

**ENGINE SYSTEMS, INC.**

175 Freight Road, Rocky Mount, NC 27804

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**TELEFAX**

**Date:** March 21, 2019  
**Company:** NRC Operations Center  
**Fax Number:** 301/816-5151  
**Verification No.:** 301/816-5100  
**Reference:** Report No. 10CFR21-0124, Rev. 0  
**From:** Dan Roberts  
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Dear Sir:

Following this cover is a copy of our Report 10CFR21-0124, Rev.0, for a 10CFR21 reportable notification on excitation transformers for Vickers voltage regulator system. This is a follow-up to our interim report 10CFR21-0124-INT, Rev. 0 issued on January 24, 2019. Our evaluation determined that the deviation is reportable in accordance with 10CFR21 Part 21.

A copy of the report will be mailed to the NRC Document Control Desk.

Should you have questions, please let us know.

Sincerely,

ENGINE SYSTEMS, INC.

A handwritten signature in cursive script that reads 'Dan Roberts'.

Dan Roberts  
Quality Manager



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**Report No. 10CFR21-0124**  
**Rev. 0: 03/21/19**

**10CFR21 REPORTING OF DEFECTS  
AND NON-COMPLIANCE**

**COMPONENT:** Excitation Transformers for Vickers Voltage Regulator System

Part Number	Device Description
8408213-ESI	Power Current Transformer (PCT)
8408218-ESI	Saturable Reactor (Reactor)
8411387-ESI	Excitation Power Transformer (EPT)

**SYSTEM:** Emergency Diesel Generator – Voltage Regulator System

**CONCLUSION:** Reportable in Accordance with 10CFR21

Prepared By: *Ju Lin*  
Engineering Manager

Date: 3/21/19

Reviewed By: *Dan Roberts*  
Quality Assurance Manager

Date: 3/21/19

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REV	DATE	PAGE	DESCRIPTION
0	03/21/19		Initial issue.

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## **SUMMARY**

On January 24, 2019, Engine Systems Inc. (ESI) issued interim report 10CFR21-0124-INT, rev.0 regarding an identified deviation for which ESI was unable to complete an evaluation within the 60-day requirement. Per the interim report, ESI committed to complete the evaluation by March 22, 2019. The evaluation is now complete and the deviation is determined to be reportable in accordance with 10CFR Part 21.

Pursuant to 10 CFR 21.21(d)(4), ESI is presenting the required information as follows:

(i) Name and address of the individual or individuals informing the Commission.

<i>John Kriesel</i>	<i>Dan Roberts</i>
<i>Engineering Manager</i>	<i>Quality Manager</i>
<i>Engine Systems Inc.</i>	<i>Engine Systems Inc.</i>
<i>175 Freight Rd.</i>	<i>175 Freight Rd.</i>
<i>Rocky Mount, NC 27804</i>	<i>Rocky Mount, NC 27804</i>

(ii) Identification of the basic component supplied within the United States which fails to comply or contains a defect.

*Excitation transformers of the following part numbers:*

<b>Part Number</b>	<b>Device Description</b>
<i>8408213-ESI</i>	<i>Power Current Transformer (PCT)</i>
<i>8408218-ESI</i>	<i>Saturable Reactor (Reactor)</i>
<i>8411387-ESI</i>	<i>Excitation Power Transformer (EPT)</i>

(iii) Identification of the firm supplying the basic component which fails to comply or contains a defect.

*Engine Systems Inc. (ESI)*

(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

<b>Part Number</b>	<b>Device</b>	<b>Description of Defect</b>
<i>8408213-ESI</i>	<i>PCT</i>	<i>Insufficient core gap.</i>
<i>8408218-ESI</i>	<i>Reactor</i>	<i>Differences in coil winding and core lamination from original design.</i>
<i>8411387-ESI</i>	<i>EPT</i>	<i>Incorrect polarity.</i>

*Each of the devices listed above provide a specific function within the static exciter of a Vickers voltage regulator system. The exciter supplies DC excitation current to the generator field based on input from the voltage regulator. Failure of any one of the components to perform correctly will negatively impact excitation current supplied to the generator field which in turn directly affects generator output. Therefore, failure of any one of the components may prevent the emergency diesel generator from carrying its associated safety-related loads.*

*See Attachment 1 for additional discussion.*

(v) The date on which the information of such defect or failure to comply was obtained.

*December 6, 2018*

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part.

*The list of customers to whom ESI has supplied the transformers as dedicated, safety-related devices is listed in the table on page 2.*

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Part Number	Device	Customer	Customer PO#	Qty	ESI Order	C-of-C Date
8408213-ESI	PCT	Florida Power & Light - Turkey Point	02318321/00032	3	3012629	01/06/2015
		Northern States Power Company - Monticello	4000002229	9	8002765	08/30/2018
8408218-ESI	Reactor	Dominion Virginia Power - Surry Power Station	45936798	6	3010193	07/31/2013
		Florida Power & Light - Turkey Point	02313521/00013	1	3010993	10/18/2013
		Florida Power & Light - Turkey Point	02318321/00032	5	3012629	04/30/2014 (qty 3) 08/01/2014 (qty 2)
		Northern States Power Company - Monticello	4000002229	18	8002765	07/30/2018
8411387-ESI	EPT	Dominion Virginia Power - Surry Power Station	4500013104	1	3010356	08/07/2013
		Florida Power & Light - Turkey Point	02313521/00013	1	3010993	10/18/2013
		Florida Power & Light - Turkey Point	02318321/00032	2	3012629	08/01/2014
		BMPC - KAPL	112732-18	1	3017417	12/27/2017
		Northern States Power Company - Monticello	4000002229	9	8002765	08/31/2018

**Table 1: List of Affected Customers**

(vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.

**P/N 8408213-ESI (PCT):**

*Return to ESI for rework. The PCT requires additional insulating material to increase the core gap.*

**P/N 8408218-ESI (Reactor):**

*Return to ESI for replacement.*

**P/N 8411387-ESI (EPT):**

*Return to ESI for rework to have EPT primary terminal markings (H1 & H2) re-labeled.*

*ESI will implement inspection and test requirements to ensure additional critical characteristics identified during this evaluation process are properly verified. The dedication package revisions to include these characteristics is expected to be complete within 60 days but in all cases prior to shipment of any new or reworked transformers of the above part numbers.*

(viii) Any advice related to the potential defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.

*See Attachment 1 for additional discussion.*

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### ATTACHMENT 1

### ADDITIONAL DISCUSSION ON EXCITER TRANSFORMERS (MAGNETICS)

The Vickers voltage regulator system was original equipment supplied with many of the nuclear EDGs, primarily 1960s and 1970s vintage units. The Vickers exciter components went out of production approximately 20 years ago and ESI began a reverse engineering initiative in 2012 to offer customers replacements for their existing magnetics. This activity was performed in collaboration with a transformer manufacturer using available drawing and design information and disassembly inspection of sample units of the original design. The new transformer part numbers were given a "-ESI" suffix to denote they are made by a different manufacturer but kept the original base part number to maintain traceability to the original application.

ESI was notified on December 6, 2018 of a potential issue with exciter magnetics supplied to Monticello Nuclear Generating Plant. During system testing performed by Monticello at another vendor facility, issues with the static excitation system were identified which prevented proper control of the generator field current. This prompted the 10CFR21 evaluation that ultimately lead to this 10CFR21 report. Additional tests and inspections performed throughout ESI's evaluation determined that while many of the characteristics between the old and new magnetics are the same, key differences exist that caused the performance anomalies identified during Monticello system testing.

Within the voltage regulator system, the magnetics supply DC excitation current to the generator field based on input from the voltage regulator. A typical schematic is shown in Figure 1 below. The three components in question are the excitation power transformers (identified as EPT1, EPT2, & EPT3), power current transformers (identified as PCTA, PCTB, & PCTC) and saturable reactors (identified as L1 through L6). The issues with each component, as well as outline drawings, are contained on the following pages.

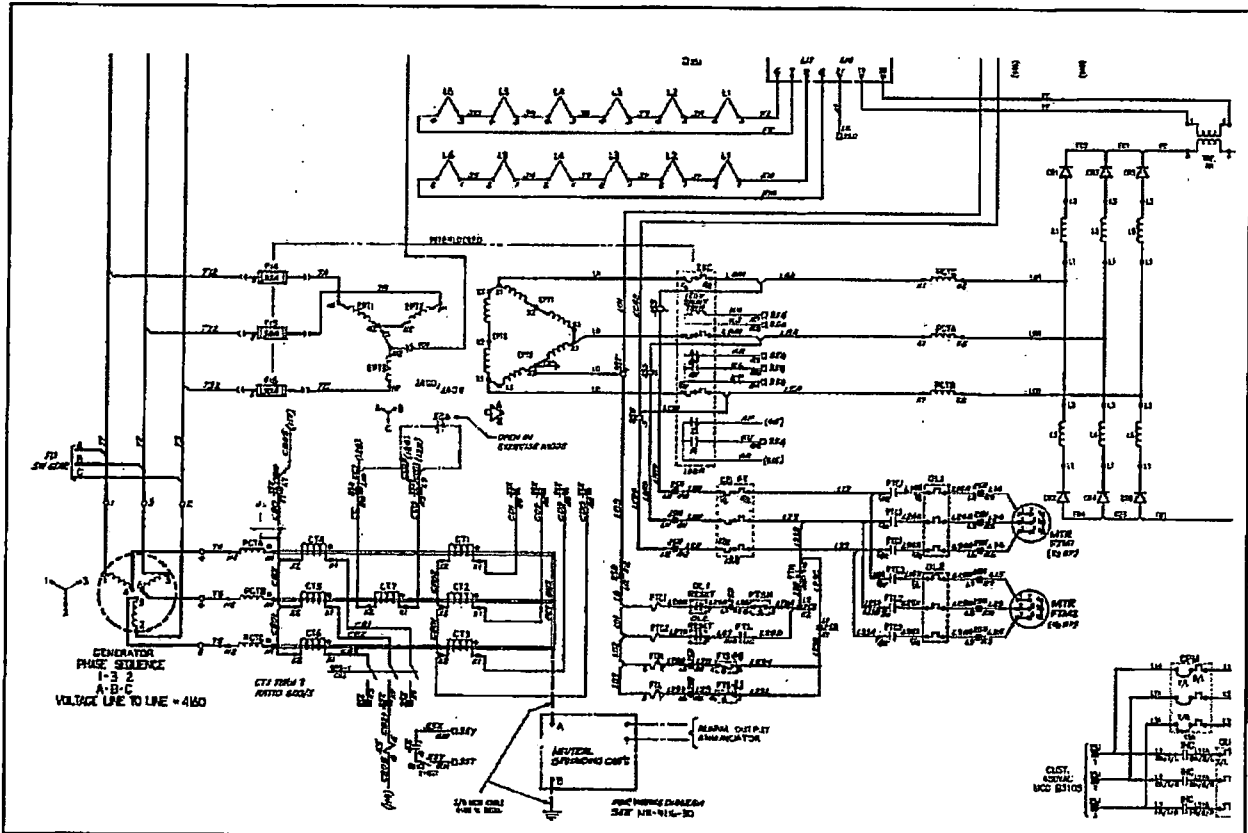


Figure 1: Typical Vickers Voltage Regulator System Schematic

**Excitation Power Transformer**

Three single-phase EPTs are wye connected on the primary and delta connected on the secondary. Per the system design, EPT primary H1 should have the same polarity of EPT secondary X1. Contrary to this requirement, EPT primary H1 has the same polarity as secondary X3.

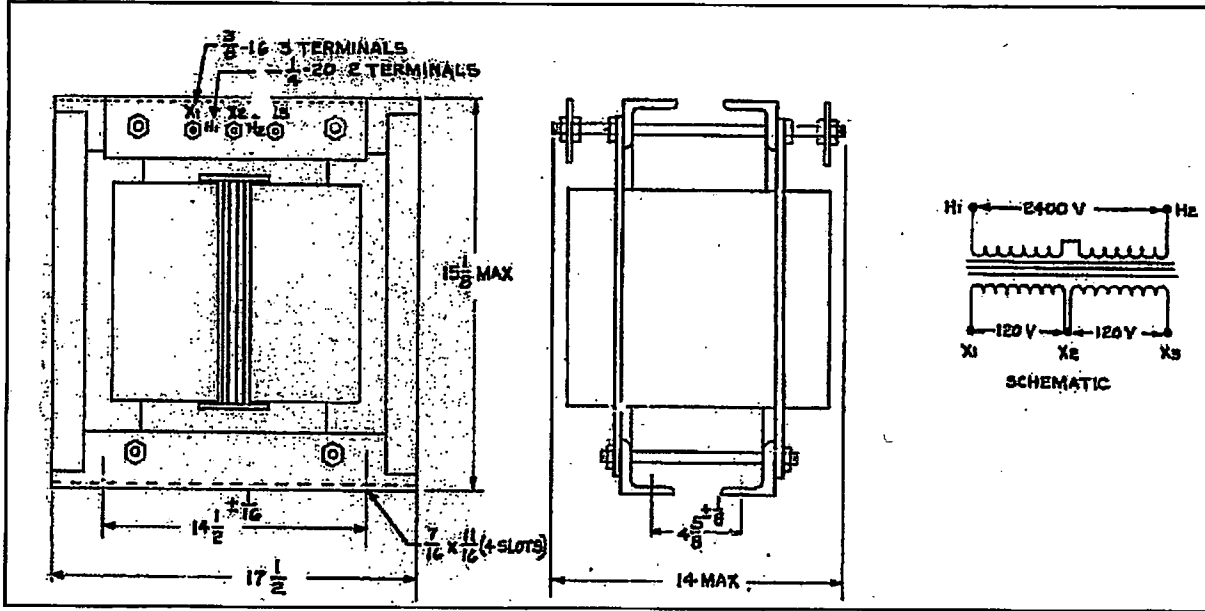


Figure 2: EPT Outline Drawing

**Power Current Transformer**

Three single-phase PCTs provide a secondary voltage proportional to the primary current. The PCT, in conjunction with the EPT, provide the power to support generator field excitation. Certain characteristics of the PCT secondary voltage are determined by the magnitude of an air gap in the core construction. It has been determined the PCT supplied by ESI has a gap of 0.030" whereas the original design PCT has a gap of 0.080".

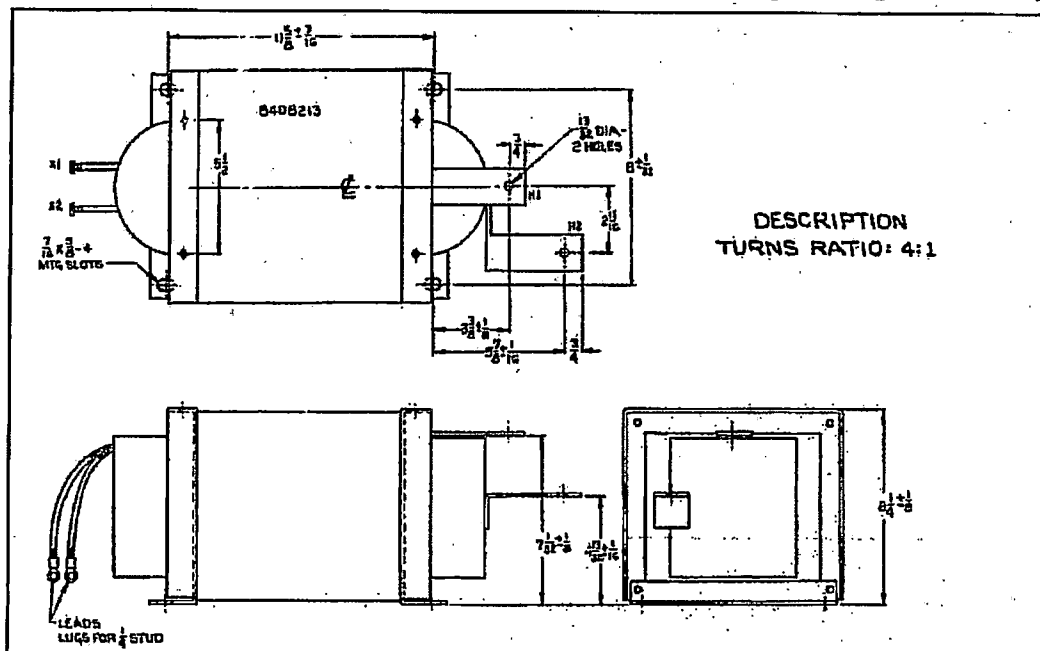


Figure 3: PCT Outline Drawing

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**Saturable Reactor**

In conjunction with a rectifier diode, the saturable reactor acts as a magnetic amplifier. Six of these magnetic amplifier assemblies are used in the rectifier bridge of the voltage regulator system. The reactor receives a bias and control current from the voltage regulator which varies the level of saturation in the reactor core. As the level of saturation changes, the reactor impedance varies which increases or decreases generator field voltage. It has been determined the saturable reactor supplied by ESI has coil winding and core winding differences from the originally supplied reactor that may cause subtle, but undesired performance differences.

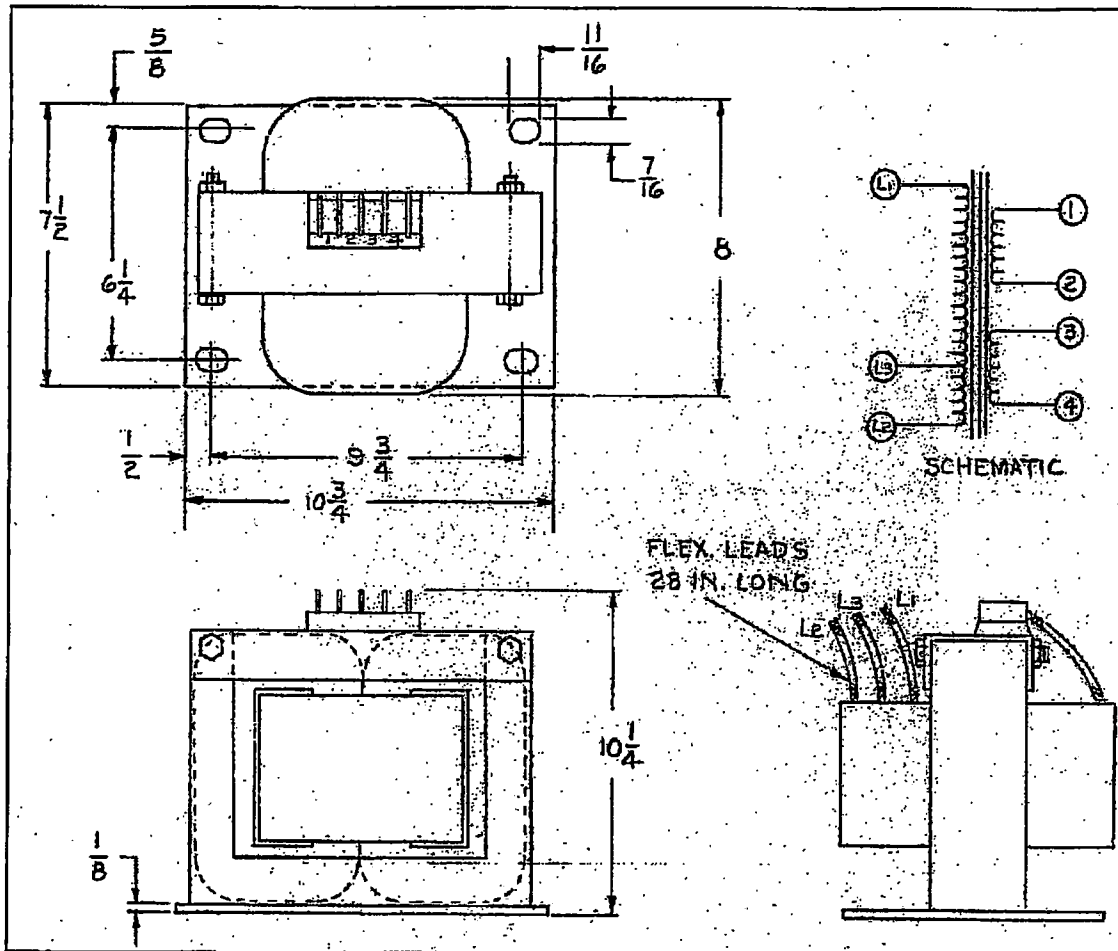


Figure 4: Reactor Outline Drawing