Watts Bar Nuclear Plant

Power System

August 19, 2013

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Degraded Voltage Relay Settings

Overview of TVA's Protection and Coordination

- Typical TVA Degraded Voltage Scheme (BFN, SQN, WBN)
  - Equipment Connections
    - 1 DVR relay connected to A-B phase
    - 1 DVR relay connected to B-C phase
    - 1 DVR relay connected to C-A phase
  - Relays require a 2 out of 3 logic to disconnect from the offsite power source
  - Protection and coordination analysis to determine maximum time delay components can operate without
    - sustaining damage,
    - loss of operating life, or
    - becoming unavailable.

Reasons TVA is not susceptible to the grounded Byron Events

- Phase monitoring is on all three phases. During a grounded open phase, voltage is lowered on 2 of the 3 phases.
- Protection logic favors protection by disconnecting from the offsite power source
  - Voltages would trigger the DVR
  - Voltages may trigger the LOV

Considerations for an Ungrounded Open Phase Event

- Station Vulnerability to Ungrounded Open Phase Conditions
- Effects of Ungrounded Open Phase on Operating (Running) Motors
- Effects of Ungrounded Open Phase on Starting Motors

Vulnerability of an Ungrounded Open Phase at TVA

- Walkdowns have been performed at all 3 stations
- Vulnerabilities where a single failure could cause an ungrounded open phase:
  - Single stinger connections to transformer bushings & small section of overhead line

Effects of an Ungrounded Open Phase on Operating Motors

- Analysis is required to determine effects
  - TVA has worked with ETAP to develop capability to accurately model an Open Phase event
  - TVA plans to use ETAP to accurately model an open phase.

Preliminary Analysis – Effects of an Ungrounded Open Phase at TVA

- Heavily loaded systems will actuate the two out of three DVR protection scheme
- Lightly loaded systems may not produce damaging negative sequence currents (i.e. motors remain within ratings and are not damaged)
- Further analysis is required to determine specific effects for specific station loading scenarios

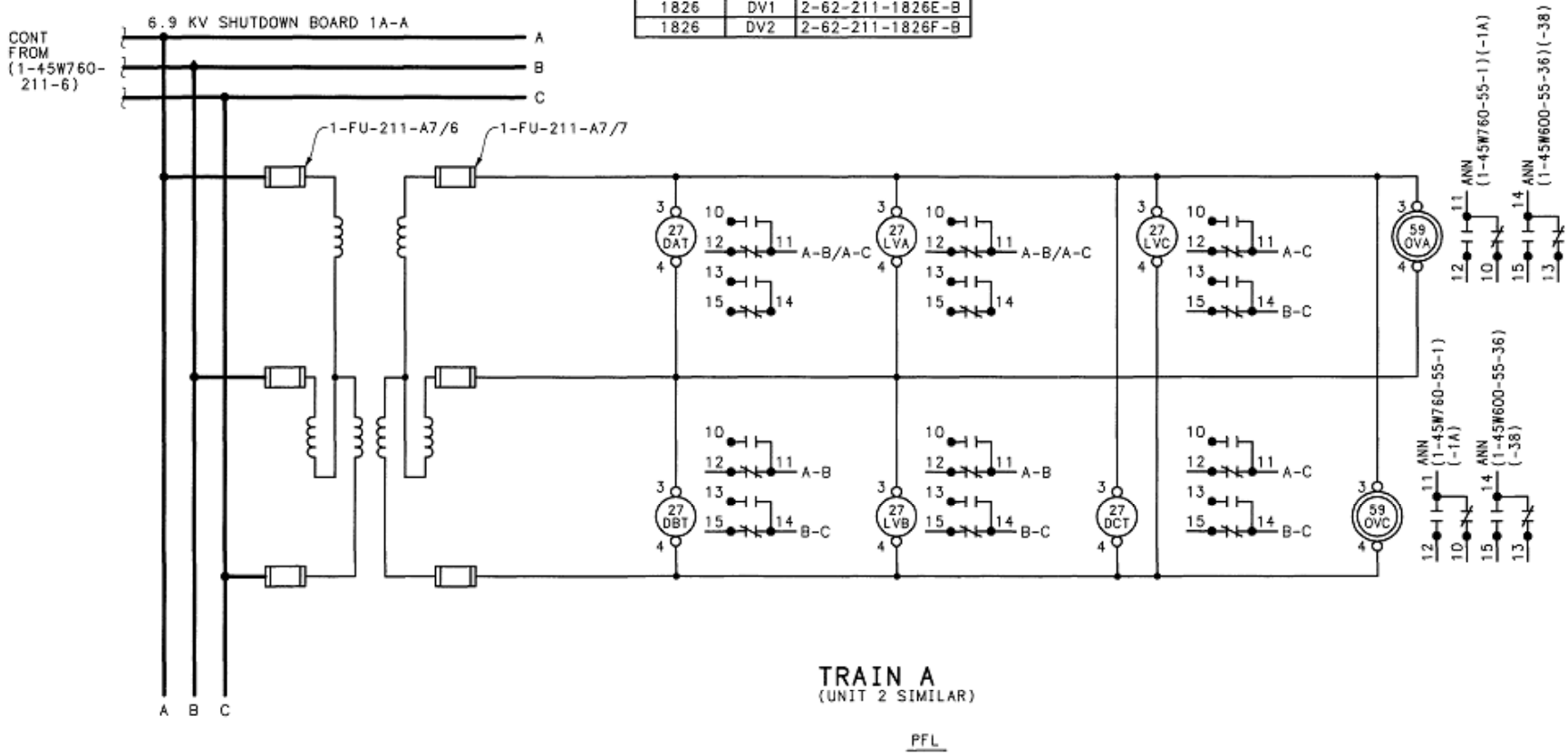
TVA's Path Forward - Typical Degraded Voltage Connections

RELAY UNIQUE IDENTIFIERS

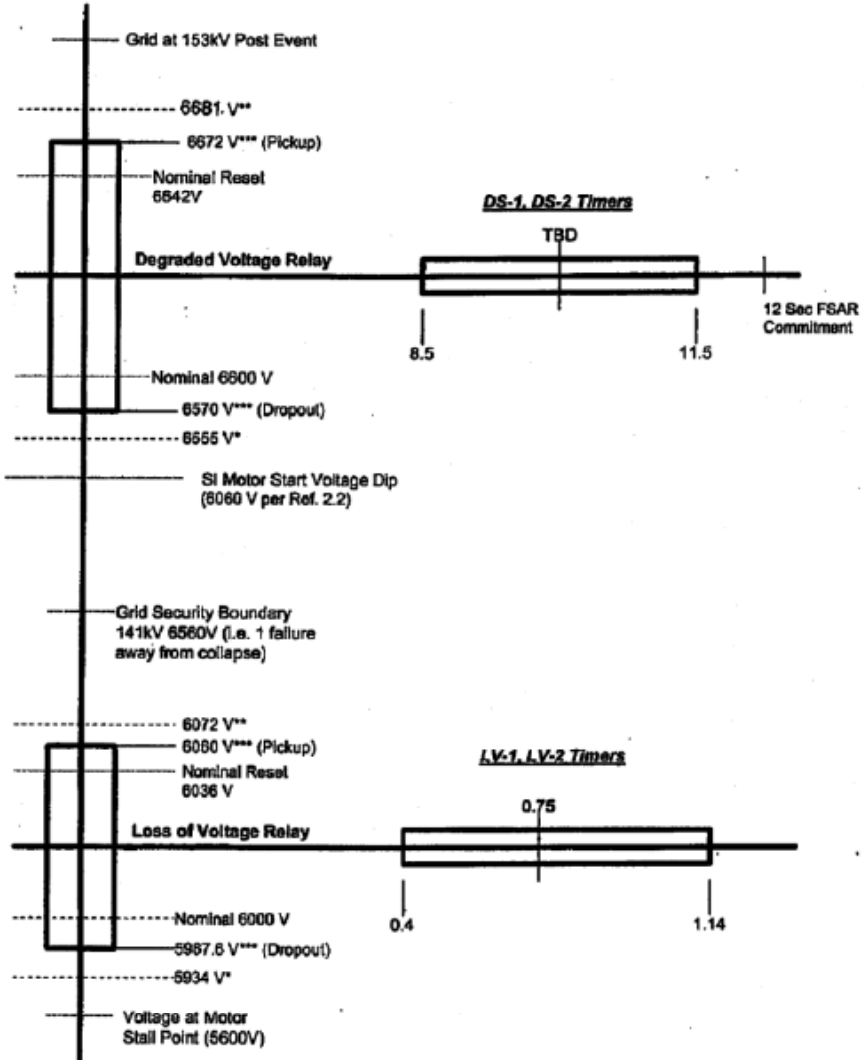
BREAKER NUMBER	RELAY	RELAY UNID
1718	DV1	1-62-211-1718E-A
1718	DV2	1-62-211-1718F-A
1726	DV1	1-62-211-1726E-B
1726	DV2	1-62-211-1726F-B
1818	DV1	2-62-211-1818E-A
1818	DV2	2-62-211-1818F-A
1826	DV1	2-62-211-1826E-B
1826	DV2	2-62-211-1826F-B

RELAY UNIQUE IDENTIFIERS

59-OVA	2-RLY-211-A000/OVA-A
59-OVC	2-RLY-211-A000/OVC-A
59-OVA	1-RLY-211-A000/OVA-A
59-OVC	1-RLY-211-A000/OVC-A
59-OVA	1-RLY-211-B000/OVA-B
59-OVC	1-RLY-211-B000/OVC-B
59-OVA	2-RLY-211-B000/OVA-B
59-OVC	2-RLY-211-B000/OVC-B



WBN Voltage Protection



Open Phase Issue Actions

- Demonstrate that safety functions remain available given an open phase condition or install plant modifications to detect and automatically disconnect from the open phase condition.
- If the open phase condition prevents the functioning of safety related structures, systems, and components, the engineered safeguard buses should transfer to an alternate GDC-17 offsite power source or to the onsite power source.

Open Phase Issue Actions

- December 31, 2014
  - Demonstrate compliance with the open phase condition criteria through analysis or identify appropriate actions required to demonstrate compliance
- December 31, 2016
  - Complete implementation of design changes, if necessary, to comply with the open phase condition criteria. The “active” protection features of new technology designs may be installed in a monitoring mode, with adequate justification, to demonstrate reliability.
- December 31, 2017
  - If a monitoring period was deemed necessary, complete any design adjustments identified during the monitoring period and enable all “active” protection features needed to demonstrate compliance with the open phase condition criteria.

Degraded Voltage

- WBN 2 will demonstrate for Unit 2 loads that:
  - All Safety Related motors successfully started with worst case grid conditions.
  - All safety related motors will continue to run assuming worst case post accident loading and the 6.9 KV Shutdown Boards at the Degraded Voltage Drop Out.
  - All safety related motors will individually start assuming worst case post accident loading and the 6.9 KV Shutdown Boards at the Degraded Voltage Drop Out.
  - All safety related loads will not trip the associated breakers or damage the motor:
    - If they are stalled due to a degraded voltage during the period that the degraded voltage relays are timing.
    - Can then be successfully started once the onsite power becomes available.

New Station Blackout Rule (SBO)

New Station Blackout Rule (SBO)

- Watts Bar Unit 2 is treated as an “Operating Plant” in the context of the Draft Rule
- Final impacts of this rulemaking are not known at this time
- The NRC considers it is reasonable to assume the impacts of a potential rule would largely be the same as those currently being incurred by the Fukushima Order on Mitigating Strategies
- Based on stakeholder feedback to date, this consideration regarding Fukushima Order requirements appears true at this time.

New Station Blackout Rule (SBO)

- The current schedule for a final rule is April 2014
- Changes in the approach would result in challenges to issuance of the draft rule or result in unanticipated impacts late in the WBN Unit 2 Licensing process.
- Implementation actions for the Fukushima Strategy may complicate and challenge the implementation of a Station Blackout Rule in parallel
- Assessments of SBO mitigating Strategies are not schedule to occur until late 2014 or Spring 2015 which impacts WBN Unit 2 License Schedule

Emergency Diesel Generator Frequency Issue

Overview of WBN Onsite AC Power

- WBN has 4 Emergency Diesels
- Each Diesel Powers 1 of 4 - 6900 Volt Shutdown Boards (1A-A, 1B-B, 2A-A, 2B-B)
  - 4 Power Trains
    - 2 per Load Group
    - 2 per Unit
- Unit 1 Tech Spec 3.8.1 Requires 4 Operable Diesels for Unit 1
- Unit 2 Tech Spec 3.8.1 Requires 4 Operable Diesels for Unit 2
- Primary ECCS loads on respective Unit diesels (U1 ECCS on U1 diesels, etc)

Current Unit 1 Technical Specification Surveillance

- Manual Start
  - Voltage and frequency controlled by operator.
- Fast Start
  - Meets minimum Steady State Voltage and > 58.8 Hz
  - Reaches steady State Condition of:
    - Voltage ≥ 6800 and ≤ 7260
    - Frequency ≥ 58.8 and ≤ 61.2 Hz

Industry Issues

- Westinghouse NSAL 93-022
  - Identified T/S Frequency Limits may not Support Safety Analysis
- WBN 2006 CDBI Result
  - Test the Diesel Governor to $\geq$ 60.0 to $\leq$ 60.1 Hz
- PWROG Drafted WCAP-17308, Treatment of Diesel Generator (DG) Technical Specification Frequency and Voltage Tolerances

WBN Unit 2 Evaluations

- Proposed Frequency T/S ≥ 59.8 to ≤ 60.2 Hz
- Westinghouse Evaluated Potential Impacts on Safety Analysis
  - Re-analysis of ECCS flow at frequency limits (established upper and lower flow limits)
  - Chapter 15 events and containment analysis re-examined with new flows
  - Minimum Flow Rates Acceptable
  - Overfill Events Acceptable
- ECCS Pump Performance Acceptable Based on Flowserve evaluation (new runout)
- TVA Evaluated Other Equipment (MOVs, Compressors, Etc) with Acceptable results for Both WBN Units

WBN Unit 1 Evaluations

- Westinghouse Evaluating Potential Impacts on Safety Analysis
  - One analysis remains to be completed. Sensitive to upper frequency limit.
  - Other events acceptable for full range 60+/-0.2 Hz.
  - Remaining Evaluation Scheduled for 1st Quarter 2014
- ECCS Pump Performance Acceptable Based on Flowserve Evaluation
- TVA Evaluated Other Equipment (MOVs, Compressors, Etc) with Acceptable results for Both WBN Units

TVA's Path Forward

- Technical Resolution Needed Earlier than Current Unit 1 Schedule
- Limit Frequency Surveillance to ≥ 59.8 to ≤ 60.0 Hz
- Westinghouse Can Complete Unit 1 Evaluation for lower frequency in Approximately 4 Weeks from Authorization
- Submit Letter with Tech Spec Mark-up on Unit 2 Based on Frequency Limit

TVA's Path Forward

- Submit LAR for Unit 1 (Interim Frequency Value)
- Continue Westinghouse Evaluation of Unit 1 for Proposed Frequency of $\geq$ 59.8 to $\leq$ 60.2 Hz
- Submit LAR for Both Units after Operating License Issued for Unit 2 to Implement the Final Technical Specification

Questions?