D. Ashley - Fwd: Info copy of 10/20 Open Item Response

From: D. Ashley
To: Noel Dudley
Date: 12/18/2006 7:30:11 AM
Subject: Fwd: Info copy of 10/20 Open Item Response

>>> <john.hufnagel@exeloncorp.com> 12/15/2006 >>>

Donnie,

Here is a Word version that has the right words, as submitted and docketed earlier. The last two pages have the correct words, and they are bolded.

- John.

<<Enclosures 1 and 2 - Open Item Responses and Commitment list udpate.doc>>

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Enclosure 1

AmerGen Responses to Open Items Identified in NRC Draft License Renewal Safety Evaluation for the Oyster Creek Generating Station

This Enclosure provides the AmerGen response to each of the five open items identified by the NRC Staff in Section 1.5 of the draft SER. For completeness, each open item (OI) is repeated here, followed by the AmerGen response.

Open Item # 1 - OI 4.7.2-1.1:

In RAI 4.7.2-1 dated March 10, 2006, the staff requested that the applicant provide the following information: For the drywell corrosion during the late 1980s and the new corrosion found during the subsequent inspections, provide the process used to establish confidence that the sampling done to identify the areas of corrosion has been adequate.

In its response dated April 7, 2006, the applicant emphasized that it employs a robust process to establish confidence that the nature and locations of sampling done and areas considered for identifying the areas of corrosion have been adequate. The applicant stated that the elements of process had been developed over several years and defined in several technical documents submitted to the NRC in the 1990s. In addition, the applicant stated that OCGS has conducted extensive examinations to identify the cause of drywell corrosion, employed a robust sampling process, quantified with reasonable assurance the extent of drywell shell thinning due to corrosion, and assessed its impact on the drywell's structural integrity.

The staff's review of the applicant's response determined that there had been no UT measurements taken in the lower portion of the spherical area above the sand-pocket area. The staff requested that the applicant clarify its UT sampling plan for the entire drywell shell assessment.

In its supplemental response dated June 20, 2006, the applicant stated:

> A review of the drywell fabrication and installation details show that the welds that attach the 0.770 inches (the correct thickness is 0.770 inches, not 0.722 inch as indicated in the meeting notes) nominal plates to the 1.154 inch nominal plates at elevation 23 ft 6 7/8 inch are double bevel full penetration welds. The external edge of the 1.154 inches plates is tapered to 3 to 12 minimum as required by ASME Section VIII, Subsection UW-35, while the internal edge of the 1.154 inch plates are flush with the 0.770 inch plates. Thus there are no ledges that could retain water leakage and result in more severe corrosion than in areas included in the inspection program. Also, this joint is located below the equatorial center of the sphere. Therefore, in the event that water may run down the gap between the drywell shell and the concrete wall it would not collect on this joint.
>
> In 1991, Oyster Creek performed random inspections of the drywell shell. Ultrasonic testing inspections were conducted at 19 locations on either the 1.154 inch thick plates or on the 0.770 inch thick plates. The UT measurements were taken on a 6 inch x 6 inch grid (49 UTs) at each location. The UT measurement results show that thinning of the plates at

these locations is less severe than the areas that are included in the corrosion-monitoring program. For this reason, the transition area was not added to the corrosion-monitoring program. Based on the above, AmerGen concludes that areas monitored under the drywell corrosion monitoring program bound the transition (from 1.154 inches to 0.770 inch thick plates) area of the drywell shell. Nevertheless, UT measurements will be taken on the 0.770 inch thick plate, just above the weld, prior to entering the period of extended operation.

The measurements will be conducted at one location using the 6 inch x 6 inch grid. A second set of UT measurements will be taken two refueling outages later at the same location. The results of the measurements will be analyzed and evaluated to confirm that the rate of corrosion in the transition is bounded by the rate of corrosion of the monitored areas in the upper region of the drywell. If corrosion in the transition area is found to be greater than areas monitored in the upper region of the drywell, UT inspections in the transition area will be performed on the same frequency as those performed on the upper region of the drywell (every other refueling outage).

Similarly, a review of fabrication and installation details of the containment drywell shell shows that the weld that connects the 2.625" knuckle plates to the 0.640"cylinder plates at elevation 71 ft 6 inch is a double bevel full penetration weld. The edges of the 2.625 inch plates were fabricated with a 3 to 12 taper to provide a smooth transition from the thicker to the thinner plate as required by ASME Section VIII, Subsection UE-35. Thus there are no ledges that could retain water leakage and result in more severe corrosion than the areas included in the inspection program.

In 1991, Oyster Creek performed random inspections of the drywell shell. Ultrasonic testing (UT) inspections were conducted at 18 locations on the 2.625 inch thick knuckle plate and at four (4) locations on the 0.640 inch thick cylinder plate. The UT measurements were taken on a 6 inch x 6 inch grid (49 UTs) at each location. The UT measurement results showed that thinning of the plates at these locations was less severe than the areas that are included in the corrosion monitoring program. For this reason the knuckle area was not added to the corrosion monitoring program. Based on the above, AmerGen concludes that areas monitored under the drywell corrosion monitoring program bound the knuckle area of the drywell shell. However, UT measurements will be taken above the 2.625 inch knuckle plate in the 0.640 inch thick plate prior to entering the period of extended operation.

The measurements will be taken at one location using the 6 inch" x 6 inch grid. A second set of UT measurements will be taken two refueling outages later at the same location. The results of the measurements will be analyzed and evaluated to confirm that the rate of corrosion in the transition is bounded by the rate of corrosion of the monitored areas in the upper region of the drywell. If corrosion in the transition area is found to be greater than areas monitored in the upper region of the drywell, UT inspections in the transition area will be performed on the same frequency as those performed on the upper region of the drywell (every other refueling outage).

The staff believes that random sampling of UT measurement is valuable if the likelihood of corrosion is almost equal at every place in the region considered for UT measurements. If the geometry of the region and water flow in the air gap suggest that one area is more likely to have corrosion than another then the sampling plan must consider areas more likely to have corrosion in addition to the randomly selected areas. If the water flow in the air gap is high, the applicant's argument that the weld transition will not allow water accumulation would be accurate. However, if the water flow is slow, the applicant's argument may not hold true. During the forthcoming outage, the applicant plans UT measurements at one location on each of the transition areas. The staff believes that measurement at four locations in each transition area would be more conservative. The locations along the thickness transition should be consistent with the areas that have large water accumulation and corrosion in the sand bed region. This item has been identified as an OI.

AmerGen Response to Open Item # 1 – OI 4.7.2-1.1

AmerGen will perform four separate sets of UT examinations of the drywell shell at two areas where there is a transition between shell plate thicknesses (i.e., four separate 49-point UT sets at the transition at elevation 23', 6 7/8" and four sets of UTs at elevation 71' 6."). These measurements will be performed prior to the period of extended operation. The specific locations to be selected will consider previous operational experience (i.e., will be biased toward areas that have experienced corrosion or have been exposed to water leakage).

This commitment will be added to AmerGen's A.5 Commitment List (modifying Appendix A of the License Renewal Application), as identified in the mark-up to Commitment # 27, which is included as Enclosure 2 to this letter.

Open Item # 2 - OI 4.7.2-1.2:

In RAI 4.7.2-1 dated March 10, 2006, the staff requested that the applicant provide the following information: For the drywell corrosion during the late 1980s and the new corrosion found during the subsequent inspections, provide the process used to establish confidence that the sampling done to identify the areas of corrosion has been adequate.

The staff's review of the April 7, 2006, response determined that the most susceptible bays in the sand pocket region of the drywell shell had been incorporated in the sampling. However, it was not clear to the staff whether the junction at elevation 6' 10.25" had been represented in the sampling. To determine whether the readings are taken at the vulnerable locations and reliable techniques are used, the staff requested that the applicant explain why this area should not be included in the sampling plan.

In its response dated June 20, 2006, the applicant noted that the drywell construction and fabrication details show that the presence of the drywell skirt prevents moisture intrusion into the plate. The applicant also noted that AmerGen has extensively investigated drywell corrosion, including the embedded shell. Plant-specific and industry operating experience indicate that corrosion of the embedded steel in concrete is not significant because the shell is protected by the high alkalinity of concrete. Corrosion could become significant only if the concrete environment is aggressive. The applicant also stated that historical data show that the environment in the sand bed region is not aggressive, and thus any water in contact with the embedded shell is not aggressive. The data show that corrosion of the drywell shell in the sand bed region is galvanic and impurities like chlorides and sulfates are not fundamentally involved in the anodic and cathodic corrosion reactions. Thus, only limited corrosion is anticipated for the drywell embedded shell.

The applicant concluded that corrosion monitoring of the sand bed region of the drywell shell is bounding with respect to corrosion that may have occurred on the drywell embedded shell before 1992. After 1992 and through the period of extended operation, corrosion of the embedded shell has not been not significant because of the mitigative measures implemented and the robust drywell corrosion AMP.

The staff understands the applicant's technical basis to support the applicant's view that the inaccessible portion of the drywell shell (i.e., embedded between the concrete floor inside, and concrete outside) is not likely to be subject to the same type of severe corrosion as experienced in the sand bed area. However, the general corrosion in the liner plates embedded in concrete of a number of pressurized water reactor (PWR) and BWR containments suggests that certain irregularities during the construction (i.e. foreign objects or voids in the concrete) could trigger corrosion not arrested by the concrete environment. This suggestion is particularly significant for the plates potentially subject to water seepage. The applicant's position that the uniformly reduced thickness used in the GE analysis compensates for any corrosion that may have occurred before the area was sealed in 1992 has some validity. The staff is still evaluating this item; therefore, it has been identified as an OI.

AmerGen Response to Open Item # 2 - OI 4.7.2-1.2

In this Open Item, the Staff questions whether the drywell shell corrosion sampling plan is adequate with respect to the lower (embedded) region of the shell. On pages 10 through 13 of Letter 2130-06-20353 dated June 20, 2006, AmerGen provided detailed information responding to the staff's concerns in this area. This information was acknowledged by the Staff as useful in addressing the issue, in both the draft SER and in more recent telephone discussions, but the Staff indicated it was still evaluating the issue.

The 1.154 inch thick plate between the support skirt and the floor of the sandbed region is likely to have experienced some corrosion due to the water from the sandbed region; however, this corrosion would not be worse than the corrosion in the sandbed region and is likely to be less due to the formation of a thin protective oxide passive film from the highly alkaline concrete. Once this area was sealed off from the sandbed region and any further water intrusion was prevented, the corrosion mechanism in this area would be stopped. AmerGen continues to believe that the 0.676 inch thick plate embedded in the concrete below the attachment point of the support skirt has always been and continues to be protected from coming in contact with water from the sandbed region and; therefore, does not represent a corrosion issue.

The Staff encouraged AmerGen to investigate the feasibility of applying state-of-the-art non-destructive examination techniques to see if any could be effectively used to investigate the condition of the embedded region. AmerGen has contacted EPRI and other utilities that potentially used such techniques. Based on these discussions, we understand that a "guided wave" technology has been developed that may be able to provide some qualitative information on whether the embedded shell has undergone corrosion. However, neither this nor any other non-destructive methods have been identified that could determine the thickness of the embedded drywell shell or the specific extent of corrosion. Therefore, AmerGen does not plan to further pursue use of such techniques at this time.

Based on discussions with the Staff, AmerGen owes no additional information to the Staff at this time in order to support closure of this issue.

Open Item # 3 - OI 4.7.2-1.3:

In RAI 4.7.2-1 dated March 10, 2006, the staff requested that the applicant provide the following information: A summary of the factors considered in establishing the minimum required drywell thickness.

In its response dated April 7, 2006, the applicant explained that the factors considered in establishing the minimum required drywell thickness at various elevations of the drywell are described in detail in engineering analyses documented in two GE reports, Index Nos. 9-1, 9-2, and 9-3, 9-4.

In the applicant's discussion, a summary of the methods and assumptions used in the buckling analysis of the shell in the sand-pocket area has been given. Although the NRC has not approved ASME Code Case N-284 for use on a generic basis, the staff does not take exception to the use of average compressive stress across the metal thickness for buckling analysis of the as-built shell. However, if the corrosion has reduced the strength of the remaining metal through the cross section, this use may not be valid. The staff requested that the applicant address this issue.

In its response dated June 20, 2006, the applicant discussed its use of ASME Code Case N-284:

> Although Revision 1 of Code Case 284 had not yet been issued when the report (An ASME Section VIII Evaluation of Oyster Creek Drywell for Without Sand Case, Part II - Stability Analysis," GE Report, Index No. 9-4, Revision 0, DRF # 00664) was written, the authors consulted with the

primary author of the revision. Based on those discussion, the plasticity correction factors used in the evaluation are the same as those in Figure 1610-1 of Code Case N-284 Revision 1.

The applicant stated that the technical approach used in the stability evaluation of Reference 2 is entirely consistent with the guidelines in ASME Code Case N-284, Revision 1. In addition, the applicant concluded that the corrosion on the outside surface of the shell will not introduce eccentricities that would significantly impact the "e/t" value of 1.0 assumed in ASME Code Case N-284. The applicant also stated that it expected additional eccentricity from shell corrosion in service to be accommodated within the allowable limit for imperfections.

The staff believes that the applicant has provided a thorough explanation of the factors considered in applying the ASME Code Case N-284-1 for buckling analysis of the corroded shell in the sand bed area of the drywell shell. However, the applicant did not address whether it is appropriate to assume the same strength across the corroded section of the shell. The incorporation of the "e/t" corrosion concept with a representative distribution of strength along the corroded section that recognize the lower strength at the corroded side and full strength at the inside surface, could support the claim of conservatism in the analysis. This has been identified as an OI.

<u>AmerGen Response to Open Item # 3 – OI 4.7.2-1.3</u>

On pages 8 and 9 of its June 20, 2006 letter (2130-06-20353) addressing drywell corrosion issues, AmerGen provided detailed technical information supporting the use of Code Case N-284-1 and the rationale for why the corrosion experienced will not cause a drywell structural integrity concern. Based on discussions with the NRC staff, AmerGen owes no additional information to the Staff at this time in order to support closure of this issue.

<u>Open Item # 4 - OI 4.7.2-1.4:</u>

In RAI 4.7.2-1 dated March 10, 2006, the staff requested that the applicant provide the following information: A summary of the factors considered in establishing the minimum required drywell thickness.

In its response dated April 7, 2006, the applicant explained that the factors considered in establishing the minimum required drywell thickness at various elevations of the drywell are described in detail in engineering analyses documented in two GE reports, Index Nos. 9-1, 9-2, and 9-3, 9-4.

For the localized thin areas, the applicant uses the provision of NE-3213.10 of Subsection NE of ASME Code Section III. This provision, although not directly applicable to the randomly thin areas caused by corrosion, if used with care and adequate conservatism, could provide information about the primary stress levels at the junction of the thin and thick areas. The staff requested that the applicant provide a summary of the process used to address this issue.

In its response dated June 20, 2006, the applicant noted that "although provisions in ASME Code Section III, Subsection NE-3213.10 are not directly applicable to the randomly thin areas caused by corrosion, AmerGen believes that the provisions are applicable to the analysis of Oyster Creek drywell shell based on the following:"

- The stress analysis of Oyster Creek drywell presented in Reference 1 satisfies the local primary stress requirements of NE-3213.10. Conservatism in the allowable primary stress intensity value, the assumed peak pressure during the LOCA condition and the assumption of local corroded thickness in the entire region of the drywell provide additional structural margin.

- The Code primary stress limits are satisfied in the corroded condition and the number of fatigue cycles is small, the surface discontinuities from corrosion do not represent a significant structural integrity concern.

- The applicant indicated that UT measurements of the drywell shell above the sand bed region had shown that the measured general thickness contains significant margin. The applicant stated that the ongoing corrosion in that region is insignificant and that the margin could be applied to offset uncertainties related to surface roughness.

- The applicant stated that UT measurements of the drywell shell in the sand bed region show that the measured general thickness is greater than the 0.736'" thickness assumed in the buckling analysis by significant margins except in two bays, 17 and 19. (Refer to response to RAI 4.7.2-1(d), Table-2). The margin in the general thickness of the two bays is 0.074" and 0.064" respectively. As significant additional corrosion is not expected in the sand bed region, the applicant applied the margin to offset uncertainties related to the surface roughness.

The staff is still evaluating this item; therefore, it has been identified as an OI.

<u>AmerGen Response to Open Item #4 - OI 4.7.2-1.4</u>

As noted in the Open Item description above, AmerGen provided detailed information on this issue in its Letter 2130-06-20353 dated June 20, 2006. Subsequent discussions with the Staff have indicated that AmerGen owes no additional information at this time to support closure of this Open Item.

<u>Open Item # 5 - OI 4.7.2-3:</u>

In RAI 4.7.2-3 dated March 10, 2006, the staff noted that leakage from the refueling seal has been identified as one of the reasons for accumulation of water and contamination of the sand-pocket area. The refueling water passes through the gap between the shield concrete and the drywell shell in the long length of inaccessible areas. As there is a potential for corrosion, ASME Code Subsection IWE would require augmented inspection of this area. The staff requested that the applicant provide a summary of inspections (visual and NDE) and mitigating actions to prevent water leaks from the refueling seal components.

In its response dated April 16, 2006, the applicant stated that the refueling seals at OCGS consist of stainless steel bellows. In the mid-to-late 1980s, GPU conducted extensive visual and NDE inspections to determine the source of water intrusion into the seismic gap between the drywell concrete shield wall and the drywell shell and accumulation in the sand bed region. The inspections concluded that the refueling bellows (seals) were not the source of water leakage. The bellows were repeatedly tested by helium (external) and air (internal) with no indication of leakage. Furthermore, any minor leakage from the refueling bellows would be collected in a concrete trough below the bellows. The concrete trough is equipped with a drain line that would direct any leakage to the reactor building equipment drain tank and prevent it from entering the seismic gap. The drain line has been checked before refueling outages to confirm that it is not blocked. The only other seal is the gasket for the reactor cavity steel trough drain line. This gasket was replaced after the tests showed that it was leaking. However, the gasket leak was ruled out as the primary source of water observed in the sand bed drains because there is no clear leakage path to the seismic gap. Minor gasket leaks would be collected in the concrete trough below the gasket and would be removed by the drain line like leaks from the refueling bellows.

In addition, the applicant noted that additional visual and NDE (dye penetrant) inspections on the reactor cavity stainless steel liner had identified a significant number of cracks, some throughwall. Engineering analysis concluded that the cracks were most probably caused by mechanical impact or thermal fatigue, not intergranular stress corrosion cracking (IGSCC). These cracks were determined to be the source of refueling water that passed through the seismic gap. To prevent leakage through the cracks, GPU installed an adhesive-type stainless steel tape to bridge any observed large cracks and subsequently applied a strippable coating. This repair greatly reduced leakage and was implemented every refueling outage while the reactor cavity was flooded.

The applicant noted that OCGS has a long-time commitment to monitor the sand bed region drains for water leakage. A review of plant documentation provided no objective evidence that the commitment had been implemented since 1998. OCGS Issue Report No. 348545 was issued, in accordance with the corrective action process, to document the lapse in implementing the commitment and to reinforce strict compliance with commitment implementation in the future, including during the period of extended operation.

The applicant also committed (Commitment No. 33) to augmented inspections of the drywell in accordance with ASME Code Section XI, Subsection IWE. These inspections consist of UT examinations of the upper region of the drywell and visual examinations of the protective coating on the exterior of the drywell shell in the sand bed region. UT measurements will supplement the visual inspection of the coating measurements from inside the drywell once before entering the period of extended operation and every 10 years during the period of extended operation.

The staff's review of the applicant's response determined that the epoxy coating applied in the sand-bed region of the shell has a limited life and that water leakage from the air gap has not been prevented. With these observations, the staff requested that the applicant provide a systematic program of examination of the coating for confidence that the preventive measure is adequately implemented at all locations in the sand-pocket areas.

In its response dated June 20, 2006, the applicant stated:

> AmerGen committed that it will monitor the sand bed region drains on a daily basis during refueling outages and take the following actions if water is detected. The actions will be completed prior to exiting the outage.

- The source of water will be investigated and diverted, if possible, from entering the gap between the drywell shell and the drywell shield wall.
- The water will be chemically analyzed to aid in determining the source of leakage.
- A remote inspection will be performed in the trough drain area to determine if the trough drains are operating properly.
- The condition of the coating and the moisture barrier (seal) in the affected bays will be inspected.
- If the coating is degraded and visual inspection indicates corrosion is taking place, then UT thickness measurements will be taken in the affected areas of the sand bed region. The measurements will be taken from either inside or outside the drywell to ensure that the shell thickness in areas affected by water leakage is measured. UT thickness measurements and evaluation will be consistent with the existing program.
- The degraded coating and/or the seal will be repaired in accordance with station procedures.
- UT measurements will be taken in the upper region of the drywell consistent with the existing program.

The applicant also committed (Commitment No. 27) to monitor the sand bed region drains quarterly during the operating cycle. The applicant stated that, if water is detected, actions listed below will be taken. Actions that can only be completed during an outage will be completed during the next scheduled refueling outage.

- The leakage rate will be quantified to determine a representative flow rate. The leakage rate will be trended.
- The source of water will be investigated and diverted, if possible, from entering the gap between the drywell shell and the drywell shield wall.
- The water will be chemically analyzed to determine the source of leakage.
- The condition of the coating and the moisture barrier (seal) in the affected bays will be inspected during the next refueling outage or an outage of opportunity.

- If the coating is degraded and visual inspection indicates corrosion has taken place, then UT thickness measurements will be taken in the affected areas of the sand bed region from either inside or outside the drywell to ensure that the shell thickness in areas affected by water leakage is measured. UT thickness measurements and evaluation of the results will be consistent with the existing program.

- UT measurements will be taken in the upper region of the drywell consistent with the existing program.

- The degraded coating or the seal will be repaired in accordance with station procedures.

The staff believes that applicant has not provided sufficient information regarding the extent that coated surfaces will be examined during each inspection. This has been identified as an OI.

AmerGen Response to Open Item #5 - OI 4.7.2-3

Based on further discussions with the Staff, it was determined that AmerGen has submitted sufficient information regarding the coating inspections to be performed. No additional information is needed from AmerGen to support closure of this Open Item.

Enclosure 2

Update to Oyster Creek License Renewal Application Appendix A Table A.5 (Commitment List) Commitment 27 Incorporating Inspections to be Performed in Response to Open Item 4.7.2-1.1

Note: Changes to previous commitment are identified in **bold** font.

Item Number	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE

27) ASME Section XI, Subsection IWE	Existing program is credited. The program will be enhanced to include: 1. Ultrasonic Testing (UT) thickness measurements of the drywell shell in the sand bed region will be performed on a frequency of every 10 years , except that the initial inspection will occur prior to the period of extended operation and the subsequent inspection will occur two refueling outages after the initial inspection, to provide early confirmation that corrosion has been arrested. The UT measurements will be taken from the inside of the drywell at the same locations where UT measurements were performed in 1996. The inspection results will be compared to previous results. Statistically significant deviations from the 1992, 1994, and 1996 UT results will result in corrective actions that include the following: • Perform additional UT measurements to confirm the readings. • Notify NRC within 48 hours of confirmation of the identified condition. • Conduct visual inspection of the external surface in the sand bed region in areas where any unexpected corrosion may be detected. • Perform engineering evaluation to assess the extent of condition and to determine if additional inspections are required to assure drywell integrity. • Perform operability determination and justification for operation until next inspection. These actions will be completed prior to restart from the associated outage. 2. A strippable coating will be applied to the reactor cavity liner to prevent water intrusion into the gap between the drywell shield wall and the drywell shell during periods when the reactor cavity is flooded. 3. The reactor cavity seal leakage trough drains and the drywell sand bed region drains will be monitored for leakage. • The sand bed region drains will be monitored	A.1.27	Prior to the period of extended operation Prior to the period of extended operation, and then two refueling outages after that. Subsequent inspection frequency will be established as appropriate, not to exceed 10-year intervals Refueling outages prior to and during the period of extended operation Periodically Daily during refueling outages