EDE-40-1190
DRF C71-00086
November 16, 1990

Setpoint Calculation
for
Reactor Protection System
Turbine Control Valve Fast Closure
Trip Function

Prepared for Commonwealth Edison Company
Quad Cities Nuclear Station

Prepared by: W. Kurt Green Date: 11/16/90
W. K. Green - Principal Engineer

Verified by: J L Leong Date: 11-16-90
J. L. Leong - Senior Engineer

Approved by: for J L Leong Date: 11-16-90
B. F. Fleischman - Manager
Reactor Protection Systems
Application Engineering

1.0 Objectives

The objective of this calculation is to determine the setpoint to be used for the Reactor Protection System (RPS) Turbine Control Valve Fast Closure (TCVFC) Trip Function after the installation of new pressure switches. These pressure switches are Part Number 184C4815P001. This information was obtained via telecon with Rob Korneta of Commonwealth Edison on November 6, 1990. The new pressure switches are being installed as part of turbine vendor (GE) recommended modifications to the turbine system. The signals from these switches will replace the signals that originally came from contacts on the turbine system fast acting solenoids.

2.0 Methodology

This setpoint calculation is being performed consistent with GE document NEDC-31336, "General Electric Instrument Setpoint Methodology," dated October 1986. This is a proprietary document that was developed under contract between GE and certain members of the Licensing Review Group Instrument Setpoint Methodology Owners Group.

3.0 Assumptions

This calculation makes the following assumptions:

The individual error terms represent a two sigma value (95 percent probability of the value being correct).

Primary Element Accuracy (PEA) and Process Measurement Accuracy (PMA) are considered negligible because of the short instrument lines and because the pressure switches are measuring the process directly.

The Calibration Accuracy term (C) is conservatively estimated to be one percent (1%) of full range. Since this value is a function of the instrumentation and procedures used for calibration, this value must be verified to be conservative by Quad Cities personnel. If it is found to be non-conservative the results of this report must be recalculated to reflect the larger value.

Instrument Drift (D) for a six month interval is equal to Instrument Accuracy (A) since there is no value given for drift on drawing 184C4815. This is consistent with NEDC-31336. Drift is assumed to be random for the subsequent intervals.

The probability for avoiding a License Event Report (LER) event should be greater than 90 percent. This is consistent with NEDC-31336.

The probability for Spurious Trip Avoidance (STA) should be greater than 95 percent. This is consistent with NEDC-31336.

4.0 Inputs to Calculation

The pressure switches to which this calculation applies are measuring directly the trip oil pressure that causes the turbine control valves to close in a rapid manner. According to information in Design Record File (DRF) C71-00017 this oil pressure is normally about 1500 to 1600 psig, and the control valve can't start to close until the pressure drops to 400 psig. During normal operation of the control valves it is considered possible to have transients that would cause the trip system pressure to drop momentarily to about 740 psig. On the basis of this information the following values are derived:

Analytical Limit (AL) = 400 psig

The pressure switch must trip by the time the oil pressure reaches this level in order to ensure that a trip signal will be generated within 30 milliseconds after start of control valve fast closure.

Operational Limit (OL) = 740 psig

The Nominal Trip Setpoint must be far enough from this value so as to minimize the probability of tripping during normal operational transients.

Drawing 184C4815 indicates that the accuracy of this pressure switch is two percent (2%) of full range. Since the full range of part one (P001) is 3000 psig, the accuracy (A) is then ±60 psig. This value is assumed to apply over the full range of operating temperatures since no information regarding temperature effect on accuracy is given.

A summary of the inputs to be used in the calculations is as follows:

Instrument Accuracy (A) = ±60 psig

Calibration Accuracy (C) = ±30 psig

Instrument Drift (D) = ±60 psig (assume 6 mo.) = ±104 psig (18 mo.)

Analytical Limit (AL) = 400 psig

Operational Limit (OL) = 740 psig

5.0 Results

The following are the results based on the methodology, assumptions, and inputs as given in sections 2.0, 3.0, and 4.0 respectively:

Parameter	Calculated Value	Recommended Value
Allowable Value (AV) or Tech. Spec. Value (TSV)	456 psig	460 psig
Nominal Trip Setpoint (NTSP)	540 psig	550 psig
Probability for License Event Report (LER) Avoidance (Using recommended values)	92%	N/A
Probability of Spurious Trip Avoidance (STA) (Using recommended values)	99%	N/A

The NTSP now needs to be adjusted for the practicalities of plant calibration procedures. The Required Limit (RL) is the value below which the NTSP must not be found in order to assure that the AV is not exceeded. The RL is a function of accuracy (A) and calibration accuracy (C) as follows:

$$RL = AV + (A^2 + C^2)^{1/2}$$

Information received on 11/4/90 from Erryl Mendenhall of Commonwealth Edison indicates that the calibration for this setpoint is accomplished using a Heise pressure gauge measuring 0 to 1000 psig with an accuracy of 1 psi. If one assumes an equal error when calibrating the Heise gauge and another 1 psi error when reading it, the total error is then:

$$C_T = (1^2 + 1^2 + 1^2)^{1/2} = (3)^{1/2} = 1.732 \text{ psi}$$

Use $C_T = 2$ psi

Then $RL = 460 + (60^2 + 2^2)^{1/2} = 520$ psig

However, this value is less than the value required for 90 percent probability of LER avoidance. Therefore, use 540 psig as the RL.

In order to obtain an STA probability of 95 percent or greater the NTSP should never exceed 638 psig. Therefore, select the NTSP to be midway between RL (540 psig) and 638 psig.

$$NTSP = 540 + (638 - 540)/2 = 589 \text{ psig}$$

Use <u>NTSP = 590 psig</u> with As-Left and Leave Alone Tolerances of ±20 psi.

TO: L. F. Gerner
Commonwealth Edison Co.
Dresden Station

January 28, 1991

SUBJECT: Confirmation of the Control Valve Fast Closure RPS Trip Function Response Time Test Method for Dresden Power Station

---

One of the variables monitored by the Reactor Protection System (RPS) is a signal representing Turbine Control Valve Fast Closure. The RPS requires that this signal be received within 30 milliseconds (ms) after the start of control valve movement. Commonwealth Edison Co. (CECo) has requested that GE-NE evaluate for adequacy the proposed test method for determining the response time of the Turbine Control Valve Fast Closure RPS Trip Function.

Turbine Control Valve Fast Closure is determined by measuring the trip system oil pressure in the turbine control system. The trip system oil pressure is normally about 1600 psig and drops to essentially 0 psig when initiating the control valve fast closure action. The pressure switch used to monitor this oil pressure is set to trip at about 590 psig.

The proposed response time test, as I understand it, is as follows:

- With the plant in the shutdown condition a turbine control valve is commanded to the full open position. Then the valve is given the fast closure command. Opening of the pressure switch contact and the output of the LVDT on the turbine control valve (used to determine the start of control valve closure) are monitored by a fast recorder in order to determine if the 30 ms requirement is met.

The question is "Does this test bound the response times expected during normal plant operation?"

Information received from a discussion with a representative of the GE Turbine Department indicates that maximum control oil pressure is present when the control valves are commanded to full open. This oil pressure is near that of the trip system pressure or about 1600 psig. The trip system oil pressure must drop to a value equal to one fourth of the control system pressure in order to cause fast closure action. This means that, in the full open condition, the trip system pressure must drop to around 400 psig in order to initiate fast closure of the turbine control valves. For any position less than full open the control system pressure is less, indicating that the trip system pressure must drop lower than 400 psig to initiate fast closure action. Therefore, the time between the dumping of the trip system oil pressure and the start of control valve fast closure would increase slightly for cases of fast closure initiation at less than full open control valve conditions due to the fact that the trip system oil pressure must drop to a lower value.

The trip system oil pressure is not affected by the control valve position. Since the pressure switches used to indicate control valve fast closure are monitoring the trip system oil pressure, the time from dumping the trip system pressure to opening of the pressure switch contacts (trip at about 590 psig) should be relatively constant. Therefore, one would expect that the response time being tested (start of control valve movement to opening of the pressure switch contact) would get shorter if control valve fast closure is initiated from less than the full open condition.

Also, information from the GE Turbine Department indicates that the steam pressure that is present during normal operation could be expected to act against valve closure action, resulting in slightly more margin in the response time being measured.

CONCLUSION

Based on the above analysis it is determined that the response time results obtained using the proposed response time test procedure would bound the response times expected during normal plant operation.

Prepared by: W. Kurt Green
W.K. Green, Lead System Engineer - Reactor Protection System

Date: 1/28/91

Approved by: B.F. Fleischman
B.F. Fleischman, Manager Reactor Protection Systems Application Engineering

Date: 1-28-91