DIABLO CANYON POWER PLANT
Pre-application Meeting, Diesel Generator License Amendment Request
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Agenda

- Diablo Canyon Power Plant (DCPP) Diesel Generator (DG) Licensing Basis
- Changes to License Amendment Request (LAR) Scope since January 15, 2013 meeting
- Issues to be Resolved by LAR
- Scope of Tech Spec (TS) Changes
- Specific TS Changes
- DG Load Margin Program
- Staff Feedback

DCPP DG Licensing Basis

- Safety Guide 9 (SG 9), dated March 10, 1971
  - Provides basis for DG design
  - DG Ratings:
    - 2600 kW, Continuous (8000 hours per year)
    - 2750 kW, 2000 hours per year
    - 2860 kW, 2 hours per 24 hours
    - 3056 kW, 30 minutes per year
    - Generator full load rating at 80% PF = 3250 kVA
  - Approved exception to SG 9, Regulatory Position C.4 for AFW pump frequency recovery time

DCPP DG Licensing Basis

- Regulatory Guide (RG) 1.108, Revision 1
  - Provides basis for DG testing
  - Approved exceptions to RG 1.108, Rev 1:
    - Regulatory Position 2.a for DG surveillance frequency
    - Regulatory Position 2.a.(5) for modified DG hot start
    - Regulatory Positions 2.a.(9), 2.d, 2.e, and 3 for DG test validation
    - Regulatory Positions 2.a.(3) and 2.c.(2) for verification that DG cooling system functions within design limits

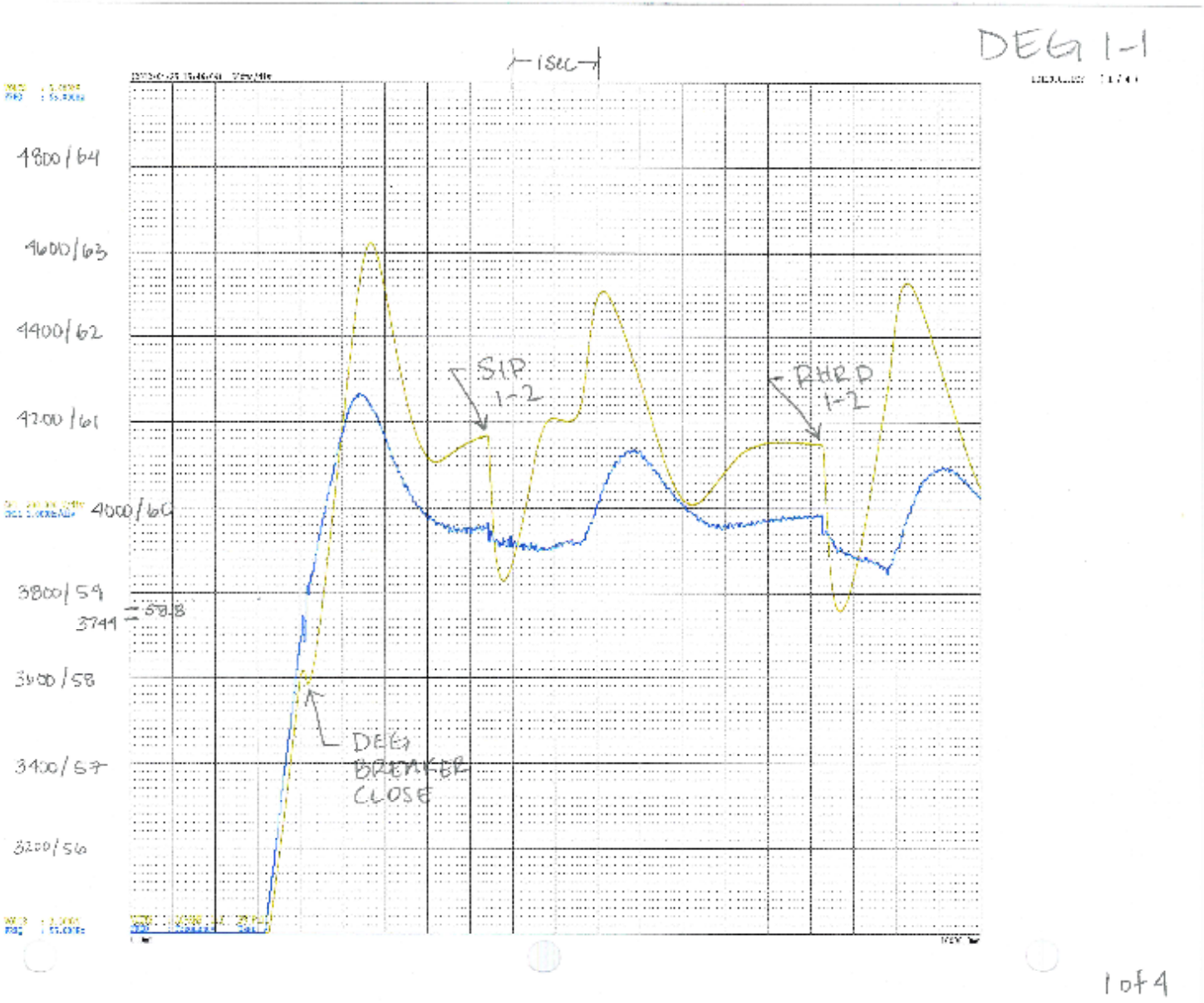
DCPP DG Licensing Basis

- RG 1.137, Revision 1
  - Endorses ANSI N195-1976 which provides basis for fuel oil and lube oil volume requirements

Changes to LAR Scope

- Incorporated ambient air temperature derate in accordance with manufacturer's recommendations.
- Included reduction in low end of frequency band. Proposed steady state frequency band is 60 ± 0.8 Hz. (Typical DG performance is ± 0.25 Hz)
- Included reduction in voltage band. Proposed steady state voltage band is 4160 ± 180 V.
- Correct TS SR 3.8.1.9 to restore compliance with RG 1.108 Rev. 1 Position 2.a.(4).

Typical DG Voltage and Frequency Loading Response Plots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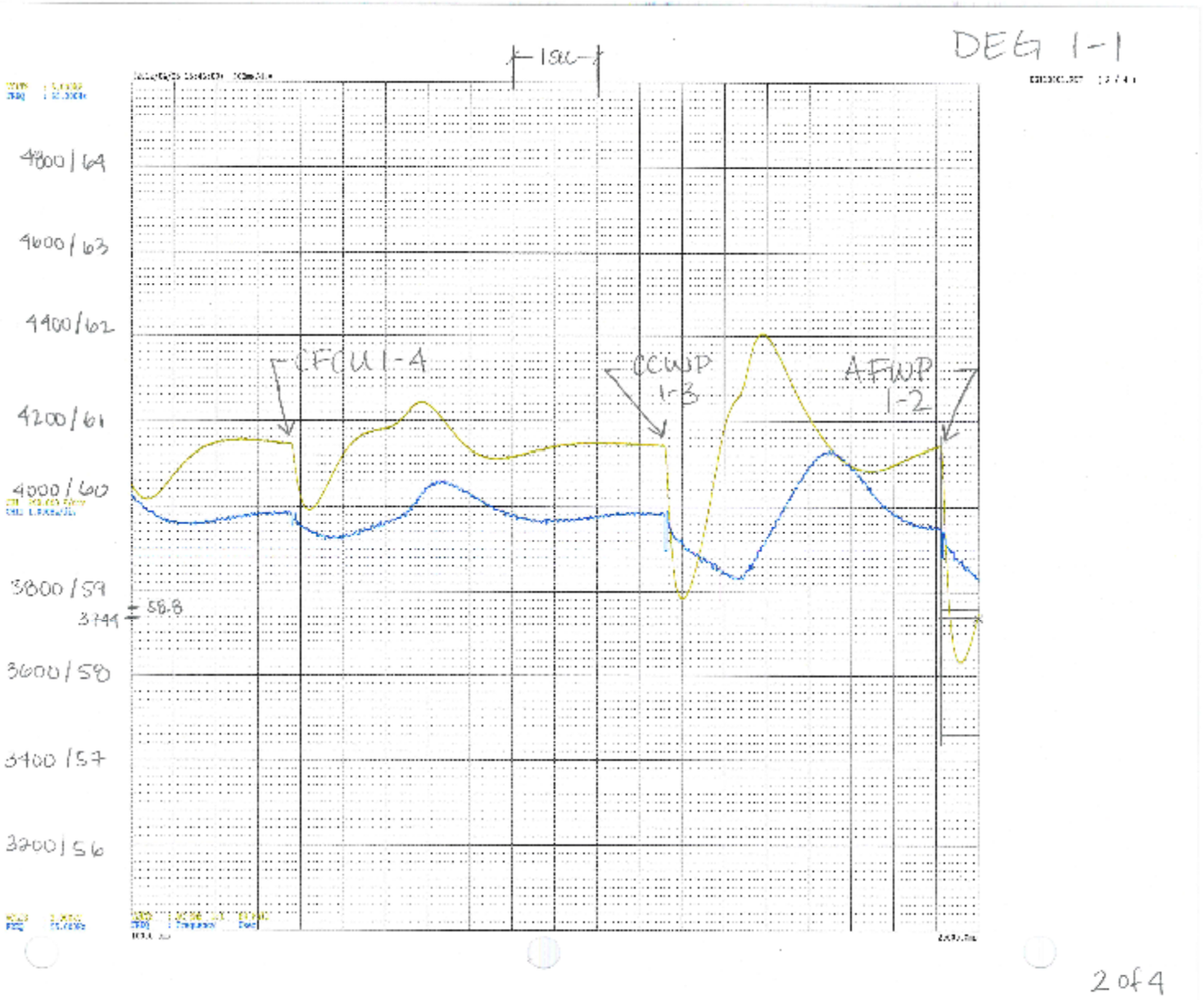
1sec
4800/64
4600/63
4400/62
4200/61
4000/60
3800/59
3744
3600/58
3400/57
3200/56
SIP 1-2
RHRP 1-2
DEG BREAKER CLOSE
1 of 4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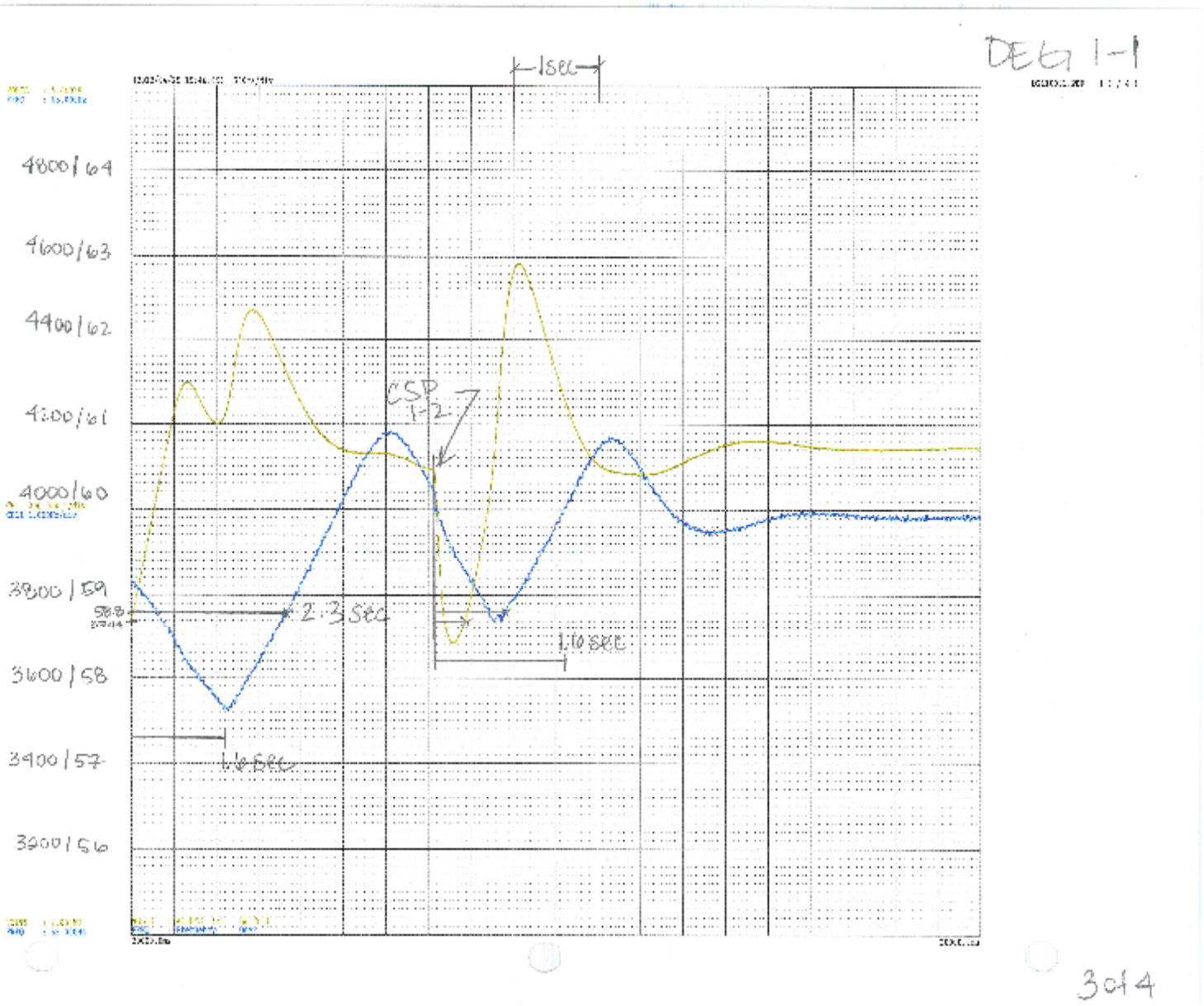
180
4800 / 64
4600 / 63
4400 / 62
4200 / 61
4000 / 60
3800 / 59
3744
58.8
3600 / 58
3400 / 57
3200 / 56
CFCU 1-A
CCWP 1-3
AFWP 1-2
2 of 4


DEG 1-1
1sec
4800/64
4600/63
4400/62
4200/61
4000/60
3800/59
3600/58
3400/57
3200/56
CSP 1-27
2.3 sec
1.10 sec
1.6 sec
3 of 4

Issues to be Resolved by LAR

- Submittal of amendment request addresses NRC Administrative Letter 98-10 guidance to submit an amendment request to correct non-conservative TS values in a timely fashion.

Issues to be Resolved by LAR

- DG maximum steady state loading exceeds 2000-hour DG rating (2750 kW) at current Surveillance Requirement (SR) maximum frequency and voltage values
  - Current SR maximum frequency value = 61.2 Hz, voltage value = 4400 V
    - Current administratively controlled maximum frequency value = 60.5 Hz (including 0.25 Hz instrument unc.)
  - DG loading analyses maximum 60.8 Hz/4340 V maintains load < 2750 kW

Issues to be Resolved by LAR

- Current SR load values based on Standard TS (STS) that are based on RG 1.9, Rev 3 as opposed to RG 1.108, Rev 1
  - RG 1.9, Rev 3 assumes maximum loading below continuous DG rating
  - RG 1.108, Rev 1 requires demonstration of full-load-carrying capability (continuous DG rating)
  - DG maximum loading at 60.8 Hz/4340 V (2663 kW) exceeds continuous DG rating (2600 kW)

Issues to be Resolved by LAR

- Current SR Power Factor (PF) values do not bound DG loading analysis calculated values
  - Current SR minimum PF value = 0.87
  - DG loading analysis minimum PF value = 84.6%

Issues to be Resolved by LAR

- Current SR day tank volume based on continuous rating versus maximum loading
  - RG 1.137, Rev 1 endorses ANSI N195-1976, which requires each day tank to contain fuel oil for at least 60 minutes of DG operation assuming fuel oil consumption with the DG running at 100% continuous rated load plus 10% additional margin
  - Required fuel oil for 1 hour of DG operation at maximum loading (2663 kW) is greater than current SR minimum day tank volume (250 gal)

Issues to be Resolved by LAR

- Current SR full load rejection test value does not meet RG 1.108, Rev 1 requirements
  - RG 1.108, Rev 1 requires demonstration of proper operation during DG load shedding, including a test of complete loss of load
  - Consistent with STS, current SR provides a loading band between 90% and 100% of continuous DG rating (2340 kW to 2600 kW)
  - DG maximum loading at 60.8 Hz and 4340 V (2663 kW) exceeds continuous DG rating (2600 kW)

Issues to be Resolved by LAR

- Current SR capability test load values do not meet RG 1.108, Rev 1 requirements
  - RG 1.108, Rev 1 requires demonstration of full-load-carrying capability (continuous DG rating) for intervals not less than 1 hour (SR 3.8.1.3) and 24 hours (SR 3.8.1.14)
  - Consistent with STS, current SRs provide a loading band between 90% and 100% of continuous DG rating (2340 kW to 2600 kW) for full-load-carrying capability tests

Issues to be Resolved by LAR

- Non-conservative TS SR 3.8.1.9
  - Current SR 3.8.1.9 allows 2.4 seconds for voltage and frequency recovery after a large load rejection.
  - RG 1.108, Rev 1 position 2.a.(4) requires demonstration that voltage and speed requirements are met after a large load rejection
  - SG 9 requires voltage and frequency recovery in 1.6 seconds.

Issues to be Resolved by LAR

- Address NRC Temporary Inspection Procedure Items
  - did not analyze for all postulated accidents
  - did not assume a single limiting failure
  - did not analyze at limiting voltage and frequency values
  - did not incorporate momentary loads
  - did not include manually initiated loads

DCPP DG Loading Analyses

- PG&E commissioned DG Load Study Analyses to evaluate vital 4160 V Engineered Safety Features (ESF) bus loading under various Design Basis Accident (DBA) Scenarios
  - Addresses NRC senior resident inspector observations related to NRC Temporary Instruction 2515/176
  - Address NRC CDBI Inspection Finding related to ambient air temperature derate.

DCPP DG Loading Analyses

- The following DBAs are considered in the DG Loading Analyses:
  - Event 1: Large Break Loss of Coolant Accident (LBLOCA)
  - Event 2: Small Break Loss of Coolant Accident (SBLOCA)
  - Event 3: Steam Generator Tube Rupture (SGTR)
  - Event 4: Steamline Rupture Inside Containment at Power
  - Event 5: Steamline Rupture Inside Containment at Hot Zero Power
  - Event 6: Feed Line Break
  - Event 7: Loss of Normal Feedwater
  - Event 8: Loss of Offsite Power (LOOP)
  - Event 9: Station Blackout (SBO)

DCPP DG Loading Analyses

- The following vital 4160 V ESF bus loading cases are considered for each of the postulated DBAs evaluated in the DG Loading Analyses:
  - Case 1: All DGs operating, all vital 4160 V ESF buses (F, G & H) energized with single component failure considerations
  - Case 2: Vital 4160 V ESF bus F has failed resulting in accident loads being supplied by vital 4160 V ESF buses G and H
  - Case 3: Vital 4160 V ESF bus G has failed resulting in accident loads being supplied by vital 4160 V ESF buses F and H
  - Case 4: Vital 4160 V ESF bus H has failed resulting in accident loads being supplied by vital 4160 V ESF buses F and G

DCPP DG Loading Analyses

- DG Loading Analyses inputs and assumptions
  - Both limiting single component failures and vital 4160 V ESF bus failures were considered in the analyses to determine the maximum steady state mechanical load demands on the vital 4160 V ESF buses
  - As-installed vendor pump/fan curves were utilized to determine the most limiting mechanical loading considering either the actual equipment performance or the equipment run-out conditions where appropriate

DCPP DG Loading Analyses

- DG Loading Analyses inputs and assumptions
  - No credit was taken for any Time Critical Operator Actions to reduce vital 4160 V ESF bus loading
  - Some credit was taken for delays in Operators manually starting loads (based on plant conditions and administratively controlled)
  - Some credit was taken for administratively controlling electrical configuration
  - Load after 2 hours reduced due to lower auxiliary feedwater flow demands
  - Load after 3 hours reduced due to lower containment spray flow demands

DCPP DG Loading Analyses

- The summarized vital 4160 V ESF bus loading results from the DG Loading Analyses with the DG operating at the proposed maximum steady state frequency of 60.8 Hz and 4340 V are as follows:

Unit	DG	Bus	Description	Loading < 2 hours	Loading 2-3 hours	Loading > 3 hours	Power Factor
1	1-3	F	Event 1, Case 4; LBLOCA, Bus H is De-Energized	2654 kW	2593 kW	2593 kW	84.6%
	1-2	G	Event 1, Case 4; LBLOCA, Bus H is De-Energized	2648 kW	2648 kW	2338 kW	85.4%
	1-1	H	Event 1, Case 3; LBLOCA, Bus G is De-Energized	2614 kW	2553 kW	2229 kW	86.6%
2	2-3	F	Event 1, Case 4; LBLOCA, Bus H is De-Energized	2663 kW	2602 kW	2602 kW	84.6%
	2-1	G	Event 1, Case 4; LBLOCA, Bus H is De-Energized	2641 kW	2641 kW	2330 kW	85.1%
	2-2	H	Event 1, Case 3; LBLOCA, Bus G is De-Energized	2592 kW	2531 kW	2207 kW	86.6%

DCPP DG Loading Analyses

- The DG Loading Analyses demonstrate that the DGs have sufficient capacity and margin to fulfill the onsite power source requirements established in GDC 17, “Electric Power Systems,” 1971

- The DG Loading Analyses demonstrate the DGs satisfy SG 9, Regulatory Position C.4 requirement that the peak continuous steady-state loading of the DGs under maximum output frequency and voltage following a postulated DBA does not exceed the smaller of the 2000-hr DG rating (2750 kW), or 90% of the 30-minute DG rating (90% of 3056 kW = 2750 kW)

Scope of TS Changes

- SR 3.8.1.2 (DG start from standby)
  - Steady state voltage and frequency ranges revised
- SR 3.8.1.3 (1-hour DG capability test)
  - DG full-load-carrying capability test band revised
  - Added DG cooling systems function within design limits
- SR 3.8.1.4 (fuel oil day tank volume)
  - Day tank fuel oil requirement revised
- SR 3.8.1.7 (DG start from standby)
  - Steady state voltage and frequency ranges revised

Scope of TS Changes

- SR 3.8.1.9 (DG partial load rejection)
  - Voltage and frequency recovery time limit revised.
- SR 3.8.1.10 (DG full load rejection)
  - DG operating PF value revised
  - DG full-load rejection test load value revised
  - Added note allowing PF > 0.84 if DG synchronized with offsite power
- SR 3.8.1.11 (LOOP)
  - Steady state voltage and frequency ranges revised

Scope of TS Changes

- SR 3.8.1.12 (DG start from SIS)
  - Steady state voltage and frequency ranges revised
- SR 3.8.1.14 (24-hour DG capability test)
  - DG operating PF value revised
  - DG 24 hour full-load-carrying capability test load values revised
  - Added DG cooling systems function within design limits
  - Added note allowing PF > 0.84 if DG synchronized with offsite power

Scope of TS Changes

- SR 3.8.1.15 (DG hot re-start test)
  - DG full-load-carrying capability pre-test load values revised
  - Steady state voltage and frequency ranges revised
- SR 3.8.1.19 (DG Start LOOP and SIS)
  - Steady state voltage and frequency ranges revised
- SR 3.8.1.20 (All DGs start from standby)
  - Steady state voltage and frequency ranges revised

Specific TS Changes

- SR 3.8.1.2 (DG start from standby)
  - Current steady state voltage band revised from
    ≥ 3785 V and ≤ 4400 V to
    ≥ 3980 V and ≤ 4340 V
  - Current steady state frequency band revised from
    ≥ 58.8 Hz and ≤ 61.2 Hz to
    ≥ 59.2 Hz and ≤ 60.8 Hz
    - Revised maximum steady state voltage and frequency to reduce post-accident DG loading.
    - Instrument uncertainty values included in surveillance test procedures

Specific TS Changes

- SR 3.8.1.3 (1-hour DG capability test)
  - Current loading band revised from
    ≥ 2340 kW and ≤ 2600 kW to
    ≥ 2680 kW and ≤ 2750 kW
    - Minimum load band value bounds maximum DG loading at frequency of 60.8 Hz and voltage of 4340 V
    - Maximum load band value allows for immediate retest
  - Added DG cooling systems function within design limits
    - Establishes compliance with RG 1.108 Rev. 1 Position 2.c(2)

Specific TS Changes

- SR 3.8.1.4 (fuel oil day tank volume)
  - Current DG day tank volume revised from ≥ 250 gal to ≥ 258 gal of usable fuel oil
  - Minimum volume value bounds fuel consumption at 2000-hour DG rating and maximum DG loading at 60.8 Hz / 4340 V
  - Meets ANSI N195-1976 requirement to ensure each day tank contains fuel oil for at least 60 minutes of operation assuming fuel oil consumption with the DG running at 100% continuous rated load plus a minimum additional fuel oil volume margin of 10%

Specific TS Changes

- SR 3.8.1.7 (DG start from standby)
  - Current steady state voltage band revised from
    ≥ 3785 V and ≤ 4400 V to
    ≥ 3980 V and ≤ 4340 V
  - Current steady state frequency band revised from
    ≥ 58.8 Hz and ≤ 61.2 Hz to
    ≥ 59.2 Hz and ≤ 60.8 Hz
    - Revised maximum steady state voltage and frequency to reduce post-accident DG loading
    - No change to transient minimum voltage or frequency values
    - Instrument uncertainty values included in surveillance test procedures

Specific TS Changes

- SR 3.8.1.9 (DG partial load rejection)
  - Current voltage recovery time limit revised from
    2.4 seconds to
    1.6 seconds
  - Current frequency recovery time limit revised from
    2.4 seconds to
    1.6 seconds
    - Restores compliance to RG 1.08 Rev. 1 Position 2.a.(4)
    - No change to the voltage or frequency ranges

Specific TS Changes

- SR 3.8.1.10 (DG full load rejection)
  - Current loading band revised from
    ≥ 2340 kW and ≤ 2600 kW to
    ≥ 2680 kW and ≤ 2750 kW
    - Minimum load band value bounds 2000-hour DG rating and maximum DG loading at 60.8 Hz/4340 V
  - Current PF revised from 0.87 to 0.84 to bound DG load analysis minimum power factor of 0.846
    - Consistent with STS, note is added that if grid conditions do not permit, the PF is not required to be met and shall be maintained as close as practicable

Specific TS Changes

- SR 3.8.1.11 (LOOP)
  - Current steady state voltage band revised from
    ≥ 3785 V and ≤ 4400 V to
    ≥ 3980 V and ≤ 4340 V
  - Current steady state frequency band revised from
    ≥ 58.8 Hz and ≤ 61.2 Hz to
    ≥ 59.2 Hz and ≤ 60.8 Hz
    - Revised maximum steady state voltage and frequency to reduce post-accident DG loading
    - Instrument uncertainty values included in surveillance test procedures

Specific TS Changes

- SR 3.8.1.12 (DG start from SIS)
  - Current steady state voltage band revised from
    ≥ 3785 V and ≤ 4400 V to
    ≥ 3980 V and ≤ 4340 V
  - Current steady state frequency band revised from
    ≥ 58.8 Hz and ≤ 61.2 Hz to
    ≥ 59.2 Hz and ≤ 60.8 Hz
    - Revised maximum steady state voltage and frequency to reduce post-accident DG loading
    - No change to the transient minimum voltage or frequency values
    - Instrument uncertainty values included in surveillance test procedures

Specific TS Changes

- SR 3.8.1.14 (24-hour DG capability test)
  - Current loading band for 2-hr portion revised from ≥ 2600 kW and ≤ 2860 kW to
    ≥ 2750 kW and ≤ 2860 kW
  - Current loading band for 22-hour portion revised from ≥ 2340 kW and ≤ 2600 kW to
    ≥ 2680 kW and ≤ 2750 kW
    - Minimum load band values bound maximum DG loading at maximum 60.8 Hz / 4340 V (worst case steady-state accident load)

Specific TS Changes

- SR 3.8.1.14 (24-hour DG capability test)
  - Current PF revised from 0.87 to 0.84 to bound DG load analysis minimum power factor of 0.846
    - Consistent with STS, note is added that if grid conditions do not permit, the PF is not required to be met and shall be maintained as close as practicable
  - Added DG cooling systems function within design limits
    - Establishes compliance with RG 1.108 Rev. 1 Position 2.c(2)
  - Minimum load band value is an exception to RG 1.108 Rev 1 Position C.2.a.(3) to test at load equivalent to 2-hour rating (2860 kW)

Specific TS Changes

- SR 3.8.1.15 (DG hot re-start test)
  - Current loading band for pre-test DG operation revised from ≥ 2340 kW and ≤ 2600 kW to
    ≥ 2680 kW and ≤ 2750 kW
    - Meets RG 1.108, Rev 1, Regulatory Position C.2.a.(5) requirements to demonstrate functional DG capability at full-load temperature conditions

Specific TS Changes

- SR 3.8.1.15 (DG hot re-start test)
  - Current steady state voltage band revised from
    ≥ 3785 V and ≤ 4400 V to
    ≥ 3980 V and ≤ 4340 V
  - Current steady state frequency band revised from
    ≥ 58.8 Hz and ≤ 61.2 Hz to
    ≥ 59.2 Hz and ≤ 60.8 Hz
    - Revised maximum steady state voltage and frequency to reduce post-accident DG loading
    - No change to the transient minimum voltage or frequency values
    - Instrument uncertainty values included in surveillance test procedures

Specific TS Changes

- SR 3.8.1.19 (DG Start LOOP and SIS)
  - Current steady state voltage band revised from
    ≥ 3785 V and ≤ 4400 V to
    ≥ 3980 V and ≤ 4340 V
  - Current steady state frequency band revised from
    ≥ 58.8 Hz and ≤ 61.2 Hz to
    ≥ 59.2 Hz and ≤ 60.8 Hz
    - Revised maximum steady state voltage and frequency to reduce post-accident DG loading
    - Instrument uncertainty values included in surveillance test procedures

Specific TS Changes

- SR 3.8.1.20 (All DGs start from standby)
  - Current steady state voltage band revised from
    ≥ 3785 V and ≤ 4400 V to
    ≥ 3980 V and ≤ 4340 V
  - Current steady state frequency band revised from
    ≥ 58.8 Hz and ≤ 61.2 Hz to
    ≥ 59.2 Hz and ≤ 60.8 Hz
    - Revised maximum steady state voltage and frequency to reduce post-accident DG loading
    - No change to the transient minimum voltage or frequency values
    - Instrument uncertainty values included in surveillance test procedures

Specific TS Bases Changes

- TS 3.8.1 Bases
  - Addition of statement that DG loads in SRs 3.8.1.3, 3.8.1.10, 3.8.1.14 and 3.8.1.15 that no instrument uncertainties for test load values included in surveillance procedures
    - DG test load values are not modeled in accident analyses
    - DG test load values are limited by vendor ratings (define maintenance intervals)
    - Instrument uncertainty for DG load displayed by digital meters on the control room vertical board = 90 kW
    - Applying 90 kW uncertainty to each side of test load band adds 180 kW and could unnecessarily operate DG above rated values

Specific TS Bases Changes

- TS 3.8.1 Bases
  - Addition of statement that DG loads in SRs 3.8.1.3, 3.8.1.10, 3.8.1.14 and 3.8.1.15 that no instrument uncertainties for test load values included in surveillance procedures (cont.)
    - DG load analyses assume simultaneous maximum 60.8 Hz / 4340 V, difference in DG loading at nominal frequency (60 Hz) and voltage (4160 V) is ~109 kW
    - DG load analyses assume simultaneous operation of all intermittent loads (~77 kW), several of which require operator to start and may not be used
    - DG load analyses assumptions are considered to bound instrument uncertainty for load testing values

Specific TS Bases Changes

- TS 3.8.1 Bases
  - Each bases section for revised TS is updated to
    - Reflect the new TS values and ranges
    - Describe how the TS values and ranges comply with various Regulatory Guides (Safety Guides) and associated NRC Position Statements

DG Load Margin Program

- Planning has begun to uprate DGs and reduce DG loading physically
  - DG low margin entered into DCPP Margin Management Program and ranked “High Risk”
  - DG uprate feasibility studies completed
  - DG uprate and load reduction options have been selected and are in the funding approval process
  - DG uprate and associated testing program will require NRC approval

Staff Feedback

- Staff Feedback