**DATA REQUEST**

**AG-KIUC 1_1**

Refer to the Application in the first paragraph wherein it states the Company applies to the Commission for "approval of accounting treatment to establish a regulatory asset to accumulate and defer for later review and recovery the of the costs of the Mitchell Cooling Tower Project" and in paragraph 26 wherein it states: "The Company proposes to accumulate and defer the costs of the Mitchell Cooling Tower Project, including Construction Work in Progress, until the costs can be incorporated into the Company's proposed Generation Rider, if the Generation Rider is approved in Case No. 2025- 00257. Alternatively, if the Generation Rider is not approved in Case No. 2025-00257, the Company proposes to accumulate and defer the costs of the Mitchell Cooling Tower Project until the costs can be included in its rate base in a subsequent base rate case or other appropriate mechanism. To that end, the Company requests Commission approval to establish a regulatory asset and a deferral, including a return on the unamortized balance at the Company's approved weighted average cost of capital."

a. Confirm that the costs of the Mitchell Cooling Tower Project are not an "expense," as that term is defined for GAAP and FERC USOA purposes.

b. Confirm the costs of the Mitchell Cooling Tower Project are capital expenditures and that they will be recorded to CWIP, regardless of whether the costs are recovered through base rates or included and recovered in the Generation Rider (Tariff G.R.) adopted in Order 2025-00257.

c. Explain in detail the basis and provide all reasons for the Company's request for an alternative accounting treatment wherein it proposes to record the costs to a regulatory asset instead of to CWIP.

d. Confirm the Company records AFUDC on all qualifying construction expenditures in accordance with GAAP and the FERC USOA and does so without specific authorization from the Commission in the normal course of business.

e. Confirm the costs of the Mitchell Cooling Tower Project will qualify for AFUDC without specific authorization from the Commission in the normal course of business unless the Commission approves CWIP in rate base ratemaking recovery. If denied, then provide all support the costs will not qualify for AFUDC.

f. Confirm that the Generation Rider adopted by the Commission in Case 2025-00257 includes CWIP in rate base and also includes an AFUDC offset so there is no revenue requirement effect during the construction period. If this is not correct, then provide a corrected statement and provide all support relied on for the corrected statement.

**RESPONSE**

a. Confirmed.

b. Confirmed.

c. Given the approval of the Generation Rider in Case No. 2025-00257, the Company is proposing that capital costs incurred during construction of the cooling tower be recorded to construction work in progress (CWIP). The Company is proposing that all other non-capital expenses associated with the cooling tower, such as engineering and related work required to investigate potential alternatives, depreciation expense and a pre-tax WACC return on rate base/construction work in progress, incremental property tax expense and incremental O&M expense be recorded to a regulatory asset. Please refer to page 15 of Company Witness Wolffram's Direct Testimony.

d. It is the Company's normal practice to record AFUDC on all qualifying construction facilities except when the Commission grants authority to deviate from this practice, as the Company is proposing in this case. Please see the Company's response to KPSC 1_25 for an explanation as to why the Company proposed CWIP recovery in this instance.

e. Confirmed.

f. Confirmed in part. If the Commission approves CWIP treatment for capital costs incurred during construction, then the Company would not record AFUDC and thus no offset would be needed.

Witness: Tanner S. Wolffram

Kentucky Power Company
KPSC Case No. 2026-00001
AG-KIUC's First Set of Data Requests
Dated March 20, 2026

**DATA REQUEST**

**AG-KIUC 1_2** Refer to the Direct Testimony of Tanner Wolffram at 15 wherein he lists the costs the Company seeks to defer to a regulatory asset as follows: "This regulatory asset would correspond to those costs associated with the Mitchell Cooling Tower Project, including engineering and related work required to investigate potential alternatives, depreciation expense and a pre-tax WACC return on rate base/construction work in progress, incremental property tax expense and incremental O&M expense."

a. Confirm that the costs of Mitchell property tax expense were retained in the base revenue requirement in Case 2025-00257 and not included in the Generation Rider.

b. Indicate whether the Company's definition of "pre-tax WACC return" is the grossed-up rate of return or the WACC. If the latter, confirm that the rate base/construction work in progress CWIP would be reduced by the ADIT related to the grossed-up rate of return deferred to the regulatory asset, effectively resulting in a net of tax return deferred to the regulatory asset. If this is not correct, then provide a corrected statement and all support relied on for your response.

**RESPONSE**

The Company objects to the extent the request mischaracterizes Company Witness Wolffram's Direct Testimony. Without waiving this objection, the Company states as follows:

a. The Company objects to the extent this request calls for a legal conclusion. The Company further objects that the Commission's Order in Case No. 2025-00257 speaks for itself. Without waiving these objections, the Company states as follows. Confirmed.

b. Pre-tax WACC return is the grossed-up rate of return. That said, to the extent the Commission approved CWIP recovery as the Company proposes, there would be no ADIT offset until the plant is placed in service, because the Company would not be accruing AFUDC, as explained in the Company's response to KPSC 1_1 subpart f.

Witness: Tanner S. Wolffram

**DATA REQUEST**

**AG-KIUC 1_3** Refer to the Direct Testimony of Tanner Wolffram at 17 wherein he states the following: "Should the Generation Rider be approved, costs recoverable through this mechanism would begin with the Company's February 2027 Generation Rider update with rates to begin with the April 2027 billing period. The Company would reflect CWIP and other initial costs for the Project in the Generation Rider until the new cooling tower is placed in service."

a. Confirm the Commission Order in Case 2025-00257 approving an AFUDC offset in the Generation Rider revenue requirement formula will delay the recovery of costs from customers until after the cooling tower is completed and placed in-service. If this is not correct, then provide a corrected statement and all support relied on for your response.

b. Describe how the cost of removal incurred for the partial demolition of the existing cooling tower will be recorded for accounting purposes.

c. Describe how the cost of removal incurred for the partial demolition of the existing cooling tower will be recovered from ratemaking purposes, e.g., through a reduction in the accumulated depreciation (for cost of removal) included in the Generation Rider revenue requirement.

d. Confirm the retirement of the cooling tower will result in a reduction of depreciation expense and the Generation revenue requirement. If this is not correct, then provide a corrected statement and all support relied on for your response.

**RESPONSE**

a. The Company objects to the extent this request calls for a legal conclusion. The Company further objects that the Commission's Order in Case No. 2025-00257 speaks for itself. Without waiving these objections, the Company states as follows. Denied. See the Company's response to AG-KIUC 1_1. The Company is proposing CWIP treatment for this investment and, as such, there would be no AFUDC offset associated with this project.

b. Actual removal costs incurred will be recorded as a debit to account 108 in accordance with the FERC USofA.

c. Please see the response to part b. Any removal costs incurred reduce the accumulated depreciation balance and those costs are included in subsequent depreciation studies which update depreciation rates for the asset.

d. Any original cost retirement causes depreciation to cease on the asset retired. Similarly, depreciation expense is incurred on newly installed assets that are placed in service.

Witness: Tanner S. Wolffram

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_4** | Refer to the Direct Testimony of Tanner Wolffram at 17 and the table showing the estimated effects on customer rates by year. Provide a revised version of this table reflecting the effects on the Generation Rider revenue requirement of the changes in the Company's calculations to reflect the AFUDC offset and to reflect the effects of the cost of removal and the cessation of depreciation expense due to the retirement of the existing cooling tower plant in service. |

**RESPONSE**

The Company objects that the request is unduly burdensome because it is seeking information that is not kept in the ordinary course of business. Without waiving this objection, the Company states as follows. See the Company's responses to AG-KIUC 1_1 and 1_3. Given that the Company is proposing CWIP treatment on this investment, there is no change to the revenue requirement necessary for the AFUDC offset, or for costs incurred for cost of removal.

Witness: Tanner S. Wolffram

**DATA REQUEST**

**AG-KIUC 1_5** Refer to the Direct Testimony of Nicole Coon at 7 wherein she states: "The total capital cost for Option 3 of approximately $196 million used in the analysis was provided by Company Witness Malone. Option 3's estimated useful life is 25 years and would go into service in 2029 as provided by Company Witness Malone."

a. Explain why the Company used a 25-year life for the Option 3 economic analysis.

b. Reconcile the 25-year life used for the economic analysis to the Company's request to use a 12-year life for the calculation of depreciation expense for accounting and ratemaking purposes.

c. Confirm that the $196 million includes the cost of removal for the partial demolition of the existing cooling tower.

d. If the $196 million includes the cost of removal, then provide the cost of removal component of the $196 million capital cost.

e. Confirm the cost of removal is a debt (reduction) to accumulated depreciation and will not be recorded to CWIP, and will not qualify for AFUDC. If any of these statements are incorrect, then provide corrected statements and all support relied on for your response.

**RESPONSE**

a. and b. Please see Company Witness Coon's Direct Testimony at page 12, lines 4–23.

c. Confirmed.

d. Please see KPCO_R_KPSC_1_5_Attachment1.

e. Confirmed.

Witness: Tanner S. Wolffram

Witness: Nicole M. Coon

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_6** | Refer to Exhibits NMC-1 and NMC-2.<br><br>a. Provide each exhibit in Excel live format with all formulas intact.<br><br>b. Provide a revised version of these exhibits reflecting changes in the Company's calculations to reflect the AFUDC offset in the Generation Rider and to reflect the effects of the cost of removal and the cessation of depreciation expense due to the retirement of the existing cooling tower plant in service in the Generation Rider. |

**RESPONSE**

a. Please see the attachments contained in the Company's response to KPSC 1_10 and KPSC 1_11.

b. The Company objects that the request is unduly burdensome because it is seeking information that is not kept in the ordinary course of business. Without waiving this objection, the Company states as follows. The Company included no AFUDC in the project costs utilized in calculating Exhibit NMC-2, so no offset is needed. Please also see the Company's response to AG-KIUC 1_5 subpart f. The Company has not performed the requested analysis for Exhibit NMC-1.

Witness: Nicole M. Coon

**DATA REQUEST**

**AG-KIUC 1_7** Refer to the Direct Testimony of Shawn Malone at 10 wherein he states: "The current estimated total capital cost for the Mitchell Cooling Tower Project is approximately $191,000,000. This estimate includes direct costs, indirect costs, and owner's costs. Kentucky Power's share of the capital cost for the Mitchell Cooling Tower Project is $95,500,000." Also refer to the Direct Testimony of Shawn Malone at 11 wherein he lists the costs included in the estimate total capital cost and Public Exhibit SPM-1, which provides Worley's cost estimates.

a. Confirm the Worley estimate was developed as a feasibility study estimate and is not a final estimate.

b. Provide a schedule showing the Company's buildup of the estimated total capital costs, starting with the Worley estimate and then each of the additional costs described by Witness Malone included in the $191 million amount.

**RESPONSE**

The Company objects to the extent the request mischaracterizes Company Witness Malone's Direct Testimony. Without waiving this objection, the Company states as follows:

a. Confirmed.

b.

| | |
|---|---|
| Design & Engineering | =$13M |
| Equipment | =$68M |
| Labor | =$40M |
| Owner Costs | =$19M |
| Contingency | =$15M |
| Demo of Exist Tower | =$36M |
| **TOTAL** | |

Witness: Shawn P. Malone

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_8** | Explain whether any local, state of West Virginia, or federal regulation or regulatory authority mandates or at any time mandated periodic inspections of Mitchell cooling towers. |

**RESPONSE**

The Company objects to the extent this request calls for a legal conclusion. The Company further objects that the request is vague, overly broad, and unduly burdensome as it is not limited in scope of time. Without waiving these objections, the Company states as follows. The Company is not aware of any state- or federally-mandated periodic inspection requirements.

Witness: Daniel W. Pizzino

Witness: Tanner S. Wolffram

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_9** | Explain how many inspections of the Mitchell cooling towers AEP and its relevant affiliates conducted, and provide the frequency of those inspections.<br><br>a. Explain also the types of inspections that were conducted, together with the types of instruments and equipment utilized during the inspections.<br><br>b. Were all inspections always conducted in the same manner and with the same instruments and equipment? If not, why not?<br><br>c. Explain whether any licensed professional engineers were involved in all prior inspections of the cooling towers, and if so, in what aspects of the inspections they were involved.<br><br>d. Explain whether the AEP Generation Major Projects Team was involved with the initial planning and construction of the Mitchell plant and its cooling towers, and if so, in what ways. |

**RESPONSE**

AEPSC Engineering and third-party inspectors conducted a total of five inspections for the Mitchell Unit 1 cooling tower shell and a total of 11 inspections for the Mitchell Unit 2 cooling tower shell. See the Company's response to KPSC 1_1 for the Mitchell Unit 1 cooling tower shell inspections and KPSC_1_14 for the Mitchell Unit 2 cooling tower shell inspections.

a. As further described in the inspection reports, inspections of the cooling towers included direct visual, drone, and LiDAR scan assessments. Direct visual inspections were performed by inspectors in baskets or on the ground; some also incorporated hammer testing and other inspection techniques. Drone inspections used high-resolution cameras to capture the detailed condition of the tower including cracks and other defects. LiDAR scan inspections were conducted using a 3D laser scanner mounted on a tripod. LiDAR scan data can be used to compare prior scans to detect changes in the tower shell's geometry.

b. As further described in the inspection reports, not all inspections were conducted in the same manner. As noted above, there are different techniques, instruments, and equipment that are used based on the type of data and information being gathered. These techniques have changed over time as technology has evolved.

c. Licensed professional engineers were involved in all inspections. The inspections were either performed by, directed by, or reviewed by a professional engineer.

d. The Company objects that the request is unduly burdensome because it is seeking information that is not kept in the ordinary course of business. Without waiving this objection, the Company states as follows. The requested information is beyond the record retention practice for this type of data.

Witness: Daniel W. Pizzino

Witness: Shawn P. Malone

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_10** | Explain whether KPCo, or any relevant AEP affiliate, maintains records of inspections of the Mitchell cooling towers. If not, explain why not. If so:<br><br>a. Explain when the earliest inspection occurred.<br><br>b. Identify the earliest inspection date upon which the "surface irregularities and deformations" in the Mitchell Unit 2 Cooling Tower, as identified in Application paragraph 6, were detected.<br><br>c. Identify where the records are maintained. |

**RESPONSE**

Digital copies of Mitchell Unit 1 and Unit 2 cooling tower shell inspections dating back to 1990 have been kept and maintained on AEPSC servers and in the AEPSC document retention system.

a. The first known Mitchell cooling tower shell inspection that the Company has records of was performed on Mitchell Unit 1 in 1990. The first documented inspection performed on Mitchell Unit 2 was conducted in 2016.

b. The first known indication of the "surface irregularities and deformations" in the Mitchell Unit 2 cooling tower, as identified in Paragraph 6 of the Application, were detected in April 2016.

c. Inspection records are kept on AEPSC servers and the AEPSC document retention system.

Witness: Daniel W. Pizzino

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_11** | Reference the Pizzino testimony at 8:5 through 9:10. Explain when the referenced monitoring program was begun. |

**RESPONSE**

The monitoring program was first established in 2016 for Mitchell Unit 2 after the "surface irregularities and deformations" were discovered. The monitoring program began with survey monuments that were measured monthly. In 2018, motion detection sensors with remote data access and a notification system were installed to provide continuous monitoring in conjunction with a weather station. Additional motion detection sensors were added in 2020. The monitoring system was upgraded in 2024 to the system that is currently in service as previously described in Company Witness Pizzino's Direct Testimony.

Witness: Daniel W. Pizzino

Kentucky Power Company
KPSC Case No. 2026-00001
AG-KIUC's First Set of Data Requests
Dated March 20, 2026

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_12** | Explain how the "surface irregularities and deformations" were first detected. |

**RESPONSE**

As stated on page 5 of Company Witness Pizzino's Direct Testimony, the first observation of the structural anomalies occurred in April 2016. A plant employee observed a deformation in the cooling tower and shared this information with local management and AEP Engineering which led to subsequent detailed inspections and engineering analyses.

Witness: Daniel W. Pizzino

**DATA REQUEST**

**AG-KIUC 1_13** Reference the Pizzino testimony at 5.

a. Confirm that the "initial structural engineering assessment" referenced at 5:6-14 concluded that the structural deformations in the tower likely occurred years prior to the April 2016 observations.

b. Provide a copy of the "initial structural engineering assessment" referenced at 5:6-14.

c. Provide a copy of the "subsequent detailed engineering analysis."

d. Explain what measures AEP, and its relevant affiliates took upon completion of the original construction of the water towers to inspect them and accept the project from the construction contractor(s) prior to them being placed into commercial operation.

e. Explain whether AEP or any relevant affiliate identified any "surface irregularities and deformations," and/or any other issues of concern in the cooling towers. If so, provide all supporting documentation.

f. Refer to Application paragraph 6. Explain whether the term "Surface irregularities and deformations" as used in lines 1-2 of that paragraph include the "more cracking and deterioration" as used on line 4 of that paragraph.

**RESPONSE**

a. Confirmed.

b. Please see KPCO_R_AG_KIUC_1_13_Attachments 1 and 2.

c. Please see KPCO_R_AG_KIUC_1_13_Attachment3.

d. The Company objects that the request is unduly burdensome because it is seeking information that is not kept in the ordinary course of business. Without waiving this objection, the Company states as follows. The Company does not maintain records from the period that would include the requested information.

e. Please refer to the inspection reports referenced in the Company's response to AG-KIUC 1_9.

f. The two descriptions are mutually exclusive. The "surface irregularity and deformations" describe the flat spots, inward protrusion of the surface of the cooling tower. The "more cracking and deterioration" describes cracking in the surface of the concrete shell and areas of concrete deterioration.

Witness: Daniel W. Pizzino

**Trip Report**

| | | | |
|---|---|---|---|
| **Project:** | Mitchell Plant | | |
| **Subject:** | Unit 2 – Cooling Tower Concrete Shell Observation Report | | |
| **Trip To:** | Mitchell Plant | **Trip Date:** | April 6, 2016 |
| **From:** | Douglas Polack | **Date:** | April 12, 2016 |
| **To:** | Shane Bickmeier – Mitchell Plant System Owner Principal | | |
| **Cc:** | Pedro Amaya, Bob Cashner, Keegan Kirwin, Frank Michell, George Tierney | | |
| **Report Number:** | SES – RPT – 00269-1 | | |
| **Participants:** | Shane Bickmeier, Keegan Kirwin, Douglas Polack | | |
| **Purpose of Visit:** | The Plant requested a structural observation of the Unit 2 cooling tower concrete shell. They had noticed several areas of the mid height shell surface that appear to be warped out of plane. | | |

| | | | | | |
|---|---|---|---|---|---|
| **Results:** | **Objective Accomplished:** | **Yes** | X | **No** | |
| | **Items Generated:** | **Yes** | X | **No** | |

## Background

The Plant contacted the AEP Structural Engineering Section (SES) in Columbus regarding the cooling tower shells condition. Douglas Polack and Keegan Kirwin visited the site on April 6, 2016. Observations were limited to walkways on top of the water cooling fill structure, ground level, and the end of access walkway through the fill (south eastern side). The top of the concrete shell is 370 feet high and the bottom of the shell is at the top of the fill, 66 feet high. Thus, the shell is 304 tall.

## Findings

1. The concrete shell has numerous surface dimples and flat spots. These dimples are most pronounced in-between roughly twenty percent to seventy percent of the tower height above the fill and they exist all around the tower. See the attached photos.
2. A hole through the shell in the northwest area about mid-height is visible from inside at the access walkway.



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3. A severe spall on the outside may be the same as hole through the shell noted above.
4. AEP does not have the complete structural drawings for the shell only a few sections.
5. There are no records of previous structural inspections for the Unit 2 cooling tower.

## Conclusions and Recommendations

In conclusion, structurally, the warping of the concrete shell is very concerning but the distortions in the concrete shell appear to be pre-existing for there is no evidence of recent cracking or spalling.

Therefore the SES recommends the following additional actions:

1. Drawings: Contact the engineer of record for the concrete towers to see if they can provide the existing drawings. The company was "The Marley Company" and they now are "SPX".

2. Photos: Research to find old photos of these structures to verify the age and extent of the concrete surface irregularities.

3. Interviews: Contact employees who were at the Plant between 1967 and the 1980's and ask them if they know of this condition.

4. Concrete Inspection (Ground/Lift Visual): Gain access to the interior of the tower and perform a concrete inspection from the ground and a lift (if possible). This inspection will provide additional visual perspectives of the concrete surface and limited physical concrete condition assessment.

5. Concrete Inspection (Drone Visual): Hire a consultant to fly the structure with a drone to get a closer look at the current condition.

6. Concrete Inspection (Suspended Scaffold Visual): Hire a consultant to perform an interior/exterior inspection from a suspended scaffold for the entire height in pre-determined locations.

7. Imaging: Hire a consultant to create a three dimensional model of the current state of the interior and exterior concrete surface. This will be used to determine the depth of the dimples and corresponding interior surface.

8. Engineer of Record: Ask SPX if they have any historic documentation of the current deformed shape of the concrete shell.

9. Consultants: Hire an outside consultant, regularly engaged in natural draft cooling tower design and repair, to visually inspect the towers and provide a letter of recommendations.


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10. After review of the above findings, the SES will provide recommendations for further inspection, testing, monitoring and repairs.


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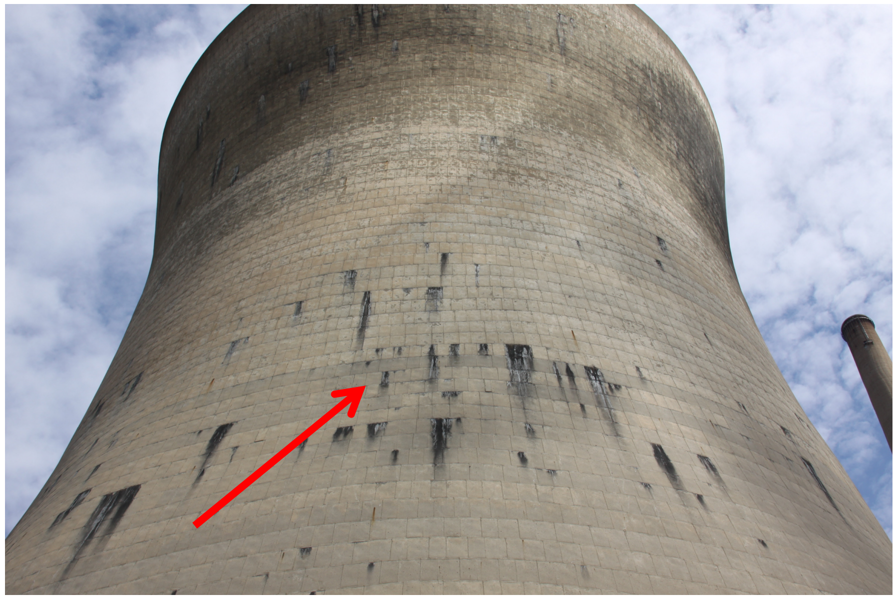
| Photo # 1 | |
|---|---|
| **General photo of the exterior from the southwest. Arrow point to edge of dimple area.** |  |
| **Photo # 2** | |
| General photo of horizontal steel reinforcement where the concrete cover has spalled off. |  |



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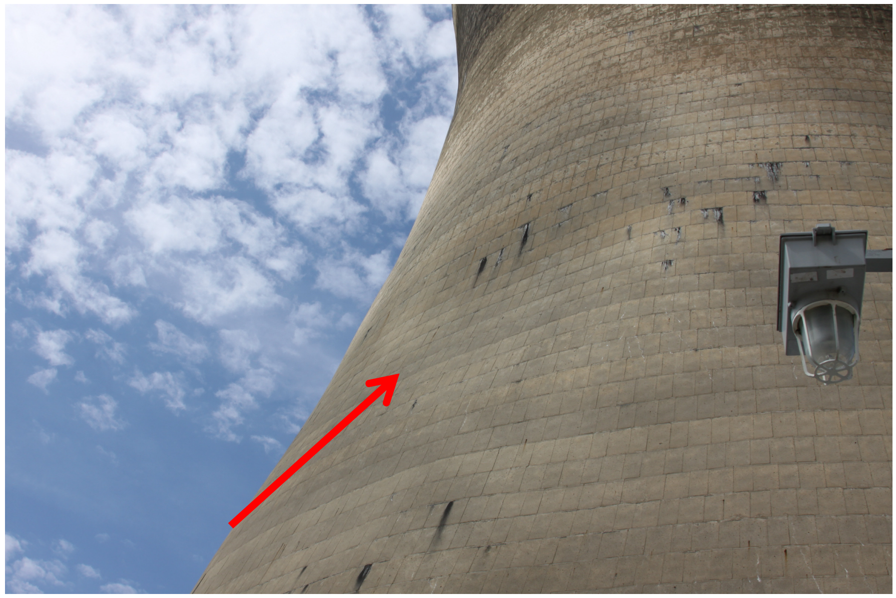
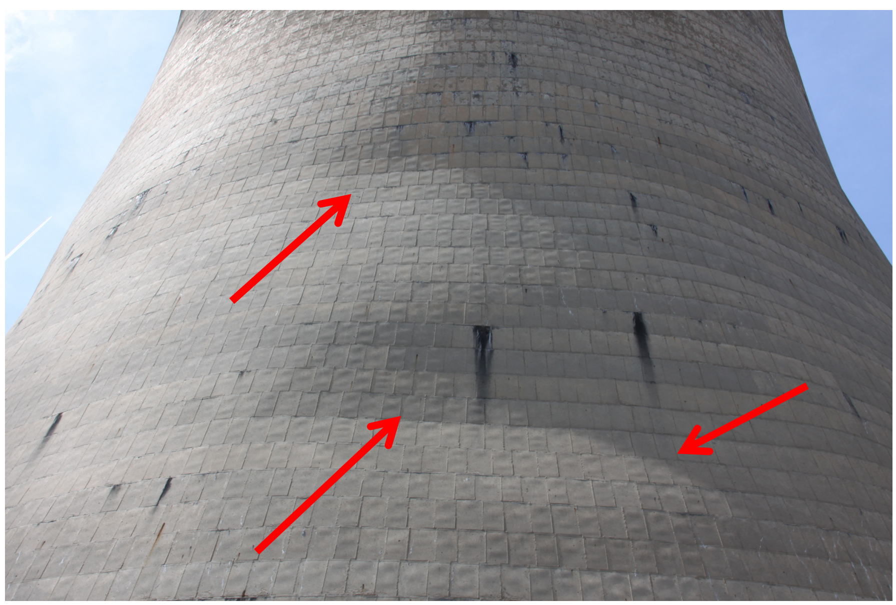
| Photo # 3 | |
|---|---|
| General photo of the southeast side. Arrow points to the edge of a large dimpled area. |  |
| **Photo # 4** | |
| General photo of the east side. Arrows point to some irregular areas. |  |



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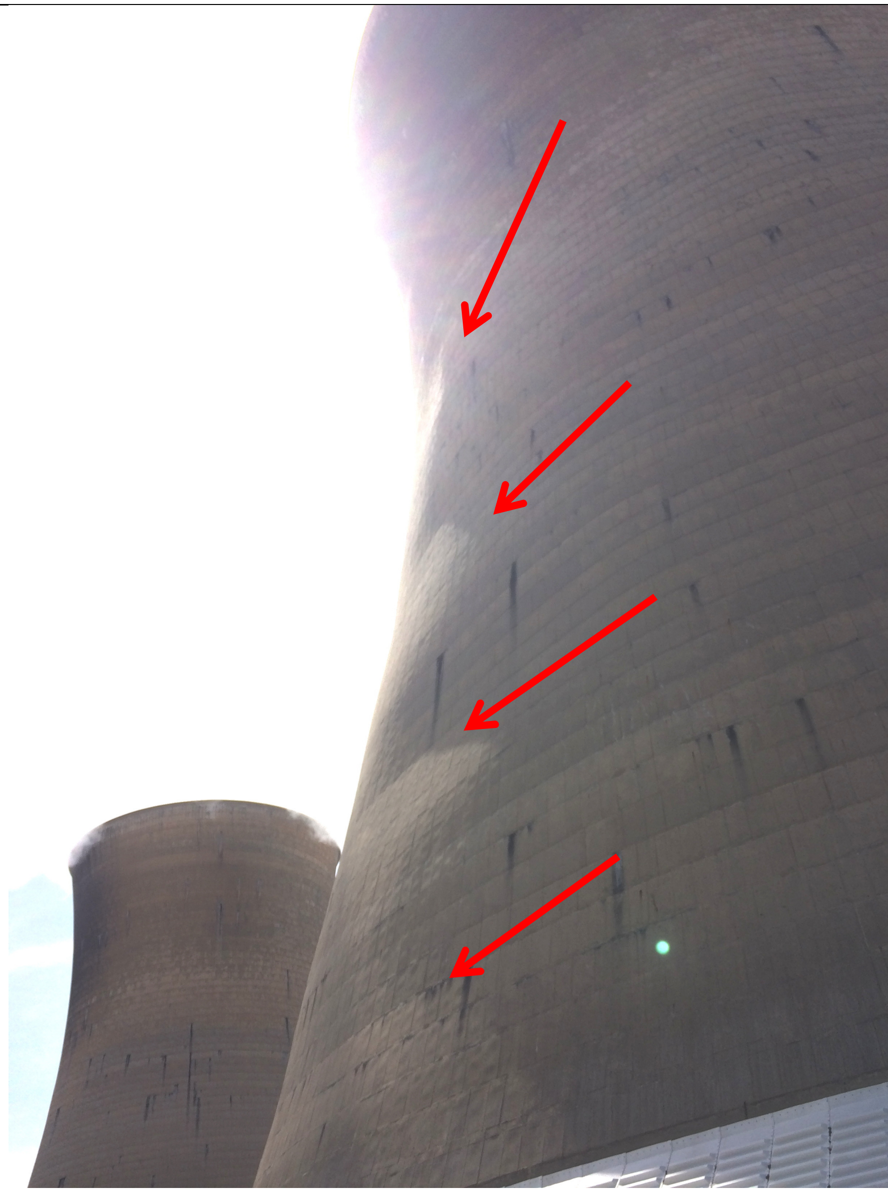
| Photo # 5 |  |
| --- | --- |
| General photo from the northeast side of the east side. Arrows point to a recessed areas. | |



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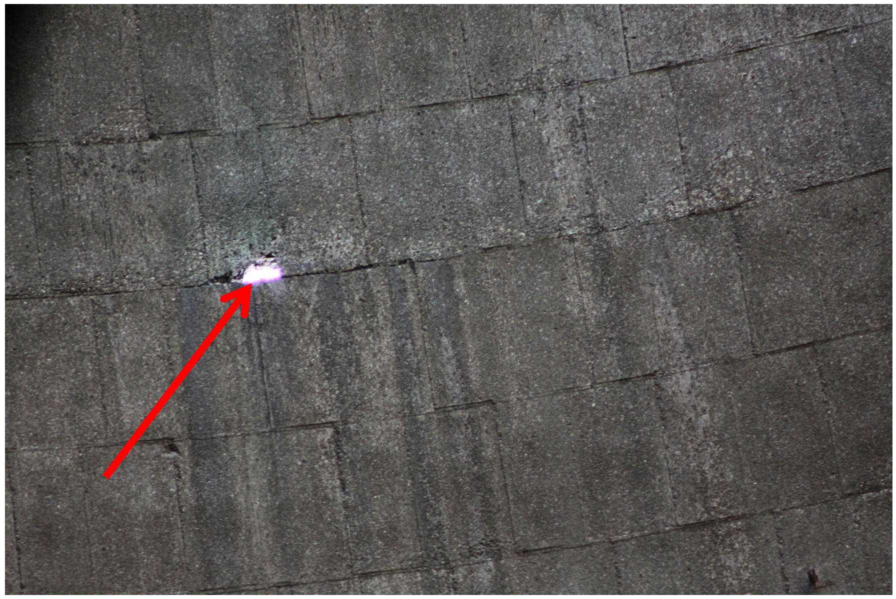
| **Photo # 6** | |
|---|---|
| General photo of a hole in the northwest area of the cooling tower shell seen from the inside looking out. The hole is below mid-height of the wall. |  |



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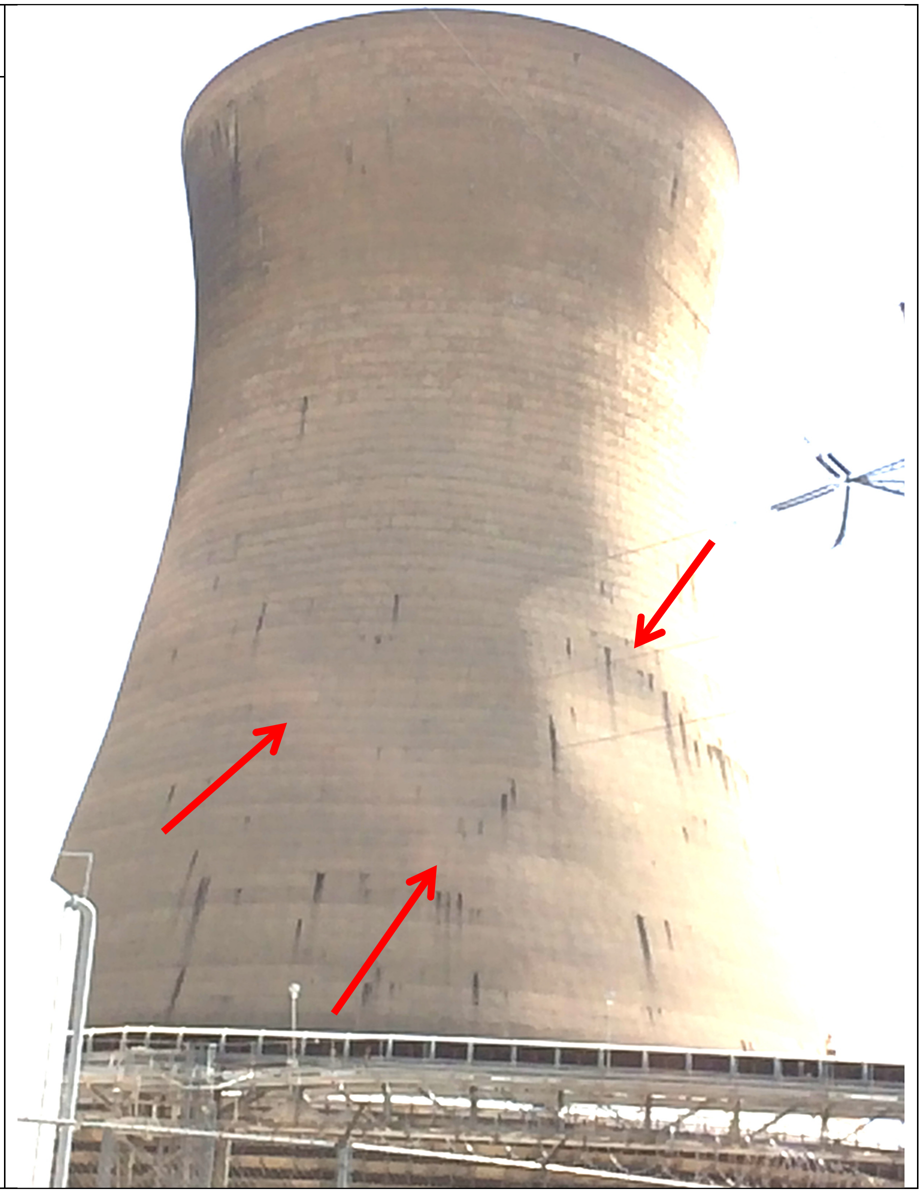
| **Photo # 7** |  |
| --- | --- |
| Another general photo of the north (northwest) side of the tower. | |



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**Research Report**

| | |
|---|---|
| **Project:** | Mitchell Plant |
| **Subject:** | Unit 2 – Cooling Tower Investigation |
| **Report Date:** | 4-12-2016 |
| **From:** | Keegan Kirwin |
| **To:** | Pedro Amaya |
| **Cc:** | George Tierney; Doug Polack; Bob Cashner; Frank Michell; Shane Bickmeier |
| **Report Number:** | N/A |
| **Participants:** | N/A |
| **Purpose:** | Conduct an investigation, using historical photographs, to determine how long irregularities on Unit#2 cooling tower have been present. |

| **Results:** | | | | | |
|---|---|---|---|---|---|
| | **Objective Accomplished:** | **Yes** | x | **No** | |
| | **Items Generated:** | **Yes** | x | **No** | |

## Background

The plant contacted AEP structural engineering section in Columbus to observe the U2 cooling tower structure. On April 6, 2016, Douglas Polack and Keegan Kirwin observed what appeared to be numerous flat spots, dimples and irregularities from about twenty percent to seventy percent of the tower height. These were found all the way around the tower.

## Findings

The flat spots and dimples can be traced photographically back to 1976, although the extent around the tower and the magnitude cannot be accurately determined from these older aerial photos.

## Conclusions and Recommendations

From the evidence in the following photographs, it is clear that the irregularities observed on April 6, 2016, did not come about suddenly. It still is not clear whether the tower was built this way, or if it is progressively getting worse. SES is recommending further inspections as described in SES report SES-RPT-0029.



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AMERICAN ELECTRIC POWER

**Photo # 1**

**DATE: 4-25-1974**

This photograph is the first aerial found to show the side of U2 cooling tower. Earlier photos back to 1971 are available, but they do not show the side of either cooling tower.


**Photo # 2**

**DATE: 5-5-1976**

This photo contains the first clear evidence of the irregular sides of the U2 cooling tower.




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AEP AMERICAN ELECTRIC POWER

**Photo # 3**

**DATE: 2-24-1984**

Edge of shadow shows irregularities.


**Photo # 4**

**DATE: 1-30-1990**

Edge of shadow shows irregularities.




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**Photo # 5**

**DATE: 4-25-1991**

This photo contains particularly pronounced irregularity for its age.


**Photo # 6**

**DATE: 10-4-1994**

Edge of shadow shows irregularities. Very slight in this photo.




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**Photo # 7**

**DATE: 4-13-2001**

Edge of shadow shows irregularities.


**Photo # 8**

**DATE: 11-8-2001**

There appears to be a flat spot located on the east face. This is consistent with field observations.




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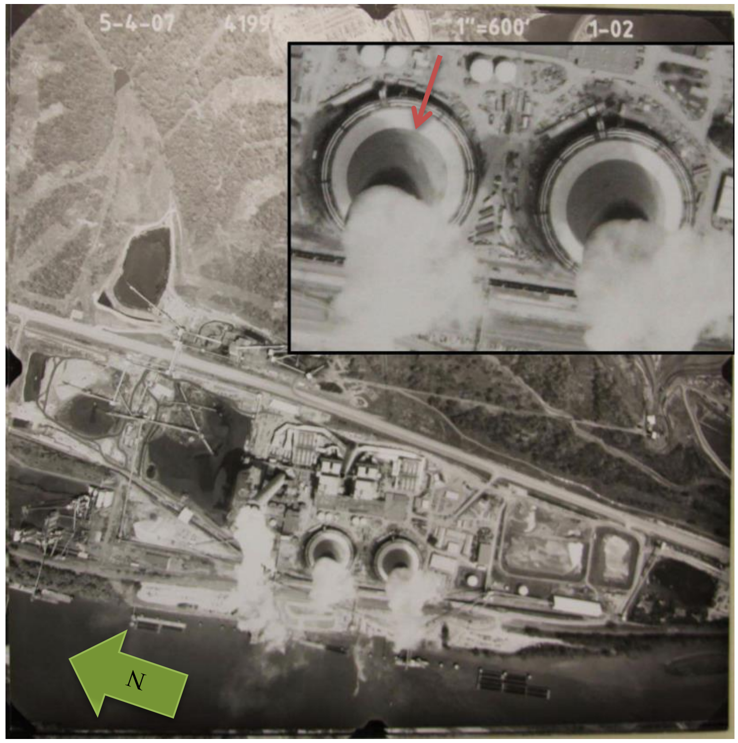
AEP AMERICAN ELECTRIC POWER

| **Photo # 9** |  |
|---|---|
| **DATE: 5-4-2007**<br><br>Edge of shadow shows irregularities. Very slight in this photo. | |



| **Photo # 10** |  |
|---|---|
| **DATE: 5-13-2008**<br><br>Edge of shadow shows irregularities. Very slight in this photo. | |





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**Photo # 11**

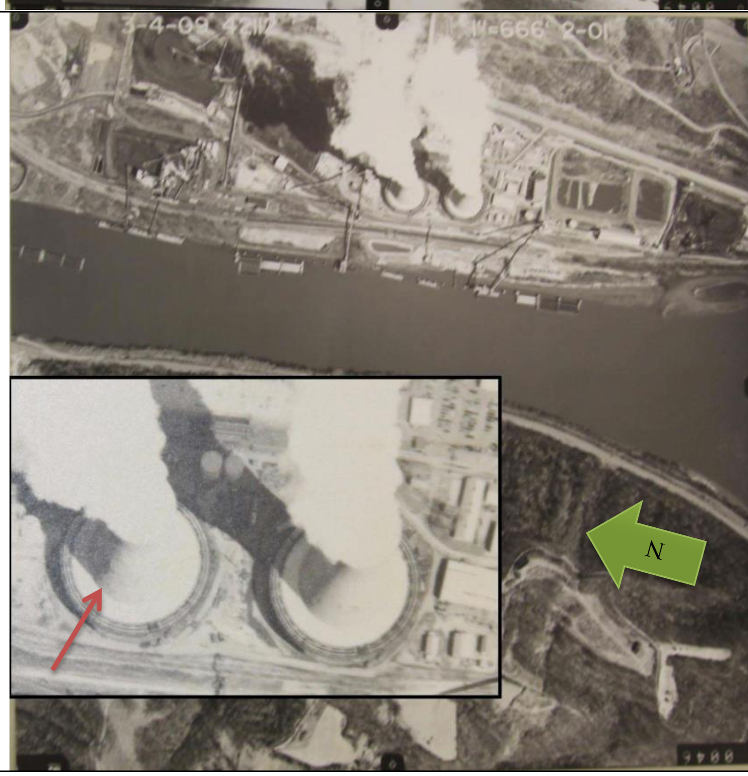
**DATE: 3-4-2009**

Edge of shadow shows irregularities. Very slight in this photo, but can be compared to U1 tower.


**Photo # 12**

**DATE: 3-4-2009**

Edge of shadow shows irregularities on west face.



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<table>
<tr><td>Photo # 13<br><br>DATE: 5-5-2010<br><br>Edge of shadow shows irregularities on west face.</td><td><br></td></tr>
<tr><td>Photo # 14<br><br>DATE: 11-10-2010<br><br>Edge of shadow shows very slight irregularities on west face.</td><td><br></td></tr>
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<table>
<tr><td>Photo # 15</td><td rowspan="2"></td></tr>
<tr><td>DATE: 5-5-2011<br><br>Edge of shadow shows irregularities on north east face about halfway up the tower.</td></tr>
<tr><td>Photo # 16</td><td rowspan="2"></td></tr>
<tr><td>DATE: 5-27-2011<br><br>Edge of shadow shows very slight irregularities on the base of the north east face.</td></tr>
</table>



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| | |
|---|---|
| **Photo # 17**<br><br>**DATE: 5-27-2011**<br><br>Edge of shadow shows ripples on west face. |  |
| **Photo # 18**<br><br>**DATE: 5-27-2011**<br><br>Edge of shadow shows ripples on west face. |  |





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| Photo # 19 | |
|---|---|
| **DATE: 5-11-2012**<br><br>Edge of shadow shows indentation on east face. |  |
| **Photo # 20** | |
| **DATE: 5-11-2012**<br><br>Edge of shadow shows ripples on west face. |  |



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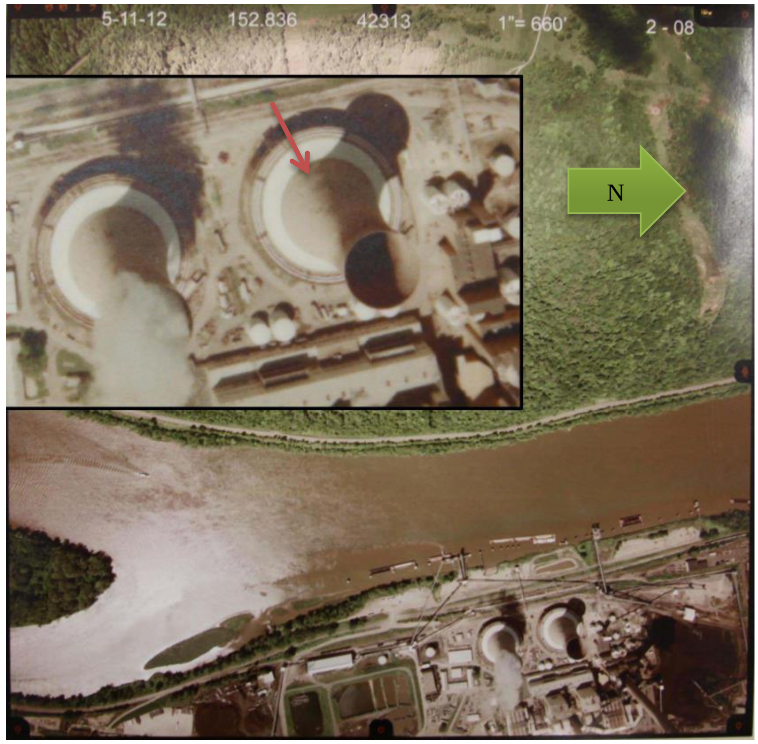
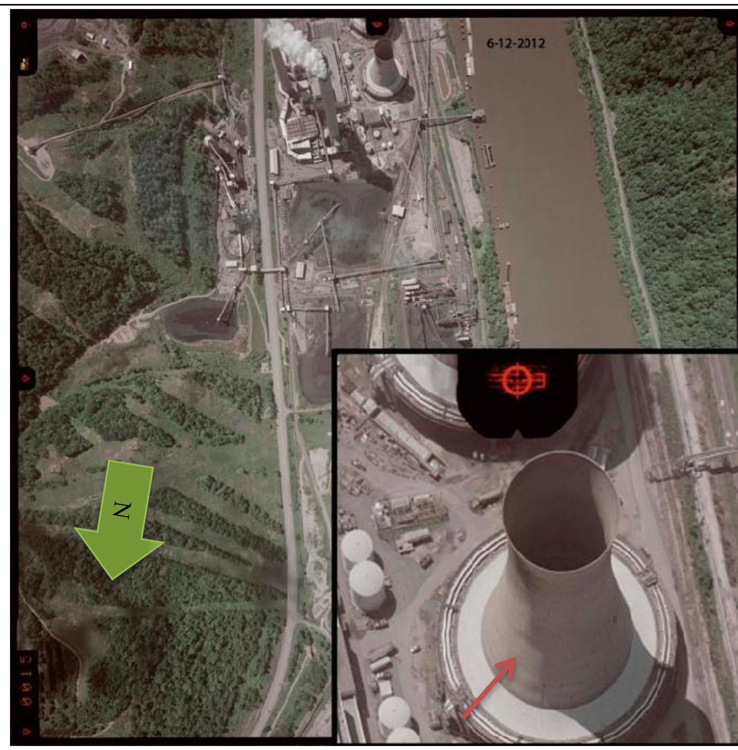
| **Photo # 21** |   |
| **DATE: 5-11-2012**<br><br>Edge of shadow shows ripples on west face. | |
| **Photo # 22** |   |
| **DATE: 6-12-2012**<br><br>Edge of shadow shows flat spot and indentation on north east face. | |



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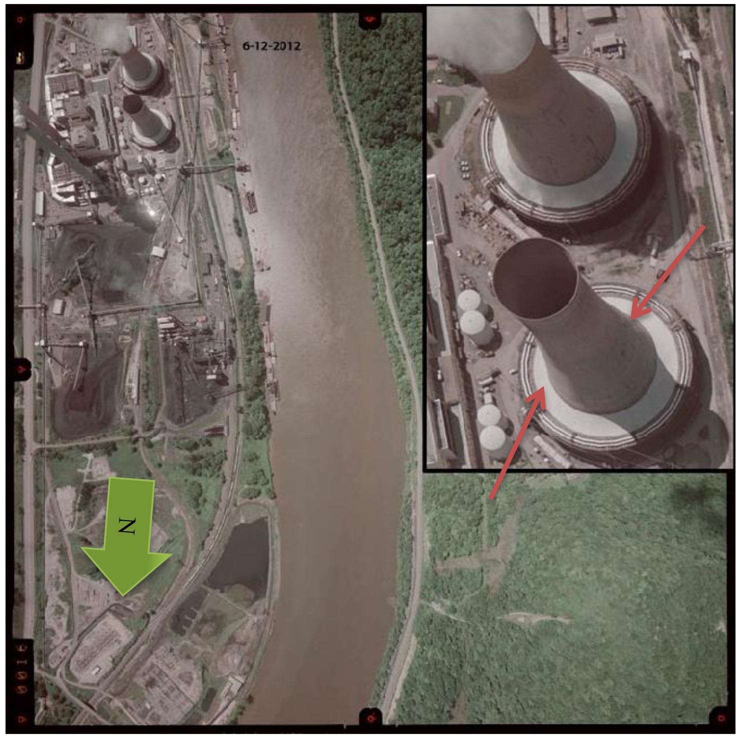
<table>
<tr><td>Photo # 23<br><br>DATE: 6-12-2012<br><br>Edge of shadow shows flat spot on northeast and southwest faces.</td><td>
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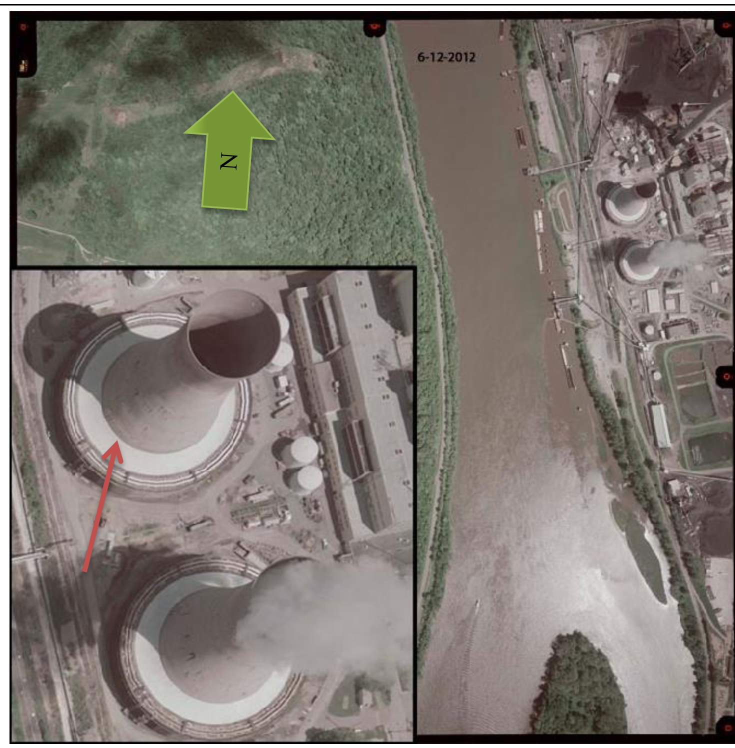
<tr><td>Photo # 24<br><br>DATE: 6-12-2012<br><br>Edge of shadow shows ripples on west face.</td><td>
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| Photo # 25 |  |
|---|---|
| **DATE: 5-3-2013**<br><br>This photo contains little evidence. | |
| **Photo # 26** |  |
| **DATE: 3-31-2014**<br><br>Edge of shadow shows very slight irregularities. | |







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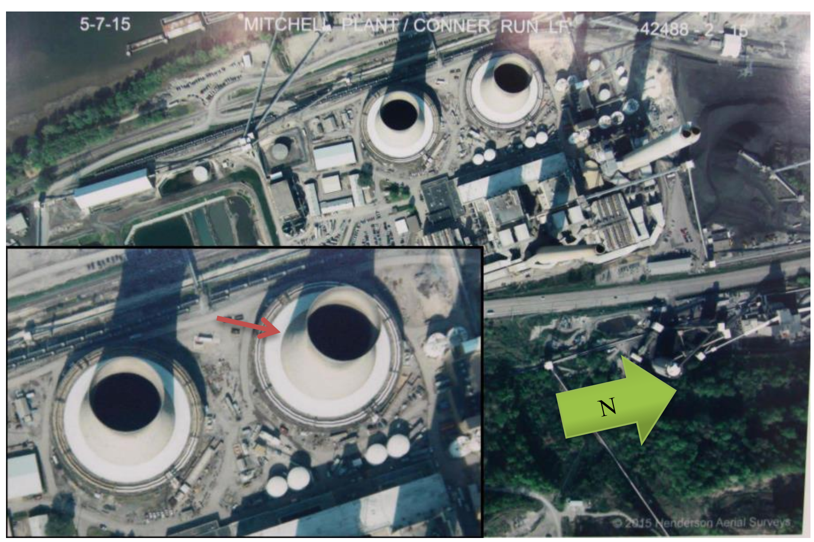
| Photo # 27 | |
|---|---|
| **DATE: 3-31-2014**<br><br>This photo is the digital version of photo #26. It has better definition, and shows ripples on the east side of the tower. |  |
| **Photo # 28** | |
| **DATE: 5-7-2015**<br><br>Edge of shadow shows very slight irregularities. |  |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AEP AMERICAN ELECTRIC POWER

| Photo # 29 | |
|---|---|
| **DATE: 5-7-2015**<br><br>This photo is the digital version of photo #28. It has better definition, and shows ripples or bumps on the southwest side of the tower. |  |



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# ANALYTICAL EVALUATION OF MITCHELL PLANT UNIT #2 NATURAL-DRAFT COOLING TOWER

MOUNDSVILLE, WEST VIRGINIA

PREPARED FOR

AMERICAN ELECTRIC POWER (AEP)

WALTER P MOORE PROJECT NUMBER D03.16093.00

NOVEMBER 11, 2016

# Analytical Evaluation of Mitchell Plant Unit #2 Cooling Tower
Moundsville, West Virginia

Prepared for
American Electric Power
1 Riverside Plaza
Columbus, OH 43215

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D03.16093.00

November 11, 2016

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# EXECUTIVE SUMMARY

American Electric Power (AEP) retained Walter P Moore to determine the probable cause of excessive shape distortion and potential loss of structural capacity of the Unit #2 hyperbolic crossflow cooling tower at the Mitchell Power Plant. The following two scenarios were considered: 1) as-designed and 2) existing (deformed) condition. The columns, ring beam, and veil of the cooling tower were modeled using SAP2000 to study elastic structural behavior, including linear-elastic buckling, and ANSYS to study non-linear structural behavior (material and geometric nonlinear behavior). It is well established in the literature that hyperbolic cooling towers behave in the linear elastic range until the onset of concrete cracking. Continued loading leads to extensive crack propagation and a limit state in the cooling tower structural capacity.

The following conclusions can be reached from the evaluation:

1. Based on the computer analysis conducted, it is most likely that gravity loads, creep effects, and thermal loads combined with initial imperfections in the cooling tower veil forming produced the buckled shape in the tower veil. It is unclear from a review of historic aerial photography whether this deformation condition has worsened over time.
2. Deformations from buckling are more prevalent on the north median of the veil face and less prevalent on the south meridian of the veil face, suggesting that the buckling behavior is not symmetric.
3. The results of the analysis of the tower with a geometry according to the record drawings and subjected to the design loads at the time of construction suggest that the reinforcement specified in the record drawings appears to be adequate to resist the load effects.
4. The results of the analysis of the tower with the current deformed shape and subjected to the current design loads show that the veil reinforcement specified in the record drawings is inadequate to resist the effects caused by the current design loads. Furthermore, under design wind loads uplift of some columns would be expected.
5. The results of the buckling analysis of the tower with the current deformed shape and subjected to the current design loads show a

buckling factor of approximately 1.0, indicating no additional factor of safety to resist tower buckling.

6. Given the large magnitude of deformation in the current deformed shape, full depth concrete cracking in the veil is very likely and existing circumferential reinforcement is solely engaged to resist further deformation (dilation) of the veil. This lack of redundancy is detrimental to the strength of the tower.

The following recommendations are provided to further investigate and restore the structural integrity of the cooling tower:

1. Conduct an up-close investigation of the cooling tower veil by means of aerial access. This investigation would seek to provide concrete distress and crack mapping, acoustic sounding, corrosion testing, and other test methods to further study the present condition of the cooling tower.
2. Evaluate the cooling tower concrete material properties by core extraction and laboratory testing. Provide a comparison between in-situ concrete properties and the original design properties.
3. Conduct a geotechnical investigation to study differential movement potential of the ring foundation.
4. Conduct additional structural analysis to evaluate strengthening options for the cooling tower veil. Such conceptual options could include concrete circumferential stiffening rings and/or application of carbon fiber composites to strengthen the veil.
5. After consideration of tower strengthening options, develop and implement a comprehensive repair program to restore the structural integrity of the tower and satisfy the design provisions of the current building code.

# INTRODUCTION

## Project Information

### Project Description

American Electric Power (AEP) retained Walter P Moore to determine the probable cause of excessive shape distortion and potential loss of structural capacity of the Unit #2 hyperbolic crossflow cooling tower at the Mitchell Power Plant. The evaluation was initiated after reports of apparent visual distortions in the cooling tower veil by power plant staff.

### Project Approach

The following approach was followed to deliver the requested services:

1. Review available construction documents to develop an overall familiarity with the cooling tower construction
2. Review and utilize a three-dimensional (3D) laser scanning of Unit #2
3. Model the columns, ring beam, and veil of the cooling tower using finite-element software packages for the as-designed and existing condition scenarios
4. Evaluate the undeformed tower response under loads (gravity and wind) per the original design building code
5. Evaluate the undeformed tower response under seismic loading per the current building code
6. Utilize nonlinear material and nonlinear geometric behavior necessary to model concrete shell buckling
7. Determine the probable cause of the current deformed shape of the veil, as determined from the latest 3D laser survey
8. Investigate wind-induced interference effects for cooling tower groups

# Background

## Structure Description

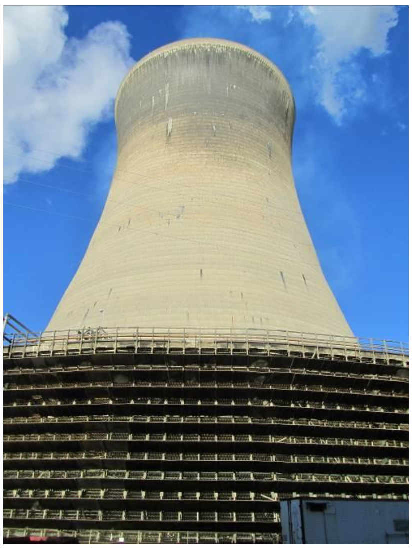

Figure 1. Unit #2 cooling tower at the Mitchell Plant

Figure 2. North view of Unit #2; visible distortion in cooling tower veil

There are two hyperbolic crossflow cooling towers at AEP's Mitchell Power Plant. These reinforced concrete towers are mostly identical in construction and are designated Unit #1 and Unit #2 (Figure 1). According to the record drawings for both towers, the tower cornice (top) was modified between the tower designs. Unit #2 is the focus of this investigation as it has a visible distorted veil shape (Figure 2).

The height of the Unit #2 cooling tower is approximately 376 feet from the ground. At the base of each cooling tower, there is a basin that is approximately 288 feet in diameter. Along the circumference of the basin, there are 32 pedestals into which two diagonal X-columns frame. Each column also frames at the top into a ring beam at the bottom of the veil. The diameter at the bottom of the veil is 248 feet, the diameter at the throat (least veil diameter) is 160.5 feet, and the diameter at the top of the veil is 178 feet. The thickness of the reinforced concrete veil wall is for the most part 5-1/2 inches and increases near the top and bottom elevations of the veil.

The veil is cast-in-place reinforced concrete construction with the concrete placement lift height being approximately every 4 feet. The veil is reinforced with layered, center mat of Grade 60 reinforcement with outer diamond bar pattern and circumferential center bars. The concrete columns and lower ring beam are of precast concrete construction. According to the original drawings, the concrete veil has a concrete compressive strength of 3,000 psi and the concrete columns have a compressive strength of 4,000 psi.

Construction drawings were provided to Walter P Moore for review. The towers were designed by The Marley Company (now SPX Corporation) and L.T. Mart Company Ltd. in 1968, and it is believed that construction commenced shortly thereafter.

## Study of Previous Cooling Tower Failures

Historical studies of hyperbolic cooling tower shape distortion and failures were reviewed to better understand the structural behavior of these towers under ultimate loading conditions. In 1965, three of five hyperbolic cooling towers collapsed at Ferrybridge, England. Collapses also occurred in Ardeer (Britain) in 1973, Bouchain (France) in 1979, and Fiddler’s Ferry (Britain) in 1984. These failures can be attributed to the following circumstances (Chen 1997):

1. The maximum design wind speed was often underestimated, so that the safety margin for the wind load was insufficient.
2. Group effects leading to higher wind speeds and increased vortex shedding influence on downstream towers were neglected.
3. Large regions of the shell were reinforced only in one central layer (in two orthogonal directions), or the double layer reinforcement was insufficient.
4. The towers had no upper edge members or the existing members were too weak for stiffening the structure against dynamic wind actions.
5. Substantial initial imperfections in the concrete veil forming.

Items 1, 3, and 5 above are applicable to Unit #2 in the present study.

Structural collapses have initiated changes in the design philosophy for hyperbolic cooling towers. Prior to the 1970s, hyperbolic cooling towers were mostly designed with thin concrete shell walls (approximately 5 to 6 inches thick) and a reinforcing mat in the center of the shell section. This design was deemed acceptable at the time based on the structural performance of constructed towers. From the 1970s, cooling towers have mostly been designed with an increased concrete shell thickness (approximately 8 to 10 inches thick) and an inner and outer mat of reinforcing steel. There is also a more refined understanding of wind loading and the variation of wind pressures on cooling towers.

## TOWER 3D LASER SCAN

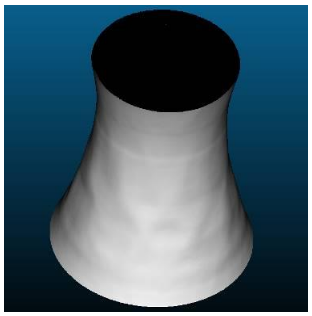

Figure 3. Unit #2 point cloud model

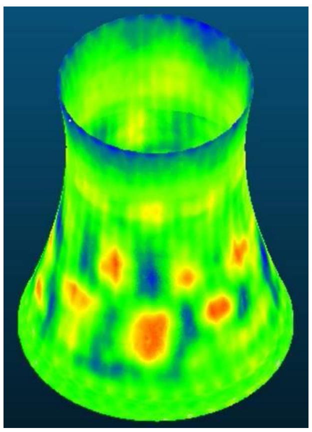

Figure 4. Unit #2 point cloud analysis (north meridian view)

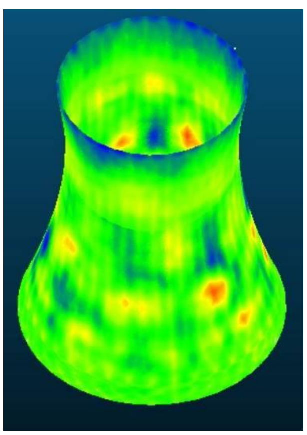

Figure 5. Unit #2 point cloud analysis (south meridian view)

### Three-dimensional laser scan

Walter P Moore requested a three-dimensional (3D) laser scan of Unit #2 in order to further study the existing deformed condition of the tower. A graphical representation of that laser scan is provided in Figure 3. Tower veil deformations are not readily apparent in this view due to the magnitude of the deformation compared to the size and scale of the cooling tower.

An analysis was conducted with the data from the survey (i.e., three-dimensional coordinates of multiple locations around the veil), referred to here as point-cloud data, and a comparison was made between an idealized hyperbolic cooling tower shape (based on the design drawings) and the existing cooling tower shape. The data comparison in a color scale was developed to better visualize the magnitude of deformation, with blue coloring representing the largest outward deformation, red coloring representing the largest inward deformation, and green coloring representing neutral or limited deformation. From this analysis, the maximum inferred deformations in the veil were approximately 21 inches inward and 15 inches outward. Figure 4 shows the point-cloud analysis from the perspective of the north meridian. Of particular note is the undulating shape of the tower on the north elevation and the appearance of three distinct zones of undulation from the base of the tower to near the throat. These undulations are representative of hyperbolic tower buckling under self-weight (gravity) loading. Figure 5 shows the point-cloud analysis from the perspective of the south meridian. The undulations are not as pronounced (less in magnitude) on the south elevation, but are nevertheless present. When viewing the deformed shape holistically, it appears that the tower has undergone unsymmetrical buckling.

It is also worth noting that the laser scan revealed Unit #2 to have been constructed 6 inches taller than the record drawings and 4 feet wider in circumference at the tower cornice. This difference in geometry is reflected in the blue coloring at the tower cornice in Figures 4 and 5.

# FINITE ELEMENT MODELING

## Analytical Models

Full three-dimensional models of the as-designed and existing condition scenarios were created using finite-element software packages SAP2000 (Computers and Structures Inc. 2014) and ANSYS (ANSYS Inc. 2017). SAP2000 was utilized to model the cooling tower structural behavior using isotropic materials and assuming linear-elastic, stress-strain relationships; geometric nonlinearities such as restraints at the base that only resist compression and p-delta effects for buckling analyses were considered. ANSYS was utilized to model the ultimate behavior of the cooling towers, considering the nonlinear behavior of reinforced concrete (yielding of reinforcement and cracking and crushing of concrete) and nonlinear geometry (large displacement, p-delta effects).

Each model included the columns with associated foundation boundary conditions, the ring beam, and the veil. In the SAP2000 model, the columns were modeled as beam elements and the ring beam and veil were modeled as shell elements. In the ANSYS model, the columns were modeled as beam elements. The ring beam and the veil were modeled as solid elements with smeared layer of reinforcement at appropriation location and orientation (Solid186 with Reinf265), with a nonlinear reinforced-concrete model. The ring foundation system and column plinths were not included in the study models.

Figure 6. As-designed scenario model using SAP2000

## Modeling Scenarios

The cooling tower was modeled in the as-designed and the existing (deformed) condition scenarios. Specific information on each of the two modeling scenarios is presented below. Assumptions were necessary to model the structure in the as-designed and existing condition.

### As-Designed

For the as-designed scenario, geometry, dimensions, reinforcement and material properties of the columns, ring beam, and veil were obtained from the construction drawings. Figure 6 presents an image of the as-designed scenario model in SAP2000.

## Existing Condition

Figure 7. Existing scenario model using SAP2000

The existing condition modeling sought to recreate the existing deformed shape, provided from the 3D laser survey of the tower veil. For the analysis of this condition, the veil geometry obtained from the 3D laser survey was used as an unstressed structure and then the dead load and all subsequent loads were applied. This modelling approach produces larger dead-load and thermal deformations caused by p-delta effects. In reality the dead load and thermal loads contributed to produce the existing deformed shape. SAP2000 was utilized to perform design checks for current-code lateral load combinations and to perform linear buckling analyses, considering different load cases that could initiate global buckling. Figure 7 presents an image of the existing condition scenario model in SAP2000.

ANSYS was utilized to apply the deformations from the 3D laser scan at discrete locations on the veil to force the veil into a shape that resembles the existing deformed condition. Given the magnitude of the existing deformations, discrete application of deformation resulted in non-linear behavior (both material and geometric) and analysis convergence issues. Instead, an analysis with geometric nonlinearity and linear material properties was performed to generate unstressed deformed geometry for the cooling tower that resembles the existing deformed condition. Deformed geometry from the analysis wasn't representative of existing deformed condition and not used for further evaluation using ANSYS.

# STRUCTURAL ANALYSIS

## Loads

Based on a code review with the City of Moundsville and State of West Virginia, the design code at the time of construction was likely the Uniform Building Code (UBC) 1967. The current design code is the International Building Code (IBC) 2015, which references to the Minimum Design Loads for Buildings and Other Structures (ASCE 7-10) for applicable loads. The analyses considered the effects of dead, thermal, seismic, and wind loads on the cooling tower.

### Dead

A unit weight of 150 pounds per cubic foot was assumed for normal-weight concrete. The loads were automatically assigned to the concrete elements by the finite element software in direct proportion to their volume.

### Thermal

Temperature variations on cooling towers arise from operating conditions and diurnal thermal heating. Temperature variations caused by operating conditions of cooling towers arise from the difference of temperature between the interior and the exterior of the tower while in operation. Operating conditions can result in temperature gradients between interior and exterior of the tower of up to approximately 80˚F during the winter months (Chen 1997). Diurnal thermal heating effects result from uneven heating from sun rays as the sun travels from east to west. The portion of the tower that is being heated by the sun expands with respect to the cool side. To account for diurnal thermal heating, a temperature gradient between the heated and cool side of 45˚F was distributed as a half cosine wave around one half of the circumference of the cooling tower (Chen 1997). Figure 8 presents a schematic representation of the temperature distribution associated with diurnal thermal heating.

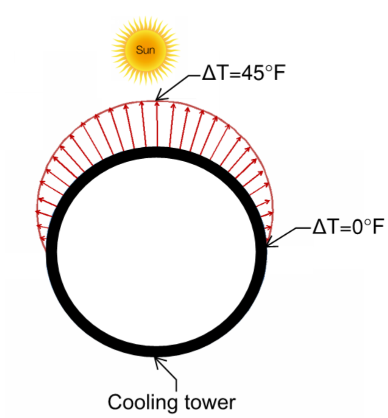


Figure 8. Schematic representation of the temperature distribution associated with diurnal thermal heating

### Seismic

Seismic lateral loads were considered using both the code at the time of construction and the current code for comparison. Based on the code of at the time of construction, the tower resides in Seismic Zone 1, which would not be expected to control the tower design. Based on the current design code provisions, the assigned Seismic Design Category of the cooling tower is 'B', which also produce forces that are smaller than those produced by wind loading.

The design code at the time of construction specified static lateral loads whose magnitude were proportional to the mass of each element and increasing with height. The seismic load analysis with the current design code is performed using a response spectrum analysis.

## Wind

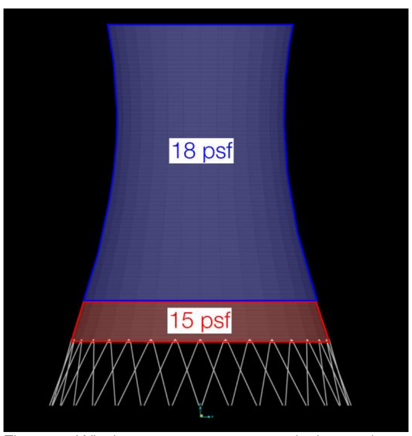

Figure 9. Wind pressure contour per design code at the time of construction.

Wind loads were considered using both the code at the time construction and the current code for comparison. Given the location of the cooling towers, the code at the time construction assigned a nominal wind pressure of 20 pounds per square foot at 30 feet above ground. Given the location and importance of the cooling towers, the current design code assigns an ultimate design wind speed of 120 miles per hour (mph), expressed as a 3-second gust and at 30 feet above ground.

The design code at the time of construction specified horizontal loads, expressed as a pressure, to be applied on the vertical projected area normal to the wind direction and increasing with height as shown on Figure 9. These pressure values combine the inward and outward pressures on the exterior surfaces.

An important consideration of the analysis for the current design code involved the determination of the wind pressure distribution. Wind-induced pressures acting on a hyperbolic cooling tower are determined by the characteristics of the oncoming wind flow, the tower geometry, and the features of the tower surface (such as the number and dimension of the ribs to mitigate wind-induced vortices, if any). The wind pressure at any point of the tower increases with an increase in height and varies for different angular coordinates with respect to the windward meridian. The wind pressure variation along the height is specified by the code. The assumed wind pressure variation in hyperbolic cooling towers at any angular coordinate with respect to the windward meridian was taken as

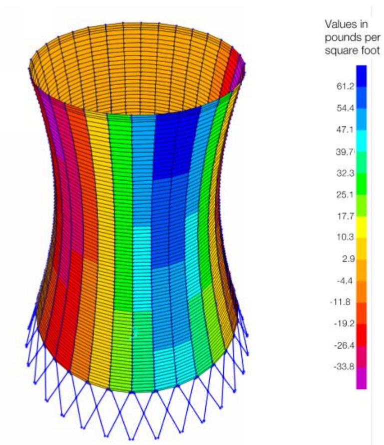

Figure 10. Wind pressure contour per current code for 120 mph wind speed.

recommended in the literature (Chen 1997, Simiu and Scanlan 1986). It is important to note that these pressure distributions are equivalent static pressures. In other words, the dynamic effects of wind are incorporated in the static pressure distributions. Also, these pressures include the external wind pressures and the internal suction from operation conditions. Figure 10 shows the wind pressure contours associated with a 120-mph wind speed. The wind pressures in the models were applied normal to the surface of the veil.

## Load Combinations

The models and analyses using SAP2000 incorporated factored loads. The following ultimate load combinations were considered:

UBC 1967
1. 1.5D + 1.2T
2. 1.25(D + W) + 1.0T
3. 1.25(D + E) + 1.0T
4. 0.9D + 1.1W + 1.0T
5. 0.9D + 1.1E + 1.0T

IBC 2015
1. 1.2D + 1.0W + 1.0T
2. 1.2D + 1.0E + 1.0T
3. 0.9D + 1.0W + 1.0T
4. 0.9D + 1.0E + 1.0T

where:
D: Dead Load
T: Thermal Load
E: Seismic (Earthquake) Load
W: Wind Load

The strength-reduction factors used for the design checks corresponding to UBC 1967 load combinations were in accordance with that code and in accordance with the American Concrete Institute (ACI 318-11) for the load combinations of IBC 2015. Design checks were performed for the columns, ring beam, and veil using the results from the SAP2000 models. Design checks included plotting axial load and moment pairs into interaction diagrams and shear-stress checks. It is important to reiterate that isotropic materials with linear-elastic, stress-strain relationships were used in the SAP2000 analyses.

The analyses performed in ANSYS to estimate the ultimate wind load capacity considered unfactored dead plus thermal loads and increasing the wind load (i.e., 1.0D+1.0T+λW where λ is a multiplier that increases starting at a value equal to zero and it is also referred to as buckling factor) until unstable conditions occur.

## Stability analysis

To estimate the structural capacity of the cooling tower, two analyses were made: 1) a linear buckling analysis (i.e., eigenvalue analysis) using SAP2000 for the as-designed and the existing conditions, and 2) a nonlinear buckling analysis for the as-design tower condition using ANSYS. The results from the SAP2000 models should be considered upper-bound estimates because linear-elastic material relationships were used. The results from the ANSYS model account for material and geometric nonlinearities, and produce a better estimate of the capacity of the cooling tower to resist (lateral) wind loads. The wind-load variation along the height and circumference used in these analyses correspond to the current design code.

## Analysis Results

### Effects of Thermal Loads

A stress analysis was conducted for a load combination involving dead and thermal loads using SAP2000 and ANSYS. The results showed that resulting vertical and horizontal stresses exceed the expected tensile strength of the concrete in a large percentage of the veil. Therefore, modification factors to reduce the axial (equal to 0.35) and bending (equal to 0.25) stiffness of the veil elements were used in all subsequent analyses in SAP2000 to account for cracking in the entire veil as suggested by ACI 318. In ANSYS stressed induced from thermal loads and corresponding concrete cracking were accounted using a thermomechanical analysis. The effects of cracking and stiffness reduction in cooling towers caused by thermal loads are phenomena recognized in the literature (ACI 334.1 R-84, Billington 1982).

### As-designed Condition

An analysis of the tower with the geometry as specified in the design drawings was performed using SAP2000. Design checks were performed for the columns, ring beam, and veil for loading specified in the code at the time of construction and for current-code loads.

The following observations were made for the case of the design loads at the time of construction (UBC 1967):

1. The specified proportions and reinforcement appeared to be adequate to resist the imposed loads.
2. It was found that even for load combinations including lateral loads (i.e., wind and seismic) all the columns were subjected to downward compressive forces.
3. The equivalent veil reinforcing ratios in the circumferential and meridian directions appeared to meet the minimum code-required values for temperature and shrinkage and for elements subjected to flexure.

The following observations were made for the case of the current design loads (IBC 2015):

1. Zones of insufficient vertical reinforcement to resist load combinations including wind loads were identified approximately below the throat and over a length of approximately 23 feet high (Figure 11).
2. The record drawings show the columns are inserted into formed pockets at the top of the plinths without any reinforcement between these two members to provide uplift resistance. It was found that for load combinations including wind loads, uplift occurred at the base of some columns. The maximum uplift is approximately 3 inches. The depth of the pocket in which the columns are inserted into the plinths is 6 inches.

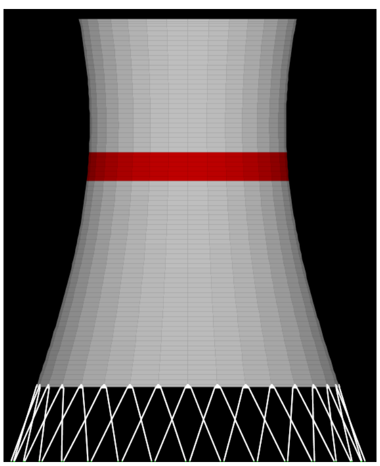

Figure 11. Zone of insufficient vertical reinforcement for current-code wind-load combinations colored in red.

The base shear and overturning moment at the base produced by the ultimate wind load of the current code (IBC 2015) are similar to those produced by the unfactored wind load specified in the code at the time of construction (UBC 1967); these quantities are less than 4% and 2%, respectively, larger for the current loads. Nevertheless, items of concern were noted for wind loads from the current code. The difference in the results may be caused by a combination of the different load combination factors and differences on how the wind pressure is applied on the structure.

## Existing Condition

An analysis of the tower with the geometry obtained from the 3D laser survey was performed using SAP2000. Design checks were performed for the columns, ring beam, and veil for different load combinations including unfactored dead load only, unfactored dead plus thermal loads and load combinations specified in the current code (IBC 2015). The following observations were made:

1. Small percentages of the veil area were identified as having insufficient horizontal reinforcement to resist bending moments produced by unfactored dead loads only (less than 0.2% in terms of the total external surface area of the veil) and unfactored dead plus thermal loads (less than 0.4% in terms of the total external surface area of the veil). These zones are located in the lower half of the veil. It is important to reiterate that the results from this analysis are conservative because the loads were applied to an unstressed deformed structure. Furthermore, moment redistribution is expected to decrease the magnitude of the moments in these areas and, therefore, it is deemed that in the current deformed shape the tower can resist the effects of dead and thermal loads.
2. To estimate the wind direction at which the tower in the current deformed shape is more vulnerable, linear buckling analyses (1.0D+1.0T+λW) were performed to determine the wind direction that produced the lower buckling factor **λ**. In this analysis, a unit lateral pressure constant throughout the height of the tower and applied normal to the vertical project area was applied to the tower. The wind direction was applied in the four cardinal directions and in the four intermediate directions. A northeast wind was found to be the most vulnerable direction for the current deformed shape (Figure 12). It is interesting to note that the northeast quarter face of the tower appeared to present more pronounced (larger in magnitude) undulations (Figure 4). For all analyses of the existing condition, wind and seismic loads from the current code were applied in the northeast-southwest direction, the northeast side being the windward meridian.

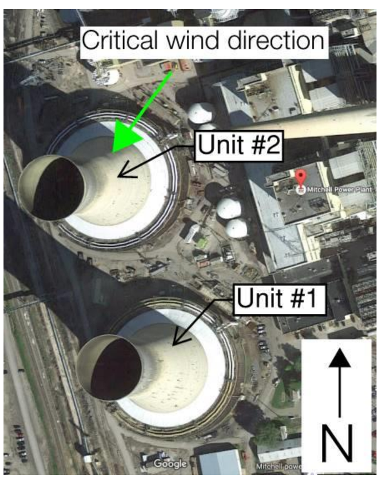


Figure 12. Critical wind direction of Unit #2 (Background image taken from Google Maps).

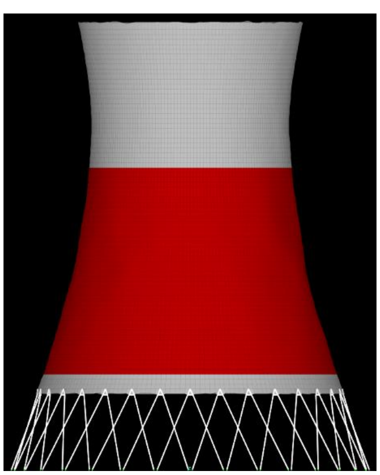

Figure 13. Zone of insufficient vertical and/or horizontal reinforcement for current-code load combinations including wind or seismic loads colored in red.

3. Zones of the veil were identified as having either insufficient vertical or horizontal reinforcement to resist a combination of tensile forces and bending moments produced by load combinations including wind or seismic loads. These zones of concern were distributed from approximately 16 to 240 feet above the base of the veil and around the circumference (Figure 13).
4. In load combinations including wind loads, uplift occurred at the base of some columns. The maximum uplift is approximately 3 inches. The depth of the pocket in which the columns are inserted into the plinths is 6 inches.

## Stability Analysis

Stability of the tower was checked by performing linear buckling analyses (i.e., eigenvalue analyses) for different types of loads using SAP2000 and a nonlinear buckling analysis using ANSYS. Table 1 presents the results from the buckling analyses. It is worth reiterating that the results from the linear analyses accounted for cracking due to thermal effects but are upper-bound estimates because linear-elastic, stress-strain material relationships were used.

Table 1: Buckling safety factors.

| Veil geometry | Linear analysis | | Nonlinear analysis |
|---|---|---|---|
| | 1.0T+λD | 1.0D+1.0T+λW | 1.0D+1.0T+λW |
| | λ | λ | λ |
| From record drawings | 3.1 | 2.1 | 1.6 |
| Current deformed shape | 2.1 | ~1.0 | Not performed |

λ: Buckling safety factor, D: Dead load, T: Thermal load, W: Current design code wind load based on a 120 mph 3-second gust.

The case of buckling under dead load (1.0T+λD) is only a theoretical exercise because dead load is not likely to increase by large amounts (current design codes specify a load combination factor of 1.4 for dead load only for ultimate strength design). Nevertheless, this quantity helps to quantify the effect of the existing deformed shape on the structural capacity compared to the geometry as specified on the record drawings. The impact of the current deformed shape produced a decrease of approximately 32% in the buckling factor with respect to the geometry from the record drawings to a value of 2.1. For a structure to stand, the buckling factor for dead load must be at least 1.0. From the analysis of the tower subjected to unfactored dead loads (i.e., λ=1.0) (see Existing Condition in the Results section), it was noted that small regions of the veil (less than 0.4%) were near their capacity. These two observations suggest that the actual buckling safety factor for dead loads of the cooling tower is between 1.0 and 2.1.

Suggested buckling safety factors for wind load vary greatly depending on the load combination factors used and the code provisions. In a study of buckling safety factors in cooling towers, Srinivasa et al. (1991) found that for the same tower the safety factor for wind load can vary from 2.5 to 20 when evaluated using different load combinations and code provisions. Buckling safety factors are reduced when cracking from thermal loads is taken into account. Previous standards for cooling tower shells in the United States (ACI 334.1 R-84) recommended a minimum buckling safety factor for wind of 2 when cracking is taking into account, but the current standard does not recommend a value (ACI 334.1 R-92). The code intent is to ensure the tower design is controlled by strength and not buckling. The nonlinear buckling analysis of the undeformed tower yielded a buckling safety factory of 1.6 for wind load (1.0D+1.0T+λW); lower than the ACI 334.1 R-84 recommended value of 2.0 and the linear buckling safety factor of 2.1. Figure 14 and 15 show the resultant deformation and equivalent plastic strain distribution at 1.0D+1.0T+1.6W. At 1.0D+1.0T+1.6W load, concrete plasticity is observed over a large area on the windward side with high plastic strains at veil transition from thinner to thicker section.

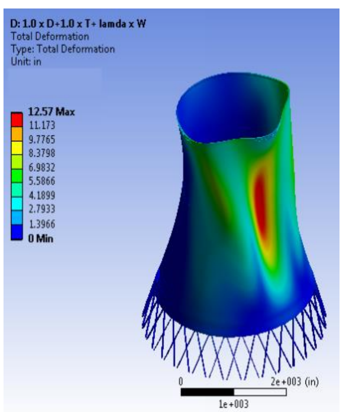


Figure 14. Resultant deformation at 1.0D+1.0T+1.6W load.

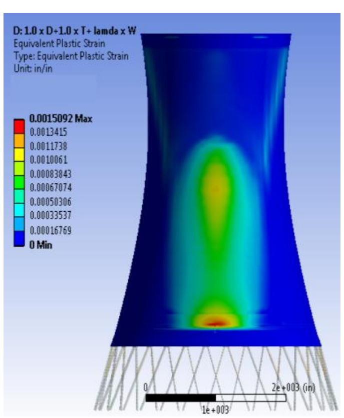


Figure 15. Equivalent plastic strain distribution at 1.0D+1.0T+1.6W load.

The linear analysis results show that the deformed shape reduced the buckling factor for wind load (1.0D+1.0T+λW) from 2.1 to approximately 1.0. Recall that for a λ value of 1.0 and similar load combination factors for dead load, strength deficiencies were noted in the veil (see Existing Condition in the Results section). The buckling safety factor from nonlinear buckling analysis was lower compared to linear buckling analysis for the as-designed condition. These three observations indicate that the cooling tower would be controlled by strength but it is not likely to withstand the current-code design wind speed of 120 mph, expressed as a 3-second gust.

The result from the linear-elastic analysis of the deformed shape of the tower indicates that the wind speed that produces buckling is approximately a 120 mph 3-second gust (Table 1). This result can be used to associate 3-second gust wind speeds expressed in miles per hour with buckling safety factors $\lambda$ by evaluating the expression $v \sim 120 \div \sqrt{\lambda}$. For example, a buckling safety factors $\lambda = 2.0$ would imply a wind speed of 85 mph. Similarly, a buckling safety factors $\lambda = 3.0$ would imply a wind speed of 70 mph.

## Wind-Induced Interference Effects of Cooling Tower Groups

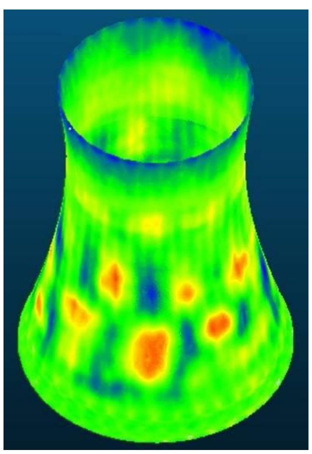
Figure 4. Unit #2 point cloud analysis (north meridian view)

The effect of wind-load amplification on Unit #2 produced by the proximity of Unit #1 was investigated. Based on satellite images (Figure 13), the center to center distance between towers is approximately 550 feet and Unit #1 is south of Unit #2 (approximately S17°±5°E). Given the geometry of the towers and their center-to-center spacing, a wind-load amplification factors of approximately 1.1 would be reasonable to expect (BTR 1997). AEP performed a computational fluid dynamics (CFD) analysis for wind flow over Unit #2 and informed Walter P Moore that the effects of Unit #1 on the wind load of Unit #2 are minimal.

The results from linear eigenvalue wind buckling analyses to determine the most vulnerable wind direction showed that the ratio of the buckling factor for south wind to the critical buckling factor (i.e., northeast wind) is approximately 3/2. This result indicates that a south wind with an amplification factor of 1.1 is not likely to produce worse effects than a northeast wind with an amplification factor of 1.0.

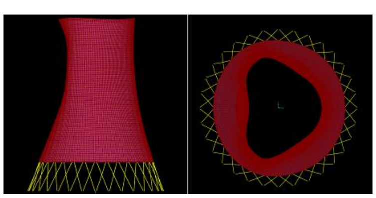
Figure 16. Plan and elevation views of deformed shape under wind load amplified 50 times (windward side is on the left).

## Current Deformed Shape

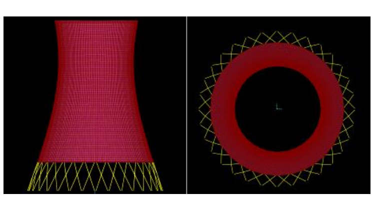
Figure 17. Plan and elevation views of deformed shape under seismic load amplified 50 times.

The pattern of the deformations caused by different loads were compared to the current deformed shape of the veil as determined from the 3D laser survey. Figures 4 and 5 show the current deformed shape of the veil. Figure 4 is presented again in this page for ease of comparison. The current deformed shape presents undulations in a checker board pattern and with larger undulation magnitudes on the north half of the tower.

Figures 16 and 17 show the deformed configuration of the tower subjected to the current code wind and seismic loads, respectively. Wind loads push the veil towards the center of the tower in the windward side and stretch it in the two directions perpendicular to the wind direction. Seismic loads move the tower laterally in a more uniform way with increasing displacements at higher elevations. Displacements from seismic loads are smaller than those from wind.

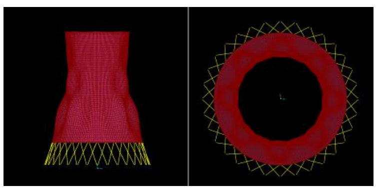

Figure 18. Plan and elevation views of buckled shape under dead load.

Figure 18 shows the buckled shape (i.e., buckling mode) of the cooling tower for dead load. The buckled shape for dead load presents undulations in a checkerboard pattern. The undulations at any elevation occur along the entire circumference and the amplitude of the undulations at the crests are equal (similarly at the troughs).

A comparison of the deformations caused by wind and seismic loads show that these deformed shapes do not resemble the undulating pattern of the current tower shape. The current deformed shape of the tower is similar to, at least in part, the buckled pattern under dead load. These two observations suggest that lateral loads were not likely to produce the current deformed shape and that dead load may have contributed to produce that shape. The fact that the magnitude of the undulations are larger on the north half of the tower indicate that initial imperfections during construction may have been present or more prevalent on the north half of the veil. Dead load, concrete creep effects, and thermal loads likely amplified the magnitude of the initial imperfections and produced the current deformed shape of the veil. All the deformation from dead load occurs at the time of form removal. A large percentage of the deformation from creep effects likely took place during the first five years after construction (ACI 318). Deformations from thermal loads vary depending on the time of the year and are cyclical. It is unclear from a review of historic aerial photography whether the veil deformation condition has worsened over time.

## CONCLUSIONS

The following conclusions can be reached from the evaluation:

1. Based on the computer analysis conducted and 3D laser scan survey, it is most likely that gravity and thermal loads combined with initial imperfections in the cooling tower veil forming produced the buckled shape in the tower veil. It is unclear from a review of historic aerial photography whether this deformation condition has worsened over time.
2. Deformations from buckling are more prevalent on the north median of the veil face and less prevalent on the south meridian of the veil face, suggesting that the buckling behavior is not symmetric.
3. The results of the analysis of the tower with a geometry according to the record drawings and subjected to the design loads at the time of construction suggest that the reinforcement specified in the record drawings appears to be adequate to resist the load effects.
4. The results of the analysis of the tower with the current deformed shape and subjected to the current design lateral loads show that there are areas in the veil where the reinforcement specified in the record drawings is inadequate to resist the effects imposed by the loads. Furthermore, under design wind loads uplift of some columns would be expected.
5. The results of the buckling analysis of the tower with the current deformed shape and subjected to the current design loads show a buckling factor of approximately 1.0, indicating no additional factor of safety to resist tower buckling. In this condition, there is no margin of safety for variations in the expected loading or structural behavior for the tower.
6. Given the large magnitude of deformation in the current deformed shape, full depth concrete cracking in the veil is very likely and existing circumferential reinforcement is solely engaged to resist further deformation (dilation) of the veil. This lack of redundancy is detrimental to the strength of the tower.

## RECOMMENDATIONS

The following recommendations are provided to further investigate and restore the structural integrity of the cooling tower:

1. Conduct an up-close investigation of the cooling tower veil by means of aerial access. This investigation would seek to provide concrete distress and crack mapping, acoustic sounding, corrosion testing, and other test methods to study the present condition of the cooling tower.
2. Evaluate the cooling tower concrete material properties by core extraction and laboratory testing. Provide a comparison between in-situ concrete properties and the original design properties.
3. Conduct a geotechnical investigation to study the differential movement potential of the ring foundation.
4. Conduct additional structural analysis to evaluate strengthening options for the cooling tower veil. Such conceptual options could include concrete circumferential stiffening rings and/or application of carbon fiber composites to strengthen the veil.
5. After consideration of tower strengthening options, develop and implement a comprehensive repair program to restore the structural integrity of the tower and satisfy the design provisions of the current building code.

## LIMITATIONS

This report has been prepared to assist AEP in determining the wind load capacity of the cooling tower structures in the as-designed and existing condition scenarios.

Walter P Moore modeled the structures for the as-designed and existing condition scenarios based on information provided by AEP. Walter P Moore has no direct knowledge of, and offers no warranty regarding the accuracy of the information provided to us by AEP and how that information matches with as-built or existing conditions.

Assumptions were made to model the as-designed and existing condition of the structure which may not represent actual conditions. In this study we did not include a review of concealed conditions or detailed analysis to verify adequacy of the foundation to carry the imposed loads.

If there are perceived omissions or misstatements in this report regarding the assumptions made in the analysis, we ask that they be brought to our attention as soon as possible so that we have the opportunity to fully address them in a timely manner.

This report has been prepared on behalf of and for the exclusive use of AEP. This report and the findings contained herein shall not, in whole or in part, be disseminated or conveyed to any other party or used or relied upon by any other party, in whole or in part, without prior written consent.

## REFERENCES

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2. American Concrete Association (1984), "Reinforced Concrete Cooling Tower Shells – Practice and Commentary", ACI 334.2 R-84.
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11. Simiu, E. and Scanlan, R. H. (1986), "Wind Effects on Structures," John Wiley and Sons, Inc.
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13. BTR Bautechnik bei Kuhltermen (1997), "VGB-Richtlinie fur den bautechnischen Entwurf, die Berechnung, die Konstrucktion und die Ausfuhrung von Kuhltur-men," VGB-R 610 U.

Kentucky Power Company
KPSC Case No. 2026-00001
AG-KIUC's First Set of Data Requests
Dated March 20, 2026

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_14** | Explain when "cracking and deterioration" were first identified, and explain all measures KPCo and/or any and all other relevant AEP affiliates took to address the "cracking and deterioration." |

**RESPONSE**

The Company objects that the request is unduly burdensome because it is seeking a comprehensive description of all measures that took place over the course of a decade. Without waiving this objection, the Company states as follows. The cracking and deterioration of the Mitchell Unit 2 cooling tower shell was first documented during the initial drone inspection in April 2016. As described in testimony and responses to discovery, the identification "cracking and deterioration" led to numerous inspections of the Unit 2 cooling tower shell and eventually led to the repair project that began in 2024.

Witness: Daniel W. Pizzino

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_15** | Was any “cracking and deterioration” occurring prior to July 2025? If so, provide complete details. |

**RESPONSE**

The Company objects that the request is unduly burdensome because it is seeking a comprehensive description of all details that took place over the course of a decade. Without waiving this objection, the Company states as follows. Yes, the Mitchell Unit 2 “cracking and deterioration” was first documented as far back as the 2016 initial structure engineering assessment. As stated on pages 6 and 7 of Company Witness Pizzino’s Direct Testimony, the full extent of the “cracking and deterioration” was not known until inspections performed during the 2024 repair project. Details of the original assessment and subsequent inspections can be found in the Company’s response to AG-KIUC 1_9, KPSC 1_1 and KPSC 1_14.

Witness: Daniel W. Pizzino

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_16** | Following the construction of the Mitchell plant including the cooling towers, explain whether AEP or any relevant affiliate obtained any warranties and/or insurance coverage applicable to the cooling towers. |

**RESPONSE**

AEP maintains operational property insurance for all assets, with the exception of lines, poles, and towers. As such, once the cooling towers become operational, they are automatically included in the corporate operational property insurance program, subject to certain deductibles.

Witness: Tanner S. Wolffram

Kentucky Power Company
KPSC Case No. 2026-00001
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Dated March 20, 2026

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_17** | Provide a discussion of whether inspections of the other Mitchell cooling tower have been conducted, and if so, provide all details on the results of those inspections. |

**RESPONSE**

Please see the Company's responses to AG-KIUC 1_9, KPSC 1_1, and KPSC 1_14.

Witness: Daniel W. Pizzino

Kentucky Power Company
KPSC Case No. 2026-00001
AG-KIUC's First Set of Data Requests
Dated March 20, 2026

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_18** | Provide all documentation describing the scope of the "Initial Repair Project" identified in Application paragraph 6. Explain who conducted that project, and whether any licensed professional engineers were involved in that project. |

**RESPONSE**

Please refer to Company Witness Pizzino's Direct Testimony starting on page 5, line 16 through page 6, line 8.

The project was conducted (performed the construction activities) by International Chimney Corporation Commonwealth.

Licensed professional engineers were involved in engineering and design, as well as the review process, and were engaged for quality control in the field during construction for the repair project.

Witness: Shawn P. Malone

Witness: Daniel W. Pizzino

Kentucky Power Company
KPSC Case No. 2026-00001
AG-KIUC's First Set of Data Requests
Dated March 20, 2026

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_19** | Provide all documents illustrating or discussing the projected lifespan of the Mitchell cooling towers when they were first constructed. |

**RESPONSE**

The Company objects that the request is vague, overly broad, and unduly burdensome because it is seeking information that is not kept in the ordinary course of business and is not limited in scope of time. Without waiving these objections, the Company states as follows. The Company does not maintain records from the period that would include the requested information.

Witness: Daniel W. Pizzino

Witness: Shawn P. Malone

**DATA REQUEST**

**AG-KIUC 1_20** Reference Table SPM-1 ("Summary of Options") included in the Malone testimony.

a. Given that the projected lifespan of the replacement for the Mitchell cooling tower is 25 years, is it logical and appropriate to assume that the projected lifespan of the original tower was also 25 years?

b. Explain whether AEP or any relevant affiliate increased the frequency of inspections of the cooling towers once the 25-year lifespan had been achieved. If not, explain fully why not.

**RESPONSE**

a. No, they are two different types of technology and there are other considerations that impact projected lifespan. For planning purposes, a newly constructed mechanical draft cooling tower is assumed to have a 25-year life. With routine maintenance and periodic component replacement, these towers routinely remain in service well beyond the initial projected timeframe.

b. AEPSC Engineering provides inspections as necessary throughout the life of cooling tower shells. AEP does not automatically increase inspection frequency upon reaching certain age; instead, formal inspections are based on performance, manufacturer guidance, operating history, and risk-based prioritization.

Witness: Daniel W. Pizzino

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_21** | Explain whether structural failure of a cooling tower that had surpassed its expected lifespan was a known and demonstrated hazard. |

**RESPONSE**

The Company objects to this request as it calls for a legal conclusion.

Respondent: Counsel

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_22** | Given that the other Mitchell Cooling Tower has also exceeded its lifespan, explain whether KPCo and/or its relevant affiliates have any plans to replace it. |

**RESPONSE**

The Company objects to the extent the request mischaracterizes the nature of the Mitchell Unit 1 cooling tower's lifespan. Without waiving this objection, the Company states as follows. Mitchell Unit 1's cooling tower remains within its expected service life and shows no surface irregularities (*e.g.*, anomalies, flat spots) or the same type of surface cracking observed on Mitchell Unit 2. Therefore, there are currently no plans to replace the Mitchell Unit 1 cooling tower.

Witness: Daniel W. Pizzino

Witness: Shawn P. Malone

Kentucky Power Company
KPSC Case No. 2026-00001
AG-KIUC's First Set of Data Requests
Dated March 20, 2026

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_23** | Explain whether any portion of the projected cost estimates were necessary due to federal tariffs. If so: (i) explain whether those tariffed items will be removed due to the U.S. Supreme Court ruling in Learning Resources, Inc. v. Trump, Docket 24-1287;1 and (ii) explain whether KPCo and its relevant affiliates will be seeking a tariff rebate. 1 Accessible at: https://www.supremecourt.gov/opinions/25pdf/24-1287_4gcj.pdf |

**RESPONSE**

The Company objects to the extent this request calls for a legal conclusion. The Company further objects because the request is vague, undefined, and cannot be answered without further clarification.

Respondent: Counsel

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_24** | Provide the link to the West Virginia Public Service Commission ("WV PSC") docket in which Wheeling Power Co. ("WPCo") has filed its CPCN application requesting permission to build the replacement tower for the Mitchell Plant, together with .pdf versions of all documents filed.<br><br>a. Confirm that if the WV PSC grants WPCo's CPCN, its ratepayers will pay the same sum that KPCo ratepayers will pay.<br><br>b. Explain whether WPCo is requesting the same exemption from the AFUDC offset that KPCo seeks in the instant docket. |

**RESPONSE**

The link to the WV PSC docket in which WPCo filed its CPCN application requesting to build the replacement tower for the Mitchell Plant is:
https://www.psc.state.wv.us/WebDocket/default.htm

Clicking the "Activities" link allows for download of documents filed into the record.

a. The Company objects that the request calls for speculation about a future event based upon an incomplete hypothetical. Without waiving this objection, the Company states as follows. The cost of the project will be shared equally between Kentucky Power and Wheeling Power, with each Company being allocated 50% of those costs. However, there are other differences in terms of cost recovery; for instance, the companies' authorized ROEs and weighted average cost-of-capital are different. Therefore, the sum to be recovered will not be the same.

b. The Company objects to the extent this request calls for a legal conclusion. Without waiving this objection, the Company states as follows. The WV PSC docket speaks for itself.

Witness: Tanner S. Wolffram

**DATA REQUEST**

**AG-KIUC 1_25** Provide a discussion regarding what efforts KPCo and its relevant affiliates undertook to procure federal grants and/or other financial assistance for the Mitchell cooling tower project.

a. Confirm the Worley estimate was developed as a feasibility study estimate and is not a final estimate.

b. Provide a schedule showing the Company's buildup of the estimated total capital costs, starting with the Worley estimate and then each of the additional costs described by Witness Malone included in the $191 million amount.

**RESPONSE**

Please see the discussion in Company Witness Wolffram's Direct Testimony on page 14, lines 1-9 wherein he describes that the Company applied for a grant from the U.S. Department of Energy. Please also see the Company's response to KPSC 1_3.

a. Please see the Company's response to AG-KIUC 1_7 subpart a.

b. Please see the Company's response to AG-KIUC 1_7 subpart b.

Witness: Shawn P. Malone

Witness: Tanner S. Wolffram

Kentucky Power Company
KPSC Case No. 2026-00001
AG-KIUC's First Set of Data Requests
Dated March 20, 2026

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_26** | Discuss the advantages of the mechanical draft option, as opposed to rebuilding a new natural draft cooling tower. |

**RESPONSE**

There are a number of advantages to a mechanical draft cooling tower option; the primary ones are as follows. The main benefit of a mechanical draft cooling tower is lower construction costs compared to the natural draft cooling tower. Secondly, the footprint of the mechanical draft cooling tower is much less than the natural draft cooling tower.

Witness: Daniel W. Pizzino

**DATA REQUEST**

| | |
|---|---|
| **AG-KIUC 1_27** | Confirm that once the replacement tower is constructed and commercially operable, the existing tower will be reduced to approximately one-half of its current height and will never be used again. |

**RESPONSE**

The Company objects that the request calls for speculation about a future event based upon an incomplete hypothetical. Without waiving this objection, the Company states as follows. Per the Company’s plan, once the replacement mechanical draft tower is constructed and commercially operational, the existing Mitchel Unit 2 parabolic cooling tower will be reduced by 120 feet to approximately 256 feet and the Company has no plans to use it again.

Witness: Daniel W. Pizzino

**VERIFICATION**

The undersigned, Nicole M. Coon, being duly sworn, deposes and says she is a Regulatory Consultant Principal for American Electric Power Service Corporation, that she has personal knowledge of the matters set forth in the foregoing responses and the information contained therein is true and correct to the best of her information, knowledge, and belief.

Nicole M. Coon
Nicole M. Coon

_________________ )
)  Case No. 2026-00001
_________________ )

Subscribed and sworn to before me, a Notary Public in and before said County and State, by Nicole M. Coon, on 3/26/26.

______________________
Notary Public

My Commission Expires Never

Notary ID Number No ID

NOTARIAL SEAL STATE OF OHIO

Paul D. Flory
Attorney At Law
Notary Public, State of Ohio
My commission has no expiration date
Sec. 147.03 R.C.

**VERIFICATION**

The undersigned, Shawn P. Malone, being duly sworn, deposes and says he is the Director of Projects for American Electric Power Service Corporation, that he has personal knowledge of the matters set forth in the foregoing responses and the information contained therein is true and correct to the best of his information, knowledge, and belief.

Shawn P. Malone

Shawn P. Malone

State of OHIO )
County Franklin ) Case No. 2026-00001
)

Subscribed and sworn to before me, a Notary Public in and before said County and State, by Shawn P. Malone, on March 27, 2026.

Dianna L Fields

Notary Public

DIANNA L FIELDS, NOTARY PUBLIC
COMM. EXP. DECEMBER 17, 2030
STATE OF OHIO

My Commission Expires Dec, 17, 2030

Notary ID Number 2025-RE-897557

**VERIFICATION**

The undersigned, Daniel W. Pizzino, being duly sworn, deposes and says he is the Director of Generation Engineering for American Electric Power Service Corporation, that he has personal knowledge of the matters set forth in the foregoing responses and the information contained therein is true and correct to the best of his information, knowledge, and belief.

Daniel W. Pizzino

State of Ohio )
County Franklin )
)

Case No. 2026-00001

Subscribed and sworn to before me, a Notary Public in and before said County and State, by Daniel W. Pizzino, on March 24, 2026.

Notary Public

My Commission Expires December 17, 2030

Notary ID Number 2025-RE-897557

DIANNA L FIELDS, NOTARY PUBLIC
COMM. EXP. DECEMBER 17, 2030
STATE OF OHIO

# VERIFICATION

The undersigned, Tanner S. Wolffram, being duly sworn, deposes and says he is the Director of Regulatory Services for Kentucky Power, that he has personal knowledge of the matters set forth in the foregoing responses and the information contained therein is true and correct to the best of his information, knowledge, and belief.

Tanner S. Wolffram

Commonwealth of Kentucky )
) Case No. 2026-00001
County of Boyd )

Subscribed and sworn to before me, a Notary Public in and before said County and State, by Tanner S. Wolffram, on April 1, 2026.

Notary Public

My Commission Expires May 5, 2027

Notary ID Number KYNP71841

MARILYN MICHELLE CALDWELL
Notary Public
Commonwealth of Kentucky
Commission Number KYNP71841
My Commission Expires May 5, 2027