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Lynch, Steven

From: Lynch, Steven *ML*
Sent: Monday, September 19, 2011 3:55 PM
To: Khanna, Meena
Subject: FW: Request from OPA to review North Anna Q&As
Attachments: VAQuake Talking Points_0919.docx; 9.19.1230pm_FAQs_VAQuake_srb.docx; Summary of Earthquake Information for the North Anna NPP (plain language).docx

The scope of the mission of the (Fukushima) External Communication Team is up for re-interpretation. It looks like we will be meeting with Louise and/or Joe tomorrow to discuss.

-Steve

R

From: Gibson, Lauren *ML*
Sent: Monday, September 19, 2011 3:40 PM
To: Markley, Michael
Cc: Giitter, Joseph; Lund, Louise; Lynch, Steven
Subject: Request from OPA to review North Anna Q&As

Mike,

As we discussed, we should meet tomorrow to consider how to handle this request related to North Anna in light of the existing database being centered on the Fukushima event.

Thank you,
Lauren

R

From: Stuckle, Elizabeth *OPA*
Sent: Monday, September 19, 2011 3:11 PM
To: Gibson, Lauren; Lynch, Steven
Subject: FW: Materials for your review

I understand Tilda is out of the office, so I am forwarding my e-mail to you.

From: Stuckle, Elizabeth *OPA*
Sent: Monday, September 19, 2011 3:09 PM
To: Liu, Tilda
Cc: Hayden, Elizabeth; Burnell, Scott
Subject: Materials for your review

Tilda – Would you please review the attached materials for use in a Virginia quake section on the public website? If at all possible, could we get your review by noon on Wednesday? Thank you.

Elizabeth M. Stuckle
OPA
301-415-2169
elizabeth.stuckle@nrc.gov

E
11 (3)

9.19.11 12:30 pm

release all
8/23

OPA

1/13/12

TALKING POINTS

AUG. 23, 2011 NORTH ANNA ALERT AND VIRGINIA EARTHQUAKE

- Due to seismic activity, North Anna declared an Unusual Event on Aug. 25 at 0118 EDT following a reported 4.5 magnitude aftershock at approximately 0107 EDT, epicenter approximately 5 miles south of Mineral, Va. Another minor quake was felt on Aug. 25 at 1149 EDT and the plant exited that Unusual Event later that week. North Anna declared a new Unusual Event on Sept. 1 for an aftershock at 0518 EDT, exiting the event shortly after noon that day. There were no personnel injuries or damage.
- On Aug. 29, the NRC dispatched an Augmented Inspection Team to the North Anna nuclear power station to further review the effects of last week's earthquake, the operators' response and the plant staff's activities to check equipment. The AIT will hold an exit meeting with the company upon completion of the inspection to discuss its preliminary findings. That meeting will be open to interested members of the public and the news media, and team members will be available to answer questions after the results are presented. The AIT will also issue a written report 30 days after the completion of the inspection.
- North Anna's design basis ground acceleration is 0.12g for rock and 0.18g for soil. NRC staff, using data from USGS instruments, have concluded the peak ground acceleration at the site was approximately 0.26g. Dominion's analysis of onsite instrumentation suggests the plant's shaking at higher frequencies exceeded the design limit. Data analysis continues and estimates could change.

- Continuing examination of the site indicates minimal earthquake damage, with all safety-related equipment performing appropriately (one emergency diesel developed a coolant leak an hour later and was replaced by another diesel generator). The NRC will ensure the plant is capable of continuing to operate safely before the agency would authorize restart of the reactors.
 - This would be the first instance of an operating reactor exceeding its design limit for ground acceleration. In 1986 the Perry plant in Ohio exceeded its design basis limit while under construction but was found acceptable for operation before its license was issued. In 1979 the Summer plant in South Carolina exceeded its operating basis earthquake (half of the design basis) while under construction but was found acceptable for operation before its license was issued.
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- The NRC continues its effort to have U.S. nuclear power plants better characterize seismic risk and their response to earthquakes. The NRC expects by the end of the year to issue new seismic models and require some individual plant analysis; the plants' responses would be available within one or two years, depending on the analysis used.

9/19 12:30 pm

VA Quake - Frequently asked Questions and Answers

Q. Has there been another reactor site that has exceeded its design limit for ground acceleration?

A. This would be the first instance of an operating reactor exceeding its design limit for ground acceleration. In 1986 the Perry plant in Ohio exceeded its design basis limit while under construction but was found acceptable for operation before its license was issued. In 1979 the Summer plant in South Carolina exceeded its operating basis earthquake (half of the design basis) while under construction but was found acceptable for operation before its license was issued.

Q. What is the NRC doing on seismic risk in response to recent earthquake events?

A. The NRC continues its effort to have U.S. nuclear power plants better characterize seismic risk and their response to earthquakes. The NRC expects by the end of the year to issue new seismic models and require some individual plant analysis; the plants' responses would be available within one or two years, depending on the analysis used.

Q. What time did North Anna report any aftershocks and new Unusual event?

A. Due to the seismic activity, North Anna declared an Unusual Event on Aug. 25 at 0118 EDT following a reported 4.5 magnitude aftershock at approximately 0107 EDT, epicenter approximately 5 miles south of Mineral, Va. Another minor quake was felt on Aug. 25 at 1149 EDT and the plant exited that Unusual Event later that week. North Anna declared a new Unusual Event on Sept. 1 for an aftershock at 0518 EDT, exiting the event shortly after noon that day. There were no personnel injuries or damage.

Q. What time did North Anna downgrade from ALERT to an NOUE?

A. North Anna downgraded its original ALERT to an Notification of Unusual Event (NOUE) at 11:16 a.m. on August 24, 2011. North Anna Unit 1 has commenced cooldown to cold shutdown. North Anna Unit 2 plans to initiate cooldown to cold shutdown upon Unit 1 reaching cold shutdown.

Q. What time did North Anna elevate to an Alert?

A. 14:55 Tuesday, Aug. 23.

Q. How long can the diesels operate?

A. Required to have 7 days of diesel fuel on site and to keep the diesels resupplied for at least 28 days.

Q. What level of earthquake is the North Anna plant built to? What did the instruments show?

A. North Anna's design basis ground acceleration 0.12g for rock and 0.18g for soil. NRC staff, using data from USGS instruments, have concluded the peak ground acceleration at the site was approximately 0.26g. Dominion's analysis of onsite instrumentation suggests the plant's shaking at higher frequencies exceeded the design limit. Data analysis continues and estimates could change.

A. See answer below 9 and 12

Q. When was the electrical power restored at North Anna?

A. The plant had electrical power at 17:40 on Tuesday, Aug. 23.

Q. Was there any damage at the plant?

A. The NRC is Continuing examination of the site indicates minimal earthquake damage, with all safety-related equipment performing appropriately (one emergency diesel developed a coolant leak an hour later and was replaced by another diesel generator). The NRC will ensure the plant is capable of continuing to operate safely before the agency would authorize restart of the reactors.

Q. When will North Anna nuclear plant restart?

A. The NRC will only allow North Anna to restart when Dominion proves to the agency's satisfaction that all of its systems and components can meet their functional requirements to protect public health and safety.

Q. Where to find out more about seismic issues for nuclear power plants?

A. NRC Factsheet

<http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-seismic-issues.html>

Q. What will happen if the ground acceleration exceeded the design basis safe shutdown for North Anna? What will NRC Do?

A. The NRC initially dispatched a seismic expert and another structural expert to assist the agency's resident inspectors on site. Further reviews indicated that additional inspection is warranted. The NRC inspection has now been officially classified as an AIT or Augmented Inspection Team.

On Aug. 29, the NRC dispatched the Augmented Inspection Team to the North Anna nuclear power station to further review the effects of last week's earthquake, the operators' response and the plant staff's activities to check equipment.

No significant damage to safety systems has been identified, but Dominion has reported to the NRC that initial reviews determined the plant may have exceeded the ground motion for which it was designed. This determination is in line with NRC's preliminary independent analyses, although data is still being collected and analyzed to determine the precise level of shaking that was experienced at key locations within the North Anna facility. The company and the NRC will continue to carefully evaluate information to determine if additional actions may be necessary. NRC regulations require that the station not start up

until it can demonstrate that no functional damage occurred to those features needed for continued safe operation.

An AIT is formed by the NRC to review more significant events or issues at NRC-licensed facilities. The AIT will include technical experts from NRC headquarters in Rockville, Md. as well as two additional inspectors from the regional office in Atlanta. The AIT will be led by NRC Region II Branch Chief Mark Franke and North Anna Senior Resident Inspector Greg Kolcum and will officially begin work at the North Anna station on Tuesday.

The AIT will **hold an exit meeting** with the company upon completion of the inspection to discuss its preliminary findings. That meeting will be open to interested members of the public and the news media, and team members will be available to answer questions after the results are presented. The AIT will also issue a **written report 30 days** after the completion of the inspection.

Q. Somewhere I read that government seismometers at nuclear reactors (run by NRC, USGS?) got taken down years ago for budget reasons. Is this true?

A. The NRC requires the plants to operate and maintain seismic monitors on site.

Q. Is there any way of verifying the ground-movement readings that nuclear reactors reported last month? Or does the NRC just record what they say?

A. Following any event at or near a nuclear plant the NRC has the option to verify the information provided by the licensee depending on the significance of the event. For example, the seismic information for North Anna will be reviewed by our Augmented Inspection Team which is now onsite.

Q. Exelon reported that ground acceleration at Peach Bottom was .011G during the earthquake. (The tolerance is .12G.) Can NRC confirm that?

A. The inspectors are continuing to follow-up on the licensee's seismic analysis at Peach Bottom.

Q. Why does the NRC's estimate of ground acceleration differ so much from Dominion's?

A. NRC estimate of peak ground acceleration is from USGS Shakecast at 0.26g. NRC also ran ground motion equations based on the earthquake magnitude 5.8 and distance 18 km which gave a peak ground acceleration value of about 0.2g. Both of these estimates are made for the "free-field" or away from structures at the ground surface. Dominion has seismic instrumentation in the nuclear power plant but not in the free-field. This may account for some of the differences as the nuclear structure will impact the input motion from the earthquake

Q. (Alternate version) Why is the NRC overestimating ground acceleration at North Anna?

A. See response to previous question.

Q. Why is Dominion offering an array of measurements?

A. The shaking from the M5.8 earthquake as it entered the nuclear power plant was strongly affected by the response of the structure, which varies considerably at different locations and elevations within the structure. North Anna has seismic instruments of various types at different locations throughout the plant. The readings from these instruments have been compared to the design level values for that particular location within the structure. Many of these comparisons show that the accelerations from the earthquake are higher than the original design values.

Q. Why isn't the NRC immediately forcing Dominion to reinforce North Anna to resist a quake that repeats the Aug. temblor?

A. The NRC initiated a Generic Issue back in 2005 to evaluate the latest seismic characterizations and models of earthquakes in the Central and Eastern United States with respect to the early estimates of the seismic hazard performed in the 1990s under the NRC's Individual Plant External Events Evaluation (IPEEE). Preliminary results from the NRC's study show that the ground motions from earthquakes in the Central and Eastern United States are higher than previously estimated. As such, the NRC has developed a draft Generic Letter which requests nuclear licensees to re-evaluate their seismic hazards using the latest methods and models. The draft Generic Letter is currently out for public comment.

Q. What is the direct cause of their reactors' shut-down? Considering news paper and press release of NRC, there are two possibilities for the shut-down.

- 1. Observed actual seismic acceleration, which triggered directly shut-down.**
 - 2. Outer line outage triggered turbine trip followed by reactor shut-down.**
- There is no clear explanation on the direct cause of the shut-down in these materials.**

A. It's premature to respond to the question. Root cause still in progress.

Q. How does the Mineral Va. earthquake impact what we were doing with regard to GI-199? Was the earthquake "bounded" by the GI-199 information or do we need to re-assess what we need licensee's to analyze for their plants?

A. The ground motion estimates from the earthquake in VA strongly appear to validate the NRC's current seismic hazard assessment approaches and the basis for GI-199 reviews. When the new hazard estimates for performing the GI-199 GL evaluations become available, the ground motion estimate at the NA site will definitely bound the VA earthquake response spectrum measured at the plant. Tentatively, the licensee's long term action will, in some fashion, refer to its future response to the GL as a means to ascertain its seismic adequacy and desired CDF of 10E-5 or less.

Whether the GI-199 ground motion (GMRS) should become the new seismic design basis for the plant is a regulatory decision that we need to ponder carefully before rushing into a decision at this stage.

Q. Describe what occurred at the North Anna nuclear power plant as a result of the earthquake, including the sequence of events that led to the shutdown of the two reactors, the failures of any safety equipment to operate following the earthquake, and any problems that may have occurred when the plant restarted.

A. Just after 2 pm on August 23, 2011, the North Anna Power Station declared an Alert condition due to significant seismic activity onsite. Both units experienced automatic reactor trips from 100% power and were stabilized in hot shutdown. All offsite electrical power to the site had been lost. All four emergency diesel generators (EDG) started automatically and provided power to the emergency buses. While operating, the one EDG developed a coolant leak and was shutdown. The corresponding emergency bus was re-energized with another diesel-powered generator.

On August 29, 2011, the Nuclear Regulatory Commission dispatched an Augmented Inspection Team (AIT) to the North Anna Power Station to further review the effects of the earthquake, the operators' response and the plant staff's activities to check equipment. This team is currently scheduled to complete its inspection on September 16, 2011 and will document its inspection results by October 16, 2011. More details will become available upon the completion of the inspection with regards to the cause of reactor trips and issues associated with the safety equipment. Currently, both units are in shutdown condition, and will remain shutdown until the plant operator, Dominion, proves to the NRC's satisfaction that the plant can be restarted and operated safely.

Q. Describe whether the North Anna plant fully addressed all past safety problems found at the facility, including the problems that the NRC detailed in the May 13, 2011 report and structural integrity issues or other problems that may have occurred as a result of the August 23, 2011 earthquake. If the plant has not fully addressed all of these safety issues, provide a timeline by which the plant will have addressed all such problems.

A. As documented in Integrated Inspection Report 05000338,339/2011003 of July 28, 2011, NRC inspectors reviewed Inspection Report 05000338,339/2011010 of May 13, 2011 and conducted detailed follow-up inspection, and there were no inspection findings identified during this follow-up inspection. The AIT in response to the August 23, 2011 earthquake is currently in progress and more information will become available after the inspection is complete. The AIT inspection report is scheduled to be issued by October 16, 2011.

Q. Describe the seismic hazards that the plant is designed to withstand, the date that those hazards were estimated, the basis for estimated seismic hazards, and any more recent data on seismic hazards that may differ from the information used to originally estimate the seismic hazards for the North Anna plant.

A. The North Anna Power Station (NAPS) has two Design Basis Earthquake (DBE) ground motions. The first is for structures, systems, and components (SSCs) founded on top of rock, and is anchored at 0.12g (12 percent of the force of gravity). The other DBE is for SSCs founded on top of soil, and is anchored at 0.18g, with the consideration that soil

will amplify a quake's ground motion. These seismic hazards were estimated during the time that the construction licenses were issued in 1971. These design values are addressed in the NAPS Final Safety Analysis Report (FSAR). The FSAR indicates that the estimates were based on the Modified Mercalli Intensity (MMI) of VII, which is associated with the largest potential earthquake related to the Arconia Syncline occurring close to the site area. The North Anna plant was evaluated as part of the Individual Plant Examination for External Events (IPEEE) effort in response to NRC Generic Letter 88-20, Supplement 4, and found to be capable to withstand a significantly higher seismic ground motion than the design basis earthquake. The seismic hazard analysis that was used for the Early Site Permit Application for North Anna, Unit 3, differs from this earlier estimate, in that it provides for a higher response spectrum, mostly with regards to the high frequency side for the site, using the performance based approach, as recommended in Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," dated March 2007.

Q: There have been reports that the plant was designed to withstand a 5.9-6.1 magnitude earthquake and the earthquake experienced was a 5.8 magnitude earthquake. Given the current understanding of the seismic risks, describe the difference in the margin of safety assumed at the time the plant was built versus when the earthquake occurred.

A: As indicated in the response to Q9 above, the design of NAPS is based on a Modified Mercalli Intensity (MMI) of VII. This intensity does not correlate directly with the measured magnitude 5.8 experienced at the plant site. The preliminary information on the measured response spectra from the ground motion experienced by plant structures indicates that the ground motion may have exceeded the design spectra at certain frequencies, however, well within the IPEEE review level earthquake mentioned above. This does not appear to appreciably encroach on the built-in seismic design margin of safety related structures and components. It should be noted that the ground response spectrum from the recent earthquake experienced at North Anna is weaker than the anticipated response spectrum the licensee would be expected to use in its seismic risk evaluation in conjunction with the response to the proposed generic letter for Generic Issue 199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," currently under development.

Q. Following up on the NRC's September 2010 report titled "Implications of Outdated Probabilistic Seismic Hazard Estimates in the Eastern and Central United States on Existing Plant," describe:

- a. Whether there are any new seismic-hazard estimates that the report anticipated would be finished in late 2010 or early 2011. If so, please provide those estimates;**
- b. The status of implementation of the report's recommendations, including a description of the plants that have and have or recalculated their seismic core damage frequency;**
- c. The timeline for completing individual safety reviews at all of the nation's nuclear power plants; and**

d. Steps that the NRC could take to expedite the implementation of safety reviews and the completion of any work needed to address safety issues found during such a review.

- A. Please note a correction of the title for the cited NRC report. The NRC report is an Information Notice (IN) 2010-018, entitled "Implications of Updated Probabilistic Seismic Hazard Estimates in the Eastern and Central United States on Existing Plant." Since the publication of this IN, NRC issued a draft Generic Letter (GL) entitled, "Seismic Risk Evaluations for Operating Reactors," on September 1, 2011, for public comments.
- a) The information on updated seismic hazard estimates is expected to be available at the end of calendar year 2011.
 - b) According to the draft GL, addressees would start their evaluations following formal issuance of the final GL. The GL provides a proposed schedule for various milestones that they are required to follow for submitting the requested information.
 - c) The above mentioned milestones specify proposed completion of seismic evaluations within one or two years from the date of issuance of the GL, depending on the chosen type of seismic evaluation (i.e., seismic margin assessment or seismic probabilistic risk assessment)
 - d) The NRC may opt to use contractors to support the review of licensees' seismic risk evaluations and proposed actions.

Q. Describe the status of the San Onofre and Diablo Canyon Nuclear Power Plant reassessments of seismic risks. Please include the following information:

- a. Will the NRC consider and utilize all of the new information on seismic risks generated by these plants in the licensing proceedings for these facilities?**
- b. How will the NRC do so, and will it protect the ability of communities to challenge the NRC's relicensing decision?**

- A. The NRC's regulations for license renewal (10 CFR Part 54) require licensees to manage the age-related degradation of systems, structures, and components (SSCs) to ensure they will fulfill their safety-related functions, as specified in the current licensing basis, for the period of extended operation. A plant's licensing basis, including its seismic design basis, is established outside of the license renewal process during initial plant licensing and subsequent license amendments and dynamically evolves during subsequent license amendments and licensing actions as new information and plant modifications are incorporated into the plant design and license. The NRC has multiple processes to evaluate the adequacy of plant licensing bases (e.g., Reactor Oversight Process, Generic Issues Program) and new information or operating experience and, if necessary, the NRC will direct additional measures to maintain established safety thresholds commensurate with risk and safety benefit (e.g., require plant improvements through the backfit process). Any age-related degradation affected by seismic events will be evaluated by the applicant and reviewed by the NRC staff as part of the license renewal process.

For the Diablo Canyon license renewal review, the staff has issued a safety evaluation report (SER). The staff has also delayed the review schedule based on a request of the applicant to allow completion of the State's processing of Diablo Canyon's coastal consistency certification. Therefore, prior to finalizing a decision on license renewal for

Diablo Canyon, the staff will supplement the SER, as necessary, and consider any information that affects the information in the license renewal application and SER, including results from the seismic studies associated with age-related degradation. The staff will also consider any new and relevant information from the seismic studies in the completion of its environmental review.

The scope of the Generic Issue 199 (GI-199) Safety/Risk Assessment Report is limited to plants in the Central and Eastern United States, and while Western plants such as Diablo Canyon and San Onofre sites are not included in the GI-199 Safety/Risk Assessment Report, the Information Notice on GI-199 is addressed to all operating power plants in the U.S. (as well as all independent spent fuel storage installation licensees). The staff plans to consider inclusion of operating reactors in the Western U.S. in its future generic communication information requests.

In keeping with NRC's open and transparent processes, the NRC's review will continuously include dialogue with all stakeholders, including public interest groups, industry, Federal, State, and local agencies, and members of the public, as well as making associated documents available on the NRC website, as appropriate, to enhance understanding of the regulatory decision making process. In addition, members of the public have the opportunity to intervene in the license renewal process.

Q. The Diablo Canyon Power Plant has recently asked to change the type of earthquake that the plant could safely withstand to focus on the Hosgri Fault. Describe whether the plant has proposed to use a method of seismic review that is consistent with NRC regulations, including 10 CFR 50.59 (concerning the completeness and accuracy of information presented to the NRC) and whether the plant has conducted any new studies to support this modification.

A. In multiple public meetings, Pacific Gas and Electric Company (PG&E) has informed the NRC staff of its intention to submit a licensing amendment request (LAR) to: 1) change the Safe Shutdown Earthquake (SSE) from the double-design earthquake (DDE) to the Hosgri earthquake (HE), and 2) establish a methodology for the evaluation of new seismic information. The submission of this LAR is currently scheduled for late September 2011. In a meeting held on June 22, 2011, PG&E informed the NRC staff that there are no new calculations and no plant modifications being performed to support this request. The staff learned from this meeting that PG&E plans to request approval for this change based on existing licensing basis documentation that the HE is qualified to the standard accepted by the staff during the licensing process. PG&E performed a 10 CFR 50.59 evaluation regarding this change and determined that NRC staff review and approval is required to make change regarding the HE as some of the methods used for the seismic reviews could not be reconciled under 10 CFR 50.59.

From Japan's FAQs

Q(7) How many US reactors are located in active earthquake zones?

A. Although we often think of the US as having "active" and "non-active" earthquake zones, earthquakes can actually happen almost anywhere. Seismologists typically separate the US into low, moderate, and high seismicity zones. The NRC requires that every nuclear plant be designed for site-specific ground motions that are appropriate for their locations. In addition, the NRC has specified a minimum ground motion level to which nuclear plants must be designed.

Q(8) What level of earthquake hazard are the US reactors designed for?

A. Each reactor is designed for a different ground motion that is determined on a site-specific basis. The existing nuclear plants were designed on a "deterministic" or "scenario earthquake" basis that accounted for the largest earthquakes expected in the area around the plant, without consideration of the likelihood of the earthquakes considered. New reactors are designed using probabilistic techniques that characterize both the ground motion levels and uncertainty at the proposed site. These probabilistic techniques account for the ground motions that may result from all potential seismic sources in the region around the site. Technically speaking, this is the ground motion with an annual frequency of occurrence of 1×10^{-4} /year, but this can be thought of as the ground motion that occurs every 10,000 years on average. One important aspect is that probabilistic hazard and risk-assessment techniques account for beyond-design basis events. NRC's Generic Issue 199 (GI-199) project is using the latest probabilistic techniques used for new nuclear plants to review the safety of the existing plants. [see questions 16 to 21 for more information about GI-199]

Q(9) What magnitude earthquake are currently operating US nuclear plants designed to?

A. Ground motion is a function of both the magnitude of an earthquake and the distance from the fault to the site. Nuclear plants, and in fact all engineered structures, are actually designed based on ground motion levels, not earthquake magnitudes. The existing nuclear plants were designed based on a "deterministic" or "scenario earthquake" basis that accounted for the largest earthquakes expected in the area around the plant. A margin is further added to the predicted ground motions to provide added robustness.

Q(12) What is the likelihood of the design basis or "SSE" ground motions being exceeded over the life of a nuclear plant?

A. The ground motions that are used as seismic design bases at US nuclear plants are called the Safe Shutdown Earthquake ground motion (SSE). In the mid to late 1990s, the NRC staff reviewed the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE). From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting GI-199 to again assess the resistance of US nuclear plants to earthquakes. Based on NRC's preliminary analyses to date, the mean probability of ground motions exceeding the SSE over the life of the plant for the plants in the Central and Eastern United States is less than about 1%.

It is important to remember that structures, systems and components are required to have “adequate margin,” meaning that they must continue be able withstand shaking levels that are above the plant’s design basis.

Q(14) What is magnitude anyway? What is the Richter Scale? What is intensity?

A. An earthquake’s magnitude is a measure of the strength of the earthquake as determined from seismographic observations. Magnitude is essentially an objective, quantitative measure of the size of an earthquake. The magnitude can be expressed in various ways based on seismographic records (e.g., Richter Local Magnitude, Surface Wave Magnitude, Body Wave Magnitude, and Moment Magnitude). Currently, the most commonly used magnitude measurement is the Moment Magnitude, M_w , which is based on the strength of the rock that ruptured, the area of the fault that ruptured, and the average amount of slip. Moment magnitude is, therefore, a direct measure of the energy released during an earthquake. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology and was based on the behavior of a specific seismograph that was manufactured at that time. The instruments are no longer in use and the magnitude scale is, therefore, no longer used in the technical community. However, the Richter Scale is a term that is so commonly used by the public that scientists generally just answer questions about “Richter” magnitude by substituting moment magnitude without correcting the misunderstanding.

The intensity of an earthquake is a qualitative assessment of effects of the earthquake at a particular location. The intensity assigned is based on observed effects on humans, on human-built structures, and on the earth’s surface at a particular location. The most commonly used scale in the US is the Modified Mercalli Intensity (MMI) scale, which has values ranging from I to XII in the order of severity. MMI of I indicates an earthquake that was not felt except by a very few, whereas MMI of XII indicates total damage of all works of construction, either partially or completely. While an earthquake has only one magnitude, intensity depends on the effects at each particular location.

Q(15) How do magnitude and ground motion relate to each other?

A. The ground motion experienced at a particular location is a function of the magnitude of the earthquake, the distance from the fault to the location of interest, and other elements such as the geologic materials through which the waves pass.

Q(16) What is Generic Issue 199 about?

A. GI-199 investigates the safety and risk implications of updated earthquake-related data and models. These data and models suggest that the probability for earthquake ground motion above the seismic design basis for some nuclear plants in the Central and Eastern United States, although is still low, is larger than previous estimates.

Q(17) Does GI-199 provide rankings of US nuclear plants in terms of safety?

A. The NRC does not rank nuclear plants by seismic risk. The objective of the GI-199 Safety/Risk Assessment was to perform a conservative, screening-level assessment to evaluate if further investigations of seismic safety for operating reactors in the central and eastern US (CEUS) are warranted, consistent with NRC directives. The results of the GI-199 safety risk assessment should not be interpreted as definitive estimates of plant-specific seismic risk because some analyses were very conservative making the calculated risk higher than in reality. The nature of the information used (both seismic hazard data and plant-level fragility information) make these estimates useful only as a screening tool.

Q(18) What are the current findings of GI-199?

A. Currently operating nuclear plants in the US remain safe, with no need for immediate action. This determination is based on NRC staff reviews of updated seismic hazard information and the conclusions of the first stage of GI-199. Existing nuclear plants were designed with considerable margin to be able to withstand the ground motions from the “deterministic” or “scenario earthquake” that accounted for the largest earthquakes expected in the area around the plant. The results of the GI-199 assessment demonstrate that the probability of exceeding the design basis ground motion may have increased at some sites, but only by a relatively small amount. In addition, the probabilities of seismic core damage are lower than the guidelines for taking immediate action. Although there is not an immediate safety concern, the NRC is focused on assuring safety during even very rare and extreme events. Therefore, the NRC has determined that assessment of updated seismic hazards and plant performance should continue.

Q(19) What do you mean by “increased estimates of seismic hazards” at nuclear plant sites?

A. *Seismic hazard* (earthquake hazard) represents the chance (or probability) that a specific level of ground motion could be observed or exceeded at a given location. Our estimates of seismic hazard at some Central and Eastern United States locations have changed based on results from recent research, indicating that earthquakes occurred more often in some locations than previously estimated. Our estimates of seismic hazard have also changed because the models used to predict the level of ground motion, as caused by a specific magnitude earthquake at a certain distance from a site, changed. The increased estimates of seismic hazard at some locations in the Central and Eastern United States were discussed in a memorandum to the Commission, dated July 26, 2006. (The memorandum is available in the NRC Agencywide Documents Access and Management System [ADAMS] under Accession No. ML052360044).

Q(20) Does the Seismic Core Damage represent a measurement of the risk of radiation release or only the risk of core damage (not accounting for additional containment)?

A. Seismic core damage frequency is the probability of damage to the core resulting from a seismic initiating event. It does not imply either a meltdown or the loss of containment, which would be required for radiological release to occur. The likelihood of radiation release is far lower.

Q(21) Where can I get current information about Generic Issue 199?

- A. The public NRC Generic Issues Program (GIP) website (<http://www.nrc.gov/about-nrc/regulatory/gen-issues.html>) contains program information and documents, background and historical information, generic issue status information, and links to related programs. The latest Generic Issue Management Control System quarterly report, which has regularly updated GI-199 information, is publicly available at <http://www.nrc.gov/reading-rm/doc-collections/generic-issues/quarterly/index.html>. Additionally, the US Geological Survey provides data and results that are publicly available at <http://earthquake.usgs.gov/hazards/products/conterminous/2008/>.

Q. In the wake of Fukushima, what if anything has the commission or Congress done to make sure that cooling systems and backup electricity at U.S. plants are adequate?

- A. Subsequent to the Fukushima event the NRC issued two temporary instructions (inspections) to gather information on the adequacy, among other things, of reactor and spent fuel cooling systems and back-up electrical power. This information was used in the preparation of the NRC's near-term task force report. This report is currently be evaluated by the NRC to assess what actions should be taken and to prioritize them.

Summary of Earthquake Information for the North Anna NPP as of August 24, 2011

The design basis for earthquakes at North Anna is not based on the Richter Scale, but on ground motion, specifically, ground acceleration. The design basis Safe Shutdown Earthquake is the maximum ground acceleration that a plant must be able to withstand in order to safely shutdown the reactor, and is based on the maximum historical seismic activity recorded in the area in which the facility is located, as well as the type of soil.

For North Anna, the design basis for systems, structures, and components (SSCs) located on top of rock is 0.12g, which is 0.12 times the acceleration due to gravity. For SSCs located on top of soil, the design basis is 0.18g.

The recent earthquake occurred at a close distance to the plant with a magnitude of 5.8 at a relatively shallow depth. USGS estimates of the maximum ground motion at the plant evolved as new data become available. The current best estimate of the Peak Ground Acceleration (PGA) for the North Anna site is 0.2g, which contains uncertainty and may be updated later. This estimate indicates that the ground motion likely exceeded the SSE design basis for Units 1 and 2 (0.12g) over a considerable frequency range.

The USGS numbers are developed from ground motion prediction equations, modified by intensity information provided through the USGS "Did You Feel It?" (DYFI) system, which accepts large numbers of reports from affected persons to develop intensity maps.

NRC staff performed an independent analysis using the best estimate of the earthquake location and magnitude together with the Electric Power Research Institute (EPRI) ground motion prediction equations. The ground motions calculated by the staff are close to the USGS predictions.

Currently, the licensee is retrieving its seismic instrumentation recordings. However, we do not yet know the type and quality of the recording data that will be available to the NRC. Information from the NANPP will be used to evaluate the USGS estimates of ground motion and will be compared against the FSAR design basis. The data will be used to inform the staff whether additional analysis is needed.

The licensee is expected to perform plant walk downs in accordance with RG 1.167, "Restart of a Nuclear Power Plant Shutdown by a Seismic Event," which endorses EPRI's "Guidelines for Nuclear Plant Response to an Earthquake" with conditions. If the SSE is exceeded at certain frequencies, the staff will assess the licensee's evaluation of SSCs that are most sensitive to ground motion in that frequency band.