PP&L

ENGINEERING STUDIES, ANALYSES, AND EVALUATIONS COVERSHEET

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| QUALITY LEVEL | EO/CTN NO. 743153 |
| ☐ SAFETY | SEA NO. SEA-EE-204 |
| ☐ ASME | DCP NO. |
| ☐ OTHER | PAGE 1 OF 4 |
| ☐ NON QUALITY | |

EVALUATION OF UNIT 1 & 2

MAIN TURBINE GENERATOR FIELD

COMPUTER INPUTS



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| 0 | 10/31/89 | G.P. Ahuja 10/20/89 | A F Slevo 10/23/89 | [illegible] 10/30/89 |
| REVISION NO. | DATE | PREPARED BY | REVIEWED BY | APPROVED BY |

# EVALUATION OF UNIT 1 & 2 MAIN TURBINE GENERATOR FIELD COMPUTER INPUTS

## 1.0 SCOPE

The purpose of this SEA is to evaluate the effects of an open Main Turbine Generator Field circuit and determine if the voltage, produced by this open circuit, could migrate through the computer and prevent safety systems, connected to the computer, from meeting their minimum performance requirements.

## 2.0 PROBLEM STATEMENT

At Susquehanna SES, low-energy instrumentation computer inputs are tapped directly from Class 1E circuits. PP&L has taken exception to Regulatory Guide 1.75 as discussed in FSAR Section 8.1.6.1q(7), and classified these inputs as nonClass 1E without adding Class 1E electrical isolation devices. Since some computer inputs are developed from transducers in the Main Turbine Generator Field circuits, the potential for high-energy feeding into the computer, in the event the Main Turbine Generator Field opens under load, must be addressed. The concern is that this potential high-energy source causes the transducer to fail and migrates through the computer to non-isolated Class 1E circuits and prevents these circuits from meeting their minimum performance requirements.

The Main Turbine Generator Field circuits are the only computer inputs developed through D.C. shunts which are connected to the computer. The other computer inputs developed from D.C. shunts, namely the emergency diesel generator field circuits, have been disconnected from the computer.

## 3.0 CONCLUSION

The evaluation in Section 5 of this SEA shows that in the event a Main Turbine Generator Field circuit opens, the high energy produced by this fault will not migrate to the computer. Therefore, Class 1E circuits connected to the computer do not require further consideration. This conclusion is based upon the fact that the Type 4920E transducers, used to develop computer inputs, prevents the stored energy in the field winding from migrating to the computer.

## 4.0 RECOMMENDATION

The present design practices used for the Main Turbine Generator Field computer inputs should be continued for all future D.C. field winding inputs to the computer. Transducers specifically designed for use in field winding circuits should be used to develop these future computer inputs.

This recommendation will be included in the Design Description Manual, Chapter 28 for the Main Generator and Auxiliaries.

## 5.0 DISCUSSION

An electric shunt is a calibrated, low-resistance device which is used to transform D.C. current to a low-energy millivolt signal. This signal can be used as inputs to the computer, indicating metering, etc. The shunt resistance is very low to minimize the resistance in the D.C. circuit.

As illustrated in Figure 1, computer inputs are developed from the Main Turbine Generator Field winding shunts which are designed to yield a 100 millivolt output for a 6000 ampere input. The shunt outputs are connected through 6 ampere fuses to General Electric Type 4920E transducers. The transducer output is connected to the computer through a resistive voltage divider network.

The General Electric Type 4920E transducers are static devices specifically designed for use in generator field circuits. These transducers produce isolated, low-energy signals. Per General Electric Instruction Leaflet No. GEK-15024A, these devices are used to "Isolate the Main Generator Field Voltage from the Control Room and the Operator." Internal to the transducer are diodes which short the input of the transducer operational amplifier in the event abnormal voltage appears at the transducer input terminals. The transducer reference output terminal (TB5) is connected to ground at the Main Generator Exciter Cabinet. (Refer to FF110720, Sh. 2101 , ATTACHED) JPA 10/31/89

In the event that the Main Generator Field opens, the stored energy in the field winding causes voltage in the circuit to increase in an attempt to maintain current flow. Since the resistance network is maintained through the shunt primaries, there is a negligible effect on the transducer connected to the shunt because the shunt resistance limits the transducer input voltage to approximately 0.2% of the total circuit voltage. (R shunt = 0.000017 ohm; R total = 0.09 ohm).

Based upon the above discussion, it can be concluded that in the event a Main Turbine Generator Field circuit opens, the high energy produced by this condition, will not migrate to the computer or the non-isolated Class 1E circuits connected to the computer. Therefore, a Main Turbine Generator Field open circuit will not prevent Class 1E circuits connected to the computer from meeting their minimum performance requirements.

## 6.0 REFERENCES

-- NCR 87-0021.
-- GE Instruction GEK-15024A. (ATTACHED) JPA 10/31/89
-- FF110720 Sh. 2101, Sh. 3701-3706, Sh. 3720, Sh. 3725.

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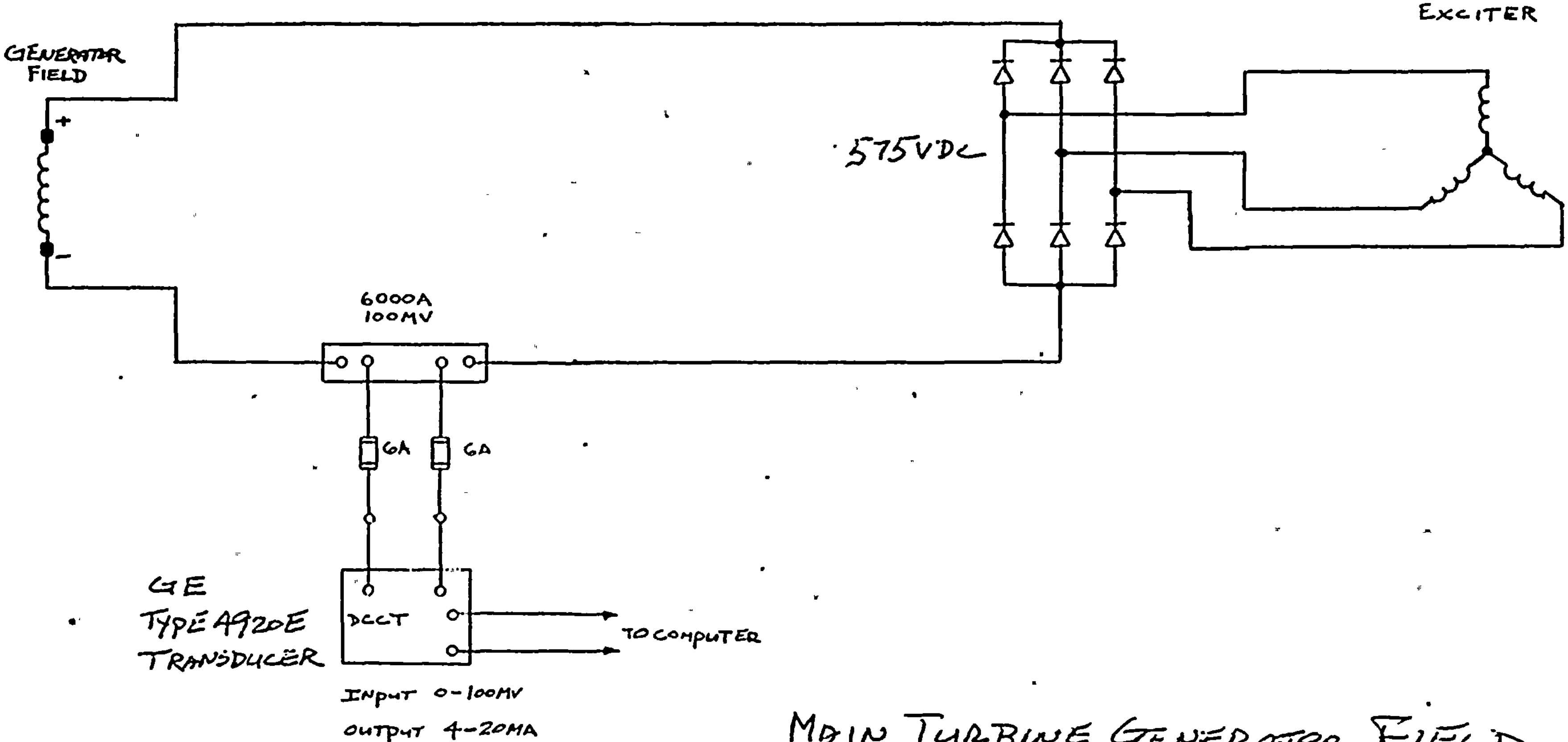


MAIN TURBINE GENERATOR FIELD

FIGURE 1

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INSTRUCTIONS

# TRANSDUCERS

## Types 4920-E2856, E2869, E2870, And E2876

## INTRODUCTION

The Type 4920-E control transducers are static devices that are used for transmitting an isolated, low power level signal that may be used to indicate Generator and/or Exciter field current (DCCT) or Generator and/or Exciter field voltage (DCPT).

This signal may also be used as a computer or data logger input.

## DESCRIPTION

### DCCT

This device is used to produce an output signal of 10 to 50 ma that is proportional to generator or exciter field current and to isolate the main generator field voltage from the control room and the operator.

Because this device uses circuitry based upon instrument type saturable reactors operated at 3KC square wave, an AC source (120 V AC, 60 Hz) is required in addition to the input signal.

The output of the DCCT is a current source and equal to 10 to 50 ma for a zero to full scale input signal. It may be terminated into any load from 50 to 225 ohms and will have a linearity of ±1% of full scale.

**CAUTION**

Because the output is a current source, all burdens connected to it must be in series and not exceed 225 ohms or fall below a minimum of 50 ohms.

The input signal is generally a 0 to 100 mv signal taken from a shunt, although other input ranges are available. The shunt is not furnished with the transducer.

### DCPT

This device is used to produce an output signal of 10 to 50 ma that is proportional to generator or exciter field voltage, and to isolate this high voltage from the control room and the operator.

This device also uses the same type of circuitry as the DCCT and also requires an AC source (120 V AC, 60 Hz) in addition to the input signal.

The output of the DCPT is a current source equal to 10 to 50 ma for a zero to full scale input signal and may be terminated into any load from 50 to 225 ohms since the output is a current source.

**CAUTION**

Because the output is a current source, all burdens connected to it must be in series and not exceed a maximum of 225 ohms or fall below a minimum of 50 ohms.

The input signal to the DCPT is the generator or exciter field voltage, which is applied directly to the transducer. The output of the DCPT is then proportional to the zero to full scale input signal (0-500 V DC, 0-600 V DC, etc.). When the DCPT is ordered, the field voltage that it is to be used on must be specified.

Both the DCCT and DCPT transducer will have a 50 ohm, 1 watt resistor connected across output terminals 6 and 7 on the transducer terminal board. The output leads from the transducer to R152 and R153 for the DCPT and R158 and R159 for the DCCT will be connected to terminals 5 and 7. This will assure that the minimum resistance required will be in the circuit.

With this resistor in the circuit, the maximum burden the customer may place on the transducer will be up to 175 ohms.

In the event the burden exceeds 175 ohms, the output leads from the transducer should be connected across terminals 5 and 6. This removes the 50 ohm resistor from the circuit and will allow a burden of up to 225 ohms to be used. The burden may not exceed 225 ohms.



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## INSTALLATION

If the DCCT and DCPT panel is to be installed in the field, it should be placed in the breaker and special equipment section of the regulator cubicle.

If for some reason it is not possible or desirable to locate the devices there, they should be installed in a well ventilated, clean, dry location where the ambient temperature is not greater than 50°C. The equipment should be readily accessible for adjustment and testing. Connections must be made in accordance with the diagrams supplied for each particular installation. Care must be exercised to determine that the connections are correct to avoid damaging the equipment.

## ADJUSTMENT

Although each transducer has been adjusted at the factory, conditions in actual service may differ somewhat from factory test conditions. In this case, slight readjustment in the field may be required and the following procedure should be followed:

1. Disconnect the output burden that is on the transducer. Place a milliammeter (0-50 ma or 0-100 ma movement) across the output of the device and in series with a 0 to 250 ohm potentiometer. Adjust the potentiometer until the burden on the transducer output is between 50 and 225 ohms. Anywhere in this range is acceptable.

2. Energize the transducer for at least 30 minutes prior to making any final adjustments. This will allow all components to become temperature stabilized.

3. Bias and gain adjustments are provided by means of multi-turn potentiometers located above the terminal board on the top of the unit.

4. Apply maximum input signal and adjust the "Gain" potentiometer until the output is approximately correct. Then reduce the input signal to the minimum and bring the output to approximately the correct value by adjusting the "Bias" potentiometer. Repeat the foregoing steps using successively smaller increments of adjustment on the potentiometers until the correct output is obtained over the complete range of input signals.

5. For Amplidyne applications, the transducer input signal varies from some negative value, thru zero and to some positive value of voltage, (Ex. - 150-0-150 V DC) and one more step is necessary to obtain proper operation.

After the unit has been calibrated for maximum and minimum input, it must be calibrated to read exactly 30 ma with zero volts input (simulates Amplidyne nulled).

Apply an input signal of zero volts. Adjust the BIAS potentiometer slightly until the transducer output is exactly 30 ma.

All potentiometers should now be locked in position.

6. After the DCCT and/or DCPT has (have) been adjusted, all test meters and connections should be removed and the unit reconnected in the circuit correctly.

Care should be taken to be sure that the output circuit burden is in the proper range and the input signal is connected properly.

This completes checkout and adjustment of the Type 4920-E transducer.

## MAINTENANCE

Since the Type 4920-E transducers are built entirely from static type components, (saturable reactors, diodes, transistors, capacitors, etc.) there are no periodic maintenance required except the following.

The equipment should be kept relatively clean and dry. If vibration is present, all screw type connections should be checked regularly to determine that they are properly tightened.

In the event that a fault condition occurs in the circuitry connected to the transducer which damages the transducer, it should be replaced. The damaged unit should be returned to the factory with a description of the fault condition that caused the damage.

## RENEWAL PARTS

When ordering renewal parts, the following information should be given:

1. Catalog number stamped on the part, with a complete description, including use and location.

2. Complete nameplate data appearing on the assembly of which the part is a component.

3. If possible, data on original order on which equipment was first supplied, including all numerical references.

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