Exelon.
Generation

NP-11-0040
September 1, 2011

10 CFR 52, Subpart A

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Exelon Nuclear Texas Holdings, LLC
Victoria County Station Early Site Permit Application
Response to Request for Additional Information Letter No. 06
NRC Docket No. 52-042

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) Letter No. 06, dated March 31, 2011, related to Early Site Permit Application (ESPA), Part 2, Sections 02.04.04, 13.03, and 15. NRC RAI Letter No. 06 contained twenty (20) Questions. This submittal comprises the final partial response to RAI Letter No. 06, and includes response to the following Question:

02.04.04-1

When a change to the ESPA is indicated by a Question response, the change will be incorporated into the next routine revision of the ESPA, planned for no later than March 31, 2012.

Of the remaining nineteen (19) RAIs associated with RAI Letter No. 06, responses to two (2) Questions were submitted to the NRC in Exelon Letter NP-11-0012, dated April 26, 2011, and responses to seventeen (17) Questions were submitted to the NRC in Exelon Letter NP-11-0014, dated May 13, 2011. This submittal completes the Exelon response to NRC RAI Letter No. 06, dated March 31, 2011.

Regulatory commitments established in this submittal are identified in Attachment 2. If any additional information is needed, please contact David J. Distel at (610) 765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 1st day of September, 2011.

Respectfully,

Marilyn C. Kray
Vice President, Nuclear Project Development

Attachments:
1. Question 02.04.04-1
2. Summary of Regulatory Commitments

cc: USNRC, Director, Office of New Reactors/NRLPO (w/Attachments)
USNRC, Project Manager, VCS, Division of New Reactor Licensing (w/Attachments)
USNRC Region IV, Regional Administrator (w/Attachments)

RAI 02.04.04-1:

Question:

The staff has reviewed the application in accordance with the requirements of "Factors to be considered when evaluating sites" 10 CFR 100.20(c), and "Contents of application: technical information in the final safety analysis report" 10 CFR 52.79(a). The staff has reviewed FSAR Section 2.4.4, Potential Dam Failures and the dam breach outflow hydrographs for the postulated breach of the cooling basin. The outflow hydrographs are too short to determine if wave runup will impact the site and there is no discussion of the basis for selection of the breach location. Please describe the justification for breach locations and wave runup conclusions and provide a complete outflow recession curve.

Response:

The response to this RAI is addressed in two parts, with the first part comprised of two subparts. Part 1a provides the results of an extended period simulation of the postulated cooling basin breach event, Part 1b provides the wind wave effects, and Part 2 provides additional information on the location of the cooling basin embankment breaches.

Part 1a – Extended Period Simulation of the Cooling Basin Breach

An extended period simulation of 96 hours was conducted for the critical cooling basin failure scenario that corresponds to a breach 410 meters (1345 feet) wide on the west side of the northern embankment. This postulated failure scenario results in the highest flood level at the power block area as given in SSAR Tables 2.4.4-4 and 2.4.4-5. The simulation period was selected such that flow leaving the cooling basin at the end of the period becomes negligible.

The breach model described in SSAR 2.4.4.2.2.4 considered three initial water level conditions for the area outside the cooling basin: (1) elevation 82.0 feet (25.0 meters) NAVD 88, (2) elevation 84.0 feet (25.6 meters) NAVD 88, and (3) dry bed. For the extended simulation, the dry bed initial condition was specified as it enables the model to simulate more realistically the flow pattern in the recession period after the flood level at the power block reaches its peak. Based on the topographic setting at the VCS site, the breach flow leaving the cooling basin is expected to be diverted eventually towards lower terrain such as the adjacent Guadalupe River valley on the east and Kuy Creek on the west, as indicated in SSAR Figures 2.4.4-25 and 2.4.4-28. The other two initial conditions tested in SSAR 2.4.4 assume that the entire model domain (outside the cooling basin and the area bounded by the security wall), would be filled to 82 feet NAVD 88 and 84 feet NAVD 88 respectively. With the nominal natural grade in the power block vicinity at about 80 feet NAVD 88, and lower farther to the east and west in the river valley and creeks, these initial water levels would potentially create a backwater effect and impede flow movement towards lower ground, especially during the recession period. The use of the dry bed initial condition for extended simulation circumvents this modeling limitation. Further, as discussed in SSAR Subsection 2.4.4.2.2.4, the predicted maximum water level near the power block area was found to be insensitive to downstream initial conditions.

Proposed SSAR Figure 2.4.4-21a (attached) provides the predicted water level hydrograph of the extended simulation run, for the first 150 minutes after the postulated breach, at the southwest corner of the security wall where the maximum power block flood level occurs. The maximum still water level is 90.6 feet (27.6 meters) NAVD 88 and occurs within the first 30 minutes of embankment breach, the same as reported in SSAR Section 2.4.4. Proposed SSAR Figure 2.4.4-21b (attached) details the water level hydrograph for the entire extended simulation period of 96 hours. As shown, the water level drops rapidly in the 12 hours past the peak and then more gradually to about 86.3 feet (26.3 meters) NAVD 88 at the end of 96 hours. The reason for the water level not returning to the initial level, i.e., the grade elevation of about 83 feet (25.3 meters) NAVD 88, is that this location of the maximum water level is situated in a drainage ditch, which is surrounded by higher ground of 86 feet (26.2 meters) NAVD 88 and above. Flood water is detained inside this local depression and presents no flood risk to the power block. Proposed SSAR Figure 2.4.4-21c (attached) details the time history of flow leaving the cooling basin. As the figure indicates, the flow leaving the cooling basin is negligible near the end of 96 hours of the postulated embankment breach.

SSAR Subsection 2.4.4 will be revised to incorporate the above discussion.

Part 1b – Wind Wave Effects

Although the maximum water level near the power block area was estimated using conservative assumptions and the flooding levels have a short time scale and would not be sustained for a period long enough for any considerable wind wave action, additional conservatism was added by considering wind-generated wave runup.

As shown in Figure 1 of ANSI/ANS-2.8-1992 (SSAR Reference 2.4.4-3), the 2-year fastest mile wind speed at 30 feet (9.15 meters) above ground at the VCS site is 50 mph (80.5 km/hr). This value is adjusted for duration, wind speed above water, and fetch length, as applicable, to estimate wave runup on the swale slope surrounding the power block area. Methodologies described in the U.S. Army Corps of Engineers Coastal Engineering Manual (Reference 1) were used to determine the wave height, wave period, and wave runup elevation.

In the wind-wave analysis, the following parameters and values were used:

- Maximum still water level of 90.6 feet (27.6 meters) NAVD 88, as obtained from the postulated embankment breach flood simulation,
- A fetch length of 18,682 feet (5694.3 meters), the maximum distance between the location of the maximum water level (i.e., the southwest corner of the security wall) and the southern embankment of the cooling basin,
- Cooling basin bottom at elevation 69 feet (21.0 meters) NAVD 88,
- Side slope of 3 percent for the swale that surrounds the power block area (although the maximum side slope of the swale is 2%, a side slope of 3% is adopted to account for any localized higher slopes), and
- Top of security wall at elevation 90.0 feet (27.4 meters) NAVD 88, which would limit the wave height propagating towards the power block.

Based on these parameters and values, the following results were obtained:

- Minimum required wind duration of about 70 minutes for the given fetch,
- Spectral peak wave period of about 2.9 seconds,

- Wave height of about 0.4 feet (0.12 meters), limited by the top of the security wall, and
- Maximum wave runup of about 0.3 feet (0.09 meters).

Therefore, including conservatively the estimate of 0.3 feet of wave runup, the maximum flood level adjacent to the power block area of VCS is elevation 90.9 feet (27.7 meters) NAVD 88, lower than the design basis flood elevation of 91.0 feet (27.7 meters) NAVD 88, adopted in the SSAR. In addition, this maximum flood level is below the minimum power block finished site grade elevation of 95 feet (29.0 meters) NAVD 88.

SSAR Subsection 2.4.4 will be revised to incorporate the above discussion.

Part 2 – Location of the Cooling Basin Breaches

As shown in SSAR Figures 2.4.4-16 and 2.4.4-17, the distance between the northern embankment of the cooling basin and the security wall is over 500 feet. The area in between is built up (with fill materials) to elevations in the general range of 86 to 102 feet NAVD 88, from the natural grade of about 80 feet (24.4 meters) NAVD 88. A local drainage ditch south of the security wall has invert elevations slightly lower than 86 feet (26.2 meters) NAVD 88. Specifically:

- Along the mid-section, the grade is filled to 102 feet (31.1 meters) NAVD 88 immediately north of the embankment, decreasing to about 92 feet (28.0 meters) NAVD 88 at 400 feet away at the northern edge of the parking lot, before the drainage ditch and the security wall. The grade elevation gradually decreases towards the east and west from the mid-section.

- Along the western end of the security wall, the grade elevation is approximately 94 feet (28.6 meters) NAVD 88 immediately north of the embankment, dropping to 93 feet (28.3 meters) NAVD 88 at 400 feet away to the north.

- Similarly, along the eastern end of the security wall, the grade is filled to 93 feet (28.3 meters) NAVD 88 immediately north of the embankment, and to 92 feet (28.0 meters) NAVD 88 at 400 feet away to the north.

As described above, most of this built-up area is higher than or has similar elevation to the initial cooling basin level of 93.9 feet (28.6 meters) NAVD 88 for the postulated embankment breaches. It is therefore highly unlikely that the cooling basin will breach through the large amount of fill materials placed between the cooling basin and the security wall. Further towards the east and west, the grade elevations continue to decrease gradually, and the probability that a breach might occur increases slightly. Conservatively, the breach analysis in SSAR 2.4.4 postulates that the embankment would fail where the grade elevation immediately to the north of the embankment is below elevation 96.0 feet (29.3 meters) NAVD 88 on the west and 94.0 feet (28.7 meters) NAVD 88 on the east as shown in the revised SSAR Figures 2.4.4-16 and 2.4.4-17 (attached), respectively.

SSAR Subsection 2.4.4 will be modified to include the above discussion and revisions to SSAR Figures 2.4.4-16, 2.4.4-17, 2.4.4-23 and 2.4.4-26. The figures include details on breach locations. Figure 2.4.4-21 will be revised to make the water level scale consistent with the other figures.

Reference

1. U.S. Army Corps of Engineers, Coastal Hydraulics Laboratory, EM1110-2-1100, Coastal Engineering Manual, 2008.

Associated ESPA Revisions:

A new paragraph will be added to the end (after the fifth paragraph) of SSAR Subsection 2.4.4.2.2 in a future revision of the ESPA as indicated:

The embankment breach model evaluation is conducted for two simulation periods. The first model has a 30-minute simulation period and focuses on capturing the peak water level at the power block, which is expected to occur in the 30-minute period after the beach begins. The second evaluation extends the simulation to 96 hours and focuses on the water level and flow hydrographs during the recession period after the arrival of the flood peak at the power block.

SSAR Subsection 2.4.4.2.2.4 will be updated in a future revision of the ESPA as indicated:

The breach model used to study the flood elevations considered that the cooling basin would be initially filled to elevation 93.9 feet (28.6 meters) NAVD 88, which corresponds to the one-half PMP condition on top of the normal maximum operating water level of 91.5 feet NAVD 88 in the cooling basin (Subsection 2.4.8) per the guideline given in ANSI/ANS-2.8-1992 (Reference 2.4.4-3). Three initial, downstream flood levels were considered as part of a sensitivity analysis: (1) elevation 82.0 feet (25.0 meters), (2) elevation 84.0 feet (25.6 meters), and (3) dry conditions. The sensitivity analysis concluded that the maximum flood level at the power block area is not sensitive to the initial downstream flood levels.

For the extended simulation, the dry bed initial condition was specified, as it enables the model to simulate more realistically the flow pattern in the recession period after the flood level at the power block reaches its peak. Based on the topographic setting at the VCS site, the breach flow leaving the cooling basin is expected to be diverted eventually towards lower terrain such as the adjacent Guadalupe River valley on the east and Kuy Creek on the west, as indicated in Figures 2.4.4-25 and 2.4.4-28. The other two initial conditions tested assume that the entire model domain (outside the cooling basin and the area bounded by the security wall) would be filled to 82 feet (25.0 meters) NAVD 88 and 84 feet (25.6 meters) NAVD 88. With the nominal natural grade in the power block vicinity at about 80 feet (24.4 meters) NAVD 88, and lower farther to the east and west in the river valley and creeks, these initial water levels would potentially create a backwater effect and impede flow movement towards lower ground, especially during the recession period. The use of the dry bed initial condition for the extended simulation circumvents this modeling limitation.

The first paragraph of SSAR Subsection 2.4.4.2.2.5 will be updated in a future revision of the ESPA as indicated. This revision incorporates and supersedes the revision of the paragraph previously provided in response to RAI 02.04.04-2 with addition of tested Manning's *n* values:

The surface roughness in the model was represented by Manning's *n* values. Based on the suggested values in Reference 2.4.4-14, Manning's *n* was specified as 0.030 uniformly in the two principal directions (east-west and north-south) throughout the model domain. ~~This value corresponds to pasture flood plains with no brush but short grasses, which are representative of the VCS site.~~ The selected Manning's *n* corresponds to flood plain type terrains occupied by pastures with short grasses, comparable to the general characteristics of the existing conditions at the power block area and vicinity. After construction, the ground between the cooling basin and the power block would consist of paved areas, such as parking lots (see Figure 1.2-2), and gravel/grass covered areas with lower surface roughness. For example, the suggested Manning's *n* values range from 0.013 to 0.016 for asphalt-lined channels and 0.022 to 0.033 for engineered channels with gravel and grass covers (Reference 2.4.4-14).To address the differences in the surface roughness and potential impact on flow resistance, a sensitivity analysis was performed to evaluate the effect of the Manning's *n* on the flood level at the power block area. Manning's *n* values ranging from 0.01 to 0.2 were tested, and the results show that the flood water levels at the power block area are not sensitive to the Manning's *n* values. ~~However, Manning's *n* values of 0.025 and 0.035 were also evaluated as part of the sensitivity testing. The results show that for the range of the Manning's *n* values evaluated, the flood levels are not sensitive to the Manning's *n* value.~~

The second paragraph of SSAR Subsection 2.4.4.2.2.5 will be updated in a future revision of the ESPA as indicated:

The simulations were run for a 30-minute period at a model time step of 0.01 minutes (0.6 seconds), which was selected based on a verification effort to demonstrate that the time~~-~~ step would be independent of the model results. For the extended period simulation of 96 hours, a time step of 0.04 minutes (2.4 seconds) was adopted. The maximum water levels obtained from the two time steps were similar with no noticeable difference.

The first paragraph of SSAR Subsection 2.4.4.2.2.6 will be updated in a future revision of the ESPA as indicated:

~~The minimum finished site grade for the power block is at elevation 95 feet (29.0 meters) NAVD 88, which is higher than in one-half PMP water level at the cooling basin (elevation 93.9 feet or 28.62 meters NAVD 88). In addition, the conceptual site grade abutting the northern embankment of the cooling basin and facing the power block area was set above elevation 93.9 feet (28.62 meters) NAVD 88. Any embankment breach away from the power block area could potentially flood the power block area due to runup. Therefore, two breaching scenarios were considered: (1) cooling basin embankment breaching west of the power block (western breach) area, and (2) cooling basin embankment breaching east of the power block (eastern breach) area. The breaches begin where the finish grade in front of the embankment is below elevation 94.0 feet (28.7 meters) NAVD 88.~~

As shown in Figures 2.4.4-16 and 2.4.4-17, the distance between the northern embankment of the cooling basin and the security wall is over 500 feet (150 meters). The area in between is built up (with fill materials) to elevations in the general range of 86 feet (26.2 meters) to 102 feet (31.1 meters) NAVD 88, from the natural grade of about 80 feet (24.4 meters) NAVD 88. A local drainage ditch south of the security wall has invert elevations slightly lower than 86 feet (26.2 meters) NAVD 88. Specifically:

- Along the mid-section, the grade is filled to 102 feet (31.1 meters) NAVD 88 immediately north of the embankment, decreasing to about 92 feet (28.0 meters) NAVD 88 at 400 feet (122 meters) away at the northern edge of the parking lot, before the drainage ditch and the security wall. The grade elevation gradually decreases towards the east and west from the mid-section.

- Along the western end of the security wall, the grade elevation is approximately 94 feet (28.6 meters) NAVD 88 immediately north of the embankment, dropping to 93 feet (28.3 meters) NAVD 88 at 400 feet (122 meters) away to the north.

- Similarly, along the eastern end of the security wall, the grade is filled to 93 feet (28.3 meters) NAVD 88 immediately north of the embankment, and to 92 feet (28.0 meters) NAVD 88 at 400 feet (122 meters) away to the north.

As described above, most of this built-up area is higher than or has similar elevation to the initial cooling basin level of 93.9 feet (28.6 meters) NAVD 88 for the postulated embankment breaches. It is therefore highly unlikely that the cooling basin will breach through the large amount of fill materials placed between the cooling basin and the security wall. Further towards the east and west, the grade elevations continue to decrease gradually, and the probability that a breach might occur increases slightly. Conservatively, the breach analysis postulates that the embankment would fail where the grade elevation immediately to the north of the embankment is below elevation 96.0 feet (29.3 meters) NAVD 88 on the west and 94.0 feet (28.7 meters) NAVD 88 on the east as shown in Figures 2.4.4-16 and 2.4.4-17, respectively. Therefore, two breaching scenarios were considered: (1) cooling basin embankment breaching west of the power block (western breach) area, and (2) cooling basin embankment breaching east of the power block (eastern breach) area.

The third paragraph of SSAR Subsection 2.4.4.2.2.6 will be updated in a future revision of the ESPA as indicated:

Figures 2.4.4-21 and 2.4.4-22 detail the time history of the simulated flood level at the southwestern corner of the security wall and near the midsection of the security wall on the south side, respectively (model simulations begin at an arbitrarily selected date of 26-April-2008). As indicated in the figures, the flood wave arrives at the southwestern corner of the security wall and the southern entrance to the power block area in about 1 and 14 minutes after the embankment breaches, respectively. Figure 2.4.4-21a provides the predicted water level hydrograph of the extended simulation run, for the first 150 minutes after the postulated breach, at the southwest corner of the security wall where the maximum power block flood level occurs. The maximum still water level occurs within the first 30 minutes of embankment breach. Figure 2.4.4-21b details the water level hydrograph for the entire extended simulation period of 96 hours. As shown in that figure, the water level drops rapidly in the 12 hours past the peak and then more gradually to about 86.3 feet (26.3 meters) NAVD 88 at the end of 96 hours. The reason for the water level not returning to the initial level (i.e., the grade elevation of about 83 feet [25.3 meters] NAVD 88) is that this location of the maximum water level is situated in a drainage ditch, which is surrounded by higher ground of 86 feet (26.2 meters) NAVD 88 and above. Flood water is detained inside this local depression and presents no flood risk to the power block. Figure 2.4.4-21c details the time history of flow leaving the cooling basin. As the figure indicates, the flow leaving the cooling basin is negligible near the end of 96 hours of the postulated embankment breach.

The sixth paragraph of SSAR Subsection 2.4.4.2.2.6 will be updated in a future revision of the ESPA as indicated

~~Coincidental wind setup and wave run-up were not added to~~ Although the highly conservative ~~-~~cooling basin breach flooding levels ~~because these flood scenarios~~ have a short time scale and would not sustain for a period long enough for any considerable wind wave action, coincidental wind wave runup was considered for additional conservatism, and the results are provided in Subsection 2.4.4.3.2.

SSAR Subsection 2.4.4.3.2 will be updated in a future revision of the ESPA as indicated:

The predicted maximum still water level at the power block area for the postulated breaching of the cooling basin northern embankment is at elevation 90.6 feet (27.6 meters) NAVD 88. In accordance with the guidelines in ANSI/ANS-2.8-1992 (Reference 2.4.4-3), the flood level at the plant site considers the effects of wave runup from the coincidental occurrence of a 2-year design wind event. As shown in Figure 1 of ANSI/ANS-2.8-1992 (Reference 2.4.4-3), the 2-year fastest mile wind speed at 30 feet (9.2 meters) above ground at the VCS site is 50 mph (80.5 km/hr). This value is adjusted for duration, wind speed above water, and fetch length, as applicable, to estimate wave runup on the swale slope surrounding the power block area. Methodologies described in the *U.S. Army Corps of Engineers Coastal Engineering Manual* (Reference 2.4.4-18) were used to determine the wave height, wave period, and thus wave runup elevation. In the wind wave analysis, a fetch length of 18,682 feet (5694.3 meters) (the maximum distance between the location of the maximum water level and the southern embankment of the cooling basin), cooling basin bottom at elevation 69 feet (21.0 meters) NAVD 88, maximum swale slope of 3 percent, and top of security wall at elevation 90.0 feet NAVD 88 (which would limit the height of waves approaching the power block area) were used. Based on these parameters and values, the following results were obtained: the minimum wind duration is approximately 70 minutes for the given fetch, the spectral peak wave period is approximately 2.9 seconds, and maximum wave runup is approximately 0.3 feet (0.09 meters). Therefore, the maximum water level adjacent to the power block area of VCS is elevation 90.9 feet (27.7 meters) NAVD 88. After rounding the predicted maximum water level, a value of elevation 91.0 feet (27.7 meters) NAVD 88 is adopted. ~~The effects of wind setup and wave run-up are not considered as the result of the short duration of the flooding incident.~~ This maximum flood level is below the minimum power block finished site grade ~~of~~ at elevation 95 feet (29.0 meters) NAVD 88.

The following reference will be added to SSAR Subsection 2.4.4.4:

2.4.4-18 U.S. Army Corps of Engineers, Coastal Hydraulics Laboratory, EM1110-2-1100, *Coastal Engineering Manual*, 2008.

The following figures in SSAR Subsection 2.4.4 will be revised: 2.4.4-16, 2.4.4-17, 2.4.4-21, 2.4.4-23, and 2.4.4-26.

The following figures will be added to SSAR Subsection 2.4.4 after Figure 2.4.4-21: 2.4.4-21a, 2.4.4-21b, and 2.4.4-21c.

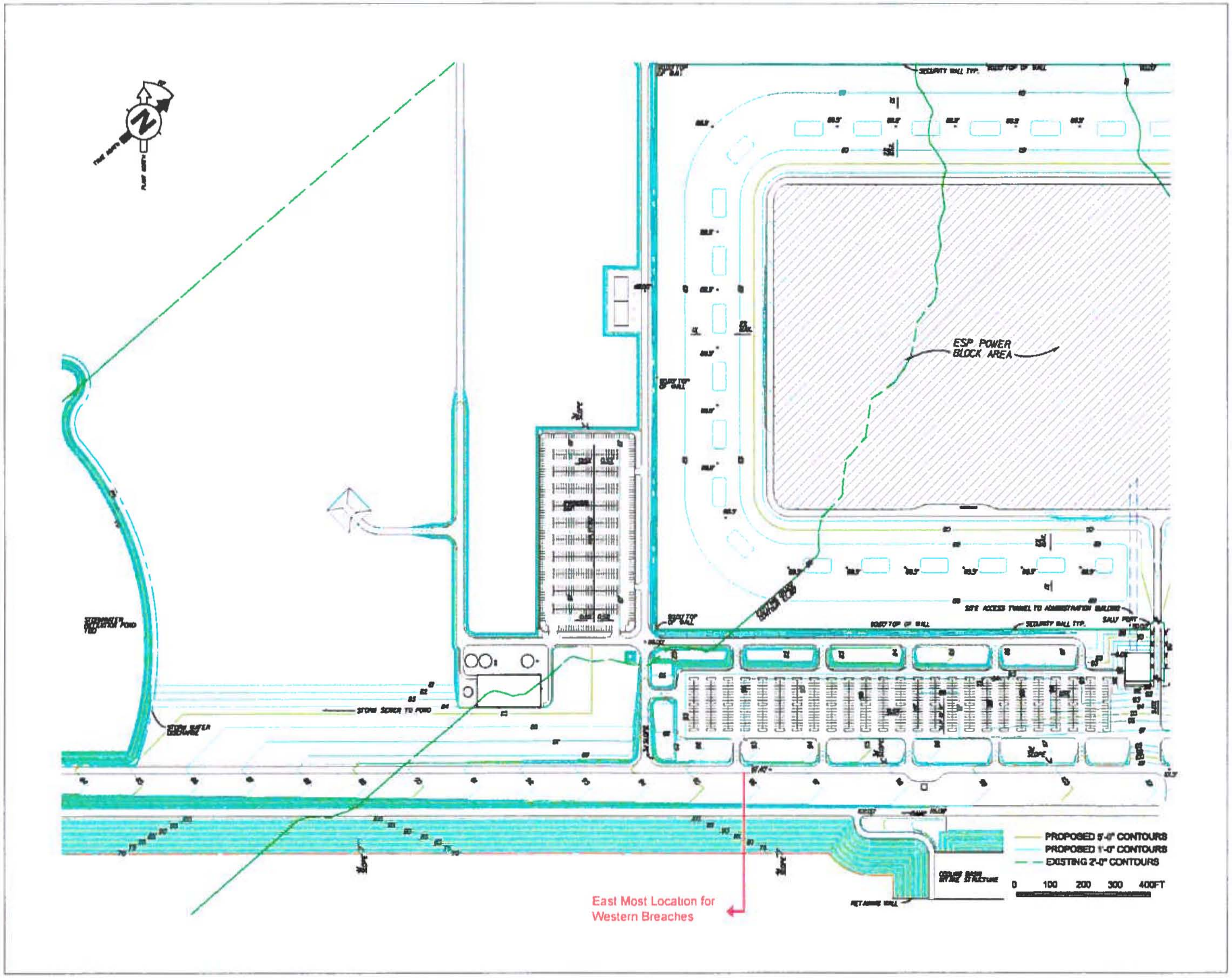

Figure 2.4.4-16 Finish Grading West of the Power Block and Location where Western Breach Begins

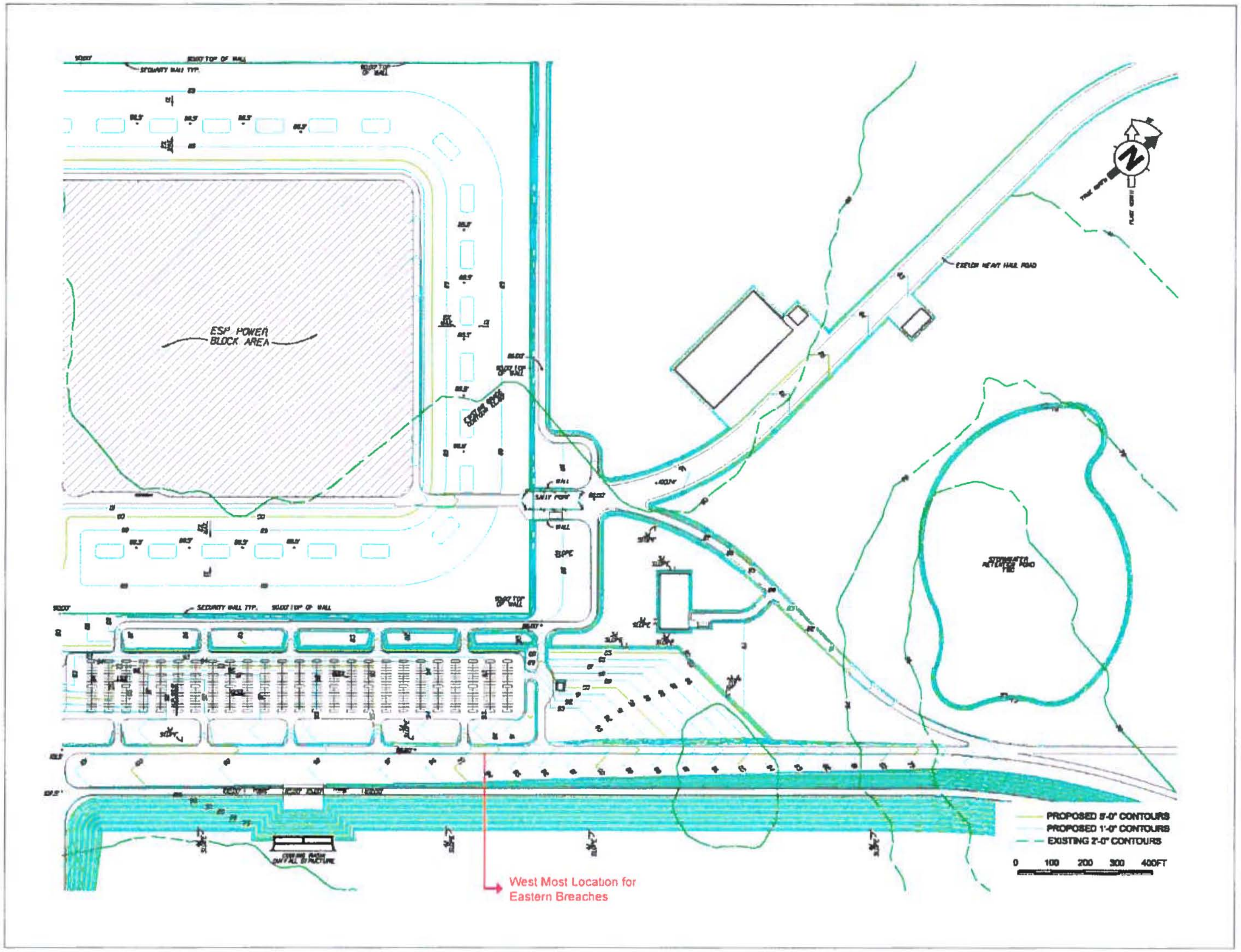

Figure 2.4.4-17 Finish Grading East of the Power Block and Location where Eastern Breach Begins

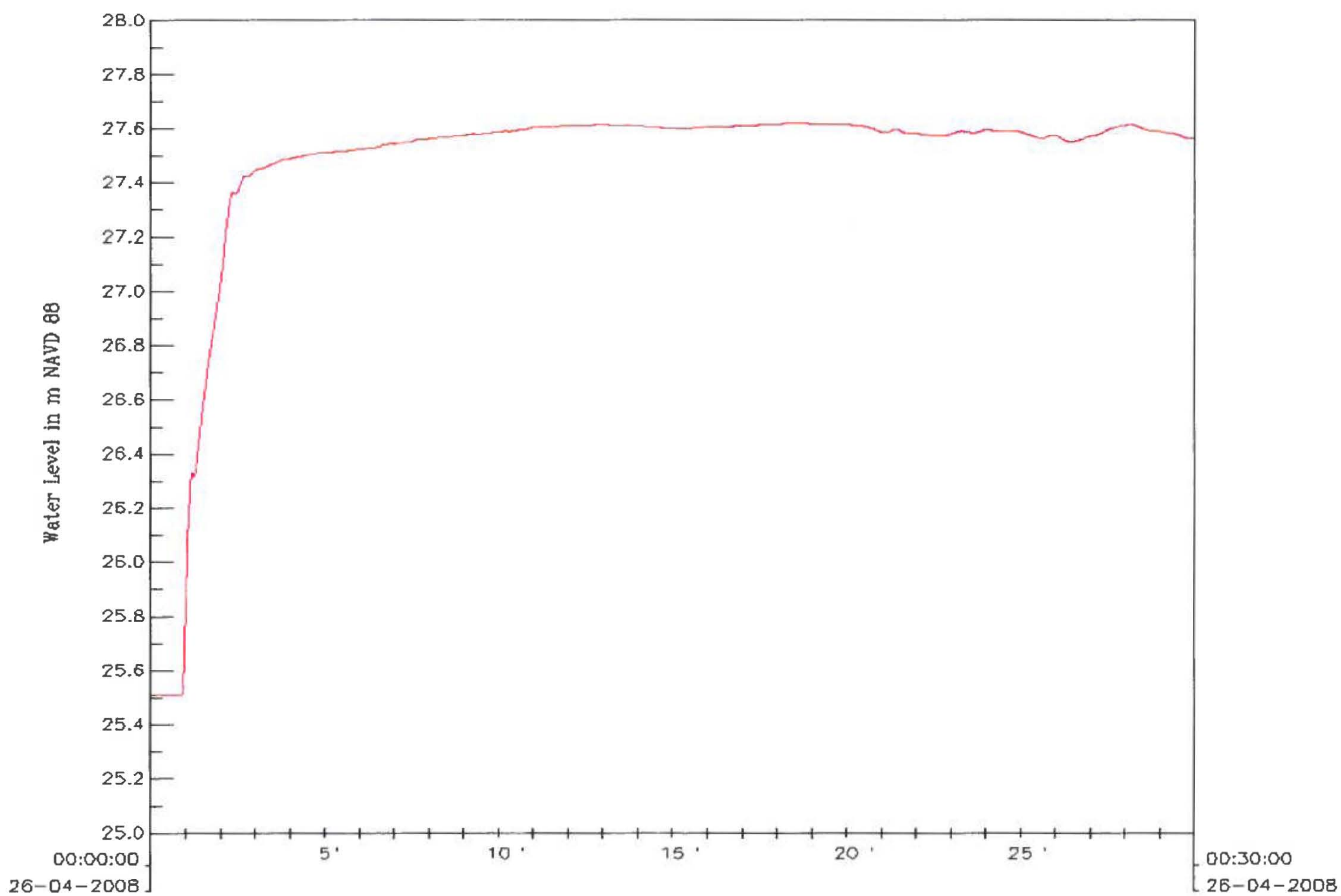

Figure 2.4.4-21 Water Level Time Series at the Southwestern Corner of the Security Wall

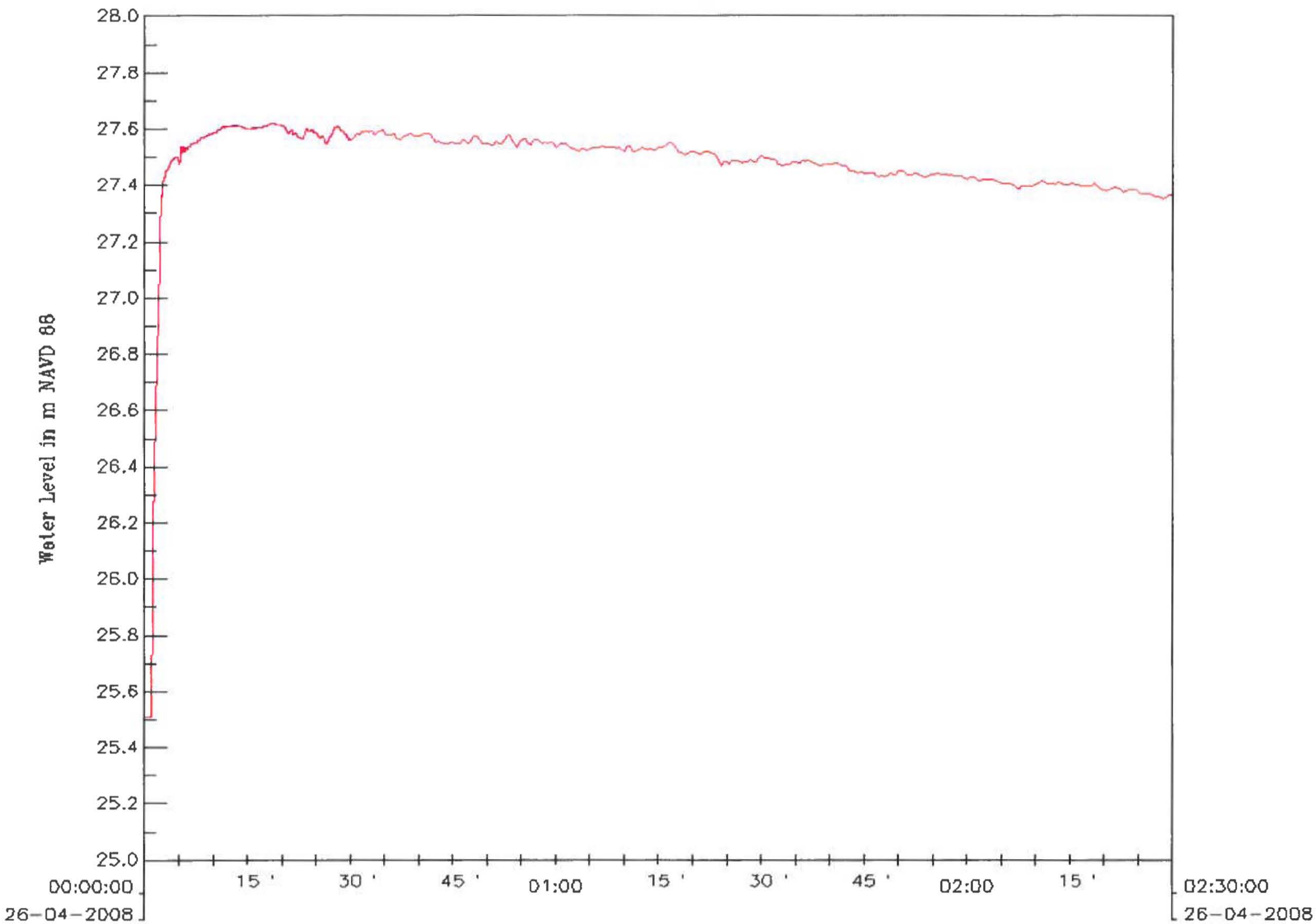

Figure 2.4.4-21a Water Level Time Series at the Southwestern Corner of the Security Wall (water level for the first 30 min. is based on time step of 0.01 min.)

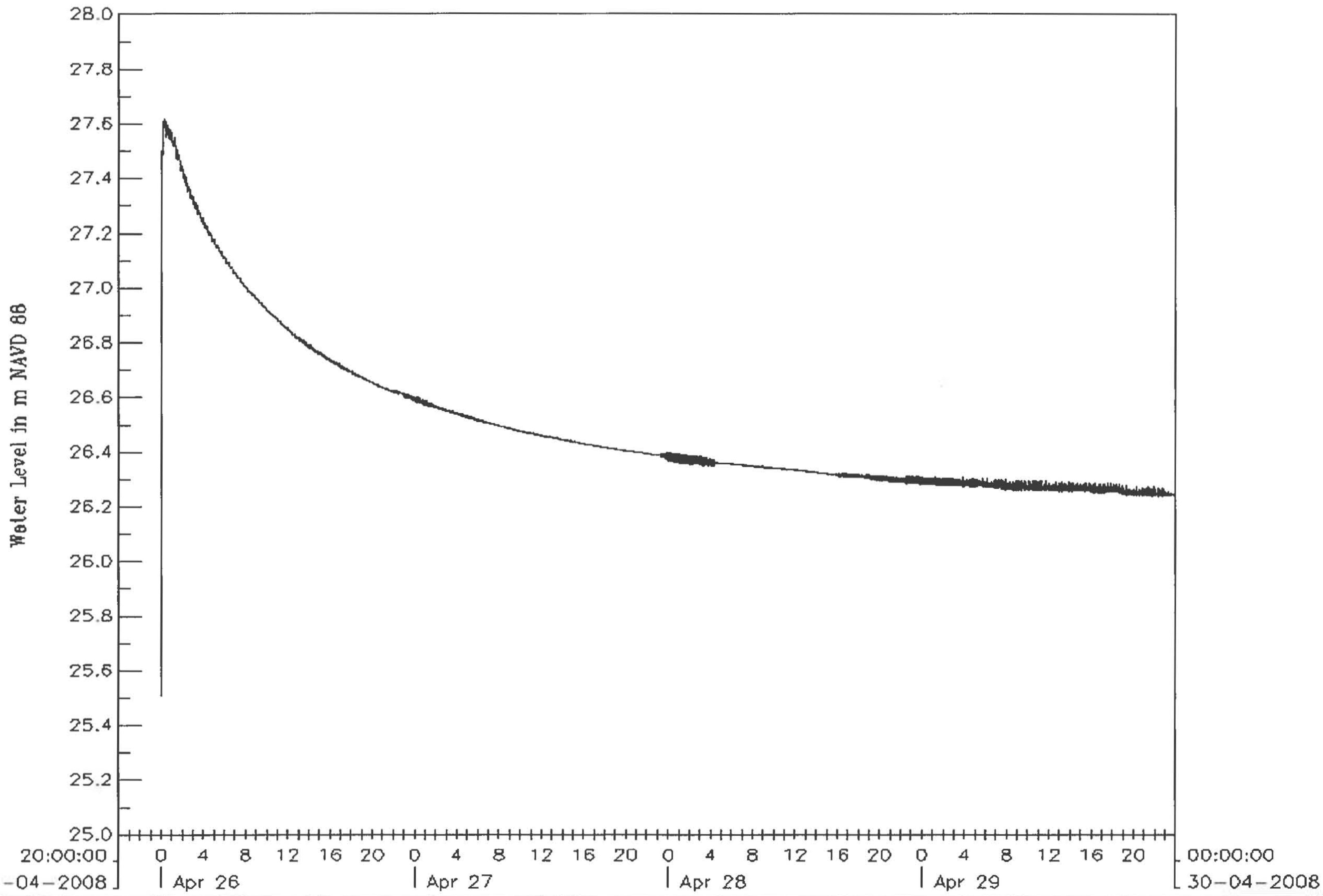

Figure 2.4.4-21b Extended Time History of Water Level at the Power Block where the Maximum Flood Level Occurs

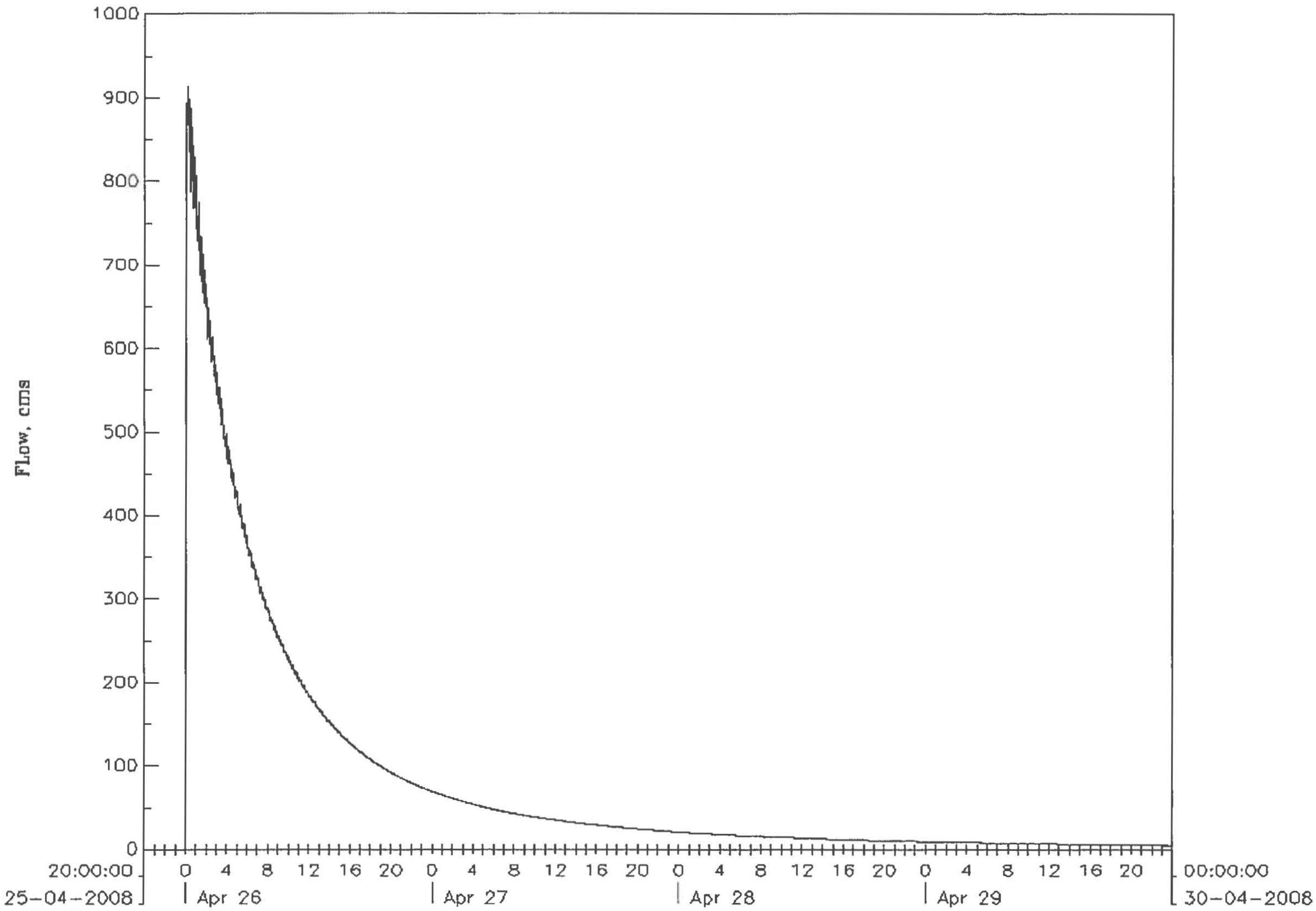

Figure 2.4.4-21c Extended Time History of Breaching Flow from the Cooling Basin

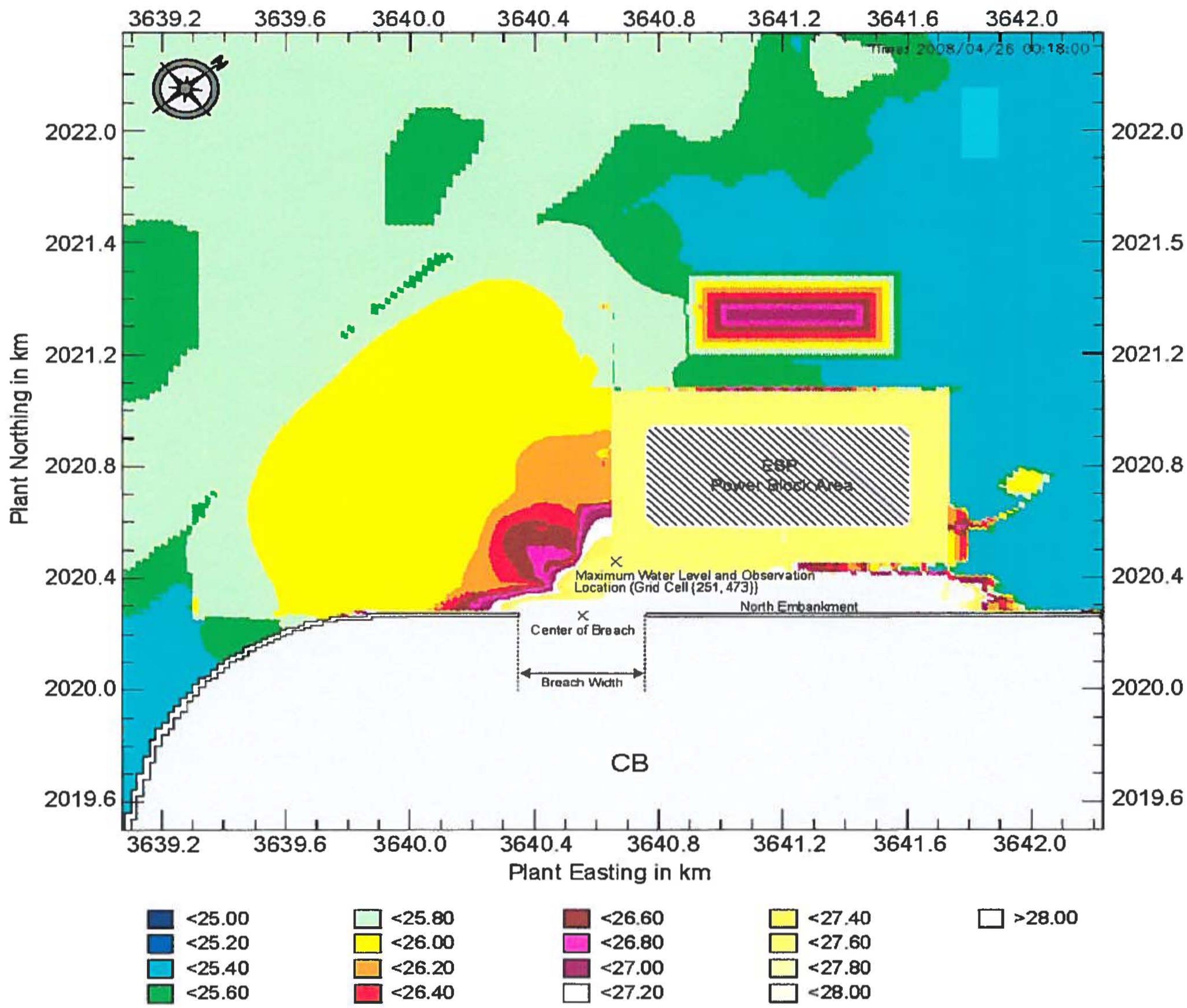

Figure 2.4.4-23 Water Level Contours (in meters, NAVD 88) after 18 Minutes of the Western Cooling Basin Breach

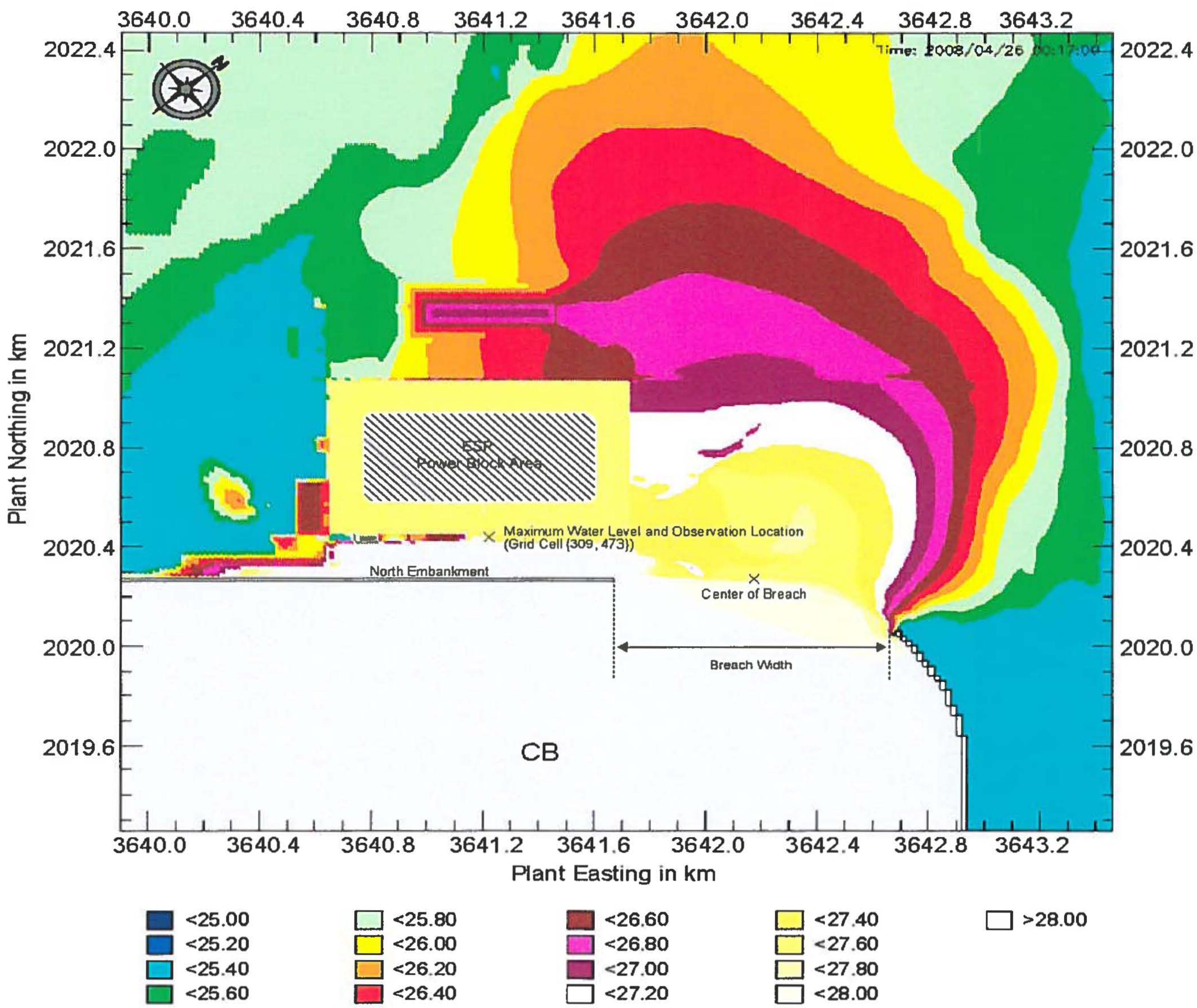

Figure 2.4.4-26 Water Level Contours (in meters, NAVD 88) after 17 Minutes of the Eastern Cooling Basin Breach

ATTACHMENT 2

SUMMARY OF REGULATORY COMMITMENTS

(Exelon Letter to USNRC, NP-11-0040, dated September 1, 2011)

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
Exelon will revise the VCS ESPA SSAR Section 2.4.4 to incorporate the change shown in the enclosed response to the following NRC RAI: 02.04.04-1 (Attachment 1)	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No