

September 7, 2012

MEMORANDUM TO: James W. Andersen, Chief
Electrical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

FROM: Swagata Som, Electrical Engineer /RA/
Electrical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF AUGUST 21, 2012, PUBLIC MEETING ON
BULLETIN 2012-01, "DESIGN VULNERABILITY IN ELECTRIC
POWER SYSTEM."

On August 21, 2012, a Category 2 public meeting¹ was held between the U.S. Nuclear Regulatory Commission (NRC) and representatives of the Nuclear Energy Institute (NEI) and nuclear power plant industry at NRC Headquarters, Two White Flint North, 11545 Rockville Pike, Rockville, Maryland. The purpose of the meeting was to discuss the recently issued Bulletin 2012-01, "Design Vulnerability in Electric Power System," and to address any questions regarding the Bulletin's required responses. The enclosure contains the list of meeting attendees.

The NRC staff presented information² regarding the Bulletin³. Specifically, the staff discussed the purpose and reasons for issuing the Bulletin, regulatory requirements, and the information requested about plant specific design, licensing basis and operating practices related to the electric power system.

The industry representative provided an overview⁴ of the industry efforts to analyze the event at Byron Nuclear plant and possible hardware fixes. He noted that a commercial software company (ETAP) had developed a module for a power system analyses program that can be used to evaluate single phase open conditions on a three phase electric power system.

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1. The original meeting notice is available via the Agencywide Documents Access and Management System (ADAMS) under Accession No. ML12222A267.

2. NRC presentation is available under ADAMS Accession No. ML12242A444

3. The Bulletin is available under ADAMS Accession No. ML12074A115

4. Industry overview is available under ADAMS Accession No. ML12242A444

5. Industry presentation regarding Questions on Bulletin 2012-01 is available under ADAMS Accession No. ML12242A444

He further noted that licensees are evaluating possible digital and programmable relays that can be used for sensing single open phase conditions and isolate the affected circuits. The main consideration is that any proposed solution should not reduce the reliability of the offsite power source(s) by inadvertently tripping a reliable source or prematurely separating an offsite source during momentary degraded conditions. The industry will engage NRC staff as they determine potential success paths.

NEI discussed a draft template being prepared to assist the licensees in responding to the requested information in the Bulletin. During the meeting NEI also discussed the industry questions⁵ and clarifications needed on the Bulletin requested information. The NRC staff provided responses to the industry questions during the meeting and stated that the meeting summary will also capture its responses.

The NEI questions and NRC responses discussed during the August 21, 2012, meeting are provided below:

Questions on Requested Action 1:

Q. Please provide clarification on “credited off-site power circuit or another power sources.” What is meant by ‘another power source’?

NRC Response:

GDC 17 requires two independent offsite circuits to mitigate the consequences of abnormal operating occurrence and accidents. As a demonstration of ‘defense in depth’ philosophy, some licensees have indicated that other circuits from different switchyards or related grid connections are available to support safe shutdown capability in addition to the required GDC 17 circuits. As an example, these ‘other’ circuits may include backfeed through the main step up transformer which may be used during plant shutdown conditions. The question is applicable to ‘other’ such circuits.

Q. We believe that most of the industry did not design to detect and automatically respond to a single open phase and anticipate that most will answer “No” to this question. If answered “no”, we anticipate providing information on the existing undervoltage relays as response to 1a and 1b. Do you anticipate anything additional?

NRC Response:

If the plant design does not detect and automatically respond to a single phase open circuit condition and the licensee has established that such a vulnerability exists, then:

- Provide details on the protection schemes available to sense a single open phase including the existing undervoltage scheme and the reason(s) for the ‘no’ answer, and

- Provide details on the interim actions that may include analyses and preventive measures to compensate for this vulnerability that were initiated as part of the corrective action program and also describe any other long term actions planned.

Q. For Question 1c, we anticipate addressing assumed *electrical* consequences only answered from the perspective of generic information (EPRI Report 1025772 and Basler 2002 technical paper). Do you anticipate anything additional?

NRC Response:

The staff expects licensees to address the consequences of a single phase open circuit and/or high impedance ground fault condition on the plant *electrical* system. The potential impact on the fluid systems is not in the scope of this Bulletin. However, if a licensee identifies a potential failure mechanism in the safety related non electrical systems, it should be addressed as part of their corrective action program.

Staff has not reviewed EPRI Report 1025772 and Basler 2002 technical paper to determine the acceptability of these documents to meet the NRC requirements.

Q. The summary of the Byron Event states that it resulted “in a phase C open circuit and a high impedance ground fault.” The ground was a result of the open connection and was not a separate occurrence. The requests are for discussion of “a single-phase open circuit condition or high impedance ground fault condition.” We anticipate addressing the high resistance ground only as it affects the open phase. Do you anticipate anything additional?

NRC Response:

The Bulletin cites examples of an open circuit condition at Beaver Valley Unit 1, James FitzPatrick Nuclear Plant, and Nine Mile Point Nuclear Station Unit 1, that went undetected for extended duration. The Byron event, in addition to open circuit condition, also resulted in a high impedance ground fault condition that was detected by the protective relaying but did not isolate the degraded circuit due to ‘high’ setpoint of the relay. Hence the response to the Bulletin should evaluate plant vulnerability to:

- Single phase open circuit conditions, and/or
- High impedance ground fault conditions whether alarmed in the Control Room or not

[Note: • The event(s) can occur in the plant or in the switchyard side of the offsite power source
• High impedance ground fault: low enough to alarm, but not high enough to trip (high and low side) of transformer]

Q. The staff is asking the licensees to provide the details on consequences of “a single-phase open circuit condition or high impedance ground fault condition”. Some plants may not have completed their analyses for high impedance ground faults by the due date. What is staff’s expectation? (Follow-up question from licensee)

NRC Response:

The staff expects licensees to provide the results of bounding analyses for impact of (i) Single phase open circuit and/or (ii) High impedance ground fault condition on safety related (energized) equipment. In the event that a licensee has not completed the plant specific analyses by the Bulletin submittal date, the staff will accept interim results, an estimate of the bounding analyses completion dates, and a separate submittal of the completed bounding analyses within 45 days.

Questions on Requested Action 2:

- Q. For Question 2a, "Offsite power sources" is not defined in the Bulletin. We anticipate this response will identify stations which power their ESF buses from sources other than the station main generator during normal power operations. Do you anticipate anything additional?

NRC Response:

Question 2 is related to normal operation of the plant. Due to plant-specific reasons some plants do not power some or all of their auxiliary loads directly from the main generator using unit auxiliary transformers. The response to this question should identify the various operating configurations that are used to power ESF loads (i.e., how the ESF buses are powered during normal operations (at power)).

- Q. This item requests information on "what major loads are connected". We anticipate responding with the major loads on the ESF buses that are energized during normal operations. Do you anticipate anything additional?

NRC Response:

Unbalanced loading conditions can adversely impact *operating* equipment. The intent of this question is to identify safety related equipment that may be degraded during postulated single phase open circuit and/or high impedance ground fault condition that is not immediately detected and cleared. Any electrical equipment that is *not connected* (de-energized) should not be affected by the postulated event and can be omitted from the list of major loads.

Enclosure:

List of Attendees

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ADAMS Accession No.: ML12243A426

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NAME	SSom	RMathew	JAndersen
DATE	8/ 29 /2012	9/6 /2012	9/7 /2012

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LIST OF ATTENDEES
AUGUST 21, 2012, MEETING WITH NUCLEAR INDUSTRY, EXTERNAL STAKEHOLDERS
ON BULLETIN 2012-01, "DESIGN VULNERABILITY IN ELECTRIC POWER SYSTEM

Name	Organization
Patrick Hiland	NRC
James Andersen	NRC
Roy Mathew	NRC
G. Singh Matharu	NRC
Peter J. Kang	NRC
Robert Fitzpatrick	NRC
Prem Sahay	NRC
Vijay Goel	NRC
Swagata Som	NRC
Booma Venkataraman	NRC
Adaku Foli	NRC
Alfredo Matos-Marin	NRC
Andrea Russell	NRC
Bruce Bavol	NRC
Rui Li	NRC
Alan Dahbur	NRC
Robert Daley	NRC
Rebecca Nease	NRC
Marcus Riley	NRC
Shane Sandal	NRC
TC Su,	NRC
Delza Mas-Penaranda	NRC
Robert Patterson	NRC
Sheila Ray	NRC
Gordon Clefton	NEI
Alex Marion	NEI
Jon Butler	NEI
Scot Greenlee	Exelon
Patricia Campbell	GEH
Paul Gaffney	Duke/Progress
Paul Guill	Duke Energy
Paul Colaianni	Duke Energy
Dave Waters	Duke Energy
Richard A. DeLong	Westinghouse
Donald E. Durkosh	Westinghouse
Mark DeMaglio	Westinghouse
Robert Kimmick	Westinghouse
Paul Oreshack	Palo Verde/APS
Jacques Vanderbrock	SCE
Phil Lashley	FENOC
Gregory P. Norris	Entergy
Tamatha Womack	TVA

ENCLOSURE

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AUGUST 21, 2012, MEETING WITH NUCLEAR INDUSTRY, EXTERNAL STAKEHOLDERS
ON BULLETIN 2012-01, "DESIGN VULNERABILITY IN ELECTRIC POWER SYSTEM
(CONTINUED)

R. Roy Lyon II	SNC
Ken Fleischer	FPL/NextEra
Sandhya Madan	MPR Associates
Mohit Malik	MPR Associates
Al Haeger	Certrec Corporation
George Madden	FPL
Ken Pigg	Duke Energy
James E. Stoner Jr.	Lee Nuclear Station
Donna Lippy	Fort Calhoun Station
Robert M. Stark	Calvert Cliffs Nuclear Power Plant
Mark Hypse	Palo Verde/APS
Dale Vincent	Xcel Energy
Benjamin H. Scott	Constellation Energy Nuclear Group
Frank Mowasat	San Onofre Nuclear Generating Station
Dean Kersey	SCE&G
Sung Kim	Entergy