



Briefing of Committee to Review Generic Requirements

**NRC BULLETIN 2012-01: DESIGN VULNERABILITY
IN ELECTRIC POWER SYSTEM**

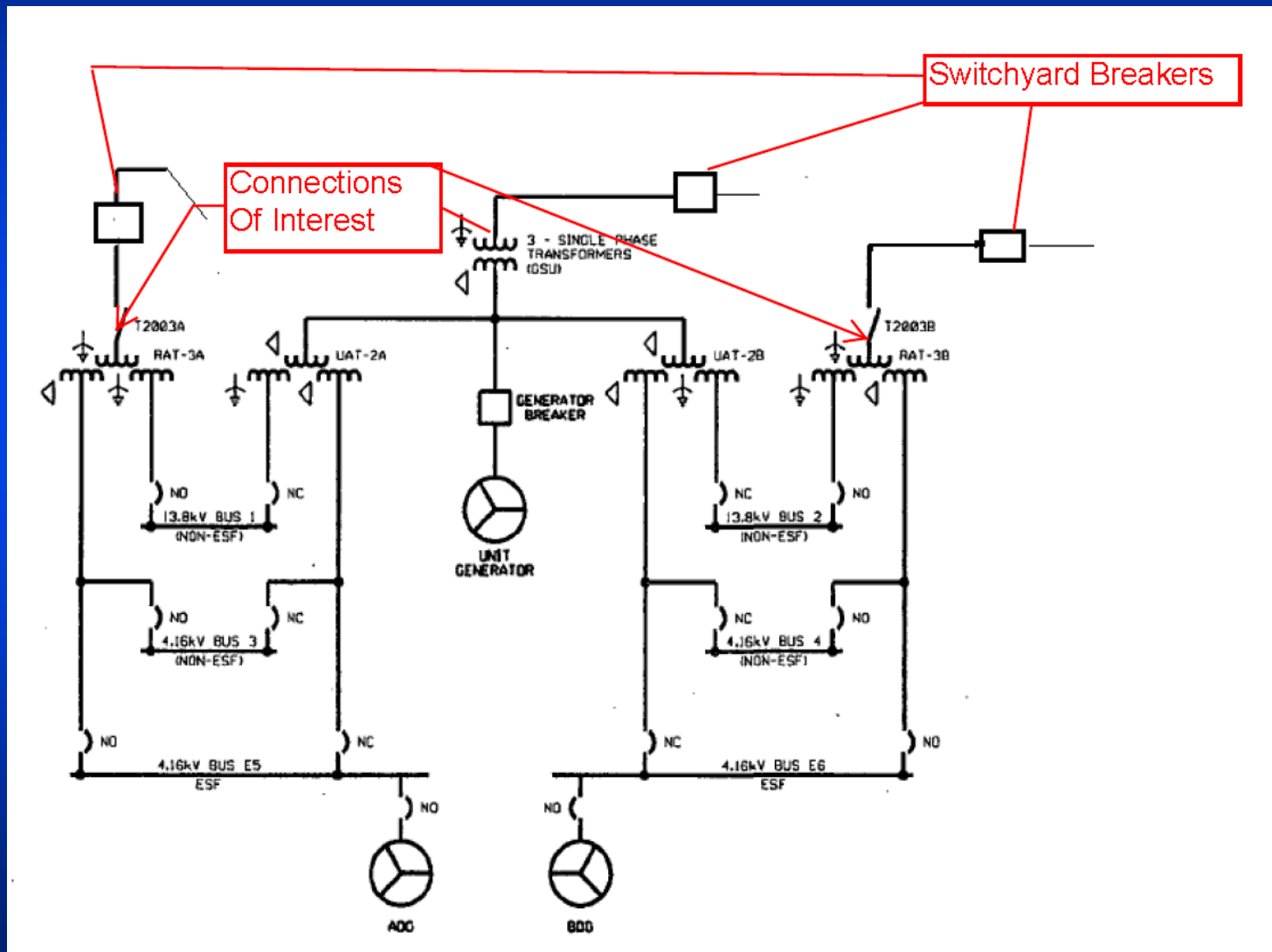
**Serita Sanders, NRR
Roy Mathew, NRR
Robert Fretz, OE
David Beaulieu, NRR**

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- **Open Phase Condition (OPC)**
- **Operating Experience**
- **NRC Actions**
- **Regulatory Requirements**
- **Precedents**
- **Industry Initiatives**
- **Proposed Regulatory Action**
- **Backfit Evaluation**
- **Schedule/Path Forward**

What is an OPC?

- **Loss of one of the three phases** of the offsite power circuit on the high voltage side of a transformer connecting an offsite power circuit to the transmission system coincident with or without a high-impedance ground fault; or
- **Loss of two of the three phases** of the offsite power circuit on the high voltage side of a transformer connecting an offsite power circuit to the transmission system
- **Creates Unbalance in AC power system** (sequence voltages and currents)
 - Transformer winding configuration (Wye-Wye-Wye, Delta-Wye-Wye, Wye-Delta-Delta, Wye-Wye-Buried Tertiary Delta, Delta-Wye, Wye-Delta, Wye-Wye-Delta, and Wye-Wye with Delta stabilizing winding)
 - Grounding (solid or resistance ground)
 - Type of transformer core (Shell or Core)
 - Loading condition and operating configuration (standby/no load/lightly loaded)
 - Phase angle shift
 - Reduced starting torque for motors
 - Overheating of motors/overload/loss of life/damages to rotating machines
 - Protective device actuation and lock out



- **Thirteen operating events (2001-2015)**
 - Failure of insulators and switchyard connections
 - Malfunction of breakers

- ❖ **South Texas Project Unit 2, US – March 1, 2001**
- ❖ **Koeberg, South Africa – November 11, 2005**
- ❖ **Fitzpatrick/and Nine Mile Point, US – December 19, 2005**
- ❖ **Vandellos, Spain – August 9, 2006**
- ❖ **Dungeness A, UK – May 14, 2007**
- ❖ **Beaver Valley, Unit 1, US – November 1, 2007**
- ❖ **Byron Station, Unit 2 – January 30, 2012**
- ❖ **Byron Station, Unit 1 – February 28, 2012**
- ❖ **Bruce Power, Unit 1, Canada – December 22, 2012**
- ❖ **Forsmark, Unit 3, Sweden – May 30, 2013**
- ❖ **Dungeness B, UK - April 2014**
- ❖ **Oconee Nuclear Station, Units 1 and 3 – December 2015**

BYRON Unit 2 Event



Operating experience at Byron Station revealed a design vulnerability associated with OPCs

- Loss of safety functions of Engineered Safety Features - both offsite and onsite electric power systems were not able to perform their intended safety functions due to the design vulnerability
- Potential Noncompliance with general design criteria (GDC) 17 and other requirements
- Inoperable Electric Power Systems (TS 3.8.1)
- ASP analysis¹ – CCDP = 1×10^{-4}

- **NRC Special Inspection²** at Byron Station
- **Information Notice** 2012-03³
- **Bulletin 2012-01**: Design Vulnerability in Electric Power System⁴
- **Summary Report** – documented NRC staff review of licensee responses and staff recommendations⁵
 - All operating nuclear power plants susceptible to OPC except Seabrook Station
 - Existing protection schemes based on voltage magnitude cannot identify OPC and take appropriate mitigation measures (i.e., automatically transfer power to ESF buses from an alternate offsite or onsite power source)
 - Staff recommended regulatory action to address the open phase issue

- **Briefed Advisory Committee for Reactor Safeguards (ACRS)**
 - Full Committee (December 4, 2014)
 - Sub-Committee (November 17, 2014)
- **ACRS issued Recommendation letter⁶**
 - Staff provided response⁷
- **Participated in an IAEA effort** to issue a Safety Report and also an IEEE working group to develop a Standard
- **Developed BTP 8-9⁸** to provide staff guidance for licensee amendment reviews
- **Issued BTP 8-9** after resolution of public comments and review by both ACRS Committees

Regulatory Requirements

- **General Design Criterion (GDC) 17**
“Electric Power Systems,” or the applicable principal design criteria in the updated final safety analysis report
- **Design criteria for protection systems** under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3)
- **Technical Specification (TS) requirements**
 - 10 CFR 50.36(c)(2) & (3)
 - TS LCO – offsite and onsite power systems
 - TS Surveillance Requirements

- **Regulatory Impact**

- In the responses to Bulletin 2012-01, licensees stated that the OPC design vulnerability exists at all operating reactors (except Seabrook)
- As such, licensees may not be in compliance with NRC regulations or not in conformance with applicable design requirements

- **Degraded Voltage Protection**
 - GDC 17
 - Operating events at Millstone and ANO
 - GSI – A35: Adequacy of Offsite Power System
 - Common cause failure concerns
 - NRC requested licensees to provide second level undervoltage protection for electric power system for continued compliance with GDC 17 or principle design criteria in the UFSAR (June 3, 1977)
 - NRC Regulatory Issue Summary (RIS) 2011-12, Revision 1⁹

- **Tornado Missile Protection**
 - GDC 2
 - EGM 15-002 “Enforcement Discretion for Tornado-generated Missile Protection Noncompliance”¹⁰
 - RIS-15-06, Tornado Missile Protection¹¹
- **Examples of GDC Violation**
 - Severity Level (SL)-III Violation – GDC 17
 - LaSalle Units 1 and 2 Inspection Report 05000373/2015010; 05000374/2015010¹²

- **Industry Action**
 - February 16, 2012 – INPO Issued Level 2 IER
 - Document described the Byron Unit 2 event
 - Required review of corrective actions by all licensees and development of corrective action plans and schedules

 - 4th Quarter 2012 - INPO Interim Actions for Operating Plants
 - Have adequate plant operating procedures
 - Promptly diagnose and respond to open phase conditions

- **Industry Action**
 - October 9, 2013 (Letter)¹³ – Industry-wide initiative submitted
 - Nuclear Energy Institute submittal to support resolution of OPC issue
 - Industry initiative addresses all operating plants and new reactor active plant designs
 - Implementation of design changes by December 31, 2017
 - Endorsed by Nuclear Strategic Issues Advisory Committee (NSIAC)

 - March 16, 2015 (Letter)¹⁴ – Industry-wide initiative updated
 - Implementation of design changes extended 1-year to December 31, 2018 due to enhanced knowledge of issue and potential modification options
 - Endorsed again by NSIAC
 - Implementation of design changes by December 31, 2018

- **NRC Response**

- Letter to NEI dated November 25, 2014¹⁵

- The staff noted that the capability of the onsite power system to permit functioning of SSCs may depend upon successful operation of OPIS
- Proposed solution needs to fully address GDC 17 or the principal design criteria specified in each plant's UFSAR.
- The staff also communicated 4 functional criteria for demonstrating compliance with regulatory requirements.

- Enforce current requirements
- Grant enforcement discretion for licensees who determine electric power systems are inoperable
 - Seek Commission approval
 - Send the SECY paper package to the Commission

Interim Enforcement Policy

- The staff is seeking Commission approval to allow enforcement discretion while licensees correct the design deficiency under the industry initiative.
- Available if a licensee determines that the electric power system is not in compliance with GDC 17 or the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), or is not in conformance with the analogous UFSAR principal design criteria, as described in the current licensing basis.

Interim Enforcement Policy (cont.)

- The staff will normally exercise enforcement discretion related to a failure to comply with the associated TSs due to inoperable power sources if the licensee takes:
 - **Immediate Actions** (e.g., interim compensatory measures)
 - **Short-term Actions** (e.g., develop an action plan and submit required license amendment requests to NRC)
 - **Long-term Actions** (plant modifications)
- IEP in place until January 30, 2019
- Maintains safety and provides reasonable assurance of adequate protection of public health and safety
 - Corrective actions
 - Compensatory measures

Potential Backfitting

- In the event that the actions taken by a licensee to correct the OPC design vulnerability do not adequately address potential OPCs that might occur in offsite power sources by the date committed to under the industry's initiative (December 31, 2018), the NRC staff may consider implementing plant-specific backfits in accordance with 10 CFR 50.109, "Backfitting."
- The staff has reviewed the backfitting issue and has prepared a Documented Evaluation that supports the conclusion that the consideration of potential OPCs in offsite power sources is necessary to bring a facility into conformance with the licensee's written commitments.
- This evaluation further supports updating the CLB for operating nuclear reactors, on a plant-specific basis, to require that the electric power systems meet GDC 17 or the analogous principal design criteria specified in the UFSAR.

Backfit Evaluation

- Staff prepared a documented evaluation of the compliance backfit exception.
- Evaluation supports changing the current licensing basis for operating nuclear reactors to require that the electric power system meet 10 CFR Part 50, Appendix A, "General Design Criterion 17, "Electric Power Systems," or the principal design criteria specified in the final safety analysis report assuming all potential open phase conditions in offsite power.
- Evaluation provides the basis that this proposed backfit falls within the compliance exception in 10 CFR 50.109(a)(4)(i)

Backfit Evaluation (cont.)

- 10 CFR 50.109(a)(4)(i) provides that a backfit analysis need not be prepared to support an NRC backfitting action if a documented evaluation demonstrates that the modification constituting backfitting is “necessary to bring a facility into compliance with a license or the rules or orders of the Commission, or into conformance with the written commitments by the licensee....”
- The Commission shed additional light on how the compliance exception should be interpreted in the Supplementary Information published with its 1985 final backfitting rule:
 - The compliance exception is intended to address situations in which the licensee has failed to meet known and established standards of the Commission because of omission or mistake of fact. It should be noted that new or modified interpretations of what constitutes compliance would not fall within the exception and would require a backfit analysis and application of the standard.

- **Basis for Compliance Exception**

- The “known and established standards” at issue
- The prior NRC staff approval(s) of the licensee’s method of compliance with such “known and established standards
- The specific omission or mistake of fact that undermines the prior NRC staff approval(s)
- An evaluation explaining that, but-for the identified omission or mistake of fact, the NRC staff would not have issued the prior approval;
- A description of how the NRC has interpreted the “known and established standards” at issue (with respect to the specific licensee in the case of a facility-specific backfit, or generically in the case of a generic backfit).

- IEP/SECY to Commission 5/30
- IEP Issued Following Commission Approval
- RIS Issued 4th Qtr 2016.
- TI (1) to verify interim corrective actions issued to regions when IEP approved
- TI (2) to be developed in 2017 and verifies each plant's final plant modification

Reference Documents

Ref. No.	ADAMS Accession No.	Document
1	ML12306A362	Accident Sequence Precursor Analysis for the Byron Unit 2 1/30/2012 Event
2	ML12087A213	IR 05000455-12-008 Byron Station, Unit 2, Special Inspection Report
3	ML120480170	NRC Information Notice 2012-03, "Design Vulnerability in Electric Power System," dated March 1, 2012
4	ML12074A115	NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," dated July 27, 2012
5	ML13052A711	Summary Report for NRC Bulletin 2012-01 Responses, dated February 26, 2013
6	ML14343A485	ACRS Letter for November 17, 2014 Sub Committee and December 4, 2014 Full Committee Briefing
7	ML14364A348	Response to ACRS Letter
8	ML15057A085	Branch Technical Position 8-9, dated July 2015
9	ML15111A269	Enforcement Guidance Memorandum 15-002, Enforcement Discretion for Tornado-Generated Missile Protection Noncompliance
10	ML113050583	RIS 2011-12, Revision 1, "Adequacy of Station Electric Distribution System Voltages"
11	ML15020A419	RIS 2015-06, "Tornado Missile Protection"
12	ML15308A566	LaSalle County Station, Units 1&2, Unresolved Item Closure Inspection Report

Reference Documents

Ref. No.	ADAMS Accession No.	Document
13	ML13333A147	Nuclear Energy Institute (NEI) letter, dated October 9, 2013
14	ML15075A455	Nuclear Energy Institute (NEI) letter, dated March 16, 2015
	ML15075A456	Nuclear Energy Institute (NEI) letter, dated March 16, 2015, Attachment
15	ML14120A203	William M. Dean (NRC) letter to Anthony Pietrangelo (NEI), dated November 25, 2014
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QUESTIONS ?