UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
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March 18, 2015

MEMORANDUM TO: Steven West, Deputy Director
Office of Nuclear Regulatory Research

FROM: Cynthia D. Pederson, Regional Administrator ***/RA/***

SUBJECT: SUBMITTAL OF POSSIBLE GENERIC ISSUE CONCERNING LOSS OF ULTIMATE HEAT SINK DUE TO STORM-WAVE INTERACTIONS OR SEICHE WITH LOW GREAT LAKES WATER LEVELS

In the winter of 2012-2013 Lake Michigan-Huron reached an all-time low level. The regional office in conjunction with headquarters experts determined that absent any other natural events or other weather-related phenomena there was no safety impact to the plants using Lake Michigan as the ultimate heat sink (UHS). However, based on a review of the issue, a potential vulnerability does exist if severe storm-wave or seiche conditions would occur. This vulnerability exists because in addition to wave action causing levels to rise upward (high level storm surges are in the plants' design and are being reevaluated as part of the post-Fukushima task-force lessons learned), it is also possible that this wave action can cause lake levels to set down or recede based on actual meteorological and hydrological conditions. In discussion with experts in the U.S. Nuclear Regulatory Commission (NRC) as well as other federal partners, the frequency of such events with large enough fluctuations to impact the UHS is not likely, but the actual probability is unknown. It appears the plants are not designed nor licensed for this low level phenomenon. This issue does not present an immediate safety concern.

The enclosed provides the information discussed in Management Directive 6.4, "Generic Issues Program." This issue has been discussed with your office and the Office of Nuclear Reactor Regulation (NRR). It should be noted that the criteria for processing a generic issue (GI) requires seven criteria be met (DH 6.4, paragraph F.1). We realize for one of the items, concerning that the issue's risk can be adequately determined (subparagraph (e)), will require additional information. There is limited information on seiche frequency and magnitude.

Enclosure:
Background Information

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BACKGROUND

IDENTIFICATION OF POSSIBLE LOSS OF ULTIMATE HEAT SINK DUE TO STORM-WAVE INTERACTIONS OR SEICHE CONCURRENT WITH LOW GREAT LAKES WATER LEVELS

In general, the Great Lakes are in the midst of an extended low-water period with all of the Great Lakes levels below their long-term average[1]. Water-levels in Lakes Michigan and Huron (hydrologically connected at the Strait of Mackinac and, therefore, considered to act as one water body) and Lake Superior have been below their long-term average (i.e., 1918-present water-level monitoring) for the past 14 years. This is the longest recorded period of time of sustained low levels in their monitored histories.[2] During the period, December 2012 and January 2013, Lake Michigan-Huron monthly average water level dropped below the lowest previously recorded level (previously in 1964).[3] If water-levels continue to decrease, the UHS operability of the three nuclear power plants adjacent to Lake Michigan-Huron, namely, D.C. Cook, Palisades and Point Beach, could be challenged.

Recently, the U.S. Army Corps of Engineers (USACE) released a bulletin addressing low water-levels in the Great Lakes. The bulletin highlights the difficulty of predicting future Great Lake water-levels based on historical trends:[4]

> *"There are no discernible long term cycles of water levels apparent over our period of record (1918-2012) for Great Lakes water levels. While the historical record shows periods of high and low water, it is not possible to predict with any certainty when/if water levels would return to long term average levels.* ***Lake levels could go higher or lower from their current levels in future years."***

In the absence of a discernible historical trend to predict future Great Lakes water-levels, models have been developed. Some of these models predict that decreased precipitation and increased evaporation in the Great Lakes region will cause prolonged declines in average lake water-levels into the distant future.[5,6] However, these models are generally applied to assess the mean changes over 10-15 year intervals. They do not provide any information about changes in lake-levels over much shorter timeframes. The climate models and the lake models are not typically run in a coupled fashion. The hydrologic model is run with perturbed climate data for some period with the results from the first part of the period being discarded because it is assumed that the lake system is still adjusting to the changed climate state. Therefore, for a 30-year future climate data set, the first 15-years or so are used to "spin-up" the lake model and the next 15 years are examined for impacts from the changed climate.

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[1] Weather and climate patterns are the major drivers of Great Lakes water-levels. Human activities (e.g., dams, dredging, diversions, and withdrawals) and glacial rebound have measurable but relatively small impacts on lake levels.
[2] U.S. Army Corps of Engineers, "Great Lakes Low Levels 2013," Bulletin, June 2013.
[3] National Oceanographic and Atmospheric Administration – Great Lakes Environmental Research Laboratory (NOAA-GLERL), "Great Lakes Water-Level Dashboard" (See March 2013) http://www.glerl.noaa.gov/data/now/wlevels/dbd/.
[4] U.S. Army Corps of Engineers, "Great Lakes Low Levels 2013", Bulletin, June 2013.
[5] U.S. Army Corps of Engineers and Great Lakes Commission, Bulletin, February 2000.
[6] National Oceanographic and Atmospheric Administration – Great Lakes Environmental Research Laboratory, Great Lakes Water Level Dashboard, Multi-Decadal Forecast, Web, accessed 21 Aug 2013. http://www.glerl.noaa.gov/data/now/wlevels/dbd/,

With uncertainty related to the future trends in Great Lakes water-levels and the anticipated record low levels in Lake Michigan-Huron, Region III began a preliminary investigation of the potential impact to nuclear power plant UHS operability in the fall of 2012. Region III interfaced with the Office of Nuclear Regulatory Research (RES), Region I, and the NRR. The Region determined there was no immediate safety issue, but further assessment was needed. The Region established a charter and created a team with regular communication protocols with the USACE and National Oceanographic and Atmospheric Administration's Great Lakes Environmental Research Laboratory (NOAA-GLERL). The focus was to determine if risk existed based on low levels in the Great Lakes. Since the lake-level started very low, this assessment looked at changes to Lake Michigan-Huron that would cause levels to go down further potentially impacting the UHS.

Additionally, storm surges can cause significant short-term fluctuations in lake-levels. When combined with dramatic changes in atmospheric pressure or a sudden drop in the wind speed, storm surges can produce a seiche which is a standing wave that oscillates in a lake as a result of seismic or atmospheric disturbances creating huge fluctuations (see http://oceanservice.noaa.gov/facts/seiche.html). The team looked at seiches that occur on the Great Lakes. While the site's analysis had information on the higher levels produced by a seiche, it became apparent that the wave set down caused by storm surges or seiches were not evaluated. Wave set down is the lake-level drop corresponding to the amount the storm surges up at the opposite end of the lake, or corresponding to the seiche height when the seiche is reflected or released (See attachment 7).

The ability of wave set down in conjunction with low levels in Lake Michigan-Huron to induce cavitation damage to safety-related pumps such as essential service water pumps was investigated as the primary concern to the loss of heat sink. Since Lake Michigan was at historic lows during 2013, the three operating reactors using this as a heat sink were investigated. It was determined there were no issues with the other plants in Region III on Lake Erie or Region I plants on Lake Ontario, as they are less affected by the current climate conditions, and are closer to historic averages. However, wave set down could have some impact on those plants based on wave propagation and seiche activity. Therefore, this submittal is applicable to these plants as well.

Specifically, seiches were investigated as they were judged to pose the greatest threat to UHS operability for the three plants located on Lake Michigan due to their frequency and duration. It was determined that a margin of approximately 5.5–17 feet from the starting lake level exists prior to onset of pump damage. This margin takes into account that forebay levels are typically about 1–2 feet lower than actual lake level.[7] The primary mechanism for pump damage was found to be air ingestion via vortex formation or cavitation via inadequate net positive suction head (NPSH).

Based on the findings of the investigation, it was judged that current lake-levels present no immediate safety issue. However, further investigation into the frequency and severity of storm-wave interactions is strongly recommended as the current licensing basis does not consider the impact of wave set down in conjunction with low lake-levels. This assessment was conducted by surveying the licensing basis of all three Lake Michigan plants. The licensees indicated their licensing basis assumed the set up or high level due to the seiche, but did **not** evaluate the

[7] Attachment 5 captures all of the relevant lake levels at which plant action occurs, or is required to prevent equipment damage.

possible wave set down that would be caused by a storm surge or seiche. Their assessment was consistent with the Final Safety Analysis Reports (FSARs) for these plants.

Initial discussion with NRR indicated that this is likely the case. No detailed licensing basis review was conducted at these sites. Since a seiche of about 10 feet could occur in Lake Michigan, a wave set down of 10 feet would impact the heat sink with some margins as low as 5.5 feet.

APPPLICABLE REGULATORY REQUIREMENTS

- 10 CFR 50.34(a)(1), (a)(3), (a)(4), (b)(1), (b)(2), and (b)(4)
- 10 CFR 50.54, “Conditions of Licenses”
- Appendix A, “General Design Criteria for Nuclear Power Plants”, to 10 CFR Part 50, GDC 2, “Design Bases for Protection against Natural Phenomena”
- 10 CFR 50, Appendix B, Part III, “Design Control”
- 10 CFR 52.79(a)(1)(iii), “Contents of applications; Technical Information in Final Safety Analysis Report”
- 10 CFR Part 100, “Reactor Site Criteria”

In addition to the applicable regulatory requirements for identifying probable maximum surge and seiche flooding hazards, the appropriate sections of the following regulatory guides also apply:

- Regulatory Guide 1.102, “Flood Protection for Nuclear Power Plants,” as it relates to requirements to consider site characteristics important for safety of plant systems, structures and components and the ultimate heat sink intake structure;
- Regulatory Guide 1.27, “Ultimate Heat Sink for Nuclear Power Plants,” as it relates to requirements to consider site characteristics important for safety of the ultimate heat sink intake structure and reliability of the UHS water supply;
- Regulatory Guide 1.59, “Design Basis Floods for Nuclear Power Plants,” as supplemented by best current practices, as it relates to requirements to consider site characteristics important for safety of plant systems, structures and components and the UHS intake structure;
- ANSI/ANS–2.8–1992, “American National Standard for Determining Design Basis Flooding at Nuclear Reactor Sites,” provides the methodology for estimating storm surges and seiches at estuaries and coastal areas on oceans and large lakes;
- JLD–ISG–2012–05, “Guidance for Performing the Integrated Assessment for External Flooding,” provides NRC staff technical guidance for reviewing external flood assessments;
- JLD–ISG–2012–06, “Guidance for Performing a Tsunami, Surge, or Seiche Hazard Assessment,” provides NRC staff technical guidance for reviewing storm surge or seiche hazard assessments; and
- Regulatory Guide 1.70, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants.”

CURRENT DESIGN BASIS

The nuclear generating facilities bordering Lake Michigan-Huron use the largest observed seiche in a 100-year period to determine the design basis seiche. This seiche occurred on

June 26, 1954, and resulted in eight foot waves at Montrose Harbor and ten foot waves at North Avenue. On the eastern shore of Lake Michigan-Huron, waves of 5.5 to 6.2 feet were observed at Michigan City, IN.[8] The design basis seiche for each licensee is listed in Attachment 5.

Wave events such as surges, seiches, or waves are only considered in licensees' FSAR from the standpoint of flooding and wave run-up. As a result, these external hazards are postulated in conjunction with record high lake-levels. This effectively eliminates any possibility for damage to safety-related pumps due to inadequate NPSH or air ingestion. Protection of safety functions from high lake-levels and seiches is being evaluated in conjunction with the Fukushima Lessons Learned. Low levels assessment is not being performed.

The wave set down resulting from a surge, seiche, or wave is not analyzed or discussed in the FSAR of Point Beach, Palisades, or DC Cook from a record low level standpoint. Furthermore, the Palisades FSAR section 2.2.2.3.b states that:

> *"There is no recorded evidence of short-time variations in lake-levels (seiches) along the eastern shore of Michigan that would be expected to affect the Plant site."*

If the design basis seiche is applied in conjunction with record low lake-level, the Palisades safety-related pumps would be rendered inoperable from a technical specification standpoint. However, a margin of approximately 6.8 feet of lake-level exists prior to onset of pump damage. The margin to pump damage varies from 3.7-6.8 feet amongst the Point Beach, Palisades and DC Cook nuclear plants.

DISCUSSION

The 1954 seiche has been studied in detail, and it has been suggested that this seiche was caused by a squall-line which traveled across Lake Michigan-Huron at a speed of about 66 mph and was accompanied by an atmospheric pressure jump of 0.1 in. Hg with winds of up to 60 mph.[9] It has been postulated that the amplitude of a deep water wave associated with this event was magnified due to "Proudman resonance."[10] This phenomenon is experienced when squall lines travel from northwest to southeast at a characteristic speed.

Based on interactions with experts at the NOAA-GLERL and extensive modeling done by a researcher, Dr. Wu[11], in the field of Great Lakes wave generation, it was concluded that a storm-wave interaction or seiche **can** cause wave set down which impacts Palisades and DC Cook, contrary to the current design basis. Supporting evidence for this conclusion can be found in an event which occurred on April 10, 2013, in which forebay levels at Palisades and DC Cook were decreased by a maximum of 1.7 feet and were disrupted by oscillatory wave motion for a period of about 20 minutes, evidence of a seiche.[12]

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[8] Ewing, Press, and Donn, "An Explanation of the Lake Michigan Wave of 26 June 1954", Science, Vol. 120, No. 3122, pg. 684-686, 1954.
[9] Ewing, Press, and Donn, "An Explanation of the Lake Michigan Wave of 26 June 1954", Science, Vol. 120, No. 3122, pg. 684-686, 1954.
[10] Ewing, Press, and Donn, "An Explanation of the Lake Michigan Wave of 26 June 1954", Science, Vol. 120, No. 3122, pg. 684-686, 1954.
[11] Bechle and Wu, "The Lake Michigan Meteotsunamis of 1954 revisited", Natural Hazards, Vol 74, Iss 1, pg 155-177, 2014.
[12] Attachment 3 and 4, 10 Apr 2013 forebay level logs for DC Cook and Palisades nuclear generating station.

On April 10, 2013, a storm front passing from northwest to southeast across the southern basin of Lake Michigan-Huron generated a seiche.[13] There are no NOAA-GLERL deep-water wave measurement buoys in the immediate vicinity of Palisades or DC Cook, so no wave height data in the vicinity of the intake structures is available (this information is of interest because the intake structures are located in deep water).[14] However, NOAA-GERL wave models predict that this storm produced waves of 1.7 to 3.5 feet in the vicinity of the intake structures to these facilities.[15] This leads to the conclusion that waves are indeed transmitted through the under-lake intake structures and can disrupt forebay water levels.

Also of note, the winds associated with the April 10, 2013, storm event do not appear to be associated with a strong change in barometric pressure or squall line, which has been suggested to magnify the severity of a group of waves or seiche.[16,17] Yet, the April 10, 2013, storm event caused an impact to the site, which was noticeable. This is also contrary to the Palisades FSAR statement that discusses the effect of a seiche on the site. It is to be noted that the amplitude and frequency of a seiche are important in determining its potential effect on plant operation.

A researcher studying storm wave interactions on Lake Michigan (commonly referred to as “meteotsunamis”) has suggested that the 1954 wave event may not be a worst case scenario, stating that “...”meteotsunami” waves reported in the Great Lakes are primarily meteorologically induced, some with heights similar to large seismic tsunamis on the Coasts.”[18] An example of this type of wave event occurred May 27, 2012, on Lake Erie and produced seven foot waves near Cleveland, OH.[19]

In conclusion, local shoreline bathymetry prevents wave run-up due to a seiche from being a threat to UHS operability; however, wave transmittal through intake structures in combination with low Lake Michigan-Huron levels may be a threat. Therefore, it may not be conservative to assume that a seiche cannot impact the sites on low levels caused by storms or seiches, as assumed in the FSAR.[20] It is for this reason that Region III recommends that licensees analyze the impact of seiches in conjunction with low lake water-level.

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[13] Attachment 1 and 2, 10 Apr 2013 weather radar and wind speeds in the Lake Michigan-Huron basin during the storm-wave interaction.
[14] See Attachment 6 for a generic intake structure configuration.
[15] National Oceanographic and Atmospheric Administration – Great Lakes Environmental Research Laboratory, Great Lakes Observing System – Great Lakes Costal Forecasting System (GLCFS), GLCFS point query, Web, accessed 22 Aug 2013. http://data.glos.us/glcfs/
The following coordinates were used to access information from the model:
DC Cook - (41.9757 latitude, -86.5860 longitude)
Palisades - (42.3249 latitude, -86.3167 longitude)
[16] Wu, “Understanding and Characterizing Meteotsunamis in the Great Lakes”, Summary for a proposal to the National Science Foundation.
[17] Ewing, Press, and Donn, “An Explanation of the Lake Michigan Wave of 26 June 1954”, Science, Vol. 120, No. 3122, pg. 684-686, 1954.
[18] Wu, “Understanding and Characterizing Meteotsunamis in the Great Lakes”, Summary for a proposal to the National Science Foundation.
[19] Anderson, Schwab, Lombardy, LaPlante, “Detection and Modeling of a Meteotsunami in Lake Erie During a High Wind Event on May 27, 2012.” Poster, American Geophysical Union Fall 2012 Meeting.
[20] Attachment 5 lists the design basis of the nuclear stations adjacent to Lake Michigan-Huron.

RISKS

There are no formal models that NOAA or USACE have to assess the frequency of occurrences for seiches, their heights and durations of occurrence. Current academics and NOAA scientists are reviewing this issue, but no model exists. The FSAR for all the Lake Michigan plants used empirical information (based on seiches that occurred in the past half century) to estimate a seiche impact only for wave set up (i.e., flooding) and not for wave set down which could adversely affect intake to the UHS.

The impact on the ultimate heat sink if low levels occur is also not well assessed. The calculations at the site provide a cavitation and a loss of suction value based on a certain lake height. Level below this vortexing/cavitation value may not cause a loss of the pump if it exists only for a very short period of time. A seiche induced wave set down could occur from several minutes to several hours. Finally, strategies to protect a pump if a seiche were to occur (for example, placing pump in standby to save it during set down) do not exist.

In summary, it is hard to quantify the risk impact based on low levels in Lake Michigan. It is possible that these seiches can cause both low and high levels which could affect plant operation.

LICENSING ACTIONS

Licensees were briefed on these actions. All licensees briefed indicated they would investigate long term effects of low levels on Lake Michigan. However, no licensee has indicated they would take action to evaluate the low level set down from transient affects caused by storm surges.

CURRENT CONDITIONS

Although a large setdown from a seiche could still challenge the ultimate heat sink, Lake Michigan levels have recovered quickly and significantly since 2013, increasing the margin of safety. Current levels in the beginning of 2015 are about 3 feet higher than the all-time low and close to average levels. One unintended effect of levels recovering rapidly was the required trips of both DC Cook units this fall. During a strong storm on October 20, 2014, wave action uprooted previously exposed Lake Grass, and this Grass mixed with sand clogged the plant's traveling screens. This caused a loss of circulating water and main condenser vacuum; however, the safety systems were adequately protected by safety related strainers and no impact occurred.

OTHER GENERIC CONSIDERATIONS

The Region 3 team discussed these issues with Headquarters and the other Regions to see if the effects were more generic. Without conducting an exhaustive search, the team concluded that the seiche setdown effect could affect other plants on the Great Lakes, but to a lesser extent. There are three main considerations:

1. Can a seiche occur?

2. Is the ultimate heat sink directly the Great Lake or is there a reservoir that serves this purpose for the plant's licensing basis?

3. How low is the current Lake level in reference to a level which can cause loss of suction on ultimate heat sink pumps?

Seiches can occur on all the Great Lakes; some plants, like Fermi have a protected UHS thereby removing the impact by transient seiches. Region I plants on Lake Ontario could be at some risk, but the starting level in that Lake has been within a foot of the average most of the time.

Outside of the Great Lakes, another point of consideration is whether or not there are other weather events that could cause the rapid loss of heat sink water. The team working with headquarters experts looked at possible seiches in the Gulf of Mexico; setdown during large, hurricane storm surges; and earthquakes or mechanical events causing outsurges. The review was not exhaustive, but served to see if there were any immediate concerns not under review. On the first question, the Gulf of Mexico is semi-enclosed so a seiche with some setdown could occur. However, there is not much historical evidence of large seiche wave action. On the second question, anytime you have waves breaking against a shoreline or structure you will have both wave setup and wave set-down (relative to the still water level). Wave theory says that the set-down should be on the order of 5 percent of the height of the breaking wave. So wave set-down on an open coast should not be an issue. Regarding the earthquake effects, previously NRO had worked with US Geological Service (USGS) for tsunami effects from a submarine landslide off the Atlantic Coast for a license review. This was reviewed for high level effects. On the recent question of low level effects, the USGS expert believed that although the drawdown would exist, the positive amplitude phase overruns the negative phase during propagation across the continental shelf and the drawdown would not be significant. The expert acknowledged the maximum drawdown was not explored in detail.

In conclusion, although there are other potential areas for review as there are open questions, the Lake Michigan seiche effects appear to standout as the most concerning based on the size of seiches and the known effects on these plants.

RECOMMENDATIONS

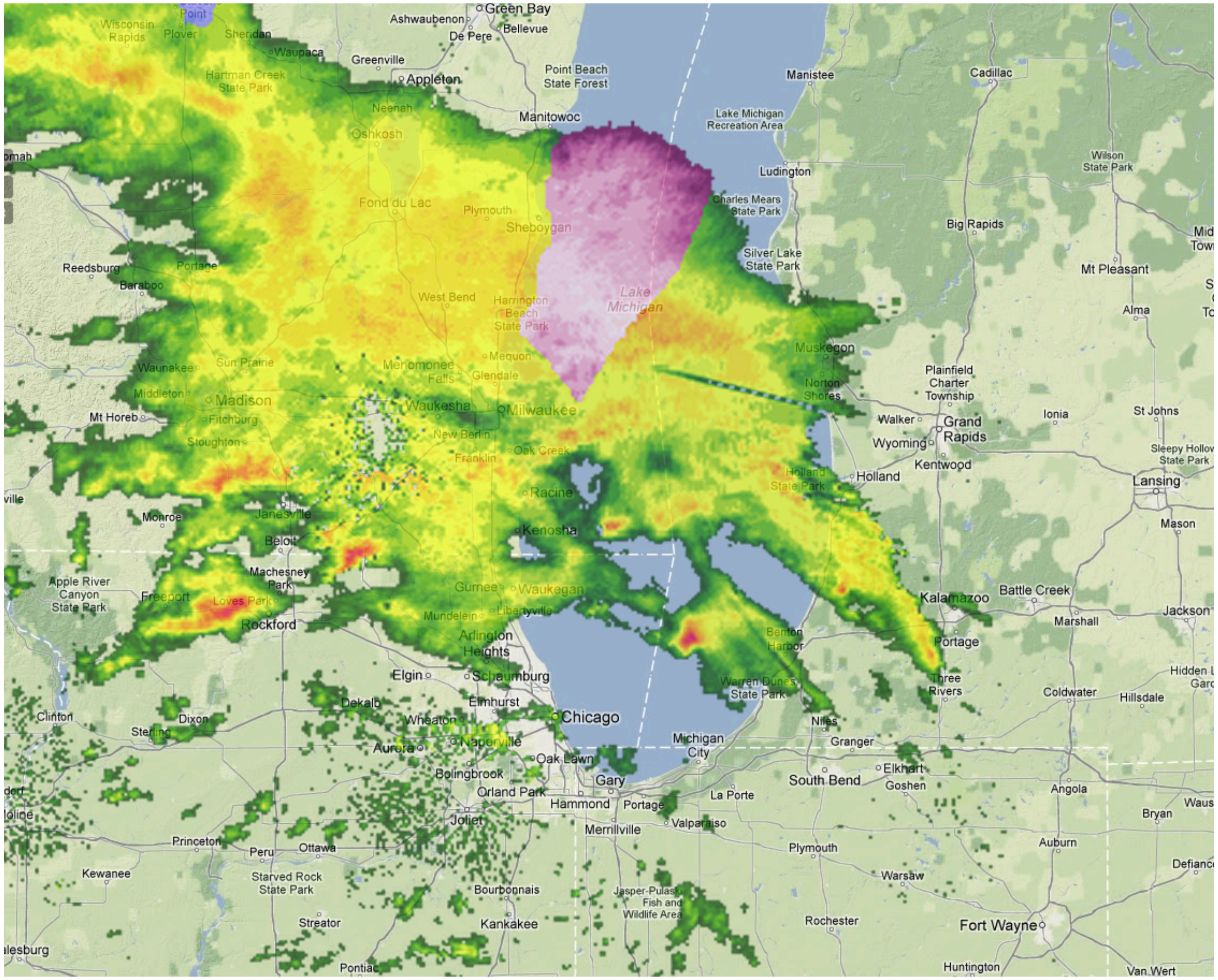
- Calculate the level at which vortices will form at service water pump suctions, which induces pump air ingestion. Evaluate current calculations that determine minimum submergence to prevent pump suction vortex formation for applicability. These calculations utilize empirical formulae (from American National Standard for Pump Intake Design, ANSI/HI 9.8-1998 pg. 32), which may be invalid in a dynamic (sloshing) forebay environment.

- Construct a model to determine wave set down at the intake structure of Palisades and DC Cook. This event can help correlate the effect of storm-wave interactions on forebay levels.

- Continue collaboration with the Great Lakes Environmental Research Laboratory to develop a predictive model to estimate potential magnitudes for wave set down. This model, in addition to the current six-month lake still water level prediction models (updated monthly), could be used to assess safety impacts with a reasonable lead time to facilitate licensees' development of adequate operational procedures.

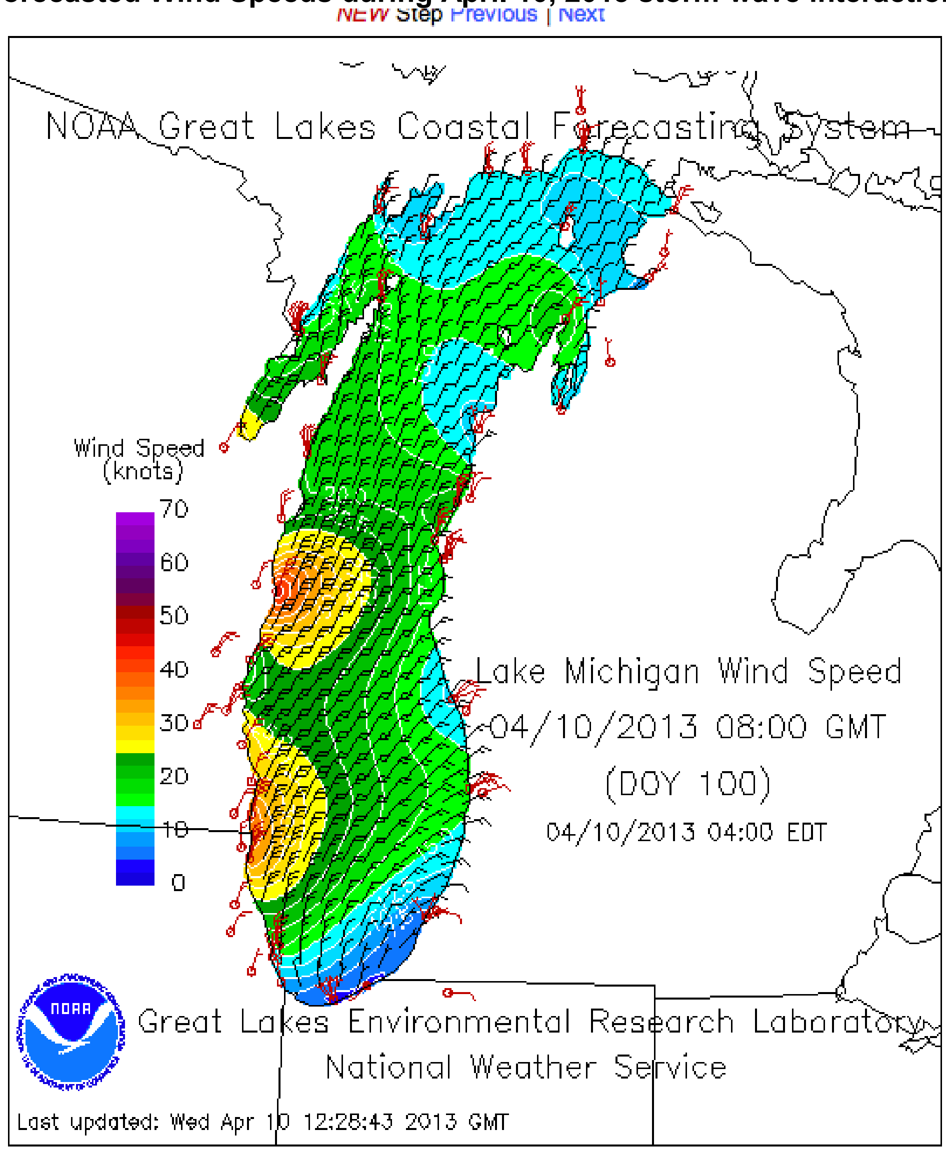
- Determine if a Generic Safety Issue exists for storm surge and seiche effects to the UHS.
- Determine probability of seiche occurrences to support risk modeling of seiches and storm surges.
- Discuss with NOAA having a joint NRC/NOAA buoy.
- Discuss with licensees the advantage of installing buoys near their intake structures as input to storm surge and seiche assessments, and to verify modeling results. NOAA is interested in sharing data and possible cost sharing for the buoys.

Weather radar during April 10, 2013 storm-wave interaction (Doppler)

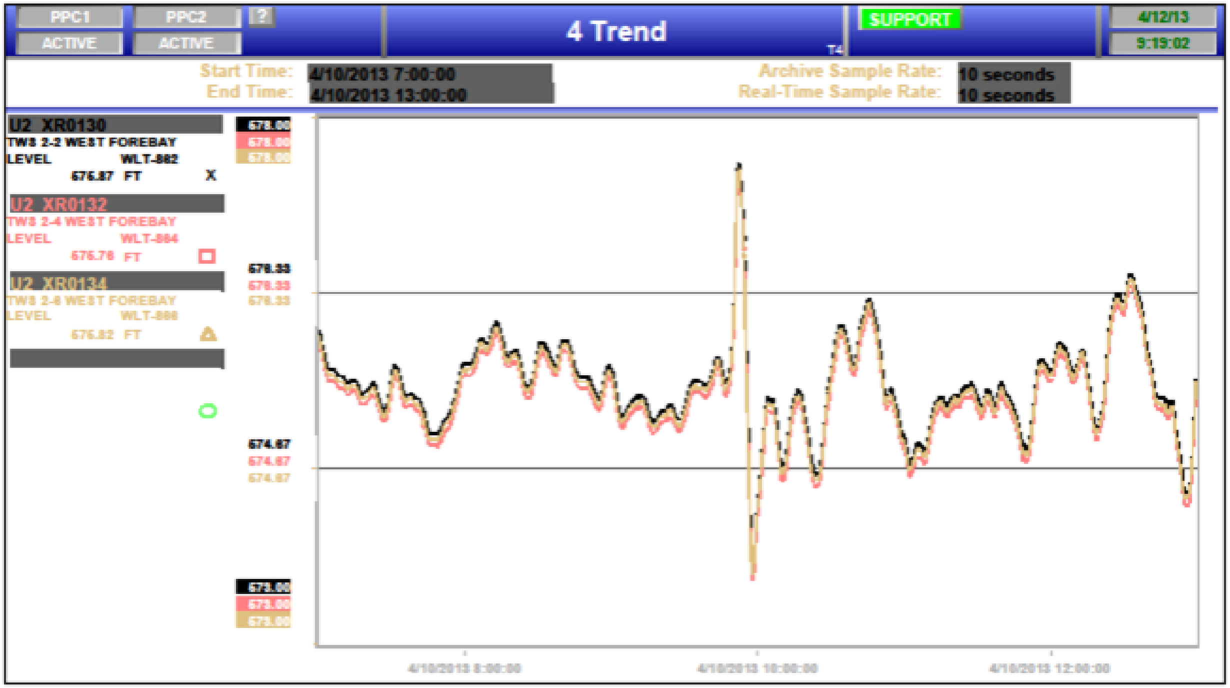


Attachment 1

Forecasted Wind Speeds during April 10, 2013 storm-wave interaction

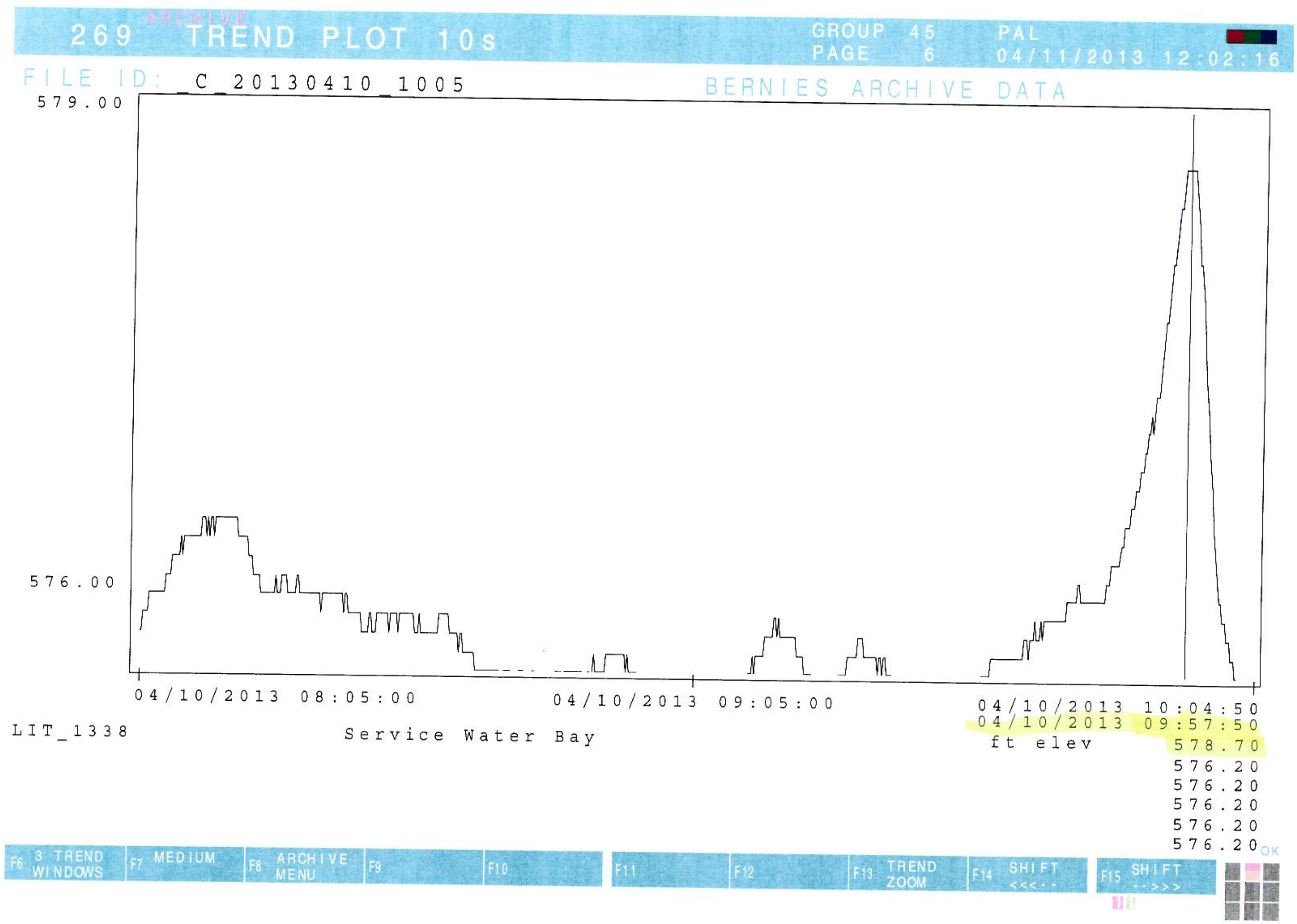


DC Cook forebay water level logs for April 10, 2013



Attachment 3

Palisades forebay water level logs for April 10, 2013



Michigan-Huron Low Lake Water Level Milestones [1]

Nuclear Plant	Plant Grade	Tech Spec Operability Forebay Level	Minimum Forebay Level Required for Pump Operation	Unusual Event Forebay Level	Alert Forebay Level	Unit Trip Forebay Level	Design Basis Seiche	Design Basis Flood[2]	Design Basis Deep Water Wave Runup
DC Cook	607.25	None	560.25	None	None	561.25	11	23	3.7
Palisades	589	568.25	557.25*	572	569	572	10.9	10.9	8
Point Beach	580.9 (0 feet)	569.9 (-11 feet)	561.5 (-19.4 feet)	565.9 (-15 feet)	561.9 (-19 feet)	567.9 (-13 feet)	2	4.14 (+5.84 feet)	6.72 (+8.42 feet)

- Lake Michigan-Huron's January 2013 monthly mean water level set an all-time record low at 576.02 ft. Previous low level record of 576.05 set in Mar-Apr 1964.
- Current average Lake Level is 578 feet.
- All information current as of June 2013.
- *A weir at approximately 568 feet essentially isolates the lake from the pump suction; therefore, in a short period of time levels lower than 568 will cause loss of suction.

Note 1: All elevations listed above have been converted to 1985 International Great Lakes Datum (IGLD 1985); deviation from source documents is listed below:

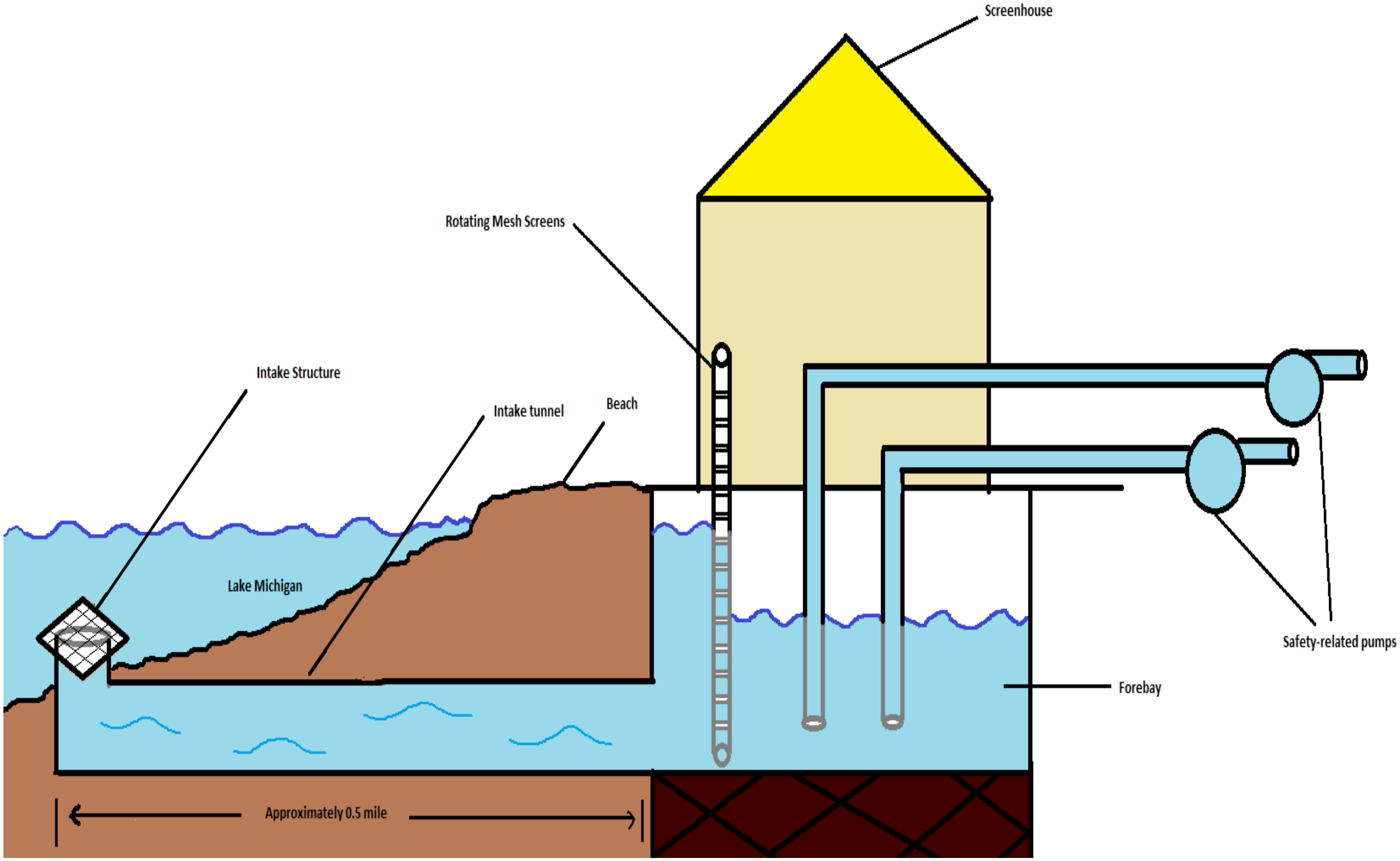
Per FSAR 2.6.2.3 all DC Cook elevation references are National Geodetic Vertical Datum 1929 (NGVD 1929), elevation value converted to IGLD85 using the following conversion equation: IGLD 1985 = NGVD 1929–0.752'.

Per FSAR 2.5 all Point Beach elevation references are IGLD 1955. Reported values converted to IGLD 1985 using the following equation: IGLD 1985 = IGLD 1955 + 0.7'

Emergency action levels and Technical Specifications do not reference lake-level; all refer to Forebay level which is typically about 1 ft. lower than lake-level.

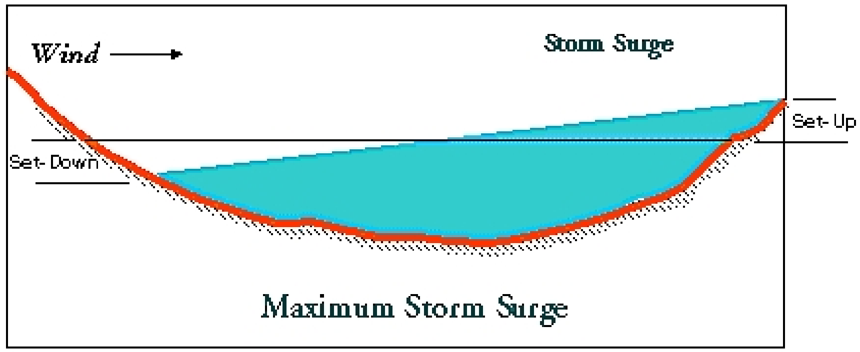
Note 2: For the purposes of design basis DC Cook uses a 23 ft. deep water wave, Palisades uses a 10.9 ft. surge, and Point Beach considers separate cases of both a 4.14 ft. storm surge and a 23.5 ft. deep water wave coincident with record high lake-levels (581.9 ft. / +1.7 feet). The Palisades design basis wave run-up is based on the intake pump house as a limiting structure.

Generic intake structure layout for UHS of plants bordering Lakes Michigan-Huron



Palisades: Intake structure is approximately 3000’ into lake and lies in 15’ of water.
DC Cook: Intake structure is approximately 2500’ into lake and lies in 25’ of water.

Generic intake structure layout for UHS of plants bordering Lakes Michigan-Huron



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Office of Nuclear Regulatory Research

FROM: Cynthia D. Pederson, Regional Administrator ***/RA/***

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In the winter of 2012-2013 Lake Michigan-Huron reached an all-time low level. The regional office in conjunction with headquarters experts determined that absent any other natural events or other weather-related phenomena there was no safety impact to the plants using Lake Michigan as the ultimate heat sink (UHS). However, based on a review of the issue, a potential vulnerability does exist if severe storm-wave or seiche conditions would occur. This vulnerability exists because in addition to wave action causing levels to rise upward (high level storm surges are in the plants' design and are being reevaluated as part of the post-Fukushima task-force lessons learned), it is also possible that this wave action can cause lake levels to set down or recede based on actual meteorological and hydrological conditions. In discussion with experts in the U.S. Nuclear Regulatory Commission (NRC) as well as other federal partners, the frequency of such events with large enough fluctuations to impact the UHS is not likely, but the actual probability is unknown. It appears the plants are not designed nor licensed for this low level phenomenon. This issue does not present an immediate safety concern.

The enclosed provides the information discussed in Management Directive 6.4, "Generic Issues Program." This issue has been discussed with your office and the Office of Nuclear Reactor Regulation (NRR). It should be noted that the criteria for processing a generic issue (GI) requires seven criteria be met (DH 6.4, paragraph F.1). We realize for one of the items, concerning that the issue's risk can be adequately determined (subparagraph (e)), will require additional information. There is limited information on seiche frequency and magnitude.

Enclosure:
Background Information

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