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RELATED CORRESPONDENCE

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OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket Nos. 50-413-OLA
DUKE ENERGY CORPORATION	)	50-414-OLA
	)	
(Catawba Nuclear Station,	)	
Units 1 and 2)	)	

DUKE ENERGY CORPORATION'S SECOND SET OF INTERROGATORIES AND REQUESTS FOR PRODUCTION OF DOCUMENTS DIRECTED TO BLUE RIDGE ENVIRONMENTAL DEFENSE LEAGUE

In accordance with the schedule established in the Atomic Safety and Licensing Board ("Licensing Board") Order dated March 30, 2004,[1] Duke Energy Corporation ("Duke") hereby requests that the Blue Ridge Environmental Defense League ("BREDL" or "Intervenor") (1) answer this set of interrogatories fully, in writing and under oath, and (2) produce the documents requested below. In accordance with the Order, these responses and documents should be provided by Monday, May 10, 2004, pursuant to the schedule set forth by the Licensing Board.

[1] *See Duke Energy Corp.* (Catawba Nuclear Station, Units 1 & 2), "Corrected Order (Confirming Matters Addressed at March 25 Telephone Conference)," Mar. 30, 2004 ("Order").

Template = SECY-035

SECY-02

I. DEFINITIONS AND INSTRUCTIONS

The Definitions and Instructions set forth in Duke Energy Corporation's First Set of Interrogatories and Requests for Production of Documents Directed to Blue Ridge Environmental Defense League, dated March 31, 2004, should be applied in responding to these interrogatories and requests for production of documents.

II. GENERAL

Interrogatory 31

Identify each person who supplied information for responding to these interrogatories and requests for the production of documents. Note the specific interrogatories for which each such person supplied information.

III. BREDL CONTENTION I

Interrogatory 32

In the April 14, 2004 response to Duke's First Set of Interrogatories, Interrogatory 4, BREDL listed a number of specific MOX fuel behaviors that BREDL asserts will affect a LOCA scenario. For each of the following, provide the requested additional information:

a. Rod centerline temperature as a function of power: Duke has stated that Framatome ANP performed the MOX fuel LOCA analyses[2] using MOX fuel specific fuel temperatures and properties based on the COPERNIC code. Given this fact, is it BREDL's position that the MOX fuel-specific rod centerline temperature is not modeled properly in the MOX fuel design basis LOCA event analyses? If not, explain why not.

b. Fuel-clad interaction: What specific type of fuel-clad interactions does BREDL assert will affect a LOCA? Classify each different interaction as a mechanical, nuclear, or chemical interaction. Describe any basis that BREDL has that MOX fuel will interact

2 Letter, M. S. Tuckman (Duke) to U. S. Nuclear Regulatory Commission, Proposed Amendments to McGuire and Catawba Facility Operating Licenses to Allow Insertion of Mixed Oxide Fuel Lead Assemblies, February 27, 2003.

with cladding in a manner that is different from LEU fuel. If there is an asserted difference in quantitative terms, how would this difference have an adverse impact on the response to a design basis LOCA event?

c. Peak clad temperature ("PCT"): Explain how PCT is a specific MOX fuel behavior that will affect a design basis LOCA event.

d. Oxidation potential: Duke assumes that, as used in BREDL's April 14, 2004 discovery response, this refers to oxidation potential of the fuel pellet. If this is not correct, describe the phenomenon asserted.

e. Linear heat generation rate: Given that LOCA analyses establish acceptable peak linear heat generation rates (LOCA limits), and assuming that the plant operates within the envelope defined by the LOCA limits and the core design, how does the MOX fuel linear heat generation rate constitute a "specific MOX fuel behavior" that will affect a design basis LOCA event?

f. Fission product release rates and magnitudes: (Given that none of these behaviors is active in a design basis LOCA evaluation under 10 C.F.R. § 50.46, Duke assumes that BREDL considers these behaviors relevant to the LOCA dose calculation.) The MOX fuel lead assembly LOCA dose calculation was based on the TID-14844 source term.[3] Is BREDL asserting that the TID-14844 source term is appropriate for cores containing all LEU fuel but not appropriate for cores containing four MOX fuel assemblies? If so, provide the basis and rationale.

g. Radial and axial power distribution: As noted above, under "linear heat generation rate," core design defines a plant operating envelope within which peaking is less severe than that assumed in the LOCA analyses. Given this, explain how MOX fuel radial power distribution and axial power distribution affect a LOCA scenario in a manner different from LEU fuel. Does BREDL assert that the MOX fuel radial power distribution and axial power distribution render the MOX fuel design basis LOCA event analyses invalid? If so, explain how.

h. Potential for fuel crumbling and relocation following clad ballooning: Describe BREDL's basis (*e.g.*, test, analysis, papers,

3 Letter, U. S. Nuclear Regulatory Commission to H. B. Barron (Duke), Safety Evaluation for Proposed Amendments to the Facility Operating License and Technical Specifications to Allow Insertion of Mixed Oxide Fuel Lead Assemblies, April 5, 2004.

treatises, or expert opinion other than Dr. Lyman) to assert that MOX fuel behavior for this phenomenon would be any different from LEU fuel behavior? If there is any reason to suspect a difference, describe how such a difference would render MOX fuel worse than LEU fuel, relative to a design basis LOCA event.

i. Particle size distribution of fuel pellet fragments: Describe the basis (*e.g.*, test, analysis, papers, treatises, or expert opinion other than Dr. Lyman) for asserting that MOX fuel behavior in this area would be any different from LEU fuel behavior. What is the basis demonstrating that such a difference would render MOX fuel worse than LEU fuel, relative to a design basis LOCA event? If available, quantify the difference.

j. Characteristics of fuel relocation: Describe the basis (*e.g.*, test, analysis, or expert opinion) for asserting that MOX fuel behavior in this area would be different from LEU fuel behavior. If there is any reason to suspect a difference, describe BREDL's basis for asserting that such a difference would render MOX fuel worse than LEU fuel, relative to a design basis LOCA event? If so, quantify the difference.

Interrogatory 33

In its April 14, 2004 response to Duke's First Set of Interrogatories, Interrogatory 5, BREDL listed a number of specific M5 cladding behaviors that will affect a LOCA scenario. For each of the following, provide the requested additional information:

a. Clad ballooning: How is M5 different from Zircaloy-4 in this regard? Quantify the difference to the extent possible and provide the basis for BREDL's assertion.

b. Fuel-clad interaction: What specific type of fuel-clad interaction does BREDL assert will affect a LOCA? Is such an asserted interaction a mechanical, nuclear, or chemical interaction? What basis does BREDL have for an assertion that M5 cladding will interact with MOX fuel in a manner that is different from Zircaloy-4 cladding? If there is an asserted difference, how would this difference have an adverse impact on the response to a LOCA?

c. Clad oxidation: Given that M5 cladding oxidation properties are superior to Zircaloy-4 (*i.e.*, M5 shows lower corrosion during normal operation), how would M5 clad oxidation lead to adverse impacts in a design basis LOCA?

d. <u>Hydrogen uptake</u>: Given that M5 cladding hydrogen uptake is superior to Zircaloy-4 (*i.e.*, M5 shows significantly less hydrogen uptake), how would M5 cladding uptake lead to adverse impacts in a design basis LOCA?

e. <u>Loss of ductility</u>: Given that all cladding exhibits loss of ductility with burnup, and that M5 performance is better than Zircaloy-4 in this regard (*i.e.*, M5 retains ductility better with burnup), describe how M5 ductility loss would lead to adverse impacts in a design basis LOCA.

f. <u>Reaction with fission product releases</u>: Duke assumes that the basis of the BREDL response was the fact that advanced cladding alloys (such as M5) are generally characterized by no tin (M5) or lower tin content than Zircaloy-4, along with the fact that the lower tin content has been postulated to contribute to higher tellurium releases during a hypothetical severe accident. Is this correct, or is there another basis for BREDL's response? If so, state that basis. Does BREDL consider tellurium to be a significant contributor to offsite consequences, relative to other radioisotopes? Has BREDL quantified such contribution. If so, describe the quantification.

g. <u>Maximum flow blockage</u>: Given that the MOX fuel LOCA analyses evaluated the M5 cladding with worst-case (unirradiated) properties with respect to ballooning, describe the basis for BREDL's position that the analyses are non-conservative with respect to ballooning and flow blockage.

<u>*Interrogatory 34*</u>

In response to Interrogatory 9, regarding the ability of computer codes to assess the impact of MOX fuel behavior differences, BREDL's April 14, 2004 Response states that "BREDL shares the skepticism of the Expert Panel on Source Terms for High-Burnup and MOX Fuels." Is it not true that the comments of the Expert Panel were directed exclusively at codes used to analyze severe accidents, not evaluation models for design basis LOCAs and compliance with 10 CFR § 50.46? Does BREDL assert that the Expert Panel statement is relevant to a design basis LOCA evaluation model? If so, describe the basis for such position.

Interrogatory 35

In response to Interrogatory 10, BREDL states that "BREDL does not assert that Duke fails to comply with Appendix K." If the MOX fuel LOCA analysis complies with 10 C.F.R. Part 50, Appendix K, describe how the analysis is not adequate to demonstrate acceptable emergency core cooling system performance.

Interrogatory 36

In response to Interrogatory 12, BREDL states that ". . . the likelihood and progression of fuel relocation during a design basis LOCA will in general be different between the MOX LTAs and conventional LEU fuel." BREDL cites three differences (fuel-clad interaction, particle size distribution of fuel fragments, and the clad ballooning geometry). Describe how each cited difference will affect relocation and in what manner. Also, describe the quantitative and qualitative bases for your conclusion.

Interrogatory 37

In response to Interrogatory 13, BREDL states that IRSN postulated a PCT increase of 180°F due to fuel relocation. Please confirm whether BREDL's position is that IRSN is referring to fuel relocation in general during a design basis LOCA, and not specifically to fuel relocation in MOX fuel during a design basis LOCA.

Interrogatory 38

In response to Interrogatory 13, BREDL notes that the Framatome ANP analysis of MOX fuel during a design basis LOCA does not model fuel relocation and its effects. BREDL notes that 180°F is a "significant change" as defined in 10 CFR § 50.46(a)(3)(i), and implies that the regulations therefore require the Framatome ANP evaluation model to address fuel relocation. Is this an accurate statement of BREDL's position? If not, explain BREDL's position and describe the basis for that position. Also, is it BREDL's view that the 180°F value would apply to LEU fuel as well?

Interrogatory 39

In response to Interrogatory 13, BREDL states that ". . . an M5-clad MOX LTA forms fragments at lower burnups than Zircaloy-clad LEU fuel." Describe the basis for this statement.

Interrogatory 40

In response to Interrogatory 13, BREDL states that "MOX fuel has a higher linear heat generation rate." However, by the nature of the proposed Catawba Technical Specifications for MOX fuel lead assemblies, the MOX fuel must be non-limiting. Therefore, the linear heat generation rate of MOX fuel will be lower than the linear heat generation rate of at least some LEU fuel. Given this fact, explain how linear heat generation rate can support BREDL's conclusion that fuel relocation will be more severe for MOX fuel than for LEU fuel.

Interrogatory 41

In response to Interrogatory 13, BREDL states that "MOX fuel develops a larger balloon because of the greater ductility of M5 cladding." Explain the comparison (*i.e.*, greater than what, and at what conditions?). Is this a comparison to Zircaloy-4 or to ZIRLO?

Interrogatory 42

In response to Interrogatory 13, BREDL states that fuel relocation can result in an increase in peak cladding temperature of 180° F. Describe the calculation upon which this statement is based. For both the base calculation and the calculation modeling fuel relocation, discuss (1) how the cladding rupture and fuel relocation phenomena were modeled, (ii) the packing factor that was assumed for relocated fuel, and (iii) whether or not credit was taken for extra cooling due to rupture-inducted turbulence. Also describe the evaluation model that was used to perform the calculation; and the plant type that was analyzed.

Interrogatory 43

In response to Interrogatory 15, BREDL states that "uncertainties regarding the behavior of the MOX LTAs under design basis LOCA conditions are sufficiently large that high assurance of compliance with NRC requirements cannot be provided." What, specifically, does BREDL mean by "high assurance?" Does BREDL believe that the NRC "reasonable assurance" standard does not apply to the MOX fuel lead assembly license amendment request?

Interrogatory 44

In response to Interrogatory 15, BREDL states that "uncertainties regarding the behavior of the MOX LTAs" are too large to permit the lead assembly program to go forward. Would BREDL agree, however, that lead assembly programs, by their very nature, are intended to gather data to reduce uncertainty?

Interrogatory 45

In response to Interrogatory 16, BREDL states that "BREDL considers the information from the VERCORS tests to be germane to the performance of MOX fuel during a design basis LOCA, as does the Expert Panel Report on Source Terms." Does BREDL agree that the VERCORS tests and results are irrelevant to the issue of MOX fuel compliance with 10 CFR § 50.46 emergency core cooling system requirements? Does BREDL agree that to the extent the VERCORS tests are relevant, it is in relation to dose analyses only? If not, describe the basis for BREDL's position.

Interrogatory 46

In connection with Duke's license amendment application ("LAR"), the NRC Staff issued a Safety Evaluation Report ("SER") on April 5, 2004, addressing many of the issues raised in BREDL's Interrogatories 4 though 22. The Staff determined that Duke's LAR demonstrates with reasonable assurance satisfaction of LOCA criteria in 10 C.F.R. § 50.46 and 10 CFR Part 50 Appendix K, as well as meeting LOCA radiological consequences through independent NRC radiological analysis. In this context, please respond to the following:

a. In connection with the SER's findings regarding LOCA for LAR Sections 2.1, 2.2, 2.3, 2.4, 2.7, 3.0, 3.1, 3.2, 3.3 and 4.0, indicate each specific error that BREDL asserts in the NRC evaluation and analysis.

b. Provide the supporting basis for each asserted error and supporting documentation for each asserted error.

c. Describe how, in BREDL's view, these asserted errors individually or collectively would change overall conclusions in the SER.

d. For every fuel behavior (BREDL Interrogatory Response 4), cladding behavior (BREDL Interrogatory Response 5), and fuel property (BREDL Interrogatory Response 6), identify the NRC regulatory guidance that identifies this behavior or property as a factor for consideration in design basis accidents.

IV. BREDL CONTENTION II

Interrogatory 47

Please respond to the following questions in order to clarify BREDL's response to Interrogatories 18 and 19:

a. Will the presence of four MOX fuel lead assemblies affect the probability of non-LOCA transients leading to a "core disruptive accident," as BREDL defined the term in its response to Interrogatory 17?

b. If so, provide a detailed basis for the assertion, describe the change in probability, and discuss the resulting impact on overall risk.

c. Will the presence of four MOX fuel lead assemblies affect the probability of LOCAs leading to a "core disruptive accident," as BREDL defined the term in its response to Interrogatory 17?

d. If so, provide a detailed basis for the assertion, describe the change in probability, and discuss the resulting impact on overall risk.

Interrogatory 48

In response to Interrogatory 22, BREDL states that "BREDL is concerned that the ECCS criteria are not met for MOX fuel." Please reconcile that statement with the response to Interrogatory 10, *i.e.*, that "BREDL does not assert that Duke fails to comply with Appendix K."

Interrogatory 49

Confirm that BREDL's response to Interrogatory 23 limits BREDL's concerns with the Duke Environmental Report (submittal in connection with the license amendment application) to the treatment of severe accidents related to early containment failure or bypass.

Interrogatory 50

BREDL's response to Interrogatory 23 refers to "the impact of greater tellurium release fraction observed in the VERCORS and Phebus tests." Describe the specific tests that BREDL asserts indicate a "greater" release fraction, and provide all of the data or documents that support this statement. Also, please clarify — "greater than" what?

Interrogatory 51

BREDL's response to Interrogatory 23 refers to "the greater ruthenium and actinide releases associated with late in-vessel degradation in air." Describe the specific data that indicate greater ruthenium and actinide releases during the late in-vessel phase and provide all of the data or documents that support this statement. Also, please clarify — "greater than" what?

Interrogatory 52

BREDL's response to Interrogatory 24 refers to endnote 56 of the Lyman paper as providing the actual radionuclide release fractions. However, there is a lack of clarity about the release fractions used in the sensitivity study. Page 19 of Dr. Lyman's paper[4] states that: "A sensitivity study was carried out to assess the impact of varying the actinide release fractions." Endnote 56, however, discusses varying "the low-volatile release fractions" and uses strontium as an example. All "low-volatile" isotopes are not actinides. For example, strontium (specifically cited in Endnote 56 of the Lyman paper) is not an actinide. The paper itself implies that only actinide release fractions were modified, but the endnotes imply differently. In order to clarify what was actually done in Dr. Lyman's analysis, please provide an isotope-by-isotope table showing the nominal release fraction, the release fraction used for the ST-H study, and the release fraction used for the ST-L study.

Interrogatory 53

BREDL's response to Interrogatory 26 states that: "BREDL believes that a change in the likelihood or consequences of credible accidents that would result in serious injury or death to any additional individual could not be dismissed as insignificant." Does BREDL assert that any of the accident scenarios at issue under Contentions I and II constitute "credible accidents?" If so, which ones? If so, please describe the accident scenario with specificity — *i.e.*, the initiating event and sequence of events involved, including equipment failures and human failures, if any, that are required to produce adverse impacts on public health and safety.

4 "Public Health Risks of Substituting Mixed-Oxide for Uranium Fuel in Pressurized-Water Reactors," *Science and Global Security*, 2000, Volume 9.

V. BREDL CONTENTION III

Interrogatory 54

Identify each person whom Intervenor expects to provide testimony or sworn affidavits in connection with Contention III in this proceeding. For each person identified, describe that person's professional affiliation, area of professional expertise, qualifications, and educational and scientific experience. Also, describe the general subject matter on which each person identified is expected to provide testimony or sworn affidavits in this proceeding.

Interrogatory 55

Identify each document, book, periodical, magazine article, technical report, thesis, website, computer output or correspondence that BREDL expects to submit, reference, cite, or otherwise rely upon in connection with testimony or sworn affidavits in support of Contention III.

Interrogatory 56

Does BREDL consider a MOX fuel lead assembly program at Oconee Nuclear station ("Oconee") to be a feasible alternative to a lead assembly program at McGuire or Catawba? Explain why or why not.

Interrogatory 57

Does BREDL consider that a MOX fuel lead assembly program at Oconee would have equivalent or better technical value than a lead assembly program at Catawba, relative to ultimate large-scale use of MOX fuel at either McGuire or Catawba?

Interrogatory 58

Does BREDL consider that a successful MOX fuel lead assembly program executed at Oconee would be adequate in-reactor experience to qualify MOX fuel for large-scale use at McGuire or Catawba?

Interrogatory 59

State all reasons that BREDL asserts support a contention that Oconee must be considered as an alternative for batch use of MOX fuel assemblies.

Interrogatory 60

Does BREDL agree that all three Oconee units have only 75% of the thermal power capacity of the four McGuire and Catawba units, and therefore cannot provide an equivalent plutonium disposition capacity? If not, explain why not.

VI. DOCUMENT PRODUCTION REQUESTS

Request 3

Provide all documents that are identified, or referred to, in responding to all of the above interrogatories.

Request 4

Please provide all of the SAS2H/ORIGEN-S input decks used in developing the radionuclide inventories used in all of the analyses documented in the Lyman paper. In addition, provide any calculations or computations used to develop the values in those input decks. Provide any post-processing computations (*e.g.*, spreadsheets) used to develop the MACCS core radionuclide inputs from the SCALE outputs. Finally, if there is other information (not described above) used to develop the MACCS radionuclide inputs, provide that information as well. Provide this information for each of the cases and sensitivity studies discussed in Reference 4 (*e.g.*, DEIS, DCS, reactor grade MOX), and clearly differentiate the cases.

Respectfully submitted,

David A. Repka

David A. Repka
Anne W. Cottingham
WINSTON & STRAWN LLP
1400 L Street, NW
Washington, D.C. 20005-3502
(202) 371-5726

Lisa F. Vaughn
DUKE ENERGY CORPORATION
422 South Church Street
Mail Code: PB05E
Charlotte, N.C. 28201-1244

ATTORNEYS FOR DUKE ENERGY CORPORATION

Dated in Washington, District of Columbia
This 26th day of April 2004

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket Nos. 50-413-OLA
DUKE ENERGY CORPORATION	)	50-414-OLA
	)	
(Catawba Nuclear Station,	)	
Units 1 and 2)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "DUKE ENERGY CORPORATION'S SECOND SET OF INTERROGATORIES AND REQUESTS FOR PRODUCTION OF DOCUMENTS DIRECTED TO BLUE RIDGE ENVIRONMENTAL DEFENSE LEAGUE" in the captioned proceeding have been served on the following by deposit in the United States mail, first class, this 26th day of April, 2004. Additional e-mail service, designated by **, has been made this same day, as shown below.

Ann Marshall Young, Chairman**
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
(e-mail: AMY@nrc.gov)

Anthony J. Baratta**
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
(e-mail: AJB5@nrc.gov)

Dr. Thomas S. Elleman**
Administrative Judge
5207 Creedmoor Road, #101
Raleigh, NC 27612
(e-mail: elleman@eos.ncsu.edu)

Office of the Secretary**
U.S. Nuclear Regulatory Commission
Washington, DC 20555
Attn: Rulemakings and Adjudications Staff
(original + two copies)
(e-mail: HEARINGDOCKET@nrc.gov)

Office of Commission Appellate Adjudication
Mail Stop O-16C1
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Adjudicatory File
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Susan L. Uttal, Esq.**
Antonio Fernandez, Esq.**
Margaret J. Bupp, Esq.**
Office of the General Counsel, O-15D21
U.S. Nuclear Regulatory Commission
Washington, DC 20555
(e-mail: slu@nrc.gov)
(e-mail: axf2@nrc.gov)
(e-mail: mjb5@nrc.gov)

Diane Curran**
Harmon, Curran, Spielberg &
Eisenberg, LLP
1726 M Street, N.W.
Suite 600
Washington, DC 20036
(e-mail: dcurran@harmoncurran.com)

Mary Olson
Director, Southeast Office
Nuclear Information and Resource
Service
P.O. Box 7586
Asheville, NC 28802

David A. Repka

David A. Repka
Counsel for Duke Energy Corporation

DC:355010.1