

Attachment 1: Review of CCF Events

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Attachment to presentation:

4Component Reliability Data Issues for Discussion with NRC, March 19-20, 2020 – Rev01.pptx

The following tables document the current assessment of CCF events from the NRC/INL NROD database.

- Table 1: 10 CCF events from 2006 to 2015 related to EDGs or MDPs.
- Table 2: 7 CCF events from 2016 to 2019 related to all components.

Previous PWROG reviews of CCF events were reviewed to compare assessments, including:

- WCAP-16951, CCF events from 2006 to 2007
- WCAP-17517, CCF events from 2009 to 2011
- PWROG-14009, CCF events from 2012 to 2014

These CCF events are classified using the categories from earlier CCF event reviews in PWROG Reports:

- A: No Recommended Change to Event
- B: Misclassified Event
- C: Independent Failure Event
- D: Non-PRA Significant
- E: Duplicated Event

The tables include the following parameters, with their definitions :

- CCCG = size of common cause component group
- P_Value
 - 1.00 = Hard failure
 - 0.50 = Can perform some function (partially degraded)
 - 0.10 = Slightly degraded or failure is incipient
- Coupling Strength (CouplStr)
 - 1.00 = Cause is the same and from the same root
 - 0.50 = Description does not clearly state same cause but strong evidence the underlying root is the same
 - 0.10 = Different causes/failure mechanisms/affected piece-parts but still some evidence of underlying root cause
- Time Delay Factor (TimeDly)
 - 1.00 = Within PRA mission time (demand) or within ½ the test interval (testing)
 - 0.50 = Outside the PRA mission time less than one month (demand) or between ½ and full test interval (testing)
 - 0.10 = More than one month apart (demand) or greater than test interval

TABLE 1: Assessment of CCF Events from 2006 to 2015 related to EDGs or MDPs

Event Date	Plant	System, Component	Failure Mode	INPO ICES Event ID	NROD CCF Event ID	Summary Description	Failures, CCGG	CouplStr, TimeDly	P_Value	PWROG Assessment	Basis for Assessment
11/3/2006		AFW, MDP, TDP	FTS	223703, 223704, 223705	415	Both trains not aligned for automatic actuation. Third event included only shows up when TDP is selected, though it also says MDP. Group size is three. So, it appears the TDP is included in this group (note that this is the only TDP CCF event in NROD).	3 3	1.0, 1.0	1.0, 1.0, 1.0	B: Misclassified Event. [P Values = 0.1, 0.1, 0.1, based on recoverability.]	These events involved AFW system controls not aligned for auto actuation while in Mode 2 & 3. In those modes, the time available for actuation of AFW is much longer. To characterize these events as CCF events is to over-emphasize the importance of common cause failures for AFW. There is no means to provide limited weighting that doesn't overstate the real impact of these events. This should not be counted as a CCF event. This CCF event was assessed in WCAP-17517 as "A".
6/21/2008, 6/28/2008		SWN, MDP	FTR	232923, 233001	359	Debris obstructed flow to oil cooler. Related to recent flooding.	2 3	1.0, 0.5	1.0, 1.0	B: Misclassified Event. [Failure Mode Appl. Factor = 0.1]	These events (June, Aug, & Oct 2008) are applicable only to a limited plant configuration where SWS pumps are cooled by service water and potentially subject to debris clogging. These events should not be counted as generic CCF events. This CCF event was assessed in WCAP-17517 as "A".
7/12/2008		EPS, EDG	FTR	233170	421	Five EDGs with cracked rubber gland in generator coupling due to poor maintenance.	5 5	1.0, 1.0	1.0, 0.1, 0.1, 0.1, 0.1	B: Misclassified Event. [Time Delay Factor = 0.1]	While one EDG can be considered failed due to high vibration, the other EDGs had not shown high vibrations and the inspections showed "varying indications of degradation (cracking)." The other EDGs were not declared inoperable and the plant continued to operate with the EDG couplings replaced over the next few weeks. This should not be counted as a CCF event. If this is considered a CCF event based on potential events, the Time Delay factor should be decreased to 0.1. It is unlikely the couplings on all 5 EDGs would have failed over the same time period. This CCF event was assessed in WCAP-17517 as "A".

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8/25/2008, 8/29/2008		SWN, MDP	FTR	233596, 233726, 233797	360	Debris obstructed flow to oil cooler. Related to recent flooding.	2 3	1.0, 0.5	1.0, 1.0	B: Misclassified Event. [Failure Mode Appl. Factor = 0.1]	These events (June, Aug, & Oct 2008) are applicable only to a limited plant configuration where SWS pumps are cooled by service water and potentially subject to debris clogging. These events should not be counted as generic CCF events. This CCF event was assessed in WCAP-17517 as "A".
10/6/2008		SWN, MDP	FTR	234302, 234303, 234304, 234319	240	Pumps were in standby and lost cooling water to motor bearing oil coolers. Would have failed to run if needed. Related to recent flooding.	3 3	1.0, 1.0	1.0, 1.0, 1.0	B: Misclassified Event. [Failure Mode Appl. Factor = 0.1]	These events (June, Aug, & Oct 2008) are applicable only to a limited plant configuration where SWS pumps are cooled by service water and potentially subject to debris clogging. These events should not be counted as generic CCF events. This CCF event was assessed in WCAP-17517 as "A".
10/7/2009		EPS, EDG	FTS	N/A	384	Both EDGs unavailable due to improper switch position.	2 2	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [Failure Mode Appl. Factor = 0.1, P Values = 0.1, 0.1 based on recoverability.]	This condition occurred during Modes 4 & 5 when much longer time is typically available to locally start the EDGs compared to Mode 1. The condition was recognized and corrected within 7 hours. This CCF event was assessed in WCAP-17517 as "A".
8/14/2012		EPS, EDG	FTR	301768, 301870	451	Two EDGs inoperable due to flames coming from turbocharger exhaust extensions due to gasket leaks.	2 2	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [P Values = 0.5, 0.5]	Based on the INPO record, these events were determined to not be MREF or MSPI failures. While the EDGs were declared inoperable to identify and remedy the minor oil leak, this did not impact the ability of the EDGs to function. This CCF event was assessed in PWROG-14009 as "A" but cause code should be DM (manufacturing error or inadequacy).

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1/15/2013		EPS, EDG	FTLR	305146	454	Two of four EDGs failed because breaker closing circuit was disabled due to surveillance test.	2 4	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [Failure Mode Appl. Factor = 0.1]	This event occurred during a surveillance test on the Remote Shutdown Panel. The "failure" was the unexpected start of 2 EDGs due to a failed under-voltage relay (failed closed) and actuation of the second UV relay as part of the surveillance test (thus satisfying the 2 of 2 logic). The EDGs started but did not load because the load breaker circuitry was disabled as part of the surveillance test. This CCF event was assessed in PWROG-14009 as "A".
8/13/2014, 8/14/2014		EPS, EDG	FTR	313047, 312656	489	Two of three EDGs failed due to cylinder cap screws (manufacturing defect).	2 3	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [P Values = 0.1, 0.1]	The INPO record includes the following, "Based on the extensive analysis performed by MPR, there is a strong justification that EDG 2-2 and 2-3 would have been capable of performing its specified safety function during its 24 hour mission time with the failure of 2 special cap screws on one cylinder on each EDG." Thus, with one bolt broken on one EDG and a second bolt cracked on another EDG, there appears to be no EDG failure events. This should not be counted as a CCF event. This CCF event was assessed in PWROG-14009 as "A".

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3/21/2015		EPS, EDG	FTLR	316055	497	Relays potentially susceptible to noise from adjacent relays, could have prevented loading two EDGs under certain conditions. The EDG3 output breaker failed to remain closed during testing of simulated LOOP, and the relays of both EDG3 and EDG4 were replaced. Post-maintenance testing of EDG4 saw the EDG4 output breaker cycle before successfully dosing; however, this was due to improper operation of the newly-installed relays, and not related to the previous issue.	2 4	1.0, 1.0	0.1, 0.1	B: Misclassified Event. [Coupling Str. Factor = 0.1, Failure Mode Appl. Factor = 0.1]	This condition only occurred if the EDGs were already running and received a breaker closure (LOOP). Also, while the output breaker on EDG3 failed to close due to this condition, the EDG4 output breaker cycled unexpectedly but closed. Thus, the coupling strength should not be 1.0. Also, even the minimum P_value of 0.1 over-weights these events. The Failure Mode Applicability factor is appropriate to account for this unusual configuration.

TABLE 2: Assessment of All CCF Events from 2016 to 2019

Event Date	Plant	System, Component	Failure Mode	INPO Event ID	NROD CCF Event ID	Summary Description	Failures, CCGG	CouplStr, TimeDly	P_Value	PWROG Assessment	Basis for Assessment
5/5/2016		CWS, STR	FTOp		515	Circ water traveling screens C and D failed due to sheared pin. The failures occurred during a seaweed intrusion. The pins were an incorrect size.	2 4	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [Failure Mode Appl. Factor = 0.1]	This failure required the environmental condition of "seaweed intrusion". Use the "Failure Mode Appl." factor to account for the limited time this condition would occur.
2/5/2017		RHR, MDP	FTR > 1H		520	RHR pump A and C minimum flow valves were found sealed shut rather than sealed open. This was corrected in a timely fashion due to the associated LCO, with the entire Inoperable time lasting about 3 hours.	2 3	1.0, 1.0	0.1, 0.1	A: No Recommended Change to Event [Questions on use of Failure Mode App Factor]	It appears that the recovery potential was used to justify the P-Values of 0.1 (normally described as slightly degraded or failure is incipient). These events were assessed as recoverable in 15 to 30 minutes. This CCF record also has the Failure Mode App = 0.10.
4/13/2018		MFW, AOV	FTCntrol		524	Feedwater control valves failed to control at low power level. The feedwater signal converters (I/P) in the control string for both Main Feedwater Control Valves had failed sometime previously. The failure mode was such that detection was not possible until the unit maneuvered into a low power state (<20%).	2 2	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [Failure Mode Appl. Factor = 0.1]	Failure only applicable in low power POSs. Apply a Failure Mode App factor based on the limited time at low power. (The dataset would need to include the caveat that the weighing for some events may not be appropriate for LPSD use.)

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Event Date	Plant	System, Component	Failure Mode	INPO Event ID	NROD CCF Event ID	Summary Description	Failures, CCGG	Couplstr, Timedly	P_Value	PWROG Assessment	Basis for Assessment
8/1/2018		EPS, SBO EDG	FTLR		526	Failed Programmable Logic Controllers affects all 3 SBO diesels. During initial troubleshooting, it "appeared" that the SBO diesels were able to be started at the human machine interface (HMI). The HMI did not indicate the ability to close any of the breakers on the PB bus. The physical Lower Medium Voltage Sys 4.16 KV Bus breakers have the capability of being closed via mechanical push buttons, but there are no site procedures that provide guidance to do so.	3 3	1.0, 1.0	0.5, 0.5, 0.5	A: No Recommended Change to Event [Questions on use of P_value]	The P_Value (0.5, partially degraded) seems to be based on the potential for recovery, although the recovery assessment says, "non-recoverable."

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9/30/2018		CDS, MDP (condensate system)	FTR		529	Automatic Scram Due to a Loss of Two Condensate Pumps. The 3B pump transformer 13kV high side cabling faulted (grounded) on the B phase. The trip of the 3B condensate pump resulted in a ground current transient which was detected by the 3A condensate pump 250G relay and caused the 3A condensate pump to trip due to the cable grounding shield braid not being routed through the current transformer. Incorrect cabling work for the 3B pump performed in 2017 resulted in the fault on the 13kV high-side cabling, causing the 3B condensate pump trip.	2 2	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [Classify as IE rather than CCF event]	This event would be more appropriately considered as a Loss of Main Feedwater IE.

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Event Date	Plant	System, Component	Failure Mode	INPO Event ID	NROD CCF Event ID	Summary Description	Failures, CCGG	CouplStr, TimeDly	P_Value	PWROG Assessment	Basis for Assessment
10/11/2018		EPS, EDG	FTS		525	During the start of Unit 1 B EDG, the air start valves failed to close. This depressurized the common air start header 1B EDG shares with Unit 2 A and B EDGs. Failure of newly-installed diodes for the 1B EDG was the cause, which exploited an original design vulnerability of having a common header. Operators were able to quickly isolate the 1B air start control valve, allowing pressure to recover for the Unit 2 EDGs (within 30 minutes).	2 3	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [P Values = 0.2, 0.2, based on recoverability]	Event report say, "The 2A and 2B diesel generators were restored to operable in 30 minutes following re-pressurization of the starting air header and receivers." This seems to indicate recoverability of these failures.
4/20/2019		MFW, MDP	FTR		534	Both MFPs tripped on low suction pressure. Loss of IA pressure to the condensate demin. system due to catastrophic failure of the inline air filter bowl was the cause.	2 2	1.0, 1.0	1.0, 1.0	B: Misclassified Event. [Classify as IE rather than CCF event]	This event looks like a failure due to a common support system, instrument air. This event would be more appropriately considered as a Loss of Main Feedwater IE.