

Brunswick Nuclear Plant

Loss of Voltage/Degraded Voltage Relays

NRC Teleconference
February 23, 2010



Agenda

- Background
- Actions Taken
- Design and Licensing Review
 - Loss of Power (LOP) Instrumentation – TS 3.3.8.1
 - AC Electrical Power Sources – TS 3.8.1
 - Technical Specification (TS) Bases 3.3.8.1
- Logic System Functional Test (LSFT)
- Actions Remaining

Background

- During development of EC 73119 (Vendor Exceptions to Degraded Voltage Relay 27DV Procurement Specification) discrepancies were discovered with DC control voltage values (Nuclear Condition Report (NCR) 369186)
- As part of the operability review, several questions were raised regarding adequacy of the Loss of Voltage and Degraded Voltage functions (Tech Spec 3.3.8.1) of the Class IE 4KV Emergency Buses

Actions Taken

- Determined Design and Licensing Basis requirements for Undervoltage Relays and EDG start logic
- Reviewed TS and TS Bases for conformance to the Design and Licensing Basis
- Performed LSFT review for Undervoltage and Emergency Diesel Generator (EDG) start functions
- Performed 480V load study on Degraded Voltage condition
- Performed review of Protective Relay settings of Degraded and Loss of Voltage Relays
- Conducted Third Party Reviews
- Constantly reassessed operability and safety, via Operability Concern Review (OCR) process, pending completion of third party reviews
- Conducted periodic Plant Nuclear Safety Committee meeting reviews

LOP Instrumentation - TS 3.3.8.1

- TS 3.3.8.1 Loss of Voltage Relay 27/59E
 - Electromechanical inverse time delay undervoltage relay
 - One-out-of-One trip function
 - Function
 - Trip E bus motor load breakers
 - Trip E bus tie breakers
 - Provide EDG breaker close permissive

LOP Instrumentation – TS 3.3.8.1

- TS 3.3.8.1 Degraded Voltage Relay 27DV
 - Consists of three definite time solid state undervoltage relays (27/DVA, 27/DVB and 27/DVC)
 - Two-out-of-Three trip function
 - Function
 - Isolate E Bus from offsite source (trip Master and Slave Breakers)

AC Electrical Power Sources – TS 3.8.1

- Class 1E Undervoltage Relay monitor the voltage on each 4.16 kV emergency bus
 - High Speed Undervoltage Relay 27HS
 - Definite time solid state undervoltage relay
 - One-out-of-One trip function
 - Function
 - Start EDG

LOP Instrumentation – TS 3.3.8.1

- Under degraded voltage conditions coincident with a Large Break LOCA, the LOCA Initiation signal is the credited EDG start signal rather than the 27HS or slave breaker contacts since these devices would not actuate early enough to meet the time to injection requirements of the accident analysis
- The LOCA initiation function is covered under other instrumentation specs
- All instruments associated with the EDG start and EDG output breaker closure have been excluded from TS 3.3.8.1
- The remaining instruments are devices covered under TS 3.8.1

TS Bases 3.3.8.1

- The TS Bases for the loss of voltage relays (27/59E) do not match the current plant design or current Licensing Bases (NCR 369409)
- TS Bases Section 3.3.8.1 indicates instrumentation functions for Loss of Voltage 27/59E Relay performs functions that it was not designed to accomplish
 - Transfer the associated bus from offsite power to the EDG
 - Start the EDG
- Current descriptions for the Loss of Voltage and Degraded Voltage functions in BNP TS Bases are essentially identical to the descriptions provided with the generic Improved Technical Specification (ITS) bases in NUREG 1433 Rev. 1, which was used to prepare BNP's ITS Submittal in November 1996
- These generic descriptions do not accurately reflect the BNP design configuration or licensing basis for these functions
- BNP when transitioning to ITS incorrectly adopted the generic ITS bases

Results

Design and Licensing Basis Review

- Current LOP Instrumentation TS 3.3.8.1 reflects existing plant LOP Instrumentation design
 - Design is consistent with Licensing Basis
 - Current Instrumentation TS reflects existing Design
 - Loss of Voltage function accomplished by 27/59E relays
 - Degraded Voltage function accomplished by the 27DV relays
- DG Start Signal Review determined 2 credited starts
 - 27HS (Loss of Voltage), Loss of Offsite Power coincident with LOCA
 - Degraded Voltage coincident with LOCA
- 480V load study on Degraded Voltage conditions shows 480V loads would operate as required
- The TS Bases for the loss of voltage relays (27/59E) do not match the current plant Design or current Licensing Basis (NCR 369409)

Logic System Functional Test

- Performed LSFT review for Undervoltage and EDG start functions
- Performed Detailed Review of the Logic
 - ◆ Contact by contact review using current drawings and surveillances
 - ◆ Color coded drawings to document review

Logic System Functional Test

- 27HS is the Class 1E instrument responsible for the credited EDG start during a LOOP coincident with LOCA
 - ◆ 27HS is in a parallel channel with the master and slave breaker logic associated with the 27DV Relays
 - ◆ The Slave breaker contact initiates the EDG start before the 27HS for Degraded Voltage. Slave contact not credited. LOCA initiation signal is credited for Degraded Voltage with LOCA
 - ◆ Logic required to be tested under TS Surveillance Requirement 3.8.1.14
 - ◆ 27HS contact in the EDG start logic are not functionally verified during the performance of the LSFT (NCR 379456)
 - ◆ 27HS had been last functionally tested when installed in 1983
 - ◆ Proactively performed the following, while still investigating the requirements:
 - ◆ PRA completed on 12/10/09
 - ◆ Testing conducted satisfactorily on 02/06/10
 - ◆ Missed surveillance in accordance with SR 3.0.3

Logic System Functional Test

- LOCA initiation EDG start is the credited EDG start during the Degraded Voltage coincident with LOCA
 - ◆ Test Relays (8 contacts) in the EDG start logic found not functionally verified during the performance of the LSFT (NCR 379454)
 - ◆ 4 of the 8 Test Relay contacts have Plant Information System Data that show these relay contacts perform the required function
 - ◆ For the remaining 4 contacts there is no verification of the “as left” configuration of the contacts
 - ◆ Logic required to be tested under TS Surveillance Requirement 3.8.1.14
 - ◆ Proactively performed Continuity Check on 01/28/10, while still investigating the requirements
 - ◆ Identified as a never performed surveillance

Results

Logic System Functional Test

- Identified the following not functionally verified during the performance of the LSFT:
 - 27HS contact in the EDG start logic (NCR 379456)
 - Test Relays (8 contacts) in the EDG start logic (NCR 379454)
 - Logic required to be tested under TS Surveillance Requirement 3.8.1.14
- Not Reportable: Testing demonstrated equipment is operable
- Loss of Voltage 27/59E and Degraded Voltage 27DV relay settings were determined to be acceptable based on the calculations

Actions Remaining

- Revise TS Bases 3.3.8.1 to eliminate confusion associated with the LOP Instrumentation functions (NCR 369409)
- Revise appropriate surveillance procedures to verify the “as left” configuration of contacts for the EDG Test Relays and incorporate required testing for the 27HS (NCR 379454 and 379456)
- Implement design change to Undervoltage scheme (NCR 369186)
 - Unit 2 - 2011 Refuel Outage
 - Unit 1 - 2012 Refuel Outage

Actions Remaining

- LSFT 96-01 Extent of Condition Review (NCR 379762)
 - Risk significant systems selected for review
 - EDG Load Sequencing Logic
 - Automatic Depressurization System (ADS) Logic
 - High Pressure Coolant Injection System Logic
 - Scope of review will be expanded to additional Systems if additional issues are identified
 - Verify Design Functions are Tested
 - Reviews to be performed in accordance with Guidance provided in Generic Letter 96-01 Logic System Functional Testing including Lessons Learned from other LSFTs not adequately performed

Questions?