Entergy Nuclear Operations, Inc
Palisades Nuclear Plant
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PNP 2012-093

October 25, 2012

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

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

Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

REFERENCE: 1. NRC Bulletin 2012-01: *Design Vulnerability in Electric Power System*, dated July 27, 2012

Dear Sir or Madam:

On July 27, 2012, the NRC issued Bulletin 2012-01 (Reference 1), 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 the Entergy Nuclear Operations, Inc. 90-day response to Reference 1 for the Palisades Nuclear Plant in Attachment 1.

There are no new commitments contained in this submittal.

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

Executed on October 25, 2012.

Sincerely,

for Tony Vitale

ajv/rbh

Attachments: 1. Palisades Nuclear Plant 90 Day Response to NRC Bulletin 2012-01

cc: Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC

Attachment 1

PNP 2012-093

Palisades Nuclear Plant 90 Day Response to NRC Bulletin 2012-01

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

Overview:

Nuclear Regulatory Commission (NRC) Bulletin 2012-01 requested actions are grouped in the following three categories with a figure and tables supplementing the responses:

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

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

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

- Figure 1: Simplified One-Line Diagram
- 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 Major Loads
- Table 4: Offsite Power Transformers
- Table 5: Protective Devices

System Description

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

NRC Request

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).*

Entergy Nuclear Operations, Inc. (ENO) Response

2. For the simplified diagram of Engineered Safety Features (ESF) Class 1E buses see Figure 1, "Simplified One-Line Diagram".

   The 345kV system provides continuously connected offsite power to two (2) two-winding transformers; Safeguards Transformer 1-1 (SGT 1-1) and Start-Up Transformer 1-2 (SUT 1-2) for Palisades Nuclear Plant (PNP). SGT 1-1 normally provides power to 2.4kV buses 1C, 1D, and 1E. SUT 1-2 is an alternate source and also provides power to 2.4kV buses 1C, 1D, and 1E. Buses 1C and 1D are ESF buses. Bus 1E is not an ESF bus.

   The 2.4kV system can be connected to Station Power Transformer 1-2 (SPT 1-2) by backfeeding through the Main Transformer.

NRC Request

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

ENO Response

1.d. For offsite power transformer winding and grounding configurations reference Table 4.

NRC Request

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.*

ENO Response

2.a. For at power (normal operating condition) configurations, ESF buses are powered by offsite sources. The offsite source also powers non-safety loads during normal (at power) operations.

For ESF bus power sources reference Tables 1 and 2.

For ESF bus major loads energized during normal power operations, including their ratings reference Table 3.

NRC Request

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.*

ENO Response

2.c. The following at power (normal operating condition) configurations have been confirmed to be consistent with the current licensing basis (CLB):

#1 Circuit	Power to ESF buses via 345kV switchyard and Safeguards Transformer 1-1 (SGT 1-1)
#2 Circuit	Power to ESF buses via 345kV switchyard and Start-Up Transformer 1-2 (SUT 1-2)
#3 Circuit	Power to ESF buses via Main Turbine Generator and Station Power Transformer 1-2 (SPT 1-2)

For any changes in the offsite power source alignment to the ESF buses from the original plant licensing basis reference Table 1.

System Protection

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

NRC Request

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. Also, include the following information:*

ENO Response

1. Consistent with the current licensing basis (PNP FSAR Section 8.6.1, "Automatic Transfer, Voltage Protection and Load Shedding Controls – Design Basis"), 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 concurrent with certain design basis accidents. The relay systems were not specifically designed to detect an open single phase of a three phase system. Detection of a single-open phase condition is beyond the approved design and licensing basis of the plant. This is true for all three circuits noted in 2.c, above.

PNP FSAR Chapter 8, "Electrical Systems", Section 8.1.1, "Design Basis," states:

> "The Plant electrical system and the 345 kV switchyard are designed to reliably function and supply power during normal, abnormal, and emergency conditions. This electrical power system is required to meet 10 CFR 50, Appendix A, General Design Criterion 17, for onsite and offsite power source requirements. The system will supply and distribute the electrical power necessary to operate the systems which preserve the Plant's three fission product barriers under all conditions of start-up, power generation and shutdown...
>
> During the Systematic Evaluation Program, NRC and CPCo [Consumers Power Company, former plant owner] staff reviewed as built electrical design against licensing criteria current at the time. The purpose of the review was to determine if the designs in older plants provided a measure of safety comparable to that provided by design in newer plants; or as a minimum, were acceptable based on plant specific challenge and response capability. The adequacy of as built characteristics designed to promote safety related availability such as channel separation, isolation and independence was evaluated. In many cases, these reviews concluded that although the existing as built design did not feature the specific configuration required by current criteria, the design was considered acceptable. Summaries of these reviews are found in NUREG 0820, the NUREG 0820, Supplement, and individually docketed SEP submittals and related NRC Safety Evaluation Reports."

It has been concluded in PNP FSAR Section 5.1.3.11 General Design Criteria – Conclusions, the intent of GDC 17 is met:

> "Based on the discussions in various parts of Subsection 5.1.3, it is concluded that the Palisades Plant was designed in conformance with the intent of Group II criteria, except Criterion 17 has since been interpreted to require separate transmission towers for the circuits bringing power into the Plant from the substation. As discussed in 5.1.3.8 above and Chapter 8, the plant has been modified to provide two independent, immediate access sources of offsite power from the switchyard."

Preferred power is taken from two physically and electrically independent 345kV lines originating in the onsite 345kV substation. Therefore, a single open phase condition does not affect both offsite sources.

The electrical analyses for the offsite circuits have been reviewed with regard to high impedance grounds and determined to be inconclusive without detailed studies.

Palisades ESF buses do have ground detection relaying on the secondary side of the offsite sources. However, detailed loading analysis is needed in order to conclude that high impedance ground on a single phase would result in an unbalanced voltage condition sufficient to adversely affect connected equipment.

Palisades preferred offsite sources are primarily protected by differential protection with current transformers mounted on the high side of the transformers. The zone of protection on the high side overlaps with the 345kV bus protection.

NRC Request

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

ENO Response

1.a. Consistent with the current licensing basis and General Design Criteria 17 (GDC-17), 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 Table 5 for undervoltage protective devices and the basis for the device setpoint(s).

Existing electrical protective devices are also sufficiently sensitive to detect a ground fault. However, protective devices for high impedance grounds were not found. Table 5 lists the ground alarm on the Engineered Safety Features (ESF) buses and the basis for the device setpoints.

NRC Request

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.*

ENO Response

2.b. Not applicable as the ESF buses at PNP are powered by offsite power sources.

NRC Request

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?*

ENO Response

2.d. The system used to collect data from operator rounds (eSOMS), requires a shiftly recording of all three phases for secondary side voltages from both offsite power sources: Safeguards Transformer 1-1; and Start-Up Transformer 1-2

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:

NRC Request

1.b. *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.*

ENO Response

1.b. At PNP installed relays were not designed to detect single phase open circuit conditions. Existing loss of voltage and degraded voltage relays may respond depending on load and possible grounds. 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 plant response for a loaded power source with or without a high impedance ground, cannot be calculated without specifying the amount of loading and the specific loads involved

NRC Request

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.*

ENO Response

1.c. A high impedance ground on the high voltage side of SGT 1-1 that is sufficiently large enough will trip the switchyard F-Bus and fast transfer 2400V loads from SGT 1-1 to SUT 1-2 without a plant trip.

A high impedance ground on the high voltage side of SUT 1-2 that is sufficiently large enough will trip the switchyard R-Bus and transfer trip to the plant to trip all of the three start-up transformer's low voltage side breakers. Loss of all auxiliary loads will result in a plant trip.

The 2400V system is an ungrounded delta connected system. A high impedance ground will have no immediate effect on plant operation. If the ground is sufficiently large enough to affect plant operation, protective relaying will detect the ground and alarm in the control room.

a. There is no credit in the PNP Current Licensing Basis (CLB) that the Class 1E protection scheme (for the emergency safeguard feature (ESF) buses) was designed to detect and automatically respond to a single-phase open circuit condition on the credited off-site power source as described in the updated FSAR and Technical Specifications.

   The qualified offsite power circuits at PNP consists of two independent circuits from 1) SGT 1-1 to incoming circuit breakers on ESF buses 1C and 1D, and 2) SUT 1-2 to incoming circuit breakers on ESF buses 1C and 1D. SPT 1-2 is an unqualified source since it is not independent of the other two offsite circuits.

   PNP FSAR Chapter 8, "Electrical Systems" Section 8.1.2, "Introduction; Description and Operation", states:

   > "2,400-volt reactor and turbine plant loads, including the engineered safeguards electric system, are normally supplied from either the offsite power source 345 to 2.4 kV Safeguard Transformer 1-1 or the offsite power source 345 to 2.4 kV Start-Up Transformer 1-2. Capability is also provided to power the 2,400-volt electrical system from the main turbine generator via 21 - 2.4 kV Station Power Transformer 1-2. If the turbine generator is out of service for an extended time, the generator

isophase bus motor operated disconnect switch may be opened and Main Transformer 1 can be used to backfeed 2,400 volt auxiliary power through Station Power Transformer 1-2."

PNP Technical Specification Bases B 3.8.1, "AC Sources – Operating", states:

"The qualified offsite circuits available are Safeguards Transformer 1-1 and Startup Transformer 1-2. Station Power Transformer 1-2 is not qualified as a required source for LCO 3.8.1 since it is not independent of the other two offsite circuits. This LCO does not prohibit use of Station Power Transformer to power the 2400 V safety related buses, but the two qualified sources must be OPERABLE."

b. Since PNP does not credit the ESF bus protection scheme as being capable of detecting and automatically responding to a single phase open circuit condition, an open phase fault was not included in the design criteria for either the loss of voltage, the degraded voltage relay (DVR) scheme or secondary level undervoltage protection system (SLUPS) design criteria. Since open phase detection was not credited in the PNP design or licensing basis, no design basis calculations, or design documents exist that previously considered this condition.

c. Without formalized engineering calculations or engineering evaluations, the electrical consequences of such an open phase event (including plant response), can only be evaluated to the extent of what has already been published by EPRI and Basler; which is a generic overview. The difficulty in applying these documents to the PNP specific response is that these are generic assessments and cannot be formally credited as a basis for an accurate response. The primary reason is that detailed plant specific models would need to be developed (e.g., transformer magnetic circuit models, electric distribution models, motor models; including positive, negative, and zero sequence impedances (voltage and currents), and the models would need to be compiled and analyzed for the PNP specific Class 1E electric distribution system (EDS)).

An EMTP type study is being initiated to analyze the plant response to a single open phase electrical circuit. Subsequent to the study, long term corrective actions will then be developed, as necessary.

NRC Request

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.*

ENO Response

2.e. Consistent with the CLB protective circuitry will separate the ESF buses from a failed offsite source due to a loss of voltage or a sustained balanced degraded grid voltage concurrent with certain design basis accidents. The relay systems were not specifically designed to detect an open single phase of a three phase system. Detection of a single-open phase circuit is beyond the approved design and licensing basis of the plant. No calculations for this scenario have been done.

Simplified One-Line Diagram

GDC-17 credited off-site circuits begin at switchyard connection and end at feeder breaker to ESF buses

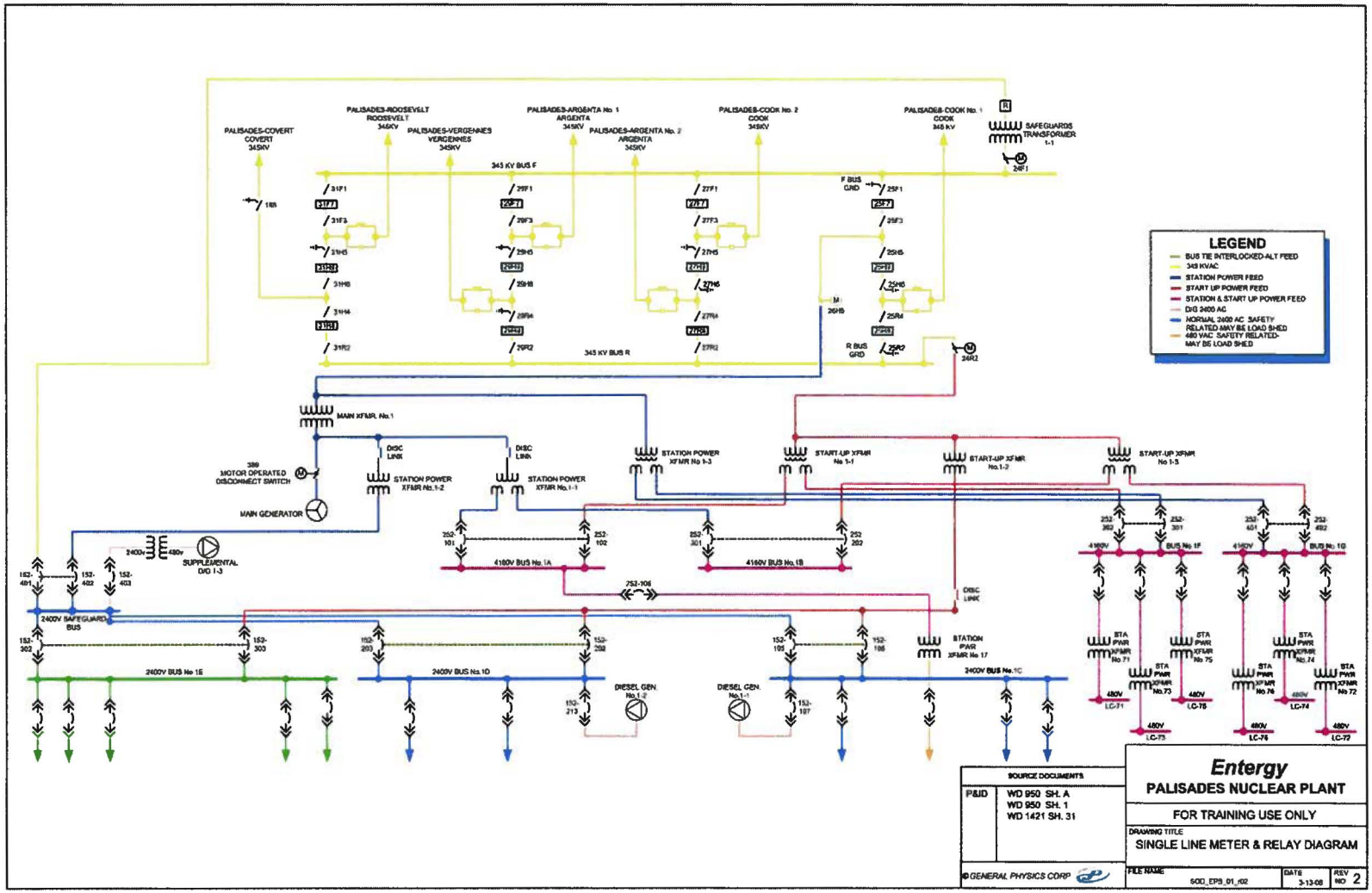

Table 1 - ESF Buses Continuously Powered From Offsite Power Sources

Description of ESF Bus Power Source	ESF Bus Name (normal operating condition).	Original licensing basis configuration (Y/N)
Safeguards Transformer 1-1; Preferred Source	1C, 1D	N; added 1989; GDC 17 qualified source*
Start-Up Transformer 1-2; Alternate Source	1C, 1D	Y; GDC 17 qualified source*
Station Power Transformer 1-2; Alternate Source, Backfeed		Y; non-qualified source*

* References:
Technical Specification Bases B 3.8.1-5, "AC Sources – Operating", Revised 01/11/2012
PNP FSAR Section 8.1, "Electrical Systems", Section 8.3.2, "2,400 Volt Systems", Revision 30.

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)
Note: Table 2 is not applicable to Palisades Nuclear Plant.	N/A	N/A

Table 3: ESF Buses Normally Energized Major Loads

ESF Bus	Load	Voltage Level	Rating (HP) or KVA
1C	Dilution Water Pump P40A	2300	600 HP
1C	Service Water Pump P7B	2300	350 HP
1C	Station Power Transformer 13	2400 / 480	750 KVA
1C	Component Cooling Water Pump P52A	2300	300 HP
1C	Station Power Transformer 77 / Switchyard Station Power Transformer No. 2	2400 / 480 2400 / 240 / 120	500 KVA 225 KVA
1C	Station Power Transformer 19	2400 / 480	750 KVA
1C	Station Power Transformer 11	2400 / 480	750 KVA
1C	Component Cooling Water Pump P52C	2300	300 HP
1D	Service Water Pump P7A	2300	350 HP
1D	Service Water Pump P7C	2300	350 HP
1D	Component Cooling Water Pump P52B	2300	300 HP
1D	Station Power Transformer 20	2400 / 480	750 KVA
1D	Station Power Transformer 12	2400 / 480	750 KVA
1D	Pressurizer Heater Transformer	2400 / 480	750 KVA

Reference drawing: E-3 sheet 1 Rev 50, "Single Line Meter & Relay Diagram 2400 Volt System"

Table 4: Offsite Power Transformers

Transformer	Winding Configuration	MVA Size (AO/FA/FA)	Voltage Rating (Primary/Secondary)	Grounding Configuration
Safeguards Transformer 1-1	Wye-Delta	10.5 OA/ Future 13.125 FA	354kV/2.52kV	High Side (wye) neutral grounded only[1]
Start-Up Transformer 1-2	Wye-Delta	10.5 ONAN	345kV/2.52kV	High Side (wye) neutral grounded only[2]
Station Power Transformer 1-2	Delta-Delta	8.0 OA	21kV/2.4kV	Ungrounded [2]

1. Reference Drawings: MWD 1421 Sheet 1A Revision K; Palisades Substation
2. Reference; Drawings: E-1 Sheet 1 Revision 83; "Single Line Meter & Relay Diagram 480 Volt Motor Control Center Warehouse"

Table 5: Protective Devices

Protection Zone	Protective Device	UV Logic	Setpoint (Nominal)	Basis for Setpoint
2.4 KV ESF Bus	Loss of Voltage Relay (1st level UV) 127-1, 127-2	3 of 3	1860V (77.5% of 2400V)	To actuate upon sudden loss of ESF Bus voltage condition while permitting starting and accelerating of large motors [1, 2]
2.4 KV ESF Bus	Degraded Grid (2nd level UV) 127-7, 127-8	3 of 3	2200V (91.67% of 2400V)	To protect safety related equipment from severely degraded voltage conditions and prevents spurious trips due to momentary voltage dips [1, 3]
2.4 KV ESF Bus	Ground Protection, 164-1, 164-2	1 of 1	2800V (117% of 2400V)	To alarm upon ground of ESF buses [1, 4]

1. Reference Drawing: E3 sh1 rev 50, "Single Line Meter & Relay Diagram 2400 Volt System"
2. Reference Setting sheets: 127-1, & 127-2
3. Reference Setting sheets: 127-7, & 127-8
4. Reference Setting sheets: 164-1, & 164-2