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February 4, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Dresden Station Units 2 and 3
Quad Cities Station Units 1 and 2
Information Concerning Reactor
Protection System (RPS) Power
Monitoring System Modifications
NRC Docket Nos. 50-237, 50-249,
50-254, and 50-265

Reference (a): T. J. Rausch letter to D. B.
Vassallo dated July 23, 1982.

Dear Mr. Denton:

In Reference (a) Commonwealth Edison provided additional information and our revised schedule for installing the subject modifications at Dresden Units 2 and 3 and Quad Cities Units 1 and 2. Subsequently, telephone conferences were held in August and December, 1982 with members of your staff to discuss the RPS monitoring system setpoints and associated time delays. The attachment to this letter provides a description, basis, and justification for each of the setpoints chosen for this system.

In Reference (a), we also indicated that we would provide proposed Technical Specification changes prior to return from service in the outages associated with the modification installation. Because we had not yet reached agreement with your staff regarding the setpoints and time delays for the RPS power supply monitoring system, it was impossible to supply proposed Technical Specifications on the schedule we indicated (at least for Quad Cities 1 and Dresden 2). It is now our intention to supply DRAFT Dresden and Quad Cities Technical Specifications (as requested in the August 1982 conference call) to the NRC by April 15, 1983. We have determined that operation with the RPS protection system modification installed in accordance with 10 CFR 50.59 without appicable Technical Specifications does not in any way compromise the safe operation of these facilities.

Please direct any questions you may have concerning this matter to this office.

A001

One (1) signed original and sixty (60) copies of this transmittal are provided for your use.

Very truly yours,

Thomas J. Rausch
Nuclear Licensing Administrator

lm

cc: Region III Inspector - Dresden
Region III Inspector - Quad Cities
R. Bevan - NRR
R. Gilbert - NRR

Attachment

5937N

Revision: 0
Date: 1-28-83

Reactor Protection System
Redundant Protective Relaying
Setpoint Review

1. Setpoints as Specified by System Planning:

1.1	Undervoltage	108.0V ± 2.5%	MIN. 105.3V MAX. 110.7V
1.2	Overvoltage	126.5V ± 2.5%	MIN. 123.3V MAX. 129.6V
1.3	Underfrequency	56.0 Hz ± 1% (of 60Hz)	MIN. 55.4 Hz MAX. 56.6 Hz
1.4	Time Delays	3.0 Sec ± 5% (all)	

2. Basis for Setpoints, Tolerances, and Time Delays:

2.1.1 All voltage setpoints are based on a nominal operating voltage of 115.0V. Line drop measurements have been obtained from both Dresden and Quad Cities Stations. The worst case drop was observed to be 3.2V on Dresden Unit 3. Actual OV and UV setpoints are calculated to be within ± 10% of the nominal operating voltage such that the most distant device will not be called upon to operate at less than its - 10% rating. Tolerances are specified to allow for possible setpoint drift due to normal aging of components. These tolerances will avoid Tech. Spec. violations by allowing for this drift. Time delays are chosen such that significant heat build-up will not occur while at the same time preventing false trips due to brief transients. Tolerances are given to the time delays for the same reasons as stated above.

2.1.2 The frequency setpoint is based on a nominal operating frequency of 60 Hz. It should be noted here that this parameter is being included as additional protection beyond the original design scope. The intent of the new relaying is to protect the RPS components from extreme under or over voltage resulting from an undetectable failure in the RPS power supply (Motor-Generator set regulator). The RPS Power supply does not control frequency and no postulated failure in the power supply could change the frequency. Therefore, the frequency setpoint is protection from excursions occuring in the Bulk Power Supply System. This setpoint must then be chosen to coordinate with the system while still providing adequate protection to the RPS components. The details of this setpoint are described in paragraph 3.3.

2.2 The tolerances specified for the setpoints are based partially on the manufacturers recommendations and partially on actual operating experience on the other relays. The manufacturers recommendations were obtained from the General Electric, "Electrical Protection Assembly, 914 E 175" instruction manual, Revision 0, dated 7-16-82. (Note: this supercedes the original issue dated 12-17-80.) The G.E. instruction manual claims tolerances on the setpoints as follows (page 4 of 50):

a) Overvoltage Trip Point +0.0% to -2.5%
b) Undervoltage Trip Point +2.5% to -0.0%
c) Underfrequency Trip Point +2.0% to -0.0%

These design tolerances claim that the overvoltage trip setting will not drift up, the undervoltage trip setting will not drift down, and the underfrequency trip setting will also not drift down. Although this claim may be true, operating experience has shown that a tolerance of 0.0% is rarely achieved. If this tolerance were used as the basis of a Tech Spec., then violations are almost certain to occur. Our approach to the tolerance problem is to specify an exact setpoint with a realistic upward and downward drift tolerance. It must be emphasized that in order for an RPS device to be subjected to an extreme under or over voltage condition, several events must occur simultaneously. First, an undetectable failure must occur in the RPS power supply. Second, both of the series-connected Electrical Protection Assemblies must have their setpoints drift in the same direction. Finally, the voltage excursion must be of sufficient magnitude to be outside the design tolerances of the critical RPS components. Although the exact probability of this senario is not known, it is believed to be sufficiently low to justify increasing the 0.0% tolerances specified by G.E. The same reasoning applies to the frequency trip setting except that the frequency excursion is caused by an immediately detectable event on the Bulk Power Supply System. Extreme frequency excursions on the Bulk Power System are very rare.

2.3 The time delays specified for each setpoint are based upon the transient response of the RPS power supply and the need to provide adequate protection to the RPS contactors and scram solenoids. G.E. recommends a very short time delay (0.1 sec.) but provides adjustability from 0.1 sec. to 3.0 sec. Actual tests have been performed by the CECo-System Operational Analysis Department (copy attached) which demonstrate that time delays up to and including 3.0 sec. do not impose an unacceptable stress on critical RPS components. In fact, the test report shows that times greatly in excess of 3.0 sec. are still acceptable. Based on these test results, time delays have been chosen which both protect the RPS components and coordinate with normal system transients. This ideal time delay will protect the RPS components while also preventing false trips. False trips would be an unnecessary stress on reactor safety components. A time delay of 0.1 sec. would likely result in numerous false trips during the remaining life of the plant.

3. Detailed review of undervoltage, overvoltage, and underfrequency setpoints.

3.1 Undervoltage setpoint calculation and review

3.1.1 Based on a nominal operating voltage of 115.0V and critical RPS device ratings of 115V (nameplate) and a worst case line drop of 3.2V, the undervoltage setpoint is calculated as follows:

minimum setpoint = 115.0V - (10% of 115) + 3.2V
= 106.7V

This is the minimum allowable setpoint for the worst case line drop. The CECo System Planning Department has chosen a setpoint of 108.0V which both provides adequate margin and proper trip coordination.

3.1.2 Tolerances and time delays have been applied to the undervoltage setpoint using the basis as described in paragraphs 2.2 and 2.3.

3.1.3 Setpoint review and justification

The chosen setpoint of 108.0V and its allowable drift of +2.5% (MAX. 110.7V) to -2.5% (MIN. 105.3V) provides both trip coordination and RPS component protection. Although the minimum drift value of 105.3V is less than the minimum calculated setpoint of 106.7V, the 108V setpoint is still adequate. The 106.7V value is based on a single worst case voltage measurement of 3.2V on Dresden Unit 3. Other voltage measurements have typically been in the 1.6 to 1.8 Volt range. The probability of the simultaneous events required to apply less than the minimum allowable voltage to the Dresden Unit 3 components (from which the measurement was taken) is believed to be sufficiently low such that the chosen setpoint of 108V ± 2.5% is adeuqate for all EPA's at Dresden and Quad Cities Stations. The chosen time delay of 3.0 sec. ± 5% is proven adequate in the attached test reports.

3.2 Overvoltage setpoint calculation and review

3.2.1 Based on a nominal operating voltage of 115.0V and critical RPS device ratings of 115V (nameplate), the overvoltage setpoint is calculated as follows:

actual setpoint = 115.0V + (10% of 115V)
= 126.5V

This value of 126.5V is the setpoint chosen by the System Planning Department. This setpoint provides adequate margin and proper trip coordination allowing for the fact that critical RPS components will never be subjected to this voltage due to the characteristic line drops.

3.2.2 Tolerances and time delays have been applied to the overvoltage setpoint using the basis as described in paragraphs 2.2 and 2.3

3.2.3 Setpoint review and justification

The chosen setpoint of 126.5V and its allowable drift of +2.5% (maximum 129.6V) to -2.5% (minimum 123.3V) provides both trip coordination and RPS component protection. Although the maximum allowable drift of 129.6V exceeds the +10% rating of the RPS components, the setpoint is still adequate for the same reasoning as described in paragraph 3.1.3. The chosen time delay of 3.0 sec. ± 5% is justified in the attached test report. The chosen setpoint of 126.5V ± 2.5% is therefore adequate for all EPA's at Dresden and Quad Cities Stations

3.3 Underfrequency setpoint calculation and review

3.3.1 An underfrequency setpoint calculation is not provided here because the setpoint is not calculated from allowable percentage deviations, but rather it is chosen to coordinate with other underfrequency setpoints already in service throughout the Bulk Power System. As stated in paragraph 2.1.2, the underfrequency trip point is protection beyond the original design scope. It is essential that this trip setting coordinate with similar settings on the Bulk Power Supply System to insure System reliability. A setting of 56.0 Hz ± 1% (of 60Hz) provides the necessary coordination and adequately protects the RPS components.

3.3.2 Tolerances and time delays have been applied to the underfrequency setpoint using the basis as described in paragraphs 2.2 and 2.3.

3.3.3 Setpoint review and justifications

The chosen setpoint of 56.0Hz and its allowable drift of +1% of 60Hz (MAX. 56.6Hz) to -1% of 60Hz (MIN. 55.4Hz) provides both trip coordination and RPS component protection. It should be noted that the same device which has a rating of 115V, 60Hz also has a rating at 50Hz at a lower voltage for foreign applications. No design changes are made to the device to apply this 50Hz rating. Only the voltage is lowered to allow for the additional heat build-up due to the lower impedance of the device while operating at a lower frequency. This means that operating the RPS components at less than the G.E. recommended value of 57.0Hz will not exceed any design parameters of the devices as long as heat build-up is not excessive. The attached test report demonstrates the heating need not be considered until the operating frequency is less than 55.0Hz at rated voltage. The minimum allowable setpoint is above this value. The chosen setpoint of 56.0Hz ± 1% of 60Hz is therefore adequate for all EPA's at Dresden and Quad Cities Stations. The associated time delay of 3.0 sec. ± 5% is justified in the test report.

4. Summary and Conclusions

It has been observed thru operating experience and proven by test that the failure mechanism of critical RPS components is heat. The objective of the RPS protective relaying modification is to prevent failure of RPS components (in the unsafe mode) resulting from heat damage created by voltage extremes. It is a simple fact that increased voltage will result in elevated temperature levels. It is also a simple fact that an instantaneous voltage rise will not result in an instantaneous temperature rise. In addition, a decrease in operating voltage will result in a corresponding decrease in operating temperature. This implies that the ideal operating voltage should be as low as possible without preventing normal pickup and dropout of RPS components and not so low as to apply insufficient voltage to instrument power supplies fed from the RPS distribution busses. Since this ideal operating voltage would be in conflict with industry standards and would be difficult to ascertain, we have chosen setpoints such that our operating voltage is maintained within a narrow range. This review and the attached test report show that the setpoints chosen by the CECo System Planning Department adequately protect the RPS components from extreme power supply excursions and in addition, prevent false tripping. It is our opinion that the setpoints suggested by G.E. would result in false trips and would degrade the reliability of the Bulk Power Supply System. For this reason we will be using the setpoints as specified by our system planning department. As described in the cover letter, we intend to provide DRAFT Technical Specification changes to the NRC by April 15, 1983.

ER-54-82
1-4-83

OPERATIONAL ANALYSIS DEPARTMENT REPORT
ON
REACTOR PROTECTIVE SYSTEM COMPONENTS
AT
G.E. NUCLEAR STATIONS

Two G.E. HFA relays and an ASCO solenoid valve were tested in the laboratory as requested by Station Nuclear Engineering Department. This testing is associated with the installation of the G.E. Electrical Protection Assembly, or EPA (SOAD report #ER-15-82 and addendum). The EPA is intended to safeguard from any deterious effects the components of the Reactor Protection System, or RPS, on excursions of voltage and frequency of the RPS motor-generator set or alternate auxiliary power source. The HFA and solonoid valve are both used on the RPS.

Previous experience would predicate that the deterious factors in the case of varying voltage and frequency would be heat and mechanical vibration. Mechanical vibrations were not noticeable except near the pick-up and drop-out voltage levels which are considerably below the normal working voltage range of the RPS. Also, an operation would occur on drop-out resulting in an alarm or "scram" condition. Therefore, the tests run are those concerned with temperature rise. Frequency variations from 56 Hz to 60 Hz had little effect on temperature rise on any of these components. Temperature rise only occurred with increasing voltage levels or frequency levels well below 55 Hz. The EPA relay is the determining factor as to how low the frequency trip can be set. This limit of 56 Hz is well above the point where frequency affects the temperature and performance of the three relays tested, as can be seen in this report. All tests performed indicate that the three RPS relays all operate acceptably beyond the possible extremes as determined by the G.E. EPA.

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Temperature Tests

The relay settings for the EPA as set forth by the Relay Planning Section of System Planning are as follows:

UV	108V±2.5%	Min - 105.3V Max - 110.7V
OV	126.5V±2.5%	Min - 123.3V Max - 129.6V
UF	56 HZ±1%	Min - 55.4 Hz Max - 56.6 Hz

The most significant temperature rise should occur at the maximum overvoltage condition of 129.6V. Temperatures were measured for varying values of voltage applied to the relay coils. Both transient and steady-state values were recorded. A temperature probe was used to measure the temperature at the point where the relay armature makes contact with the relay coil on the HFA. On the ASCO solenoid relay, temperature was measured on the metal incasement of the voltage coil. The results of these tests are shown in figures 1 and 2. Figure 1 shows the rise in temperature vs. time in all three relays. All three devices took somewhere between two and three hours to reach steady state temperature.

While both the HFA relays reached a higher value of steady-state temperature than the ASCO solenoid (at the points where temperature was measured), none of the relays exhibited any signs of heat damage nor did they misoperate after the test. Figure 2 shows steady state temperature vs. voltage applied to the pick-up coil.

Frequency Test

The voltage on the coils of the relay were then varied in frequency, from 40 to 60Hz at 115 volts, in order to determine the effect, if any, it has on their performance. At each frequency, temperature was allowed to reach a constant value. The results are shown in figure 3. The curves shown indicate that from 55 to 60 Hz, heating of the relays was negligable and did not become significant until the frequency dropped below 55 which is below the setting recommended by System Planning.

Drop-out and pick-up voltage levels were also measured at the same frequency values after the temperatures stabilized. The results are shown in Table I. Both pick-up and

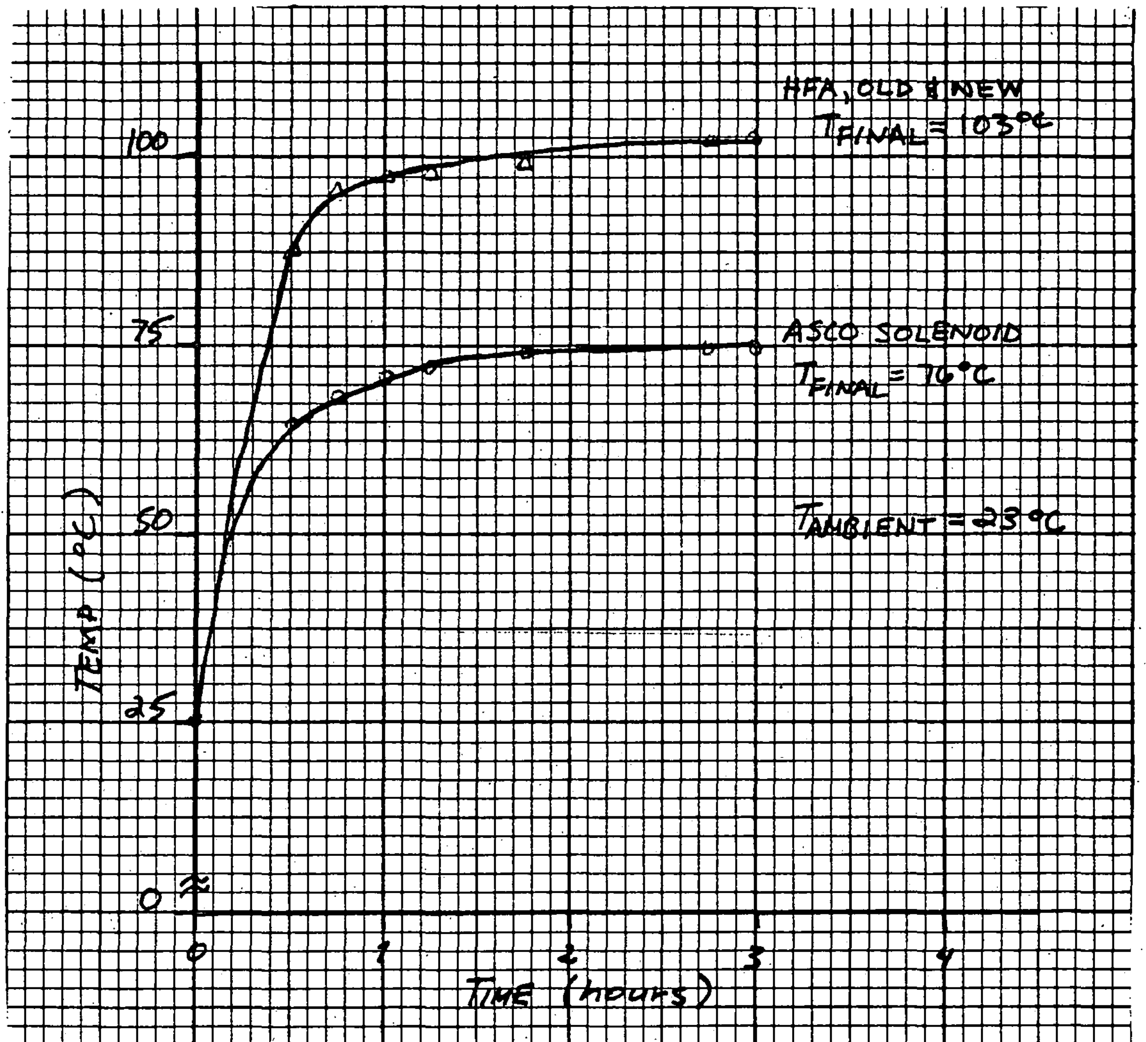

FIGURE 1. TEMP. VS. TIME.

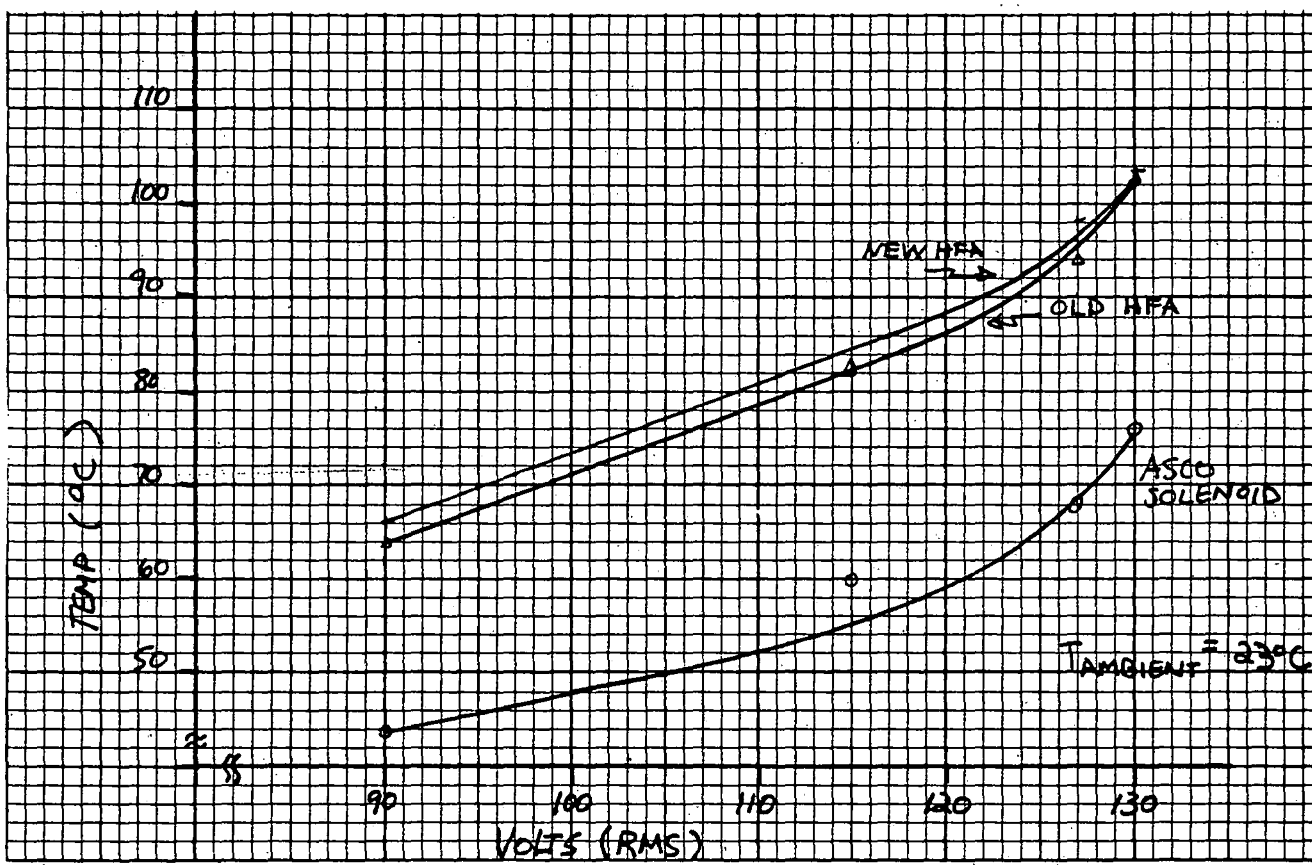

FIGURE 2. STEADY STATE TEMP. VS. COIL VOLTAGE

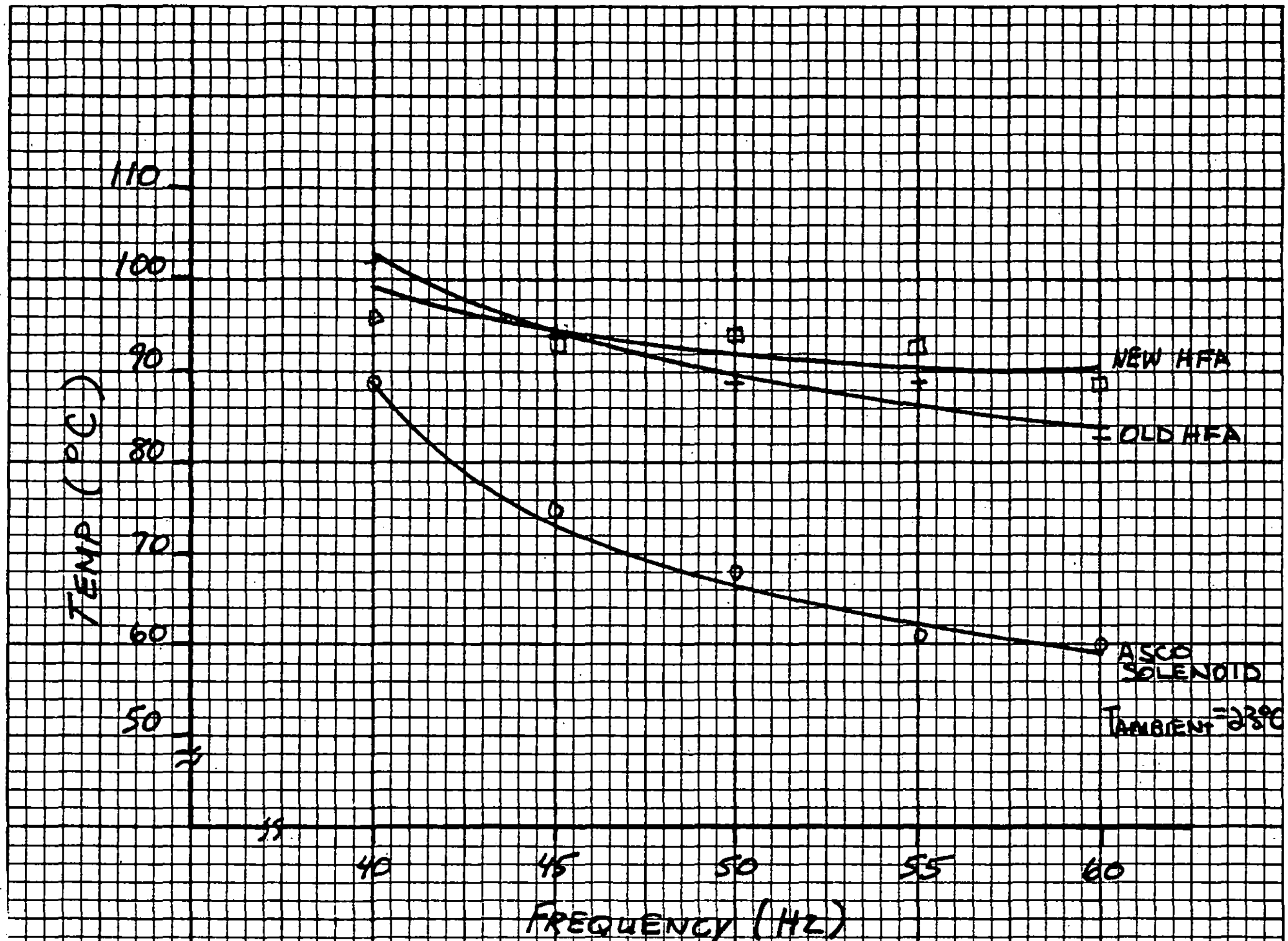

FIGURE 3. TEMP VS. FREQ.

drop-out levels decreased as the frequency decreased.

Table I. Pick-up and drop-out values of voltage at various values of frequency. Values of voltage in RMS.

	New HFA		Old HFA		ASCO SOLENOID	
Freq (Hz)	PU	DO	PU	DO	PU	DO
60	80	69	80	60	83	64
55	73	61	77	59	80	62
50	66	57	65	55	75	60
45	60	54	59	50	68	57
40	56	50	53	49	57	53

Combined Overvoltage, Underfrequency and Heat Test

As a worst case, all three relays were placed in the thermotron environmental chamber with 130V at 55 Hz and an ambient air temperature of 55°C. After eight hours, the relays were removed and again tested. No heat damage occurred nor was any mechanical vibration noticed during the test. After removal from the chamber the relays performed as they did previously to the test.

Conclusion

The three relays were tested in order to determine if they could withstand the tolerable variations which could occur on the Reactor Protective System. The two G.E. HFA relays and ASCO solenoid were tested for overvoltage,underfrequency and high ambient temperature, all of which contributed to temperature rise in each relay. However, even when the relays were exposed to these extremes simultaneously, the heat rise did not cause any damage nor cause any malfunction in the relays. Nor did they fail to drop out when voltage was lowered below drop out levels. These results indicate that the relays could tolerate the extremes of the RPS as dictated by the EPA settings set forth by the Relay Planning section of the System Planning Department.

NAMEPLATE DATA

1.	New HFA:	Model:	12HFA51A49F	Type: HFA	
			115 volts	60 Hz	
			INST. GEH-2024		
			P.B. GEF-2757E		
2.	Old HFA:	Model:	12HFA51A49H	Type: HFA	
			115 volts	60 Hz	
			INST. GEH-2024		
			P.B. GEF-2757		
3.	ASCO Solenoid	Model:	HVA 90405		
			115 volts	60 Hz	10.5 watts
			ORIFICE: 518	PIPE: 112	

Equipment Used:

1. Fluke 8020B Multimeter
2. Fluke 80T-150C Temperature Probe
3. Calico 101T AC Power Source with 800T Precision Oscillator
4. Heath SM-109A Frequency Counter
5. Simpson 260-6 Volt-ohm-meter
6. Doble PRT-5L 3 phase test system.