CNWRA Comments on BNFL Inc. Report "Compliance with Risk Goals and Project Reliability Database, BNFL RPT–W375–SA00006"

This attachment provides the CNWRA staff observations and comments on the BNFL Inc. Report, "Compliance with Risk Goals and Project Reliability Database, BNFL RPT–W375–SA00006." Both Revisions A and B of the report were reviewed. In addition, a summary of pertinent points discussed at the January 2000 topical meeting on the subject is provided. The section numbers and page numbers in the comments provided next refer to Revision B of the report unless otherwise stated.

Comments

1. Section 2.3, Revision A, of the report, indicates that the acceptable probability of event sequences will be calculated by dividing the acceptable risk by the midpoint of the consequence bins in which groups of accidents are binned. This assumes that the consequences of accidents within a bin are distributed uniformly across each bin, which could be nonconservative. A conservative methodology would be to divide the acceptable risk by the maximum consequence of the bin. This methodology has been removed in Revision B of the report, but no revised methodology is presented.

2. On page 5, section 3.1, it is not clear whether the formula used to calculate the frequency of design basis event (DBE) sequences accounts for common cause failure of multiple control strategies. BNFL Inc. should indicate how they will account for common cause failure of control strategies in the calculation of risk from the facility.

3. On page 6, section 4.1, unlike Revision A of the report, Revision B does not indicate how the aggregate frequency of a bin of events represented by a single DBE consequence calculation will be calculated. The original (Revision A) report outlines three methods that could be used to estimate the aggregate frequency of a set of events represented by a single consequence evaluation. The first method is definitely conservative, whereas the second and third methods have the potential to be nonconservative, particularly if there are events in the bin that are relatively high consequence with average or above-average probability.

4. On page 9, section 4.4, the report indicates that if the facility cannot meet the risk goals for the facility, BNFL Inc. will seek regulatory relief to solve the problem. BNFL Inc. should consider solutions such as movement of the facility to a safer location or a significant redesign to the plant prior to seeking regulatory relief to run an excessively risky facility.

5. On page 10, section 5.1, the definitions provided for deflagration and detonation under Scenario #1, third bullet, are not customary. The definitions state that a deflagration is a burn and a detonation is an explosion. Both involve burning, and a deflagration can result in an explosion. It seems appropriate to state this and to distinguish between a deflagration and a detonation by explaining that deflagration has a subsonic burning velocity, where detonation has a supersonic burning velocity that can be a unique velocity.

6. On page 11, the paragraph just before Scenario #2, the terms benign burn, energetic burn, and detonation are used. This wording bears on how a deflagration differs from a detonation. It would be informative if the definition of deflagration considered in the analysis was given some quantitative comparison to the detonation considered in the analysis. Similarly, on page 22, section 6.4.2, in the first paragraph, the description of deflagration is that it is "expected" to be "relatively benign." This wording should be quantified or defined as a magnitude.

7. On page 11, section 5.1, the first sentence beginning with "Subsequential or consequential ... ." is unclear and needs explanation.

8. On pages 30 and 31, section 9.2, the report indicates the use of the Sellafield database (SDB). As indicated in item #2 of the topical meeting summary, BNFL Inc. has decided not to pursue SDB, unless specific data needed for reliability analysis are not available in recognized databases. BNFL Inc. should revise the text in section 9.2 to reflect their position at the January 2000 topical meeting.

9. In table 8, on page 48, BNFL Inc. should include for completeness the calculation of risk to the colocated worker or the member of the public.

10. On pages 48 and 49, it is not clear why the risk estimate to a facility worker for the unplanned release of radioactive material during pump removal (3.0×10^{-5}/yr) in Table 11 does not correspond to the risk to the facility worker for the maintainer exposure during removal of the pump in Table 12 (4.5×10^{-7}/yr). If the risk to workers is mitigated by a factor that accounts for the fraction of time a worker is in a given area, this should be clearly stated and justification given for this reduction factor.

11. On page A-2, Appendix A, the first paragraph states that the efficiency of the hydrogen explosion is 0.3. Scientific basis for the statement is not provided. It should be noted that the scenarios are not for an unconfined hydrogen gas cloud. What is assumed is that only 30 percent of the energy of the hydrogen present in a vessel ullage contributes to the explosion. Also, it is assumed that a vessel is at its capacity with waste when the explosion occurs. BNFL Inc. should analyze the effect of capacity versus vessel free space to ensure that a conservative assessment is made.

12. Appendix A contains quantitative predictions for the release of airborne radioactive material, which results from detonation of hydrogen in concentrations of 20 and 16 percent in the ullage of high-level waste and low-level waste vessels. Also, resulting dose calculations for colocated workers and offsite public receptors and facility workers for the released masses are provided. The reference sources of prediction equations and data are listed. Calculations were numerically correct, given the equations and the data. However, references were not available to review and assess the applicability of the equations and data.

13. On page A-7, Appendix A, the calculations for the mass concentration in the room appear to have used an incorrect room volume. The room volume was assumed to be 300 m^3; the calculation instead used 3 m^3.

14. Page A-5, section 3.1 of Appendix A, indicates that the consequence evaluation will be conducted based on a best estimate wind speed and stability class instead of the 95th percentile methodology, as is done typically in accident evaluations. This is acceptable, as long as BNFL Inc. demonstrates that the best estimate wind speed and stability class will produce results equal to or more conservative than the average of the results that would be produced if the actual range of wind speeds and stability classes found at the site were sampled according to the appropriate wind rose diagram for the site. Otherwise, the 95th percentile weather conditions provide a reasonably conservative bound on the actual consequences that would be incurred from accidents at the site.

15. On pages A-6 to A-8, section 4.0, Appendix A, calculations of dose to the facility worker are nonconservative and not dimensionally correct. By assuming an airborne concentration of 100 mg/m^3 (which is not sufficiently justified), the volume of the room no longer should be included in the

equation. Therefore, dividing by the 300 m^3 room volume is incorrect, and all of these dose estimates should be multiplied by 300 to determine the correct estimate of dose due to these accidents.

January 2000 Topical Meeting Summary, Richland, Washington

BNFL Inc. provided an overview of the report at the meeting. The main points not discussed in the report are summarized next.

1. According to the presenters at the January 2000 topical meeting in Richland, Washington, the strategy for developing risk goals is in the development stage and the two examples presented in the BNFL Inc. document are for demonstration purposes only, and should not be considered as final results. Actual data will be generated after DBEs are defined based on the integrated safety management cycle II results.

2. At the topical meeting, BNFL Inc. explicitly stated that the SDB will not be the primary source of reliability data. The BNFL Inc. review of the SDB led to the following observations:

   - SDB is proprietary, and therefore is not accessible to the public.
   - While SDB failure data for active components was in agreement with other databases, the SDB failure rate for passive components was less consistent with other recognized sources.
   - SDB does not provide demand failure rates and numerical estimates of uncertainty.

Based on these observations, BNFL Inc. had opted to develop and implement a database based on the standard recognized databases used in the United States. If reliability data are taken from the SDB, these data should be qualified to ensure applicability.