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PWR Owners Group Program Management Office
Fax Cover Page

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To:

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Chief, Rules, Announcements, and Directives Branch (RADB)
Office of Administration
U.S. Nuclear Regulatory Commission
MS TWB-05-B01M
Washington, DC 20555-0001
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Attachment	Title	Number of Pages
OG-12-73	Comments on Draft NUREG "Common-Cause Failure Analysis in Event and Condition Assessment: Guidance and Research," (Docket ID NRC-2011-0254), as published in the Federal Register, Volume 76, Number 212, November 2, 2011 (pages 67764 to 67765), PA-RMSC-0696	14

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Cadd = S. Peng-Hua
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PWROG
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Program Management Office
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February 28, 2012

OG-12-73

Ms. Cindy Bladey
Chief, Rules, Announcements, and Directives Branch (RADB)
Office of Administration
U.S. Nuclear Regulatory Commission
MS TWB-05-B01M
Washington, DC 20555-0001

Subject: Pressurized Water Reactor Owners Group
Comments on Draft NUREG "Common-Cause Failure Analysis in Event and Condition Assessment: Guidance and Research," (Docket ID NRC-2011-0254), as published in the Federal Register, Volume 76, Number 212, November 2, 2011 (pages 67764 to 67765), PA-RMSC-0696

The Pressurized Water Reactor Owners Group (PWROG) is pleased to provide comments on the draft NUREG, "Common-Cause Failure Analysis in Event Condition and Assessment: Guidance and Research," as published in the subject Federal Register Notice (FRN). A subsequent FRN (Volume 77, No. 24, February 6, 2012) extended the comment deadline date to March 2, 2012.

The draft common cause failure (CCF) NUREG has developed proposed guidelines for estimating the risk significance of degraded conditions, such as equipment failure caused by performance deficiencies, which are assessed as part of the Nuclear Regulatory Commission's (NRC's) significant determination process (SDP). To perform an event and condition assessment (ECA) to support an SDP determination, it is critical to determine the conditional probability that redundant components could fail following the observed failure of one or more components as a result of an identified performance deficiency. The PWROG offers the following general, technical, and editorial comments regarding the draft CCF NUREG.

The body of this letter provides general comments on the draft CCF NUREG. Specific comments related to the content or technical approaches contained in the draft CCF NUREG and its Appendices are provided in Attachment 1. Editorial comments on the draft CCF NUREG and its Appendices are provided in Attachment 2.

General Comments

The purpose of the draft NUREG is to assist the staff in dealing with modeling considerations of CCF in the context of an ECA. This draft NUREG is intended to replace the text that was removed in the RASP Handbook that was related to treatment of CCFs. Section 1 establishes the philosophical underpinnings supplemented by three ground rules and some examples. Thus, Section 2 provides the recommended approaches to the NRC staff. If these approaches were sufficiently robust and representative of a consensus of PRA practitioners, the draft NUREG would end there; however, Section 3 discusses a variety of issues related to current CCF modeling approaches (especially in a SPAR model) in the contexr of ECA. Section 4 reinforces these issues by citing the research that is currently being (or planned to be) performed to address some of the identified issues – with some of the timeframes being long-term (to be completed in more than five years). This suggests in the context of an ECA that the currently used CCF models are not sufficiently robust to support the application at hand. Perhaps some simpler, more grounded approaches are needed to deal with CCF in the context of ECA at this time. When the stated research resolves some of the identified issues, then the concept presented in this draft NUREG will be more viable.

Starting in Section 1.1 and continuing throughout Sections 1 and 2, especially the discussion in Section 1.4, is the concept that the underlying performance deficiency (e.g., poor maintenance practice) should be the basis to consider the full impact of CCF in the retrospective assessments. In a presentation made by NRC at the Electric Power Research Institute's (EPRI's) Configuration Risk Management Forum (CRMF) on this draft CCF NUREG, this concept was discussed. The concept as proposed in the draft NUREG sets a dangerous precedent as there is apparently no "line" established that would limit the CCF impact to the common cause component group (CCCG). While the NRC recognizes the limitation of this concept, the final NUREG needs to be explicit about this limitation. Otherwise, with a performance deficiency of poor maintenance, which could potentially affect any component, without some explicit limitations in the draft CCF NUREG, the scope of the CCF impact could extend beyond the normally-considered intra-system CCF affects to include a wide range of inter-system CCF impacts that would potentially result in conservatism insights, which are not supported by CCF data.

The text supporting Figure 1 needs to be clear that the A1, B1, A2, B2, etc. represent sub-components of a single modeled component in the PRA, i.e., A1, B1, etc. are not separately modeled in the probabilistic risk assessment (PRA). Second, it must be clear the components A and B are in the same CCCG. Without these explicit constraints, there would be no bounds on the impact of subsequent CCFs.

With these conditions established, there is potential for being overly conservative. Using the example of "poor maintenance process" as the performance deficiency, there is no differentiation of how the maintenance practices have contributed to the observed failure. The draft CCF NUREG suggests that if sub-component A2 was over-torqued (leading to its failure) due to a poor maintenance procedure or poorly trained technician, then all other sub-components are

subject to failure due to poor maintenance and the entire value of CCF for all the components in the CCCG must remain in the model. This ignores the fact that there are varied forms of maintenance for which the component may be subject. All of these forms are not torqueing (e.g., calibration, filling an oil reservoir, cleaning, etc.). Further, these similar and dissimilar maintenance activities may be performed by different maintenance personnel, with different levels of training and experience. Another consideration is that all maintenance procedures are not "created equal." Thus, to consider the full impact of the CCF (e.g., not reducing the alpha factor or beta factor) in light of the "uncommon" aspects of the underlying performance deficiency will over-estimate the impact of CCF on the risk metric results. Adjusting the CCF factors to account for these issues is permitted by the definition of "failure memory approach" where it states that "failure probabilities ... are conditioned as necessary to reflect the details of the event."

Focusing on the common elements, there is also an issue of "extent of condition." The draft CCF NUREG states that the failure memory concept does not acknowledge subsequent verification of extent of condition. This is overly conservative if there are some "uncommon" factors present, (e.g., different inspectors, different maintenance personnel, experience and training, etc.).

NRC Inspection Manual Chapter 308, Attachment 3, Section 3.C specifies ten specific attributes and principles for risk-informed SDP tools. Principle 10 states that:

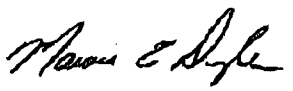
> All technical judgments made by the staff within any probabilistic-based SDP tool should have bases that are clearly observable as "reasonable," as well as reasoned, based on best available information, and not purposefully biased in a conservative manner simply because of uncertainties which are applicable in both conservative and non-conservative directions. As a corollary, this also requires that staff technical or probabilistic judgments not be "traded off" within a risk model by allowing a conservative bias in one modeling factor simply because another factor is believed to be non-conservatively biased.

It should be ensured that this principle is maintained in the guidance for treatment of CCF in an ECA by ensuring that the process is sufficiently "reasonable" and reasoned, and not biased in a conservative manner to account for perceived uncertainties in the probabilistic treatment of CCF.

The PWROG appreciates your consideration of these comments and would be supportive of meeting with the staff to discuss this document. For any technical questions regarding this letter and its contents, please contact Rupert Weston at (860) 731-6468.

If you have any questions regarding all other aspects of this letter, please do not hesitate to call me at (620) 364-4127 or Mr. W. Anthony Nowinowski, Program Manager of the PWR Owners Group, Program Management Office at (412) 374-6855.

Sincerely yours,



Maurice A. Dingler, Chairman
PWR Owners Group

MAD:TZ:las

Attachment (2)

cc: PWROG PMO
PWROG Risk Management Subcommittee
D. McCoy, Westinghouse
S. Levinson, AREVA
R. Weston, Westinghouse
J. Stringfellow, SNC
R. Schneider, Westinghouse
M. Howard, Westinghouse
P. Hijeck, Westinghouse
M. Lucci, Westinghouse
R. Lutz, Westinghouse
J. Rowley, US NRC
R. Bradley, NEI
V. Anderson, NEI

Pressurized Water Reactor Owners Group (PWROG) Content/Technical Suggestions to Improve the Usability of the Draft CCF NUREG

Comment Number	Section	Comment	Proposed Resolution
1	Pages 7, 21, 22, and 23	**Missing Expressions:** There are several missing expressions, which make it difficult to follow the discussion.	Include the missing expressions.
2	Sections 1.1 and 1.2	**Modeling of CCF in PRA Models:** The draft common cause failure (CCF) NUREG states Section 1.1 states that "Inter-components dependencies, which are not captured explicitly in the PRA models, span a wide range ..." This type of inter-component dependencies is specifically referring to CCF. The statement appears to contradict subsequent discussion in that paragraph, and in Section 1.2, which acknowledges that CCF is included in the probabilistic risk assessment (PRA). Such a statement may be misleading.	Provide additional clarification to explain what is meant by "not captured in the PRA models."
3	Section 1.3	**Common Cause Failure Definition:** The definition of CCF states that the "failure mechanisms do not have to be shared." This is true to a certain extend. For example, an earthquake may cause different components to fail via different mechanisms is clearly identified as a CCF with the same cause, e.g., the earthquake. If one component fails because the manufacturer used an under-specified sub-component and a second component in the same common cause component group (CCCG) fails due to a faulty maintenance procedure – these failures are not considered to be a CCF event. While the mechanisms differ, there is no shared cause to generate those mechanisms.	Provide one or more examples to clarify the definition of CCF.

Comment Number	Section	Comment	Proposed Resolution
4	Section 1.3	**Common Mode Failure Definition:** The draft CCF NUREG, as stated in this Section 1.3, does not encourage the use of the term "common mode failure," which was first used in WASH-1400. The standardized plant analysis risk (SPAR) models used by the NRC to support the significance determination process (SDP) are less detailed that the industry's PRA models and may not explicitly include failures caused by shared components or latent human errors. Such failures are included in the CCF database and used to estimate CCF parameters. The PWROG has an ongoing program to identify such failures when the CCF data sets are reviewed.	Include a clarifying statement to indicate that disparity between the SPAR and industry's PRA models could impact the quantification results of an ECA, if failures caused by shared components and latent human errors are not treated the same way in the models.
5	Section 1.4	**CCF Parameter Update:** Failure probabilities are conditioned as necessary to reflect the details of an event associated with the performance deficiency as part of an ECA. As noted in the first ground rule, such performance deficiencies are usually identified in the Nuclear Regulatory Commission's (NRC's) inspection reports. In the majority of cases, such events are classified as potential CCFs that have not yet entered into the CCF database. The calculation of conditional CCF probabilities (i.e., alpha factors) is based on the CCF parameters derived from events already included in the CCF database. The draft CCF NUREG does not discuss whether a Bayesian update of the CCF parameters should be performed to include the event associated with the performance deficiency. The NRC should not be updating CCF parameters on the basis of a single failure and a retrospective assessment (to determine what might have happened). The CCF database must be developed and maintained on the basis of CCF event that have actually occurred.	Include a clarifying statement to indicate whether update of the CCF parameters is necessary in performing the ECA.

Comment Number	Section	Comment	Proposed Resolution
6	Section 1.4.1	**Deviations from Ground Rules:** This section provides a caution when "revising CCCG boundaries, because typical performance deficiencies, which reflect organizational problems, such as poor maintenance, can couple the emergency diesel generators (EDGs) despite design differences.	Provide a stronger statement that would permit revising CCCG boundaries, or alpha factors, for example, when "organizational problem" *does* reflect the design difference.
7	Section 1.5	**CCF Examples:** In Section 1.5 (first paragraph), there is a footnote that indicates that the events from this section would be "included in future revisions of the database." These events each involve the failure of a single component – there is no CCF to put into the database. For the purpose of an event and condition assessment (ECA), a CCF is assumed to be able to occur in the future. The database should be reserved for when a CCF event actually occurred.	Either delete this footnote, or add clarification to include the CCF determination process prior to inclusion in the CCF database.
8	Section 2.1	**Basic Principles of CCF Treatment in ECA:** These principles, particularly item (6), convey that in the context of ECA, all failures are dependent failures unless proof can be shown of failure independence. This is not reflective of operating/failure experience, and in the context of ECA will be overly conservative with the number (and nature) of dependent failure.	See general comments.

Comment Number	Section	Comment	Proposed Resolution
9	Section 2.1	**Failure Memory Approach:** In discussing the guidance on "Basic Principles of CCF Treatment in ECA," the draft CCF NUREG indicates that in using the failure memory approach in ECA no credit is given *"to observed successful equipment operation."* To determine the potential for CCF, given that one or more components within the CCCG were observed to be incapable of performing their intended function, testing of the redundant components within the CCCG may be performed. Certain limiting conditions of operation (LCO) (i.e., emergency diesel generators) for the Technical Specifications require the performance of additional tests when one component within the CCCG is observed to be in a degraded condition. Successful operability tests give assurance that the component will perform its intended function when demanded. The failure memory approach appears to be in conflict with certain LCOs. It appears that some credit should be given for successful equipment operation in the reduction of CCF potential.	Provide added clarification to demonstrate why the "failure memory approach" in ECA is not in conflict with certain LCOs of the plant's Technical Specification. How to quantify the reduced CCF potential may be challenging and require further research.
10	Section 2.2	**ECA Workspace:** In Section 2.2, "CCF Treatment Categories," the draft CCF NUREG indicates that examples are provided in Appendix C that illustrate the ECA Workspace of Systems Analysis Programs for Hands-on Integrated Risk Evaluations (SAPHIRE) 8. Appendix C was not included as part of the draft CCF NUREG.	Provide Appendix C. These examples need to be clarified in Appendix C or the information should be included as part of the final NUREG.

Comment Number	Section	Comment	Proposed Resolution
11	Section 3.1.2	**BPM Symmetric Assumption:** The Basic Parameter Model (BPM) assumes that each component in the CCCG has the same failure rate or failure probability. This assumption is invalidated if one of the components within the CCCG is degraded and has a failure rate or failure probability that differs for the others. SAPHIRE 8 addresses the treatment of the degraded component, but the draft CCF NUREG provides no explanation on how the degraded condition is modeled in SAPHIRE 8 when performing an ECA.	Provide an explanation on how SAPHIRE 8 addresses the treatment of degraded components.
12	Section 3.2.1	**Treatment of Shared Components and Latent Human Errors:** The treatment of shared components and latent human errors can be a source of uncertainty in the ECA. The analyst must determine whether such treatment is implicit or explicit. To make such a determination, the analyst should obtain necessary information from the utility. This can be a source of uncertainty that may or may not be recognized the ECA analyst. The draft CCF NUREG has not discussed the potential sources of uncertainty that may be encountered in performing the ECA.	Include guidance that would be helpful in the identification and characterization of sources of uncertainties.

Comment Number	Section	Comment	Proposed Resolution
13	Section 3.2.2	**Prior Distribution of Alpha Factors:** The prior distributions for alpha factors are currently estimated using data from the CCF database for the 1995-2005 timeframes, as noted in this section. The latest released version of the CCF database includes events up through 2010. The NRC has an ongoing program that collects CCF events, which are used to update the CCF database. This section contains the following: Because it was felt that the number of complete CCF events may be under-represented, especially for large group sizes, a statistical model was developed to estimate the number of "missing" complete events, and these were then added to the partial event counts for each group size. This statement is not particularly strong in conviction. What is the basis for the "feeling" that the number of CCF events "may" be underestimated? What is the basis for a statistical program to fill in "missing" events? This appears to be an unsubstantiated and ad hoc process to develop a prior distribution.	The NUREG should discuss how updates to the CCF database will affect the prior distributions for alpha factors. Also, provide more details regarding the statistical program that was used to estimate the number of "missing" complete CCF events.
14	Section 3.2.4	**Treatment of Staggered Testing:** The discussion in this section indicates a question about what, if anything, should be done. A paper is referenced that states that "both of these equations may be in error." And further that the "net impact on ECA of these equations being incorrect remains to be examined." This reinforces the discussion in the general comment that the premise upon which the draft CCF NUREG is based raises a number of questions about the validity of the methods proposed.	Discuss the value of keeping the references in the NUREG.

Comment Number	Section	Comment	Proposed Resolution
15	Appendix A	**Conditional CCF Probability:** Appendix A (first paragraph) of the draft CCF NUREG states that Appendix B to the SAPHIRE 8 technical reference includes details of the conditional CCF calculations. These calculations are not available to the draft CCF NUREG reader.	Provide an appendix with appropriate information from the SAPHIRE 8 technical reference.
16	Table 2 of Appendix A	**Rounding Errors:** The values provided in this table and the appropriate expression from Equation A.8 are used to calculate the basic event probabilities provided in Table 3 of Appendix A. The values provided in Table 3 of Appendix A are rounded to two significant numbers after the decimal point. The rounded values slightly over-estimated the probabilities, for cutsets with multiple basic events, provided in Table 4 of Appendix A. Using the values provided in Table 2 of Appendix A, the calculated probability for cutset {A-S, B-R, C-R} is 6.579E-07, which is slightly lower that the calculated probability of 6.607E-07 that was obtained using the rounded values in Table 3 of Appendix A. Depending on the number of cutsets, the overall conditional probability can also be overestimated. For the basic event unavailability cases considered in Appendix A, the calculated probabilities should be based on the actual values provided in Table 2 of Appendix A.	The computed values in Table 3 should be done to the same number of significant digits as Table 2 (three after the decimal point), and then use these revised values from Table 3 to perform the computations for Table 4.

Pressurized Water Reactor Owners Group (PWROG) Editorial Comments on the Draft CCF NUREG*

*Note in "Proposed Resolution" column, the suggested text to add is indicated in **bold and red**, and the suggested text to remove is indicated by ~~strikethrough~~.

Comment Number	Section	Comment	Proposed Resolution
1	Pg. 1, Section 1, third paragraph	Revise wording.	"As an example, if the deficiency that led to an observed failure ~~were~~ was poor quality control ..."
2	Pg. 1, Section 1, third paragraph	Revise wording.	"Because nuclear plants ~~utilize~~ use redundant safety ..."
3	Pg. 5, Figure 2	The title for this figure is too long. This comment also applies to Figure 3 on page 6.	Simplify the titles.
4	Pg. 7, Section 1.4	"Section" is used inconsistently throughout the document.	Change "Sec. 2" to "Section 2."
5	Pg. 9, Section 1.4	A period is missing at end of sentence.	Insert a period (.) after the word "window" in the last paragraph of the second ground rule.
6	Pg. 15, Section 2.1, item (5)	Revise sentence.	Revise as follows "... conditional CCF probability of ~~CCF of~~ remaining components to zero."
7	Pg. 15, Section 2.1, item (6)	Revise wording. .	"... to be considered qualitatively ~~in~~ during the ..."
8	Pg. 16, Section 2.2	"Appendix" is used inconsistently throughout the document.	Change "App. C" to "Appendix C."
9	Pg. 16, Section 2.2.3	"Section" is used inconsistently throughout the document.	Change "Sec. 3" to "Section 3."
10	Pg. 18, Section 2.2.7	"Section" is used inconsistently throughout the document.	Change "Sec. 2.2.6" to "Section 2.2.6."
11	Pg. 18, Section 2.2.8	"Section" is used inconsistently throughout the document.	Change "Sec. 2.2" to "Section 2.2"
12	Pg. 19, Section 3	A space is missing between words.	Insert space ( ) between "In" and "Section 4," in the last sentence of the paragraph.
13	Pg. 19, Section 3.1.1, fourth paragraph	A comma is missing at the end of the phrase.	Add a comma (,) after the phrase "If the failure were judged to have no potential for shared common cause,"
14	Pg. 22, Section 3.1.5	Replace abbreviation for "equation."	"Eq. 3.1" with "Equation 1" in the text after Equation (2).
15	Pg. 23, Section 3.1.5	Replace abbreviation for "equation."	Replace "Eq. 3.5" with "Equation 5" in the text in the last sentence of the section.
16	Pg. 24, Section 3.2.1	"Section" is used inconsistently throughout the document.	Replace "Sec. 1" with "Section 1" in the first paragraph of this section.

Comment Number	Section	Comment	Proposed Resolution
17	Pg. 24, Section 3.2.1	Replace abbreviation for "equation."	Replace "... using equations such as 3.6" with "... using Equation 6."
18	Pg. 24, Section 3.2.2	Replace abbreviation for "equation."	Replace "Eq. 3.6" with "Equation 6."
19	Pg. 26, Section 3.2.2	Revise sentence.	Revise to say "... the **four Nuclear Steam Supply System-designed** reactor protection systems ..." in the first paragraph on this page.
20	Pg. 26, Section 3.2.2	Replace abbreviation for "equation."	Replace "Eq. 3.6" with "Equation 6."
21	Pg. 26, Section 3.2.3	Revise the sentence.	Refer to the specific section where "asymmetric component configurations" are discussed, rather than just indicating that it is "discussed above" in the first bullet.
22	Pg. 27, Section 3.2.3	Replace abbreviation for "equation."	Replace "Eq. 3.6" with "Equation 6." Likewise, replace "Eq. 3.7" with "Equation 7." There is one occurrence each in both the penultimate and the last paragraph.
23	Pg. 27, Section 3.2.3	"Appendix" is used inconsistently throughout the document.	Replace "App. B" with "Appendix B."
24	Pg. 28, Section 4	"Section" is used inconsistently throughout the document.	For consistency with other parts of the document, change "Sec. 3" to "Section 3."
25	Pg. 28, Section 4.1	Revise wording in the sentence.	Suggest the following additional text "... was given in Figure 1, reproduced here as **Figure 10** for convenience."
26	Pg. 30, Section 4.3.1	"Section" is used inconsistently throughout the document.	For consistency with other parts of the document, change "Sec. 3" to "Section 3."
27	Pg. 30, Section 4.3.3	."Section" is used inconsistently throughout the document.	For consistency with other parts of the document, change "Sec. 3" to "Section 3."
28	Pg. 30, Section 4.3.3	"Appendix" is used inconsistently throughout the document.	"App. B" with "Appendix B."
29	Pg. 31, Reference	A period is missing at the end of the line.	Add a period at the end of Decision Systems Laboratory. (2010).
30	Pg. 31, Reference"	An extra space is included.	Delete extra space after "Safety" in Galan, S.F., et. al. (2007).
31	Pg. 31, Reference	A space between the two references is missing.	Insert a space after Marshall & Olkin (1967).
32	Pg. 32, Reference	An extra space is included.	Delete extra space after "Attachment 3" in US NRC (2006).

Comment Number	Section	Comment	Proposed Resolution
33	Pg. 33, Appendix A	The numbering of equations, figures, and tables are not consistent.	Suggest like the equation numbers, the Tables are identified as A.1, etc., and the Figures as A.1, etc. (if implemented, all Table and Figure references and titles will needed to be modified).
34	Pg. 34, Section A-1	Incorrect word is used.	Change "Chapter 3" to "Section 3."
35	Pg. 35, Equation (A-8)	Incorrect expression cited.	The subscript of the basic event involving three componenis in the basic parameter model should be changed from "1" to "3."
36	Pg. 36, Section A.2	Inconsistent use of format.	For consistency with the tables in this section, it is suggested that the scientific format be used for $1.24x10^{-4}$.
37	Pg. 36, Table 2	Incorrect character is inserted in scientific format.	Change "8.840□-05" to "8.840E-05."
38	Pg. 36, Table 3	The rows of this table are separated unnecessarily.	Move this table to a new page.
39	Pg. 37, Section A.2.1	The incorrect figure number is specified.	Change "... Figure 1" to "... Figure 11."
40	Pg. 37, Table 5	The rows of this table are separated unnecessarily.	Move this table to a new page.