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## Calibration Report

**Calibration of**  
**Danfysik STH2000HF Current Transformer s/n: 10065636,**  
**STH5000-140 Current Transformer s/n: 10070435, 866-600 Current**  
**Transformer s/n: 10056162, 866-150 Current Transformer s/n:**  
**10038471, with Saturn units s/n: 10050963, 10069747**

For

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NRC Order Number: 469321

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The Danfysik current transformer heads S/N 10065636, 10070435, 10056162, 10038471, with electronics S/N 10050963, 10069747 and model 10908, were calibrated at ambient conditions (temperature  $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ) in the high voltage laboratory of NRC, according to the ISO 17025 compliant quality procedure EPM 522: AC Current Transformer Calibration using an NRC current comparator based current transformer test set. Measurements were made between 2009-6-22 and 2009-6-29. Following calibration, the transformers were marked with calibration labels numbered EPM-2008-0034 dated 6-2009. Measurements were made at 60 and 400 Hz.,  $0.1\Omega$  burden, ratios and current test points as indicated in Table 1.

The transformers were received at the NRC high voltage laboratory on 2009-3-10 and inspected on receipt: they were in operational condition.

The errors of the current transformers in Table 1 are defined by the following equation:

$$\alpha + j\beta = (I_s - I_p/n) / (I_p/n) 10^5$$

Where:

$\alpha$  and  $\beta$  are the in-phase (ratio) and quadrature (phase)<sup>1</sup> errors,  $I_p$  and  $I_s$  are the primary and secondary currents, and  $n$  is the nominal ratio.

The total estimated uncertainties quoted in this report encompass the Type A uncertainty (2 sigma of the average of the three sets of measurements) and the Type B uncertainty of the NRC calibration system, which is  $1 \times 10^{-5}$  in both in-phase and quadrature. The total uncertainty (coverage factor  $k = 2$ ) of the test results at the specified burdens is estimated to be not more than  $2 \times 10^{-5}$  for the in-phase and  $2 \times 10^{-5}$  for the quadrature errors. The confidence level that the true values of both the in-phase and quadrature errors are within the quoted uncertainties is estimated at 95%.

The reported in-phase and quadrature errors and the associated uncertainties apply at the time and under the conditions specified. These uncertainties are primarily due to the repeatability characteristics of the current transformers and are not an indication of their long-term stability, nor the effect of temperature. The calibration was performed with symmetrical primary current return conductors. The uncertainty in this calibration does not include the uncertainty due to the effect of non-symmetrical primary return conductors.

The calibration results are traceable to the SI through current-comparator-based measurement standards maintained within the Electrical Power Measurements Group at the Institute for National Measurement Standards, NRC.

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<sup>1</sup> The transformer in-phase and quadrature errors are measured in parts in  $10^5$ . The equivalence of quadrature error in parts in  $10^5$  to phase angle in microradians is valid for errors less than  $3 \times 10^{-3}$ .

**Table 1**  
**Calibration Results for**  
Danfysik Current Transformers and Saturn / GMW Electronics Units combinations  
0.1Ω Burden

Current Transformer (s/n)	Electronics Unit (s/n)	Ratio	Secondary Current A (rms)	Transformer Error ( $\alpha + j\beta$ ) x 10 <sup>-5</sup>	
				Frequency	
				60 Hz	400 Hz
866-600 (10056162)	866 & 867 Power Supply model 10908	1500 / 1	0.02	-4 - j 8	-17 - j 7
			0.04	-4 - j 7	-17 - j 8
			0.08	-4 - j 7	-16 - j 9
			0.12	-4 - j 6	-15 - j 10
			0.16	-4 - j 6	-15 - j 10
			0.2	-4 - j 6	-15 - j 10
			0.24	-4 - j 6	-15 - j 10
			0.28	-5 - j 6	-15 - j 10
			0.32	-5 - j 6	-15 - j 10
			0.36	-9 - j 4	-15 - j 10
			0.4	-19 + j 3	-16 - j 9
866-150 (10038471)	866 & 867 Power Supply model 10908	750 / 1	0.01	0 - j 3	-6 - j 3
			0.02	0 - j 3	-6 - j 4
			0.04	0 - j 2	-6 - j 5
			0.06	0 - j 2	-6 - j 5
			0.08	0 - j 2	-5 - j 5
			0.1	0 - j 2	-5 - j 5
			0.12	1 - j 2	-5 - j 5
			0.14	1 - j 2	-5 - j 5
			0.16	1 - j 2	-5 - j 5
			0.18	1 - j 2	-5 - j 5
			0.2	1 - j 2	-5 - j 6
STH2000HF (10065636)	Saturn (10069747)	1000 / 1	0.1	12 + j 9	20 - j 3
			0.2	7 + j 7	15 - j 3
			0.4	4 + j 6	12 - j 4
			0.6	3 + j 5	11 - j 4
			0.8	2 + j 4	11 - j 4
			1	2 + j 4	10 - j 4
			1.2	2 + j 4	10 - j 5
			1.4	2 + j 3	10 - j 5
			1.6	1 + j 3	10 - j 5
			1.8	1 + j 3	10 - j 5
			2	1 + j 3	10 - j 5

Continued....

**Table 1 (continued)**  
**Calibration Results for**  
Danfysik Current Transformers and Saturn / GMW electronics units combinations  
0.1Ω Burden

Current Transformer (s/n)	Electronics Unit (s/n)	Ratio	Secondary Current A	Transformer Error ( $\alpha + j\beta$ ) x 10 <sup>-5</sup>	
				Frequency	
				60 Hz	400 Hz
STH5000-140 (10070435)	Saturn (10050963)	2500 / 1	0.1	36 + j 37	84 + j 55
			0.2	23 + j 29	67 + j 49
			0.4	15 + j 22	52 + j 39
			0.6	11 + j 19	42 + j 32
			0.8	9 + j 17	36 + j 27
			1	8 + j 15	
			1.2	7 + j 14	
			1.4	6 + j 13	
			1.6	5 + j 12	
			1.8	5 + j 11	
			2	5 + j 10	

