the LOW Level Displacer, therefore e_2 is the same as the e_1 value.

$e_2 = \pm (e_1^2)^{1/2}$
$e_2 = \pm (0.84^2)^{1/2}$
$e_2 = \pm 0.84"$

The LOW-LOW Level setting & LOW Level setting relationship has impact on the fuel oil inventory between the two displacer settings. Since the low-low and low switch As-Found values, with uncertainty are used for evaluating available fuel oil, there is no need to separately evaluate the uncertainty of the difference between the values.

8.2.3 As-Found Tolerance (AFT) for the Magnetrol Switches

As-Found Tolerance (AFT) for the Magnetrol Switches will be determined by:
$AFT = \pm (RA^2 + DR^2 + ALT^2)^{1/2}$
$AFT = \pm (0.25^2 + 0.0^2 + 0.60^2)^{1/2}$
$AFT = \pm 0.65"$

8.3 Level Indicator (dipstick direct reading) Uncertainty (e_3).

The dip stick direct reading uncertainty only includes RA (see 8.1.1)
$e_3 = \pm (RA^2)^{1/2} = \pm (0.0625^2)^{1/2}$
$e_3 = \pm 0.0625"$

8.4 Level Indicator Uncertainty - Manometer/Bubbler Reading (e_4 / e_5 / e_6 / e_7)

The dip stick direct reading uncertainty only includes RA (see 8.1.1)
$e_5 = e_4 = e_6 = e_7 = \pm (RA^2)^{1/2} = \pm (0.125^2)^{1/2}$
$e_5 = e_4 = e_6 = e_7 = \pm 0.125"$

9.0 CALCULATE CHANNEL UNCERTAINTY

9.1 Magnetrol Switch (LS)

9.1.1 **FOR LOW-LOW SWITCH SETTING (CU_1):**

$CU_1 = \pm (PM_{SG\text{-}LL}^2 + PE^2 + e_1^2 + IRE^2)^{1/2} \pm B"$
$CU_1 = \pm (0.075^2 + 0^2 + 0.84^2 + 0^2)^{1/2} \pm 0"$ (see Section 7.2.1 & 8.2.1)
$CU_1 = \pm 0.84"$

9.1.2 **FOR LOW SWITCH SETTING (CU_2):**

$CU_2 = \pm (PM_{SG\text{-}L}^2 + PE^2 + e_2^2 + IRE^2)^{1/2} \pm B"$
$CU_2 = \pm (0.6^2 + 0^2 + 0.84^2 + 0^2)^{1/2} \pm 0"$ (see Section 7.2.1 & 8.2.2)
$CU_2 = \pm 1.03"$

9.2 Uehling Indicator - Manometer/Bubbler Reading

9.2.1 Evaluate $CU_4/CU_5/CU_6/CU_7$ - For Tank 31, 32 & 33

9.2.1.1 **FOR LI AT LOW LS SETTING:** (CU_4/CU_5) - [without correction for SG]

$e_4 = e_5$ = level at the indicator ± 1/8" (see Section 8.1.1)
PM = ± RA × 1.25
PM = ± 0.125" × 1.25 = 0.15625" - Round to 0.16"
PM = ± 0.16"
$CU_4 = CU_5 = \pm (e_4^2 + PM^2)^{1/2} = \pm (0.125^2 + 0.16^2)^{1/2} = \pm 0.2$"
$CU_4 = CU_5 =$ **± 0.2"**

9.2.1.2 **FOR LI AT LOW-LOW LS SETTING:** (CU_6/CU_7) - [without correction for SG]

$e_6 = e_7$ = level at the indicator ± 1/8" (see Section 8.1.1)
PM = ± RA × 1.25
PM = ± 0.125" × 1.25 = 0.15625" - Round to 0.16"
PM = ± 0.16"
$CU_6 = CU_7 = \pm (e_4^2 + PM^2)^{1/2} = \pm (0.125^2 + 0.16^2)^{1/2} = \pm 0.2$"
$CU_6 = CU_7 =$ **± 0.2"**

9.2.2 Evaluate $CU_4/CU_5/CU_6/CU_7$ - For Tank 31, 32 & 33 – [corrected for SG]

9.2.2.1 Evaluate CU_4 (tank 31 & 32) & CU_5 (tank 33) (@ TS LOW Setpoint)
CU_4 and CU_5 have essentially the same considerations at 6804 gallon (87" & 87.5") alarm value -

$e_4 = e_5$ = level at the indicator ± 1/8" (see Section 8.1.1)
PM = ± 0.16"
$CU_4 = CU_5 = \pm (e_4^2 + PM^2 + SG_{ie\,l}^2)^{1/2}$
$CU_4 = CU_5 = \pm (0.125^2 + 0.16^2 + 2.93^2)^{1/2} = \pm 2.94$" - Round to 2.95"
$CU_4 = CU_5 = \pm 2.95$"

9.2.2.2 Evaluate CU_6 (tank 31 & 32) & CU_7 (tank 33) (@ TS LOW-LOW Setpoint)
CU_6 and CU_7 have essentially the same considerations at 17.1" pump shut off value -
RA = level at the indicator ± 1/8" (see Section 8.1.1)

$e_6 = e_7$ = level at the indicator ± 1/8" (see Section 8.1.1)
PM = ± 0.16"
$CU_6 = CU_7 = \pm (RA^2 + PM^2 + SG_{ie\,l\text{-}l}^2)^{1/2}$
$CU_6 = CU_7 = \pm (0.125^2 + 0.16^2 + 0.5^2)^{1/2} = \pm 0.5397$" - Round to 0.55"
$CU_6 = CU_7 = \pm 0.55$"

9.3 **FOR DIPSTICK LEVEL INDICATION (TANK SOUNDING)**

The dip stick (direct reading) uncertainty includes e_3 (see 8.3) & PM (see 7.2.1).
$CU_3 = \pm (e_3^2 + PM^2)^{1/2} \pm (0.0625^2 + 0.50^2)^{1/2}$
$CU_3 = \pm 0.5$" [This reading is uncorrected for any SG effects]
$CU_3 =$ **± 0.5"** (see section 8.3)

10.0 EDG TANKS

10.1 EVALUATE ERROR DUE TO TANK SLOPE FOR TABLE 1 – [Ref. Att 4.12 - IP3-RPT-EDG-01632]

10.1.1 EVALUATE ERROR DUE TO SLOPE OF TANK NO. 31 AND NO. 32

The change in height over horizontal 51.0" is 1.0625" (See Attachment 4.12)

$$\text{TAN } \varphi = \frac{1.0625"}{51.0"} = 0.0208333$$

$\therefore \varphi = 1.1935°$ (tank tilt in degrees)

Determine ΔH Between The Tank Centerline and The Pump Location

The distance between the centerline and the pump is 61.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 61.0" = \therefore 0.0208333 \times 61.0" = 1.2708"$

$\therefore$ For any height at the tank centerline (H), the height at the pump will be H-1.2708" (INPUT FOR TABLE 1)

Determine ΔH Between The Tank Centerline and The Level Switch Location

The distance between the centerline and the level switch is 79.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 79.0" = \therefore 0.0208333 \times 79.0 = 1.6458"$

$\therefore$ For any height at the tank centerline (H), the height at the level switch is H-1.6458" (INPUT FOR TABLE 1)

Determine ΔH Between The Tank Centerline and The Level Indicator Location

The distance between the centerline and the level indicator is 30.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 30.0" = \therefore 0.0208333 \times 30.0 = 0.6249"$

$\therefore$ For any height at the tank centerline (H), the height at the level indicator is H+ 0.6249" (INPUT FOR TABLE 1)

Determine ΔH Between The Tank Centerline and The Sounding Tube Location

The distance between the centerline and the Sounding Tube is 81.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 81.0" = \therefore 0.0208333 \times 81.0 = 1.6875"$

$\therefore$ For any height at the tank centerline (H), the height at the sounding tube is H+ 1.6875" (INPUT FOR TABLE 1)

10.1.2 **EVALUATE ERROR DUE TO SLOPE OF TANK NO. 33**

The change in height over 51.0" is 1.4375" (See Attachment 4.12)

$$\text{TAN } \varphi = \frac{1.4375"}{51.0"} = 0.0281863$$

$\therefore \varphi = 1.6145°$ (tank tilt in degrees)

Determine ΔH Between The Tank Centerline and The Pump Location

The distance between the centerline and the pump is 61.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 61.0" = \therefore 0.0281863 \times 61.0" = 1.7194"$

$\therefore$ For any height at the tank centerline (H), the height at the pump will be H-1.7194" (INPUT FOR TABLE 1)

Determine ΔH Between The Tank Centerline and The Level Switch Location

The distance between the centerline and the level switch is 79.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 79.0" = \therefore 0.0281863 \times 79.0 = 2.2267"$

$\therefore$ For any height at the tank centerline (H), the height at the level indicator is H-2.2267" (INPUT FOR TABLE 1)

Determine ΔH Between The Tank Centerline and The Level Indicator Location

The distance between the centerline and the level indicator is 30.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 30.0" = \therefore 0.0281863 \times 30.0 = 0.8456"$

$\therefore$ For any height at the tank centerline (H), the height at the level switch is H+ 0.8456" (INPUT FOR TABLE 1)

Determine ΔH Between The Tank Centerline and The Sounding Tube Location

The distance between the centerline and the sounding tube is 81.0" (Ref. 3.7.2)

$\Delta H = \text{TAN } \varphi \times 81.0" = \therefore 0.0281863 \times 81.0 = 2.2831"$

$\therefore$ For any height at the tank centerline (H), the height at the sounding tube is H+ 2.2831" (INPUT FOR TABLE 1)

10.2 DETERMINE EDG FUEL REQUIREMENT

Technical Specification Task Force Change Traveler TSTF-501A identifies allowed standard format changes to Technical Specifications to identify need for 7 days of EDG fuel oil storage, and AOT if only 6 days of EDG fuel oil storage is maintained. The 6 day and 7 day terms replace actual gallon values to minimize future Technical Specification changes and allow the 50.59 controlled site procedures and programs to control and justify the required volumes.

Fuel is to be stored in site tanks for operation of each EDG for total of either 6 or 7 days (144 or 168 hours) at 24 hour maximum profile. Site tanks are defined as the local EDG FOST and other site tanks, which are maintained to the same fuel oil standards, and would contain the EDG oil until transferred to the EDG FOST. Existing IP3 Technical Specification required volume for each EDG is 5365 gallons, based upon minimum safeguards loading for 48 hours. Prior EDG fuel oil calculations identified 5871 gallons required to operate the EDG at nameplate loading for 48 hours. After review of the required volumes, size of the EDG FOST, and the fuel oil used during EDG required testing, it was decided that fuel oil for 40 hours of EDG operation at 24 hour maximum profile would provide adequate fuel oil while allowing for required testing without requiring unreasonable frequency of EDG FOST refill.

From reference 3.10, we have the following information regarding fuel oil required for each EDG:
[24 hour maximum profile is ½ hour @ 2000KW, 2 hour @ 1950KW & 21½ hour @ 1750KW]

- 23,940 gallons, @ SG of 0.83, for 7 day (168 hour) operation at 24 hour maximum profile
- 20,520 gallons, @ SG of 0.83, for 6 day (144 hour) operation at 24 hour maximum profile
- 6,840 gallons, @ SG of 0.83, for 48 hour operation at 24 hour maximum profile
- 141 gallons/hr, @ SG of 0.83, at 100% (1750KW) EDG loading

The required number of gallons to run the EDG for a specified time varies based upon the actual SG of the fuel oil to be used, based upon the mass and volumetric low (net) heat available. The relationship may be approximated by the following formula:

[Gallons @ 0.83 SG] x 0.83 / [actual SG] = Gallons @ actual SG
6,840 gallons & 141 gal/hr at 0.83 SG is equivalent to:
6,601 gallons & 136 gal/hr at 0.86 SG or
6,376 gallons & 131.5 gal/hr at 0.89 SG

10.2.1 Required fuel oil for 40 hours operation of an EDG [part of 144 and/or 168 hour requirement]

Fuel oil for 40 hours of EDG operation at 24 hour maximum profile is stored in each EDG FOST:
6,840 gallons – (8 x 141 gallons) = 6,840 – 1128 = 5,712 gallons @ SG 0.83
6,601 gallons – (8 x 136 gallons) = 6,601 – 1088 = 5,513 gallons @ SG 0.86

Less than 5,712 gallons @ 0.83 SG [or equivalent] will cause entry into associated FSAR/TRM AOT

10.2.2 Required fuel oil be stored in tanks other than the EDG FOST - for an additional 128 hours operation of an EDG [part of 144 hour (6 day) and/or 168 hour (7 day) requirement]

Fuel for 128 hours (168-40) of EDG operation at 24 hour maximum profile stored in other site tanks:
23,940 gallons – 5,712 gallons = 18,228 gallons @ SG 0.83 for each EDG

Less than 18,228 usable gallons @ 0.83 SG [or equivalent] for any EDG will cause entry into associated FSAR/TRM AOT and needs to be evaluated for impact on Technical Specification Requirements. A minimum of 36,456 gallons (2x 18,228, for two IP3 EDG operable), and a minimum of 54,684 gallons (3x 18,228, for three IP3 EDG operable), is required to be stored in tanks other than the EDG FOST. Reduction below the 7-Day required amount, by up to 3,420 gallons @ SG 0.83 results in 6-Day AOT entry for the specified EDG. 6840 (for 48 hours)/2 = 3420 (for 24 hours)
GT2/GT3 Fuel Oil Tank volume is 583 gallons/inch, and is equipped with a Varec 2500 ATG measuring tape (accurate to +/-0.5"). The required IP3 gallons should include an additional 1,000 gallon allowance for reading accuracy, and a minimum log reading of 55,684 gallons for 3 EDG operable (NO AOT).

10.3 **EDG F.O. Day Tank Considerations**

There are 3 EDG (Emergency Diesel Generator) Fuel Oil (FO) 175 gallon Day Tanks, one for each EDG. The EDG Fuel Oil Day Tank has level switches which actuate when the tank level is at specific levels, Level Switches (LC-1207S, LC-1208S & LC-1209S):

- 90% [Fill valve opens on decreasing level or closes on increasing level],
- 65% [EDG FO storage tank transfer pump start (auto stop between 65% & 90% rising level)] and
- 50%/30% [EDG day tank low level alarm, see CR-IP3-2011-05558 for conflicting information]

Evaluate the EDG Fuel Oil Day Tank volumes at 65% and 50%/30% to identify the time EDG may operate at EDG 100% Load (1750 KW) before day tank empties, with no EDG FOST transfer pump makeup.

EDG Fuel Oil Day Tank volume: 65% x 175 gallon = 113.75 gallons
EDG Full Load fuel usage: 141 gallons/hr, @ SG of 0.83 [Reference 3.10]

$\therefore$ Therefore: $\frac{113.75 \text{ gals} \times 60 \text{ min /hr}}{141 \text{ gallons/hr}}$ = 48.4 minutes to tank empty

EDG Fuel Oil Day Tank volume: 50% x 175 gallon = 87.5 gallons
EDG Full Load fuel usage: 141 gallons/hr, @ SG of 0.83

$\therefore$ Therefore: $\frac{87.5 \text{ gals} \times 60 \text{ min /hr}}{141 \text{ gallons/hr}}$ = 37.2 minutes to tank empty

EDG Fuel Oil Day Tank volume: 30% x 175 gallon = 52.5 gallons
EDG Full Load fuel usage: 141 gallons/hr, @ SG of 0.83

$\therefore$ Therefore: $\frac{52.5 \text{ gals} \times 60 \text{ min /hr}}{141 \text{ gallons/hr}}$ = 22.3 minutes to tank empty

11.0 ANALYTICAL LIMIT (AL) OR NOMINAL PROCESS LIMIT (NPL)

No AL is established in the FSAR or Technical Specifications.

The IPEC underground FOST was not designed to hold seven days' worth of ultra low sulfur fuel oil with the EDG operating at its maximum load profile conditions. Thus, the strategy has always been that to meet the seven day EDG run stipulation of Regulatory Guide 1.137, the FOST would be provided with fuel oil on an as needed basis from an on site reserve supply. Because of this strategy with respect to the necessity of re-filling the FOST, in addition to the seven day time, IPEC also contains in its current licensing basis a 48 hour EDG operating time period specifically related to the initial FOST fuel oil usable volume. It is not cited in nor is it a requirement of Regulatory Guide 1.137. This IPEC specific interim time period must also be addressed by the License Amendment Request (LAR) process. FOST fuel oil usable and stored volumes, and the corresponding EDG run time, will change. The newly determined FOST volumes and associated EDG run time will not be put in the Technical Specifications but will be placed in the Technical Specification Bases or the FSAR/TRM.

This calculation is to support a planned Technical Specification Amendment request associated with EDG FO volumes in accordance with TSTF-501A. Technical Specifications would identify the need for 7 days and/or 6 days worth of fuel, to be stored in each EDG FOST and other on-site tanks. There is then a need to place a specific EDG FOST volume requirement in a 50.59 controlled document, such as the FSAR/TRM or Technical Specification Basis. Reference 3.10 indicates the EDG FOST is not large enough to store 48 hours worth of useable fuel [past Technical Specification requirement], so the basis for a new volume will be established in this calculation.

11.1 **PROCESS LIMIT (NPL) FOR EDG FOST (FSAR/TRM):**

Considerations -
Maximum volume in any EDG FOST is 7650 gallons to prevent flooding of the local indicators, per 3-SOP-EL-009.
Unusable fuel gallons based upon allowed as-found for pump shut-off switch (section 13.1).
5712 usable gallons of fuel oil for 40 hours operation of EDG operation at 24 hour rating (section 10.2.1).
Additional fuel volume in each EDG FOST to account for periodic testing of each EDG will be based on approximately six hours of full load testing operation (TS SR 3.8.1.2 & 3.8.1.3 or return to service testing):
141 gal/hr [100%, 1750KW] x 6 hours = 846 gallons @ 0.83 SG

Therefore, FSAR/TRM Process Limit will be 5712 [@ 0.83 SG] useable gallons of fuel oil (or 5513 gallons @ 0.86 SG) to be stored in each EDG FOST, which would provide for 40 hours of EDG operation at 24 hour maximum profile load and 18,228 useable gallons of fuel oil for 128 hours of EDG operation at 24 hour maximum profile to be stored in other site tanks (Sect. 10.2.1).

11.1.1 NPL for FSAR/TRM value for EDG FOST usable gallons – Dipstick

Tank 33	Tank 31 & 32	Using Dipstick
5712	5712	Useable gallons [40 hours @ SG of 0.83] (Sect. 10.2.1)
956	915	* Unusable gallons [Difference due to tank tilt] (Sect. 13.1)
20	20	Coating of tank – margin (Ref. 3.2 & 2.14)
6688	6647	Total gallons @ SG 0.83

* Tank unusable gallons are based upon the allowed As-Found value for pump shut-off switch.

For Tank 31 & 32
NPL = 5712 usable gals, 6647 gals in the tank (See Table 1)
NPL = 87.69898 @ the sounding tube (round to 87.7")
NPL = 87.7" For Tank 31 & 32

For Tank 33
NPL = 5712 usable gals, 6688 gals in the tank (See Table 1)
NPL = 88.87515" @ the sounding tube (round to 88.88")
NPL = 88.88" For Tank 33

11.1.2 NPL for FSAR/TRM value for EDG FOST usable gallons – Indicator

Tank 33	Tank 31 & 32	Using Uehling Indicators [Calibrated at 0.86 SG]
5513	5513	Useable gallons [40 hours @ SG of 0.86] (Sect. 10.2.1)
956	915	* Unusable gallons [Difference due to tank tilt] (Sect. 13.1)
20	20	Coating of tank – margin (Ref. 3.2)
40	40	Margin & Specific Gravity (SG) – (Sect 7.2.1.2)
50	50	Indication accuracy (Ref. 8.4.1)
6579	6538	Total gallons @ SG 0.86

* Tank unusable gallons are based upon the allowed As-Found value for pump shut-off switch.

For Tank 31 & 32 –
NPL = 5513 usable gals, 6538 gallons by indicator in the tank, @ SG 0.86 (See Table 1)
NPL = 85.16" on the Indicator (round up to 85.2") [86.2" @ SG 0.86 at the sounding tube]
NPL = 85.2" on the Indicator - For Tank 31 & 32

For Tank 33 –
NPL = 5513 usable gals, 6579 gallons by indicator in the tank, @ SG 0.86 (See Table 1)
NPL = 85.93" on the Indicator (round up to 85.95") [86.8" @ SG 0.86 at the sounding tube]
NPL = 85.95" on the Indicator - For Tank 33

11.2 **NOMINAL PROCESS LIMIT (NPL) FOR LOW-LOW LEVEL DISPLACER SETTING LIMIT:**

To protect the fuel oil transfer pumps from the damaging effects of vortexing, the IP3 FSAR and the manufacturer pump submergence data indicates a low level pump cut-off of 12" (See Attachment 4.3). This protection contributes unusable gallons in the tanks, and is different due to tank slope (0.50" for tank 33 and 0.375" for tank 31 & 32) from the switch down to the pump.

From the Rockaway Tank drawing and the Gould Pumps outline drawings; the pump suction is 3.875" above the tank bottom as shown below (Reference 3.7 (2) & (3)).

$$\left(\frac{108}{2}\right) + 78 - 129.75 + 2 - 0.375 = 3.875"$$

The tolerance on all pump dimensions is +1/8" or +1/8" per 5', which ever is greater. The total dimensional error applied will be +3/8". (ref. 3.7 (3))

Therefore, for pump protection the NPL will be based on the manufacturer's submergence value plus distance from tank bottom plus the dimensional error.

NPL = 12" + 3.875" + 0.375" = 16.25"

For Tank 31 & 32
NPL = 16.250" @ the pumps [15.875 @ the switch],
NPL = 788 gals in the tank (See Table 1)

For Tank 33
NPL = 16.250" @ the pumps [15.7427 @ the switch],
NPL = 818 gals in the tank (See Table 1)

11.3 **NOMINAL PROCESS LIMIT (NPL) REVISED LOW LEVEL DISPLACER SETTING LIMIT:**

Maximum level in any EDG FOST is 7650 gallons to prevent flooding of the local indicators, per 3-SOP-EL-009
Fuel volume required to account for periodic testing of each EDG will be based on approximately six hours of full load operation per TS SR 3.8.1.2 & 3.8.1.3 or return to service testing:

141 gal/hr [full load operation] x 6 hours = 846 gallons @0.83 SG

NPL for alarm to be based on maximum level minus the fuel allowance for testing is:

7650 – 846 = 6804 gallons @0.83 SG

11.3.1 Nominal process limit (NPL) - Low Level Alarm value to protect FSAR/TRM value

By design, an alarm will be actuated when there is 6804 gallons of fuel in any EDG FOST. (Ref 3.13)

For Tank 31 & 32
NPL = 86.58466" @ the switch
NPL = 6804 gals in the tank (See Table 1).
NPL = 86.585" (round to 86.6") - For Tank 31 & 32
NPL = 86.6"

For Tank 33
NPL = 86.00376" @ the switch
NPL = 6804 gals in the tank (See Table 1)
NPL = 86.004" (round to 86.0") - For Tank 33
NPL = 86.0"

12.0 DETERMINE SETPOINT (TS)

TS = NPL ± (CU + Margin)
Positive values of CU is used for process variables that decrease towards the analytical limit.

12.1 **LOW-LOW LEVEL DISPLACER SETPOINT SETTING:**

Nominal TS of 17.1" @ the switch was implemented for tanks 31, 32, & 33 in 1994

12.1.1 Lower Displacer Setting for pump protection - For Tank 31 & 32

TS = NPL + CU - For Tank 31 & 32
TS = 15.875" + 0.84" (See Section 11.2 and 9.1.1)
TS = 16.715" @ the switch = 844 gals - Calculated setting (round to 16.7")

Implemented - For Tank 31 & 32 (see TABLE 1)
TS = 17.1" @ the switch = 870 gallons

Existing implemented setting is conservative.

12.1.2 Lower Displacer Setting for pump protection - For Tank 33

TS = NPL + CU - For Tank 33
TS = 15.7427" + 0.84" (See Section 11.2 and 9.1.1)
TS = 16.5827" @ the switch = 875 gals - Calculated setting (round to 16.6")

Implemented - For Tank 33 (see TABLE 1)
TS = 17.1" @ the switch = 910 gallons

Existing implemented setting is conservative.

12.1.3 Lower Displacer Setting - LOW-LOW switch field setting, TS =17.1" (see Section 12.1)

Level switch displacer calibrations referenced from tank bottom to bottom of displacer. From the Magnetrol installation drawing (Att. 4.2), the lower switch transfers on decreasing level of at least 1.125" (1 1/8") above the bottom of the lower displacer. Therefore the bottom of the lower displacer will be the setpoint ($TS_{LOW-LOW}$) minus 1.125":

LOW-LOW field setting = 17.1" - 1.125" = 15.975" From the Tank Bottom to the Bottom of the Displacer (TBBD)

12.2 **LOW LEVEL DISPLACER SETPOINT SETTING:**

This evaluation for the Upper Displacer Setting Limit will consider 6804 gallon alarm identified in Section 11.3.

12.2.1 Upper Displacer Setting for low level 6804 gallon alarm setting - For Tank 31 & 32

TS = NPL + CU_{LOW}
TS = 86.585" + 1.03" (See Section 11.3.1 and 9.1.2)
TS = 87.615" @ the Switch, Rounded to 87.6"

For Tank 31 & 32 (see TABLE 1) 6874 gallons
TS = 87.6" @ the Switch = 6874 gals = 89.9" @ indicator = 90.95" @ sounding tube (See TABLE 1)

12.2.2 Upper Displacer Setting for low level 6804 gallon alarm setting - For Tank 33

TS = NPL + CU_{LOW}
TS = 86.004" + 1.03" (See Section 11.2.2 and 9.1.2)
TS = 87.034" @ the Switch, Rounded to 87.05"

For Tanks 33 (see TABLE 1) 6874 gallons
TS = 87.05" @ the Switch = 6874 gals = 90.1" @ indicator = 91.55" @ sounding tube (See TABLE 1)

12.2.3 Upper Displacer Setting - LOW Level switch field setting (see Section 12.2)

Level switch displacer field settings are referenced from tank bottom to bottom of displacer. From the Magnetrol installation drawing (Att. 4.2), the upper switch transfers on decreasing level 3.5" (3 1/2") above the bottom of the upper displacer. Therefore, the upper displacer will be set at the setpoint (TS_{LO}) minus 3.5":

Tank 31 & 32 -
For field setting based on 6804 gallons in the tank, TS =87.6" (see Section 12.2.1)
LOW setting = 87.6" - 3.5" = 84.1" From the Tank Bottom to the Bottom of the Displacer (TBBD)

Tank 33 -
For field setting based on 6804 gallons in the tank, TS =87" (see Section 12.2.2)
LOW setting = 87.05" - 3.5" = 83.55" From the Tank Bottom to the Bottom of the Displacer (TBBD)

12.3 TANK LEVEL – FSAR/TRM MINIMUM LOW LEVEL INDICATION:

12.3.1 **MINIMUM LEVEL INDICATION** – Dipstick

The EDG FOST minimum Dipstick indication required volume is 6647 gallons, @ 0.83 SG, for tank 31 & 32 volume and 6688 gallons, @ 0.83 SG, for tank 33 volume (see section 11.1.1), using the dipstick @ the sounding tube.
From TABLE 1 this minimum volume is equivalent to 87.7" for Tank 31 & 32 and 88.88" for Tank 33.
The dipstick channel uncertainty (CU) associated with using the dipstick @ the sounding tube is ±0.50". The CU will be added to 87.7" for Tank 31 & 32 and to 88.88" for Tank 33; to determine the minimum read setting (TS) for the fuel oil to be measured in the tanks in Operations procedures.

TS for Tank 31 & 32

TS = 87.7" + CU
TS = 87.7" + 0.50" = 88.2"
TS = 88.2" = **6682** gallons (See TABLE 1) - @ 0.83 SG

TS for Tank 33

TS = 88.88" + CU
TS = 88.88" + 0.50" = 89.38" (Round up to 89.4")
TS = 89.4" = **6726** gallons (See TABLE 1) - @ 0.83 SG

12.3.1 **MINIMUM LOW LEVEL INDICATION** – Indicator

The EDG FOST minimum Indicator required volume is 6538 gallons, @ 0.86 SG, for tank 31 & 32 volume and 6579 gallons, @ 0.86 SG, for tank 33 volume (see section 11.1.2) when the tank level indicators are used to obtain level. From TABLE 1 this volume is equivalent to 85.2" at the Level Indicators for Tank 31 & 32 and 85.95" at the Level Indicator for Tank 33.
The tables (see section 11.1.2) identifying these values already include specific allowances for indicator uncertainty and SG affects, therefore additional allowances would not be appropriate.

TS for Tank 31 & 32 Indication

TS = 85.2" @ the Indicator = 6538 gallons @ SG 0.86

TS for Tank 33 indication

TS = 85.95" @ the Indicator = 6579 gallons @ SG 0.86

13.0 DETERMINE AS FOUND VALUE (AFV)

13.1 **LOW-LOW LEVEL DISPLACER AS FOUND VALUES:**

The SRSS of RA, DR and ALT will be subtracted from the pump cut-off setpoint (TS) to determine the minimum As-Found Value for the pump cutoff switch level setting. The SRSS of RA, DR and ALT will be added to the pump TS for inventory control maximum As-Found Value.

$AFV_{L\text{-}L} = TS \pm (RA^2 + DR^2 + ALT^2)^{1/2}$
$AFV_{L\text{-}L} = 17.1" \pm (0.25^2 + 0 + 0.60^2)^{1/2}$
$AFV_{L\text{-}L} = 17.1" \pm 0.65"$

$AFV_{L\text{-}L\,L}$= 16.45" (Lower AV for Pump Protection)
$AFV_{L\text{-}L\,H}$= 17.75" (Upper AV for Inventory Control)

For Tank 31 & 32 (see TABLE 1)
$AFV_{L\text{-}L\,L}$ = 826 gals
$AFV_{L\text{-}L\,H}$ = 915 gals

For Tank 33 (see TABLE 1)
$AFV_{L\text{-}L\,L}$ = 866 gals
$AFV_{L\text{-}L\,H}$ = 956 gals

13.2 **LOW LEVEL DISPLACER AS FOUND VALUE:**

TS elevation was determined in Section 12.2. To determine the minimum As Found Value for fuel oil 6804 gallon alarm setting; the SRSS of RA, DR and ALT for the switch will be subtracted from the Low Level Alarm calculated trip setpoint (TS). To determine the maximum As Found alarm value, the SRSS of RA, DR and ALT for the switch will be added to the the Low Level Alarm calculated trip setpoint (TS), for impact on tank fill.

13.2.1 As Found Value for Low Setpoint Setting at 6804 gallon alarm setting - For Tank 31 & 32 (see TABLE 1)

$AFV_L = TS \pm (RA^2 + DR^2 + ALT^2)^{1/2}$
$AFV_L = 87.55" \pm (0.25^2 + 0 + 0.60^2)^{1/2}$
$AFV_L = 87.55" \pm 0.65"$

$AFV_{L\,L}$ = 86.9" (Lower AV for Inventory Control)
$AFV_{L\,H}$ = 88.2" (Upper AV for tank fill)

$AFV_{L\text{-}L}$ = 6827 gals (Lower AV for Inventory Control)
$AFV_{L\,H}$ = 6914 gals (Upper AV for tank fill)

13.2.2 As Found Value for Low Setpoint Setting at 6804 gallon alarm setting - For Tank 33 (see TABLE 1)

$AFV_L = TS \pm (RA^2 + DR^2 + ALT^2)^{1/2}$
$AFV_L = 87.05" \pm (0.25^2 + 0 + 0.60^2)^{1/2}$
$AFV_L = 87.05" \pm 0.65"$

$AFV_{L\,L}$ = 86.4" (Lower AV for Inventory Control)
$AFV_{L\,H}$ = 87.7" (Upper AV for tank fill)

$AFV_{L\,L}$ = 6830 gals (Lower AV for Inventory Control)
$AFV_{L\,H}$ = 6919 gals (Upper AV for tank fill)

14.0 SUMMARY – For 0.83 SG Fuel Oil

EDG FOST TANK CAPACITY: 7,693 GAL (CALCULATED REF. 3.2) 7,700 GAL (DES. SPEC.)

14.1 **LOW-LOW LEVEL DISPLACER SETTING**

This Section addresses the LOW-LOW Level Displacer Calculated Setting For Pump STOP and Inventory Control

14.1.1 **TANK 31 & 32**

NOMINAL PROCESS LIMIT: 788 GAL (16.25" @ the pumps) (Sect. 11.2)

TRIP SETPOINT (LO-LO): 870 GAL (17.1" @ the switch) (Unusable Fuel, Pump Protection & Inventory Control) (Section 12.1)

AS FOUND VALUE: 826 GAL (LO) (16.45" @ the switch); 915 GAL (HI) (17.75" @ the switch)

14.1.2 **TANK 33**

NOMINAL PROCESS LIMIT: 818 GAL (16.25" @ the pumps) (Sect. 11.2)

TRIP SETPOINT (LO-LO): 910 GAL (17.1" @ the switch) (Unusable Fuel, Pump Protection & Inventory Control) (Section 12.1)

AS FOUND VALUE: 866 GAL(LO) (16.45" @ the switch); 956 GAL (HI) (17.75" @ the switch)

14.2 **LOW LEVEL DISPLACER CALCULATED SETTINGS** (Alarm prior to FSAR/TRM minimum value, Operator to Initiate Tank Refill)

This Section addresses the LOW Level Displacer (Alarm) Calculated Setting Based on 6804 gallons @ 0.83 SG

14.2.1 **TANK 31 & 32**

NOMINAL PROCESS LIMIT: 6804 GAL (86.585" @ the switch) (Sect. 11.3.1)

ALARM SETPOINT (LO): 6874 GAL (87.55" @ the switch) (CCR ALARM)

AS FOUND VALUE: 6822 GAL (86.85" @ the switch) (Sect. 13.2.1)

14.2.2 **TANK 33**

NOMINAL PROCESS LIMIT: 6804 GAL (86.004" @ the switch) (Sect. 11.3.1)

ALARM SETPOINT (LO): 6874 GAL (87.05" @ the switch) (CCR ALARM)

AS FOUND VALUE: 6830 GAL (86.4" @ the switch) (Sect. 13.2.2)

115 GALLONS IN EDG F.O. DAY TANK IS NOT CONSIDERED FOR THIS FUNCTION IN THIS CALCULATION

14.3 **DIPSTICK MEASUREMENT READING TO ASSURE COMPLIANCE WITH FSAR/TRM INVENTORY**

14.3.1 **TANK 31 & 32**

NOMINAL PROCESS LIMIT: 6647 GAL (87.7" @ the sounding tube) (Sect. 11.1.1)

MIN SOUNDED READING: 6682 GAL (88.2" @ the sounding tube) (Sect. 12.3.1)

14.3.2 **TANK 33**

NOMINAL PROCESS LIMIT: 6688 GAL (88.9" @ the sounding tube) (Sect. 11.1.1)

MIN SOUNDED READING: 6726 GAL (89.4" @ the sounding tube) (Sect. 12.3.1)

14.4 **INDICATOR READING TO ASSURE COMPLIANCE WITH FSAR/TRM INVENTORY**

14.3.1 **TANK 31 & 32**

NOMINAL PROCESS LIMIT: 85.2" @ the Indicator or 6538 gallons @ SG 0.86 (Sect. 11.1.2 & 12.3.1)

14.3.2 **TANK 33**

NOMINAL PROCESS LIMIT: 85.95" @ the Indicator or 6579 gallons @ SG 0.86 (Sect. 11.1.2 & 12.3.1)

15.0 EDG F.O. STORAGE TANK FIELD CALIBRATION CONSIDERATIONS

15.1 LEVEL SWITCH DISPLACER CALIBRATIONS

The following is based on field measurements (Att. 4.15) using the bottom of the tank as the reference point, as shown on drawing FP 9321-05-2990-0. It is not always practical to measure the displacer positions while they are in the tank, but it is possible to use the mounting flange as the reference and measure how far down the displacers are to be set on the activating cable. Field measurements were made to determine the distance from:

Flange to Tank Bottom (DFTB) and
Flange face to the bottom of the displacer (FFBD).

Each tank has a slightly different mounting flange dimension, so each DFTB and FFBD is different.

Tank Bottom to the Bottom of the Displacer (TBBD)

TBBD based upon field measurements, without access to the bottom of the tank, is calculated based upon the listed DFTB and FFBD values.

The measurement from the flange face to the bottom of the displacer (FFBD) will be determined by DFTB - TBBD

15.1.1 Field Measurement Review - Lower Displacer Setting - LOW-LOW switch setting, TS =17.1" (see Section 12.1)

Field value -	DFTB Measured	FFBD Measured	TBBD (Design)
TANK 31 =	145.0625"	129.0625"	15.975"
TANK 32 =	144.75"	128.875"	15.975"
TANK 33 =	145.5"	129.625"	15.975"

As-Left Tolerance = ±0.60", As-Found Tolerance = ±0.65" [comparison of Measured to calculated]

FOR TANK 31
FFBD = DFTB – TBBD (LOW-LOW)
FFBD = 145.0625" - 15.975"
FFBD = 129.0875" (calculated)

FFBD Measured = 129.0625"
TBBD (measurement based) = 16"

FOR TANK 32
FFBD = DFTB – TBBD (LOW-LOW)
FFBD = 144.75" - 15.975"
FFBD = 128.775" (calculated)

FFBD Measured = 128.875"
TBBD (measurement based) = 15.875"

FOR TANK 33
FFBD = DFTB – TBBD (LOW-LOW)
FFBD = 145.5" - 15.975"
FFBD = 129.525" (calculated)

FFBD Measured = 129.625"
TBBD (measurement based) = 15.875"

All readings are within tolerance.

15.1.2 Field Measurement Review - Upper Displacer Setting - LOW switch setting, TS =87.5" (Tank 31 & 32) & 87" (Tank 33) (see Section 12.2)

Field value -	DFTB Measured	FFBD Measured	TBBD (Design)
TANK 31 =	145.0625"	61.5625"	84.1"
TANK 32 =	144.75"	62.75"	84.1"
TANK 33 =	145.5"	62.0"	83.55"

As-Left Tolerance = ±0.60", As-Found Tolerance = ±0.65" [comparison of Measured to calculated]

FOR TANK 31
FFBD = DFTB – TBBD (LOW)
FFBD = 145.0625" – 84.1"
FFBD = 60.9625" (calculated)

FFBD Measured = 61.5625"
TBBD (measurement based) = 83.5"

FOR TANK 32
FFBD = DFTB – TBBD (LOW)
FFBD = 144.75" – 84.1"
FFBD = 60.65" (calculated)

FFBD Measured = 62.75"
TBBD (measurement based) = 82"

FOR TANK 33
FFBD = DFTB – TBBD (LOW)
FFBD = 145.5" – 83.55"
FFBD = 61.95" (calculated)

FFBD Measured = 62.0"
TBBD (measurement based) = 83.5"

Prior field measurements for Tank 32 are not within As-Left tolerances for the alarm setting.

15.2 Conclusions From Field Measurement Review

15.2.1 All AS-Left Measurements for Tanks 31, 32 & 33 LOW-LOW LEVEL settings are within the ALT requirements for the switches (see Section 8.1.5). Therefore, the pump protection and inventory control functions of the LOW-LOW Level switch are satisfactory.

15.2.2 All AS-Left Measurements for Tanks 31 & 33 LOW LEVEL settings are within the ALT requirements for the switches (see Section 8.1.5). Therefore, The Alarm function (6804 gallons) will identify to Operators that action is required to initiate tank refill.

15.2.3 The AS-Left Measurement for Tank 32 LOW LEVEL setting is not within the ALT requirement for the switch. Therefore, the field setting (TBBD) needs to be changed from 82" to 84.1" to provide the required Alarm Function (6804 gallons) to properly identify to Operators that action is required to initiate tank refill. The action, to implement this setting change, is required to implement the Technical Specification Amendment change.

TABLE 1 - EDG Fuel Oil height in tank at devices for specific gallons
Slope Effect on Measurements for EDG Fuel Oil Storage Tanks No. 31, 32 & 33

Gallons TK 31, 32, 33 @ CL	H (In) TK 31,32, 33 @ CL	H (In) @S. Tube TK 31 &32 =H @ CL +1.6875	H (In) @S. Tube TK 33 =H @ CL +2.2831	H (In) @L SW TK 31 &32 =H @ CL -1.6458	H (In) @L SW, TK 33 =H @ CL -2.2267	H (In) @ PMP, TK 31 &32 =H @ CL -1.2708	H (In) @ PMP, TK 33 =H @ CL -1.7194	H (In) @L IND TK 31 & 32 =H @ CL +.6250	H (In) @L IND TK. 33 =H @ CL + .8456
175.96	6.435	8.1225	8.7181	4.7892	4.2083	5.1642	4.7156	7.06	7.2806
271.21	8.58	10.2675	10.8631	6.9342	6.3533	7.3092	6.8606	9.205	9.4256
378.99	10.725	12.4125	13.0081	9.0792	8.4983	9.4542	9.0056	11.35	11.5706
497.78	12.87	14.5575	15.1531	11.2242	10.6433	11.5992	11.1506	13.495	13.7156
626.36	15.015	16.7025	17.2981	13.3692	12.7883	13.7442	13.2956	15.64	15.8606
704.44	16.25	17.9375	18.5331	14.6042	14.0233	14.9792	14.5306	16.875	17.0956
717.3	16.45	18.1375	18.7331	14.8042	14.2233	15.1792	14.7306	17.075	17.2956
755.3	17.0208	18.7083	19.3039	15.375	14.7941	15.75	15.3014	17.6458	17.8664
760.06	17.1	18.7875	19.3831	15.4542	14.8733	15.8292	15.3806	17.725	17.9456
763.66	17.16	18.8475	19.4431	15.5142	14.9333	15.8892	15.4406	17.785	18.0056
784.5	17.4694	19.1569	19.7525	15.8236	15.2427	16.1986	15.75	18.0944	18.315
787.51	17.5208	19.2083	19.8039	15.875	15.2941	16.25	15.8014	18.1458	18.3664
795.875	17.6458	19.3333	19.9289	16	15.4191	16.375	15.9264	18.2708	18.4914
812.6	17.8958	19.5833	20.1789	16.25	15.6691	16.625	16.1764	18.5208	18.7414
817.58	17.9694	19.6569	20.2525	16.3236	15.7427	16.6986	16.25	18.5944	18.815
826.1	18.0958	19.7833	20.3789	16.45	15.8691	16.825	16.3764	18.7208	18.9414
844.69	18.3708	20.0583	20.6539	16.725	16.1441	17.1	16.6514	18.9958	19.2164
851.91	18.4767	20.1642	20.7598	16.8309	16.25	17.2059	16.7573	19.1017	19.3223
863.43	18.6458	20.3333	20.9289	17	16.4191	17.375	16.9264	19.2708	19.4914
865.53	18.6767	20.3642	20.9598	17.0309	16.45	17.4059	16.9573	19.3017	19.5223
870.3	18.7458	20.4333	21.0289	17.1	16.5191	17.475	17.0264	19.3708	19.5914
875.3	18.8194	20.5069	21.1025	17.1736	16.5927	17.5486	17.1	19.4444	19.665
884	18.9458	20.6333	21.2289	17.3	16.7191	17.675	17.2264	19.5708	19.7914
908.84	19.305	20.9925	21.5881	17.6592	17.0783	18.0342	17.5856	19.93	20.1506
910.33	19.3267	21.0142	21.6098	17.6809	17.1	18.0559	17.6073	19.9517	20.1723
915.17	19.3958	21.0833	21.6789	17.75	17.1691	18.125	17.6764	20.0208	20.2414
924.27	19.5267	21.2142	21.8098	17.8809	17.3	18.2559	17.8073	20.1517	20.3723
955.79	19.9767	21.6642	22.2598	18.3309	17.75	18.7059	18.2573	20.6017	20.8223
1061.23	21.45	23.1375	23.7331	19.8042	19.2233	20.1792	19.7306	22.075	22.2956
1220.04	23.595	25.2825	25.8781	21.9492	21.3683	22.3242	21.8756	24.22	24.4406
1384.69	25.74	27.4275	28.0231	24.0942	23.5133	24.4692	24.0206	26.365	26.5856
1554.72	27.885	29.5725	30.1681	26.2392	25.6583	26.6142	26.1656	28.51	28.7306
1729.62	30.03	31.7175	32.3131	28.3842	27.8033	28.7592	28.3106	30.655	30.8756
1908.75	32.175	33.8625	34.4581	30.5292	29.9483	30.9042	30.4556	32.8	33.0206
2092.16	34.32	36.0075	36.6031	32.6742	32.0933	33.0492	32.6006	34.945	35.1656
2278.16	36.465	38.1525	38.7481	34.8192	34.2383	35.1942	34.7456	37.09	37.3106
2467.43	38.61	40.2975	40.8931	36.9642	36.3833	37.3392	36.8906	39.235	39.4556
2659.62	40.755	42.4425	43.0381	39.1092	38.5283	39.4842	39.0356	41.38	41.6006
2854.41	42.9	44.5875	45.1831	41.2542	40.6733	41.6292	41.1806	43.525	43.7456
3050.62	45.045	46.7325	47.3281	43.3992	42.8183	43.7742	43.3256	45.67	45.8906
3247.93	47.19	48.8775	49.4731	45.5442	44.9633	45.9192	45.4706	47.815	48.0356
3446.93	49.335	51.0225	51.6181	47.6892	47.1083	48.0642	47.6156	49.96	50.1806
3646.55	51.48	53.1675	53.7631	49.8342	49.2533	50.2092	49.7606	52.105	52.3256
3846.45	53.625	55.3125	55.9081	51.9792	51.3983	52.3542	51.9056	54.25	54.4706
3900.04	54.2	55.8875	56.4831	52.5542	51.9733	52.9292	52.4806	54.825	55.0456
4046.34	55.77	57.4575	58.0531	54.1242	53.5433	54.4992	54.0506	56.395	56.6156
4245.96	57.915	59.6025	60.1981	56.2692	55.6883	56.6442	56.1956	58.54	58.7606
4444.97	60.06	61.7475	62.3431	58.4142	57.8333	58.7892	58.3406	60.685	60.9056

TABLE 1 - EDG Fuel Oil height in tank at devices for specific gallons
Slope Effect on Measurements for EDG Fuel Oil Storage Tanks No. 31, 32 & 33

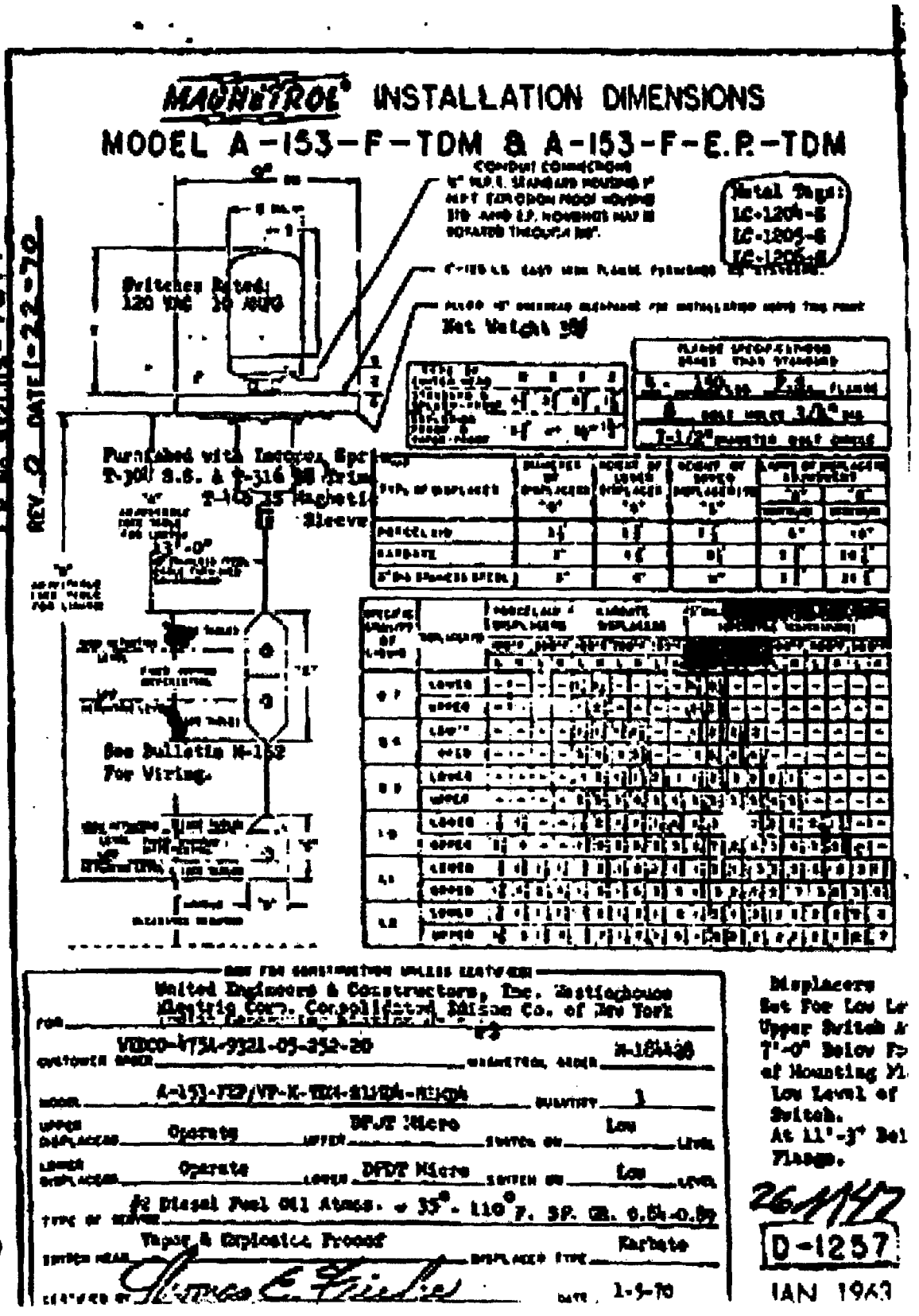
Gallons TK 31, 32, 33 @ CL	H (In) TK 31,32, 33 @ CL	H (In) @S. Tube TK 31 &32 =H @ CL +1.6875	H (In) @S. Tube TK 33 =H @ CL +2.2831	H (In) @L SW TK 31 &32 =H @ CL -1.6458	H (In) @L SW, TK 33 =H @ CL -2.2267	H (In) @ PMP, TK 31 &32 =H @ CL -1.2708	H (In) @ PMP, TK 33 =H @ CL -1.7194	H (In) @L IND TK 31 & 32 =H @ CL +.6250	H (In) @L IND TK. 33 =H @ CL + .8456
4642.27	62.205	63.8925	64.4881	60.5592	59.9783	60.9342	60.4856	62.83	63.0506
4838.49	64.35	66.0375	66.6331	62.7042	62.1233	63.0792	62.6306	64.975	65.1956
5033.27	66.495	68.1825	68.7781	64.8492	64.2683	65.2242	64.7756	67.12	67.3406
5225.47	68.64	70.3275	70.9231	66.9942	66.4133	67.3692	66.9206	69.265	69.4856
5414.73	70.785	72.4725	73.0681	69.1392	68.5583	69.5142	69.0656	71.41	71.6306
5600.73	72.93	74.6175	75.2131	71.2842	70.7033	71.6592	71.2106	73.555	73.7756
5741	74.567	76.2545	76.8501	72.9212	72.3403	73.2962	72.8476	75.192	75.4126
5780	75.026	76.7135	77.3091	73.3802	72.7993	73.7552	73.3066	75.651	75.8716
5784.14	75.075	76.7625	77.3581	73.4292	72.8483	73.8042	73.3556	75.7	75.9206
5963.27	77.22	78.9075	79.5031	75.5742	74.9933	75.9492	75.5006	77.845	78.0656
6121	79.153	80.8405	81.4361	77.5072	76.9263	77.8822	77.4336	79.778	79.9986
6137.22	79.353	81.0405	81.6361	77.072	77.1263	78.0822	77.6336	79.978	80.1986
6138.17	79.365	81.0525	81.6481	77.7192	77.1383	78.0942	77.6456	79.99	80.2106
6160	79.638	81.3255	81.9211	77.9922	77.4113	78.3672	77.9186	80.263	80.4836
6168.73	79.7458	81.4333	82.0289	78.1	77.5191	78.475	78.0264	80.3708	80.5914
6176.21	79.8384	81.5259	82.1215	78.1926	77.6117	78.5676	78.129	80.4634	80.684
6191.48	80.0294	81.7169	82.3125	78.3836	77.8027	78.7586	78.31	80.6544	80.875
6199.64	80.133	81.8205	82.4161	78.4872	77.9063	78.8622	78.4136	80.758	80.9786
6201.31	80.1544	81.8419	82.4375	78.5086	77.9277	78.8836	78.435	79.5294	81.0
6208.89	80.25	81.9375	82.5331	78.6042	78.0233	78.9792	78.5306	80.875	81.0956
6215.04	80.3267	82.0142	82.6098	78.6809	78.1	79.0559	78.6073	80.9517	81.1723
6216.32	80.3428	82.0303	82.6259	78.697	78.1161	79.072	78.6234	80.9678	81.1884
6218.87	80.375	82.0625	82.6581	78.7292	78.1483	79.1042	78.6556	81.0	81.2206
6220.52	80.3958	82.0833	82.6789	78.75	78.1691	79.125	78.6764	81.0208	81.2414
6231.11	80.5294	82.2169	82.8125	78.8836	78.3027	79.2586	78.81	81.1544	81.375
6238.15	80.6184	82.3059	82.9015	78.9726	78.3917	79.3476	78.899	81.2434	81.464
6240.999	80.6544	82.3419	82.9375	79.0086	78.4277	79.3836	78.935	81.2794	81.5
6248.55	80.75	82.4375	83.0331	79.1042	78.5233	79.4792	79.0306	81.375	81.5956
6254.68	80.8277	82.5152	83.1108	79.1819	78.601	79.5569	79.1083	81.4527	81.6733
6258.406	80.875	82.5625	83.1581	79.2292	78.6483	79.6042	79.1556	81.5	81.7206
6266.41	80.9767	82.6642	83.2598	79.3309	78.75	79.7059	79.2573	81.6017	81.8223
6308.2	81.51	83.1975	83.7931	79.8642	79.2833	80.2392	79.7906	82.135	82.3556
6472.86	83.655	85.3425	85.9381	82.0092	81.4283	82.3842	81.9356	84.28	84.5006
6631.66	85.8	87.4875	88.0831	84.1542	83.5733	84.5292	84.0806	86.425	86.6456
6636.77	85.8705	87.558	88.1536	84.2247	83.6438	84.5997	84.1511	86.4955	86.7161
6642.23	85.9455	87.633	88.2286	84.2997	83.7188	84.6747	84.2261	86.5705	86.7911
6649.46	86.0455	87.733	88.3286	84.3997	83.8188	84.7747	84.3261	86.6705	86.8911
6651.23	86.07	87.7575	88.3531	84.4242	83.8433	84.7992	84.3506	86.695	86.9156
6668.36	86.308	87.9955	88.5911	84.6622	84.0813	85.0372	84.5886	86.933	87.1536
6669.49	86.35	88.0375	88.6331	84.7042	84.1233	85.0792	84.6306	86.975	87.1956
6671	86.3705	88.058	88.6536	84.7247	84.1438	85.0997	84.6511	86.9955	87.2161
6698.24	86.7255	88.413	89.0086	85.0797	84.4988	85.4547	85.0061	87.3505	87.5711
6707.14	86.8505	88.538	89.1336	85.2047	84.6238	85.5797	85.1311	87.4755	87.6961
6716.72	87	88.6875	89.2831	85.3542	84.7733	85.7292	85.2806	87.625	87.8456
6721	87.059	88.7465	89.3421	85.4132	84.8323	85.7882	85.3396	87.684	87.9046
6728.07	87.1458	88.8333	89.4289	85.5	84.9191	85.875	85.4264	87.7708	87.9914
6741	87.319	89.0065	89.6021	85.6732	85.0923	86.0482	85.5996	87.944	88.1646
6742	87.342	89.0295	89.6251	85.6962	85.1153	86.0712	85.6226	87.967	88.1876

TABLE 1 - EDG Fuel Oil height in tank at devices for specific gallons
Slope Effect on Measurements for EDG Fuel Oil Storage Tanks No. 31, 32 & 33

Gallons TK 31, 32, 33 @ CL	H (In) TK 31,32, 33 @ CL	H (In) @S. Tube TK 31 &32 =H @ CL +1.6875	H (In) @S. Tube TK 33 =H @ CL +2.2831	H (In) @L SW TK 31 &32 =H @ CL -1.6458	H (In) @L SW, TK 33 =H @ CL -2.2267	H (In) @ PMP, TK 31 &32 =H @ CL -1.2708	H (In) @ PMP, TK 33 =H @ CL -1.7194	H (In) @L IND TK 31 & 32 =H @ CL +.6250	H (In) @L IND TK. 33 =H @ CL + .8456
6743.47	87.3717	89.05928	89.65488	85.72598	85.14508	86.10098	85.65238	87.99678	88.21738
6754.97	873519	89.2065	89.8021	85.8732	85.2923	86.2482	85.7996	88.144	88.3646
6757.54	87.57	89.2575	89.8531	85.9242	85.3433	86.2992	85.8506	88.195	88.4156
6762	87.6323	89.3198	89.9154	85.9865	85.4056	86.3615	85.9129	88.2573	88.4779
6762.94	87.6458	89.3333	89.9289	86	85.4191	86.375	85.9264	88.2708	88.4914
6781	87.902	89.5895	90.1851	86.2562	85.6753	86.6312	86.1826	88.527	88.7476
6782.77	87.9268	89.6143	90.2099	86.281	85.7001	86.656	86.2074	88.5518	88.7724
6784.05	87.945	89.6325	90.2281	86.2992	85.7183	86.6742	86.2256	88.57	88.7906
6787.59	87.9958	89.6833	90.2789	86.35	85.7691	86.725	86.2764	88.6208	88.8414
6794.46	88.1024	89.7899	90.3855	86.4566	85.8757	86.8316	86.383	88.7274	88.948
6799.94	88.174	89.8615	90.4571	86.5282	85.9473	86.9032	86.4546	88.799	89.0196
6800.17	88.1757	89.8632	90.4588	86.5299	85.949	86.9049	86.4563	88.8007	89.0213
6801	88.187	89.8745	90.4701	86.5412	85.9603	86.9162	86.4676	88.812	89.0326
6803.75	88.2267	89.9142	90.5098	86.5809	86	86.9559	86.5073	88.8517	89.0723
6808.56	88.299	89.9865	90.5821	86.6532	86.0723	87.0282	86.5796	88.924	89.1446
6811.24	88.335	90.0225	90.6181	86.6892	86.1083	87.0642	86.6156	88.96	89.1806
6827.89	88.5767	90.2642	90.8598	86.9309	86.35	87.3059	86.8573	89.2017	89.4223
6832.6	88.6458	90.3333	90.9289	87	86.4191	87.375	86.9264	89.2708	89.4914
6840.06	88.7574	90.4449	91.0405	87.1116	86.5307	87.4866	87.038	89.3824	89.603
6848.52	88.8824	90.5699	91.1655	87.2366	86.6557	87.6116	87.163	89.5074	89.728
6850	88.8998	90.5873	91.1829	87.254	86.6731	87.629	87.1804	89.5248	89.7454
6872	89.2267	90.9142	91.5098	87.5809	87	87.9559	87.5073	89.8517	90.0723
6897.28	89.6058	91.2933	91.8889	87.96	87.3791	88.335	87.8864	90.2308	90.4514
6899.98	89.6458	91.3333	91.9289	88	87.4191	88.375	87.9264	90.2708	90.4914
6929.24	90.09	91.7775	92.3731	88.4442	87.8633	88.8192	88.3706	90.715	90.9356
6936.88	90.2067	91.8942	92.4898	88.5609	87.98	88.9359	88.4873	90.8317	91.0523
6938.14	90.2267	91.9142	92.5098	88.5809	88	88.9559	88.5073	90.8517	91.0723
7066.53	92.235	93.9225	94.5181	90.5892	90.0083	90.9642	90.5156	92.86	93.0806
7195.11	94.38	96.0675	96.6631	92.7342	92.1533	93.1092	92.6606	95.005	95.2256
7313.9	96.525	98.2125	98.8081	94.8792	94.2983	95.2542	94.8056	97.15	97.3706
7421.68	98.67	100.3575	100.9531	97.0242	96.4433	97.3992	96.9506	99.295	99.5156
7516.94	100.815	102.5025	103.0981	99.1692	98.5883	99.5442	99.0956	101.44	101.6606
7597.4	102.96	104.6475	105.2431	101.3142	100.7333	101.6892	101.2406	103.585	103.8056
7659.37	105.105	106.7925	107.3881	103.4592	102.8783	103.8342	103.3856	105.73	105.9506
7692.89	107.25								

Attachment 2 Page 1 of 2

Magnetrol Drawing D-1257 (FP 9321-05-7214 Rev. 0,1/22/70) " Magnetrol Installation Dimensions Model A-153F-TDM & A-153-F-E.P.-TDM".



MAGNETROL® INSTALLATION DIMENSIONS

MODEL A-153-F-TDM & A-153-F-E.P.-TDM

FINAL ISSUE REV. 0 DATE 1-22-70

Switches Rated: 120 VAC 10 AMPS

Furnished with Instrument Spec T-301 S.S. & T-316 SS Trim

2-1/2" - 8 Magnetrol Sleeve

See Bulletin N-152 For Wiring.

Metal Tags: LC-1204-S LC-1205-S LC-1206-S

Net Weight 9#

United Engineers & Constructors, Inc. Westinghouse Electric Corp. Consolidated Edison Co. of New York

VENDOR-4751-9321-05-352-20 N-184498

A-153-F-TDT/VP-K-TDT-S1/D2-M1/D2

Operate DPDT Micro Low

Operate DPDT Micro Low

#2 Diesel Fuel Oil Atmos. @ 35°. 110° F. SP. GR. 0.84-0.89

Vapor & Explosion Proof Marbate

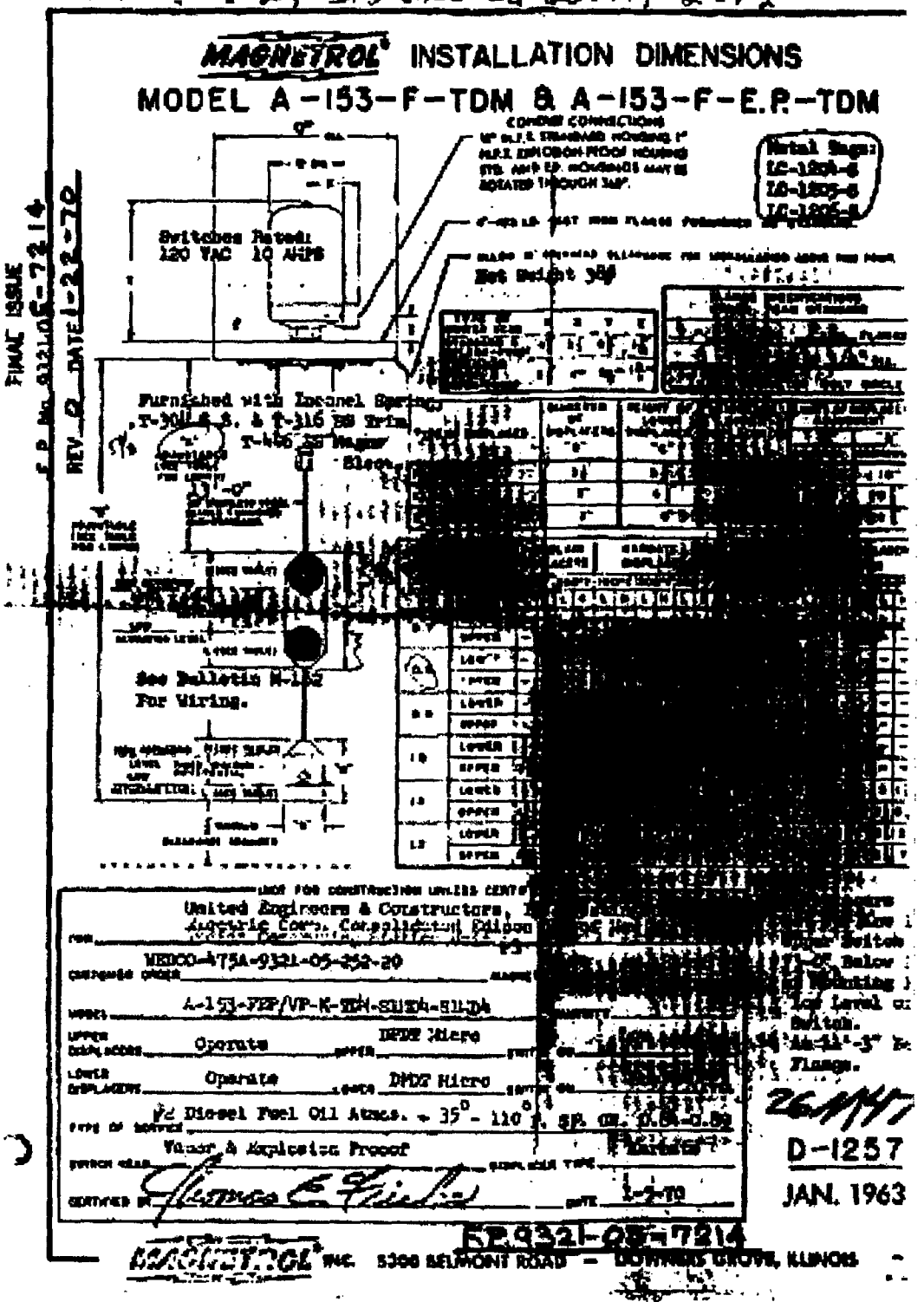
Displacers Set For Low Le Upper Switch A 7'-0" Below Fa of Mounting Fl Low Level of Switch. At 11'-3" Bel Flange.

26/1/67

D-1257

JAN 1967

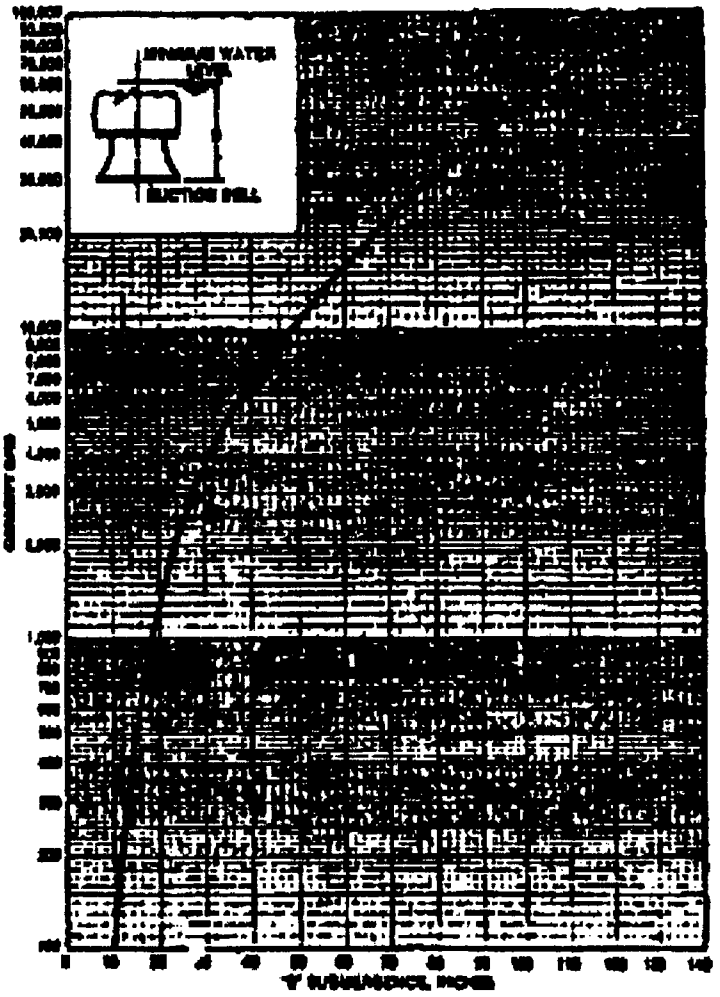
ATTACHMENT 2, IP3-CALC-EG-00217, 2 of 2



ATTACHMENT 3
Gould pumps Bowl Engineering Data, # 22.13, October 1, 1986, "Minimum Submergence Required for Vortex Suppression".

Bowl Engineering Data ATTACHMENT 3 IP3-CALC-EG-00217 1 of 1 **22.13** October 1, 1986
Minimum Submergence

MINIMUM SUBMERGENCE REQUIRED FOR VORTEX SUPPRESSION



NOTE: 1. Submergence values above are for Vortex free operation. Check performance curves for NPSH required. Submergence to satisfy NPSH requirements may be greater than "S".

2. [redacted] distance between pump centerline and other ideal flow conditions. Refer to Figure 69 and 70 in Hydraulic Institute or refer to factory for more information regarding your particular installation, as less than ideal conditions will require additional submergence.

ATTACHMENT 4
Telephone Discussion Documentation form, 6/5/91,
A. Cerwin to T. Fricke.

NEW YORK POWER AUTHORITY
NUCLEAR ENGINEERING & DESIGN SECTION
TELEPHONE DISCUSSION DOCUMENTATION FORM

ATTACHMENT 4
IP3-CALC-EG-00217
1 of 1

CALL DATE June 5, 1991 TIME 10:30 Am OUTGOING X
INCOMING

BETWEEN Anthony Cerwin OF THE AUTHORITY

AND Thomas Fricke OF Magnetrol, Inc

AND _____ OF _____

REFERENCE EDG Fuel Oil Storage Tank Level Switch

SUBJECT Accuracy / Repeatability of Setpoints

DISCUSSION/ACTION:
Vendor state that the devices (LC-1204S/LC-1205S/LC-1206S) were purchased commercial grade and do not have a specified accuracy/repeatability. During acceptance testing by Magnetrol these devices are tested to a ± ½" acceptance band. The accuracy is based on how close the physical measurements are made and the repeatability is within ± ½".

DISTRIBUTION:

NUC GEN FILES NO. _____

NOD FILE NO. _____

Anthony Cerwin 6/6/91
SIGNATURE DATE

ATTACHMENT 5
Telephone Discussion Documentation form, 11/10/93,
F. Granitto to D. Wilson.

ATTACHMENT 5
IP3-CALC-EG-00217
1 of 1

NEW YORK POWER AUTHORITY
NUCLEAR ENGINEERING & DESIGN SECTION
TELEPHONE DISCUSSION DOCUMENTATION FORM

CALL DATE NOV 10, 1993 TIME 10:00AM OUTGOING X
INCOMING

BETWEEN Fernando Granitto OF THE AUTHORITY

AND DANIEL WILSON OF NYPA • IP-3 CHEM. SUPV.

AND _____ OF _____

REFERENCE EDG FUEL OIL

SUBJECT FUEL OIL DESIGN SPECS

DISCUSSION/ACTION:

DAN INDICATED THERE IS MINIMAL TEMP VARIATION AROUND THE EDG STORAGE TANKS AND THE FUEL OIL SPECIFIC GRAVITY WILL NOT BE EFFECTED BY THE ΔT. DAN STATED THAT THE SP. GR. OF THE FUEL OIL MUST BE IN THE DESIGN SPEC OF 0.83 - 0.89. THE AVERAGE SP. GR is 0.84 AND THE LAST READING RECORDED FOR SP GR. WAS 0.836. WHEN ADDING NEW FUEL TO THE STORAGE TANKS, THE SP. GR WILL NOT VARY DUE TO THE LARGE AMOUNT OF FUEL EXISTING IN THE TANK AS COMPARED TO THE ADDED FUEL.

DISTRIBUTION:

NUC GEN FILES NO. _____

NOD FILE NO _____

Fernando Granitto 11/10/93
SIGNATURE DATE

ATTACHMENT 10

U.S. Environmental Protection Agency (EPA). 1995. *Review of Mathematical Modeling for Evaluating Soil Vapor Extraction Systems*. Office of Research and Development, Washington, D.C. EPA/540/R-95-513.

For depths greater than 100 cm, the mean annual soil temperature remains relatively stable throughou the year and can be estimated from the average shallow ground water temperatures shown in Figure 1.

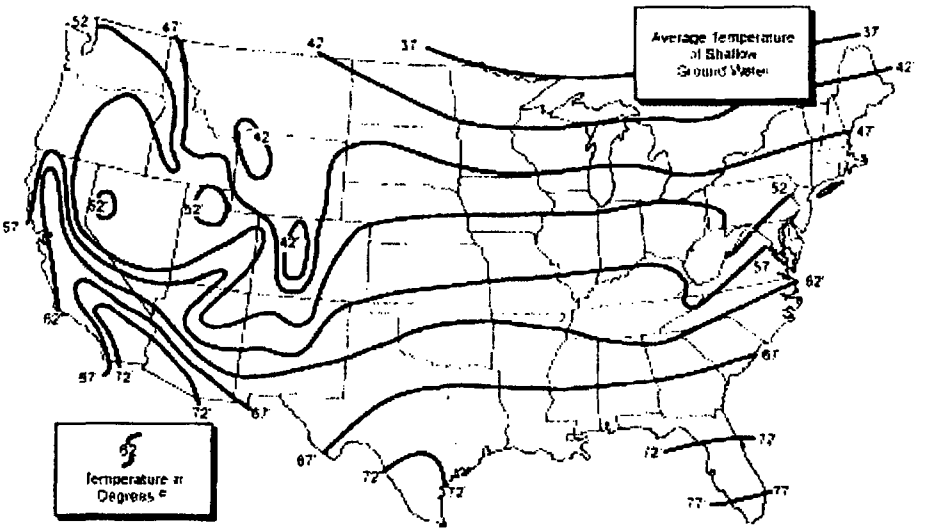


Figure 1. Average Shallow Ground Water Temperatures in the United States

ATTACHMENT 12

IP3-RPT-EDG-01632, "Operation Graphs, TC-25A through TC-25D Diesel Generator Fuel Oil Storage Tanks Slope and Specific Gravity Compensation, dated 10/21/95.

ATTACHMENT 12
IP3-CALC-EG-00217
1 of 15

NEW YORK POWER AUTHORITY

INDIAN POINT 3 NUCLEAR POWER PLANT

IP3-RPT-EDG-01632
REV. 0

OPERATION GRAPHS TC-25A THROUGH TC-25D
DIESEL GENERATOR FUEL OIL STORAGE TANKS SLOPE AND SPECIFIC
GRAVITY COMPENSATION

PREPARED BY: [signature] 10/27/95
REVIEWED BY: [signature] 10/27/95
APPROVED BY: [signature] 10/27/95

IP3-RPT-EDG-01632 REV. 0
ATTACHMENT 12
IP3-CALC-EG-00217
2 of 15

Purpose:

1) This report provides the documentation of the methodology used to correct the 31, 32 & 33 Diesel Generator Fuel Oil Storage Tank Inch vs. Gallon Graphs (Operations Graphs TC-25A,-25B,-25C & -25D). The original graph, Operation Graph TC-25 was based on calculation 200 which does not consider tank slope.

2) Emergency Diesel Generator (EDG) Level Indicators LI-1131, LI-1136 and LI-1135 are calibrated for No. 2 diesel fuel with a specific gravity of 0.86. This report details the methodology of when and how the indicators can be compensated for a change in specific gravity.

Discussion:

Tank Slope

Calculation 200, Diesel Generator Fuel Oil Storage Tanks Capacity calculation was performed to produce a graph of level versus volume of fuel oil contained in the EDG fuel storage tanks. This information was then used to produce Operations Graph TC-25 Rev 0. The EDG fuel oil storage tanks were designed to be installed with a 3" slope over a working distance of 14'-2" distance (reference drawing 1P3V-353-60021). With this design slope the nominal level at the vertical centerline of the tank yields level values which can be converted to gallons using Calculation 200. To measure the nominal level of the diesel fuel oil the level indicator readings and the dip stick readings need to be corrected to a centerline level equivalent to compensate for tank slope. Calculation 200 does not consider tank slope.

During the implementation of MRP 94-3-132 EDG Rev.1 actual slope measurements were taken for all three EDG fuel oil tanks (see attachment 1). Using these measurements "as built" slope correction factors were determined. The following correction factors were applied to the level indicators and dipstick measurements to obtain the equivalent tank centerline elevation:

	Level Indicator	Dipstick
31 EDG Fuel Oil Storage Tank	0.625"	1.688"
32 EDG Fuel Oil Storage Tank	0.625"	1.688"
33 EDG Fuel Oil Storage Tank	0.845"	2.283"

When developing the new graphs the inch vs gallon curve was offset by the above factors since the level indicator and dipstick readings indicate more fuel due to the tank slope. This was accomplished by adding the correction factors to the H column of attachment 2 of Calculation 200. Since there are different correction factors required for the level indicator and the dipstick, separate curves were generated. In addition separate curves were required because the correction factors for EDG Fuel Oil Storage Tank 31 and 32 were different than for Tank 33. Attachment 2 is the tabulated inch vs gallons tables (corrected for Tank slope) used to develop the

Operations Graphs TC-25A, -25B, -25C and -25D.

Operations Graphs TC-25A through TC-25D indicate nominal level and reflect the actual amount of fuel oil in the storage tanks based on a reading that is corrected to the level represented at tank centerline.

Specific Gravity

EDG Fuel Oil Level Indicators LI-1133, LI-1134 and LI-1135 have a calibrated scale for fuel oil with a specific gravity (SG) of 0.86. The allowable SG range for No. 2 Diesel fuel oil is .83 to .89. In order to determine the fuel oil level to the ±50 gallons instrument accuracy, the following correction for specific gravity deviation must be applied:

Actual Compensated level in inches = $\frac{0.86}{\text{current SG value}}$ x indicator inch reading

The SG compensated gallon reading can then be obtained by utilizing the appropriate Operations Graph (TC-25B or TC-25D).

In the past 5 years the SG has not deviated by more than ± 0.012. This translates to a worst case possible error of 150 gallons. To alleviate Operation personnel from applying a SG compensation to the level indication reading the following has been applied:

If the actual SG is below 0.86 the level indicators will indicate less fuel than is actually in the tank. Since the indicator reading is in the conservative direction, no correction is required.

If the SG is above 0.86 the indicators will indicate more fuel than is actually in the tank. To compensate for this condition, 150 gallons of oil has been added to the Technical Specification required level. This 150 gallon accounts for a SG deviation up to 0.872. Even though the highest SG value observed in the past 5 years was 0.872 the allowable SG range is .83 to .89. If the SG goes above 0.872 the indicator reading must be compensated for SG or the tanks must be manually sounded to ensure that the Technical Specification requirements of stored fuel has been met. Chemistry procedure NK-CA-045 requires that the Control Room Supervisor and the shift manager be notified if the recorded SG is greater than 0.872.

Conclusion:

Operations graphs TC-25A, -25B, -25C and -25D reflect nominal level, the curves have been adjusted to compensate for the actual tank slopes. Calculation 200, Diesel Generator Fuel Oil Storage Tanks Capacity calculation does not consider tank slope. Attachment 2 of calculation 200 was adjusted for both the level indicator and dipstick readings to compensate for tank slope.

EDG level indicators LI-1133,-1134 and -1135 are calibrated for No. 2 fuel oil with a SG of 0.86. The specific gravity can vary between .83

and .89. To measure the fuel oil to the ±50 gallons instrument accuracy the indicator reading must be compensated for SG deviation from 0.86. If the SG drops below 0.86 a correction is not required because the level indicator will read conservatively. For SG deviation between .860 and .872, no SG compensation is required because 150 gallons of fuel was added to the Technical Specification level requirements to account for the possible error due to the increase on SG. For SG greater than 0.872 the level indicator reading must be compensated for SG deviation or the EDG fuel oil storage tank(s) must be manually sounded to ensure Technical Specification requirements.

This information will be utilized to resolve ACTS Number 13463. Calculation IP3-CALC-EG-00217 did not consider the tank slope when determining the unusable fuel volume when determining the EDG Storage Tanks Setpoints.

References:

XMP 94-3-112 EDG Rev. 1
IP3V-439-1390 Rev. 1
Calculation 200
Operations Graph TC-25 Rev. 0
Operations Graph TC-25A Rev. 0
Operations Graph TC-25B Rev 0
Operations Graph TC-25C Rev. 0
Operations Graph TC-25D Rev. 0

ATTACHMENT 12
IP3-CALC-EG-00217
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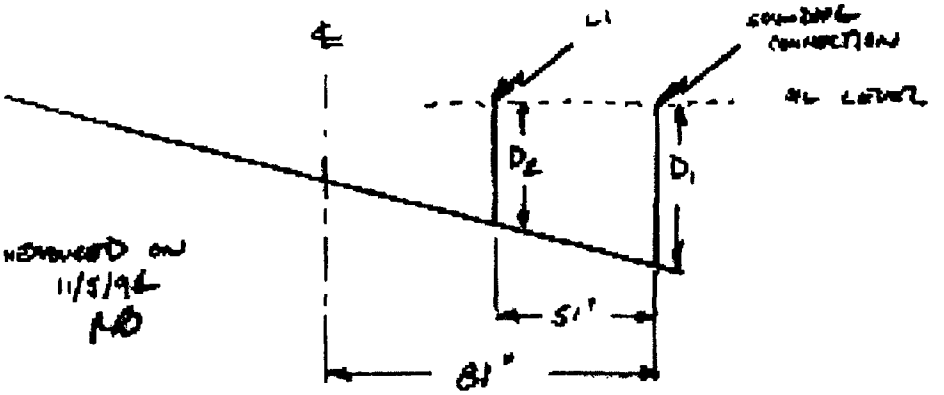
31 EDG F.O. TANK

ACTUAL TANK SLOPE



D_1 = 91.4375 } MEASURED ON 11/5/96
D_2 = 92.5 } NO

CORR FACTOR BETWEEN SOUNDING CONNECTION & L1 = $D_1 - D_2$ = 92.5 - 91.4375
= .1025"

CORR FACTOR BETWEEN SOUNDING AND TANK ℄ = X

$\frac{51}{.1025} = \frac{81}{X}$ X = 1.688"

CORR. FACTOR BETWEEN L1 & TANK ℄ = 1.688 - 1.063
= .625

ATTACHMENT 1
PAGE 10 OF 3

ATTACHMENT 12
EP3-CALC-EG-00217
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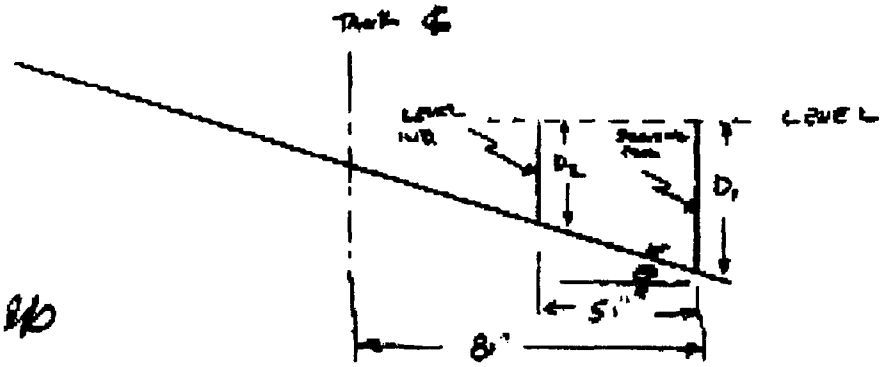
ACTUAL TANK SLOPE FOR EDG FO TANK 32



D_1 = 171 3/8"
D_2 = 170 5/16"
MEASURED 12/19/96 BD

ACTUAL CORE FACTOR FOR INDICATOR = $D_1 - D_2$ = 171 3/8 - 170 5/16
= 1 1/16 = 1.0625"

θ = TAN^{-1} = $\frac{1.0625}{5}$ = 1.194°

ACTUAL CORE FACTOR FOR TANK CENTERLINE = TANθ x B1
& SOUNDING CONNECTION = 1.688"

CORE FACTOR BETWEEN L1 & TANK CENTERLINE = 1.688 - 1.063
= .625"

ATTACHMENT 1
PAGE 2 OF 3

ATTACHMENT 12
IP3-CALC-EG-00217
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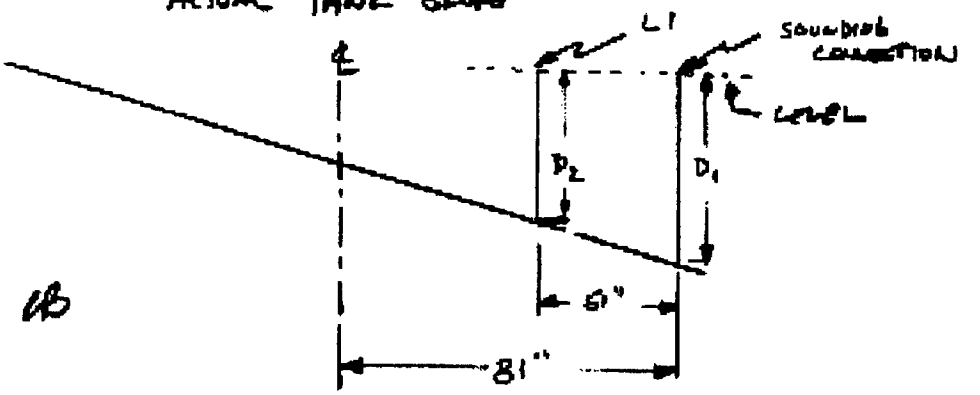
33 EDG F.O. TANK 53

ACTUAL TANK SLOPE



D_1 = 171 3/16"
D_2 = 169 3/4"
MEASURED 11/14/94 MB

CORRECTION FACTOR BETWEEN SOUNDING CONNECT & L1 = $D_1 - D_2$ = 171 3/16 - 169 3/4
= 1.4375"

CORR FACTOR BETWEEN SOUNDING AND TANK ℄ = X

$\frac{61}{1.4375} = \frac{81}{X}$ X = 2.283"

CORR FACTOR BETWEEN L1 AND TANK ℄ = 2.283 - 1.438
= .845"

ATTACHMENT 1
PAGE 3 OF 3

GALLONS	INCHES (H + 1.688)
43.05	3.833
95.5	5.978
175.96	8.323
271.21	10.268
378.99	12.413
497.78	14.558
626.36	16.703
763.66	18.848
908.84	20.993
1061.23	23.138
1220.04	25.283
1384.69	27.428
1554.72	29.573
1729.62	31.718
1908.75	33.863
2092.16	36.008
2278.16	38.153
2467.43	40.298
2659.62	42.443
2854.41	44.588
3050.62	46.733
3247.93	48.878
3446.93	51.023
3646.55	53.168
3846.45	55.313
4046.34	57.458
4245.96	59.603
4444.97	61.748
4642.27	63.893
4838.49	66.038
5033.27	68.183
5225.47	70.328
5414.73	72.473
5600.73	74.618
5784.14	76.763
5963.27	78.903
6138.17	81.053
6308.2	83.198
6472.86	85.343
6631.66	87.488
6784.05	89.633
6929.24	91.778
7066.53	93.923
7195.11	96 068
7313.9	98.213
7421.68	100.358
7516.94	102.503
7597.4	104.648
7659.37	106.793
7666.51 ##	107.25

ATTACHMENT 12
IP3-CALC-EG-00217
8 of 15

DATA FOR

OPERATIONS GRAPH TC-25A

Rev 0

* H VALUE FROM CALCULATION 200
ATTACHMENT 2

7666.51 obtained by interpolation.

ATTACHMENT 2
PAGE 1 OF 4

GALLONS	INCHES (H* + 0.625")
33.05	2.77
95.5	4.915
175.96	7.06
271.21	9.205
378.99	11.35
497.78	13.495
626.36	15.64
763.66	17.785
908.84	19.93
1061.23	22.075
1220.04	24.22
1384.69	26.365
1554.72	28.51
1729.62	30.655
1908.75	32.8
2092.16	34.945
2278.16	37.09
2467.43	39.235
2659.62	41.38
2854.41	43.525
3050.62	45.67
3247.93	47.815
3446.93	49.96
3646.55	52.105
3846.45	54.25
4046.34	56.395
4245.96	58.54
4444.97	60.685
4642.27	62.83
4838.49	64.975
5033.27	67.12
5225.47	69.265
5414.73	71.41
5600.73	73.555
5784.14	75.7
5963.27	77.845
6138.17	79.99
6308.2	82.135
6472.86	84.28
6631.66	86.425
6784.05	88.57
6929.24	90.715
7066.33	92.86
7195.11	95.005
7313.9	97.15
7421.68	99.295
7516.94	101.44
7597.6	103.585
7659.37	105.73
7683.12 **	107.25

ATTACHMENT 12
IP3-CALC-EG-217
9 of 15

DATA FOR
OPERATIONS GRAPH TC-25B
Rev. 0

* H VALUE FROM CALCULATION 200
ATTACHMENT 2

** 7683.12 obtained by interpolation

ATTACHMENT 2
Calc 2 of 4

GALLONS	INCHES (4" + 2.283")
33.05	4.428
95.5	6.573
175.96	8.718
271.21	10.863
378.99	13.008
497.78	15.153
626.36	17.298
763.66	19.443
908.84	21.588
1061.23	23.733
1220.04	25.878
1384.69	28.023
1554.72	30.168
1729.62	~~32.313~~ 32.313
1908.75	34.458
2092.16	36.603
2278.16	38.748
2467.43	40.893
2659.62	43.038
2854.41	45 183
3050.62	47.328
3247.93	49.473
3446.93	51.618
3646.55	53.763
3846.45	55.908
4046.34	58.053
4245.96	60.198
4444.97	62.343
4642.27	64.488
4838.69	66.633
5033.27	68.778
5225.67	70.923
5414.73	73 068
5600.73	75.213
5784.14	77 358
5963.27	79.503
6138.17	81 648
6308.2	83.793
6472.86	85.938
6631.66	88.083
6784.05	90.228
6929.24	92 373
7066.53	94.518
7195.11	96.663
7313.9	98.808
7421.68	100.953
7516.94	103.098
7597.4	105.243
7655.6 **	107.25

ATTACHMENT 12
IP3-CALC-EG-00217
10 of 15
DATA FOR
OPERATIONS GRAPH TC-25C

T H VALUE FROM CALCULATION 2ND
ATTACHMENT 2

** 7655.6 obtained by interpolation

ATTACHMENT 12
IP3-CALC-EG-00217
11 OF 15

DATA FOR
OPERATIONS GRAPH TC-25D
REV. 0

GALLONS	INCH (H* + 0.845")
3.05	2.99
5.5	5.135
75.96	7.28
71.21	9.425
78.99	11.57
97.78	13.715
26.16	15.86
63.66	18.005
08.84	20.15
061.23	22.295
220.04	24.44
384.69	26.585
554.72	28.73
729.62	30.875
908.75	33.02
092.16	35.165
278.16	37.31
467.43	39.455
659.62	41.6
854.41	43.745
050.62	45.89
247.93	48.035
446.93	50.18
646.55	52.325
846.45	54.47
046.34	56.615
245.96	58.76
444.97	60.905
642.27	63.05
838.49	65.195
033.27	67.34
225.47	69.485
414.73	71.63
600.73	73.775
784.14	75.92
963.27	78.065
138.17	80.21
308.2	82.355
472.86	84.5
631.66	86.645
784.05	88.79
929.24	90.935
066.53	93.08
195.11	95.225
313.9	97.37
421.68	99.515
516.94	101.66
597.4	103.805
659.37	105.95
679.69 **	107.25

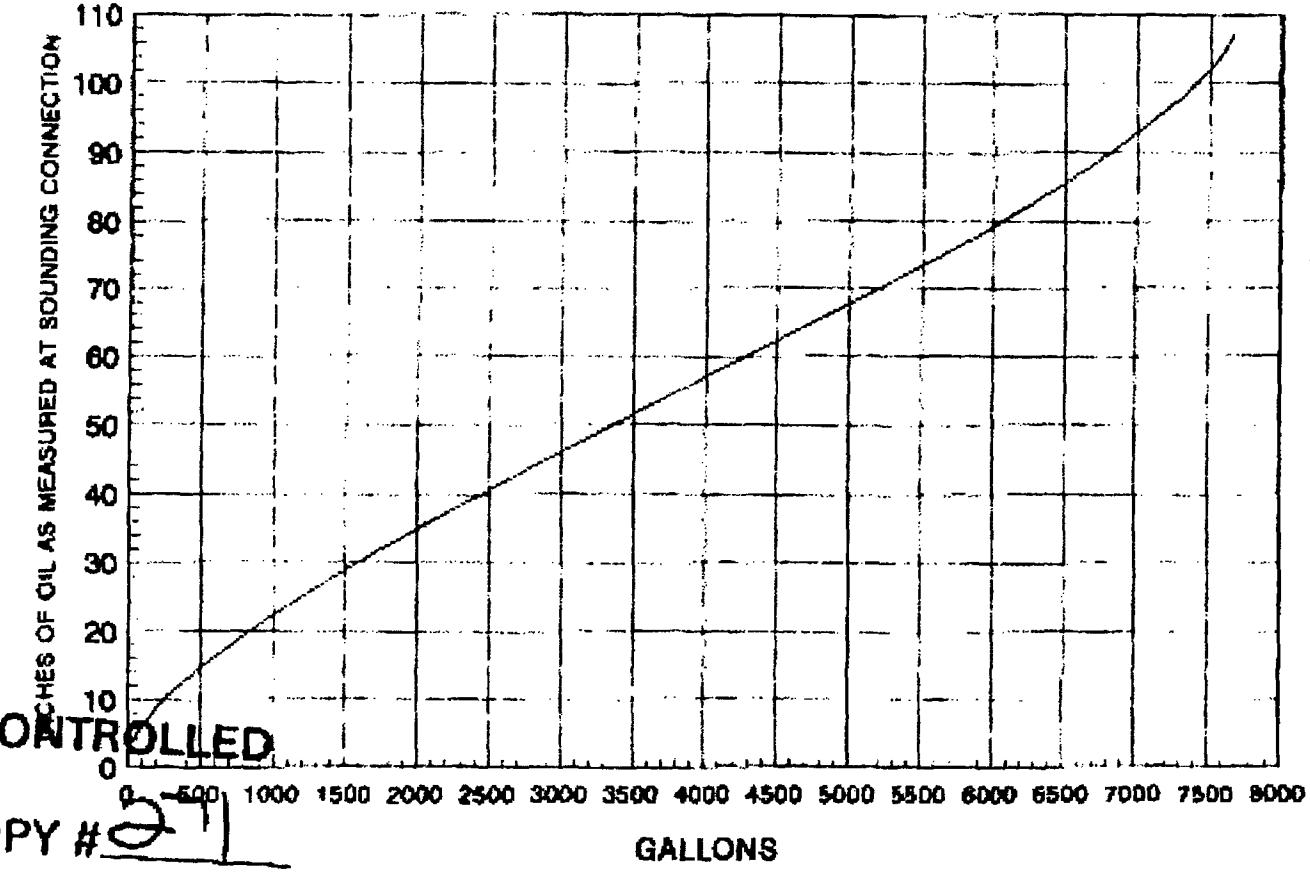
* H VALUE FROM CALCULATION 2D
ATTACHMENT 2

** 7679.69 obtained by interpolation

ATTACHMENT 2
PAGE 6 OF 6

31 & 32 DIESEL GENERATOR FUEL OIL STORAGE TANK TC-25A Rev. 0
INCHES OIL vs. GALLONS OIL
(CHART FOR DIP STICK INCH READING ONLY)

WRITTEN BY: [illegible] 4/6/04
REVIEWED BY: [illegible]
PORC REVIEW: [illegible]
APPROVED: [illegible]
EFFECTIVE DATE: [illegible]



ATTACHMENT 13
IP3-CALC-EG-00217
13 of 15

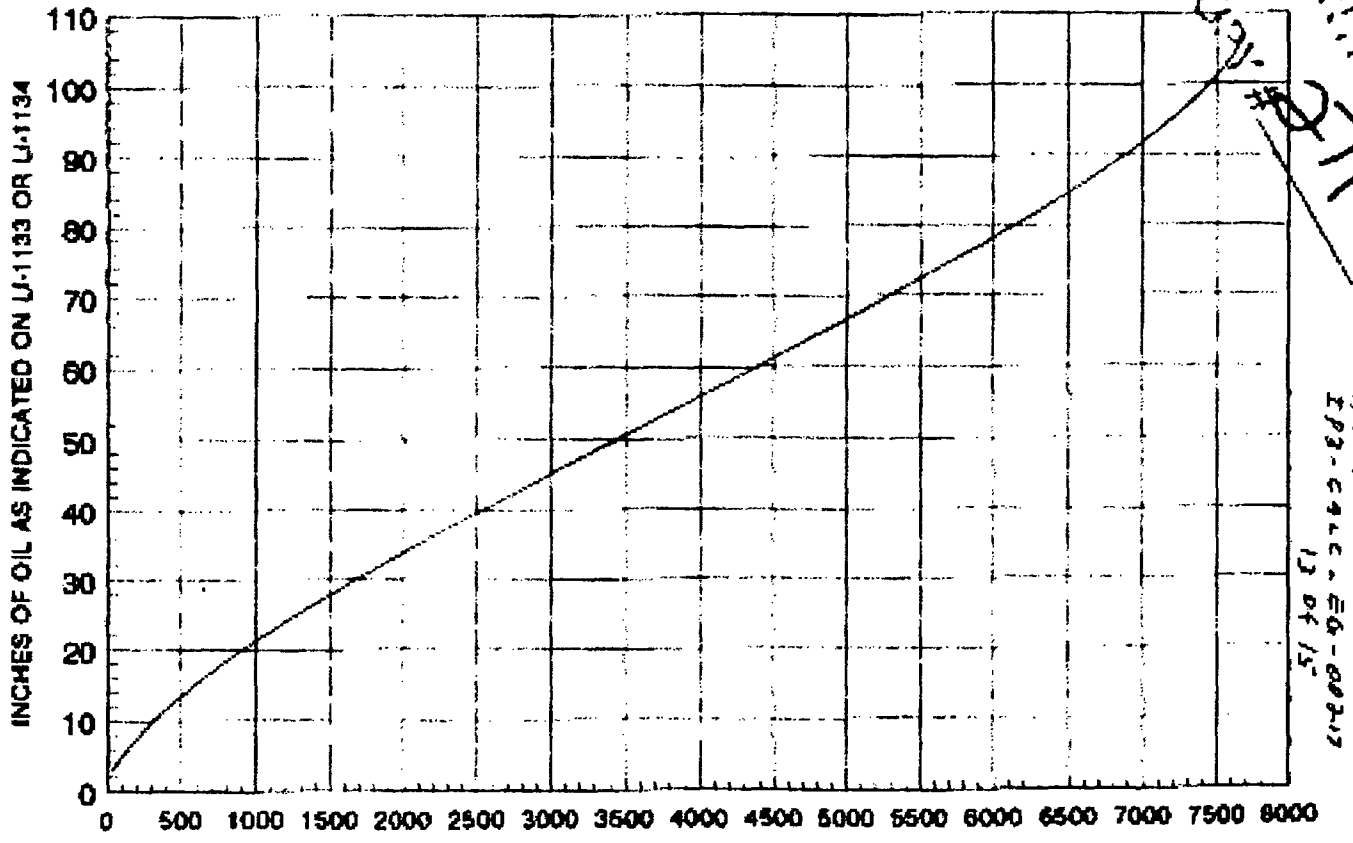
CONTROLLED
COPY # 27

CURVE COMPENSATES FOR TANK SLOPE

31 & 32 DIESEL GENERATOR FUEL OIL STORAGE TANK TC-25B Rev 0
INCHES OIL vs. GALLONS OIL
(CHART FOR LEVEL INDICATOR INCH READING ONLY)

WRITTEN BY: [illegible] 12/2/99
REVIEWED BY: [illegible] 12/2/99
PORC REVIEW: [illegible] 12/3/99
APPROVED: [illegible] 12/3/99
EFFECTIVE DATE: 12/3/99

IF THE SPECIFIC GRAVITY (SG) OF THE DIESEL FUEL IS >0.872 THEN THE LEVEL INDICATOR INCH READING MUST BE CORRECTED FOR SG.



CONTROLLED COPY #21

ATTACHMENT 12
IP3-CALC-EG-00217
13 of 15

TO CORRECT FOR SG APPLY THE FOLLOWING:

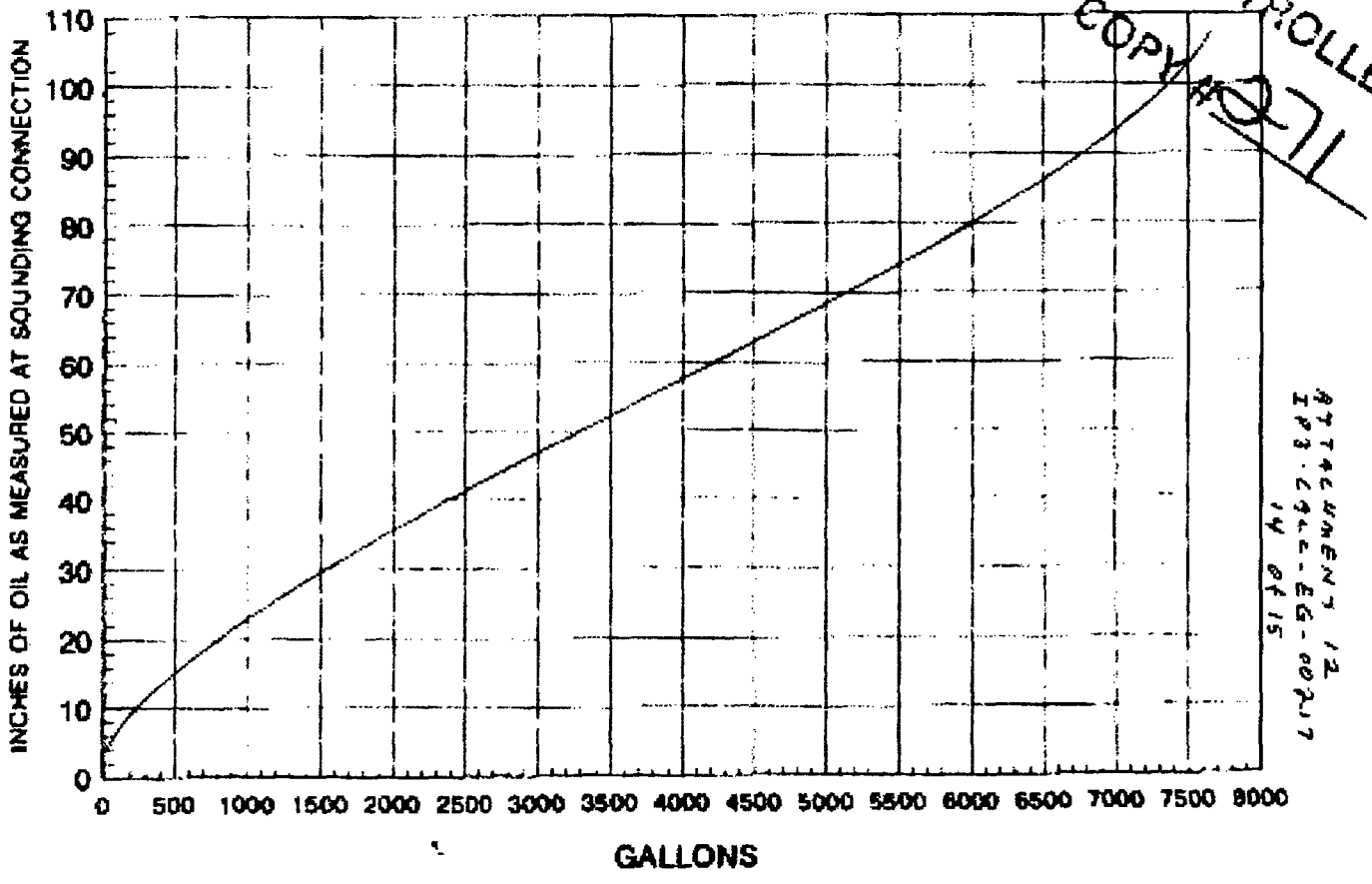
CORRECTED INCH VALUE = (0.880/CURRENT SG) X ACTUAL INCH READING FROM LI-1133 OR LI-1134

CURVE COMPENSATES FOR TANK SLOPE

33 DIESEL GENERATOR FUEL OIL STORAGE TANK TC-25C Rev. 0
INCHES OIL vs. GALLONS OIL
(CHART FOR DIP STICK INCH READING ONLY)

WRITTEN BY: [illegible]
REVIEWED BY: [illegible]
PORC REVIEW: [illegible]
APPROVED: [illegible]
EFFECTIVE DATE: [illegible]

CONTROLLED COPY #71



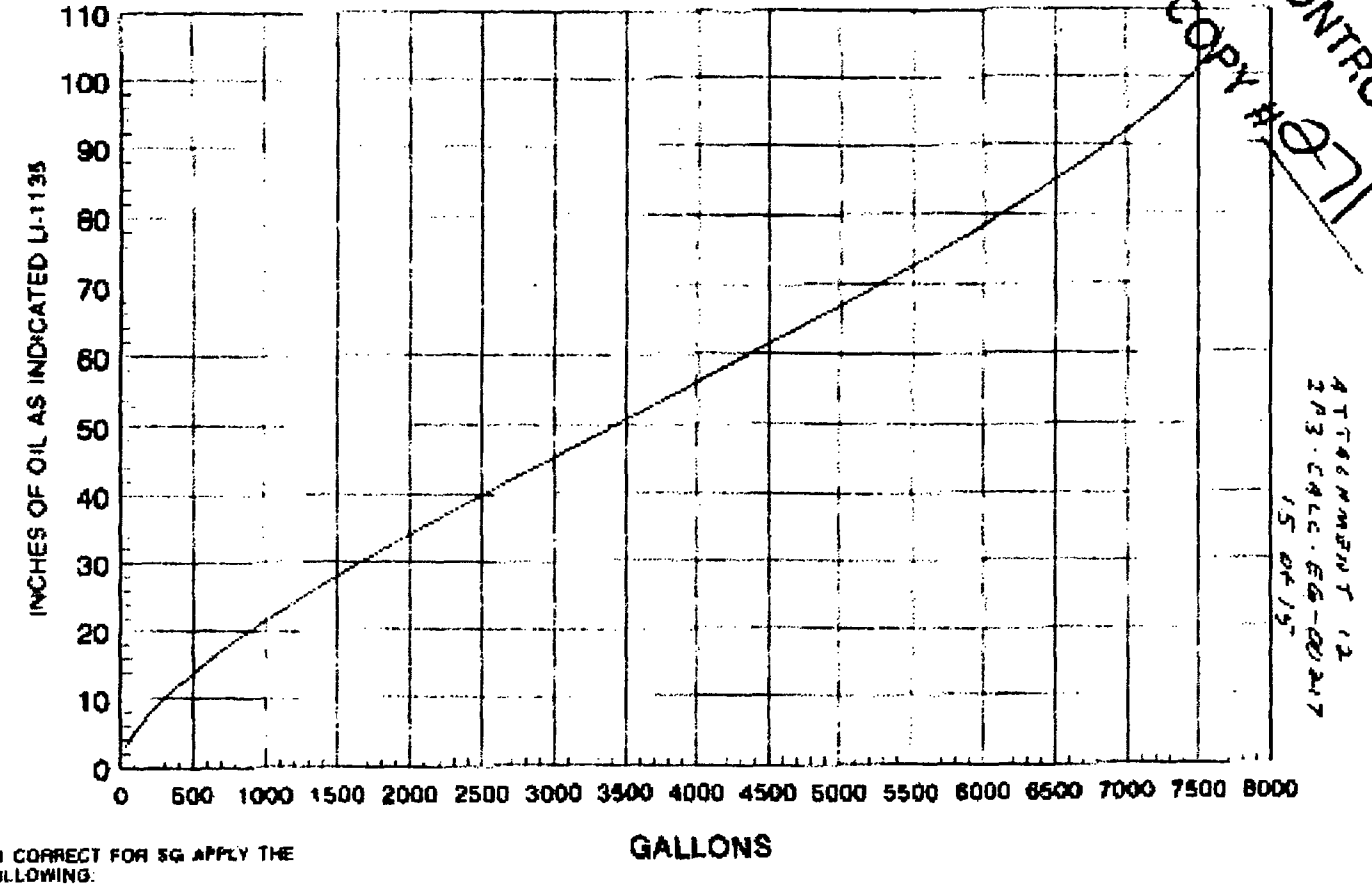
ATTACHMENT 12
IP3-CALC-EG-00217
14 of 15

CURVE COMPENSATES FOR TANK SLOPE

33 DIESEL GENERATOR FUEL OIL STORAGE TANK TC-25D Rev. 0
INCHES OIL vs. GALLONS OIL
(CHART FOR LEVEL INDICATOR INCH READING ONLY)

WRITTEN BY: [illegible]
REVIEWED BY: [illegible]
PORC REVIEW: [illegible]
APPROVED: [illegible]
EFFECTIVE DATE: [illegible]

IF THE SPECIFIC GRAVITY (SG) OF THE DIESEL FUEL IS >0.872 THEN THE LEVEL INDICATOR INCH READING MUST BE CORRECTED FOR SG.



CONTROLLED COPY #71

ATTACHMENT 12
2N3-CALC-EG-00217
15 of 15

TO CORRECT FOR SG APPLY THE FOLLOWING:
CORRECTED INCH VALUE = (0.860/CURRENT SG) X ACTUAL INCH READING FROM LI-1135

CURVE COMPENSATES FOR TANK SLOPE

ATTACHMENT 13

FAX MESSAGE, from A.E. Vazquez of Uehling, to R.F. Jones of MDM Engineering, "Certificate of Calibration" dated 12/18/95.

[redacted]
Getty Avenue, Paterson, NJ USA 07503 • Phone (201) 742-3710 • FAX (201) 742-1205

PAGE 1 OF 2

DERATIONAL FAX MESSAGE

DATE: 12/18/95

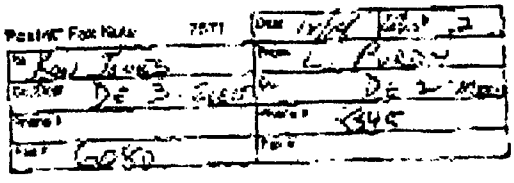
ATTACHMENT 13
IP3-CALC-EG-00217
1 of 2

TO: TOM JONES
NEW YORK POWER AUTHORITY
INDIAN POINT
BUCHANAN, NY
FAX 914-736-8877

FROM: ALLEN VASQUEZ
UEHLING INSTRUMENT COMPANY
PATERSON, NJ
FAX 201-742-1205

REFERENCE: P. O. 29164648

COPY OF CERTIFICATE OF CALIBRATION FOLLOWS.



473 Getty Avenue, Paterson, NJ USA 07503 • Phone (201) 742-8750 • FAX (201) 742-1066

Attachment 13
IP3-CALC-EG-00217
2 of 2

December 15, 1995

Certificate of Calibration

Re: (4) Uehling Gauge Model 15R173, Serial Nos. 78524 - 78527
New York Power Authority P O 59454648

Uehling Instrument Company hereby certifies that the above referenced gauges were calibrated based on tank dimensional and specific gravity data provided by the purchaser along with fixed factors such as the indicating fluid used, the bore of the Pyrex manometer tube and its relationship to the wall. The calibration is fixed permanently on the calibrated scales. No recalibration is required for the life of the gauge provided it is used for its original intended purpose.

Gauge accuracy is equivalent to the minimum reading resolution shown on the calibrated scale provided the gauge is used for it's original intended purpose, as specified, installed per manufacturers instructions and maintained in proper operating condition. A spot measurement, at the pressure pipe location, will correspond to the gauge reading within ± 1/8 inch.

Certified by: A. B. Vazquez

ATTACHMENT 14

Specification for "Liquid Level Switches", No. 9321-05-252-20, Revision 2, Pages 3, 4, & 5, dated 9/19/95

ATTACHMENT 14
IP3-CALC-EG-00217
4 of 5

2. Design Data

C. Detail Requirements for Displacement-Type Controls:

Item No.	No. Req'd.	Tag No.	Service
1	1	LC-12048	Fuel Oil Storage Tank No. 21
2	1	LC-12058	Fuel Oil Storage Tank No. 22
3	1	LC-12068	Fuel Oil Storage Tank No. 23
4	1	LC-12078	Fuel Oil Day Tank No. 21
5	1	LC-12088	Fuel Oil Day Tank No. 22
6	1	LC-12098	Fuel Oil Day Tank No. 23

1. The following information applies to all items listed above:

Fluid: Diesel Fuel, No. 2 fuel oil, commercial grade.
Specific Gravity: 0.86 (Range 0.89 - 0.84)
Pressure: Atmospheric
Temperature: 40°F (Range 35 - 110°F)
Type: Displacement, top mounting style, with 4" - 150# carbon steel flanged connection.
Displacer Diameter Limitation: A 4" schedule 80 pipe (3.826 inches inside diameter) standpipe is provided in all tanks If design conditions require displacers larger than 3" diameter, the vendor shall state the next larger pipe size required to contain the displacers and furnish corresponding size mounting flanges.
Trim & Displacer Material: Suitable for service and conditions stated.
Switches: Dry contact type micro-switches for 120 volt A.C.-10 amps.

2. The following information applies to item nos. 1,2 and3 listed above:

Type of Control: Two level stage, narrow differential each stage.
Switch Contacts: D.P.D.T.
Switch Housing: Vaporproof, suitable for outdoors, fully exposed to weather, with two conduit connections.

B. Equipment and Services to be Furnished by the Seller:

The seller shall design, fabricate and deliver liquid level switches as specified in Section I-2-B and I-2-C.

E. Equipment and Services to be Furnished by Others:

1. Unloading and installation of equipment.

2. External piping and wiring.

ATTACHMENT 14
IP3-CALC-EG-00217
2 of 3

3. Upper Switch Action: Transfer on falling level, reset on rising level. Function-alarm for fuel refill.
Lower Switch Action: Transfer on falling level, reset on rising level. Function-pump cut-out.
Distance from tank mounting to upper switch actuation level: 7 feet-0 inches.
Distance from tank mounting to lower switch actuation level: 11 feet-3 inches.
Length of explicit suspension cable from tank mounting to lower end of cable: 12 feet-3 inches.

Change 11

4. The following information applies to items nos. 4, 5 and 6 listed on page 1.

Type of Control: Three level stage tandem type.
Switch Contacts: Upper and lower switch - one (1) S.P.D.T. each switch. Middle switch - one (1) D.P.D.T..
Switch Housing: Splash-proof, with two (2) conduit connections.

The following description of operation refers to the level points as defined on the sketch on Instrument Spec. Sheet No. 3, forming a part of this specificati

1. At level point #1, upper switch to transfer on rising level.

2. At level point #2, upper switch to reset on falling level.

3. Amount of liquid level travel between level points #1 & #2 to be a minimum; vendor to state.

31
39"
45

4. At level point #3, middle switch to transfer on falling level.

5. Middle switch to reset on rising level at level point #1, or anywhere between level points #3 & #1.

6. At level point #4, lower switch to transfer on falling level.

7. Lower switch to reset on minimum rise of liquid level above level point #4, or at any point between points #3 & #4; vendor to define.

The three switches will be used to provide the following functions:

Upper Switch: On rising level, close valve in fill line to tank.
On falling level, open valve in fill line to tank.

Middle Switch: On falling level, start fill pump.
On rising level, stop fill pump.

Lower Switch: On falling level, alarm low level.
On rising level, reset alarm.

ATTACHMENT 14
IP3-CALC-EG-00217
3 of 3

SECTION II

GENERAL SPECIFICATIONS

1. Work Included

Seller shall furnish and deliver the equipment herein specified.

2. Acceptance tests

If acceptance tests are made, the Owner will make them at his own expense.

Such tests will be made six months after the equipment has been put into regular service. Conditions of tests made by the Owner, prior to acceptance, shall be mutually established by the Seller and the Owner. Additional tests may be made within one year after commencing operation to determine whether the equipment meets this specification under all conditions of operation. Seller will be given the opportunity to witness these tests at his own expense. Tests will be completed within five years after shipment of equipment.

3. Performance

The equipment supplied shall be of ample capacity to perform its function adequately under the conditions herein specified, and shall in all its parts operate successfully at all specified conditions up to and including the maximum specified condition without undue noise, overheating, straining of parts, wear or vibration.

ATTACHMENT 15

Telecopy transmittal Sheet IP3, To R. Jones (I&C), From M. Pactong (MECH ENG).
12/1/95

IP3 ... Engineering 914-736-8877 ... 01'95 ... P.001

ATTACHMENT 15
IP3-CALC-EG-00217
1 of 11

TELECOPY TRANSMITTAL SHEET

IP3 DESIGN ENGINEERING - BLDG. 2

MECHANICAL/CIVIL-STRUCTURAL

Date: 12/1/95

Sending No: 914-736-8877
Confirmation Nos: 914-736-8174 914-736-8345

To: R. JONES
I&C

From: MARIO PACTONG
MECH. ENGR.

Number of pages including transmittal sheet: _____

Those I had attached the changes required due to field dimensions being different than drawing dimensions. Let me know when the changes are incorporated & I'll issue the DCN & revised pkg.

Thx
MARIO PACTONG

ATTACHMENT 15
IP3-CALC-EG-00217
2 of 11

New York Power Authority

CALCULATION NO. IP3-CALC-EG-00217 REVISION 4

Project INDIAN POINT 3
Title EMERGENCY DIESEL GENERATOR STORAGE TANK LEVEL SETPOINTS
Preliminary ____
Final X

Page 23 of 39
Date ____
Prepared by R.E. Jones Date ____
Checked by M. Anderson Date ____

Calculated Volume ± 50 gals:

TRIP SETPOINT (LOW):	Tank 31 & 32	32 ~~33~~ 8882 GAL	USING LVL INDICATION (CT = ± 50 GAL)
	Tank 33	8981 GAL	USING LVL INDICATION (CT = ± 50 GAL)
ALLOWABLE VALUE:	Tank 31 & 32	32 ~~33~~ 8857 GAL	USING LVL INDICATION (CT = ± 50 GAL)
	Tank 33	8957 GAL	USING LVL INDICATION (CT = ± 50 GAL)
ANALYTICAL LIMIT:	Tank 31 & 32	33 8799 GAL	USING LVL INDICATION (CT = ± 50 GAL)
	Tank 33	8893 GAL	USING LVL INDICATION (CT = ± 50 GAL)

Per Reference 3.4 each Specification requires that 20 gals inventory margin be maintained in the storage tanks. Therefore 0 should be added to the storage tank to get the following volumes (as read the indication):
8857 GAL + 21 GAL = 7000 GAL

LEVEL SWITCH DISPLACER CALIBRATIONS

From the Magnetrol installation drawing (Att 2), the float settings determine the switch setpoint as follows:

*Specific gravity of 0.8 for the fuel oil.

For the lower switch:
The lower switch transfers on decreasing level at least 1.125" (1 1/8") above the bottom of the lower displacer. Therefore the bottom of the lower displacer will be set at the setpoint (TS) minus 1.125":

Lower setting = 17.1" - 1.125" = (15.975) ~ 16" above the bottom

For the upper switch:
The upper switch transfers on decreasing level 3.5" (3 1/2") above the bottom of the upper displacer. Therefore, the upper displacer will be set at the setpoint (TS) minus 3.5":

Upper setting = 87" - 3.5" = 83.5"

New York Power Authority

ATTACHMENT 15
IP3-CALC-EG-00217
3 of 11

CALCULATION NO IP3-CALC-EG-00217 REVISION 4

Project INDIAN POINT 3
Title EMERGENCY DIESEL GENERATOR STORAGE TANK LEVEL SETPOINTS
Preliminary ____
Final X

Page 24 of 39
Date ____
Prepared by R.E. Jones Date ____
Checked by M. Anderson Date ____

The previous calculations are all based on measurements using the bottom of the tank as the reference point, as shown on drawing FP 9321-05-2990-0. It is impractical to measure the displacer positions while they are in the tank, but it is possible to use the mounting flange as the reference and measure how far down the displacers are to be set on the actuating wire. Although Drawing No 9321-F-20303, Rev. 13 shows the tanks having a 3" slope (this value actually varies from tank to tank), the indication error contribution has been negated by having the mounting flange as point of reference. This measurement is the diameter of the tank plus the height of the mounting flange minus the displacer position. Each tank has a slightly different mounting flange dimension, so each displacer position must be calculated individually.

The following table shows the displacer positions required for the calculated trip setpoints. They are based on measuring from the switch mounting flange to the bottom of the displacer. (See Figures 3, 4 & 5).

Distance from Flange to Tank Bottom (DFTB) = Tank Inter. Dia. (107.25") + one wall thickness (0.375") + measured flange dimension

Lower displacer setting = DFTB - lower setting (18")

Upper displacer setting = DFTB - upper setting (83.5")

TABLE 2
DISPLACER SETTINGS

TANK	FLANGE HEIGHT	DISTANCE FROM FLANGE TO TANK BOTTOM	LOWER DISPLACER SETTINGS		UPPER DISPLACER SETTINGS	
			DECIMAL	FRACTIONAL	DECIMAL	FRACTIONAL
T-[illegible] (FIG. 3)	38.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
T-[illegible] (FIG. 4)	38.375	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
T-[illegible] (FIG. 5)	38.750	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTE: Differences in the displacer settings are due to mounting flange elevation differences.

ATTACHMENT 15
IP3-CALC-EG-00217
4 of 11

New York Power Authority

CALCULATION NO. IP3-CALC-EG-00217 REVISION 4

Project INDIAN POINT 3
Title EMERGENCY DIESEL GENERATOR STORAGE TANK LEVEL SETPOINTS
Preliminary ____
Final X

Page 26 of 39
Date ____
Prepared by R.E. Jones Date ____
Checked by M. Anderson Date ____

c. Develop an instrument surveillance procedure for level indicating switches, LC-1204S, LC-1205S & LC-1206S. The calibration should be performed using the sounding technique. A Calibration Tolerance of ± 3/8" (section 8.1.1C) should be used. The following table specifies the value in inches which should be read for the following points for the points of interest based on the particular tank slope.

Tank 31

Tank 32

Tank 33

d. The level switch displacers for each tank should be positioned in accordance with settings listed in TABLE 1 with a CT of ± 3/8".

Existing documentation which specify the setpoints, FSAR & Tech. Spec. volumes must to be revised to reflect the new settings. Documents include:

- Monthly Surveillance Test IPT-W1 Rev. 14
- Conventional Log Sheets
- ALARM RESPONSE PROCEDURE ARP-1 "PANEL SIS ELECTRICAL" REV.11

New York Power
Authority

ATTACHMENT 15
IP3-CALC-EG-00217
5 of 11

CALCULATION NO. IP3-CALC-EG-00217 REVISION 4

Project INDIAN POINT 3 Page 27 of 31
Title EMERGENCY DIESEL GENERATOR STORAGE TANK LEVEL SETPOINTS Date
Preliminary Prepared by R.F. Jones Date
Final X Checked by M. Anderson Date

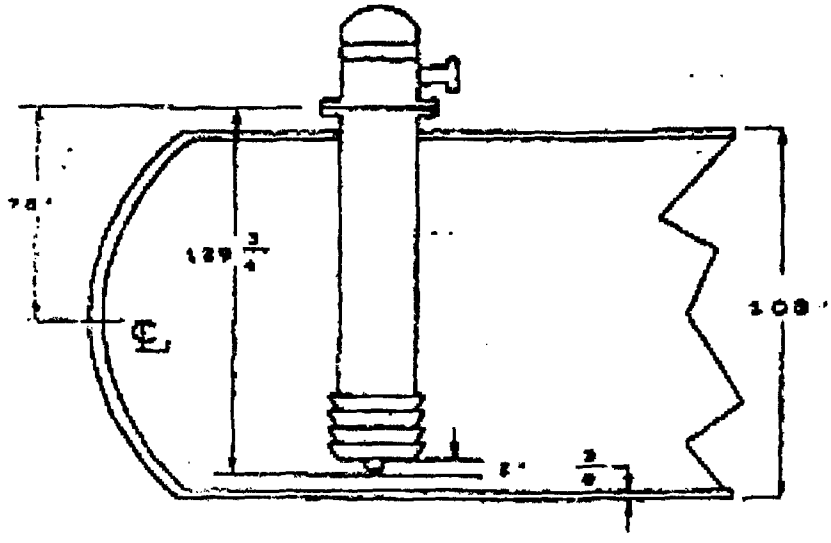


FIGURE 3 PUMP DIMENSIONS

New York Power Authority

ATTACHMENT 15
IP3-CALC-EG-00217
6 of 11

CALCULATION NO. IP3-CALC-EG-00217 REVISION 4

Project: INDIAN POINT 3
Title EMERGENCY DIESEL GENERATOR STORAGE TANK LEVEL SETPOINTS
Preliminary ____
Final X

Page 28 of 31
Date ____
Prepared by R.F. Jones Date ____
Checked by M. Anderson Date ____

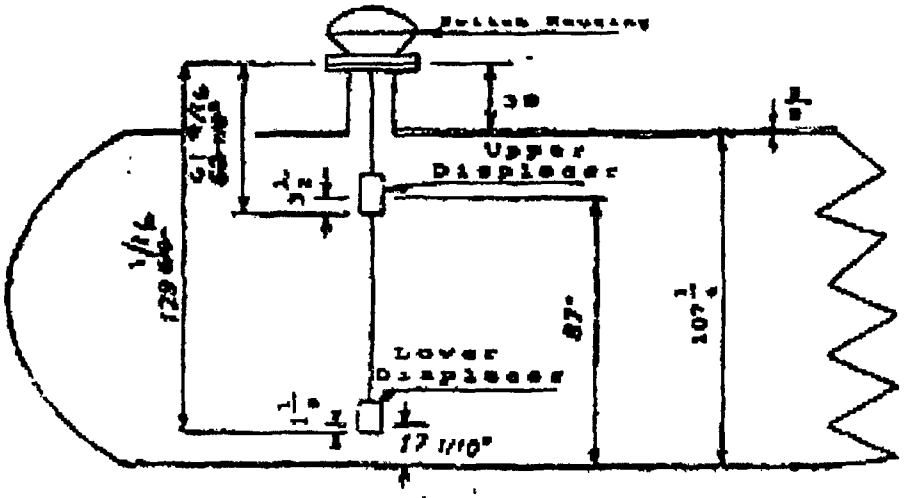


FIGURE 3 TANK DISPLACER SETTINGS

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CALCULATION NO IP3-CALC-EG-00217 REVISION 4

Project INDIAN POINT 3
Title EMERGENCY DIESEL GENERATOR STORAGE TANK LEVEL SETPOINTS
Preliminary ____
Final X

Page 39 of 31
Date ____
Prepared by R.F. Jones Date ____
Checked by M. Anderson Date ____

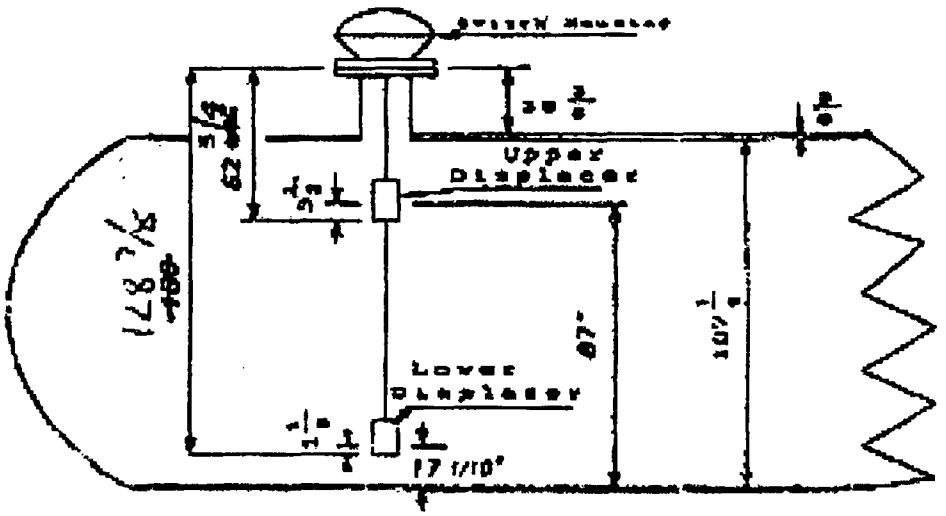

FIGURE 4 TANK 32 DIPLACER SETTINGS

IP3 Site Engineering 10:914-736-8827 DEC 7'99 13:22 NO.007 P.05

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New York Power Authority

CALCULATION NO. IP3-CALC-EG-00217 REVISION 4

Project INDIAN POINT 3
Title EMERGENCY DIESEL GENERATOR STOP/OR TANK LEVEL SETPOINTS
Preliminary
Final X

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Date
Prepared by R.F. Jones Date
Checked by M. Anderson Date

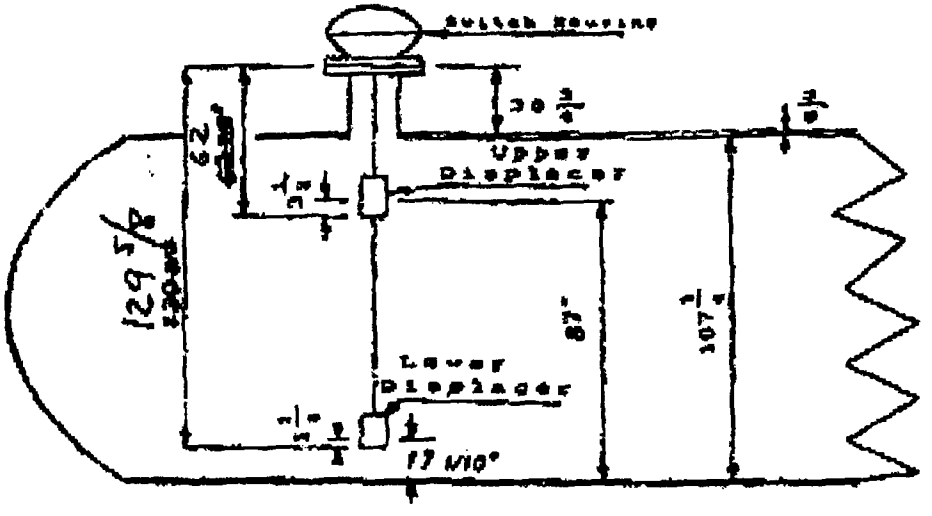

FIGURE 6 TANK 33 DISPLACER SETTINGS

IP3 Data Engineering [0:814-736-8877 DEC 01'95 15:04 No.007 P.08

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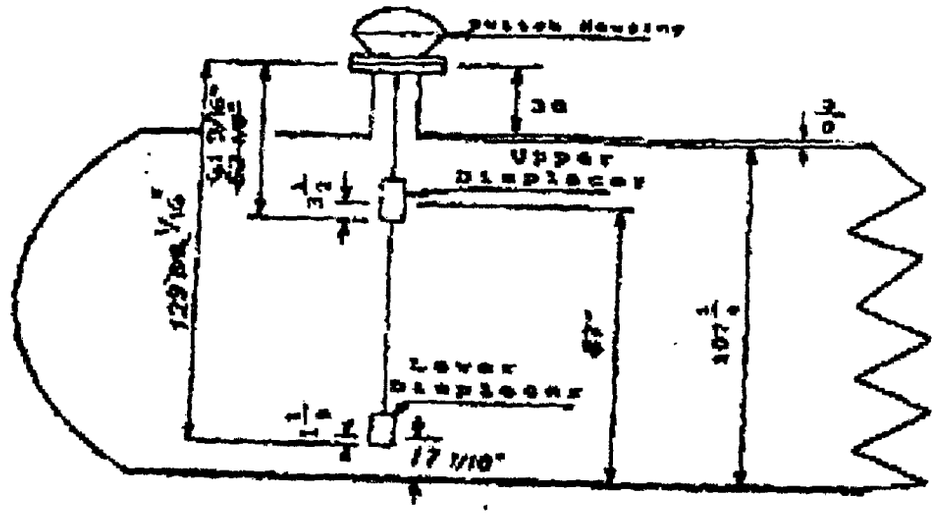

31 Displacer Settings

DISPLACER SETTINGS

TANK	FLANGE HEIGHT	DISTANCE FROM FLANGE TO TANK BOTTOM 165.0625	LOWER DISPLACER SETTINGS		UPPER DISPLACER SETTINGS	
			DECIMAL 129.0625	FRACTIONAL 129 1/16"	DECIMAL 61.5625	FRACTIONAL 61 9/16"
[illegible] (FIG. 3)	38.000	~~146.688~~	~~129.626~~	~~129 5/8~~	~~46.687~~	~~46 5/8~~
[illegible] (FIG. 4)	38.375	165.000	130.000	130	61.300	61 1/2
(FIG. 5)	38.750	146.375	130.375	130 3/8	61.875	61 7/8

NOTE: Differences in the displacer settings are due to mounting flange elevation differences.

Verify the distance from the face of the mounting flange to the bottom of the tank

ATTACHMENT B

IPE Site Engineering 10:914-736-8977 DEC 01'95 15:04 No.007 P.10

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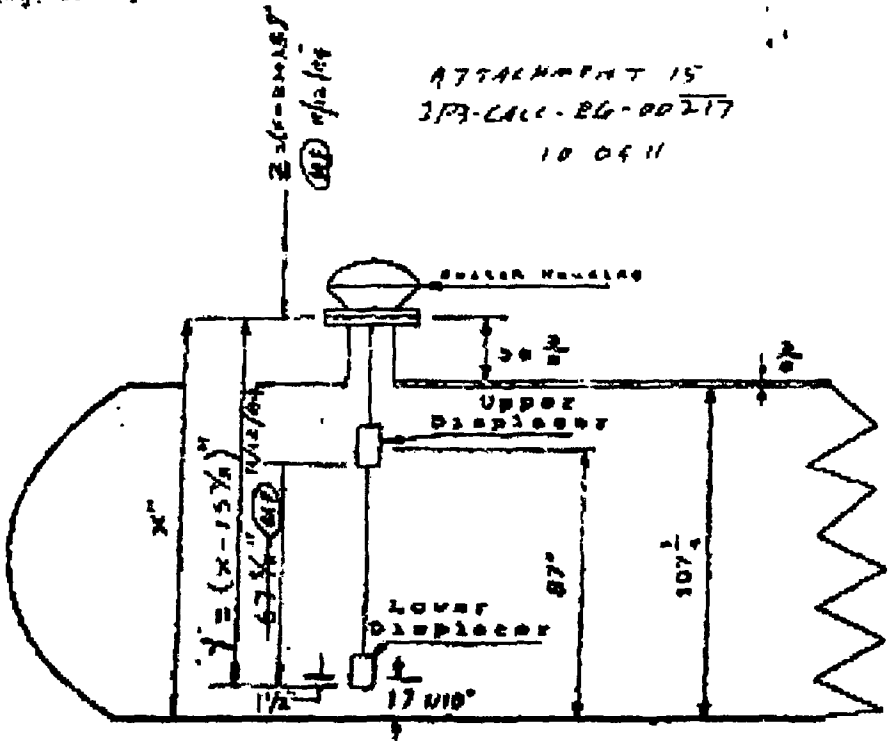

Tank 32 Displacer Settings

X = 104 3/8 INCHES
Y = 12 7/8 INCHES.
Z = 62 3/4 INCHES.

ATTACHMENT B

SCR IP3-94-0026

DEC 01'95 15:05 NO.007 P.11

IP3 Site Engineering 10:914-736-8677

ATTACHMENT 15
IP3-CALC-EG-00217
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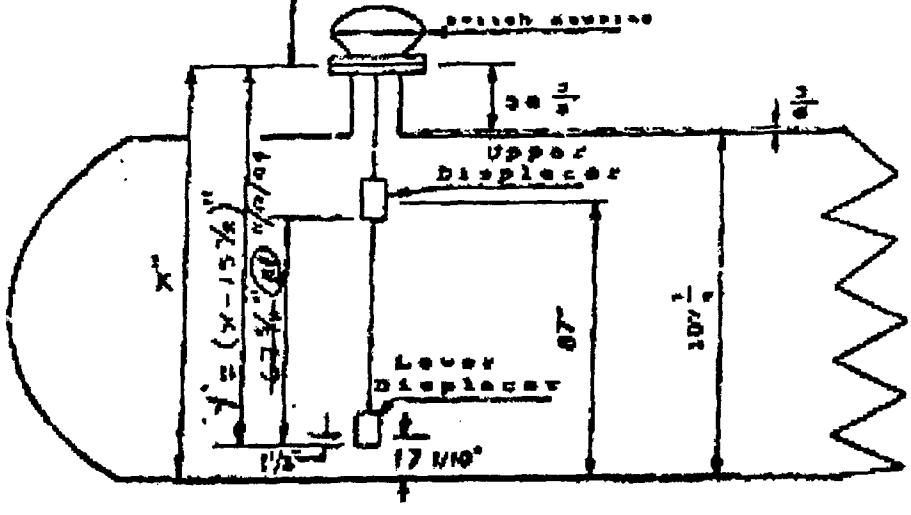

Tank 33 Displacer Settings

X = 145½ INCHES
Y = 129 5/8 INCHES
Z = 62" INCHES (MP) 11/12/94

ATTACHMENT B

SCR IP3-94-0027

DESIGN VERIFICATION COVER PAGE

☐ ANO-1	☐ ANO-2	☐ IP-2	☒ IP-3	☐ JAF	☐ PLP
☐ PNPS	☐ VY	☐ GGNS	☐ RBS	☐ W3	☐ NP

Document No.	Revision No.	Page 1 of 4
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Title:
Emergency Diesel Generator Storage Tank Level Setpoints

☒ Quality Related ☐ Augmented Quality Related

DV Method: ☒ Design Review ☐ Alternate Calculation ☐ Qualification Testing

VERIFICATION REQUIRED	DISCIPLINE	VERIFICATION COMPLETE AND COMMENTS RESOLVED (DV print, sign, and date)
☐	Electrical	
☐	Mechanical	
☒	Instrument and Control	R. A. Schimpf / See IAS
☐	Civil/Structural	
☐	Nuclear	
☐		
☐		

Originator:	B. Shepard / See IAS 2/14/12 Print/Sign/Date After Comments Have Been Resolved

IDENTIFICATION:				DISCIPLINE:
Document Title: **Emergency Diesel Generator Storage Tank Level Setpoints**				☐ Civil/Structural ☐ Electrical ☒ I & C ☐ Mechanical ☐ Nuclear ☐ Other
Doc. No.: **IP3-CALC-EG-00217**		Rev. 5	QA Cat. SR	
Verifier:	R. A. Schimpf (Print)	See IAS (Sign)	See IAS (Date)	
Manager authorization for supervisor performing Verification. ☐ N/A	N/A (Print)	(Sign)	(Date)	

METHOD OF VERIFICATION:

Design Review ☒ Alternate Calculations ☐ Qualification Test ☐

The following basic questions are addressed as applicable, during the performance of any design verification. [ANSI N45.2.11 – 1974] [**NP** QAPD, Part II, Section 3][NP NQA-1-1994, Part II, BR 3, Supplement 3S-1].

NOTE The reviewer can use the "Comments/Continuation sheet" at the end for entering any comment/resolution along with the appropriate question number. Additional items with new question numbers can also be entered.

1. Design Inputs – Were the inputs correctly selected and incorporated into the design?

   (Design inputs include design bases, plant operational conditions, performance requirements, regulatory requirements and commitments, codes, standards, field data, etc. All information used as design inputs should have been reviewed and approved by the responsible design organization, as applicable.

   All inputs need to be retrievable or excerpts of documents used should be attached.

   See site specific design input procedures for guidance in identifying inputs.)

   Yes ☒ No ☐ N/A ☐

2. Assumptions – Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are assumptions identified for subsequent re-verification when the detailed activities are completed? *Are the latest applicable revisions of design documents utilized?*

   Yes ☒ No ☐ N/A ☐

3. Quality Assurance – Are the appropriate quality and quality assurance requirements specified?

   Yes ☒ No ☐ N/A ☐

4. Codes, Standards and Regulatory Requirements – Are the applicable codes, standards and regulatory requirements, including issue and addenda properly identified and are their requirements for design met?
   Yes ☒ No ☐ N/A ☐

5. Construction and Operating Experience – Have applicable construction and operating experience been considered?
   Yes ☒ No ☐ N/A ☐

6. Interfaces – Have the design interface requirements been satisfied and documented?
   Yes ☒ No ☐ N/A ☐

7. Methods – Was an appropriate design or analytical (for calculations) method used?
   Yes ☒ No ☐ N/A ☐

8. Design Outputs – Is the output reasonable compared to the inputs?
   Yes ☒ No ☐ N/A ☐

9. Parts, Equipment and Processes – Are the specified parts, equipment, and processes suitable for the required application?
   Yes ☐ No ☐ N/A ☒

10. Materials Compatibility – Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?
    Yes ☐ No ☐ N/A ☒

11. Maintenance requirements – Have adequate maintenance features and requirements been specified?
    Yes ☒ No ☐ N/A ☐

12. Accessibility for Maintenance – Are accessibility and other design provisions adequate for performance of needed maintenance and repair?
    Yes ☐ No ☐ N/A ☒

13. Accessibility for In-service Inspection – Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?
    Yes ☐ No ☐ N/A ☒

14. Radiation Exposure – Has the design properly considered radiation exposure to the public and plant personnel?
    Yes ☐ No ☐ N/A ☒

15. Acceptance Criteria – Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?
    Yes ☒ No ☐ N/A ☐

16. Test Requirements – Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?
    Yes ☒ No ☐ N/A ☐

17. Handling, Storage, Cleaning and Shipping – Are adequate handling, storage, cleaning and shipping requirements specified?
    Yes ☐ No ☐ N/A ☒

18. Identification Requirements – Are adequate identification requirements specified?
    Yes ☐ No ☐ N/A ☒

19. Records and Documentation – Are requirements for record preparation, review, approval, retention, etc.. adequately specified? Are all documents prepared in a clear legible manner suitable for microfilming and/or other documentation storage method? Have all impacted documents been identified for update as necessary?
    Yes ☐ No ☐ N/A ☒

20. Software Quality Assurance- ENN sites: For a calculation that utilized software applications (e.g., GOTHIC, SYMCORD), was it properly verified and validated in accordance with EN- IT-104 or previous site SQA Program?
    ENS sites: This is an EN-IT-104 task. However, per ENS-DC-126, for exempt software, was it verified in the calculation?
    Yes ☐ No ☐ N/A ☒

21. *Has adverse impact on peripheral components and systems, outside the boundary of the document being verified, been considered?*
    Yes ☐ No ☐ N/A ☒

Comments / Continuation Sheet

Question #	Comments	Resolution	Initial/Date
	None		