RAS 4464

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	Docket No's. 50-369-LR, 50-370-LR, 50-413-LR, and 50-414-LR
DUKE ENERGY CORPORATION	ASLBP No. 02-794-01-LR
(McGuire Nuclear Station, Units 1 and 2, Catawba Nuclear Station, Units 1 and 2)	May 20, 2002

BLUE RIDGE ENVIRONMENTAL DEFENSE LEAGUE'S AND NUCLEAR INFORMATION AND RESOURCE SERVICE'S AMENDED CONTENTION 2

Pursuant to the Atomic Safety and Licensing Board's ("ASLB's) May 13, 2002, Order (Addressing Matters Discussed at April 29, 2002, Telephone Conference and Scheduling June 18, 2002, Telephone Conference), Intervenors Blue Ridge Environmental Defense League ("BREDL) and Nuclear Information and Resource Service ("NIRS") hereby submit Amended Consolidated Contention 2, relating to Ice Condensers and Station Blackout Risks. This amended contention satisfies the Nuclear Regulatory Commission's ("NRC's") admissibility standards in 10 C.F.R. § 2.714(b)(2), and the late-filing standard in 10 C.F.R. § 2.714(a)(1).

Background

On November 29, 2001, BREDL and NIRS submitted contentions challenging the adequacy of Duke's license renewal application ("LRA"). Blue Ridge Environmental Defense League Submittal of Contentions in the Matter of the Renewal of Licenses for Duke Energy Corporation, Etc. (November 29, 2001); Contentions of Nuclear Information and Resource Service (November 29, 2001). Among their contentions, BREDL Contention 4 asserted, *inter alia,* that Duke's Severe Accident Mitigation Alternatives ("SAMA") analysis is incomplete because it fails to incorporate new and extensive information regarding ice condenser

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vulnerabilities, particularly the findings of a recent report by Sandia National Laboratories, NUREG/CR-6427, Assessment of the DCH [Direct Containment Heating] Issue for Plants With Ice Condenser Containments (April 2000). NIRS Contention 1.1.4 asserted that Duke's license renewal application failed to mention NUREG/CR-6427, or to provide an analysis of the findings of NUREG/CR-6427, with respect to the four McGuire and Catawba reactors. NIRS Contention 1.1.5 also contended that Duke had not considered a SAMA of providing a dedicated electrical line from the hydroelectric generating dams adjacent to each reactor site.

On January 24, 2002, in LBP-02-04, a Memorandum and Order (Ruling on Standing and Contentions), the ASLB ruled, *inter alia,* that:

> BREDL and NIRS have provided a sufficient, reasonably specific explanation of the bases of their contentions to meet the requirement of section 2.714(b)(2)(ii), as well as sufficient expert opinion, facts, and references to sources and documents to support the contentions under section 2.714(b)(2)(iii) to show that a genuine dispute exists with regard to the material facts of whether and to what extent Duke's SAMA analysis should take into account the calculations and values referenced in NUREG/CR-6427 and include the alternative of a separate dedicated line as described below.

Id., 55 NRC 49, 127 (2002).

Accordingly, the ASLB partially admitted BREDL Contention 4 and NIRS Contentions 1.1.4 and 1.1.5 with respect to the adequacy of the SAMA and reworded it as follows:

> The Duke SAMA analysis is incomplete, and insufficient to mitigate severe accidents, in that it
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> (a) fails to include information from NUREG/CR-6427, and
> (b) fails to include a severe accident mitigation alternative relating to Station Blackout-Caused Accidents, namely, a dedicated electrical line from the hydroelectric generating dams adjacent to each reactor site.

Id., 55 NRC at 128.

On January 31 and February 1, 2002, Duke provided the NRC Staff with two responses to Request for Additional Information ("RAI Responses"), which addressed, for the first time,

NUREG/CR-6427 and the costs and benefits of a dedicated power line. The January 31 response addresses the NRC's RAI with respect to McGuire, and the February 1 response answers the same questions with respect to Catawba. The NRC Staff also had various meetings and telephone conversations with Duke, which were recorded in memoranda and provided to the Intervenors. In addition, the NRC issued, in draft version, Supplements 8 and 9 to NUREG-1437, the Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding McGuire Nuclear Station, Units 1 and 2.[1] Supplement 8 relates to the McGuire plant, and Supplement 9 relates to the Catawba plants. Supp. 8 was provided to the parties by the NRC under cover of a May 10, 2002, letter from Susan L. Uttal to the ASLB.

Based on this information, BREDL and NIRS have amended Contention 2 to describe the extent to which Duke's RAI responses fail to satisfy the requirement of the National Environmental Policy Act ("NEPA") for a "hard look" at the environmental factors affecting its decision. *Foundation on Economic Trends v. Heckler,* 756 F.2d 143, 151 (D.C. Cir. 1985). These factors include the costs and benefits of SAMAs for the purpose of addressing the risks of hydrogen ignition at the McGuire and Catawba plants.

In amending Contention 2, BREDL and NIRS do not intend to alter any aspect of the previously admitted contention, other than to acknowledge that Duke has now provided some discussion of NUREG/CR-6427 and the alternative of a dedicated line. The only change the Intervenors intend to make to the contention is to provide specific information about the deficiencies in Duke's discussion of NUREG/CR-6427 and the dedicated line alternative. Therefore, the Intervenors consider it unnecessary to repeat the detailed and extensive information which they provided in support of the original contentions.

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[1] The original GEIS was issued in 1996.

AMENDED CONSOLIDATED CONTENTION 2:

The Duke SAMA analysis is incomplete, and insufficient to mitigate severe accidents, in that it fails to provide an adequate discussion of information from NUREG/CR-6427 and a dedicated electrical line from the hydroelectric generating dams adjacent to each reactor site. In particular, the SAMA analysis contains the following deficiencies:

1. Failure to evaluate alternative of not renewing licenses

Contention: Severe Accident Mitigation Alternatives for McGuire and Catawba should include the alternative of not renewing the McGuire and Catawba reactors.

Basis: As discussed directly above in Subparagraph 1, NRC regulations require the agency to consider whether, in light of new information, it would be unreasonable to preserve the option of license renewal. Neither Duke's ER nor the RAI responses address this issue. Moreover, Duke's list of SAMA mitigative measures does not include discontinuing operation, which is the most obvious means of mitigating the risks of a containment breach accident that are set forth in NUREG/CR-6427. Duke's environmental analysis is seriously deficient in these respects.

2. Failure to provide adequate support for conclusory results in RAI responses.

Contention: Duke has not supported its SAMA analysis by publication of its PRA.

Basis: As discussed above, NEPA requires a "hard look" at the environmental impacts and costs and benefits of proposed NRC actions. Where the analysis of impacts and the costs and benefits of mitigative measures depends on a PRA, it is not possible to evaluate the adequacy of the analysis without access to the PRA. This is because the PRA relies on a myriad of assumptions which may affect the outcome of the analysis. Merely to publish the summary results of the

PRA, as Duke has done in its RAI responses, is insufficient to support the SAMA analysis, because there is no way to determine whether the assumptions underlying the calculations are reasonable.[2]

Examples of the difficulty of verifying the reasonableness of Duke's SAMA analysis are listed below and in other subsections of this amended contention. However, these examples do not represent all of the areas in which assumptions may be faulty; they only represent the most obvious and severe ones. Other illustrations abound. For instance, in its February 1 response to RAI 1a, Duke states that data changes in Revision 2 improve diesel generator reliability, resulting in reduced core damage frequency ("CDF") caused by loss of offsite power ("LOOP"), tornados and earthquakes. Duke also re-evaluated the failure rates caused by interfacing systems loss-of-coolant-accidents ("ISLOCA"), which Duke considers "an important risk contributor." *Id.* However, Duke's January 31 response to RAI 1a is almost entirely qualitative in nature, filled with relative terms including "significantly reduced' and "slight increase." The only specifics offered are estimates of core damage and containment failure frequencies, but the tables are only summaries which do not reveal how these numbers were generated. Moreover, the ISLOCA containment failure frequency was 27 times higher after Revision 2. Although Duke

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[2] In the April 29, 2002, telephone conference between the ASLB and parties, Judge Kelber questioned whether it is necessary for Duke to disclose the Level 1 PRA. *Id.*, tr. at 883. The Intervenors respectfully point out that there are several reasons why all levels of the PRA should be disclosed. Level 1 is involved in NUREG/CR-6427 because the conditional containment failure frequency is different for high pressure and low pressure core damage sequences. NUREG/CR-6427 assumes that 90% of the time the hot leg will fail, resulting in a low-pressure sequence. It is necessary to compare that result with the fraction of sequences in which low pressure results in Duke's PRA.

Moreover, it is necessary to see the first level of the PRA in order to evaluate the second two levels. Examination of the first level is also necessary in order to understand whether the initiating event frequencies are appropriate for each containment failure mode. Therefore, all three levels of the PRA should be disclosed.

provides a qualitative explanation for this anomaly, it is not possible to evaluate the reasonableness of the calculation without examining the PRA itself.

Another example can be seen in Duke's January 31 response to RAI 1b, in which Duke states that it conducted internal and external reviews of the PRA and IPE. According to Duke, "[I]n general, the review team found that the Duke PRA processes are sufficient to support applications requiring risk significance determination." It is not at all clear what "in general" means, or what are the exceptions. Duke also states that because Revision 3 of the PRA was incomplete at the time of the review, the analysis was based partially on Revision 3 and partially on Revision 2. We have no indication as to which revision was used or why for any specific parameter.

Similarly, in its January 31 response to RAI 1c, Duke admits that core damage frequency induced by steam generator tube rupture ("SGTR") was found to be 10,000 times higher after Revision 3 of the PRA (7.8E-10 versus 7.0E-6). This and other information in the most recent PRA may significantly alter other assessments of plant safety. Taken together, these unknown assumptions could have a significant effect on Duke's SAMA analysis. Thus, the PRA must be evaluated as a whole in order to determine the reasonableness of its results.

Duke's failure to provide the PRA in support of its SAMA analysis also prevents any meaningful evaluation of Duke's consequence analysis.

Another example of the fatal effect of this lack of documentation relates to Duke's consequence analysis. In order to carry out a technically rigorous SAMA analysis, a thorough consequence calculation is required. Because consequence analyses are highly dependent on many assumptions, the assumptions must be fully documented for the results of consequence analyses to be understood. In fact, when using a computer code like MACCS2, the entire set of input files

is needed to fully interpret the results. This documentation appears neither in Duke's environmental reports nor in the draft GEIS.

3. Failure to support conclusions regarding frequency of accident contributors

Contention: Duke's RAI answers make unsupported assertions that the frequency of Station Blackout ("SBO") and other events leading to core damage and containment rupture is lower than previously predicted. Duke's failure to support these assertions violates the requirement under NEPA that an environmental analysis must take a "hard look" at environmental consequences of proposed actions and the costs and benefits of alternatives. *Foundation on Economic Trends v. Heckler, supra,* 756 F.2d at 151.

Basis: NUREG/CR-6427 asserts that no ice condenser plant is inherently robust to all credible DCH or hydrogen combustion events in station blackout. Therefore, the frequency of SBO events is an important factor in determining the value of the benefit of SAMAs. *See, e.g.,* January 31 and February 1 responses to RAI 4; GEIS Supps. 8 and 9, Table 5-8, which gives a dollar value for back-up power to igniters and air return fans, based on "SBO values from Revision 3 of the PRA." In its responses to RAI 3, Duke asserts that the frequency of SBO events is lower than previously calculated, but it provides only summary information about its calculations regarding SBO frequency.

Earthquakes and floods constitute external events that may also cause station blackout. Again, Duke has provided insufficient documentation to permit a determination of the extent to which these accident contributors were taken into account.

Similarly, there is no way to determine whether Duke has taken into account recent studies that have identified recirculation sump clogging in PWRs following a loss-of-coolant accident as a generic safety issue, GSI 191. All PWR licensees are currently evaluating the

susceptibility of their plants to this phenomenon. Ice-condenser plants are among a subset of PWRs for which this phenomenon is of particular concern, because they must switch to recirculation in all small-break LOCAs and in a larger fraction of medium-break LOCAs than PWRs with large, dry containments. An NRC risk analysis found that the CDFs for pump-seal LOCAs and small-break LOCAs for ice-condenser plants were approximately 25 and 30 times that of PWRs with large,dry containments, respectively.[3] Access to the PRA must be provided because it is not known to what extent Duke has taken the risk of sump clogging into account in evaluating LOCA accident progression. Because this is relevant to pump-seal LOCA sequences, it will clearly have a bearing on the contribution of SBO events to core damage.

Duke provides insufficient information to allow independent verification of the assumptions that went into Duke's calculations regarding these factors. Therefore, the reader must take it on faith that Duke's the calculations are correct and reasonable. Under the circumstances, it is impossible to determine whether Duke took the requisite "hard look" required under NEPA.

4. Failure to justify departures from NUREG/CR-6427

Contention: Duke does not incorporate assumptions used in NUREG/CR-6427, or justify its failure to do so.

Basis: In response to RAI 3c, Duke states that it has calculated lower containment failure probabilities than the NRC did in NUREG/CR-6427. According to Duke, the "primary difference" between the Duke and NRC calculations stems from the assumption used about the

[3] Arthur Buslik, U.S. NRC, "Risk Considerations Associated with GSI-191," Attachment 2 to Memorandum to John H. Larkins from Michael E. Mayfield, *RES'S Proposed Recommendation for Resolution of GSI-191, "Assessment of Debris Accumulation on PWR Sump Performance,"* August 29, 2001.

amount of hydrogen assumed to be in the containment. January 31 and February 1 responses to RAI 3c. While NUREG/CR-6427 assumed that the amount of in-vessel oxidation was equivalent to 58.5% of the clad reacted, Duke assumed that the fraction of clad reacted was 14% to 53%. Although this difference is acknowledged by Duke, it is not justified. Duke also notes an "important difference" between Sandia's and Duke's assumptions with respect to the availability of an ignition source:

> A review of Figure 4.2 in NUREG/CR-6427 suggests that for the low pressure at vessel breach cases, the hydrogen is assumed to ignite at vessel breach. This assumption is conservative and the Catawba analysis assumed that a random ignition source would be required with a probability of occurrence of 0.25. For the high pressure at vessel breach case, both NUREG/CR-6427 and the [McGuire/Catawba] analyses assume a very high, essentially 1.0 probability of ignition.

Id. Again, this difference is not justified.

Another "significant difference," according to Duke, is that "the Duke analysis considers the possibility that too little hydrogen is generated in vessel for a burn to occur. This is assigned a probability of only 0.1." *Id.* Again, this difference is not explained.

NUREG/CR-6427 was an extremely careful and detailed study that focused on the characteristics of the McGuire nuclear power plant, as well as all other U.S. ice condensers. Before discarding the assumptions used in NUREG/CR-6427, Duke must do more than baldly observe the existence of the difference or an opinion that the Sandia Report was too conservative.

5. Failure to take adequate account of uncertainties

Contention: Duke has failed to take adequate account of uncertainties and their effect on the results of its analysis. To a significant extent, no uncertainty analysis has been performed. To

the extent uncertainty analysis has been performed, Duke has not taken uncertainties into account in an adequate manner.

Basis a: In its February 1 response to RAI 2, Duke asserts that an uncertainty analysis for the Catawba PRA revision 2b Level 1 was "not developed since this was an interim analysis." Duke also states that for levels 2 and 3, "a quantitative evaluation" of uncertainty for the McGuire plant is "beyond the scope of the current PRA program at Duke." In its January 31 RAI response, Duke also states that a quantitative uncertainty analysis for Levels 2 and 3 is beyond the scope of the current PRA program at Duke. Duke's failure to perform a complete uncertainty analysis fatally undermines the credibility of its SAMA results.

The use of uncertainty analysis is essential to a credible PRA, for several reasons. First, PRAs can be extremely sensitive to adjustments in their assumptions. Second, there are a number of factors contributing to the potential for an accident that cannot be quantified, such as human error and sabotage. Third, PRA involves predictions regarding complex interactions between nuclear power plant systems, which cannot be foreseen with complete certainty.

A PRA that does not acknowledge and address the extent of inherent uncertainties has little practical use. Worse, it can mislead decisionmakers by creating a false sense of confidence in the reliability of a single number to represent a prediction of a range of probabilities. To simply assign a fixed number to a probability calculation, without also attempting to quantify the degree of uncertainty involved in the calculation, creates a misleading impression that the likelihood of an event can be predicted with precision. If uncertainties are not acknowledged due to this false sense of security, the agency may not pursue mitigative measures that would reduce the level of uncertainty. In this way, misleading information may defeat the "first function of an EIS," i.e., to "balance a project's economic benefits against its adverse environmental effects."

Hughes River Watershed Conservancy v. Glickman, 81 F.3d 437, 446 (4th Cir. 1996) (rejecting EIS that contained misleading projects of a project's economic benefits). *See also South Louisiana Environmental Council, Inc. v. Sand,* 629 F.2d 1005, 1011-12 (5th Cir. 1980); *Johnston v. Davis,* 698 F.2d 1088, 1094-95 (10th Cir. 1983).

The Council on Environmental Quality's regulations for implementation of NEPA specifically require that an EIS must address "[t]he degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.'" 40 C.F.R. § 1508.27(b)(5). In addition, NRC regulations require that a Draft EIS must, to the fullest extent practicable, "quantify the various factors considered." 10 C.F.R. § 51.71(d). To the extent that environmental factors may not be quantifiable, they must be described qualitatively. *Id.* Thus, where possible, uncertainties must be presented in quantitative form; otherwise, they must be discussed qualitatively.

NRC's regulatory guidance for the preparation of Environmental Reports in license renewal cases, Supplement 1, Regulatory Guide 4.2, Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses at 4.2-S-49 (September 2000), instructs licensees to follow the methodology set forth in NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (January 1997). Section 5.4 of NUREG/BR-0184 specifically calls for the preparation of uncertainty analysis "where practical within the bounds of the state-of-the-art." Draft Regulatory Guide DG-1110, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis* (June 2001), also sets forth the "expectation" that "[a]ppropriate consideration of uncertainty is given in analysis and interpretation of findings, including using a program of monitoring, feedback, and corrective action to address significant uncertainties." *Id.*

at 8. In section 2.2.5, the Reg. Guide sets forth three types of uncertainties that must be taken into account: model uncertainty, parameter uncertainty, and completeness uncertainty. *Id.* at 21-23. For each type of uncertainty, the Reg. Guide also suggests a method for analyzing and reporting on the nature and significance of the uncertainty. Appendix A of DG-1110 sets forth basic requirements for a "technically defensible" PRA. *Id.* at 39. In a summary table, the Draft Reg. Guide calls for "identification of sources of uncertainty and their impact on the results" at each level of the PRA. *Id.* at 41-51.

NUREG/BR-0058, *Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission* (June 2000), also emphasizes the importance of uncertainty analysis:

> Uncertainties are important to consider in developing a regulatory analysis. The sources and magnitudes of uncertainties in value and impact estimates and the methods used to quantify uncertainty estimates should be discussed in all regulatory analyses.

Id. at 12. By failing to perform complete uncertainty analyses, Duke has not complied with this guidance or with commonly accepted standards for the use of probabilistic risk assessment.

Basis b: To the extent that Duke has performed uncertainty analysis, it has not taken uncertainties into account in an adequate manner. This failure undermines the credibility of Duke's SAMA analysis. For instance, in its response to RAI 2, Duke states that the 95th percentile value of the McGuire PRA Rev. 2 core damage frequency is 1.3E-04, or 2.7 times the point estimate of the core damage frequency (4.9E-05) used in the SAMA analysis. Duke goes on to point out that NUREG-1150 analysis implies that the 95th percentile value of the 50-mile population dose is approximately 5 times the mean value, an uncertainty "representative of the uncertainties in the McGuire analysis." Thus the annual risk to the population within 50 miles derived from the 95th percentile values could be over ten times higher than the value obtained

from the mean values. This alone contradicts the NRC staff's assertion that a factor of three difference between most costs and benefits of mitigative measures "provide ample margin to cover uncertainties in the risk and cost estimates (draft NUREG-1437, p. 5-27). Because variations in certain parameters can result in a variation in consequences such as total population dose of an order of magnitude or more, it is clear that even a factor of three difference between cost and benefits of mitigative measures is an insufficient margin to provide assurance that an appropriate cost-benefit analysis is being presented.

6. Failure to use reasonably conservative values in calculating accident consequences

Contention: Even assuming that Duke's use of point estimates is acceptable, Duke's SAMA analysis understates the consequences of accidents, because it relies on assumptions that are unreasonable and unsupported.

Basis: Duke makes a number of assumptions about the nature of radioactive releases during accidents that are unrealistic and inconsistent with known experience. For example:

1. Plume spreading factor: In recent NRC consequence analyses, the effect of using improved assumptions regarding spreading of the radioactive plume following a large radiological release has been evaluated and shown to increase long-term consequences (i.e. population dose) by up to 60%.[4] Neither Duke's RAI responses nor the GEIS specifies the plume spreading parameters used by Duke in its consequence analyses.

[4] U.S. NRC, *Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants*, NUREG-1738, Washington, DC, 2002, Appendix 4A, p. A4A1.

2. Source terms: Severe accident consequence analyses are highly dependent on the assumed timing and magnitude of radionuclide releases. While the GEIS claims that "the Staff reviewed Duke's source term estimates for the major release categories and found these to be in *reasonable agreement* [emphasis added] with estimates from NUREG-1150 for the closest corresponding release scenarios," Duke has made source term assumptions that lead to considerably smaller population doses than those predicted from NUREG-1150-derived source terms. Some of the source term parameters that have a significant impact on severe accident consequences are the semi-volatile and actinide release fractions, yet Duke uses non-conservative values in its SAMA analysis.

For instance, the release category for early containment failure (as opposed to containment bypass) in the McGuire IPE which appears to result in the most severe long-term consequences is RC 5.01, for which the I and Cs release fractions are both 1.6%, and the lanthanum group release fraction (which also applies to the actinides Am and Cm) is 0.003%.[5] According to the RAI response for McGuire, the total 50-mile population dose corresponding to this release is 1.57×10^6 person-rem.[6]

Now compare this result to consequences for early containment failure at ice condenser plants obtained from NUREG-1150 assumptions. The report NUREG/CR-6295 contains simplified source terms based on the results of NUREG-1150 that are ideal for consequence calculations.[7] According to NUREG/CR-6295, the simplified source term for an early containment failure at the Sequoyah ice-condenser plant that results in the most severe

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[5] Duke Power Company, McGuire Nuclear Station, *IPE Submittal Report*, November 1991, p. 2.23.
[6] Duke Energy, *Repines to NRC RAIs Concerning McGuire SAMAs*, Jan 31, 2002, p. 11.
[7] R. Davis, A. Hanson, V. Mubayi and H. Nourbakhsh, *Reassessment of Selected Factors Affecting Siting of Nuclear Plants*, NUREG/CR-6295, U.S. NRC, Washington, DC, 1997, 3-19.

consequences (RSEQ1) involves a two-plume release with total I and Cs release fractions of 59% and 62%, respectively, and a total lanthanide release fraction of 1.5%. We have used this source term to calculate the long-term consequences of this accident at an ice-condenser plant with a power rating similar to McGuire for an average population density of 100 persons/km^2 and a single set of meteorological conditions. Only exposures within the first week of the accident are considered. Other inputs may be found in a recently published article.[8]

The Intervenors have determined that the NUREG/CR-6295 RSEQ1 source term results in a 50-mile population dose of 7.74×10^6 person-rem for the bounding assumption of timely evacuation of the entire population within the 10-mile EPZ. At the other bound, in which there is no evacuation of the 10-mile EPZ, the 50-mile population dose is 1.03×10^7 person-rem. Thus the revised source term leads to a 50-mile population dose a factor of approximately 5 greater than the worst-case source term used by Duke for the McGuire SAMA analysis.

However, even more severe source terms can be envisioned as well. Under certain scenarios, the actinide release fraction can be even greater than the value in RSEQ1. A sensitivity analysis reveals that the 50-mile population dose (complete evacuation case) increases from 7.74×10^6 to 1.74×10^7 person-rem as the lanthanum group release fraction increases from 1.5% to 6%.[9]

3. Region for dose calculations: The restriction of the region to a 50-mile radius for the purposes of calculating population dose is technically indefensible and can only be regarded as a mechanism for artificially limiting the benefits of mitigative measures. For a fixed population density, the total population dose for the no-evacuation case (7.74×10^6 person-rem within 50

[8] Edwin S. Lyman, "Public Health Risks of Substituting Mixed-Oxide for Uranium Fuel in Light-Water Reactors," *Science and Global Security* 9 (2001) p. 33-79.
[9] Ibid, p.51-52.

miles) is estimated to be $1.09x10^7$ person-rem within a 100-mile radius, $1.30x10^7$ person-rem for a 150-mile radius and $1.44x10^7$ person-rem for a 200-mile radius. Thus total population dose nearly doubles as the radius considered expands from 50 to 200 miles.

The demonstrated sensitivity of population dose results to these parameters indicates that the point-value consequence calculations provided by Duke are insufficient to support the conclusion of the NRC staff that nearly all SAMAs evaluated are clearly not cost-beneficial.

7. Failure to submit PRA for peer review.

Contention: Duke has not obtained peer review for all of the revisions to the PRA and IPE on which it relies for its SAMA analysis. Therefore, there is not an adequate basis for reliance on its SAMA analysis.

Basis: As set forth in DG-1110, a peer review is an important tool for establishing confidence in a PRA:

> A peer review process can be used to identify weaknesses in the PRA and the importance of the weaknesses to the confidence in the PRA results. An acceptable peer review needs to be performed by qualified personnel, needs to be performed according to an established process that compares the PRA against desire characteristics and attributes, needs to document the results, and needs to identify both strengths and weaknesses of the PRA.

Id. at 51. DG-1110 also provides a table with a summary of "desired characteristics and attributes of a peer review," including independence and expertise of the review team, documentation of the peer review process, and review of key assumptions and results. A peer review is essential in this case, in order to provide independent verification of the reasonableness of Duke's SAMA analysis.

In the January 31 response to RAI 1b, Duke states that Revision 3 of the PRA was peer reviewed while it was still being developed. This does not constitute an adequate peer review.

In the February 1 responses to RAI 1b, Duke says that the Catawba PRA "will be reviewed" in the spring of 2002. It is not clear that the review has been done.

8. Failure to justify conclusion that return fans are essential.

Contention: In response to RAI 6, Duke assumes that return fans are essential in order to ensure the effectiveness of hydrogen igniters. This has the effect of inflating the cost of the mitigative measure of hydrogen ignition. However, the assumption is not justified.

Basis: The Intervenors are in agreement with the NRC that, "based on available technical information, it is not clear that operation of an air-return fan is necessary to provide effective hydrogen control." Supp. 8 to NUREG-1437 at 5-30. As the NRC observed:

> If only the igniters need to be powered during SBO, a less-expensive option of powering a subset of igniters from a back-up generator, addressed by Duke in responses to RAIs (Duke 2002; NURC 2002a), is within the range of averted risk benefits and would warrant further consideration. Even if air-return fans are judged to be necessary to ensure effective hydrogen control in SBOs, the results of sensitivity studies suggest that this combined SAMA might also be cost-beneficial.

Id. Duke's assertion that air-return fans are necessary for hydrogen ignition is not supported by NUREG/CR-6427, and should be rejected unless supported by a detailed analysis, because it results in the artificial inflation of the cost of the mitigative measure of hydrogen ignition.

BREDL AND NIRS SATISFY THE LATE-FILED CONTENTION STANDARD.

As set forth below, Amended Contention 2 satisfies the NRC's standards for late-filed contentions in 10 C.F.R. § (a)(1)(i)-(v). First, the Intervenors have good cause for filing late. Until the April 29, 2002, telephone conference call with the ASLB and parties, Intervenors reasonably believed that they did not have to amend Contention 2 to raise challenges to the adequacy with which Duke's January 31 and February 1 RAI responses discussed NUREG/CR-

6427 and the alternative of a dedicated line. During the April 29 telephone conference, counsel for Duke argued that by filing RAI responses which addressed NUREG/CR-6427 and the alternative of a dedicated line, Duke had "effectively mooted" the contention. *Id.*, tr. at 871. The Chair of the ASLB also stated that:

> There is certainly definite precedent to the effect that if, then, information is provided that does include information from, in this case, NUREG CR 64-27 (sic), that that could be interpreted to moot out that – a contention of that nature, such that any question about how an application, for example, analyzes a particular issue when the original contention was saying that it did not do it at all, that that could be viewed as requiring an amendment or a late-filed contention.

Id., tr. at 874.

As counsel for BREDL pointed out during the telephone conference, the Intervenors had interpreted the ASLB's ruling in LBP-02-04 to mean that the scope of the admitted contention included the adequacy of any information that Duke might submit with respect to the relevance of NUREG-6247 and the SAMA of a dedicated offsite power line. *Id.*, tr. at 875-77. Intervenors based this reliance on language in LBP-02-04 itself, which states that BREDL and NIRS demonstrated "a genuine dispute exists with regard to the material facts of whether *and to what extent* Duke's SAMA analysis should take into account the calculations and values referenced in NUREG/CR-6427 and include the alternative of a separate dedicated line." LBP-02-04, 55 NRC 49, 127 (2001) (emphasis added).

In addition, a discussion between the ASLB members and counsel for Duke during the prehearing conference on December 18, 2001, showed that both the ASLB and Duke were more concerned about the substantive degree to which the findings of NUREG/CR-6427 had been considered than the essentially procedural question of whether the report had been mentioned by name. For instance, Mr. Repka took the position that the Environmental Report had discussed

NUREG/CR-6427 in substance even though it had not named the report. Tr. at 364-65. In the course of the discussion, Judge Kelber also stated:

> Now, you contend that your SAMA analysis is correct and certainly in a hearing if this contention were to be admitted, then the issue in the hearing would be whether Duke's SAMA analysis is correct and better or whether the Sandia report analysis would make any difference in how the SAMA analysis should have been done. That would be the issue for the merits determination were this contention to be admitted.

Id., tr. at 378. Of course, the degree to which NUREG/CR-6427 was considered would also affect the results of the SAMA analysis, including the cost-benefit analysis for a dedicated line. Thus, the Intervenors reasonably assumed that the ASLB intended to treat the portion of the contention relating to the alternative of a dedicated line in the same way, because the comparison of the costs and benefits would depend on the extent to which the Environmental Report considered NUREG/CR-6427.

In consideration of the fact that LBP-02-04 contained language suggesting that the contention need not be amended, the ASLB decided to provide the Intervenors with an opportunity to amend the contention, if they did so by May 20, 2002. BREDL and NIRS submit that this is a fair resolution of the ambiguity of the ASLB's ruling.

The Intervenors also satisfy the other four elements of the late-filing standard. Aside from this proceeding, BREDL and NIRS have no means for protecting their interest in a full and fair environmental analysis of the Duke license renewal applications. In addition, the Intervenors' participation may reasonably be expected to assist in the development of a sound record. BREDL and NIRS will be presenting the views of Dr. Lyman, a highly qualified expert who has extensive experience regarding nuclear power plant safety analyses, especially with respect to ice condenser containments. Moreover, there are no other parties who can represent the Intervenors' interests. Finally, granting a hearing on Amended Contention 2 will not broaden

the proceeding unreasonably, because it involves litigation of issues that were raised in the original contention 2, and which the Intervenors and parties already expected to litigate. Accordingly, a balancing of the late-filing factors favors the admission of Amended Contention 2.

CONCLUSION

For the foregoing reasons, the ASLB should admit Amended Contention 2 for litigation.

Respectfully submitted,

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May 20, 2002

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	Docket No's. 50-369-LR, 50-370-LR, 50-413-LR, and 50-414-LR (consolidated)
DUKE ENERGY CORPORATION	
(McGuire Nuclear Station, Units 1 and 2, Catawba Nuclear Station, Units 1 and 2)	ASLBP No. 02-794-01-LR

DECLARATION OF DR. EDWIN S. LYMAN
IN SUPPORT OF BREDL/NIRS AMENDED CONTENTION 2

Under penalty of perjury, Edwin S. Lyman declares as follows:

1. My name is Edwin S. Lyman. I am scientific director of the Nuclear Control Institute ("NCI"), is a non-proliferation research and advocacy organization located in Washington, D.C.

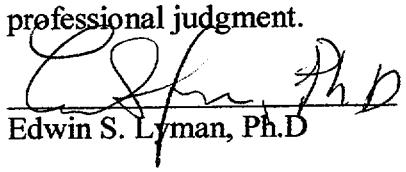
2. I am a qualified expert on issues relating to the operation of nuclear power plants, including nuclear power plant design and operation, nuclear power plant safety and safeguards issues, probabilistic risk assessment, and environmental impacts of reactor operation. I hold a Ph.D., a master of science and a bachelor's degree in physics. For over nine years, I have conducted research on security and environmental issues associated with the management of nuclear materials and the operation of nuclear power plants. I have published articles in journals and magazines, including *The Bulletin of the Atomic Scientist* and *Science and Global Security.* A copy of my resume, including a partial list of publications and invited speeches, is attached.

3. I am familiar with the license renewal application and related documents submitted by Duke Energy Corporation ("Duke") for the Catawba and McGuire nuclear power plants, as well as related correspondence between Duke and the U.S. Nuclear Regulatory Commission ("NRC") Staff. I am also familiar with NRC safety and environmental regulations and the requirements of the National Environmental Policy Act.

4. I assisted the Nuclear Information and Resource Service ("NIRS") in the preparation of Contentions 1.1.4 and 1.1.5, which NIRS submitted before the NRC's Atomic Safety and Licensing Board on November 29, 2001, and which the ASLB admitted in part as Contention 2 (Ice Condensers and Station Blackout).

5. I also assisted BREDL and NIRS in the preparation of Amended Contention 2, which they are submitting today.

6. The factual assertions in Amended Contention 2 are true and correct to the best of my knowledge and belief, and the opinions expressed therein are based on my best professional judgment.



Edwin S. Lyman, Ph.D

May 20, 2002

Edwin Stuart Lyman
Curriculum Vitæ

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Education:

Ph.D, Cornell University, Theoretical Physics, August 1992.
M.S., Cornell University, Physics, January 1990.
A.B., *summa cum laude*, New York University, Physics, June 1986; Phi Beta Kappa.

Recent Professional Experience:

July 1995-Present: Scientific Director, Nuclear Control Institute, Washington, D.C.

August 1992—June 1995: Postdoctoral research associate, Center for Energy and Environmental Studies, Princeton University, Princeton, NJ. Studies included technical and policy issues related to the disposition of surplus fissile materials; assessments of materials for encapsulation of nuclear wastes; proliferation, social and environmental aspects of international programs for the management of spent nuclear fuel and reprocessing wastes.

Spring 1995: Preceptor for Environmental Studies 302, "Perspectives on Environmental Issues: Values and Policies."

Spring 1994: Lecturer, Woodrow Wilson School. Preceptor for WWS 304, "Science, Technology and Public Policy."

July 1988—June 1992: Graduate research assistant, Newman Laboratory of Nuclear Studies, Cornell University, Ithaca, NY. Conducted thesis research on high-energy physics under the supervision of Prof. S.H.-H. Tye.

August 1986- June 1988: Andrew D. White Graduate Fellow, Physics, Cornell University.

Publications

E. Lyman, "The Pebble-Bed Modular Reactor: Safety Issues," *Physics and Society*, October 2001.

E. Lyman, "Public Health Risks of Substituting Mixed-Oxide for Uranium Fuel in Pressurized Water Reactors," *Science and Global Security* **9** (2001), 1.

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Invited talks

E. Lyman, "Perspectives on New Plant Licensing," presentation at the U.S. Nuclear Regulatory Commission Briefing on Readiness for New Plant Applications and Construction, Washington, DC, July 19, 2001.

E. Lyman, "Regulatory Challenges for Future Nuclear Plant Licensing: A Public Interest Perspective," U.S. NRC Advisory Committee on Reactor Safeguards (ACRS) Workshop on New Nuclear Plant Licensing, Washington, DC, June 5, 2001.

E. Lyman, "The Future of Nuclear Power: A Public Interest Perspective," 2001 Symposium of the Northeast Chapter of Public Utility Commissioners, Mystic, CT, May 21, 2001.

E. Lyman, statement at the U.S. Nuclear Regulatory Commission Briefing on Office of Nuclear Regulatory Research Programs and Performance, May 11, 2001.

E. Lyman, "Barriers to Deployment of Micro-Nuclear Technology," presentation at the workshop on "New Energy Technologies: A Policy for Micro-Nuclear Technologies," James A. Baker III Institute for Public Policy, Rice University, Houston, TX, March 19-20, 2001.

E. Lyman, "Aging Research and Public Confidence," presentation at the U.S. Nuclear Regulatory Commission 2001 Regulatory Information Conference (RIC), Washington, DC, March 14, 2001.

E. Lyman," NRC Reactor Safeguards Activities," presentation at the U.S. Nuclear Regulatory Commission 2001 Regulatory Information Conference (RIC), Washington, DC, March 14, 2001.

E. Lyman, "DOE's Nuclear Material Stabilization Approach: The Failure of Transparency," Embedded Topical Meeting on DOE Spent Nuclear Fuel and Fissile Material Management, American Nuclear Society Annual Meeting, San Diego, CA, June 2000.

E. Lyman, "The Status of Reactor Safeguards Initiatives," presentation at the U.S. NRC 2000 Regulatory Information Conference, Washington, DC, March 29, 2000.

E. Lyman, "Safety Questions Concerning MOX Fuel Use in Proposed U.S. Reactors," Sixth International Policy Forum on the Management and Disposition of Nuclear Weapons Materials, sponsored by Exchange/Monitor Publications, Washington, DC, June 1999.

E. Lyman, "Transparency and Plutonium Disposition," ISIS Workshop on Comprehensive Controls on Plutonium and Highly Enriched Uranium: Long-Term Problems and Prospects for Solutions, sponsored by the Institute for Science and International Security, Washington, DC, June 1997.

E. Lyman, "Ship Transportation of Radioactive Materials," presentation to the Marine Board of the National Research Council, U.S. National Academy of Sciences, Woods Hole, MA, June 20, 1996.

E. Lyman, "The Importation and Storage of High-Level Radioactive Wastes at Rokkasho-Mura: Safety Concerns," presentation at the Public Forum on High-Level Nuclear Waste and Reprocessing," Aomori, Japan, April 16, 1996.

E. Lyman, "Perspectives on U.S. Options for Disposition of Excess Plutonium," Third International Policy Forum on the Management and Disposition of Nuclear Weapons Materials, sponsored by Exchange/Monitor Publications, Landsdowne, VA, March 21, 1996.

E. Lyman, "Addressing Safety Issues in the Sea Transport of Radioactive Materials," presentation to the Special Consultative Meeting of Entities Involved in the Marine Transport of Nuclear Materials Covered by the INF Code," International Maritime Organization, London, March 4-6, 1996.

E. Lyman, "Prospects and Unsolved Issues for Plutonium Immobilization," INESAP/IANUS/UNIDIR Fissile Cutoff Workshop, Palais des Nations, Geneva, June 1995.

E. Lyman, "An Intermediate Solution for Plutonium from Dismantled Nuclear Warheads," Annual Meeting of the German Physical Society, Berlin, Germany, March 1995.

E. Lyman, "The Sea Transport of High-Level Radioactive Waste: Environmental and Health Concerns," Channel Islands International Conference on Nuclear Waste, St. Helier, Jersey, United Kingdom, January 1995.

Conference Papers

E. Lyman, "The Future of Immobilization Under the U.S.-Russian Plutonium Disposition Agreement," 42nd Annual Meeting of the Institute of Nuclear Materials Management (INMM), Indian Wells, CA, July 18, 2001.

E. Lyman, comments in *the Report of the Expert Panel on the Role and Direction of Nuclear Regulatory Research*, U.S. Nuclear Regulatory Commission, May 2001.

E. Lyman, "Can the Proliferation Risks of Nuclear Power be Made Acceptable?" Nuclear Control Institute 20th Anniversary Conference, Washington, DC, April 9, 2001.

E. Lyman and P. Leventhal, "Radiological Sabotage at Nuclear Power Plants: A Moving Target Set," 41st Annual Meeting of the INMM, New Orleans, LA, July 2000.

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Plutonium," Proceedings of the Institute for Science and International Security Conference on "Civil Separated Plutonium Stocks --- Planning for the Future," March 14-15, 2000, Washington, DC, Isis Press, 135.

E. Lyman, "The Sea Shipment of Radioactive Materials: Safety and Environmental Concerns," Conference on Ultrahazardous Radioactive Cargo by Sea: Implications and Responses, sponsored by the Maritime Institute of Malaysia, Kuala Lumpur, Malaysia, October 1999.

E. Lyman, "A Critique of Physical Protection Standards for Irradiated Materials," 40th Annual Meeting of the INMM, Phoenix, AZ, July 1999.

E. Lyman, "DOE Reprocessing Policy and the Irreversibility of Plutonium Disposition," Proceedings of the 3rd Topical Meeting on DOE Spent Nuclear Fuel and Fissile Materials Management, American Nuclear Society, Charleston, SC, September 8-11, 1998, p. 149.

E. Lyman, "Japan's Plutonium Fuel Production Facility (PFPF): A Case Study of the Challenges of Nuclear Materials Management," 39th Annual Meeting of the INMM, Naples, FL, July 1998.

E. Lyman, "Safety Aspects of Unirradiated MOX Fuel Transport," Annex 2b of the *Comprehensive Social Impact Assessment of MOX Use in Light Water Reactors*, Citizens' Nuclear Information Center, Tokyo, November 1997.

E. Lyman, "Unresolved Safety Issues in the Storage and Transport of Vitrified High-Level Nuclear Waste," 38th Annual Meeting of the INMM, Phoenix, AZ, July 1997.

E. Lyman, "A Perspective on the Proliferation Risks of Plutonium Mines," proceedings of the Plutonium Stabilization and Immobilization Workshop, U.S. Department of Energy, Washington, DC, December 12-14, 1995, CONF-951259, p, 445.

E. Lyman, "Assessing the Proliferation and Environmental Risks of Partitioning-Transmutation," Fifth International Summer Symposium on Science and World Affairs, Cambridge, MA, USA, July 1993.

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E. Lyman and P. Leventhal, New York Times

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H. Feiveson and E. Lyman, "No Solution to the Plutonium Problem," Washington Post, July 29, 1994.

E. Lyman, "Getting Rid of Weapon Plutonium," *Bulletin of the Atomic Scientists,* July/August 1994.

E. Lyman, F. Berkhout and H. Feiveson, "Disposing of Weapons-Grade Plutonium," *Science* **261** (1993) 813.

CERTIFICATE OF SERVICE

I hereby certify that on May 20, 2002, copies of Blue Ridge Environmental Defense League's and Nuclear Information and Resource Service's Amended Contention 2 and supporting Declaration of Dr. Edwin S. Lyman were served on the following by e-mail and/or first class mail, as indicated below:

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