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10 CFR 50.54(f)

NLS2012081
October 24, 2012

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: 90-Day Response to NRC Bulletin 2012-01, Design Vulnerability in Electric Power System
Cooper Nuclear Station, Docket No. 50-298, License No. DPR-46

Reference: NRC Bulletin 2012-01: Design Vulnerability in Electric Power System, dated July 27, 2012

Dear Sir or Madam:

On July 27, 2012, the Nuclear Regulatory Commission issued Bulletin 2012-01 (Reference), requesting that each licensee submit a written response in accordance with 10 CFR 50.54(f) within 90 days of the bulletin to provide requested information. This letter provides Nebraska Public Power District's 90-day response for Cooper Nuclear Station.

No new commitments are being made in this submittal.

Should you have any questions concerning this matter, please contact David Van Der Kamp, Licensing Manager, at (402) 825-2904.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: Oct 24, 2012
(Date)

Sincerely,

Brian J. O'Grady
Vice President-Nuclear and
Chief Nuclear Officer

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Attachments:
1. 90-Day Response to NRC Bulletin 2012-01, Design Vulnerability in Electric Power System
2. Simplified One-Line Diagram
3. Tables

cc: Regional Administrator w/attachments
USNRC - Region IV

Cooper Project Manager w/attachments
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector w/attachments
USNRC - CNS

NPG Distribution w/attachments

CNS Records w/attachments

Attachment 1

90-Day Response to NRC Bulletin 2012-01, Design Vulnerability in Electric Power System

Cooper Nuclear Station, NRC Docket No. 50-298, License No. DPR-46

1.0 System Description - Items 2, 1.d, 2.a, 2.c

2.0 System Protection - 1, 1.a, 2.b, 2.d

3.0 Consequences - 1.b, 1.c, 2.e

1.0 SYSTEM DESCRIPTION

Items 2, 1.d, 2.a, and 2.c request system information and will be addressed in this section:

2. Briefly describe the operating configuration of the ESF buses (Class 1E for current operating plants or non-Class 1E for passive plants) at power (normal operating condition).

See Attachment 2, for a simplified one-line diagram.

During normal plant operation the Engineered Safety Feature (ESF) buses, 4160 Volt Bus 1F (Division 1) and 4160 Volt Bus 1G (Division 2), are normally powered from the Normal Station Service Transformer (NSST) via 4160 Volt Bus 1A for ESF Bus 1F and 4160 Volt Bus 1B for ESF Bus 1G. The NSST is powered directly from the main generator.

1.d. Describe the offsite power transformer (e.g., start-up, reserve, station auxiliary) winding and grounding configurations.

See Attachment 3, Table 4 for offsite power transformer winding and grounding configurations.

2.a. Are the ESF buses powered by offsite power sources? If so, explain what major loads are connected to the buses including their ratings.

For at power (normal operating condition) configurations, ESF buses are not normally powered by offsite sources.

See Attachment 3, Tables 1 and 2 for ESF bus power sources.

See Attachment 3, Table 3 for ESF bus major loads energized during normal power operations, including their ratings.

It is also noted that the Y winding of the Start-up Station Service Transformer (SSST) normally provides power to either non-ESF Bus 1C or non-ESF Bus 1D during normal at power operating conditions. These non-ESF buses contain the Reactor Recirculation Motor Generator Drive Motors, one on each bus. These motors are rated at 4000 Volt and 7000 HP.

2.c. Confirm that the operating configuration of the ESF buses is consistent with the current licensing basis. Describe any changes in offsite power source alignment to the ESF buses from the original plant licensing.

According to Updated Safety Analysis Report (USAR) VIII-1 and USAR VIII-4, the NSST supplies power to ESF buses during normal at power operation. During startup and shutdown or whenever the NSST becomes unavailable, the SSST provides power to the ESF buses. Additionally the Emergency Station Service Transformer (ESST) provides a second source of offsite power to the ESF buses in the event that both the NSST and SSST are unavailable. The SSST and the ESST are the General Design Criteria 17 credited offsite power sources.

The following at power (normal operating condition) configurations are confirmed to be consistent with the current licensing basis:

> The ESF buses are normally powered from the NSST at power during normal operating conditions. During Startup or if the NSST becomes unavailable the ESF buses are allowed to be powered from the SSST.

The original Final Safety Analysis Report was reviewed and the offsite power source alignment to the ESF buses has not changed since the original plant licensing. One plant modification did install a motor operated disconnect switch in the offsite circuit supplied by the ESST, however this switch is maintained in the closed position during normal plant operation and does not change the offsite power arrangement to the ESF buses.

2.0 SYSTEM PROTECTION

Items 1, 1.a, 2.b, and 2.d request information regarding electrical system protection and will be addressed in this section:

1. Given the requirements above, describe how the protection scheme for ESF buses (Class 1E for current operating plants or non-Class 1E for passive plants) is designed to detect and automatically respond to a single-phase open circuit condition or high impedance ground fault condition on a credited off-site power circuit or another power sources.

Existing protective circuitry will separate the ESF buses from a connected failed offsite source due to a loss of voltage or a sustained, balanced degraded grid voltage. The relay systems were not specifically designed to detect an open single phase of a three phase system.

Loss of voltage on 4160 volt Emergency Bus 1F (1G for Division 2) is monitored by undervoltage relays on the bus, on the normal supply bus tie to the bus and on the ESST supply bus tie to the bus. The three Loss of Voltage relays are each arranged in a one-out-of-one logic configuration. Due to the relays only monitoring bus voltage between phase B-C and because the voltage may not dip below the relay setpoint, depending on loading during an open phase condition, these relays may not actuate for an open phase condition on the primary side of the offsite power source.

The second level of undervoltage protection is a Degraded Voltage scheme. Voltage on 4160 volt Emergency Bus 1F (1G) is monitored by relays on the bus and on the normal supply bus tie to emergency bus. When 4160 volt Emergency Bus 1F (1G) is energized from its normal source (via non-ESF bus 1A (1B)), a degraded voltage condition will be sensed by two undervoltage relays. When 4160 volt Emergency Bus 1F (1G) is energized from the ESST, a degraded voltage condition on 4160 volt Emergency Bus 1F (1G) will be sensed by only one relay. When 4160 volt Emergency Bus 1F (1G) is powered from the normal supply (via non-ESF bus 1A (1B)), a degraded voltage condition on 4160 volt Emergency Bus 1F (1G) will trip the tie breaker (reference Attachment 2 for one-line diagram). When 4160 volt Emergency Bus 1F (1G) is powered from the ESST, a degraded voltage condition on 4160 volt Emergency Bus 1F (1G) will trip breaker 1FS (1GS). The Degraded Voltage relays are arranged in a two-out-of-two logic configuration (both relays have to actuate) if the emergency bus is powered from its normal source, or in a one-out-of-one logic configuration if the emergency bus is powered from the ESST (only one relay has to actuate). Due to the relays only monitoring bus voltage between phase B-C and because the voltage may not dip below the relay setpoint, depending on loading during an open phase condition, these relays may not actuate for an open phase condition on the primary side of the offsite power source.

The protection for the primary feed to the SSST and the ESST was reviewed to determine the effects of a high impedance fault on the primary side of the offsite power circuits. For a fault on the feed to the SSST that has high enough impedance to not cause existing fault protection to actuate, the voltage unbalance caused by such a fault would be negligible. This is due to the fact that the 161kV system is tied directly to the 345kV system which has multiple lines coming into a local switchyard which provides a strong source. Additionally based on the magnitude of power being dissipated through such a fault, it is not credible to expect that the fault would be sustainable. With the amount of power being dissipated through this type of high impedance fault the high resistance fault will burn up in a short period of time to become a low resistance fault, or the fault will burn open. For a fault on the feed to the ESST that has high enough impedance to not cause existing fault protection to actuate, the voltage unbalance caused by such a fault could be significant. This is due to the feed for the ESST being a radial feed with the only protective device located at a remote substation. However, based on the magnitude of power being dissipated through such a fault, it is not credible for the fault to be sustainable. Because of the amount of power being dissipated through this type of high impedance fault the high resistance fault will burn up in a short period of time to become a low resistance fault, or the fault will burn open. Additionally, a project is under way which plans on installing a breaker located in a substation local to the plant. With this new configuration and planned breaker settings, a high impedance fault that would not cause the fault protection to actuate would have higher impedance and the voltage imbalance is expected to be significantly reduced.

The secondary side (4kV) of the SSST and the ESST are high resistance grounded. The ground resistance is selected to limit any ground fault current to less than approximately 12.5 amps. Therefore any high impedance ground would cause ground fault currents of less than 12.5 amps and therefore would not cause any voltage imbalances that would affect any loads.

1.a.* [Describe] *The sensitivity of protective devices to detect abnormal operating conditions and the basis for the protective device setpoint(s).

Existing electrical protective devices are sufficiently sensitive to detect design basis conditions like a loss of voltage or a degraded voltage, but were not designed to detect a single phase open circuit condition. See Attachment 3, Table 5 for undervoltage protective devices and the basis for the device setpoint.

Existing electrical protective devices are also sufficiently sensitive to detect a ground fault on the ESF buses or their 4 kV supply. As discussed in the answer to question 1, the 4 kV system is a high impedance grounded system. Therefore, it is a ground detection scheme. The ground detection will alarm for a 1.5 amp ground on the secondary windings of the NSST, SSST, or ESST. This is to alert the operator of a ground condition and is the minimum detection setting for the relay. As discussed in the answer to question 1, a ground fault on a high impedance grounded system will not adversely affect other equipment on the system.

2.b. If the ESF buses are not powered by offsite power sources, explain how the surveillance tests are performed to verify that a single-phase open circuit condition or high impedance ground fault condition on an off-site power circuit is detected.

Plant procedures require daily walkdowns of switchyards and transformers for the offsite power sources since they are not normally aligned to the ESF buses during normal at power operation. Guidance is provided in these procedures to ensure that the power supply to the offsite source is intact and that there is not a condition that would cause an open phase or ground fault condition to be present. Additionally, plant procedures require checking all three phase voltages on the primary side of the offsite power sources in case an open phase condition or ground fault condition resulted in an unbalanced voltage condition.

2.d. Do the plant operating procedures, including off-normal operating procedures, specifically call for verification of the voltages on all three phases of the ESF buses?

The surveillance procedure for offsite AC power alignment calls for verification of voltage on all three phases of the ESF Buses.

3.0 CONSEQUENCES

Items 1.b, 1.c, and 2.e request information regarding the electrical consequences of an event and will be addressed in this section:

1.b.* [Describe] *The differences (if any) of the consequences of a loaded (i.e., ESF bus normally aligned to offsite power transformer) or unloaded (e.g., ESF buses normally aligned to unit auxiliary transformer) power source.

Installed relays were not designed to detect single phase open circuit conditions. In general, there will be no plant response for an unloaded (e.g., ESF buses normally aligned to unit auxiliary transformer) power source in the event of a single-phase open circuit on a credited off-site power circuit because there is insufficient current to detect a single-phase open circuit for this configuration. The consequence of this configuration is a potential for the condition to go unnoticed for a period of time. Therefore, the actions discussed in the answer to question 2.b have been implemented (walkdowns and voltage verifications).

No Cooper Nuclear Station specific detailed analysis has been performed to determine the consequences for a loaded transformer with an open phase condition. However, in general, the consequences could range from plant undervoltage relaying actuating and transferring to an alternate source, running motors could trip and lock out on overcurrent, and motors that are not running may not be able to start and accelerate and could also trip on overcurrent and lock out.

1.c. If the design does not detect and automatically respond to a single-phase open circuit condition or high impedance ground fault condition on a credited offsite power circuit or another power sources, describe the consequences of such an event and the plant response.

See response to question 1 for discussions on a high impedance ground.

As discussed in the response to question 1 and 1.b, the existing electrical protection scheme may not detect and automatically respond to a single-phase open circuit condition. Since the existing electrical protection scheme was not designed to detect an open phase condition on the offsite power supply and this failure mode was not considered under the current design and licensing basis, no design basis calculations or design documents exist that previously considered this condition. Without formalized engineering calculations or engineering evaluations, the electrical consequences of such an open phase event (including plant response), can only be evaluated in generic terms based on current available industry guidance and Operating Experience insights from the event at Byron Station Unit 2.

For an open circuit on the feed to the SSST under normal plant operating conditions (100% power operation and normal line up) the only load on the transformer would be from the Reactor Recirculation Motor Generator Set drive motor. Based on the industry guidance documents and Operating Experience from the Byron Station Unit 2 event, it is not known if this would be enough load to cause a significant imbalance in voltage. If a significant imbalance in voltage occurred, the motor would likely trip on overcurrent or differential current. If the voltage imbalance was not significant enough to cause the motor protection to actuate, the condition would go undetected until discovered on the daily switchyard and transformer yard walkdowns. If the open circuit condition was present when the loads fast transfer from the NSST or if an open circuit condition were to occur while the plant 4 kV buses were aligned to the SSST, the resulting voltage imbalance would likely cause motors to trip on overcurrent and any large motors that attempt to start would take longer to start and potentially could stall and trip on overcurrent as well.

For an open circuit on the feed to the ESST under normal plant operating conditions (100% power operation and normal line up), there would be no immediate consequences. However, this condition would only be detected by the daily operator walkdowns of the switchyards and transformer yards. If the condition happened prior to or while the ESF buses were powered from this offsite source, the resultant voltage imbalance would be load dependent. If the load on the ESF buses was large enough, then the consequences would be similar to the SSST loaded scenario, where running motors would likely trip on overcurrent and large motors that tried to start would take longer to start or stall and cause overcurrent protection to actuate.

2.e. If a common or single offsite circuit is used to supply redundant ESF buses, explain why a failure, such as a single-phase open circuit or high impedance ground fault condition, would not adversely affect redundant ESF buses.

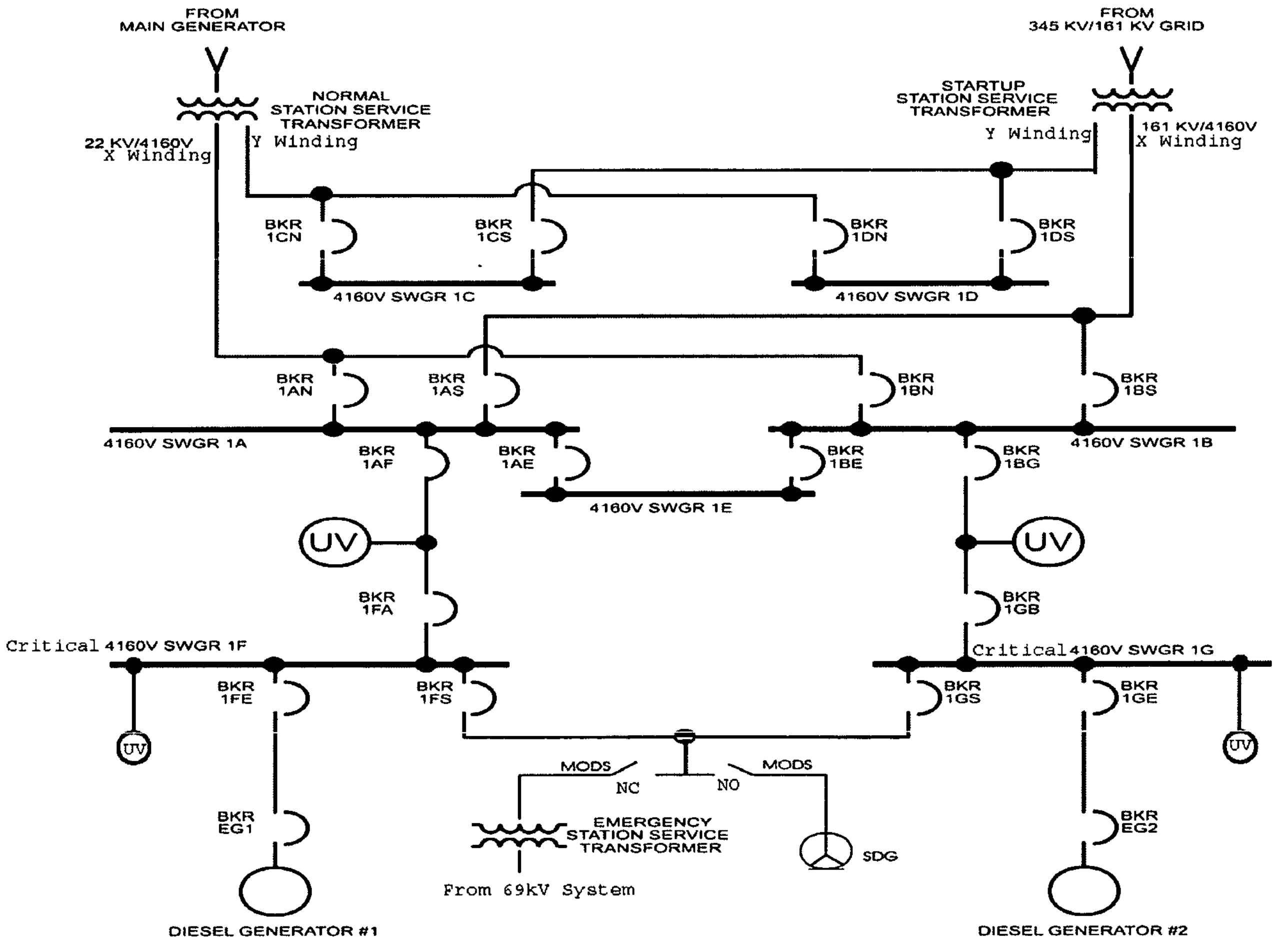
For high impedance ground fault discussion see response to question 1.

During normal at power operation (plant at 100% power normal configuration), the ESF buses would not be adversely affected by an open circuit on the feed to one of the offsite sources since they are not normally aligned to an offsite source while at power (i.e., fed from the main generator via the NSST). If an open circuit on the offsite source were to occur during plant startup or shutdown or during some other plant condition that caused the ESF buses to align to an offsite source, then redundant ESF buses would be aligned to a common offsite source and could both be adversely affected.

Attachment 2

Simplified One-Line Diagram

Cooper Nuclear Station, Docket No. 50-298, License No. DPR-46



Simplified One-Line Diagram

Attachment 3

TABLES

Cooper Nuclear Station, Docket No. 50-298, License No. DPR-46

Table 1 - ESF Buses Continuously Powered From Offsite Power Source(s)

Table 2 - ESF Buses Not Continuously Powered From Offsite Power Source(s)

Table 3 - ESF Buses Normally Energized Major Loads

Table 4 - Offsite Power Transformers

Table 5 - Protective Devices

Table 1 - ESF Buses Continuously Powered From Offsite Power Source(s)

Description of ESF Bus Power Source	ESF Bus Name (normal operating condition)	Original licensing basis configuration (Y/N)
N/A This Table is not applicable because the ESF Buses are not normally powered from an Offsite Power Source.	N/A	N/A

Table 2 - ESF Buses Not Continuously Powered From Offsite Power Source(s)

Description of ESF Bus Power Source	ESF Bus Name (normal operating condition)	Original licensing basis configuration (Y/N)
Normal Station Service Transformer through Non ESF Bus 1A.	4kV Bus 1F	Y
Normal Station Service Transformer through Non ESF Bus 1B.	4kV Bus 1G	Y

Table 3 - ESF Buses Normally Energized Major Loads

ESF Bus	Load	Voltage Level	Rating (HP)
1F	Service Water Pump A and/or C	4kV	300
1F	Reactor Equipment Cooling Pumps A and/or B	460 Volt	75
1G	Service Water Pump B and/or D	4kV	300
1G	Reactor Equipment Cooling Pumps C and/or D	460 Volt	75

Table 4 - Offsite Power Transformers

Transformer	Winding Configuration	MVA Size (OA/FA/FA)	Voltage Rating (Primary/Secondary)	Grounding Configuration
Startup Station Service Transformer	Wye-Wye-Wye with buried Delta Tertiary	18/24/30 MVA	161kV/4160V/4160V	Primary solidly grounded, Low Voltage X winding high resistance grounded, Low Voltage Y winding high resistance grounded
Emergency Station Service Transformer	Wye-Wye with buried Delta Tertiary	9/10.8/12.6 MVA	67kV/4160V	Primary solidly grounded, Low Voltage winding high resistance grounded

Table 5 - Protective Devices

Protection Zone	Protective Device	UV Logic	Setpoint (Nominal)	Basis for Setpoint
4 kV ESF Bus	Loss of Voltage Relay	1 of 1	Relay set to pick up at 2870 Volts	Actuate upon complete loss of ESF Bus voltage condition.
4 kV ESF Bus (fed through breaker 1FA(1GB))	Degraded Grid	2 of 2	Relay set to pick up at 3880 Volts	Ensure equipment is protected from a sustained degraded voltage condition on the offsite power source.
4 kV ESF Bus (fed through breaker 1FS(1GS))	Degraded Grid	1 of 1	Relay set to pick up at 3880 Volts	Ensure equipment is protected from a sustained degraded voltage condition on the offsite power source.
4 kV Buses	Ground Detection	N/A	0.5 amps secondary. CT ratio is 3:1, therefore primary current is 1.5 amps.	The 4kV system is a high impedance grounded system. Therefore, the setpoint is set to the minimum setting of the relay to provide ground detection.