St. Lucie Public Meeting for PRA RAI 11.c.02.01 – Cable Spread Room Delta Risk Calculation

February 19, 2015

Agenda

- Purpose
- Cable Spread Room Delta Risk Methodology
- Methodology Compared to FAQ 08-0054
- Comparison to R.G. 1.205
- RAI Responses

Purpose

The purpose of this presentation is to explain the method and assumptions used to develop the compliant case (and delta risk) for the St. Lucie Units 1 and 2 Cable Spread Rooms and to gain an understanding for developing the response to PRA RAI 11.c.02.01

Methodology Used to Calculate Delta Risk in the Cable Spread Room (CSR)

Compliant Case

- **Compliant Case Development**
  - The primary control station (PCS) for a CSR fire in either Unit is that Unit's Hot Shutdown Control Panel (HSCP)
  - The compliant case considers a successful single shutdown path from the HSCP
    - -- Meets the deterministic requirements of NFPA 805 4.2.3
    - -- This is not used when the variant case CCDP indicates more equipment is available which lowers risk
  - The compliant case is based on the Control Room abandonment procedure assuming all required equipment is available with control at the HSCP including offsite power
    - -- No Variances From Deterministic Requirements (VFDRs) in the compliant case since all actions are at the PCS
    - -- The VFDRs as written only affect abandonment control

The compliant case meets NFPA 805 Section 4.2.3

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Methodology Used to Calculate Delta Risk in the Cable Spread Room (CSR)

Compliant Case Conditional Core Damage Probability (CCDP)

- **CCDP developed assuming all required equipment is available at the HSCP (including offsite power)**
  - CCDP is 0.0053/0.0062 (U1/U2)
    - -- Represents the random failures of the associated equipment
    - -- Does not include the human error potential at the HSCP
- **CCDP represents the risk of potential loss of a successful single shutdown path**
  - This meets the NFPA 805 requirement of a single success path free from fire damage

Compliant Case CCDP is 0.0053/0.0062(U1/U2)

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Methodology Used to Calculate Delta Risk in the Cable Spread Room (CSR)

Delta Risk Calculation – Three Cases

- **Delta risk is the difference between the variant case (post transition) and complaint case (deterministically compliant) risk**
- **Case 1 – Small Fire**
  - Calculated variant case CCDP is smaller than compliant case CCDP developed for successful single shutdown path from the HSCP
    - -- Indicates that more equipment is available than the successful single shutdown path
    - -- Could potentially result in a negative delta risk
    - -- To prevent this from biasing the results, the CCDP of the compliant case is set to the value for the variant case
    - -- Allows compliant case based on non-abandonment, crediting all available equipment not damaged by the fire, same CCDP as variant case
    - -- This fire does not impact VFDRs since the VFDRs are for HSCP control only
    - -- Delta risk for this case is 0

Methodology Used to Calculate Delta Risk in the Cable Spread Room (CSR)

Delta Risk Calculation – Case 2

- **Case 2 is a more severe fire but no Hot Gas Layer (HGL)**
  - Variant case CCDP is > 0.0053/0.0062 (U1/U2)
  - Compliant case CCDP is 0.0053/0.0062 (U1/U2)
    - -- Represents successful single shutdown path at HSCP
    - -- All required equipment is available with control at the HSCP including offsite power
    - -- Eliminates all VFDRs that cause variant case CCDP to be higher
  - Again, delta risk is the difference between variant and compliant case

Methodology Used to Calculate Delta Risk in the Cable Spread Room (CSR)

Delta Risk Calculation – Case 3

- **Case 3 is a severe fire with a HGL in the CSR**
  - Variant case is set to a CCDP of 1.0
    - -- Assumes Control Room abandonment - no recovery at HSCP
  - Compliant case CCDP is 0.0053/0.0062 (U1/U2)
    - -- Represents successful single shutdown path at the HSCP
    - -- All required equipment is available with control at the HSCP including offsite power
    - -- Eliminates all VFDRs in the variant case that are associated with the HSCP

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Comparison to FAQ 08-0054

FAQ 08-0054 Guidance

- **B.2.2.4.2.a Variant vs. Compliant Case**
  - Pre-transition actions not at the PCS characterized as alternative shutdown may not have a single deterministically compliant condition for comparison purposes
  - One option would be to define a compliant case that is not based on the actual fire area configuration, but based on a configuration that meets the deterministic criteria of Section 4.2.3 of NFPA 805.

Comparison to FAQ 08-0054

FAQ 08-0054 Guidance

- **B.2.2.4.2.b, Perform Fire Risk Evaluation**
- **Change in Risk Calculation**
  - Change in risk is the difference between the aggregate risk for the condition associated with the VFDR and the aggregate risk for the deterministically compliant condition
  - The compliant condition is created by manipulating the Fire PRA to ‘remove’ the VFDR(s) and thereby creating the compliant condition

Comparison to FAQ 08-0054

CSR Methodology vs FAQ 08-0054

- **CSR Methodology meets the guidance in FAQ 08-0054 B.2.2.4.2.a Variant vs. Compliant Case**
  - The compliant case assumed that all required equipment was available from the hot shutdown control panel. This meets FAQ 08-0054 in that this compliant case is not based on the actual fire area configuration, but based on a configuration that meets the deterministic criteria of Section 4.2.3 of NFPA 805
- **CSR Methodology meets the guidance in FAQ 08-0054 B.2.2.4.2.b for Change in Risk Calculation**
  - The methodology is consistent with the above guidance for the change in risk calculation since the method compares the risk of the variant case with a deterministically compliant case

The methodology used to calculate the delta risk in the CSR meets the guidance in FAQ 08-0054

Comparison to R.G. 1.205 Revision 1

R.G. 1.205 Revision 1 C.2.2.4

- **Footnote to Regulatory Position C.2.2.4**
  - The “deterministically compliant plant” has been referred to as “an ideal plant” that may not exist or be feasible in practice.
  - An exception might occur for fire scenarios where evacuation of the main control room is necessary. This has been addressed in the regulatory guide by defining the term “primary control station,” which is used in the NFPA 805 definition of recovery action; see Regulatory Position 2.4
- **St. Lucie Cable Spread Rooms**
  - Each Units’ Cable Spread Room is a Control Room evacuation area in the deterministic analysis
  - Each Units’ Cable Spread Room VFDRs were developed based on Regulatory Position C.2.4

Comparison to R.G. 1.205 Revision 1

R.G. 1.205 Revision 1 C.2.4

- **2.4 Recovery Actions**
  - The staff has identified two cases where operator actions taken outside the main control room may be considered as taking place at a primary control station. These two cases involve dedicated shutdown or alternative shutdown controls, which have been reviewed and approved by the NRC
    - -- St. Lucie is alternative shutdown (second case)
  - These alternative shutdown controls may be considered the primary control station, provided that, once enabled, the systems and equipment controlled from the panel are independent and electrically separated from the fire area
  - St. Lucie meets this criteria
    - -- VFDRs developed when this criteria not met
    - -- Compliant case assumes all functions at the HSCP are unaffected by the fire

Comparison to R.G. 1.205 Revision 1

CSR Methodology vs. R.G. 1.205

- **St. Lucie is case 2 of Regulatory Position C.2.4**
  - VFDRs written when required control not available at the HCSP
    - -- Circuit not independent of Control Room or control not available at the HSCP
  - Compliant case assumes all equipment available from the HSCP
    - -- This eliminates the VFDRs developed above
    - -- Therefore, the compliant case meets R. G. 1.205 Regulatory Position C.2.4
  - Compliant case meets Regulatory Position C.2.4 with control at the PCS

CSR Methodology meets R. G. 1.205

RAI Response

PRA RAI 11.c.02.01

"The response to PRA RAI 11.c.02 implies that the modelling of compliant plant fire scenarios for fires in the cable spreading room does not appear to model the as-built and as operated plant and the reported change-in-risk calculations do not appear to be consistent with the accepted methods for calculating the change in risk such as FAQ 08-0054.

a. *The response states that, for non-HGL fire scenarios in the cable spreading room, when the compliant plant CCDP (which assumes abandonment of the MCR) is greater than the CCDP of the corresponding post-transition plant fire scenarios (which do not assume abandonment), the delta risk is set to zero and this is conservative (i.e., does not credit negative delta risk for these scenarios). This proposed method is not consistent with the accepted methods of estimating the change in risk such as those described in FAQ 08-0054, e.g., one acceptable method in FAQ 08-0054 is to manipulating the Fire PRA model to 'remove' the VFDR(s) and thereby creating a compliant condition."*

RAI Response

PRA RAI 11.c.02.01

The response to PRA RAI 11.c.02 implies that the modelling of compliant plant fire scenarios for fires in the cable spreading room does not appear to model the as-built and as operated plant and the reported change-in-risk calculations do not appear to be consistent with the accepted methods for calculating the change in risk such as FAQ 08-0054.

- **The method used to model the compliant plant fire scenarios represent an 'ideal plant' that has no VFDRs for any cable spread room fire which meets the compliant plant as defined by NFPA 805 4.2.3**
- **The reported change in risk calculations are consistent with accepted methods and meets the guidance in FAQ 08-0054.**
- **The next slides will respond to each of the questions posed in RAI 11.c.02.01**

RAI Response

PRA RAI 11.c.02.01.a Response

- **The methodology used to calculate the delta risk for the Cable Spread Room at St. Lucie meets the guidance in FAQ 08-0054**
  - The assumption that all required equipment is available at the HSCP effectively eliminates the VFDRs in the compliant case as the guidance in FAQ 08-0054 states
  - The deterministically compliant plant meets R. G. 1.205 regulatory position C.2.4 with control at the PCS (HSCP for St. Lucie). VFDRs were written and are part of the variant case when circuits were not independent from the Control Room or control was not available at the HSCP

The CSR methodology meets the guidance in FAQ 08-0054

Response to PRA RAI 11.c.02.01.a

i. Why is an acceptable method not used?

- Based on the response above the method used is an acceptable method.

ii. Confirm that this method is only applied to the cable spreading room and identify the criteria used to select a fire area in which to apply this method.

- This method is only applied to each Units' Cable Spread Room. The criteria used to select this method is a fire area where the deterministic compliance is the use of a PCS that is not the Control Room when deterministic Control Room abandonment is not caused by habitability issues. Only each Units' Cable Spread Room meets this criteria

RAI Response

Response to PRA RAI 11.c.02.01.a

iii. Provide the results of a sensitivity study (CDF, LERF, ΔCDF, ΔLERF) for the fire area from using an acceptable method instead of the proposed method.

- This is not required since the NextEra methodology described above is considered acceptable per FAQ 08-0054

RAI Response

PRA RAI 11.c.02.01.b

b. *"The response further states that, "the cable spreading room delta risk calculation methodology provides a conservative upper bound delta risk value by ensuring a conservative upper bound variant case and a conservative lower bound compliant case risk." Modelling the expected equipment available in the variant case appears to be a realistic estimate of the variant case, not a conservative upper bound. Similarly, assuming only the alternate shutdown equipment is available in the compliant plant most likely results in an overestimate of the compliant plant risk, not a conservative lower bound risk. Therefore, for less severe fires, the compliant plant risk may be substantially less than the risk assuming only one safe-shutdown train is available and the change-in-risk estimate would not be conservative but would, instead, be underestimated. For more severe fires, the MCR could be abandoned leaving only the one safe-shutdown train, but this minimal equipment would also be available for the compliant case (unless risk reduction modifications are being made) and a zero change in risk would be realistic not conservative.*

Provide justification that the, "calculation methodology provides a conservative upper bound delta risk value" by addressing the individual and synergistic effects of the method's assumptions on "more" severe and "less" severe fires and any risk-reduction modifications that may be planned in these areas."

RAI Response

PRA RAI 11.c.02.01.b

- **The methodology used results in three cases for delta risk values**
  - Case 1 Small fire (realistic)
  - Case 2 More severe fire (conservative)
  - Case 3 Severe fire (very conservative)
  - The combination of these three cases results in a conservative estimate of the delta risk as discussed below for each case

Delta risk estimates are conservative

RAI Response

PRA RAI 11.c.02.01.b Response – Case 1

- **Calculated variant case CCDP is smaller than compliant case CCDP for a successful single shutdown path at the HSCP**
  - Indicates that more equipment is available than the single shutdown path
  - Could result in a negative delta risk, however, 0 delta is used
  - To prevent this from biasing the results, the CCDP of the compliant case is set to the value for the variant case
  - Allows compliant case based on non-abandonment, crediting all available equipment not damaged by the fire resulting in same CCDP as variant case
  - This is considered to a be a realistic estimate of the delta risk

RAI Response

PRA RAI 11.c.02.01.b Response – Case 2

- **Variant case CCDP is > 0.0053/0.0062 (U1/U2)**
  - Compliant case CCDP is 0.0053/0.0062 (U1/U2)
    - -- Represents successful single shutdown path at HSCP
    - -- All required equipment is available with control at the HSCP including offsite power
  - Delta risk is the difference between variant and compliant case
  - This is considered to be a conservative estimate of the delta risk since the compliant case is a lower bound for this condition

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RAI Response

PRA RAI 11.c.02.01.b Response – Case 3

- **Variant case set to a CCDP of 1.0**
  - Assumed Control Room abandonment with no recovery at HSCP
  - Compliant case CCDP is 0.0053/0.0062 (U1/U2)
    - -- Represents successful single shutdown path at HSCP
    - -- All required equipment is available with control at the HSCP including offsite power
    - -- This is considered a very conservative estimate of the delta risk since this uses the lower bound estimate of the compliant case combined with the upper bound estimate of the variant case

RAI Response

PRA RAI 11.c.02.01.b Response – Summary

- Case 1 – Realistic
- Case 2 – Conservative
- Case 3 – Very Conservative
- Overall Results - Conservative

Closing

The treatment of the compliant case and the resulting delta risk calculation for each of the cable spread rooms at St. Lucie provide a conservative estimate of the delta risk for transition to NFPA 805 and meet the guidance in FAQ 08-0054 and R. G. 1.205 Revision 1

Questions?