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APPENDIX D DISPOSITION OF QUAD CITIES PRA PEER REVIEW

HIGH PRIORITY FACT AND OBSERVATIONS

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¹ Quad Cities PRA had no “A” Facts and Observations

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Disposition of Quad Cities PRA Peer Review

As part of the Option 2 implementation, the “A” and “B” Facts and Observations (F&Os) (i.e., the highest priority items) developed by the PRA Peer Review Team during the NEI 00-02 Quad Cities review were examined to assess their impact on the PRA for application to the Option 2 program with respect to Core Spray, SBGTS, and Feedwater.

There are no “A” Fact and Observations (F&Os) findings from the PRA Peer Review. These types of F&Os would have required immediate attention to address before applications are undertaken. Appendix C includes the “B” F&Os for Quad Cities compiled from the PRA Peer Review Report, and for each F&O a summary of the planned resolution is presented. While these resolutions have not been implemented, they are entered into the Exelon tracking systems for commitments, i.e., the URE database, for resolution as part of the next PRA update.

The results of this examination are summarized in Table D-1 by including the intent of the observation and its proposed resolution by Exelon and the potential impact of the item’s resolution on the PRA results for Option 2.

D-2

Table D-1

SUMMARY OF THE IMPACT ON THE OPTION 2 PILOT PROGRAM
DUE TO A&B FACTS AND OBSERVATIONS FROM THE QUAD CITIES PRA PEER REVIEW

| F & O Impact on Option 2 Pilot Program ¹⁾ | Facts and Observations Description | Evaluation Notes |
|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IE-5 | <p>It may be beneficial to include the loss of one DC division as a separate initiator since even though it may not trip the plant, it would lead to a manual plant shutdown with degraded components if the DC division were not recovered.</p> <p>The documentation states that this would be a low contributor to CDF based on the conditional core damage probability for the loss of feedwater events, but it would probably be best to verify this by including it as its own initiator to eliminate any uncertainty.</p> | <p>This is a difficult event to classify. The loss of a single DC division does not cause a scram or turbine trip. Therefore, it logically is not included as a transient initiator. However, the Quad Cities Technical Specifications, Item 3.9.(E) - Distribution - Operating, p. 3/4.9-17 Action (2), specifies that if one of the required <u>distribution systems</u> are not energized, re-energize the system within <u>2 hours</u> or be in <u>hot shutdown</u> within the next <u>12 hours</u> and in <u>cold shutdown</u> within the following <u>24 hours</u>.</p> <p>This would indicate that it is prudent to consider the loss of a DC bus and a demand to reach safe shutdown as part of the PRA. Therefore, this will be added to the list of initiators. It is found in other studies of BWRs that the common cause loss of DC buses, which is already included in the Quad Cities</p> <p style="text-align: right;">Negligible</p> |

PRA, is by far the largest contributor to risk associated with DC bus unavailability.

Thus, no substantial change in the risk profile or the importance of SSCs is anticipated from the addition of the single DC bus "initiating event."

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| IE-14 | The on-line surveillance testing of interfacing system valves has not been included in the development of the ISLOCA initiating event frequency analysis. This could be a dominant contributor to the frequency analysis. | A review of the latest Quad Cities Technical Specifications has been performed to identify the surveillance test interval for the Pressure Isolation Valves (PIVs) involved in the assessment of the ISLOCA contributors. The results of this evaluation indicate that these valves are leak tested and cycled every refueling. (See Section 3/4-7.) In addition, work control has identified that these tests are performed while the unit is shutdown. These results support a minimal impact on the ISLOCA frequency based on the NSAC-154, NUREG/CR-5603 and NUREG/CR-5124 evaluation guidelines. | Negligible |
| AS-14 | The end state for %DLOOP tree, DLOP-17, DLOP-20, DLOP-26 and DLOP-27 do not reflect the appropriate | The ISLOCA evaluation will be revised consistent with NSAC-154 guidelines to ensure that there are no other changes that may influence the ISLOCA frequency contribution to risk. This is a documentation item. The event tree figure and documentation will be updated to reflect this | Negligible |

plant damage class (as indicated in the LOOP presentation by the utility.)

modification. However, the change has no impact on the quantitative results. The Level 1 and Level 2 computer model and its results reflect the appropriate plant damage class. Therefore, the quantification of the risk and its contributors is accurate as is.

TH-10 There is conflicting information regarding the need for room cooling for RCIC. Calculation BSA-Q-97-04 seems to indicate that it is not required, but BSA-Q-96-01 would indicate that it is required. (See QC-PSA-006, Note 4 to Table 2-12)

There is no conflict in the Quad Cities documentation. The two calculations clearly state when there is a need for room cooling.

Negligible

RCIC room cooling is only required in the event of a gland seal leakoff failure. This is modeled in the PSA and is supported by calculation BSA-Q-97-04. Gland seal leakoff failure is modeled probabilistically. The RCIC room coolers may be required if both RCIC and Core Spray (which are co-located) are operating at the same time (see calculation BSA-Q-96-01). However, no accident sequences require simultaneous RCIC and CS operating. The operator would terminate CS because it is not required. Therefore, the RCIC room cooling is found to be appropriately modeled.

TH-12 The success criteria notebook (QC-PSA-003) documents the ATWS criteria in Tables 3-1b. However, the success criteria description or supporting text has not been provided. This makes it difficult to trace the bases for the

The modeling assumptions made in the success criteria documentation is reflective of a BWR with limited SRV/SV capacity such as Pilgrim (less than 50% of full power steam flow). This is such that even with successful

Negligible

ATWS success criteria.

Subsequent to this observation, written description of ATWS success criteria (draft) was provided to the Certification team. The write-up is and the success criteria tables are slightly inconsistent in terms of the need for FW Trip or runback. It appears that based on new information, the PRA team has decided that FW trip is not required. The success criteria Tables still indicate that FW runback is needed. It is not clear how this issue was modeled in the PRA.

RPT, the RPV pressure will continue to rise over the 1 to 2 minute time frame following an MSIV closure isolation. The Quad Cities plant has substantial combined SRV/SV capacity (more than 70% of full power steam flow); and therefore it is found that there is no need for a FW pump trip to prevent overpressure failure as long as RPT is successful. As a result, the current PRA model is slightly conservative because it introduces a failure mode that has been assessed as inapplicable to Quad Cities. The ATWS model is slightly conservative in the existing model used for the Option 2 analysis; however, the assumed failure results in an insignificant numerical impact. Therefore, the decision-making input from the PRA is unaffected.

The excess discussion of the ATWS success criteria and the associated tables will be modified in the PRA documentation (QC-PSA-003) to reflect the above information and to remove the excess conservatism in the model.

The overpressure effect of continuing FW (motor driven) injection under ATWS conditions has been found to be acceptable.

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| SY-6 | Various piping attached to the CCSTs (i.e. RCIC suction line) is not protected against inadvertent collision with forklifts or other small vehicles. The presence of a vehicle and tire tracks indicate that this is a real probability. This is a vulnerability that could cause a common cause failure of the CST and suction source for several systems | <p>The model does not require FW trip to ensure success for ATWS events with ARI failure. The suggestion is considered a viable insight and has been included in the PRA insights.</p> <p>The identified event is not an initiating event, and its coincidental failure within the 24 hour mission time of an accident mitigation is considered to be probabilistically insignificant.</p> | Negligible |
| SY-26 | There is a procedure that requires PSA Engineering to be interfaced with for changes made to the plant. There is not a procedural requirement to include PSA Engineering in the changes made to procedures, surveillances, instructions, etc. that could affect the CDF. | <p>Mitigation is approximately 1E-3</p> <p>CDF ~ 8E-10/yr</p> <p>The On-Site Risk Management Engineer monitors the on-going changes to the plant, procedures, surveillances, and instructions. These are part of the periodic PRA update. A continuous monitoring of these changes is not considered consistent with the recognized periodic PSA update process that is being implemented throughout the industry.</p> | Negligible |

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| DA-6 | The component probabilities data used in the evaluation are based on accumulated plant specific experience. However, the last three years experience has not been included in the accumulated data. | <p>As part of the Option 2 Pilot PRA application, the Quad Cities Risk Management Engineer reviewed changes to the plant since the update freeze date and confirmed that one plant modification has been made that would influence the calculations. The modification reduced the importance of FW SSCs.</p> <p>The next periodic update will include the incorporation of plant specific maintenance rule data. In the meantime, a check of the data indicates that the only SSC that have operating experience showing higher unavailability than accounted for is the PRA in the HPCI system.</p> | Negligible |
| HR-14 | The Human Reliability Analysis relied on the analysts' review and interpretation of the QGAs and other procedures. A major enhancement to the scrutability of the analysis would be to factor a structured interview or question process into the analysis and documentation. This could also help to support the cases where execution time was estimated. | <p>The impact on the PSA is that....</p> <p>The operator interview questions and results were not available to the PRA Peer Review Team at the time of their review. The operating crew interviews performed to support the HRA included a structured set of questions, the answers to which were used in the evaluation of each of the HEPs in the model. The results of the information gained from the interview process is included in the updated HRA analysis, Section 3. This documentation item is considered resolved. The addition of the documentation to the HRA document did not alter the risk profile.</p> | Negligible |
| DE-9 | Flooding is an important issue that merits further investigation by the Quad Cities PSA staff. At least two | As suggested, internal flooding has been the subject of an on-going update. The internal flood evaluation will | Negligible |

potential vulnerabilities exist at the Quad Cities Station in respect to internal flooding. 1) A rubber boot secured by hose clamps on the RCIC suction line (torus room side). 2) Ventilation penetrations below the maximum postulated torus room flood zone.

then be incorporated into the PRA. The two specific items cited in the Peer Review comment have been investigated as part of the internal flood update, and it is found that they contribute a negligible degree to the CDF and LERF.

DE-10 The lack of documented walkdowns provides for a level of uncertainty.

The Observation addresses a documentation issue related to the walkdowns performed on the Quad Cities plant. Currently, although multiple walkdowns were performed, no walkdown notes are available except those developed as part of:

- (a) the internal flood walkdowns in 1992 and 2001
- (b) the RI-ISI project
- (c) the fire events PRA Update.

Negligible

QU-8 In the top 100 sequences, cutset 96 is an ATWS scenario with mechanical scram failure, following loss of feedwater event. Core damage occurs when operator fails to inhibit ADS due to low water level. The HEP credited is for "failure to inhibit ADS w/feedwater injecting." This HEP appears to be misapplied for this sequence, since loss of feedwater

The dependency analysis itself was not criticized and is judged by Exelon to be at the state-of-the-technology. The incorporation of walkdown notes would further enhance the dependency documentation but is not believed to affect the model quantification. ADS inhibit during ATWS events is modeled with two HEPs as follows:

- ADS inhibit with FW initially available (event 1ADOP-INHIBHPH--; HEP = 1.4E-2)
- ADS inhibit will FW unavailable (event 1APOPINHIBIT-H--; HEP = 3.4E-2)

Negligible

is the initiator.

This anomaly is related to the use of the ONE4ALL model. Cutset 96 is a non-minimal cutset that should be removed from the model. Cutset 44 provides a similar scenario with FW unavailable and uses the appropriate HEP of 3.4E-2. Therefore, the current model provides conservative results. However, the quantitative impact is judged to be minor (less than 1%). The model, flag files, and mutually exclusive files, should be reviewed to ensure that for sequences with FW failure, additional cutsets with ADS inhibit for FW success are not included in the final cutsets. In addition, the ONE4ALL model should be updated to explicitly account for all event tree success paths. This will eliminate the potential for including HEPs for FW success even though FW previously failed.

QU-15 It is not clear that the EDGs (i.e. the non-SBO diesels) would have sufficient capacity to allow for RHR and RHRSW pumps to be running for both units in the dual loss of offsite power scenario.

The EDG capacity is 2850 kw rated (2000 hrs/yr). The load for SBO Response on 2 units with RHR and RHRSW pumps is 1290 kw/unit = 2580 kw total. Therefore a single EDG could carry the RHR/RHRSW loads of both units. Alternatively, the loads do not need to be continuously present but rather could be switched back and forth as necessary to maintain plant conditions. Quad Cities has a procedure to allow powering both units for safe shutdown from the swing EDG-- QCOA 6100-03 (Rev 9).

Negligible

QU-26 An uncertainty analysis was not performed as part of

An uncertainty evaluation was performed in

Negligible

the evaluation of the model results.

response to this F&O. The evaluation references the parametric uncertainty analysis performed on similar plants and reviews the types of uncertainty along with the practical insights to be derived from the uncertainty analysis.

QU-26 No special sensitivity or uncertainty cases have been performed. Typically sensitivity studies accompany the dominant sequences, initiators or other modeling feature (such as vessel rupture initiating event) which may dominate the uncertainty of the CDF point estimate of CDF. This information is needed to establish the acceptability of the final results.

See the Uncertainty Evaluation for the results. Sensitivity evaluations were performed in response to this F&O. See the Uncertainty Evaluation for the results.

Negligible

L1-7,
13
The transfer from L1 to L2 PRA is done by carrying the plant

The current conditional LERF probability is close to 0.7. The system dependencies are overwhelmed by the conservative treatment of the Level 2 phenomenological dependencies.

Negligible

Incorporation of a more realistic assessment, including the incorporation of the Level 1

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dependencies in a less conservative manner
would result in reducing the LERF frequency
and LERF conditional probability.

(See L2, 7, 20)

L2- 7,
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The LERF model is recognized as

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L2-24

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See L2-7, 13 and L2-7, 20

Negligible

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possibly
makes it
conservative.
Because of
this simplification
, the approach
may be too
conservative for
Risk-informed
applications
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MU-1,
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The existing guidance in NEP-17-04 is at a programmatic, conceptual level. There are very few working level documents in place to

The Exelon PRA Programs have been drawn together with a single focal point, Dr. W.E. Burchill. Under his leadership, the Exelon PRAs and the programmatic directions are being updated and upgraded.

At the time of the Quad Cities PRA Peer Review, the PRA Program guidance and procedures were in the final stages of completion. The PRA Peer Review Team did not review either the upgraded program procedures or their implementation.

Approximately, one year later, the Dresden PRA received a PRA Peer Review. This Peer Review Team had access to the updated Exelon program procedures and guidance, i.e., the same guidance that is now used for Quad Cities.

The results of the PRA Peer Review of the Maintenance and Update Program for Dresden (identical to that now in force for Quad Cities) were the following:

Negligible

allow the update team to perform PSA updates without relying solely on the “skill of the craft”.

The grades were all 3 and 4 except one 2 related to in-house independence of the checker

An overall grade of 3 was assigned to the Maintenance and Update Element consistent with the Option 2 expectation

No Fact and Observations were identified for Dresden

Qualitatively, the Team stated:

The guidance for model maintenance and update at Dresden is superior. Inputs for the MU process are described in Dresden procedure ER-AA-600. Changes that impact the PRA model are tracked in a computerized database. This is a superior practice. Computer program update and maintenance is controlled by procedures. Training is performed after PRA updates, but not necessarily on software revisions. A list of applications to be re-evaluated is contained in a computerized database. This is a superior practice.

Based on the Dresden PRA Peer Review results and similar results for the Byron and Braidwood PRA Peer Reviews, it is judged that the Maintenance and Update process at

Exelon is superior and that the Quad Cities
F&Os are resolved by virtue of the
subsequent program changes and
implementation efforts.

MU-4

Enhance the
data
collection
phase
of the
update
process to
include the
following
elements
that
the
“Monitoring
and

This is resolved—see MU 1,3 resolution, but
the following have not yet been included:

Industry studies
Operator training programs

Negligible

Collecting
New
Information”
sub-
element
suggested
was
missing from
the
update
procedure:

Operating
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MU-6

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Currently the models are stored in at least three separate locations. This is not considered to practically affect the technical assessments of current or future applications. (See also Response to MU 1,3)

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addressed in draft form to comply with NSP-CC-3021, but there is no guidance for the safeguard of the PSA model files.

PSA models and sensitivity

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MU-7,

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| Section 5.2.2 of NEP-17-04 describes the periodic update process. The following findings apply to this section of the process. | See Response to MU 1,3. The Program now includes: Re-evaluation of past PRA applications. In addition, the implementation of the Plan has resulted in a precedence set for each plant of a Risk Insights document that compiles the practical insights found during the PRA that can be implemented. A definition of “vulnerability” has not been established. This is not considered necessary. Finally an uncertainty analysis has been prepared for Quad Cities. This analysis is an addendum to the Quantification Notebook (QC-PSA-014). | Negligible |
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Because this is a new procedure, the results of the use of this procedure cannot be reviewed. However, the elements of the process

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See Response to MU 1,3.

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MU-12

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software/
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5.1.2.2

The
PSA
analysts are
not
performing
the
analysis of
plant

changes for the Quad Cities PSA model

5.1.2.4 The PSA analysts are not reviewing the NFS calculations on a quarterly basis.

MU-12,
13

Commonwealth Edison
wrote NEP-17-04
to codify the PSA
Maintenance and Update
Process for the entire
Nuclear Operations
Division.
As of

This procedure is currently being revised, but the current procedure or changes do not influence the ongoing applications. Future PRA updates could be affected by the final resolution of these procedures.

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The following are observations that pertain to activities performed at the sites. They are listed by the steps in NEP-17-04 that apply.

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other stations.

5.1.3.4/ 5.2.3.3

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The PRA engineer is automatically not in the loop for changes to plant procedures and Technical specifications that could impact the PRA results. It appears that PRA engineer is consulted on

The on-site PRA engineer is familiar with plant hardware, procedural, and Technical Specification changes. These changes are factored into the PRA on a periodic update basis. Other more extraordinary measures are not considered warranted.

Negligible

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¹¹⁾ Assessed impact on Core Spray, SBGTS, and Feedwater Safety Significance determination.