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Standardized Nuclear Unit
Power Plant System

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July 22, 1983

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SUBJ: Significant Deficiency Report (SDR) 83-10: Excessive AC/DC Control Circuit Voltage Drop

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Docket Nos. STN 50-482 and STN 50-483

Gentlemen:

The enclosed report is forwarded on behalf of the SNUPPS Utilities; i.e. Union Electric Company and Kansas Gas and Electric Company, as a final Significant Deficiency Report under 10CFR50.55(e) criteria. The deficiency involves excessive voltage drop in a number of AC and DC control circuits designed by Bechtel. Since the SNUPPS project utilizes a standardized design for both Callaway and Wolf Creek plants, this deficiency is considered to be generic in nature. As indicated in the enclosure, design modifications have been developed to be implemented in the field by means of Field Change Rework Plans.

The deficiency described in the enclosed report was initially reported to NRC Regions III and IV via telecon on June 23, 1983. Since the design deficiency was indicated to have impact on other Bechtel projects a 10CFR Part 21 report was forwarded by Bechtel to NRC Region I on June 30, 1983.

If you have any questions regarding the enclosed report, please advise.

Very truly yours,

S. J. Seiken
Manager, Quality Assurance

SJS/dck/18b10
Encl: Final Report on AC and DC Control Circuit Deficiencies
cc: Page Two

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FINAL REPORT

ON

AC AND DC CONTROL CIRCUITRY

PER

10CFR50.55(e)

SNUPPS Project

Bechtel Power Corporation

Gaithersburg, Maryland

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1.0 INTRODUCTION

Investigations of the SNUPPS ac and dc control circuits have revealed a deficiency in the circuit design. The studies indicate that certain 480 volt Class IE Motor Control Center (MCC) ac control circuits and power circuit breaker dc control circuits were of an excessive length. Under partially discharged station battery voltage conditions arising from a battery charger failure, and under degraded offsite power system conditions, there could have been insufficient voltage at the terminals of specific motor controllers or power circuit breakers to permit operation of this equipment. This lack of sufficient voltage results from the long length of the control circuit conductors.

The ac and dc control circuit deficiency is common to the Callaway and Wolf Creek stations of the SNUPPS project.

2.0 DESCRIPTION OF CONTROL CIRCUITS AND DEFICIENCY

The SNUPPS 480 V MCCs utilize a separate control power transformer (CPT) for each individual motor starter control circuit. The power (VA) rating of each CPT varies with the rating of the controller to which it is applied, i.e, NEMA size 1,2,3,4 or 5. The SNUPPS Class IE 4.16 kV switchgear and 480 volt load centers utilize a 125 V dc control power source from one of two Class IE 125 V dc station batteries.

The SNUPPS ac control circuits utilize 14 AWG copper wire throughout. Each CPT supplies its respective control load. The

control load carried by each CPT is not identical for all CPTs, but generally consists of the associated motor controller and several types of auxiliary loads such as auxiliary relays and indicating lights. Together, the CPT rating, controller rating, minimum controller pickup voltage, control circuit conductor size, CPT auxiliary load and minimum MCC voltage establish a maximum permissible length of each individual ac control circuit.

The SNUPPS dc control circuits also utilize 14 AWG copper wire throughout. Several indicating lights and auxiliary relays constitute a typical auxiliary load for each dc control circuit. Together, the switchgear and load center dc control bus voltage, circuit breaker closing current and minimum circuit breaker operating voltage also establish a maximum permissible length of each dc control circuit.

Investigation and quantification of the maximum permissible control circuit lengths revealed that selected Class IE ac and dc control circuits lengths were excessive. Under conditions where the MCC bus voltage or station battery voltage was near its respective minimum design or end-of-duty cycle voltage, sufficient voltage to operate the controller or circuit breaker could not be assured at the device terminals. The voltage drop across the control circuit that results when the controller or circuit breaker is energized, in combination with the parameters listed

above, produces this situation. The result of the excessive circuit lengths is, given the above voltage conditions, that the affected loads could be unavailable for events that require starting for safety systems.

3.0 SAFETY IMPLICATIONS

The deficiency described in this report affects the automatic actuation control circuitry of the following loads:

1. Hydrogen Mixing Fans
2. Motor-driven Auxiliary Feedwater Pump
3. Diesel Generator Building Supply Fans
4. Travelling Water Screens
5. Traveling Water Screen Spray Valves
6. ESW Pump Air Vent Release Valves

Load Nos. 1, 2 & 3 above are affected on only one load group at both Callaway and Wolf Creek. Loads 4, 5 & 6 above are affected on both load groups at Wolf Creek only. The safety implications of each load being unavailable following a DBE requiring their operation are discussed below.

1. Loss of one load group of Hydrogen Mixing Fans would, in itself, not compromise the safety of the station. The redundant load group, which is not affected by the deficiency described in this report, would remain available

and perform any required safety function. However if it is further postulated that the redundant load group is unavailable, due for example to loss of offsite power and failure of its diesel generator to start, none of the Hydrogen Mixing Fans would start automatically. For this condition, sufficient turbulence to preclude the formation of locally high concentrations of hydrogen would be established with the containment spray system and the containment air cooler system in operation. The two affected fans may be readily started locally from their MCC without regard to control circuit voltage drop. If this manual action were done shortly after the postulated DBE, no safety impact would be encountered.

2. The Auxiliary Feedwater System is provided to remove decay heat following a loss of offsite power or secondary side line rupture. The loss of a single motor-driven AFW pump due to the control circuit voltage drop would have no safety impact following the postulated DBE. The redundant motor driven pump or the turbine driven AFW pump would be available to perform the safety function of decay heat removal, even with a single failure in the AFW system. For example, if it were further postulated that the unaffected load group was unavailable as outlined above, the turbine driven AFW pump would be available for decay heat

removal. It should be noted that if the affected motor driven AFW pump circuit breaker is closed locally, or the redundant train motor driven AFW pump is started (by restoring offsite power or starting its associated diesel generator), at least two AFW pumps would be available, even considering a postulated single failure. Therefore, for this particular load, there is no safety impact on the station.

3. The loss of one train of Diesel Generator Building Supply Fans would have no safety impact provided that the redundant diesel generator or offsite power is available. However, if it is postulated that all offsite power is lost and that the unaffected load group diesel generator is unavailable, loss of all ac power could result if the affected supply fan were not started locally by manual operator action.

Operation of a Diesel Generator without its associated supply fan running would pose little immediate safety concern. Upon an accident signal, the Diesel Generator Building exhaust dampers would open. The diesel generator air intake, which is located within the diesel generator room, would draw air in through the building intake louvers and exhaust dampers for combustion. However, except for cold weather operation, the temperature of the Diesel Generator Building would rise above design limits after the diesel generator reached equilibrium temperature if the affected supply fan was not started locally.

4,5 Loss of all ESW travelling water screens and screen spray valves would have no short term safety impact. However prolonged operation without these loads could potentially result in ESW pump damage from loss of suction pressure if a large amount of debris accumulated on both screens. However the screens may readily be started and spray valves opened from a control panel in close proximity to these loads, irrespective of the voltage drop in the conductors of the automatic control circuitry.

6. The normally open ESW pump air vent release valves are designed to isolate the air release lines after the air in the pump suction and discharge lines is vented following pump start. Once started, the ESW pumps will not be shutdown during a DBA. The control circuit that performs this isolation function is not affected by the deficiency described in this report. However, the excessive control circuit length could cause these valves to remain closed should their associated pump be secured for an unforeseen reason. Such failure to open would result in failure to release air trapped in the ESW piping if the pumps were subsequently re-started. Should an air pocket form in the ESW piping system in the interim period, a dynamic transient could result and potentially overstress the piping system.

In summary, the SNUPPS ac and dc control circuit deficiency would have no safety impact on the normal power operation of the SNUPPS stations. However, a DBE coincident with a loss of offsite power and a postulated single failure in the redundant load group of safety-related equipment, without local operator action to restore the affected components to service could potentially compromise the ability to maintain the plant in a safe condition during the long term recovery period if the control circuit deficiency were left uncorrected.

4.0 RESOLUTION AND CORRECTIVE ACTION

In order to rectify the deficient control circuits, the project has initiated appropriate design changes to the affected motor controller and power circuit breaker compartments. Depending on the specific circuit requirement, either larger CPTs (for ac control circuits) or interposing auxiliary relays (for ac and dc control circuits) will be installed. Use of a larger CPT provides the required CPT capacity to carry all CPT control loads and operate the motor controller with minimum permissible voltage at the CPT primary for ac control circuits. Where installation of a larger CPT is not feasible, interposing relays are installed. In this design, the control circuit operates an auxiliary relay instead of the controller. The electrical characteristics of the interposing relay are such that adequate voltage is available for it to operate, considering all required design parameters, with minimum permissible CPT primary voltage. The motor controller follows the action of the interposing relay.

Interposing relays have been similarly applied to all affected dc control circuits. By designing the control circuit to operate the relay, proper operation of all power circuit breakers is assured under all design basis station battery voltage conditions.

In order to prevent future recurrence of the deficiency, the project has initiated a check in the design process to prevent the release of any control circuit until its engineered length is determined and compared against established maximum control circuit length criteria. This design check is intended to flag all potential control circuit length deficiencies prior to their release.

5.0 CONCLUSIONS

The SNUPPS ac and dc control circuits were found to have a deficiency which, if left uncorrected, could potentially compromise the capability to maintain the plant in a safe condition. The implementation of corrective and preventive measures described in this report ensures that all control circuits will be adequate to meet their safety design basis.