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**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
ATOMIC SAFETY AND LICENSING BOARD**

**OFFICE OF SECRETARY  
RULEMAKINGS AND  
ADJUDICATIONS STAFF**

**Before Administrative Judges:  
Thomas S. Moore, Chairman  
Charles N. Kelber  
Peter S. Lam**

In the Matter of )

October 8, 2003

DUKE COGEMA STONE & WEBSTER )

Docket No. 070-03098-ML

(Savannah River Mixed Oxide Fuel  
Fabrication Facility) )

ASLBP No. 01-790-01-ML

**DCS REPLY TO GANE OPPOSITION TO  
DCS MOTION FOR  
SUMMARY DISPOSITION ON CONTENTION 3**

Duke Cogema Stone & Webster LLC ("DCS") hereby replies to Georgians Against Nuclear Energy's ("GANE") Opposition to Summary Disposition on Contention 3 ("GANE Opposition").<sup>1</sup> This Reply is supported by the Supplemental Affidavit of Dr. Carl Stepp (Attachment A). The Board authorized this Reply by Order dated September 22, 2003.

GANE's Opposition fails to present genuine issues of material fact regarding whether DCS complied with the regulations in 10 CFR Part 70 governing the consideration of earthquake hazards in the design of the proposed Mixed Oxide Fuel Fabrication Facility ("MOX Facility"). Accordingly, DCS requests that the Contention be summarily disposed of without a hearing.

<sup>1</sup> See *Georgians Against Nuclear Energy's Opposition to Duke Cogema Stone & Webster's Motion for Summary Disposition of GANE Contention 3* (Sept. 16, 2003).

## I. BACKGROUND

In Contention 3, GANE argues that the seismic analysis presented in the Construction Authorization Request (“CAR”) submitted by DCS for the proposed MOX Facility is inadequate. The NRC will approve construction of the principal structures, systems, and components (“SSCs”) of a MOX Facility when the Commission has determined that the design bases of the principal SSCs “provide reasonable assurance of protection against natural phenomena.”<sup>2</sup> To demonstrate reasonable assurance, DCS must show that the design “provide[s] for adequate protection against natural phenomena with consideration of the most severe documented historical [earthquake] for the site.”<sup>3</sup> GANE argues that “DCS has not performed a seismic analysis that is either adequate in scope or adequately documented.”<sup>4</sup>

On August 22, 2003, DCS filed a Motion for Summary Disposition on Contention 3, pursuant to 10 CFR §§ 2.1237 and 2.749 (“DCS Motion”). DCS’s Motion was supported by a “Statement of Material Facts on Which No Genuine Issue Exists” (DCS Motion Attachment B, hereafter “DCS Material Facts”), and by the sworn Affidavit of Dr. Carl Stepp (DCS Motion Attachment C, hereafter “Stepp Affidavit”), as well as various figures.

The NRC Staff fully supported DCS’s Motion in its response filed on September 16, 2003.<sup>5</sup> The NRC Staff supported its response with an Affidavit of Dr. John Stamatakos.

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<sup>2</sup> 10 CFR § 70.23(b) (emphasis added).

<sup>3</sup> 10 CFR § 70.64(a)(2).

<sup>4</sup> *Georgians Against Nuclear Energy Contentions Opposing a License for Duke Cogema Stone & Webster to Construct a Plutonium Fuel Factory at Savannah River Site* (Aug. 13, 2001) (“GANE Contentions”) at 13; Revised Contention 3 at 1.

<sup>5</sup> *See NRC Staff Response to Motion For Summary Disposition Submitted By Duke Cogema Stone & Webster* (Sept. 16, 2003).

GANE filed its opposition also on September 16, 2003, supported by a Statement of Genuinely Disputed Material Facts (“GANE Disputed Facts”) and a Declaration of Dr. Leland Timothy Long (“Long Declaration”).

As the party opposing summary disposition, GANE was required to set forth specific facts showing that there is a genuine issue.<sup>6</sup> Bare assertions, general denials or educated guesses are insufficient to oppose a motion for summary disposition,<sup>7</sup> as are mere “quotations from or citations to [the] published work of researchers [or experts] who have apparently reached conclusions at variances with the movant’s affidants.”<sup>8</sup> Accordingly, the existence of apparently conflicting expert affidavits does not preclude summary disposition.<sup>2</sup>

Furthermore, DCS’s material facts are deemed admitted if those facts are not challenged by GANE in its statement of disputed facts.<sup>10</sup> If DCS makes a proper showing, and GANE does not show that a genuine issue of material fact exists, then the Licensing Board may summarily dispose of the contention on the basis of the pleadings.<sup>11</sup>

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<sup>6</sup> See 10 CFR § 2.749(b).

<sup>7</sup> See *Id.*; *Advanced Med. Sys., Inc.* (One Factory Row, Geneva, Ohio 44041), CLI-93-22, 38 NRC 98, 102 (1993); *Houston Lighting and Power Co.* (Allens Creek Nuclear Generating Station, Unit No. 1), ALAB-629, 13 NRC 75, 78 (1981); *Public Svc. Co. of New Hampshire* (Seabrook Station, Units 1 and 2), CLI-92-08, 35 NRC 145, 154 (1992) (“educated guesses” insufficient; to avoid summary disposition, intervenors have to present contrary evidence that is “so significantly probative” as to create a material factual issue” (citation omitted)).

<sup>8</sup> *Carolina Power & Light Co. and North Carolina E. Mun. Power Agency* (Shearon Harris Nuclear Plant, Units 1 and 2), LBP-84-7, 19 NRC 432, 435-36 (1984).

<sup>2</sup> See *e.g.* *Public Svc. Co. of New Hampshire* (Seabrook Station, Units 1 and 2), CLI-92-08, 35 NRC at 154 (summary disposition appropriate despite existence of affidavits from opposing parties); see also *NRC Staff Response to Motion For Summary Disposition Submitted By Duke Cogema Stone & Webster* at 5 & n. 19, 20, and 21 (Sept. 16, 2003).

<sup>10</sup> See 10 CFR § 2.749(a).

<sup>11</sup> *Northern States Power Co.* (Prairie Island Nuclear Generating Plant, Units 1 and 2), CLI-73-12, 6 AEC 241, 242 (1973), *aff’d sub. nom. BPI v. AEC*, 502 F.2d 424 (D.C. Cir. 1974).

As demonstrated below, and supported by the Supplemental Affidavit of Dr. Carl Stepp, even considering GANE's Opposition, Contention 3 is the type of contention for which no evidentiary hearing is necessary, and which can be readily and expeditiously resolved in DCS's favor through summary disposition.

A table comparing DCS's Statement of Material Facts with GANE's Statement of Disputed Facts is presented as Attachment B to this Reply. Those Material Facts not challenged by GANE's Statement of Disputed Facts are, by NRC regulation, deemed admitted.<sup>12</sup>

## **II. GANE FAILS TO RAISE A GENUINE ISSUE OF MATERIAL FACT**

The crux of GANE's opposition is that DCS erred in relying on the probabilistic seismic hazard assessments ("PSHAs") published by the Electric Power Research Institute ("EPRI") and Lawrence Livermore National Laboratory ("LLNL"). GANE claims that these PSHAs are out of date, and that "DCS made no attempt to update these studies with the considerable new information that is available regarding the seismicity of the South Carolina Coastal Plain."<sup>13</sup> GANE also claims that these PSHAs were not originally intended for site-specific use, and that DCS "misused the LLNL and EPRI studies, by applying their general conclusions without refining them through the application of site-specific information."<sup>14</sup>

To support its claims, GANE relies on the opinions of Dr. Leland Timothy Long. However, Dr. Long mis-states the date of the EPRI and LLNL PSHAs, relies on NRC

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<sup>12</sup> 10 CFR § 2.749(a) ("All material facts set forth in the statement required to be served by the moving party will be deemed to be admitted unless controverted by the statement required to be served by the opposing party").

<sup>13</sup> GANE Opposition at 2.

regulatory guidance that was not used by (nor is binding upon) DCS, relies on his own memory of hearsay regarding the site-specific use of these PSHAs, and misunderstands the robustness of both the EPRI and LLNL PSHAs and the Reg. Guide 1.60 spectrum used for the seismic design basis horizontal surface spectrum for the MOX Facility. Dr. Long's views represent bare assertions and general denials which are insufficient to defeat a motion for summary disposition.<sup>15</sup> Accordingly, they do not raise a genuine issue of material fact.

In Sections A through E below, DCS discusses these and other misunderstandings in the order they affect the issues raised in DCS's Motion.

**A. Adequacy of the Historical Check**

It is undisputed that 10 CFR § 70.64(a)(2) requires that DCS include in the seismic design of the MOX Facility consideration of the most severe documented historical earthquake for the MOX Facility site, and that the 1886 Charleston earthquake is the most severe historical documented earthquake for the MOX Facility site.<sup>16</sup> It is also undisputed that a postulated 7.3 moment magnitude earthquake, with an epicenter located 120 km southeast of the MOX Facility site, is "realistic" for modeling the historic 1886 Charleston earthquake ground motions.

DCS previously stated in its Statement of Material Facts that it was "appropriate or conservative" to use 120 kms for the historical check.<sup>17</sup> DCS relied on Dr. Long's own words

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<sup>14</sup> *Id.*

<sup>15</sup> See 10 CFR § 2.749(b); *Advanced Med. Sys., Inc.*, 38 NRC at 102; *Houston Lighting and Power Co.*, 13 NRC at 78.

<sup>16</sup> GANE Disputed Facts ¶ 1 (failure to dispute the statement).

<sup>17</sup> DCS Motion, Attachment B, ¶ 3.

from his deposition in which he stated—twice—that it was “realistic” to use 120 kms.<sup>18</sup> The characterization of “realistic” is synonymous with “appropriate.”

For the first time, Dr. Long now states that he does not agree that 120 kms is “appropriate” “because effects like Moho bounce increase shaking with increased distance.”<sup>19</sup> However, GANE does not dispute that “Moho Bounce is only important for earthquakes which have epicenters located between about 80 and 120 kms from the MOX Facility.”<sup>20</sup> Accordingly, that fact is deemed admitted.<sup>21</sup> Dr. Long also admitted during his deposition that Moho Bounce would have its “maximum effect” at 100 kms, which is consistent with his Declaration.<sup>22</sup>

Since Moho Bounce is not significant at distances greater than 120 kms, placing an earthquake epicenter greater than 120 kms from the MOX Facility would not produce more conservative ground motions at the MOX Facility than one placed at 120 kms.<sup>23</sup> Finally, for the historical check, a distance less than 120 kms is not appropriate because 120 kms was the distance for the 1886 Charleston earthquake that is the closest point to the MOX Facility site which coincides with the highest Modified Mercalli Intensity damage, or mesoseismal zone.<sup>24</sup>

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<sup>18</sup> Long Deposition Transcript at 190:1-6; 190:13-14.

<sup>19</sup> Long Declaration ¶ 56; GANE Disputed Facts ¶ 1.

<sup>20</sup> Compare DCS Material Facts ¶ 44 with GANE Disputed Facts. Nor does Dr. Long dispute that for the South Carolina Coastal Plain, which has a depth to the Moho of about 29 kms, Moho Bounce is only important for earthquakes which have epicenters located between about 80 and 120 kms from the MOX Facility. See Long Declaration ¶¶ 22, 67-68.

<sup>21</sup> 10 CFR § 2.749(a).

<sup>22</sup> Long Deposition Transcript at 220:13-14.

<sup>23</sup> Stepp Supplemental Affidavit ¶ 9, 10.

<sup>24</sup> *Id.* ¶ 10.



correct in his assertion, and assuming the largest impact that he postulates, the historical ground motions are still enveloped by the seismic design basis spectrum for all frequencies of structural interest (namely, 2.5 to 9 Hz).<sup>30</sup> Dr. Long has not provided any analyses to demonstrate the contrary; he has raised no more than a “metaphysical doubt,” which is insufficient to defeat a motion for summary disposition.<sup>31</sup>

The fact remains that the historical check is appropriate and meets the requirements of 10 CFR § 70.64(a)(2).

**B. The EPRI and LLNL PSHAs are Appropriate for Site-Specific Use**

GANE states that the EPRI and LLNL studies are not appropriate for specific sites because they “are seriously out of date and because regionally responsive attenuation relations were not used in these studies. In addition, the PSHA can be affected, particularly at higher frequencies, by the details of local seismicity.”<sup>32</sup> GANE cites to ¶ 9 of Dr. Long’s Declaration for support.

There is no genuine issue of material fact regarding the age of the EPRI and LLNL PSHAs. GANE relies heavily on a mistaken belief that the EPRI and LLNL PSHAs were “conducted in the late 1970s and early 1980s”<sup>33</sup> and “published over twenty years ago.”<sup>34</sup>

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<sup>30</sup> Stepp Supplemental Affidavit ¶ 11.

<sup>31</sup> See *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.*, 475 U.S. 574, 586-87 (1986) (to defeat a motion for summary disposition, the opposing party must show the existence of more than just some “metaphysical doubt” concerning the material facts); *Public Svc. Co. of New Hampshire* (Seabrook Station, Units 1 and 2), CLI-92-08, 35 NRC 145, 154 (1992) (to avoid summary disposition, intervenors have to present contrary evidence that is “‘so significantly probative’ as to create a material factual issue” (citation omitted)).

<sup>32</sup> GANE Disputed Facts ¶ 4.

<sup>33</sup> GANE Opposition at 4

<sup>34</sup> *Id.* at 8. See also Long Declaration ¶ 13 (“twenty-plus years since the LLNL and EPRI studies were prepared”); *Id.* ¶ 59 (“Given the tremendous growth in available information about seismicity in the southeastern United States over the past twenty years”).

GANE further states that the “NRC anticipated that the LLNL and EPRI studies would be revised every 10 years, which hasn’t happened.”<sup>25</sup> GANE concludes that with the 20-year old status of the PSHAs, “it is even more important to update the seismic analysis with current and site-specific information.”<sup>26</sup>

The dates cited by Dr. Long are off by about ten years. The EPRI and LLNL PSHAs were not published more than 20 years ago. There can be no credible dispute that these studies were published in the late 1980s and early 1990s, not in the late 1970s and early 1980s as GANE states.<sup>27</sup> It is unclear where GANE acquired its dates because GANE provides no citations in support of its argument. However, GANE’s bare—and incorrect—assertions do not create a genuine issue of material fact.

Dr. Long’s opinion that the EPRI and LLNL PSHAs were not intended for specific sites is also based on his recollection of discussions with managers of the PSHAs. During his deposition, Dr. Long stated that “I remember asking someone about that and I don’t remember who and when. It was someone involved in the studies.”<sup>28</sup> In his Declaration, Dr. Long now states:

During those studies, it was my understanding that the computations were generalized for comparison purposes. It was generally presumed that for a specific site, a more detailed evaluation would be performed. I was fully aware

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<sup>25</sup> GANE Opposition at 10.

<sup>26</sup> *Id.* at 10.

<sup>27</sup> Stepp Supplemental Affidavit ¶ 15; EPRI, *Probabilistic Seismic Hazard Evaluations at Nuclear Plant Sites in the Central and Eastern United States*, NP-4726-A, All Volumes (1988) (“the EPRI PSHA”); D.L. Bernreuter et al, *Seismic Hazard Characterization of 69 Reactor Sites East of the Rocky Mountains*, NUREG/CR-5250 (1989); P. Sobel, *Revised Livermore Seismic Hazard Estimates for Sixty-Nine Nuclear Power Plant Sites East of the Rocky Mountains*, NUREG-1488, (April 1994); J.B. Savy et al, *Eastern Seismic Hazard Characterization Update*, UCRL-ID-115111 (June 1993) (collectively “the LLNL PSHA”).

<sup>28</sup> Long Deposition Transcript at 175:11, 176:1-13.

that at close ranges the details of the seismic zones could affect the hazard, particularly if attenuation functions were allowed that properly accommodated shallow earthquakes. At the time of the studies, I was sufficiently concerned to ask the study managers if these were to be used for specific sites and the answer was no, a more detailed study would have to be made for a particular site evaluation.<sup>39</sup>

Dr. Long's statements from his memory do not create a genuine issue of material fact.

It is undisputed that Dr. Carl Stepp was the technical leader of the EPRI PSHA work, and leader of the development of its methodology. In that position, he had first hand knowledge that the EPRI PSHA outputs were expected to be used for specific sites.<sup>40</sup> Also, the same NRC Guidance GANE cites—Reg. Guide 1.165—explicitly allows the EPRI and LLNL PSHAs to be applied to specific sites.<sup>41</sup> Dr. Stamatakos—whose affidavit is offered by the NRC Staff—agrees.<sup>42</sup> Dr. Long's opinions are bare assertions and general denials, which are insufficient to defeat a motion for summary disposition.<sup>43</sup>

### C. Updating the EPRI and LLNL PSHAs results

If used, GANE believes that the EPRI and LLNL studies must be updated to take into account new information.<sup>44</sup> Specifically, GANE states that “[i]t may be correct that the LLNL and EPRI studies are suitable for ‘developing’ a site-specific PSHA, but it is not true that DCS

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<sup>39</sup> Long Declaration ¶ 9(a)(iv).

<sup>40</sup> Stepp Supplemental Affidavit ¶ 16; Dr. Stepp Affidavit ¶ 41.

<sup>41</sup> DCS Motion at 26 (quoting U.S. NRC, *Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion*, Reg. Guide 1.165 at 2-3 (March 1997)).

<sup>42</sup> Stamatakos Affidavit ¶ 5.

<sup>43</sup> See 10 CFR § 2.749(b); *Advanced Med. Sys., Inc.*, 38 NRC at 102; *Houston Lighting and Power Co.*, 13 NRC at 78.

<sup>44</sup> GANE believes that this is necessary because the EPRI and LLNL studies were published 20 years ago. As stated above, GANE is incorrect about the dates these PSHAs were conducted and published.

may place unqualified reliance on them, without conducting any further inquiry.”<sup>45</sup> DCS, however, considered new information. In fact, GANE does not appear to dispute that DCS considered:

new information regarding the potential that a magnitude 7+ earthquake could occur virtually anywhere in South Carolina, as suggested by Kafka (DCS Motion at 30); the possibility of a 7.5 earthquake in southeastern Tennessee (DCS Motion at 33-34); recent paleoseismological work on the South Carolina Coastal Plain (“SCCP”) showing more seismic activity in the last 6,000 years, and over a wider area, than previously known (DCS Motion at 35); new information showing a shorter recurrence interval of the Charleston Earthquake (DCS Motion at 39-40); and new information regarding ground motion attenuation (DCS Motion at 44-45).<sup>46</sup>

Instead, GANE argues that DCS was required to consider this information “*quantitatively*,”<sup>47</sup> and that DCS did not do so. GANE relies on the opinion of Dr. Long that “twenty years ago, the experts may have acknowledged these factors, but placed little emphasis on them. Today, if the EPRI and LLNL studies were to be conducted over again, expert opinion would be likely to shift, resulting in greater quantitative emphasis on these factors.”<sup>48</sup>

This is a question of law for the Board to decide. DCS believes it is not required to quantitatively consider new information; GANE believes DCS is so required. DCS demonstrates below why this issue should be resolved in DCS’s favor.

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<sup>45</sup> GANE Opposition at 9.

<sup>46</sup> *Id.* at 11.

<sup>47</sup> *Id.* at 12.

<sup>48</sup> *Id.*

## 1. The EPRI and LLNL PSHAs are Robust

Since new articles related to seismology are published regularly, shifting expert interpretations likely could be found in the year immediately after the EPRI and LLNL PSHA studies were published.<sup>49</sup> In fact, EPRI and LLNL anticipated that this would occur and designed the studies to include significant ranges of uncertainty to accommodate evolving expert interpretations. Fundamental to the understanding of how a PSHA should be performed and used is the fact that estimating annual frequencies of ground motions can only be attained with significant uncertainty.<sup>50</sup> Despite the time that has passed since the LLNL and EPRI studies were completed, there remain gaps in our understanding of the mechanisms that cause earthquakes and the ground motion propagation characteristics of the earth's interior. The data and information that do exist can be, and indeed are, legitimately interpreted differently by different experts, and these differences result in uncertainties that are properly captured and expressed in the final quantitative results from a PSHA.

When the EPRI and LLNL studies were conducted, a particular effort was made to capture legitimate interpretations of all PSHA parameters including seismic sources, earthquake recurrence, maximum earthquake magnitude potential, and ground motion attenuation characteristics.<sup>51</sup> The result of this substantial effort was a robust set of PSHA results—results that were expected to stand up to the test of time, to new data, information, models and interpretation. Explicit re-computation was only expected if new data or models were a major departure, and that such might only be “expected” approximately every ten

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<sup>49</sup> Stepp Supplemental Affidavit ¶ 17.

<sup>50</sup> *Id.* ¶ 18.

<sup>51</sup> *Id.* ¶ 19.

years.<sup>52</sup> It is critically important that the details of how EPRI and LLNL captured uncertainty be fully understood when judging whether new data or models represent a major departure. Both the EPRI and LLNL studies capture a wide range of interpretations of all critical PSHA input parameters, as reflected in their wide range of uncertainty estimates. These PSHAs have proven to be so robust that such re-computation has been unnecessary.<sup>53</sup> Simply put, the EPRI and LLNL studies are not erroneous based upon their age or any “failure to update,” and the Board should find that DCS’s reliance on these PSHAs is acceptable as a matter of law.

## **2. Reg. Guide 1.165 Is Not Binding on DCS and Does Not Require Re-Computation of the EPRI and LLNL PSHAs**

The above thought is embedded in Reg. Guide 1.165, Attachment E, which states that “[t]he EPRI and LLNL studies provide a wide range of interpretations of the possible seismic sources for most regions of the [Central and Eastern United States], as well as a wide range of interpretations for all the key parameters of the seismic hazard model.”<sup>54</sup> Although it cites Reg. Guide 1.165, GANE appears to ignore the guidance. The Reg. Guide does not require that DCS re-compute a PSHA.<sup>55</sup> Rather, it states that an applicant need do no more if the “new information” falls within the range of uncertainty interpretations of the EPRI and LLNL studies; it does not state that an applicant must re-weigh the new information through quantitative analyses.

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<sup>52</sup> *Id.* ¶ 20. The NRC recognizes the robustness of the EPRI and LLNL PSHAs by stating that even the discovery of new faults “will not require a modification of the seismic sources provided in the LLNL and EPRI studies.” Reg. Guide 1.165 at 1.165-38.

<sup>53</sup> Stepp Supplemental Affidavit ¶ 19.

<sup>54</sup> Reg. Guide 1.165, Appendix E, at 1.165-39.

<sup>55</sup> Stepp Supplemental Affidavit ¶ 21.

GANE cites Reg. Guide 1.165 to support its position that a MOX Facility applicant may not place unqualified reliance on the EPRI and LLNL PSHAs.<sup>56</sup> As cited by GANE, Reg. Guide 1.165 states:

For sites in the CEUS [central and eastern United States], when the EPRI or LLNL PSHA methodologies and data bases are used to determine the SSE, it still may be necessary to investigate and characterize potential seismic sources that were previously unknown or uncharacterized and to perform sensitivity analyses to assess their significance to the seismic hazard estimate.<sup>57</sup>

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It is necessary to evaluate the geological, seismological, and geophysical data obtained from the site-specific investigations to demonstrate that these data are consistent with the PSHA data bases of these two methodologies [i.e., LLNL and EPRI]. If new information identified by the site-specific investigations would result in a significant increase in the hazard estimate for a site, and this new information is validated by a strong technical basis, the PSHA may have to be modified to incorporate the new technical information.<sup>58</sup>

As a threshold matter, Reg. Guide 1.165 does not apply to the MOX Facility.<sup>59</sup> The reference to Reg. Guide 1.165 is in an Appendix to the MOX Facility Standard Review Plan (“MOX SRP”).<sup>60</sup> The MOX SRP lists guidance for nuclear power reactors—such as Reg. Guide 1.165—which “provide useful reference information” since “no regulatory guides in Division 3, Fuels and Materials Facilities, address natural phenomena events.”<sup>61</sup> Mention of a

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<sup>56</sup> GANE Opposition at 9-10.

<sup>57</sup> Reg. Guide 1.165 at 1.165-5 (emphasis added).

<sup>58</sup> *Id.* at Appendix E, at 1.165-38 (emphasis added).

<sup>59</sup> Stepp Supplemental Affidavit ¶ 21.

<sup>60</sup> *Standard Review Plan for the Review of An Application for a Mixed Oxide Fuel Fabrication Facility* (NUREG-1718), Appendix B, at B-3.

<sup>61</sup> *Id.* at B-1.

Reg. Guide in an Appendix to an SRP does not translate into a requirement that DCS use that Reg. Guide, and neither the Reg. Guide nor the MOX SRP is legally binding.<sup>62</sup>

Also, even if Reg. Guide 1.165 applied to the MOX Facility, as quoted by GANE, it only states that it “may” be necessary to investigate and characterize potential seismic sources “that were previously unknown or uncharacterized.”<sup>63</sup> GANE has not identified any previously unknown or uncharacterized potential seismic sources. It is undisputed that the EPRI and LLNL PSHAs included expert evaluations of the East Tennessee and Charleston seismic sources, including both broad and narrow interpretations of those zones that characterize the uncertainty in the evaluations.<sup>64</sup> Thus, these source zones were known and characterized.

Regardless, Reg. Guide 1.165 does not require an applicant to re-compute the EPRI and LLNL PSHAs to take into account the information contained in the individual publications cited by GANE. The guidance states that “new information is considered not significant and no further evaluation is needed if it is consistent with the assumptions used in the PSHA.”<sup>65</sup> The guidance further states that “[i]t is expected that the new information will be within the range of interpretations in the existing data base, and the data will not result in an increase in overall seismicity rate or increase in the range of maximum earthquakes to be used in the

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<sup>62</sup> See *Private Fuel Storage L.L.C. (Independent Spent Fuel Storage Installation)*, CLI-01-22, 54 NRC 255, 264 (2001) (“NUREGs, such as the Standard Review Plan, like all guidance documents, are not legally binding regulations”). DCS referenced Reg. Guide 1.165 in its Motion for Summary Disposition solely for purposes of refuting GANE’s claims that the NRC does not allow the use of the EPRI and LLNL PSHAs for specific sites. DCS Motion at 26-27.

<sup>63</sup> Stepp Supplemental Affidavit ¶ 21.

<sup>64</sup> *Id.*

<sup>65</sup> Reg. Guide 1.165 at 1.165-39.

probabilistic analysis.’<sup>66</sup> The guidance then provides examples where new information falls within the range of interpretation and, therefore, no additional analysis is required.<sup>67</sup>

The information previously identified by GANE falls within the range of interpretations included in the EPRI and LLNL PSHAs, lacks a strong technical basis, and/or need not be considered further because it would not result in a significant increase in ground motion.<sup>68</sup> Accordingly, there is no additional analysis required under the terms of Reg. Guide 1.165. While GANE might wish for a new PSHA to quantitatively consider the specific information that Dr. Long believes is important, GANE fails to identify any NRC requirement that an applicant for a MOX Facility conduct such an inquiry. Nor is there any regulatory requirement for an applicant to expend the effort required to conduct an EPRI or LLNL-type PSHA to support construction authorization of a MOX Facility. DCS has demonstrated that the “new” information identified by GANE was either considered in the seismic design of the MOX Facility or, in the words of Reg. Guide 1.165, was not validated by a strong technical basis. Accordingly, there is no genuine issue of material fact, and the Board can grant summary disposition on this issue.

### **2.1 Floating magnitude 7+ earthquakes**

GANE does not dispute that “[t]he EPRI and LLNL studies included opinions that major earthquakes could occur practically anywhere along the eastern United States.’<sup>69</sup> Rather GANE states that “[t]he question is not whether these opinions were included, but what weight

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<sup>66</sup> *Id.* at 1.165-40.

<sup>67</sup> *Id.*

<sup>68</sup> Stepp Supplemental Affidavit ¶ 22.

<sup>69</sup> DCS Material Facts ¶ 14.

they were given.”<sup>20</sup> As stated above, there is no NRC requirement that DCS reanalyze the weights given, or re-compute the EPRI and LLNL PSHAs. Accordingly, this issue is appropriate for summary disposition.

## **2.2 Consideration of a 7.5 Magnitude Earthquake in the Eastern Tennessee Seismic Zone**

GANE does not dispute that “[t]he EPRI and LLNL PSHA studies did consider the possibility of a 7.5 earthquake in southeastern Tennessee.”<sup>21</sup> Rather, GANE states that “[t]he fact that a 7.5 earthquake in southeastern Tennessee was considered is neither here nor there. What is relevant is the magnitude of the earthquake’s contribution to the PSHA.”<sup>22</sup> As stated above, there is no NRC requirement that DCS make such an inquiry. Accordingly, this issue is appropriate for summary disposition.

## **2.3 “Additional” Epicenters for Charleston-Type Earthquakes**

GANE does not dispute that:

[t]he two scenarios raised by Talwani & Schaeffer were raised a decade earlier in a document explicitly referenced by both the seismic analysis for SRS relied upon by DCS, and by Talwani & Schaeffer. In 1990, NUREG/CR-5613 identified liquefaction features to the north and south of Charleston in the same locations as the Bluffton and Georgetown locations identified in Talwani & Schaeffer. The NUREG even includes explanations for the presence of the liquefaction features located to the north and south of Charleston, including that epicenters of earthquakes could have been outside of Charleston.<sup>23</sup>

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<sup>20</sup> GANE Disputed Facts ¶ 6.

<sup>21</sup> DCS Material Facts ¶ 22.

<sup>22</sup> GANE Disputed Facts ¶ 14.

<sup>23</sup> DCS Material Facts ¶ 28 (footnote omitted).

Rather, GANE states that “[w]hile these observations were *discussed* in the PSHA, they were not factored into the PSHA computation. The question remains as to the magnitude of their quantitative effect on the PSHA.”<sup>24</sup>

The important consideration is whether the PSHA evaluations of uncertainty account for the more recent data. In Dr. Long’s opinion, they do.<sup>25</sup> The areas of Bluffton and Georgetown were included within the range of uncertainty considered as part of the EPRI and LLNL PSHAs.<sup>26</sup> As stated above, there is no NRC requirement that DCS consider this information in any other fashion, and certainly not quantitatively as GANE suggests. Accordingly, this issue is appropriate for summary disposition.

#### 2.4 Shorter Recurrence Interval of Charleston-Type Earthquakes

GANE does not dispute that:

[t]he return interval proposed by Talwani & Schaeffer is not new information for DCS to consider. NUREG/CR-5613, referenced in, and published more than a decade before Talwani & Schaeffer, included the same return interval. NUREG/CR-5613 was included as a reference to the seismic analysis for SRS relied upon by DCS.<sup>27</sup>

Rather, GANE states “[t]his is correct as far as it goes, but the relevant question for purposes of Dr. Long’s analysis is whether the PSHA includes that information and in what proportion.”<sup>28</sup> Again, a 600-year recurrence interval was included within the range of uncertainty considered

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<sup>24</sup> GANE Disputed Facts ¶ 18.

<sup>25</sup> Stepp Supplemental Affidavit ¶ 22—24.

<sup>26</sup> *Id.* ¶ 24. See also Long Deposition Transcript at 15:19-22 (“the Lawrence Livermore studies pulled in a lot of information on proposed and hypothesized mechanisms with experts varying from a large earthquake can occur anyplace for any reason to very specific zones”); 81:18-19 (“[o]ne expert had the whole east coast in one big zone.”).

<sup>27</sup> DCS Material Facts ¶¶ 34, 35.

<sup>28</sup> GANE Disputed Facts ¶ 21.

as part of the LLNL and EPRI PSHAs.<sup>79</sup> As stated above, there is no NRC requirement that DCS consider this information in any other fashion. Accordingly, this issue is appropriate for summary disposition.

## 2.5 Increased Magnitude of Historical Earthquakes on the SCCP

While GANE disagrees with DCS's characterization of the *Hu et al*<sup>80</sup> conclusions regarding earthquake magnitude as "flawed," GANE agrees that *Hu et al* did not correct the soil strength data to account for aging.<sup>81</sup> GANE states that DCS's reliance on the Masters Thesis<sup>82</sup> signed by two of the authors of the *Hu et al* articles "is not the equivalent of a published academic paper."<sup>83</sup>

In a recent personal communication between Dr. Stepp and Professor Talwani—one of the authors of the *Hu et al* articles, and signatory on the Masters Thesis—Professor Talwani stated that he considers the Masters Thesis to be a high quality product worthy of publication in a professional journal, and that two draft manuscripts describing different aspects of the thesis have been prepared and are in review for submittal to professional journals.<sup>84</sup> Professor Talwani also agreed that the estimates of earthquakes magnitudes which caused the liquefaction features are more reliable as presented in the Masters Thesis, than the estimates

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<sup>79</sup> Stepp Supplemental Affidavit ¶ 25.

<sup>80</sup> Ke Hu, Sarah L. Gassman, and Pradeep Talwani, *In-situ Properties of Soils at Paleoliquefaction Sites in the South Carolina Coastal Plain*, *Seismological Research Letters*, v. 73, No. 6, 964-978 (2002); Ke Hu, Sarah L. Gassman, and Pradeep Talwani, *Magnitudes of Prehistoric Earthquakes in the South Carolina Coastal Plain from Geotechnical Data*, *Seismological Research Letters*, v. 73, No. 6, 979-991 (2002)

<sup>81</sup> DCS Material Facts ¶ 39; GANE Disputed Facts ¶ 25 ("the assumptions in Hu et al. are properly stated and the conclusions based on those assumptions should not be affected").

<sup>82</sup> Leon, E, *Effect of Aging of Sediments on Paleoliquefaction Evaluation In the South Carolina Coastal Plain*, Dept. of Civil and Env't'l Engineering, U. of S.C. (2003).

<sup>83</sup> GANE Disputed Facts ¶ 26.

based on generalized empirical relationships which do not include correction for site-specific aging effects. In other words, even Dr. Talwani believes that the Masters Thesis data are more accurate than the data presented in *Hu et al.*

Even assuming GANE is correct for argument's sake, the conclusions of the soon-to-be published Masters Thesis raise the question of whether the *Hu et al* articles are validated by a strong technical basis such that they would need to be considered further.<sup>85</sup> The conclusions also highlight one reason individual papers do not trigger a reanalysis of a PSHA; it would be a waste of time and resources to re-evaluate PSHAs based on the conclusions of a paper that within a year or two of publication are shown to be unreliable. As stated above, there is no NRC requirement that DCS consider this information in any other fashion.

Accordingly, this issue is appropriate for summary disposition.

## **2.6 Consideration of New Ground Motion Attenuation Models**

GANE also argues that the MOX Facility seismic hazard would increase if new ground motion attenuation models were considered.<sup>86</sup> GANE relies solely on the opinion of Dr. Long, who provides no analysis of data to support his assertion.<sup>87</sup>

In its Motion, however, DCS relied on the opinion of Dr. Stepp that the uncertainty in ground motion attenuation models used in the LLNL and EPRI PSHAs envelopes the Atkinson and Boore (1995) model touted by Dr. Long as being more accurate.<sup>88</sup> Dr. Stepp has confirmed that any consideration of that model would not materially affect the MOX Facility

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<sup>84</sup> Stepp Supplemental Affidavit ¶¶ 27-30.

<sup>85</sup> *Id.* ¶ 26.

<sup>86</sup> GANE Disputed Facts ¶ 30.

<sup>87</sup> See Long Declaration ¶ 69.

<sup>88</sup> DCS Motion at 46; Stepp Affidavit ¶ 71.

seismic design, and he did so based on actual analysis that compared the Atkinson and Boore model to the models used in the EPRI and LLNL PSHAs. He concluded that:

The LLNL and EPRI ground motion attenuation models encompass a large range of uncertainty, and the Atkinson and Boore (1995) model favored by Dr. Long falls within the ranges of uncertainty in the EPRI and LLNL models. Specifically, for a moment magnitude 7.0 earthquake at a distance of 100 kms, Atkinson and Boore (1995) produces accelerations of 66.5 and 148.1 cm/sec<sup>2</sup> at 2.5 and 10 Hz spectral frequencies, respectively. These accelerations fall between the 15th and 50th fractile of uncertainty of the composite LLNL model. For the EPRI model, Atkinson and Boore (1995) produces accelerations that are: slightly higher than those obtained using Boore and Atkinson (1987), and lower than those obtained using the Nuttli (1988) and McGuire, et al. (1988) curves for 2.5 Hz; and are essentially the same as the McGuire, et al. (1988) curves for 10 Hz.<sup>82</sup>

Neither GANE nor Dr. Long comment or dispute this analysis. Rather, Dr. Long identifies a paper—from 1977—which he somehow suggests is “new information” that would be more appropriate to use than the EPRI and LLNL PSHA studies.<sup>20</sup> A paper from 1977, however, is not new information. Neither GANE nor Dr. Long raise any material disputes with respect to any new ground motion attenuation models that might need to be considered. Accordingly, this issue can be summarily dismissed.

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<sup>82</sup> Stepp Affidavit ¶ 71 (DCS Motion, Attachment C).

<sup>20</sup> *Id.* ¶ 9(c)(vi), n.6 (citing Jones, F. B., L. T. Long, and J. H. McKee, *Study of the attenuation and azimuthal dependence of seismic wave propagation in the south eastern United States*, Bull. Seismol. Soc. Amer., 67, 1503-1513 (1977)).

**D. USGS Hazard Maps**

Dr. Long has stated that he disagrees with using USGS maps for a specific site.<sup>21</sup> Accordingly, by its expert's own admission, GANE's use of the USGS Seismic Hazard Maps here has no value, and does not raise a genuine issue of material fact.

Even if Dr. Long were to alter his position, the EPRI and LLNL PSHAs were appropriately relied upon by DCS, as discussed above. In addition, although the PGA for the MOX Facility is defined by the Reg. Guide 1.60 response spectrum scaled to 0.2 g at 33 Hz, the ground acceleration for the frequencies of practical structural interest—from 2.5 to 9 Hz—are significantly higher than 0.2 g.<sup>22</sup> Specifically, Attachment E to DCS's Motion shows that the MOX Spectrum envelopes 0.5 g for 9 Hz and 0.6 g for 2.5 Hz. This conservatism is inherent in the Reg. Guide 1.60 spectral shape used as the horizontal surface spectrum for the MOX Facility.<sup>23</sup> Dr. Long provides no analysis to show that this conservatism is not appropriate.

**E. Dr. Carl Stepp's Outstanding Qualifications and Credibility are Without Doubt**

Both GANE and Dr. Long make personal attacks on the credibility of Dr. Stepp. It is understandable that Dr. Long would not be aware of Dr. Stepp's achievements since they move in different professional circles. However, these attacks are without foundation, incorrect, and egregiously irresponsible. In his Supplemental Affidavit, Dr. Stepp provides further information regarding his qualifications.<sup>24</sup> GANE's ill-advised attacks on Dr. Stepp's

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<sup>21</sup> Long Deposition Transcript at 35:19-20 ("I disagree with using their maps for a specific site").

<sup>22</sup> Stepp Supplemental Affidavit ¶ 13.

<sup>23</sup> *Id.* ¶ 14.

<sup>24</sup> Stepp Supplemental Affidavit ¶¶ 3—8. DCS also notes that Dr. Stamatakos also believes that Dr. Stepp is "well-qualified to state opinions on GANE's contention 3, as he has extensive

qualifications are both wrong and offensive. Dr. Stepp is one of the country's foremost authorities on PSHA methodology and the application of PSHAs to NRC-licensed facilities. His outstanding qualifications and long-standing credibility on the issues presented here are simply without doubt.

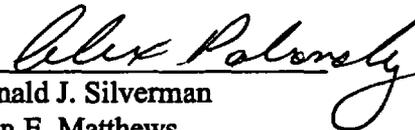
## VI. CONCLUSION

The seismic design of the MOX Facility complies with the regulations in 10 CFR Part 70 which govern the consideration of earthquake hazards in the design of the MOX Facility. Contention 3 is therefore meritless. Because Contention 3 fails to present any genuine issues of material fact, the Board should grant summary disposition.

Dated: October 8, 2003

Respectfully submitted,

DUKE COGEMA STONE & WEBSTER



Donald J. Silverman

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Washington, DC 20004

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experience in seismic hazard analyses, seismic design, and seismic regulations, especially those applicable to nuclear facilities." Stamatakos Affidavit ¶ 4.

**UNITED STATES OF AMERICA**  
**NUCLEAR REGULATORY COMMISSION**  
**ATOMIC SAFETY AND LICENSING BOARD**

**Before Administrative Judges:**  
**Thomas S. Moore, Chairman**  
**Charles N. Kelber**  
**Peter S. Lam**

In the Matter of )		
DUKE COGEMA STONE & WEBSTER )		October 6, 2003
(Savannah River Mixed Oxide Fuel )		
Fabrication Facility) )		Docket No. 070-03098-ML
		ASLBP No. 01-790-01-ML

**SUPPLEMENTAL AFFIDAVIT OF DR. CARL STEPP**

City of Blanco )  
                  )  
State of Texas )

Dr. Carl Stepp, being duly sworn, states as follows:

**INTRODUCTION**

1. This Affidavit is submitted in support of DCS's Response to GANE's Opposition to DCS's Motion for Summary Disposition on Contention 3. This Affidavit supplements my Affidavit of August 6, 2003 which was submitted as Attachment C to DCS's Motion for Summary Disposition on Contention 3, dated August 22, 2003.
2. The purpose of this Affidavit is to address GANE's allegations and Dr. Long's opinions included in GANE's Opposition filed on September 16, 2003.

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Experience

3. I usually would not discuss my qualifications in a supplemental affidavit when I previously provided those qualifications in an initial affidavit. However, both GANE and Dr. Long believe that I have overstated my expertise in the area of geophysics, and that I do not have “sufficient knowledge or experience of the current computational issues involved in seismic hazard analysis to make a credible evaluation of DCS’s seismic hazards analysis or credible criticisms of [Dr. Long’s] views.” Such statements lack foundation. They also are incorrect and egregiously irresponsible.
4. GANE and Dr. Long do not know of, or lack the appreciation of, the contributions I have made to the development and application of probabilistic hazard methodology, ground motion attenuation development, site response methodology development, and the development of integrated application technologies for seismic regulation decision making. I, in fact, pioneered the implementation of projects that integrate the knowledge of the broad range of relevant discipline expertise to develop integrated technologies for application to complex safety decision-making. The approach which I developed has now become widely accepted and is being used both in the private sector and by consortia of universities working together.
5. Appreciation of my contributions are reflected in the fact that I have served on the Research Advisory Board of the National Earthquake Engineering Research Center, served as Chairman of the Board of Directors for the Mid America Earthquake Center (Georgia Tech, where Dr. Long is employed, is a member of

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this consortium), and currently serve on the Board of Directors of the newly formed Network for Earthquake Engineering Simulation, which has as members all of the universities in the United States that have significant earthquake engineering testing programs.

6. I have served two terms on the Board of Directors and as President of the Earthquake Engineering Research Institute ("EERI"). During my tenure on the EERI Board I lead the initiation of the professional journal EARTHQUAKE SPECTRA, which is now one of the leading professional journals for earthquake engineering in the world, and I served a term on its editorial board. I and my co-authors were recognized by the Editorial Board of EARTHQUAKE SPECTRA with the outstanding paper award for 2001 for our paper on the probabilistic seismic hazard assessment of the proposed high-level nuclear waste repository site at Yucca Mountain, Nevada.
7. My resume was attached to my August 6, 2003 Affidavit. As my resume indicates, I am a technical leader; not a manager. (In any event, participation as a manager in such capacities would also demonstrate expertise.)
8. It is understandable that Dr. Long would not be aware of my achievements since we move in different professional circles. He has focused on his research and the education of students – a worthy career. Nevertheless, his attack on my qualifications is simply without foundation.

**EXPERT OPINION**

9. As I discussed in ¶ 25 of my August 6, 2003 Affidavit, "Moho Bounce" is a phenomenon where seismic waves are reflected off of the boundary between the

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Earth's crust and mantle—called the Mohorovicic (or "Moho") discontinuity. The discontinuity is a fundamental boundary in the Earth that is identified by significant density and seismic wave velocity contrasts. It is geographically continuous with significant variation in depth. "Moho Bounce" is a common term applied to seismic wave energy reflected from this discontinuity arriving at the Earth's surface. This reflected energy results in a flattening of the decay of seismic energy. This discontinuity is located about 29 kms beneath the ground surface along the path between Charleston and the MOX Facility site. The effect is that estimated amplitudes of seismic waves in the distance range of between about 80 and about 120 kms, when the Moho is around 29 kms below the ground surface, would be higher than would be estimated by an assumed uniform decay of energy with distance. Because the depth to the Moho varies geographically, for any specific site the effect varies with distance from an earthquake source, with azimuth from the site to the source, and with the depth of the earthquake. Moho Bounce is a general consequence of seismic wave propagation in the Earth's crust, and it is both travel path specific and significantly variable. However, for the purpose of modeling seismic wave propagation in the crust along the path from Charleston to the MOX Facility site, Moho Bounce is important for earthquakes that have epicenters located along this path between about 80 and about 120 kms from the MOX Facility, and its effect is variable depending on the depth of the earthquake.

10. Since Moho Bounce is not significant for seismic waves traveling along the path from Charleston to the MOX Facility at distances greater than about 120 kms,

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placing an earthquake epicenter greater than 120 kms from the MOX Facility would not produce more conservative ground motions at the MOX Facility than one placed at 120 kms. Finally, for the historical check, a distance less than 120 kms is not appropriate because 120 kms was the distance for the 1886 Charleston that is the closest point to the MOX Facility site that coincides with the highest Modified Mercali Intensity damage, or mesoseismal zone. I previously discussed this issue in ¶ 30 of my August 6, 2003 Affidavit.

11. Dr. Long has suggested that the evaluation of the historical check that DCS relies upon is in error; a suggestion he has neither verified nor quantified. He then suggests that the impact of these hypothesized errors might increase the ground motions by 10% to 50%. The figure included as Attachment F to DCS's Motion for Summary Disposition demonstrates that even if Dr. Long is correct in his assertion, and assuming the largest impact that he postulates, the estimated largest historical ground motions are still enveloped by the seismic design basis spectrum for all frequencies of structural interest (namely, 2.5 to 9 Hz).
12. In ¶ 9(c) of his Declaration, Dr. Long states that the historical check was "used by DCS to check the validity . . . of the PSHA." Dr. Long appears to misinterpret the purpose of the historical check relied upon by DCS. Such a check is not and could not be a check of the validity of the Electric Power Research Institute ("EPRI") and Lawrence Livermore National Laboratory ("LLNL") probabilistic seismic hazard assessments ("PSHAs"). Rather, it was relied upon by DCS to provide a layman level demonstration that ground motions considering the largest historic documented earthquake for the MOX Facility site vicinity are enveloped

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by the MOX Spectrum, namely the Reg. Guide 1.60 spectrum scaled to 0.2 g at 33 Hz.

13. Dr. Long also appears to not appreciate the robustness of the Reg. Guide 1.60 spectrum that is used by DCS as the horizontal ground surface spectrum for the seismic design basis for the MOX Facility. Although the effective peak ground acceleration ("PGA")<sup>1</sup> for the MOX Facility is defined by the Reg. Guide 1.60 response spectrum scaled to 0.2 g at 33 Hz, the ground acceleration for the frequencies of practical structural interest—from 2.5 to 9 Hz—are significantly higher than 0.2 g. Specifically, the figure included as Attachment E to DCS's Motion for Summary Disposition shows that the MOX Spectrum envelopes 0.5 g for 9 Hz and 0.6 g for 2.5 Hz.
14. This conservatism exists regardless of whether the EPRI and LLNL PSHAs are appropriate for DCS to rely upon because the shape of the Reg. Guide 1.60 spectrum does not rely upon the EPRI or LLNL PSHAs. As a reference point, the Vogtle Electric Generating Plant located across the Georgia border from the MOX Facility site also has its Reg. Guide 1.60 spectral shape scaled to an effective 0.2 g PGA at 33 Hz.
15. The dates cited by Dr. Long for the EPRI and LLNL PSHAs are off by about ten years. These studies were published in the late 1980s and early 1990s, not in the

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<sup>1</sup> PGA is a misleading term in the context of an appropriate value of acceleration for scaling the Reg. Guide 1.60 spectrum since it is usually neither the greatest ground acceleration nor significant for frequencies of structural interest. In this context the term effective PGA, referring to the proper acceleration value for scaling the Reg. Guide spectrum, is appropriate.

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late 1970s and early 1980s as GANE states. To confirm this statement, all one needs to do is look at the published reports that documented these studies.

16. I was the technical leader of the EPRI PSHA work, and lead developer of its overall methodology. In that position, I know first hand that the EPRI PSHA outputs were expected to be used for specific sites.
17. GANE states that “if the EPRI and LLNL studies were to be conducted over again [today], expert opinion would be likely to shift, resulting in greater quantitative emphasis on [various] factors.” Since new articles related to seismology are published regularly, shifting expert interpretations likely could be found in the year immediately after the EPRI and LLNL PSHA studies were published. In fact, EPRI and LLNL anticipated this would occur and designed the studies to include uncertainty (due to incomplete knowledge of earthquake causes and available data) in order to accommodate evolving knowledge and data.
18. Fundamental to the understanding of how a PSHA should be performed and used is the fact that estimating annual non-exceedance frequencies of ground motions at a site can only be attained with some uncertainty. A fundamental object of the EPRI and LLNL PSHA studies was to obtain a robust quantification of this uncertainty for sites of nuclear plants in the central and eastern United States. Despite the time that has passed since the LLNL and EPRI studies were completed, there remain gaps in our understanding of the mechanisms that cause earthquakes and in the ground motion propagation characteristics of the Earth. The data and information that exist at any particular time can be, and indeed are, legitimately interpreted differently by different experts, and these differences

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result in uncertainties that are properly captured and expressed in the final quantitative results from a PSHA. The EPRI PSHA evaluations incorporated uncertainty due to limitations of existing data and knowledge in order to obtain PSHA results that would provide a stable basis for nuclear facility seismic design and seismic safety assessment well into the future.

19. When the EPRI and LLNL studies were conducted, an explicit effort was made to capture legitimate interpretations of all PSHA input parameters including seismic sources, earthquake recurrence, maximum earthquake magnitude potential, and ground motion attenuation characteristics and to provide robust assessments of uncertainty in these interpretations. The result of these substantial efforts was a robust set of PSHA results—results that were expected to stand up to the test of time, to new data, information, models, and interpretations.
20. Explicit reevaluations were only expected when and if new data or models suggested a major departure in the PSHA results. It was thought that such departures might only be “expected” approximately every ten years. It is critically important that the details of how EPRI and LLNL captured uncertainty be fully understood when judging whether new data or models represent a major departure. Both the EPRI and LLNL studies capture a wide range of interpretations of all PSHA input parameters, as reflected in their wide range of uncertainty estimates. Because of these factors, the EPRI and LLNL PSHAs have proven to be adequately robust so that general reevaluations have been unnecessary.

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21. Reg. Guide 1.165 does not require DCS to re-compute a PSHA. Even if Reg. Guide 1.165 applied to the MOX Facility, it only states that it “may” be necessary to investigate and characterize potential seismic sources “that were previously unknown or uncharacterized.” GANE has not identified any previously unknown or uncharacterized potential seismic sources. It is undisputed that the EPRI and LLNL PSHAs included expert evaluations of the East Tennessee and Charleston seismic sources, including both broad and narrow interpretations of those zones that characterize the uncertainty in the evaluations. Thus, these source zones were known and characterized.
22. In my professional judgment, the information identified by GANE falls within the range of uncertainty interpretations included in the EPRI and LLNL PSHAs, lacks a strong technical basis, and/or need not be considered further because it would not result in a significant increase in ground motion hazard. Accordingly, Reg. Guide 1.165 would not require DCS to perform additional analysis even if that guidance applied to DCS.
23. GANE states that while Bluffton and Georgetown “were *discussed* in the PSHA, they were not factored into the PSHA computation. The question remains as to the magnitude of their quantitative effect on the PSHA.”<sup>2</sup>
24. In my opinion, the important consideration is whether the PSHA evaluations of uncertainty account for the more recent data. I believe they do. The areas of Bluffton and Georgetown were included within the range of uncertainty in interpretations of the Charleston seismic source included as part of the EPRI and

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<sup>2</sup> GANE Disputed Facts ¶ 18.

Supplemental Affidavit of Dr. Carl Stepp

LLNL PSHAs. For example, a review of the expert elicitations for the Charleston seismic source zone shows that LLNL and EPRI experts included diverse interpretations of this source in their uncertainty assessments and that these interpretations and uncertainty assessments included the areas of Bluffton and Georgetown.

25. In my opinion, a 600 year recurrence interval for large earthquakes in the Charleston seismic sources was also included within the range of uncertainty included in the LLNL and EPRI PSHAs. Uncertainty in recurrence of largest earthquakes quantified in these PSHAs involves complex interrelationships among uncertainties in seismic source interpretations, uncertainties in earthquake recurrence rates within seismic sources, uncertainties in the interpretations of the largest earthquakes, and uncertainties in earthquake recurrence models.
26. GANE states that a Masters Thesis relied upon by DCS and signed by the some of the authors of the *Hu et al* articles<sup>3</sup> “is not the equivalent of a published academic paper.” While I agree with this statement, the conclusions of the Masters Thesis—Leon, E, *Effect of Aging of Sediments on Paleoliquefaction Evaluation In the South Carolina Coastal Plain*, Dept. of Civil and Env’tl Engineering, U. of S.C. (2003)—raise the question of whether estimates of paleoearthquake magnitudes inferred from observed liquefaction features contained in the *Hu et al* articles remain validated by an adequately strong technical basis.

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<sup>3</sup> Ke Hu, Sarah L. Gassman, and Pradeep Talwani, *In-situ Properties of Soils at Paleoliquefaction Sites in the South Carolina Coastal Plain*, Seismological Research Letters, v. 73, No. 6. 964-978 (2002); Ke Hu, Sarah L. Gassman, and Pradeep Talwani, *Magnitudes of Prehistoric Earthquakes in the South Carolina Coastal Plain from Geotechnical Data*, Seismological Research Letters, v. 73, No. 6, 979-991 (2002)

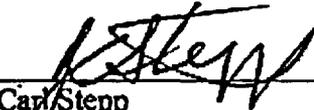
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27. In any event, in response to Dr. Long's statements, on October 1, 2003, I personally contacted Dr. Pradeep Talwani, one of the authors of the *Hu et al* articles, and signatory on the Leon Masters Thesis. Professor Talwani stated that he considers the Leon Masters Thesis to be a high quality product worthy of publication in a professional journal. Two draft manuscripts describing different aspects of the thesis work and results have been prepared and are in review by the authors in preparation for submittal to professional journals.
28. Professor Talwani considers the method of determining the resistance of materials to liquefaction based on local in-situ testing to be an important advance which when corrected for the effects of aging of the materials, as was done in the Leon Masters Thesis study, results in more reliable estimates of the level of ground acceleration that caused the liquefaction.
29. He further considers that estimation of the magnitudes of earthquakes that caused the liquefaction features using in-situ testing results corrected for the effects of aging to be more reliable than estimates based on in-situ properties uncorrected for the effects of aging. Estimation of magnitudes of the causative earthquakes based on local in-situ testing of liquefaction resistance and correction of the resistance for the effects of aging of the materials is clearly an important advance.
30. Professor Talwani accordingly agrees that Leon's estimates of the magnitudes of earthquakes which caused the liquefaction features that have been observed in the South Carolina Coastal area are more reliable than the estimates based on

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generalized empirical relationships between earthquake magnitude and maximum distance to observed liquefaction, which do not include correction for site-specific aging effects.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

  
\_\_\_\_\_  
Dr. Carl Stepp  
871 Chimney Valley Road  
Blanco, TX 87606-4643

Subscribed and sworn before me this 6 day of October, 2003.



  
\_\_\_\_\_  
Notary Public

My Commission Expires: 6-18-07

**Attachment B**

**Comparison of Disputed Material Facts**

**(in support of DCS Reply to GANE Opposition to Summary Disposition on Contention 3)**

<b>Material Fact ¶</b>	<b>DCS Material Fact (verbatim from DCS August 22, 2003 Motion Attachment B)</b>	<b>GANE's Position (from GANE's Statement Of Genuinely Disputed Material Facts)</b>	<b>DCS Response/Relevance</b>
1 & 2	<p>¶1—10CFR § 70.64(a)(2) requires that DCS include in the seismic design of the MOX Facility, consideration of the most severe documented historical earthquake for the MOX Facility site.</p> <p>¶2—The 1886 Charleston earthquake is the most severe historical documented earthquake for the MOX Facility.</p>	Not addressed by GANE in its Disputed Facts.	Admitted.
3	A 7.3 moment magnitude earthquake with an epicenter located 120 km southeast of the MOX Facility site is appropriate or conservative for modeling the historic 1886 Charleston earthquake ground motions.	“It is not necessarily conservative to put the MOX Facility 120 km from the Charleston earthquake, because effects like the Moho bounce increase shaking with increased distance.” GANE Disputed Facts ¶ 1.	Dr. Long admitted two times during his deposition that 120 kms was “realistic.” Long Deposition Transcript at 190:1-6; 190:13-14. “Realistic” is synonymous with “appropriate.” GANE also admits that “Moho Bounce is only important for earthquakes which have epicenters located between about 80 and 120 kms from the MOX Facility.” See Material Fact ¶ 44 (below). Dr. Long also admitted during his deposition that Moho Bounce would have its “maximum effect” at 100 kms which is consistent with his Declaration. Long Deposition Transcript at 220:13-14.

Material Fact ¶	DCS Material Fact (verbatim from DCS August 22, 2003 Motion Attachment B)	GANE's Position (from GANE's Statement Of Genuinely Disputed Material Facts)	DCS Response/Relevance
4—8	<p>¶4—DCS relied on seismic studies performed for the Savannah River Site (“SRS”) which used the median ground motions associated with the 1886 Charleston earthquake with a 7.3 moment magnitude and an epicenter located 120 km southeast of the MOX Facility site as an historical check against the PC-3 spectrum.</p> <p>¶5— The horizontal ground surface spectrum for the MOX Facility (“MOX Spectrum”) is a Reg. Guide 1.60 spectrum anchored at 0.2 g peak ground acceleration (“PGA”).</p> <p>¶6— The MOX Spectrum is more conservative than the PC-3 spectrum because of the Reg. Guide 1.60 spectral shape and because the PC-3 spectrum is anchored at 0.16 g PGA.</p> <p>¶7— For the 1886 Charleston earthquake, DCS relied on a computation of ground motions at the site that used modifications to a crustal velocity model known as the Hermann Crustal Model.</p> <p>¶8— Dr. Long suggests that the use of the Hermann Crustal Model may produce erroneous ground motions at the MOX Facility from the 1886 Charleston earthquake with an error rate of as much as 50%.</p>	Not addressed by GANE in its Disputed Facts.	Admitted.
9	Even if one increases by 50% the 1886 Charleston earthquake ground motions used in the historical check of the PC-3 spectrum relied upon by DCS, the MOX Spectrum still envelopes these dramatically increased ground motions for all frequencies of practical structural interest for the MOX Facility (between 2.5 and 9 Hertz).	“In Statement 9, DCS asserts that a 50% error is encompassed by the MOX Spectrum. In order to provide a reasonably reliable PSHA, DCS needs to do the work of re-calculating the seismic hazard, using current and site-specific information. It is not appropriate to guess that DCS has erred by about 50% and then add a so-called conservatism to correct it.” GANE Disputed Facts ¶ 2.	Since GANE does not challenge the DCS calculation, the statement is deemed admitted.
10	GANE has not identified an alternative model to the Hermann Crustal Model.	“This is incorrect. Long Declaration, par. 58.” GANE Disputed Facts ¶ 3. In paragraph 58, Dr. Long states “[a]t page 428 of my deposition transcript, I have	Dr. Long outlines a methodology, not a published model. In any event, there is no NRC requirement for a

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		outlined a methodology that DCS should follow to assess the effect of the Moho Bounce."	MOX Facility applicant to use such a methodology.
11	The Electric Power Research Institute ("EPRI") and Lawrence Livermore National Laboratory ("LLNL") probabilistic seismic hazard assessment ("PSHA") studies are appropriate for site-specific use.	"EPRI and LLNL studies are not appropriate for site-specific use, because the expert opinion contributions to these analyses are seriously out of date and because regionally responsive attenuation relations were not used in these studies." GANE Disputed Facts ¶ 4.	Mis-cites date of publication of EPRI and LLNL PSHAs by a decade, contradicts plain language of Reg. Guide 1.165, and are based on bare assertions.
12	NRC Regulatory Guide 1.165 explicitly permits the use of the EPRI and LLNL PSHA studies.	"To some degree, this is a legal question rather than a factual question. Nevertheless, on a factual level, DCS's assertion is contradicted by the following facts: (a) The authors of the Regulatory Guide contemplated that the LLNL and EPRI studies would be updated every ten years. This has not been done, thus making site-specific updates all the more important. (b) During the past 20 years, there have been significant developments in the collection of data and refinement of theories about the seismicity of the southeastern United States, which warrant updating of the LLNL and EPRI results in this case. (c) Regardless of what the Regulatory Guide allows or prescribes, it would be professionally irresponsible to rely on a twenty-year old study of seismicity in the South Carolina coastal region, without examining whether it should be updated to account for new information and data regarding local seismicity." GANE Disputed Facts ¶ 5.	Legal question. To the extent it is factual, GANE's arguments are not valid because they assume the EPRI and LLNL PSHAs are twenty years old, and are based on bare assertions.
13	GANE contends that the EPRI and LLNL studies did not adequately consider a theory contained in a paper authored by Kafka in 2002 which GANE characterizes as suggesting that there is a 30% chance that a magnitude 7+ earthquake could occur virtually anywhere in South Carolina	Not addressed by GANE in its Disputed Facts.	Admitted.

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14	The EPRI and LLNL studies included opinions that major earthquakes could occur practically anywhere along the eastern United States.	The question is not whether EPRI and LLNL studies included opinions that major earthquakes could occur practically anywhere along the eastern United States, but what weight they were given. GANE Disputed Facts ¶ 6.	Not challenged as incorrect, therefore, admitted. Re-weighting is not required and, therefore, GANE's assertion is incorrect as a matter of law.
15	As a statistical paper, Kafka purposefully ignored all known geologic/liquefaction data associated with the South Carolina Coastal Plain.	DCS's statement is "correct, but irrelevant." GANE Disputed Facts ¶ 7.	Admitted.
16	The data set used by Kafka did not include any earthquakes before 1924, so it necessarily excluded the 1886 Charleston earthquake and all the paleoearthquakes associated with the Charleston Seismic Zone.	"[O]bservation is irrelevant." GANE Disputed Facts ¶ 8.	Not challenged as incorrect, therefore, admitted.
17	Kafka's data set for the Southeastern United States appears to include no earthquakes greater than magnitude 4.8, and only three between magnitude 4.3 and 4.8.	"Statement 17's observation . . . is trivial." GANE Disputed Facts ¶ 9.	Not challenged as incorrect, therefore, admitted.
18	Kafka's theory is not generally accepted in the scientific community.	GANE argues (1) Kafka presents an "observation" rather than a "theory," and (2) Kafka's work is based on a distribution of epicenters known for over 60 years. GANE Disputed Facts ¶ 10.	(1) Crux of statement not challenged as incorrect, therefore, admitted. (2) If the underlying distribution has been known for 60 years, then it is not "new information" and quantification of an observation does not change it into "new information."
19	Kafka himself states that his work is "still 'exploratory.'"	"Obviously, there is always more to be learned in the area of seismology. This does not undercut the value of the data that Kafka has collected." GANE Disputed Facts ¶ 11.	Not challenged as incorrect, therefore, admitted.
20	Dr. Long believes Kafka's theory is "a pioneer paper."	"Dr. Kafka's paper does not propound a theory, it reports data. Moreover, the fact that a paper is a pioneer work does not mean it is less credible or reliable than others." GANE Disputed Facts ¶ 12.	Crux of statement not challenged as incorrect, therefore, admitted.
21	Kafka's position is undermined by other articles GANE cites, namely Talwani & Schaeffer and Hu <i>et al.</i> Those	"Kafka's paper does not represent a "position" or a "theory," but his observations. Second, the other	Summary disposition is appropriate regardless of the dispute because this

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	papers discuss the paleoliquefaction features on the South Carolina Coastal Plain believed to be caused by earthquakes that occurred over the past 6,000 years. Those studies do not indicate that major earthquakes occur in new places.	studies referenced by DCS suggest a continuing history of seismicity at Charleston and the possibility that major (M>5.5) events occurred in two other locations. That data is entirely consistent with Kafka's observations." GANE Disputed Facts ¶ 13.	fact is no longer material.
22	The EPRI and LLNL PSHA studies did consider the possibility of a 7.5 earthquake in southeastern Tennessee.	"The fact that a 7.5 earthquake in southeastern Tennessee was considered is neither here nor there. What is relevant is the magnitude of the earthquake's contribution to the PSHA." GANE Disputed Facts ¶ 14.	Not challenged as incorrect, therefore, admitted.
23	Southeast Tennessee is an area of frequent earthquakes, but these earthquakes have had a magnitude no greater than about 5.	"This statement is incorrect. It should read that 'in recent history, the largest earthquakes have been about magnitude 5.'" GANE Disputed Facts ¶ 15.	Admitted as rephrased by GANE; GANE also admits that the EPRI and LLNL PSHA studies did consider the possibility of a 7.5 earthquake in southeastern Tennessee. See GANE Disputed Facts ¶ 14.
24	The generally accepted view in the scientific community is that the geophysical structure underlying the Eastern Tennessee Seismic Zone is very unlikely to support magnitude 7+ earthquakes.	"Every seismologist known to Dr. Long who has studied Southeastern Tennessee has expressed a concern over a possible major event in the Eastern Tennessee Seismic Zone." GANE Disputed Facts ¶ 16.	GANE admits that the EPRI and LLNL PSHA studies did consider the possibility of a 7.5 earthquake in southeastern Tennessee. See GANE Disputed Facts ¶ 14. This fact is therefore not material.
25	Talwani & Schaeffer conducted no new work on the SCCP for DCS to consider, as evidenced by the very first sentence of the Abstract to their article, that they merely "present a reanalysis of results of 15 years of paleoliquefaction investigations in the South Carolina Coastal Plain."	"While Talwani and Schaeffer obtained no new data, they did new work on the old data, and came to conclusions that were significant enough to warrant a new publication." GANE Disputed Facts ¶ 17.	Even if DCS accepted suggested edit by GANE, the location of Bluffton and Georgetown as potential epicenters of Charleston-type earthquakes had been considered in 1990 in NUREG/CR-5613, see GANE Disputed Facts ¶ 18, and were considered in the EPRI and LLNL PSHAs. Stepp Supplemental Affidavit ¶ 24.
26-27	¶26—Talwani & Schaeffer discuss two scenarios for	Not addressed by GANE in its Disputed Facts.	Admitted.

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	their reanalysis of existing paleoliquefaction data. One scenario places the epicenter of all earthquakes near Charleston. The other places the epicenters near Bluffton, S.C., Georgetown, S.C., and Charleston ¶27— Bluffton is located on the Atlantic Coast of South Carolina, but south of Charleston, near the Georgia/South Carolina border. Georgetown is also located along the Atlantic Coast, but north of Charleston.		
28	The two scenarios raised by Talwani & Schaeffer were raised a decade earlier in a document explicitly referenced by both the seismic analysis for SRS relied upon by DCS, and by Talwani & Schaeffer. In 1990, NUREG/CR-5613 identified liquefaction features to the north and south of Charleston in the same locations as the Bluffton and Georgetown locations identified in Talwani & Schaeffer. The NUREG even includes explanations for the presence of the liquefaction features located to the north and south of Charleston, including that epicenters of earthquakes could have been outside of Charleston.	"While these observations were <i>discussed</i> in the PSHA, they were not factored into the PSHA computation. The question remains as to the magnitude of their quantitative effect on the PSHA." GANE Disputed Facts ¶ 18.	Not challenged as incorrect, therefore, admitted.
29	Talwani & Schaeffer do not show seismic activity over a wider area than previously known.	Not addressed by GANE in its Disputed Facts.	Admitted.
30	GANE has not provided any analysis or data to show that consideration of the earthquake sequences identified in Talwani & Schaeffer would increase the ground motions of the design earthquake for the MOX Facility.	"The distances to Charleston and Bluffton from the site are in the range affected by the Moho bounce effect, which was not a component of the EPRI or LLNL studies. Inclusion of this effect in the PSHA for these earthquakes, rather than a distribution of ranges (the large seismic zone defined by some experts) could increase the PSHA." GANE Disputed Facts ¶ 19.	Bare assertion unsupported by analysis. Bluffton and Charleston are located greater than 120 kms from the MOX Facility site ( <i>see</i> Attachment D to DCS Aug. 22 Motion). Dr. Long admits that Moho Bounce would have its "maximum effect" at 100 kms (Long Deposition Transcript at 220:13-14), and GANE admits that "Moho Bounce is only important for earthquakes which have epicenters

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			located between about 80 and 120 kms from the MOX Facility." DCS Material Fact ¶ 44 (which is not addressed by GANE Disputed Facts and is, therefore, admitted).
31	GANE contends that the return interval for characteristic Charleston earthquakes along coastal South Carolina is much shorter than previously considered in the EPRI and LLNL studies. GANE claims that "One scenario [in Talwani & Schaeffer] calls for seven magnitude seven (or stronger) Charleston events in the last 6,000 years, with a recurrence interval of 600 years."	Not addressed by GANE in its Disputed Facts.	Admitted.
32	Seven earthquakes in the last 6,000 years can not have an average return interval of 600 years; 6,000 years divided by seven events yields an average of 857 years.	"Statement 32 is false." GANE Disputed Facts ¶ 20.	This fact is no longer material.
33	Talwani & Schaeffer place greater weight on the recurrence interval of the few <u>most recent</u> Charleston-type earthquakes, which is about 600 years.	Not addressed by GANE in its Disputed Facts.	Admitted.
34	The return interval proposed by Talwani & Schaeffer is not new information for DCS to consider. NUREG/CR-5613, referenced in, and published more than a decade before Talwani & Schaeffer, included the same return interval.	"[c]orrect as far as it goes." GANE Disputed Facts ¶ 21.	Admitted.
35	NUREG/CR-5613 was included as a reference to the seismic analysis for SRS relied upon by DCS.	Not addressed by GANE in its Disputed Facts.	Admitted.
36	New information regarding magnitude of earthquakes causing liquefaction on the South Carolina Coastal Plain does not support a 600 year return interval for magnitude 7 earthquakes, but rather for magnitude earthquakes ranging between 5.3 and 6.8.	"DCS relies for its position on a Master's thesis that has not gone through the full rigors of the publication review process. Moreover, the author notes the need for more work on the subject." GANE Disputed Facts ¶ 22.	Not challenged as incorrect, therefore, admitted. GANE challenges whether the Master's thesis is appropriate to be relied on rather than what the thesis says.
37	GANE has not provided any analysis or data to show that consideration of a shorter return interval for earthquakes along the coast of South Carolina ranging in magnitude	"It is obvious that if a shorter return period is used in a PSHA, the hazard will increase. Similarly, a reduction of the magnitude estimates would decrease	Bare assertion unsupported by analysis, especially for the magnitude earthquakes identified in

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	between 5.3 and 6.8 would increase the ground motions of the design earthquake for the MOX Facility.	the hazard, everything else being constant. However, the Leon thesis on which the revised magnitudes are based has yet to be published and was not complete." GANE Disputed Facts ¶ 23, 24.	the Leon Masters thesis.
38	Relying on two articles discussing recent study of paleoliquefaction data from the South Carolina Coastal Plain authored by Hu, Gassman, and Talwani ("Hu <i>et al.</i> 1 and 2") in 2002, GANE contends that magnitudes of historical earthquakes in the South Carolina Coastal Plain may have been much greater than previously considered by the EPRI and LLNL studies.	Not addressed by GANE in its Disputed Facts.	Admitted.
39	Hu <i>et al.</i> 1 is flawed because the authors did not correct the soil strength data to account for aging.	"Hu <i>et al.</i> have not published an erratum. In any event, the assumptions in Hu <i>et al.</i> are properly stated and the conclusions based on those assumptions should not be affected." GANE Disputed Facts ¶ 25.	GANE admits that the <i>Hu et al.</i> authors did not correct for aging.
40	By correcting for aging, the prehistoric earthquakes that occurred during the past 6,000 years and caused paleoliquefaction features in the South Carolina Coastal Plain have magnitudes ranging from 5.3 to 6.8.	"DCS's assertion is based on the Leon thesis, which is not the equivalent of a published academic paper." GANE Disputed Facts ¶ 26.	Not challenged as incorrect, therefore, admitted.
41	GANE contends that the LLNL and EPRI studies did not adequately consider recent attenuation models which more accurately model Moho Bounce.	Not addressed by GANE in its Disputed Facts.	Admitted.
42	The only attenuation model GANE identifies is Atkinson and Boore (1995).	"While it is true that Atkinson and Boore's model more accurately represents the local structure, the attenuation model is also documented in an article by Jones, Long, and McKee." GANE Disputed Facts ¶ 27.	GANE identifies an article from 1977, which predates both the EPRI and LLNL PSHAs and, therefore, is not "new information." DCS notes that GANE had not previously identified this article as one upon which its expert planned to rely.
43 & 44	¶43—GANE believes that the curve presented in the Atkinson and Boore (1995) ground motion model exhibits pronounced non-uniform decay to approximate the Moho Bounce.	Not addressed by GANE in its Disputed Facts.	Admitted.

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	¶44— Moho Bounce is only important for earthquakes which have epicenters located between about 80 and 120 kms from the MOX Facility.		
45	A PSHA—like the EPRI and LLNL studies—takes into account, with various weights, multiple earthquakes at multiple distances from a particular location. Many of these locations are <u>not</u> within the distance range where Moho bounce would occur. Moho bounce is not relevant for these potential earthquake locations.	“DCS correctly asserts that many earthquakes are located in places where the Moho bounce would not be relevant.” GANE Disputed Facts ¶ 28.	Admitted.
46	In any event, the LLNL and EPRI PSHAs envelope the Atkinson and Boore (1995) model such that consideration of that model would not materially affect the MOX Facility seismic design.	“This statement does not make sense. A PSHA and an attenuation model are not directly comparable.” GANE Disputed Facts ¶ 29.	Argues with phrasing, but does not argue that uncertainty in ground motion attenuation models used in the EPRI and LLNL PSHAs envelopes the model presented in Atkinson & Boore (1995) ( <i>see</i> specific calculations discussed in Stepp Affidavit ¶¶ 70, 71 (Attachment C to DCS's Aug. 22 Motion)).
47	GANE has not provided any analysis or data to show that consideration of Atkinson and Boore (1995) or any other model would increase the ground motions of the design earthquake for the MOX Facility.	“This argument is incorrect. If the major contribution to the PSHA is from the Charleston earthquake and from other possible large events at a distance where the reflection from the Moho can cause amplitudes that are anomalously high, then the integrated results will be higher than those where the events are distributed.” GANE Disputed Facts ¶ 30.	Bare assertions which are refuted by specific calculations that show that the uncertainty in ground motion attenuation models used in the EPRI and LLNL PSHAs envelopes the model presented in Atkinson & Boore (1995) ( <i>see</i> Stepp Affidavit ¶¶ 70, 71 (Attachment C to DCS's Aug. 22 Motion)).
48	GANE alleges that the June 2002 U.S. Geological Survey Seismic Hazard Maps show a return period for 0.2g at the MOX Facility site of about 2,500 years, while DCS states that the return period for 0.2g PGA at the MOX Facility is approximately 10,000 years.	“[T]he hazard reported by the USGS analysis is larger than that assigned to the MOX facility. The statistical relations used would differ only slightly (other than by the factor of 4 difference) between the USGS computation for 2500 years and the EPRI and	Not challenged as incorrect, therefore, admitted.

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		LLNL computations for 10,000 year return periods. The only possible difference would be introduced by the truncation of larger magnitude earthquakes by using the characteristic earthquake model. This would result in a slightly lower hazard for the same large time period." GANE Disputed Facts ¶ 31.	
49 & 50	<p>¶49—Unlike EPRI and LLNL, the USGS maps were not developed for nuclear facilities and are not intended for such use. The USGS hazard maps are not appropriate for facilities where an applicant is concerned about earthquakes with annual probabilities of exceedance of <math>1 \times 10^{-4}</math> or lower (<i>i.e.</i>, 10,000 years or longer). The USGS hazard maps depict probabilistic ground motions with 10%, 5%, and 2% probabilities of exceedance in 50 years, which corresponds to return periods of 500, 1,000 and 2,500 years.</p> <p>¶50—The USGS maps were developed specifically for use in conjunction with seismic design codes for ordinary new buildings—the International Building Code and the National Earthquake Hazard Reduction Program (“NEHRP”) Recommended Seismic Provisions—which have performance requirements that are significantly different from the performance requirements of nuclear facilities.</p>	“Whether or not these claims are true, it would have no bearing on whether the USGS maps are accurate or reliable. The purpose of a USGS hazards map has no effect on its content.” GANE Disputed Facts ¶ 32.	Not challenged as incorrect, therefore, admitted.
51 & 52	<p>¶51— The USGS hazard map ground motions are developed using site conditions assumptions characterized by USGS as “firm-rock.” Such conditions are intended to represent rock properties generally prevalent in the Western United States. The USGS modeled firm-rock site conditions with a shear-wave velocity of 760 m/sec.</p> <p>¶52— Firm-rock conditions do not exist beneath or in the vicinity of the MOX Facility site. Rather, “hard-rock”</p>	GANE Disputed Facts ¶ 33.	Not challenged as incorrect, therefore, admitted.

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	conditions exist beneath and in the vicinity of the MOX Facility site. The shear-wave velocity of hard-rock near the MOX Facility site has been measured at between 2,438 and 3,352 m/sec.		
53	Applying USGS firm-rock assumptions to a hard-rock site overestimates the ground motions at the MOX Facility site. This effectively causes a decrease in the return period for a given peak acceleration such as 0.2 g. This is consistent with GANE's observation that the June 2002 USGS seismic hazard maps suggest a 2,500 year return period for 0.2g PGA rather than a 10,000 year return period as identified in the CAR.	"This statement is not supported by Dr. Stepp's affidavit. In any event, the question raised by DCS's assertion is not a simple issue. Such conditions would be common for western data. However, the data for the eastern United States would come from sites of considerably higher velocity. Hence, Dr. Long would have to see how the data actually have figured into the computations of site amplitude. If the USGS used different relations for the East and West this could negate the difference in velocity." GANE Disputed Facts ¶ 33.	Irrelevant for a summary disposition because it was appropriate for DCS to rely on the EPRI and LLNL PSHAs.



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