# Appendix F

## GEIS Environmental Issues Not Applicable to Dresden Units 2 and 3

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The following table lists those environmental issues listed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996; 1999)[(a)] and 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are not applicable to Dresden Units 2 and 3 because of plant or site characteristics.

**Table F-1**. GEIS Environmental Issues Not Applicable to Dresden Units 2 and 3

| ISSUE - 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | Category | GEIS Sections | Comment |
|---|---|---|---|
| **SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)** | | | |
| Altered salinity gradients | 1 | 4.2.1.2.2; 4.4.2 | The Illinois River is an inland freshwater river with no salinity gradient. |
| Altered thermal stratification of lakes | 1 | 4.2.1.2.3; 4.4.2.2 | The discharge is to the Illinois River |
| **GROUNDWATER USE AND QUALITY** | | | |
| Groundwater-use conflicts (Ranney wells) | 2 | 4.8.1.4 | Dresden Units 2 and 3 do not have or use Ranney wells. |
| Groundwater quality degradation (Ranney wells) | 1 | 4.8.2.2 | Dresden Units 2 and 3 do not have or use Ranney wells. |
| Groundwater-use conflicts (potable and service water, and dewatering; plants that use >100 gpm) | 2 | 4.8.1.1; 4.8.1.2 | Dresden Units 2 and 3 use <100 gpm of groundwater. |
| Groundwater quality degradation (saltwater intrusion) | 1 | 4.8.2.1 | The cooling pond at Dresden is not near a saltwater body. |
| Groundwater quality degradation (cooling ponds in salt marshes) | 1 | 4.8.3 | The cooling pond at Dresden is not near a saltwater body or a marsh. |
| **TERRESTRIAL RESOURCES** | | | |
| Bird collisions with cooling towers | 1 | 4.3.5.2 | This issue is related to a heat-dissipation system that is not installed at Dresden Units 2 and 3. |

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

## F.1 References

10 CFR 51. Code of Federal Regulations, *Title 10, Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

# Appendix G

# NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Dresden Nuclear Power Station, Units 2 & 3, in Support of the License Renewal Application Review

# Appendix G

# NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Dresden Nuclear Power Station, Units 2 & 3, in Support of the License Renewal Application Review

## G.1 Introduction

Exelon Generation Company, LLC (Exelon) submitted an assessment of SAMAs for Dresden as part of the ER (Exelon 2003a). This assessment was based on the most recent Dresden Probabilistic Risk Assessment (PRA) available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2), and insights from the Dresden Individual Plant Examination (IPE) (ComEd 1996) and Individual Plant Examination of External Events (IPEEE) (ComEd 1997). In identifying and evaluating potential SAMAs, Exelon considered SAMA analyses performed for other operating plants which have submitted license renewal applications, as well as industry and NRC documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a). Exelon identified 265 potential SAMA candidates. This list was reduced to 10 unique SAMA candidates by eliminating SAMAs that were not applicable to Dresden due to design differences, had already been implemented, or had high implementation costs. Exelon assessed the costs and benefits associated with each of the potential SAMAs and concluded that none of the candidate SAMAs evaluated would be cost-beneficial for Dresden.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to Exelon by letter dated May 30, 2003 (NRC 2003). Key questions concerned: dominant risk contributors at Dresden and the SAMAs that address these contributors, the potential impact of external event initiators and uncertainties on the assessment results, and detailed information on some specific candidate SAMAs. Exelon submitted additional information by letter dated July 23, 2003 (Exelon 2003b). In the response, Exelon provided: tables containing importance measures for various events and their relationship to evaluated SAMAs; rationale for why the core damage frequency (CDF) for fire events would be substantially lower than reported in the IPEEE; results of a revised screening based on consideration of the potential impact of external events and uncertainties; more realistic estimates of the benefits and implementation costs for several SAMAs that appeared to be cost-beneficial based on the revised screening; and the costs and benefits associated with several lower cost alternatives. Exelon's responses addressed most of the staff's concerns and reaffirmed that none of the SAMAs would be cost-beneficial.

Based on its review, the staff concluded that the contribution to risk from fire events would be higher than assumed in Exelon's SAMA analysis. The staff adjusted Exelon's risk reduction estimates to account for the contribution to risk (and risk reduction) from fire events, and found that none of the candidate SAMAs would be cost-beneficial, but that two SAMAs are close to being cost-beneficial, and could be cost-beneficial given a more detailed assessment of their benefits in external events or when uncertainties are taken into account. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation, and therefore need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

An assessment of SAMAs for Dresden is presented below.

## G.2 Estimate of Risk for Dresden

Exelon's estimates of offsite risk at Dresden are summarized in Section G.2.1. The summary is followed by the staff's review of Exelon's risk estimates in Section G.2.2.

### G.2.1 Exelon's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the Dresden Level 1 and 2 PRA model, which is an updated version of the Modified Individual Plant Examination (IPE) (ComEd 1996), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the SAMA analysis. The SAMA analysis is based on the most recent Level 1 and 2 PRA model available at the time of the ER, referred to as the 2002 Update model. The scope of the Dresden PRA does not include external events.

The baseline CDF for the purpose of the SAMA evaluation is approximately $1.9\times10^{-6}$ per year, and the baseline large early release frequency (LERF) is approximately $3\times10^{-7}$ per year. The CDF and LERF are based on the risk assessment for internally-initiated events. Exelon did not include the contribution to risk from external events within the Dresden risk estimates, nor did it account for the potential risk reduction benefits associated with external events in the SAMA screening process described in the ER. It is Exelon's position that the existing fire and IPEEE programs have already addressed potential plant improvements related to these areas (Exelon 2003a). In response to an RAI, Exelon performed a separate assessment of the impact on the results if the SAMA benefits (for internal events) were increased to account for additional benefits in external events. This is discussed further in Sections G.4 and G.6.2.

The breakdown of CDF by initiating event/accident type is provided in Table G-1. As shown in this table, loss of offsite power and transients (such as a transient with feedwater unavailable and main condenser available, and loss of turbine building closed cooling water) are dominant contributors to the CDF. Bypass events (i.e., interfacing systems LOCA) contribute less than one percent to the total internal events CDF.

**Table G-1**. Dresden Core Damage Frequency

| Initiating Event/Accident Class | CDF (Per Year) | % Contribution to CDF |
|---|---|---|
| Loss of Offsite Power (LOOP)[1] (dual-unit and single-unit) | $7.8 \times 10^{-7}$ | 41 |
| Transients | $6.3 \times 10^{-7}$ | 34 |
| Loss of Multiple DC Buses | $1.5 \times 10^{-7}$ | 8 |
| Loss-of-Coolant Accident (LOCA) | $1.1 \times 10^{-7}$ | 6 |
| Internal Flooding | $5.7 \times 10^{-8}$ | 3 |
| Manual Shutdown | $5.7 \times 10^{-8}$ | 3 |
| Others | $5.7 \times 10^{-8}$ | 3 |
| Loss of Service Water | $3.8 \times 10^{-8}$ | 2 |
| Interfacing Systems LOCA (ISLOCA) | $1.9 \times 10^{-9}$ | 0.1 |
| **Total CDF (from internal events)** | **$1.9 \times 10^{-6}$** | **100** |

[1]Includes station blackout (SBO)

The Level 2 PRA model has been updated since the IPE. During 1999, Exelon revised the PRA to include a simplified LERF methodology as described in NUREG/CR-6595 (NRC 1999). In 2002, Exelon replaced the simplified LERF model with a full Level 2 PRA. The source terms were also updated to account for the extended power uprate which was approved by the NRC in 2001 (NRC 2001b). The conditional probabilities, fission product release fractions, and release characteristics associated with each release category were provided in response to an RAI (Exelon 2003b).

The offsite consequences and economic impact analyses use the MACCS2 code to determine the offsite risk impacts on the surrounding environment and public. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within a 80 km [50-mi] radius) for the year 2031, emergency response evacuation modeling, and economic data.

In the ER, Exelon estimated the dose to the population within 80 km (50 mi) of the Dresden site to be approximately 0.1023 person-Sv (10.23 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table G-2.

**Table G-2**. Breakdown of Population Dose by Containment Release Mode

| Containment Release Mode | Population Dose (Person-Rem[1] Per Year) | % Contribution |
|---|---|---|
| Early containment failure | 8.04 | 79 |
| Late containment failure | 2.14 | 21 |
| Containment Bypass | 0.05 | <1 |
| No Containment Failure | ~0 | ~0 |
| **Total Population Dose** | **10.23** | **100** |

[1]One person-Rem = 0.01 person-Sv

## G.2.2 Review of Exelon's Risk Estimates

Exelon's determination of offsite risk at Dresden is based on the following three major elements of analysis:

- the Level 1 and 2 risk models that form the bases for the 1996 "Modified" IPE submittal (ComEd 1996) and the 1997 IPEEE submittal (ComEd 1997),

- the major modifications to the IPE model that have been incorporated in the Dresden PRA, and

- the MACCS2 analyses performed to translate fission product release frequencies from the Level 2 PRA model into offsite consequence measures.

Each of these analyses was reviewed to determine the acceptability of Exelon's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the Dresden IPE is described in an NRC report dated November 9, 1995 (NRC 1995). Based on a review of the original IPE submittal, the staff could not reach the conclusion that Commonwealth Edison had met the intent of Generic Letter 88-20 (NRC 1988). By letter dated June 28, 1996, Commonwealth Edison submitted a “Modified” IPE (ComEd 1996). The staff’s review of the Modified IPE is documented in a letter dated October 2, 1997 (NRC 1997b). In that review, the staff focused on whether the licensee addressed the concerns documented in the November 9, 1995, staff evaluation. The staff concluded that Modified IPE submittal met the intent of Generic Letter 88-20; that is, the Modified IPE was of adequate quality to be used to look for design or operational vulnerabilities.

The Modified IPE CDF, which included internal floods, was reported to be $3x10^{-6}$ per year for Unit 2 and $5x10^{-6}$ per year for Unit 3. The PRA used in the SAMA analysis, i.e., the 2002 Update model, indicates a decrease in the total CDF to $1.9x10^{-6}$ per year for both units. The reduction is attributed to plant and modeling improvements that have been implemented at Dresden since the Modified IPE was submitted, including changes related to the extended power uprate (EPU). A summary listing of those changes that resulted in the greatest impact on the total core damage frequency was provided in the ER and in response to an RAI (Exelon 2003b), and include:

- installed SBO diesel generators and the Division 1 4-kV cross-tie which reduced the LOOP contribution,
- revised LOOP/dual-unit LOOP analysis for initiating event frequencies and non-recovery probabilities,
- increased the medium break LOCA (MBLOCA) frequency using the latest Electric Power Research Institute (EPRI) methodology, added credit for feedwater in MBLOCA event tree, and added a higher human error probability (HEP) for operators to depressurize with a MBLOCA,
- reduced general transient frequency, and updated initiating event frequencies based on operating experience,
- revised human reliability analysis based on most recent operator interviews, and
- revised treatment of anticipated transient without scram (ATWS) sequences, including revised failure probabilities based on NUREG/CR-5500 (NRC 1999), added a failure to inhibit automatic depressurization system to several ATWS sequences, and added a manual scram following an inadvertent open relief valve to the ATWS event tree logic.

The CDF value for Dresden is at the lower end of the range of the CDF values reported in the IPEs for other boiling water reactor (BWR) 3/4 plants. Figure 11.2 of NUREG-1560 shows that the IPE-based total internal events CDF for BWR 3/4 plants ranges from $1x10^{-6}$ to $8x10^{-5}$ per year (NRC 1997a). It is recognized that other plants have reduced the values for CDF subsequent to the IPE submittals due to modeling and hardware changes. The current internal events CDF results for Dresden remain comparable to other plants of similar vintage and characteristics.

The staff considered the peer reviews performed for the Dresden PRA, and the potential impact of the review findings on the SAMA evaluation. In response to an RAI, Exelon described the previous peer reviews, the most significant of which was the Nuclear Energy Institute/Boiling Water Reactor Owners Group (BWROG) Peer Review of the 1999 PRA model conducted in January 2000 (Exelon 2003b). The BWROG review concluded that the Dresden PRA is consistent with other industry PRAs in scope, methods, data usage, and results, and does not have unique PRA features. Exelon stated that there were no “A” level facts and observations, and that all “B” level, and a number of the “C” level facts and observations were resolved in the 2002 Update. The most significant recommendations identified weaknesses in the area of Level 2 analysis, internal flooding, and thermal hydraulic analysis. Exelon stated that efforts to enhance the PRA in these areas have been completed and include incorporation of a new internal flooding study and a full Level 2 model into the 2002 PRA Update. Exelon concluded that improvements made since the Peer Review and the independent review have corrected any significant weaknesses identified and that the 2002 PRA Update model fully supports the SAMA identification and evaluation process.

One recommendation that was not addressed was that a capability to model uncertainties be added to the model and uncertainty analyses be performed. In an RAI, the staff requested that Exelon provide an estimate of the uncertainties associated with the internal events CDF, and an assessment of the impact on the Phase 1 screening and Phase 2 evaluation if the risk reduction estimates are increased to account for uncertainties (NRC 2003). In response to this request, Exelon estimated the uncertainties based on a review of other plants’ CDF uncertainty distributions (Exelon 2003b). Exelon’s evaluation and results are discussed in further detail in Section G.4 and G.6.2.

Given that the Dresden PRA has been peer reviewed and the peer review findings were either addressed or judged to have no impact on the SAMA evaluation, and that Exelon satisfactorily addressed staff questions regarding the PRA, the staff concludes that the Level 1 PRA model is of sufficient quality to support the SAMA evaluation.

Exelon submitted an IPEEE in December 1997 (ComEd 1997), in response to Supplement 4 of Generic Letter 88-20. Exelon did not identify any fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events related to seismic, fire, or other external events. However, a number of areas were identified for improvement in both the seismic and fire areas. In response to a staff RAI, Exelon replaced the seismic and fire sections with revised sections including additional and updated information (ComEd 2000). In a letter dated September 28, 2001, (NRC 2001a), the staff concluded that the submittal met the intent of Supplement 4 to Generic Letter 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities.

The IPEEE uses a focused scope EPRI seismic margins analysis. This method is qualitative and does not provide the means to determine the numerical estimates of the CDF contributions from seismic initiators. All equipment in the seismic IPEEE scope was reviewed in accordance with Unresolved Safety Issue (USI) A-46 program procedures. Exelon found that, based on the EPRI assessment methodology, some of the plant's high confidence low probability of failure (HCLPF) values were less than the 0.3g review level earthquake used in the IPEEE. The most limiting (or lowest) HCLPF values were:

| | |
|---|---|
| electrical buses | 0.17g |
| electrical distribution panels | 0.17g |
| condensate storage tank | 0.20g |
| diesel fuel oil storage day tank | 0.26g |

Other components, mostly electrical, had HCLPF values ranging from 0.27g to 0.29g. In response to an RAI regarding the IPEEE, Exelon stated that a number of improvements were made in the seismic area, primarily in equipment anchorages, during the resolution of the USI A-46 program (NRC 2000). As a result of either plant modifications or more rigorous evaluation, only the condensate storage tanks and diesel fuel oil storage day tank now have capacities at or less than 0.26g (Exelon 2003b).

During the review of the IPEEE, the staff questioned the availability of an ultimate heat sink in the event of a failure of the Dresden Lock and Dam which has a HCLPF value of 0.1g. In response to the RAI, Commonwealth Edison (now Exelon) stated that the success path identified for decay heat removal was the low pressure coolant injection (LPCI) system in the torus cooling mode with the containment cooling service water (CCSW) providing cooling to the LPCI heat exchangers. However, for a dam failure, the isolation condenser for each unit will be used as the means of decay heat removal in lieu of CCSW and LPCI mode of torus cooling. Exelon noted that a modification to develop a seismically-qualified or verified makeup path to supply water from the ultimate heat sink to the shell of the isolation condenser was being developed, and would be completed in conjunction with the approved schedule for resolution of USI A-46 outliers. According to the USI A-46 safety evaluation report (NRC 2000), the outliers will be resolved within two refueling outages per unit following receipt of the NRC safety evaluation report on the USI A-46 submittal.

In addition to the seismically-qualified/verified makeup path to the isolation condenser modification, Exelon stated that a study would be performed to ensure that a small break LOCA, with no torus cooling but with the isolation condenser in operation, does not result in unacceptable torus temperatures. During review of Exelon's EPU amendment application, the staff noted that Exelon had not yet implemented the modification to the isolation condenser makeup path, nor performed the small break LOCA (SBLOCA) confirmatory study. Therefore, the staff requested that Exelon augment its IPEEE seismic margins analysis by performing some simplified seismic risk evaluations of the current and EPU plant configurations for these two seismic outliers (e.g., seismically-qualified isolation condenser makeup path, and seismically-induced SBLOCA effects).

As described in the EPU SER, the SBLOCA confirmatory study demonstrated that the isolation condenser and available emergency core cooling systems (ECCS) are sufficient to mitigate a seismically-induced SBLOCA for a 24-hour period, but showed that additional equipment, specifically a cooling water supply to the CCSW heat exchangers, will be required shortly after 24 hours to supply suppression pool cooling. In a letter dated September 26, 2001, Exelon stated that it plans to use large portable pumps to restore the required CCSW cooling flow via suction from the intake canal (Exelon 2001). These pumps would be stored in an area that could withstand the postulated seismic event and would be staged with hose connections to the CCSW piping. The necessary fittings will be installed on the existing CCSW piping. Power for the portable pumps will be supplied either by portable diesel engines or by temporary power connections to the available existing electrical buses. Procedures will be developed to ensure that the necessary actions will be taken within the 24 hour period to establish suppression pool cooling flow. These actions will provide the capability to mitigate the seismically induced SBLOCA for the 72-hour time frame given in EPRI NP-6041-SL (EPRI 1991). In response to an RAI, Exelon stated that the CCSW fitting modification and development of associated procedures are scheduled to be completed on the same schedule as the isolation condenser makeup seismic upgrade. This modification essentially constitutes implementation of Phase 2 SAMA 2.

In the ER, Exelon evaluated increases to the seismic ruggedness of plant components as Phase 2 SAMA 5, and in dispositioning this SAMA indicated that "this SAMA remains under investigation for resolution as part of the Dresden close out of the IPEEE commitments." In an RAI, the staff asked for a description of the improvements under investigation, their status, and expected implementation schedule (NRC 2003a). In response to the RAI, Exelon stated that, as indicated in NUREG-1742 (NRC 2002a), an extensive number of plant improvements or other actions were planned to resolve USI A-46 outliers, and that all outliers have either been resolved or will be completed no later than the end of the Unit 2 refueling outage scheduled for October 2003, except for a Unit 3 modification to some motor control centers, which is currently scheduled for the fall of 2004 (Exelon 2003b). Exelon indicated in its comments concerning the draft SEIS that the plant improvements and other actions related to USI A-46 planned for the October 2003 outage were completed (Exelon 2004). No further seismic upgrades are planned.

The staff inquired about systems, structures, and components that limit the plant HCLPF and asked Exelon to explain why modifications to increase seismic capacity would not be cost-beneficial when evaluated consistent with the regulatory analysis guidelines (NRC 2003). In its response, Exelon provided a listing of systems, structures, and components with HCLPF values less than 0.3g. As discussed previously, either plant modifications or more rigorous evaluation, only the condensate storage tanks and diesel fuel oil storage day tank now have capacities at or less than 0.26g. Exelon stated that modifications to increase the condensate storage tank (CST) seismic capacities would be expected to cost more than several hundred thousand dollars, and that only minimal benefit is expected from increasing the remaining outliers to values greater than 0.3g (Exelon 2003b). The staff evaluated the benefit from increasing the seismic capacity of the CST to 0.3g. The staff estimates that this would result in a reduction in the CDF of about $5 \times 10^{-6}$ per year. The associated benefit would be on the order of $100,000. Although Exelon stated that the cost of such a modification would be more than several hundred thousand dollars, it is likely that it would cost $1M or more. Therefore, increasing the seismic capacity of the CSTs is not cost-beneficial.

Based on the licensee's efforts to identify and address seismic outliers, the staff concludes that the opportunity for seismic-related SAMAs has been adequately explored and that there are no cost-beneficial, seismic-related SAMA candidates.

The Dresden fire analysis employed the Fire Induced Vulnerability Evaluation methodology for screening of compartments and EPRI's Fire PRA Implementation Guide (EPRI 1995) for detailed evaluation of the unscreened compartments. The licensee's overall approach in the IPEEE fire analysis is similar to other fire analysis techniques, employing a graduated focus on the most important fire zones using qualitative and quantitative screening criteria. The fire zones or compartments were subjected to at least two screening stages. In the first stage, a compartment was screened out if it was found to not contain any safe shutdown circuits and equipment, equipment important to plant safety, or plant trip initiators. In the second stage, a CDF criterion of $1 \times 10^{-6}$ per year was applied. The licensee used the IPE model of internal events to quantify the CDF resulting from a fire initiating event. The conditional core damage probability was based on the equipment and systems unaffected by the fire. Initially, all fire event sequences were quantified assuming all equipment/cables in the area would fail by the fire. The CDF for each zone was obtained by multiplying the frequency of a fire in a given fire zone by the conditional core damage probability associated with that fire zone. The screening methodology applied by the licensee makes less and less conservative assumptions (e.g., equipment that may survive the fires in the area) until a fire zone is screened out, the results do not indicate a vulnerability, or a vulnerability is identified and addressed. After the screening, three compartments remained for Unit 2 that contributed more than the screening value of $1.0x10^{-6}$, and six remained for Unit 3. These compartments are:

| Compartment Description (fire area) | CDF |
|---|---|
| **Unit 2** | |
| Control Room | $7.15x10^{-6}$ |
| Trackway/Switchgear Area | $5.38x10^{-6}$ |
| Reactor Building Mezzanine | $1.65x10^{-6}$ |
| **Unit 3** | |
| Control Room | $7.11x10^{-6}$ |
| West Corridor and Trackway | $6.85x10^{-6}$ |
| Reactor Building Mezzanine | $3.54x10^{-6}$ |
| Mezzanine Floor | $3.44x10^{-6}$ |
| Auxiliary Electric Equipment Room | $2.53x10^{-6}$ |
| Cable Tunnel | $2.12x10^{-6}$ |

The fire CDFs for Unit 2 and Unit 3 are $1.7x10^{-5}$ and $3.1x10^{-5}$ per year, respectively, which are about factors of 9 and 16 higher than the internal events CDF of $1.9x10^{-6}$ per year. In light of these values, the staff inquired why Exelon neither considered fire explicitly in the SAMA study nor considered the impact of fire CDF in its uncertainty assessment. In an RAI (NRC 2003), the staff asked Exelon to explain, for each fire area, what measures were taken to further reduce risk, and explain why these CDFs can not be further reduced in a cost-effective manner. While not explicitly addressing the fire areas, Exelon cited a list of nine insights from the fire IPEEE results, and provided a disposition of the insights with respect to the SAMA analysis (Exelon 2003b). Exelon also performed a review of the Dresden Fire PRA model cut sets to determine the dominant sequence types. Excluding the control room severe fire, Exelon identified three dominant sequence types–loss of decay heat removal, loss of injection at high pressure, and loss of injection at low pressure. These sequence types are also dominant contributors to the internal events CDF. For each of the dominant sequence types, Exelon provided a list of potential improvements evaluated during the SAMA analysis, and showed that each of the dominant sequence types were addressed by numerous SAMAs (that were previously identified based on internal events). Exelon did make modifications to seismically mount a hydrogen seal oil control panel at Unit 2 and hydrogen monitors at both units. Hydrogen lines are routed through the cabinets in question, so the potential for hydrogen gas release in this area existed. These concerns have been resolved by design change packages 9900205 (Unit 2) and 9900204 (Unit 3). With regard to the SAMA evaluation, Exelon judged that the best approach to address additional fire-related improvements was to rely on SAMAs identified for external events, and to apply extra margin to account for internal events, and to apply extra margin to account for potential benefits from external events.

Exelon also described three areas in which it believes significant conservatism exists in the fire CDF estimates -- initiating event frequencies, system response/fire modeling, and human reliability modeling. Removal of or reduction in the conservatism in these areas would result in a reduction of the fire CDF to about $5.2 \times 10^{-6}$ per year which is a factor of three greater than the internal events CDF (Exelon 2003b). Exelon accounted for the contribution from external events, as well as uncertainty, by applying a multiplier of five to the averted cost estimates reported in the ER. Exelon characterized the result as an "upper bound averted cost estimate" (Exelon 2003b). The staff's review is described in Section G.6.2.

The Dresden IPEEE evaluated high winds, floods and other events using the progressive screening approach recommended in NUREG-1407 (NRC 1991). Based on this evaluation, the licensee determined that the risk from high winds, floods and other events was negligible. Additionally, the Dresden IPEEE demonstrated that transportation and nearby facility accidents were not considered to be significant vulnerabilities at the plant.

The staff reviewed the process used by Exelon to extend the containment performance (Level 2) portion of the PRA to an assessment of offsite consequences (essentially a Level 3 PRA). This included consideration of the source terms used to characterize fission product releases for the applicable containment release category and the major input assumptions used in the offsite consequence analyses. The MACCS2 code was utilized to estimate offsite consequences. Plant-specific input to the code includes the Dresden reactor core radionuclide inventory, source terms for each release category, emergency evacuation modeling, site-specific meteorological data, and projected population distribution within a 80 km (50 mile) radius for the year 2031. This information is provided in Appendix E of the ER (Exelon 2003a).

Exelon characterized the releases for the spectrum of possible radionuclide release scenarios using a set of 10 release categories, defined based on the timing and magnitude of the release. Two of the categories were combined with other release categories resulting in the use of only eight release categories. Each end state from the Level 2 analysis is assigned to one of the release categories. The process for assigning accident sequences to the various release categories and selecting a representative accident sequence for each release category is described in response to RAIs (Exelon 2003b). The release categories and their frequencies are presented in Table 4-4 of the ER (Exelon 2003). Table 3-4 of the response to an RAI provides a break out of the source term by release category (Exelon 2003b). The source terms used for the SAMA evaluation have been updated since the Modified IPE to account for the EPU and are based on the MAAP 4.0.4 code. The staff concludes that the assignment of release categories and source terms is consistent with typical PRA practice and acceptable for use in the SAMA analysis.

The core inventory input used in the MACCS2 was obtained from the MACCS2 User's Guide, and corresponds to the end-of-cycle values for a 3,578 MWth BWR plant. A scaling factor of 0.8264 was applied to provide a representative core inventory of 2,957 MWth for Dresden (the uprated power level). All releases were modeled as occurring at ground level. The staff questioned the non-conservatism of this assumption and requested an assessment of the impact of alternative assumptions (e.g., releases at a higher elevation). In response to the RAI, Exelon reassessed the doses for all eight release categories assuming that all plumes originated from the top of the reactor building. The results showed that the 50-mile population dose could increase by up to about eight percent (Exelon 2003b), which equates to about a six-percent increase in the maximum attainable benefit. This small increase has a negligible impact on the analysis and its results.

Exelon used site-specific meteorological data, obtained from the plant meteorological tower, processed from hourly measurements for the 2000 calendar year as input to the MACCS2 code. Data from this year was selected because it contained the fewest data voids. Data voids were filled with data from other tower measurements for smaller gaps, and from the Joliet Municipal Airport tower for larger gaps. The staff notes that previous SAMA analyses results have shown little sensitivity to year-to-year differences in meteorological data and considers use of the 2000 data in the base case to be reasonable.

The population distribution the applicant used as input to the MACCS2 analysis was estimated for the year 2031, based on the NRC geographic information system for 1990 (NRC 1997c), and the population growth rates were based on 2000 County-level census data (USBC 2001). The staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending out 16 km (10 mi) from the plant. It was assumed that 95 percent of the population would move at an average speed of approximately 1.19 meters per second (2.7 miles/hour) with a delayed start time of 15 minutes (Exelon 2003a). This assumption is conservative relative to the NUREG-1150 study (NRC 1990), which assumed evacuation of 99.5 percent of the population within the emergency planning zone. The evacuation assumptions and analysis are deemed reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data were provided from SECPOP90 (NRC 1997c) by specifying the data for each of the 21 counties surrounding the plant, to a distance of 50 miles. In addition, generic economic data that are applied to the region as a whole were revised from the MACCS2 sample problem input when better information was available. The agricultural economic data were updated using available data from the 1997 Census of Agriculture (USDA 1998). These included per diem living expenses, relocation costs, value of farm and non-farm wealth, and fraction of farm wealth from improvements (e.g., buildings).

Exelon did not perform sensitivity analyses for the MACCS2 parameters, such as evacuation and population assumptions. However, sensitivity analyses performed as part of previous SAMA evaluations for other plants have shown that the total benefit of the candidate SAMAs would increase by less than a factor of 1.2 (typically about 20 percent) due to variations in these parameters. This change is small and would not alter the outcome of the SAMA analysis. Therefore, the staff concludes that the methodology used by Exelon to estimate the offsite consequences for Dresden provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by Exelon.

## G.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by Exelon are discussed in this section.

### G.3.1 Process for Identifying Potential Plant Improvements

Exelon's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of plant-specific improvements identified in the Dresden IPE and IPEEE and subsequent PRA revisions
- review of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants
- review of other NRC and industry documentation discussing potential plant improvements, e.g., NUREG-1560.

Based on this process, an initial set of 265 candidate SAMAs was identified, as reported in Table F-1 in Appendix E to the ER. In Phase 1 of the evaluation, Exelon performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- the SAMA is not applicable at Dresden due to design differences,
- the SAMA is sufficiently similar to other SAMAs, and as such is combined with another SAMA,
- the SAMA has already been implemented at Dresden,

- the SAMA has no significant safety benefit, or has implementation costs greater than any possible risk benefit.

Based on this screening, 215 SAMAs were eliminated leaving 50 for further evaluation. Of the 215 SAMAs eliminated, 47 were eliminated because they were not applicable to Dresden, 46 were similar and combined with other SAMAs, 83 were eliminated because they already had been implemented at Dresden, and 39 were eliminated because they either had no significant safety benefit or had implementation costs greater than any risk benefit. A preliminary cost estimate was prepared for each of the 50 remaining candidates to focus on those that had a possibility of having a net positive benefit. A screening cutoff of approximately $456K, the maximum attainable benefit (MAB), which corresponds to eliminating all severe accident risk, was then applied to the remaining candidates (see discussion in Section G.6.1 for a derivation of the MAB). Forty of the 50 SAMAs were eliminated because their estimated cost exceeded this MAB, leaving 10 candidate SAMAs for further evaluation in Phase 2.

In response to an RAI concerning the impact of external events and uncertainties on the SAMA identification process, Exelon re-evaluated the Phase 1 SAMAs using a screening value of $2M rather than $456K. As a result, 87 Phase 1 SAMAs were identified for further consideration (rather than the 50 SAMAs originally identified). These SAMAs were subsequently reassessed using the same criteria as described in the ER. Table 7-2 of the response to the RAI contains the 87 SAMAs and their subsequent disposition. Twelve of the 87 SAMAs were retained for further evaluation in Phase 2 as discussed in Section G.6.2 (the 10 SAMAs identified through the original screening plus two additional SAMAs) (Exelon 2003b).

The 12 remaining SAMAs were further evaluated and subsequently eliminated in the Phase 2 evaluation, as described in Sections G.4 and G.6.1 below.

### G.3.2 Review of Exelon’s Process

Exelon’s efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF and containment failure contributors or issues that tend to have a large impact on a number of accident sequences at Dresden.

The preliminary review of Exelon’s SAMA identification process raised some concerns regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific risk contributors. The staff requested clarification regarding the portion of risk represented by the dominant risk contributors (NRC 2003). Because a review of the importance ranking of basic events in the PRA could identify SAMAs that may not be apparent from a review of the top cut sets, the staff also questioned whether an importance analysis was used to confirm the adequacy of the SAMA identification process. In response to the RAI, Exelon provided a tabular listing of the contributors with the greatest potential for reducing risk as demonstrated by the risk reduction worth assigned to the event (Exelon 2003b). Exelon used a cutoff of 1.01, and stated that events below this point would influence the CDF by less than one-percent. This equates to an averted cost-risk (benefit) of approximately $4,000. Exelon also reviewed the LERF-based risk worth reduction events to determine if there were additional equipment failures or operator actions that should be included in the provided table. Similarly, Exelon correlated the top risk worth reduction events with the SAMAs evaluated in the ER (Exelon 2003b). Based on these additional assessments, Exelon concluded that the set of 265 SAMAs evaluated in the ER addresses the major contributors to CDF and LERF, and that the review of the top risk contributors does not reveal any new SAMAs.

The staff questioned Exelon about lower cost alternatives to the SAMAs evaluated, including the use of a portable generator to power the battery chargers, and backup nitrogen bottles or portable air compressors as backup to instrument air (NRC 2003). In response, Exelon provided estimated benefits and implementation costs for several lower cost alternatives, including those in the form of potential procedural changes (Phase 2 SAMAs 1, 3b, 4, and 11) (Exelon 2003b). These are discussed further in Section G.6.2.

Exelon considered potential improvements to further reduce external events risk. Exelon is planning to implement a seismic enhancement to a makeup path to the isolation condenser and to some motor control centers, and a modification to permit the use of portable pumps to restore the required CCSW cooling flow via suction from the intake canal following a SBLOCA. The latter modification essentially constitutes implementation of Phase 2 SAMA 2. Although Exelon did not evaluate specific fire modifications as part of the SAMA analysis, several of the SAMAs identified based on the internal events risk profile would also be effective in fire events, e.g., procedure and hardware modifications to aid in decay heat removal. Based on the revised fire analyses, the staff has not identified any fire-related vulnerabilities and thus, no additional SAMAs have been identified besides those identified by the licensee that would specifically address fire-related risks.

The staff notes that the set of SAMAs submitted is not all inclusive, since additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that Exelon used a systematic and comprehensive process for identifying potential plant improvements for Dresden, and that the set of potential plant improvements identified by Exelon is reasonably comprehensive and therefore acceptable. This search included reviewing insights from the IPE and IPEEE and other plant-specific studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its PRA personnel. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the prior/pending implementation of plant modifications for fire and seismic events and the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

## G.4 Risk Reduction Potential of Plant Improvements

Exelon evaluated the risk-reduction potential of the 12 Phase 2 SAMAs that were applicable to Dresden. A majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit and are conservative.

Exelon used model re-quantification to determine the potential benefits. The CDF and population dose reductions were estimated using the 2002 Update of the Dresden PRA. The changes made to the model to quantify the impact of SAMAs are detailed in Section F.6 of Appendix E to the ER (Exelon 2003a) and in the response to the RAI (Exelon 2003b). Table G-3 lists the assumptions considered to estimate the risk reduction for each of the 12 Phase 2 SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk as used in the staff's assessment. The determination of the benefits for the various SAMAs is further discussed in Section G.6.

The staff has reviewed Exelon's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on Exelon's risk reduction estimates reported in the ER, but applied a multiplier of five to these values to account for benefits in external events as discussed in Section G.6.2.

## G.5 Cost Impacts of Candidate Plant Improvements

Exelon estimated the costs of implementing the 12 candidate SAMAs through the application of engineering judgment and review of other plants' estimates for similar improvements. The cost estimates conservatively did not include the cost of replacement power during extended outages required to implement the modifications, nor did they include recurring maintenance and surveillance costs or contingency costs associated with unforeseen implementation obstacles. Cost estimates typically included procedures, engineering analysis, training, and documentation, in addition to any hardware.

The staff reviewed the bases for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates (presented in Table 7-3 of the response to the RAI) to

**Table G-3**. SAMA Cost/Benefit Screening Analysis

| Phase 2 SAMA | Assumptions | % Risk Reduction | | Total Benefit ($) | | Cost ($) |
|---|---|---|---|---|---|---|
| | | CDF | Population Dose | Baseline [1] | Best Estimate | |
| 1 - Enhance procedures to direct reactor pressure vessel (RPV) depressurization given the loss of recirculation pump seal cooling or damage to the seals | Eliminate all seal failures | 2 | 2 | 41,500 | | 50,000 |
| 2 - Provide an alternate means of cooling the low pressure coolant injection (LPCI) heat exchangers, e.g., diesel-driven fire pump | CCSW is completely reliable | 2 | 2 | 38,500 | | >100,000 |
| 3 - Develop an enhanced drywell spray system<br>a) install hardware modification and develop procedures to use the fire protection system (FPS) for injection to the RPV or the containment spray<br>b) develop procedures to use LPCI cross-tie from other unit as an alternate containment spray source | Assign complete success to the drywell spray effectiveness in Level 2 for all sequences except Class II, IV, and V | <1 | 18 | 345,000 | 38,000 | a) >265,000<br>b) 50,000 |
| 4 - Provide procedural enhancements to re-open main steam isolation valves (MSIV) | Reduce human error probability (HEP) for failure to restore condenser from 0.5 to 3.7E-3 | 0 | 0 | negligible | | 25,000 |
| 5 - Increase the seismic capacity of components on the safe shutdown paths with capacities less than 0.3g to 0.3g | Extend the safety shutdown path seismic capacity to at least 0.3g | | | 100,000 | | >200,000 for CST (largest outlier) |
| 6 - Add a rupture disk to the hardened vent to provide passive overpressure relief | Set vent failure modes to zero for non-ATWS sequences | 2 | 2 | 32,000 | | >100,000 |

| Phase 2 SAMA | Assumptions | % Risk Reduction | | Total Benefit ($) | | Cost ($) |
|---|---|---|---|---|---|---|
| | | CDF | Population Dose | Baseline [1] | Best Estimate | |
| 7 - Provide an alternate means of opening a pathway to the RPV for standby liquid control (SBLC) injection | Set the random and common cause failure of the explosive valves to zero | 2 | 6 | 122,500 | | >100,000 |
| 8 - Enrich boron to reduce the time required to achieve shutdown, thereby increasing time available for successful activation of SBLC | Reduce the HEPs for boron initiation and reactor pressure vessel water level control by 50% | <1 | 0 | 7,000 | | >50,000 |
| 9 - Install a modification to allow operator intervention to bypass the low RPV pressure permissive signal that inhibits the opening of the ECCS injection valves when RPV pressure is too high | Set logic, sensor, and miscalibration failure modes to zero | 1 | 5 | 123,000 | | >100,000 |
| 10 - Improve instrument air reliability, thereby increasing ability to vent containment via backup bottles or portable air compressors to open valves when instrument air is lost | Set instrument air recovery basic event to zero | 2 | 2 | 30,000 | 10,000 | 50,000 |
| 11 - Align LPCI or core spray to the CST on loss of suppression pool cooling | Reduce HEP for aligning ECCS pump suction from 0.1 to 0.01 | 1 | 1 | 18,500 | | 25,000 |
| 12 - Bypass MSIV in turbine trip ATWS scenarios | Reduce HEP for operator failure to bypass MSIV low RPV level interlock (or ATWS) from 0.93 to 0.01 | 1 | 1 | 30,500 | | >100,000 |

[1] Values are based on Exelon averted cost estimates reported in the ER, but are increased by a factor of 5 to account for additional risk reduction benefits in external events.

estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The cost estimates provided in the response to the RAI were typically in the form of ranges. The staff reviewed these ranges and found them to be consistent with estimates provided in support of other plants' analyses. In response to an RAI, Exelon provided more specific values, typically at the upper end of the previously provided ranges. For purposes of evaluating specific SAMAs, the staff selected values from the range to represent a reasonable or typical cost.

The staff concludes that the cost estimates provided by Exelon, as adapted by the staff (see Section G.6.2), are sufficient and appropriate for use in the SAMA evaluation.

## G.6 Cost-Benefit Comparison

Exelon's cost-benefit analysis and the staff's review are described in the following sections.

### G.6.1 Exelon Evaluation

The methodology used by Exelon was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997d). The guidance involves determining the net value for each SAMA according to the following formula:

Net Value = (APE + AOC + AOE + AOSC) - COE

where,

APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted onsite costs ($)
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. Exelon's derivation of each of the associated costs is summarized below.

<u>Averted Public Exposure (APE) Costs</u>

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/year)
x monetary equivalent of unit dose ($2,000 per person-rem)
x present value conversion factor (10.76 based on a 20-year period with a 7-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997d), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, Exelon calculated an APE of approximately $220,200 for the 20-year license renewal period, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

For the purposes of initial screening which assumes all severe accidents are eliminated, Exelon calculated an annual offsite economic risk of about $18,400 based on the Level 3 risk analysis. This results in a discounted value of approximately $198,100 for the 20-year license renewal period.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction
x occupational exposure per core damage event
x monetary equivalent of unit dose
x present value conversion factor.

Exelon derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997d). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $2,000 per person-rem, a real discount rate of 7-percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents are eliminated, Exelon calculated an AOE of approximately $700 for the 20-year license renewal period.

<u>Averted Onsite Costs (AOSC)</u>

Averted onsite costs (AOSC) include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. Exelon derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997d).

Exelon divided this cost element into two parts – the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and the replacement power cost.

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

ACC = Annual CDF reduction
x present value of cleanup costs per core damage event
x present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $\$1.5 \times 10^9$ (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents are eliminated, Exelon calculated an ACC of approximately $22,300 for the 20-year license renewal period.

Long-term replacement power costs (RPC) were calculated using the following formula:

RPC = Annual CDF reduction
x present value of replacement power for a single event
x factor to account for remaining service years for which replacement power is required
x reactor power scaling factor

Exelon based its calculations on the value of 912 MWe. Therefore, Exelon applied a power scaling factor of 912 MWe/910 MWe to determine the replacement power costs. For the purposes of initial screening, which assumes all severe accidents are eliminated, Exelon calculated an RPC of approximately $14,900 for the 20-year license renewal period.

Using the above equations, Exelon estimated the total present dollar value equivalent associated with completely eliminating severe accidents at Dresden to be about $456K.

Exelon's Results

If the implementation costs were greater than the MAB of $456K, then the SAMA was screened from further consideration. Forty of the 50 SAMAs surviving the initial Phase 1 screening were eliminated from further consideration in this way leaving 10 for final analysis. The Phase 1 screening was revisited using a screening value of $2M rather than $456K to account for the potential impact of external events, and two additional SAMAs were identified.

Exelon applied a multiplier of five to the averted cost estimates (for internal events) for each SAMA to account for the potential impact of external events and uncertainties. As a result, four of the 12 SAMAs were found to be potentially cost-beneficial. Exelon performed a more detailed assessment of each of the four SAMAs to more realistically estimate the risk reduction and implementation costs for each SAMA. Based on this assessment, Exelon concluded that none of the four SAMAs would be cost-beneficial.

### G.6.2 Review of Exelon's Cost-Benefit Evaluation

The cost-benefit analysis performed by Exelon was based primarily on NUREG/BR-0184 (NRC 1997d) and was executed consistent with this guidance.

In response to an RAI, Exelon considered the uncertainties associated with the internal events CDF (see Table G-4 below). Since Exelon does not currently have an uncertainty analysis for the Dresden PRA, it estimated the uncertainty distribution by reviewing representative distributions for several plants (Exelon 2003b). Exelon used the results of the LaSalle Risk Methods Integration and Evaluation Program (RMIEP) PRA to obtain the Dresden 95$^{th}$ percentile value. The ratio of the 95$^{th}$ percentile CDF to the mean CDF value in the LaSalle RMIEP study is 4.5. The $1.9 \times 10^{-6}$ per year point estimate mean CDF for Dresden was multiplied by this ratio, yielding a 95$^{th}$ percentile value of $8.5 \times 10^{-6}$ per year for Dresden. This value and an error factor of eight are used to obtain the median value, and subsequently the 5$^{th}$ percentile value. If the 95$^{th}$ percentile value of the CDF were utilized in the cost-benefit analysis instead of the mean CDF value, the estimated benefits would increase by about a factor of five.

**Table G-4**. Uncertainty in the Calculated CDF for Dresden

| Percentile | CDF (per year) |
|---|---|
| 95th | $8.5 \times 10^{-6}$ |
| mean | $1.9 \times 10^{-6}$ |
| median | $1.1 \times 10^{-6}$ |
| 5th | $1.3 \times 10^{-7}$ |

In the IPEEE, Exelon reported a fire CDF of $1.7 \times 10^{-5}$ and $3.1 \times 10^{-5}$ per year for Units 2 and 3, respectively. This is approximately 9 to 16 times higher than the internal events CDF of $1.9 \times 10^{-6}$ per year. Due to the relatively large contribution from fire events, the staff asked Exelon to consider the impact on the SAMA identification and screening process if risk from external events is included. In response to the RAI, Exelon stated that the methodology used to determine the fire CDF is judged to be highly conservative, particularly in the areas of initiating event frequencies, response/fire modeling and human reliability analysis/level of detail. In Attachment A to its response, Exelon discusses the conservatism it believes exists in the model in each of these areas, and the approximate reduction that the conservatism affords. Exelon's rationale and the staff's assessment are summarized below.

For initiating events, Exelon refers to a recently issued NRC report concerning a revised fire events database (NRC 2002b). Exelon states that the NRC data would support the use of lower fire initiating event frequencies than used in the Dresden IPEEE. Based on a comparison of the initiating event frequencies from the report and from the Dresden model for several fire areas, Exelon states that a factor of two reduction in the initiating event frequency portion of the fire CDF can be made as a reasonable assumption to provide a more accurate comparison to the internal events CDF. Exelon essentially argues that reductions in initiating event frequencies in these fire areas directly translate into similar reductions in specific equipment ignition frequencies. A staff review of the NRC report verified that the initiating frequencies were lower than those originally reported in the Dresden IPEEE; however, the data is only provided for fire areas and does not support the determination of ignition frequencies for specific equipment. In addition, less significant fires were screened from the data. Therefore, the data represent the fire ignition frequencies for more severe fires. These data are not directly comparable to the ignition frequencies in the IPEEE. Although the staff believes that reductions in the ignition frequencies have occurred, it does not believe that the evidence provided by the licensee is sufficient to justify a factor of two reduction. This is especially true for the risk-significant fires where ignition frequencies are typically low and the development of the ignition frequency is typically more rigorous.

For system response/fire modeling, Exelon states that the Dresden fire model typically utilized bounding approaches regarding the immediate effects of the fire (e.g., all cables in a tray are always failed for a cable tray fire, and all failed cables lead to failure states of the associated equipment). Severity factors were utilized for the purposes of distinction (size and consequence of fire). The complement of the severity factor was also maintained in the analysis such that the total frequency was always preserved. In addition, Exelon repeats its discussion regarding lower initiating event frequencies. The staff finds that there are three points presented in support of this reduction factor: lower ignition frequencies, lower severity factors, and bounding approaches regarding the fire's immediate effects. The staff's view on lower ignition frequencies is discussed above. For severity factors, a review of the NRC report did not find evidence that it supported a reduction in severity factor. The report states "Fire severity, risk implications, and duration of power operation fire events were not updated from the initial study." As a result the staff can not support this contribution to the system response/fire modeling reduction. The final point is the claim that the bounding approaches were used regarding the fire's immediate effects. A review of the Dresden IPEEE submittal found that detailed fire modeling practices were used for risk-significant contributors. Given these observations, the staff believes that the proposed reduction factor is not supported.

For human reliability analysis and level of detail, Exelon provides examples of what it believes are simplified human reliability analysis (HRA) modeling and lack of sufficient level of detail in the model, and concludes that such factors can easily lead to an additional factor of 1.5 reduction in the fire CDF. The IPEEE Revision 1 submittal states that the fire PRA model incorporated all of the operator actions included in the plant's internal events PRA. Actions in the main control room were not considered adversely impacted by postulated fire events outside the control room. For fires in the control room, actions with a required response time of 30 minutes or less were considered failed. For all actions outside the control room, the HEP was set to 1.0 except for two. These two actions were considered as applicable and not modified from their internal-events values. The IPEEE submittal also states "The extensive use of a HEP of 1.0 for potential operator actions outside the control room is conservative but does not have a significant impact on the overall analysis results. This is because these events do not appear in the dominant cutsets for the analysis." Although the staff believes that the consideration of additional actions would likely reduce the calculated risk, it does not believe that the factor of 1.5 reduction due to HRA and level of detail is fully supported.

As a result of the improvements in ignition frequency, response/fire modeling and human reliability analysis/level of detail, Exelon states that it believes the fire CDF can be reduced by a factor of six. As such, the fire CDF would be about 1.5 to three times the internal events CDF for Units 2 and 3. Based on this assessment, Exelon applied a multiplier of five to the averted cost estimates (for internal events) for each SAMA, and characterized the result as an upper bound averted cost estimate. These values could be considered to account for SAMA benefits in internal events, external events, and internal floods. These values would also represent the impact of uncertainties in internal event frequencies (i.e., the impact if the CDF was increased from the mean value of $1.9x10^{-6}$ per year to the $95^{th}$ percentile value of $8.5x10^{-6}$ per year).

The staff agrees that the Dresden IPEEE fire analysis contains numerous conservatisms, and that a more realistic assessment could result in a substantially lower fire CDF. In the staff's view, the factor of six reduction in CDF claimed by Exelon represents the maximum reduction that could be justified. However, the staff believes that the information provided by Exelon is not sufficient to support the full reduction, and that the reduction in fire CDF may be smaller than claimed by Exelon, and closer to a factor of two to three. Given a factor of three reduction in the IPEEE fire CDF, the resulting fire CDF would be about three to five times higher than the internal events CDF for Units 2 and 3, respectively. This would justify use of a multiplier of five to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events. Consideration of uncertainties would result in further increases in this multiplier.

In assessing the cost-benefit results for the various SAMAs, the staff adopted Exelon's upper bound averted cost estimates as baseline estimates of the benefits for each SAMA. This implicitly assumes that each SAMA would offer the same percentage reduction in external event CDF and population dose as it offers in internal event CDF and population dose. The baseline benefit values are shown in Table G-3 for the 12 Phase 2 SAMAs. To account for a potentially greater contribution from external events and the impact of uncertainties, the staff also considered the impact that further increases in the multiplier would have on the identification and dispositioning of candidate SAMAs, as described below.

As shown in Table G-3, the baseline benefits exceed the estimated implementation costs for three of the Phase 2 SAMAs (3,7, and 9). Exelon re-examined each of these SAMAs to ensure that the averted cost estimates from the internal events analysis appropriately represent the potential benefit rather than the maximum benefit. This included re-examining the assumptions used in the initial screening analysis, as well as recognizing existing model limitations that could lead to over-estimation of the averted costs. In some cases, the implementations costs were also refined to better represent the actual costs that would be incurred. The results of this reassessment are provided in Table 7-4 of the RAI response (Exelon 2003b), and summarized below. The revised benefit values, where provided, are also reported in Table G-3.

- SAMA 3 involves two options for enhancing the drywell (DW) spray system: a) installing a hardware modification and developing procedural guidance to use the fire protection system (FPS) as an alternative source of water, and b) developing procedural guidance to use a cross connect to the other unit's LPCI as an alternate containment spray source. The staff initially estimated the benefit of this SAMA to be $345,000 per unit based on Exelon's risk reduction estimate reported in the ER and a factor of five adjustment to account for external events. Exelon states that two classes of scenarios account for much of the calculated averted cost and that these scenarios would not benefit from SAMA 3. In one scenario class, Exelon states that power would not be available to the DW spray valves precluding any benefit from the proposed improvement. The other scenario class does not credit the recovery of the LPCI pumps for the DW spray function even though these pumps are available. The staff finds this rationale to be reasonable. When credit for the SAMA is eliminated for these two scenarios, the total benefit is reduced to $38,000 per unit for option a. Exelon estimated the cost of implementing this option to be $265,000, of which $250,000 is attributed to a hardware modification that includes installation of a flange on safety-related piping and associated engineering analyses. Therefore, this option has a negative net value. The cost for a similar SAMA evaluated for Quad Cities was estimated to be $50,000; however, the implementation at Quad Cities did not include a hardware modification. Accordingly, the staff agrees that this SAMA would not be cost-beneficial at Dresden.

For option b, in addition to the rationale presented above, Exelon states that the averted risk is high by a factor of at least two due to the conservatisms and uncertainty associated with the very unlikely global common cause failure value of all of the suppression pool suction strainers assumed within the PRA model, and that with more realistic treatment the total benefit would be reduced, by a factor of two, to $19,000 per unit. The staff agrees that there is considerable uncertainty associated with the likelihood of sump clogging. However, given this uncertainty, and the estimated $1x10^{-4}$ failure likelihood that is currently used for the common cause failure of the strainers, the staff does not believe that an adequate technical basis has been provided to reduce the value by a factor of two. This is especially true in light of the stated bases for the current number as "engineering judgement." The staff therefore considers the original benefit of $38,000 to be reasonable. Costs to implement option b were estimated by Exelon to be about $25,000 to $50,000 per unit. The staff expects the costs to be at the upper end of this range because of the need to develop new procedures and to perform engineering analysis to support procedure development. The staff concludes that this SAMA has a negative net value. However, the costs and benefits are generally comparable, and the SAMA could be cost-beneficial given a more detailed assessment of its benefits in external events, or when uncertainties are taken into account.

- SAMA 7 involves a modification to the explosive valves to provide an alternate means of opening a pathway to the RPV for SBLC injection. The staff estimates the benefit of this SAMA to be $122,500 per unit based on Exelon's risk reduction estimate reported in the ER and a factor of five adjustment to account for external events. Exelon did not provide details on the modification but stated that any hardware change would easily exceed the minimum hardware cost of $100,000. It is expected that the modification would involve wiring circuits and switches into the control room, or changes to the valves. The staff expects that such a hardware modification would cost much more than the minimal cost provided by Exelon, and could be on the order of $1M, especially when the costs associated with the required engineering analysis, procedure modification, and training are taken into account. Therefore, the staff agrees that this SAMA would not be cost-beneficial.

- SAMA 9 involves installation of a bypass switch and associated circuitry that would allow the LPCI and core spray injection valves to open in the event that the two pressure sensors in these systems fail to generate the permissive signal needed to open the valves. The staff estimates the benefit of this SAMA to be $123,000 per unit based on Exelon's risk reduction estimate reported in the ER and a factor of five adjustment to account for external events. As is the case for SAMA 7, Exelon stated that any hardware change would easily exceed the minimum hardware cost of $100,000. It is expected that the modification would involve changes to safety-related circuits and switches. The staff expects that such a hardware modification would cost much more than the minimal cost provided by Exelon, and could be on the order of $1M, especially when the costs associated with the required engineering analysis, procedure modification, and training, and possible licensing changes (e.g., license amendment) that would accompany such a modification are taken into account. Therefore, the staff agrees that this SAMA would not be cost-beneficial.

The staff also considered the impact that further increases in the contribution from external events or analysis uncertainties would have on the dispositioning of the nine Phase 2 SAMAs that were screened out. It is noted that SAMA 1, which involves a procedure change to the emergency operating procedures (EOPs) that would direct RPV depressurization given the loss of recirculation pump seal cooling or damage to the seals, is close to being cost-beneficial. The staff estimated the benefit of this SAMA to be $41,500 per unit based on Exelon's risk reduction estimate reported in the ER and a factor of five adjustment to account for external events. In estimating the risk reduction for this SAMA, Exelon assumes that the recirculation pump seals would never fail. This assumption is optimistic. Exelon stated that such a procedure change would be contrary to current BWROG EOP strategies, and that extensive engineering analysis would be required in order to validate a recommended approach. This would raise the cost for this SAMA to well over $50K per unit. The staff agrees with Exelon's cost estimate, and therefore, concludes that this SAMA would have a negative net value, even when uncertainties are taken into account.

Two SAMAs have estimated benefits within a factor of two of the estimated implementation costs, i.e., Phase 2 SAMAs 10 and 11. SAMA 10 involves the use of backup nitrogen bottles or portable air compressors to supply air to open the containment vent valves. The staff initially estimated the benefit of this SAMA to be $30,000 per unit based on Exelon's risk reduction estimate reported in the ER and a factor of five adjustment to account for external events. Exelon's estimated benefit in the ER is based on the assumption that recovery of instrument air is perfect. Exelon claims that the instrument air recovery is less than perfect, and that existing capabilities could be more realistically credited. To further support its position, Exelon compares the 0.9 instrument failure recovery probability used in the Dresden PRA model with a more realistic value of 0.148 used in the Quad Cities model. When this conservatism is removed, Exelon estimates that the averted cost estimate is high by at least a factor of three, and should be reduced to $10,000 per unit. Considering the limited credit for recovery and the similarities between Dresden and Quad Cities, the staff finds the revised risk reduction estimate, and benefit of $10,000 per unit to be reasonable. The cost estimate for this improvement is estimated to be $25,000 to $50,000 per unit. The staff expects the costs to be at the upper end of this range because of the need for a minor hardware modification. Therefore, the staff concludes that this SAMA is not cost-beneficial.

SAMA 11 involves developing procedures to align LPCI or core spray to the CST on loss of suppression pool cooling. The staff estimated the benefit of this SAMA to be $18,600 per unit based on Exelon's risk reduction estimate reported in the ER and a factor of five adjustment to account for external events. Exelon notes that current procedures exist to align LPCI or core spray to the CST on loss of suppression pool cooling and are assigned an HEP of 0.1 based on uncertainty associated with environmental conditions that may exist when performing the actions in the reactor building. Exelon estimated the benefits of this improvement by assuming a factor of ten reduction in the human error probability of aligning ECCS pump suction. However, Exelon notes that this benefit could only be achieved by significant restructuring of the procedures to make this action always viable before environmental conditions put its performance in doubt. Exelon estimates the cost of such procedural enhancements to be $25,000 per unit. The staff finds the potential cost of $25,000 per unit to be reasonable. The staff concludes that this SAMA would have a net negative value. However, the costs and benefits are generally comparable, and the SAMA could be cost-beneficial given a more detailed assessment of its benefits in external events, or when uncertainties are taken into account.

As discussed previously, Exelon plans to implement modifications related to Phase 2 SAMA 2 during Fall 2003, and has argued that further improvements to the seismic capacity of the plant (i.e., Phase 2 SAMA 5) would not be cost-beneficial.

Two additional SAMAs have estimated benefits within a factor of four of the estimated implementation costs, i.e., Phase 2 SAMAs 6 and 12. The benefits for these SAMAs are estimated to be around $31,000 (including a factor of five adjustment to account for external events) and the implementation costs are estimated by Exelon to be greater than $100,000.

The staff notes that each of these SAMAs involve hardware modifications as well as procedure changes. In response to an RAI, Exelon indicated that the cost of hardware modifications would generally range from $100,000 to $1M or more. Although Exelon did not provide details on the specific hardware modifications needed for these SAMAs, the staff believes that such modifications would be significantly greater than the minimal hardware cost provided by Exelon. Therefore, the staff does not believe that these SAMAs would be cost-beneficial at Dresden.

Exelon also performed a sensitivity analysis that addressed variations in discount rate. The use of a three-percent real discount rate (rather than seven percent used in the baseline) results in an increase in the maximum attainable benefit of approximately 37 percent. The results of the sensitivity study are bounded by Exelon’s upper bound averted cost estimates, which applied a multiplier of five to the internal events benefits, and were adopted by the staff as baseline estimates for each SAMA.

The staff concludes that the costs of all of the SAMAs assessed would be higher than the associated benefits. Two SAMAs (3b and 11) have a negative net value in the baseline analysis (which includes a multiplier of five on internal events benefits) but could be cost-beneficial given a more detailed assessment of its benefits in external events, or when uncertainties are taken into account.

## G.7 Conclusions

Exelon compiled a list of 265 SAMA candidates using the SAMA analyses as submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, and the plant-specific insights from the Dresden IPE, IPEEE, and current PRA model. A qualitative screening removed SAMA candidates that (1) were not applicable at Dresden due to design differences, (2) were sufficiently similar to other SAMAs, and therefore combined with another SAMA, (3) had already been implemented at Dresden, or (4) had no significant safety benefit or had implementation costs greater than any risk benefit. A total of 215 SAMA candidates were eliminated based on the above criteria, leaving 50 SAMA candidates for further evaluation.

Using guidance in NUREG/BR-0184 (NRC 1997d), the current PRA model, and a Level 3 analysis developed specifically for SAMA evaluation, a MAB of about $456K, representing the total present dollar value equivalent associated with completely eliminating severe accidents at Dresden, was derived. Forty of the 50 SAMAs were screened from further evaluation because their implementation costs were greater than this MAB. Exelon performed a revised screening based on consideration of the potential impact of external events and uncertainties, and two additional SAMAs were identified. For the 10 SAMA candidates and two additional alternatives identified during the re-screening, a more detailed assessment and cost estimate were developed. Exelon applied a multiplier of five to the averted cost estimates (for internal events) for each SAMA, and characterized the result as an upper bound averted cost estimate. Based on a comparison of averted costs and estimated implementation costs, four of the Phase 2 SAMAs were retained for further analysis. Exelon re-examined each of these SAMAs to ensure the averted cost estimates from the internal events analysis appropriately represent the potential (realistic) benefit rather than the maximum benefit, and used the estimated averted costs and implementation costs accordingly. As a result of this reassessment, the cost-benefit analyses showed that none of the candidate SAMAs were cost-beneficial.

The staff reviewed the Exelon analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Exelon are reasonable and sufficient for the license renewal submittal. The unavailability of a seismic and fire PRA model precluded a detailed quantitative evaluation of SAMAs specifically aimed at reducing risk of these initiators; however, to account for external events, the estimated internal events benefits were increased by a multiplier of five. Based on this evaluation, and the use of realistic estimates of averted costs and implementation costs, none of the SAMAs appear to be cost-beneficial. However, two SAMAs could become cost-beneficial given a more detailed assessment of their benefits in external events, or when uncertainties are taken into account . These involve development of procedures to use a cross connect to the other unit's CCSW as an alternate containment spray source (SAMA 3b), and procedural changes to align LPCI or core spray to the CST on loss of suppression pool cooling (SAMA 11). Improvements realized as a result of the IPEEE process and resolution of seismic outliers at Dresden would minimize the likelihood of identifying further cost-beneficial enhancements. It is also noted that, although not cost-beneficial, Exelon plans to implement modifications related to SAMA 2 during Fall 2003 independent of this SAMA evaluation.

Based on its review of the Exelon SAMA analysis, the staff concurs that none of the candidate SAMAs are cost-beneficial, except as noted above. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the Dresden PRA and the fact that Dresden has already implemented many plant improvements identified from the IPE and IPEEE processes. Given the potential risk reduction and the relatively modest implementation costs of the two SAMAs identified above, the staff concludes that further evaluation of these SAMAs by Exelon is warranted. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

## G.8 References

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# Appendix H

# Correspondence Incorporated by Reference into Remarks Made During a Public Meeting on the Draft Supplemental Environmental Impact Statement and NRC Responses

# Appendix H

## Correspondence Incorporated by Reference into Remarks Made During a Public Meeting on the Draft Supplemental Environmental Impact Statement and NRC Responses

Appendix H has been created to provide a mechanism for ensuring this supplemental environmental impact statement (SEIS) presents a complete record of the environmental review. This Appendix contains two letters to the NRC and the NRC responses to the letters. The two letters to the NRC were incorporated by reference into the remarks made by Mr. Corey Conn, representing the Nuclear Energy Information Service, at an NRC public meeting on the draft environmental impact statement (DEIS) in Morris, Illinois, on January 14, 2004. The letters are not relevant to the substance of this environmental review but are nevertheless included in this SEIS in order to, as stated above, present a complete record of this review. No further action within the scope of this environmental review is warranted.

The two incoming letters and the two responses are:

> Letter dated September 15, 2003, to Chairman Nils Diaz and Commissioners Edward McGaffigan, Jr., and Jeffery S. Merrifield from Mr. Don Eichelberger, Abalone Alliance Safe Energy Clearinghouse, et al., Subject: Votes of No Confidence in Nuclear Regulatory Commission.
>
> Letter dated October 20, 2003, to Mr. David Lochbaum, Union of Concerned Scientists, from Chairman Nils Diaz responding to the above letter dated September 15, 2003.
>
> Letter dated December 1, 2003, to Mr. Doug Coe and Ms. Lisamarie M. Jarriel, NRC staff from Mr. David Lochbaum, Union of Concerned Scientists, Subject: Request for Public Meeting Regarding NRC's Handling of Allegations and its Quality Assurance Inspection Process.
>
> Letter dated March 15, 2004, to Mr. David Lochbaum responding to the above letter dated December 1, 2003.

FROM: COREY J. CONN
NUCLEAR ENERGY INFORMATION SERVICE

TO: DUKE WHEELER
U.S. NUCLEAR REGULATORY COMMISSION
FAX: (301) 415-2300
- · 2002

JANUARY 29, 2004

Mr. Wheeler:

Per our conversation yesterday, please include the following pages in the record of the recent Dresden License Hearing.

As I indicated in my oral remarks, NEIS endorses the UCS call for a meeting between Mr. Shirani, UCS staff, and the suggested NRC staff.

NEIS has signed on to the Letter expressing 'No Confidence'; Mr. Cameron, in his remarks following mine, indicated that this would be added to the record. I appreciate your contacting me so that this would not be omitted.

Should you have any further questions, you may phone me at (312) 996-1628.

Regards,

Corey J. Conn

Appendix H

September 15, 2003

Chairman Nils J. Diaz
Commissioner Edward McGaffigan, Jr.
Commissioner Jeffrey S. Merrifield

**SUBJECT: VOTES OF NO CONFIDENCE IN NUCLEAR REGULATORY COMMISSION**

Dear Chairman and Commissioners:

The Nuclear Regulatory Commission (NRC) lists "improving public confidence" as one of its four strategic goals. Yet, Mrs. Patricia G. Norry, Deputy Executive Director for Management Services at the NRC, conceded to a group of us at the July 22nd meeting on public interfaces that the agency does not measure its progress against this goal, despite the goal having been established several years ago. The purpose of this letter is to make our views on this goal crystal clear to you:

**WE LACK CONFIDENCE IN THE NUCLEAR REGULATORY COMMISSION.**

The primary factors, in no particular order, for our votes of no confidence are:

- The Commission has held more "closed" meetings per the Sunshine Act regulation in the past three years than in the prior 15 years combined. The Commission cannot gain our confidence by hiding from us.

- The safety culture within the NRC is deplorable, as evidenced by recent surveys that report nearly half the NRC's work force is reluctant to raise safety concerns and a third of those who voice safety concerns feel they have been retaliated against for it. The public cannot trust NRC management when so many NRC workers do not.

- The NRC recently revised its public meeting process to provide expanded opportunities for public attendees to ask questions or express concerns. But the agency has not backed up this initiative with ways for its staff to provide meaningful responses to public input. Public confidence is not improved when the NRC simply makes it easier for us to provide input that is then ignored.

- For most US nuclear power plants, the NRC makes but one appearance each year to meet with the public. The agenda for these "public" appearances is determined by the NRC *and the plant owner*. Members of the public cannot suggest items for the agenda and the NRC staff often refuses to discuss issues raised by the public that are not on the NRC/plant owner's agenda. The NRC must engage us on safety matters of concern to us to warrant our confidence.

- During an NRC-sponsored workshop on public communications in December 1997, every public stakeholder in attendance, including several of the signatories to this letter, praised the agency for its Public Document Rooms (PDRs) and website. The NRC responded to that praise by stopping the flow of information to local PDRs, inflicting ADAMS on the world, and re-designing its website to make it virtually useless. The NRC cannot gain our confidence by using our praise for the agency to plan its next attacks on public participation.

- The public petition process, 10 CFR 2.206, continues to be a mockery of a meaningful way for the public to engage the agency regarding possible enforcement actions against the agency's licensees. This mockery will continue as long as the public lacks a formal appeal process, either within the NRC or outside it, for Director's Decisions. To have confidence in the NRC, we need the basic right of appeal decisions we feel are wrong, just as the nuclear industry currently has the right to appeal NRC decisions it feel is wrong..

- The NRC prepared an order to shut down the Davis-Besse nuclear plant for safety inspections, then shelved it. Documents obtained under the Freedom of Information Act clearly indicate that the NRC knew at the time that it was violating four of the five criteria it had established for such safety decisions. The NRC cannot deliberately violate its own safety principles and gain our confidence.

- Following the tragic events of 09/11, the NRC revised security measures for nuclear facilities through a series of closed-door meetings with plant owners and trade group representatives. The NRC rebuffed every attempt by public stakeholders to engage in these important policy discussions, even to the point where the agency refused to listen to our concerns. The NRC cannot ignore us and gain our confidence at the same time.

- Following the tragic events of 09/11, the NRC removed considerable material from the public arena. Some of this material returned to the public arena after review, but much material remains in limbo awaiting the agency's final decision on where to draw the line on publicly available information. The reaction is understandable, but the NRC continues to proceed with 'business as usual' on licensing matters even though the public's ability to participate has been severely impaired. The NRC should have suspended all but emergency licensing actions until it finalized the post-09/11 line and returned material on the right side of the redrawn line to the public arena. The NRC could restore our confidence by distributing the 09/11 burden more equitably between us and its licensees instead of placing the majority of the 09/11 burden on *our* shoulders.

- In licensing proceedings since 09/11, intervenors, including several signatories to this letter, have contended that existing or proposed nuclear facilities lack proper protection against sabotage and acts of malice. The NRC has steadfastly dismissed these contentions on the grounds that such assertions are incredible. At the same time, the NRC restricts access to information and policy discussions based on the very real threat of sabotage and acts of malice. The NRC cannot gain our confidence by taking contradictory stances as needed to prevent public participation.

- Since June 1998 when the US Senate threatened to slash the agency's budget, the NRC put its primary focus on the business objectives of the nuclear industry instead of on public health and safety. The Davis-Besse debacle can be traced to this lost focus, given that the agency failed to ensure resident inspector staffing at Davis-Besse that conformed to even its lowered staffing requirements. The improper focus also delayed resolution of long-standing safety issues including steam generator tube integrity, fire protection, and pressurized water reactor containment sump reliability. **The NRC cannot gain our confidence when its priority is financial safety instead of reactor safety.**

- In July 1998, an NRC senior manager cancelled the agency's force-on-force testing program of nuclear power plant security even though the program had not yet examined every plant site and the testing to date had revealed serious deficiencies. The ensuing public outcry forced the agency to reinstate the testing program. The same NRC senior manager then zeroed out the budget for the NRC security tests, even though a plan to replace it with an industry self-assessment program had not been piloted. Very shortly after 09/11, the same NRC senior manager recommended that the Commission relax its security measures – even as the nation's commercial air fleet was grounded – because they were costing nuclear plant owners too much money. This NRC senior manager suffers from more than a security blind spot. After an NRC inspection at the D C Cook nuclear plant in Michigan revealed problems so serious that both reactors had to be immediately shut down in September 1997 for repairs, this senior manager went to the NRC manager responsible for the inspection program and the NRC staffer leading the D C Cook inspection team – not to congratulate them for their fine job of protecting public health and safety but to chastise them. Later, this NRC senior manager ordered the NRC staff, in writing, not to bother plant owners with more than a single set of questions about reactor safety issues. When Indian Point 2's owner provided inadequate answers to questions about steam generators in 1999, this edict prevented the NRC staff from following up to ascertain the true facts. They allowed the plant to operate past a December 31, 1999, deadline without the required steam generator inspections. Less than 60 days later, the plant experienced an accident involving the steam generators. This NRC senior manager was also primarily responsible for the aforementioned flawed decision regarding Davis-Besse. The NRC cannot gain our confidence when led by senior managers who repeatedly demonstrate bad judgment.

- Several nuclear reactors have been relicensed by the NRC for 20 more years of operations and many others are planning to seek relicensing. The NRC's license renewal rule depends on a determination by the agency that the applicant has an adequate aging management program for important systems, structures, and components. Adequate aging management means that the condition of equipment is monitored and it is repaired or replaced before it fails. Indian Point's broken steam generator tube (2000), Summer's leaking hot leg pipe (2000), Oconee's broken control rod drive mechanism nozzles (2001), Quad Cities' broken jet pump (2002), and Davis-Besse's broken reactor vessel head are but a sampling of growing evidence that aging management programs aren't working. The NRC cannot gain our confidence by ignoring evidence that its basis for granting license extensions is fundamentally flawed.

- The NRC's responses to allegations we have submitted, whether based on our own concerns or based on concerns brought to us by plant workers, have gotten worse over the past two years, declining to the point where many of us believe the NRC's allegation process is not viable. Many of the responses simply fail to address the issues raised. The NRC cannot gain our confidence solely by giving lip service to safety allegations we submit.

- The NRC is moving towards risk-informed regulation. Yet, the agency has neither established nor endorsed quality standards for the risk assessments that provide input for risk-informed regulatory decisions. The NRC cannot gain our confidence with "garbage in, garbage out" as a regulatory precept.

* The NRC's Inspector General determined that this NRC senior manager is solely responsible for the fact that the NRC Chairman issued false information to the public related to this matter.

We respectfully ask you to direct your staff to develop an action plan for addressing these factors. The action plan must include assignments for tasks within the plan and target deadlines for completion of the tasks. To help ensure that these tasks are completed in a timely manner, we ask that you direct your staff to provide you, and the public, status reports on the action plan every six months until the final task is completed. You must realize that failure of the agency to properly respond to these identified issues will only serve to reinforce our current lack of confidence.

Sincerely,

The Undersigned (sign-ons on file)

State individuals/organizations (in alphabetical order):

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UNITED STATES
**NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 20555-0001

CHAIRMAN

October 20, 2003

Mr. David Lochbaum
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Dear Mr. Lochbaum:

On behalf of the Nuclear Regulatory Commission (NRC), I am responding to the September 15, 2003, letter, from you and a number of individuals and organizations. It is obvious that you and your colleagues have concerns with the NRC's actions on a number of issues. Clearly, there may be areas in which we can improve our practices and policies and we are constantly seeking to raise our performance to a higher level.

We are disappointed, though, that you chose this approach to express such broad dissatisfaction with the NRC. My colleagues and I have gone to extraordinary lengths in terms of our open door policy with you and others and we believe we have been very responsive to a number of your concerns over the past several years. We have also maintained a productive and ongoing dialogue with various representatives of other non-governmental organizations. Having said that, we recognize that some of the points you raise warrant attention and, in fact, we already have certain initiatives in place to enhance our public communication efforts. On other issues, we must agree to disagree.

Your letter incorrectly states that the NRC violated its own safety principles regarding Davis-Besse and that we focused on the business objectives of the nuclear industry instead of on public health and safety. This is patently untrue. The NRC staff allowed the Davis-Besse reactor to continue to operate only after knowledgeable staff and management reached agreement that there was no significant safety concern relating to nozzle cracks that would preclude the brief period of operation beyond December 31, 2001. Recall that boric acid corrosion of the reactor pressure vessel head was not recognized as a potential significant safety concern at that time. Ensuring public health and safety is our highest priority, not the financial health of the licensee. As a separate matter, a lessons-learned task force spent more than 7000 hours reviewing the processes and activities associated with the staff's review of the Davis-Besse issues, and recommended improvements, some of which have been implemented, and some of which we are addressing.

In addition, you state that we've held a series of closed-door meetings with plant owners and trade group representatives, and removed information from the public web site, effectively undermining public participation in our processes. As you know, we have always been one of the most open federal agencies in terms of the scope and volume of information we make publicly available. We are proud of the transparency of our operations, and of the progress we have made in offering the public a chance to be involved in our meetings through our recently revised public meeting policy. However, in our efforts to ensure we do our part to protect our nation from the risk of terrorism, a small fraction of that information has, for what should be obvious and prudent reasons, been restricted. Following the terrorist attacks, the number of closed meetings involving security-sensitive discussions regarding threat assessments, Orders to licensees, and other protected information increased. We must admit that the overwhelming focus of our efforts was on strengthening the defenses of our licensed facilities. Where threats to the nation's infrastructure are concerned, open communication and public participation cannot continue without some thoughtful caution on our part. For obvious reasons, we simply cannot publicly disseminate the details of our efforts to develop defensive strategies. We will continue our efforts to develop a means for the public to participate in some limited security discussions.

As a separate matter, although we did close the local public document rooms because of resource constraints, we believe electronic access to our documents is better than ever. Web-based ADAMS has greatly eased the access process, and although in your view our web page is "virtually useless," other stakeholders both within and outside government have singled it out as one of the most factually rich and easily navigable web sites they have encountered. We continue to respond to stakeholder feedback and improve our web page.

There are a number of initiatives we are planning in the upcoming months that we believe will improve our responsiveness to the public. In addition, we are considering recommendations made by the staff as a result of the Office of Inspector General's 2002 Survey on NRC's Safety Culture and Climate. It is our hope that by institutionalizing these improvements we will both enhance the lines of communication within our own organization as well as communicate better with those outside NRC. Our goal is to sustain a working environment that fosters innovation between the NRC staff and creates an atmosphere where employees can feel free to speak about any issue. In addition, we are reinforcing to the staff the need to be more responsive to public input, questions and comments. We will be emphasizing this in training courses, in messages to the staff, and in written guidance.

The NRC has been actively engaging the public, particularly local residents, at an early stage, in order to involve them in the full spectrum of our activities. For example, we have been holding meetings in local communities before early site permit applications for nuclear plants are received to inform residents of the agency's licensing process and safety role. We have also conducted numerous meetings with a variety of stakeholders in the Yucca Mountain, Nevada, area for several years in anticipation of the upcoming application for a high-level waste repository. We will continue to host open houses, schedule training workshops for tribal governments and attend local officials' meetings on this issue.

I and my fellow Commissioners continue to be proud of our record in regulating public health and safety and of our policies of openness and public participation. Please continue to contact us with your concerns.

Sincerely,

Nils J. Diaz

cc: State individuals/organizations that
undersigned the September 15, 2003 letter

<u>CC list for letter to David Lochbaum, dated October 20, 2003</u>

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**Pennsylvania (continued)**

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Appendix H

Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

December 1, 2003

Mr. Doug Coe, Section Chief
Reactor Inspection Section
Inspection Program Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Earth

Ms. Lisamarie M. Jarriel, Agency Allegations Advisor
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**SUBJECT: REQUEST FOR PUBLIC MEETING REGARDING NRC'S HANDLING OF ALLEGATIONS AND ITS QUALITY ASSURANCE INSPECTION PROCESS**

Dear Ms. Jarriel and Mr. Coe:

I am writing to you to request a public meeting be held at your Rockville, Maryland, headquarters offices regarding the NRC's handling of allegations made by Mr. Oscar Shirani and the related topic of NRC's inspections of quality assurance programs by licensees and their contractors. Our objective for this public meeting would be for the NRC staff to leave the meeting with a better, if not nearly complete, understanding of Mr. Shirani's concerns and for Mr. Shirani to come away with a better understanding of the NRC's plans and processes for handling his concerns. It is not our expectation that any of Mr. Shirani's concerns be resolved at the meeting, although we'd strive not to prevent it from occurring.

With respect to allegations, Mr. Shirani made formal allegations to Region III about his findings while working at Exelon that he believes triggered his departure. Likewise, Mr. Shirani has made allegations about his activities at Calvert Cliffs that also resulted in his being terminated. For the responses received to date from the NRC staff to these allegations, Mr. Shirani feels that his fundamental concerns have not been addressed in the staff's response. UCS believes that a meeting would be productive in answering the following questions:

1. Did the NRC staff understand the fundamental concerns in Mr. Shirani's allegations?
2. Did Mr. Shirani understand the NRC staff's resolutions?
3. Assuming any misunderstandings are remedied, are there any unresolved concerns?

Again, the objective of the requested meeting is not to resolve any concerns at that time, but rather to identify and eliminate any communication barriers and to ascertain whether there are any concerns previously considered to be resolved by the NRC staff requiring another look.

With respect to NRC's inspections of quality assurance, Mr. Shirani's experience auditing areas shortly before or shortly after NRC inspections of the same areas makes him, and UCS, question the efficacy of the NRC's inspections. The disparate results from nearly simultaneous examinations with NRC's results always being significantly less critical strongly suggests a serious flaw in the NRC's inspection regime.

**Washington Office: 1707 H Street NW Suite 600 • Washington DC 20006-3919 • 202-223-6133 • FAX: 202-223-6162**
Cambridge Headquarters: Two Brattle Square • Cambridge MA 02238-9105 • 617-547-5552 • FAX: 617-864-9405
California Office: 2397 Shattuck Avenue Suite 203 • Berkeley CA 94704-1567 • 510-843-1872 • FAX: 510-843-3785

December 1, 2003
Page 2 of 2

Again, the objective of this requested meeting is not to prove or disprove the notion that the NRC's inspections are flawed, but rather for the NRC staff to understand Mr. Shirani's concerns about this important subject. Hopefully, the NRC staff will followup on the requested meeting with information on revisions to the inspection processes to address Mr. Shirani's concerns or with information on why they believe the existing processes are sufficient.

We propose that the requested meeting be scheduled for at least a three-hour duration: one hour for Mr. Shirani to cover each of his two areas of concerns (allegations and inspections) and one hour for the NRC staff to ask clarifying questions. Because Mr. Shirani's concerns are overlapping, we think the NRC staff attending this meeting participate throughout the entire meeting, rather than attempt to have Mr. Coe's people or Ms. Jarriel's people pop in for just their slice of the meeting. But we leave the attendance at the meeting to the discretion of the NRC.

As has probably already been surmised, UCS is very interested in this matter and plans on attending the public meeting in support of Mr. Shirani. Along with representatives from other public interest groups, we have participated in prior meetings between Mr. Shirani and U.S. Senate staff and the NRC Inspector General's office. Please contact me to schedule the time and date of the meeting. I will interface with Mr. Shirani and the other public interest groups to ensure that all can attend on the proposed date.

Thank you in advance for your consideration of this matter and UCS looks forward to the requested meeting.

Sincerely,

*<ORIGINAL SIGNED BY>*

David Lochbaum
Nuclear Safety Engineer
Union of Concerned Scientists
1707 H Street NW, Suite 600
Washington, DC 20006
(202) 223-6133
(202) 223-6162, fax

cc: Oscar Shirani
Jim Riccio, Greenpeace
Paul Gunter, NIRS
Dave Ritter, Public Citizen

UNITED STATES
**NUCLEAR REGULATORY COMMISSION**
WASHINGTON, DC 20555 - 0001

March 15, 2004

David A. Lochbaum
Union of Concerned Scientists
1707 H Street NW, Suite 600
Washington, D.C. 20006-3919

Dear Mr. Lochbaum:

Thank you for your interest in maintaining healthy communications as indicated in your December 1, 2003, letter regarding the U.S. Nuclear Regulatory Commission's (NRC) handling of a certain individual's allegations and inspection of licensee quality assurance processes. Your letter suggested that the NRC staff may not have a complete understanding of the individual's concerns and that the individual may not have a full understanding of the staff's responses. To address these issues you requested a public meeting with the involvement of third parties.

It is not our policy, nor would it be appropriate, to conduct a public meeting to discuss individual allegations. As outlined in the NRC's Management Directive 8.8, "Management of Allegations," specifically Section A.3, "Protecting an Alleger's Identity," it is the NRC's practice to neither confirm nor deny that an individual has come to the NRC with an allegation. This not only protects the individual in question, it also protects the integrity of the NRC's Allegation Program as a safe alternative avenue to raise safety concerns for those not wishing to advertise their identities. Furthermore, the meeting you are requesting does not meet the criteria for public participation as outlined in NRC's Management Directive 3.5, "Attendance at NRC Staff Sponsored Meetings," Section 1.B in that it could result in the inappropriate disclosure and dissemination of preliminary, predecisional, or unverified information.

Nevertheless, the NRC does believe that there is a need to ensure healthy communications with concerned individuals. Upon receiving any allegation, our first priority and objective is always to attain a full understanding of the concern. This ensures, among other things, that our inspection activities are appropriately focused. We offer all allegers the option of providing either written input and/or meeting opportunities for discussion, and find it to be most effective when we communicate directly with the alleger having first-hand knowledge of the facts surrounding the concern. We do not believe public meetings and the involvement of third parties will assist us in better understanding the concerns. However, should an alleger desire a meeting with NRC staff or management to bring forward new information or further clarify his or her concerns, we continue to invite such input. We would make ourselves available to facilitate such a meeting.

Thank you again for your continuing interest in improving communications and safety.

Sincerely,

**/RA/**

Lisamarie L. Jarriel
Agency Allegations Advisor

Distribution:
OE r/f
ADAMS
F. Congel
J. Luehman
L. Jarriel

FILE NAME: G:\NRC response to USC.wpd *See previous concurrence

| OFFICE | OE* | NRR* | EDO | OE |
|---|---|---|---|---|
| NAME | L. Jarriel | D. Coe | M. Landau | F. Congel |
| DATE | 01/29/04 | 01/29/04 | 02/4/04 | 03/15/04 |

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