INSTRUMENT ERROR ANALYSIS FOR FORT CALHOUN CLRT

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Prepared for

Omana Public Power District

By

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INSTRUMENT ERROR ANALYSIS

I. Instrumentation

A. Pressure Digital Readout

Inst #	PI-1, PI-2
Mfg	Mensor Corp.
Type	Bourdon Tube Capsule & Precision Pressure Gage
Range	0-100 psia
Stability	± .002 psi
Repeatability	± .0005 psi
Resolution	± .001 psi
Accuracy	± .015 psi

B. Temperature Elements

Inst #	T-001 through T-030
Mfg	Hy-Cal Engrg
Type	100 Ω Platium RTD
Range	Calibrated for 60°, 85°, and 110°F
Repeatability & Hysteresis	± 0.1°F
Accuracy	± 0.02°F

C. Dew Point Measurement System

Inst #	DPT-31 through DPT-40
Mfg	Volumetrics
Model	Dewcell
Range	Calibrated for 50°, 80°, 100°F
Accuracy	±.00726 psi
Repeatability	±.002 psi
Stability (for three days)	±.00006 psi

D. Readout System

Mfg	Data logger	
Model	3000	
accuracy	± .19°F	± .0024 psi
repeatability	± .05°F	± .0006 psi
stability	± .05°F	± .0006 psi

E. Flow Measurement System

Inst #	FI-1
Mfg	Fisher-Porter
Model	087-615-588
Calibration	.4 to 4 scfm of air @ 60 psig & 80°F
Accuracy	± 1% of full scale

II. Formula

$$E_L = 100\sqrt{2\left(\frac{E_p}{P-Pv}\right)^2+2\left(\frac{E_T}{T}\right)^2+2\left(\frac{E_v}{P-Pv}\right)^2}$$

where:

E_L = error in leakage rate in % by weight per day

E_p = pressure instrument error $/\sqrt{\text{no. inst.}}$

= error in total absolute pressure in psia

E_T = temperature instrument error $/\sqrt{\text{no inst.}}$

= error in temperature in °R

E_V = vapor pressure instrument error $/\sqrt{\text{no. inst.}}$

= error in water vapor pressure in psia

Assuming:

A. Initial and final temperatures are identical

B. Initial and final pressures are identical

III. Calculation of E_p

$$E_p = \sqrt{\frac{(\text{repeatability})^2 + (\text{resolution})^2 + (\text{stability})^2}{\#\text{ of senors}}}$$

$$= \sqrt{\frac{(.0005)^2 + (.001)^2 + (.002)^2}{2}}$$

$$= 1.6\ 202 \times 10^{-3}\ \text{psi}$$

IV. Calculation of E_T

$$E_T = \sqrt{\frac{(\text{repeatability of RTD})^2 + (\text{repeatability of data logger})^2 + (\text{stability of data logger})^2}{\text{\# sensors}}}$$

$$= \sqrt{\frac{(.1)^2 + (.05)^2 + (.05)^2}{30}}$$

$$= .02236 \ ^{\circ}F$$

V. Calculation of E_V

$$E_V = \sqrt{\frac{(\text{repeatability of detector})^2 + (\text{stability of detector})^2 + (\text{repeatability of readout})^2 + (\text{stability of readout})^2}{\text{\# of sensors}}}$$

$$= \sqrt{\frac{(.002)^2 + (.00006)^2 + (.0006)^2 + (.0006)^2}{9}}$$

$$= .00072 \quad \text{psi}$$

VI. Calculation of E_L

$$E_L = 100\sqrt{2\left(\frac{E_p}{P-Pv}\right)^2 = 2\left(\frac{E_T}{T}\right)^2 + 2\left(\frac{E_V}{P-Pv}\right)^2}$$

$$= 100\sqrt{2\left(\frac{.0016202}{74.7}\right)^2 + 2\left(\frac{.02236}{530}\right)^2 + 2\left(\frac{.00072}{74.7}\right)^2} = .0068\% \text{ by wt/day}$$

VII. Calculation of E_F

Standard conditions for the flowmeters are defined as 14.73 psia and 60°F.

$$\text{Flowmeter Accuracy} = \frac{1 \times 4.0}{100} = .04 \text{ scfm}$$

$$\text{Flowmeter Error} = E_F = \frac{P_{60}}{T_{80}} \times \frac{T}{P-Pv} \times \frac{60 \times 24 \times 100}{1.05 \times 10^6} \times .04$$

$$= \frac{60 + 14.7}{80 + 460} \times \frac{76 + 460}{75.107-.143} \times .137 \times .04 = .0054$$

VIII. Calculation of E_L'

$$E_L' = E_L + E_F = .0068 + .0054 = .0122\% \text{ by wt/day}$$