BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

MIDWEST GENERATION, LLC)
Petitioner,)
v.) PCB 2018-058
ILLINOIS ENVIRONMENTAL) (Thermal Demonstration – Water)
PROTECTION AGENCY)
Respondent.)

NOTICE OF FILING

To:

Don Brown, Clerk of the Board Illinois Pollution Control Board James R. Thompson Center, Suite 11-500 100 W. Randolph Street Chicago, IL 60601 don.brown@illinois.gov	Stefanie N. Diers Illinois Environmental Protection Agency 1021 N. Grand Avenue East P.O. Box 19276 Springfield, IL 62794 Stefanie.diers@illinois.gov
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PLEASE TAKE NOTICE that I have today electronically filed with the Office of the Clerk of the Pollution Control Board Petitioner, Midwest Generation, LLC’s Response to Illinois Pollution Control Board Questions, a copy of which is herewith served upon you.

Dated: January 11, 2019 MIDWEST GENERATION, LLC

By: /s/ Susan M. Franzetti

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CERTIFICATE OF SERVICE

The undersigned, an attorney, certifies that a true copy of the foregoing Notice of Filing and Petitioner, Midwest Generation, LLC's Response to Illinois Control Board Questions was electronically filed on January 11, 2019 with the following:

Don Brown, Clerk of the Board
Illinois Pollution Control Board
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and that a true copy was mailed via email on January 11, 2019 to the parties listed on the foregoing Service List.

Dated: January 11, 2019 /s/ Susan M. Franzetti ___________________

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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

MIDWEST GENERATION, LLC)
Petitioner,)
) PCB 18-58 (Thermal Demonstration)
v.)
)
ILLINOIS ENVIRONMENTAL)
PROTECTION AGENCY)
Respondent.)

MIDWEST GENERATION, LLC WILL COUNTY GENERATING STATION ALTERNATIVE THERMAL EFFLUENT LIMITATION DEMONSTRATION RESPONSES TO ILLINOIS POLLUTION CONTROL BOARD QUESTIONS FOR PETITIONER

Petitioner Midwest Generation, LLC ("MWGen"), by its undersigned counsel, responds to each of the written questions of the Illinois Pollution Control Board (the "Board") below. For each of the eight questions the Board presented to Petitioner, the Board's question is set forth first, followed by Petitioner's response. MWGen believes it has fully responded to each of the Board's questions, but in the event the Board identifies any further information or clarifications that are needed before the Board may issue an opinion and order on the requested thermal alternative effluent limitation ("AEL") relief, MWGen will respond further to any such additional information requests.

1. 106.1130(b)(1) Description of Method for Heat Dissipation

> Midwest Generation (Midwest Gen) states, "Cooling water, once passed through the cooling condensers, exits the plant through this approximately 250-foot discharge canal which leads directly back to the CSSC. There are no flow controlling structures or gates associated with the WCGS discharge canal." Pet. at 9. Midwest Gen noted that the cooling water intake structure withdraws water from the entire water column. Pet. at 6. For the cooling water discharge, Midwest Gen stated, "[T]he thermal plume is surficial in nature…" Exh. 2. The cross section vertical profiles south of the outfall show the surficial nature of the thermal plume. Exh. 4, App. D.

35 Ill. Adm. Code 302.102(b)[(1)][1] provides:

> Mixing must be confined in an area or volume of the receiving water no larger than the area or volume which would result after incorporation of outfall design measures to attain optimal mixing efficiency of effluent and receiving waters. These measures may include, but are not limited to, use of diffusers and engineered location and configuration of discharge points.

a. Please describe the flow dynamics of the discharge canal and how the flow dynamics provide for mixing in the CSSC as required under 35 Ill. Adm. Code 302.102(b)[1].

RESPONSE: The WCGS 316(a) model (MIKE3) does not include Computational Fluid Dynamic (CFD) capabilities for describing flow dynamics, but it is apparent from both the configuration of the discharge canal in relation to the Chicago Sanitary and Ship Canal ("CSSC"), as well as from previous field thermal plume studies (see Petition, Exh. 4, App. H), that mixing is rapid within the surficial layers, especially during periods of moderate to high canal flow. This is also demonstrated by the MIKE3 model output for typical flow conditions. The flow pattern in the CSSC is erratic, with high and low variations occurring year-round on an hourly basis. The erratic flow pattern in the CSSC enhances the degree of mixing, as does the commercial barge traffic that frequently traverses this area.

The WCGS discharge canal is relatively short, narrow, and approximately half the depth (or less) of the main canal channel. All of these characteristics serve to increase the overall exit velocity of the thermal discharge, as well as maintain its surficial character. As discussed further in Response 1.b below, because the mixing occurs primarily in the upper water column, a zone of passage is maintained for aquatic life in lower depths. The high relative velocity of the discharge helps to ensure that the surface plume is distributed across the surface of the waterway.

Based upon both field observations and conservative calculations, the exit velocity of the WCGS thermal plume from the discharge canal is at least 1.5 times greater than the average velocity of the CSSC (as measured by the USGS gaging station at Lemont). This is corroborated by the results of both field studies and hydrothermal modeling. These results show that under average or "typical" conditions, the thermal plume is readily dispersed in the waterway.

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[1] Although the original reference in the question is to subparagraph "(2)" of 35 Ill. Adm. Code 302.102(b), the language provided is instead found in subparagraph (1). Accordingly, the regulatory citation has been revised here and in Question 1.a. to refer to "35 Ill. Adm. Code 302.102(b)[1]."

b. Is maintaining the thermal plume near the surface more beneficial in terms of providing a zone of passage than rapid mixing with the entire water column?

RESPONSE: Because warmer water is positively buoyant, the thermal plume remains surficial in nature upon entering the CSSC, as demonstrated both by previously performed thermal plume studies and by modeling under typical canal and weather conditions. Maintaining the thermal plume near the surface is more beneficial in terms of providing a zone of passage. A surface thermal plume has much less biological significance than one that extends deeper into the water column. A buoyant plume provides cooler temperatures at greater depths than occur at the surface, allowing fish to move under and/or around critical water temperatures that may be outside of their preferred range. In contrast, if diffusers were used to create full mixing throughout the water column, this would create a risk of producing critical temperatures throughout the near-field cross-section in which the mixing occurs. This could block fish from avoiding critical temperatures and would not assure the protection and propagation of the waterbody's balanced, indigenous population of shellfish, fish and wildlife.[2]

c. Although Midwest Gen contends that there is not sufficient space to install helper cooling towers to meet the thermal water quality standards (Pet. at 6-7), please comment on whether modifications to the discharge structure or canal have the potential to increase the zone of passage when upstream canal flow provides a dilution ratio greater than 3:1.

RESPONSE: The WCGS discharge canal is confined to a small area and is cut into the surrounding limestone bedrock. There is no available space in the canal to install any type of diffuser or other similar device to further enhance thermal mixing or otherwise dissipate heat more quickly. MWGen has considered this possibility in the past and found it to be infeasible, due to those space constraints.

Additionally, because the CSSC is relatively narrow at the location of the WCGS discharge and is utilized as a navigational channel essentially from bank to bank, it would be impossible to install any type of diffuser structure that extends into the CSSC itself to further assist with the mixing of the WCGS thermal plume when the dilution ratio is less than 3:1.

As discussed in Response 1.b, the WCGS discharge is relatively shallow and promotes surficial mixing that plays an important role in maintaining a zone-of-passage to assure protection of the balanced, indigenous population of aquatic life. And because waterway conditions (barge traffic, erratic changes in flow) promote surficial mixing, the concentration of heat in the surface layers does not create large volumes of water above critical levels. A typical purpose of outfall diffusers is to

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[2] In reference to aquatic life in the CSSC, this document uses the terms "balanced, indigenous, population" and "balanced, indigenous, community" (also called "BIP" or "BIC" respectively). These terms are used interchangeably, as both terms appear in state and federal regulations, and the Board's regulations specify that they share the same meaning. See 35 Ill. Admin. Code 106.1110.

distribute the thermal load more evenly through the water column to promote mixing from the surface to the bottom in the vicinity of the outfall. For the WCGS thermal discharge, the use of a diffuser, even if technically feasible to install, would not necessarily achieve a greater degree of protection of the balanced indigenous population because of the potentially harmful impact it has on reducing the zone of passage when discharge temperatures are above the thermal water quality standard.

For dilution ratios greater than 3:1, the modeling results discussed in Appendix D, as well as field thermal plume studies discussed in Appendix H, indicate that there is sufficient canal flow to quickly dissipate the WCGS thermal plume, allowing for a 75% zone of passage, or greater, for the proposed thermal AELs.

As indicated in the Demonstration Report in Appendix D, pages D-33 to D-41, the zone of passage is much larger when the dilution-flow ratio is at or greater than 3:1. (In most cases, 75% or greater.) Due to the fact that the WCGS Near-Field Thermal Compliance Model uses a rolling 24-hour average antecedent flow as input, the constantly fluctuating canal flows would need to be extremely low for long contiguous periods of time (*i.e.*, for more than just a few hours) in order for the corresponding 24-hour average antecedent flow to drop below a 3:1 ratio. Therefore, the proposed 50% zone of passage would be relevant for WCGS thermal compliance only in situations when upstream flows remain low for these longer periods of time, and the station is running at higher load with all circulating water pumps on.

The proposed 50% zone of passage is designed to cover a “worst-case” situation when the factors affecting thermal compliance may potentially combine to create adverse conditions. Because the use of a 50% zone of passage is allowed by Title 35, Subtitle C, Chapter I, Section 302.102(b)(8) when the dilution ratio is less than 3:1, MWGen’s intent in expressly identifying it as part of the AEL was to clarify that this provision has already been authorized by the Illinois water quality regulations and does not represent a term that is created as part of the AEL itself. In the case of the WCGS discharge, the allowed 50% zone of passage under low-dilution conditions mitigates against the erratic flow regime of the CSSC and the potential impact of chronic low flows on the ability of WCGS to maintain ongoing thermal AEL compliance. However, given that the provisions of Subsection 302.102(b)(8) would apply regardless of whether they are expressly stated in the requested AEL, the Board may prefer not to include such language in the text of the AEL relief granted to the WCGS.

Depending upon the combination of real-time station operations, weather, and river flow conditions (which are accounted for in the WCGS Near-Field Thermal Compliance Model on a 24-hour average antecedent basis), it is impractical to select a single canal flow value which would always require the use of a 3:1 ratio in order for WCGS to remain in compliance with the proposed thermal AELs. This would need to be determined on a dynamic basis, which is what the Near-Field Thermal Compliance Model does with its constantly updated set of input parameters. In general, a CSSC flow of less than 2,646 cfs would represent a less than 3:1 dilution ratio, but compliance would also depend upon station operations and ambient canal temperatures at any given time, as well as how long that flow rate continued. As such, continued use of the IEPA-approved WCGS Near-Field Thermal Compliance Model inherently provides an output that assimilates the changing canal flow conditions and calculates a zone of passage temperature based on the appropriate dilution factor.

Supplemental Information on CSSC Flows:

In further response to the Board's question, the table provided below shows the percentile distribution of daily average CSSC flows for the 2011-2016 period of record. At the 50th percentile (*i.e.,* flow at or below these values 50% of the time), the corresponding canal flows would be less than a 3:1 ratio during primarily the non-summer months. Similarly, at the 75th percentile (*i.e.,* flow at or below these values 75% of the time or less), flows at a less than 3:1 ratio occurred only during January, February, October, November, and December. However, this table also shows that flows of less than a 3:1 ratio can occur at any time of the year at a reduced frequency.

Daily average flows less than the published 7Q10 value of 1,315 cfs occurred only during the non-summer months from 1% to 20% of the time during the period of record reviewed (2011-2016). Unlike a natural waterway that follows seasonal trends, the 7Q10 flow holds little meaning in an artificial system such as the CSSC, because flow is dictated by manipulation of both the Brandon Road and Lockport Lock and Dams in order to serve flood control and navigational purposes, as well as hydropower use by the Lockport Powerhouse owned and operated by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC).

This daily average flow data shows that during the periods when WCGS is expected to operate at higher discharge temperatures (*e.g.*, the summer period from June through September), canal flows are generally higher. This is due to supplementation of the canal system by diversion of Lake Michigan water (subject to the International Joint Commission Agreement[3]), as well as contributions from rainfall, runoff, and publicly owned treatment works (POTW) effluents, which often have higher flows during this period. As such, adverse thermal effects on the indigenous aquatic community have not been found in the past and are unlikely to occur in the future as the result of WCGS operations.

While the daily average flow data is slightly different than the rolling 24-hour average antecedent real-time flows used in the WCGS Near-Field Compliance Model, they are similar enough to demonstrate that there have been and will continue to be periods when the dilution ratio will be less than 3:1. The biological information collected during the period of record (2011-2016) when these lower flows occurred, and while WCGS was in operation, do not indicate any appreciable harm (Exh. 4, at "4-13".)

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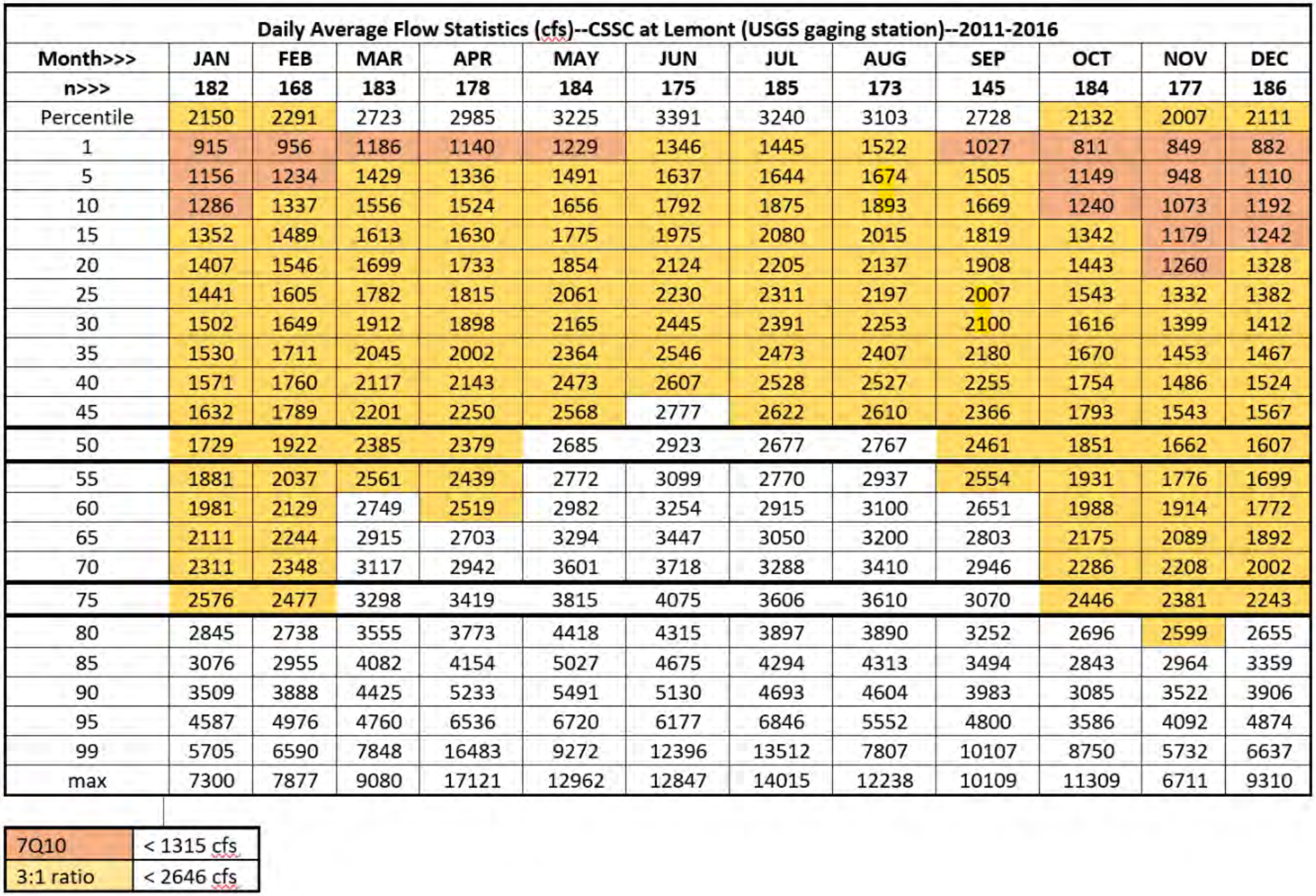
[3] See U.S. Supreme Court Decree in the *Wisconsin, et al v. Illinois et al*, 388 U.S. 426 (1967) as modified 449 U.S. 48 (1980)

Therefore, MWGen’s proposal for coverage under the 50% zone of passage provision meets the key requirement of the Subpart K regulations that the balanced indigenous population will be protected.



Daily Average Flow Statistics (cfs)--CSSC at Lemont (USGS gaging station)--2011-2016

Month>>>	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
n>>>	**182**	**168**	**183**	**178**	**184**	**175**	**185**	**173**	**145**	**184**	**177**	**186**
Percentile	2150	2291	2723	2985	3225	3391	3240	3103	2728	2132	2007	2111
1	915	956	1186	1140	1229	1346	1445	1522	1027	811	849	882
5	1156	1234	1429	1336	1491	1637	1644	1674	1505	1149	948	1110
10	1286	1337	1556	1524	1656	1792	1875	1893	1669	1240	1073	1192
15	1352	1489	1613	1630	1775	1975	2080	2015	1819	1342	1179	1242
20	1407	1546	1699	1733	1854	2124	2205	2137	1908	1443	1260	1328
25	1441	1605	1782	1815	2061	2230	2311	2197	2007	1543	1332	1382
30	1502	1649	1912	1898	2165	2445	2391	2253	2100	1616	1399	1412
35	1530	1711	2045	2002	2364	2546	2473	2407	2180	1670	1453	1467
40	1571	1760	2117	2143	2473	2607	2528	2527	2255	1754	1486	1524
45	1632	1789	2201	2250	2568	2777	2622	2610	2366	1793	1543	1567
50	1729	1922	2385	2379	2685	2923	2677	2767	2461	1851	1662	1607
55	1881	2037	2561	2439	2772	3099	2770	2937	2554	1931	1776	1699
60	1981	2129	2749	2519	2982	3254	2915	3100	2651	1988	1914	1772
65	2111	2244	2915	2703	3294	3447	3050	3200	2803	2175	2089	1892
70	2311	2348	3117	2942	3601	3718	3288	3410	2946	2286	2208	2002
75	2576	2477	3298	3419	3815	4075	3606	3610	3070	2446	2381	2243
80	2845	2738	3555	3773	4418	4315	3897	3890	3252	2696	2599	2655
85	3076	2955	4082	4154	5027	4675	4294	4313	3494	2843	2964	3359
90	3509	3888	4425	5233	5491	5130	4693	4604	3983	3085	3522	3906
95	4587	4976	4760	6536	6720	6177	6846	5552	4800	3586	4092	4874
99	5705	6590	7848	16483	9272	12396	13512	7807	10107	8750	5732	6637
max	7300	7877	9080	17121	12962	12847	14015	12238	10109	11309	6711	9310

7Q10	< 1315 cfs
3:1 ratio	< 2646 cfs

2. **106.1130(e)(3) Results of Studies: Summaries of physical, chemical, biological and technical data supporting the demonstration, along with a discussion of the data**

Midwest Gen requests that the proposed alternative thermal effluent limitations be effective at the edge of the allowed 26-acre mixing zone and that compliance be demonstrated through the continued use of the WCGS Near-Field Thermal Compliance Model as was previously done under the terms of its NPDES Permit. Pet. at 26. Midwest Gen. states that it uses the Near-Field Thermal Compliance Model to determine the water temperature in the CSSC at the edge of the 26-acre mixing zone. Midwest Gen explains, "The Near-Field Thermal Model utilizes real-time station operating data and 24-hour antecedent flow to calculate fully mixed temperatures in the main body of the waterway…The results produced by the Near-Field Thermal Model have been demonstrated to be equivalent to the approximate edge of the allowed 26-acred mixing zone for WCGS." Pet. at 10. Additionally, the model "is also designed to allow for the accounting and reporting of excursion hour use." App. D, Exh. D. "The Excel-based Near-Field Thermal Compliance Matrix can be used by station personnel on an as-needed basis to ensure that compliance with the Secondary Contact thermal standards is maintained under current receiving stream conditions." Exh. 4, App. D, Exh. D at 2.

The chart provided in Exh. 4, App. D, Exh. D, Att. 1 is a sample output produced by the Near-Field Thermal Compliance Model based on certain inputs for pump rate, mixing ratio, upstream canal flow, available dilution flow, intake temperature, and discharge temperature. Exh. 4, App. D, Exh. D at 2. The calculated maximum downstream temperatures are displayed for the various input parameters. Calculated temperatures that exceed the water quality standard are highlighted in yellow to indicate situations under certain flow rates and intake temperatures where excursion hours are being used for water temperatures greater than the standard. Station personnel can read off the chart whether excursion hours are being used by lining up the Upstream Canal Flow and Available Dilution with the Intake Temperature.

a. The chart lists a range for "Upstream Canal Flow" from 1,405 to 5,205 cfs. Please explain why the chart does not extend all the way down to the 7Q10 flow[4] of 1,315 cfs. Exh. 4, App. D at D-13, D-30.

RESPONSE: The Board correctly notes that the Near-Field Thermal Compliance Model is run using an Excel-based spreadsheet, with embedded formulas that derive compliance temperatures based on changing inputs for pump rate, mixing ratio, and other variables.

The referenced chart attached to the Demonstration excluded some lower flow rates because it was provided strictly as one example of output (*i.e.*, a snapshot) of the results that can be obtained by using the Near-Field Thermal Compliance Model on a real-time

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[4] The 7Q10 is the lowest 7-day average flow that occurs (on average) once every 10 years.

basis. Pursuant to the terms of the WCGS NPDES Permit, this is what is currently performed by station personnel to determine ongoing compliance and excursion-hour use, so every combination of flow and intake temperature that occurs can be captured for compliance monitoring purposes. The model updates the compliance temperature every 15 minutes based on real-time data input. As such, a "live" Excel spreadsheet of this kind cannot be reproduced in a Board filing.

The purpose of the chart was to provide a visual illustration of the model information that MWGen compliance personnel are seeing "on the ground" in real time. It was intended to present how the model determines temperature limit compliance and the use of excursion hours by the WCGS. Station personnel use the dynamic model itself—not a static table as presented in the attachment—for purposes of monitoring compliance with the thermal effluent limitations.

In response to Question 2.c, MWGen requested that EA prepare the attached set of supplemental tables (Attachment A). These tables show a larger range of upstream flow values (including the published 7Q10 of 1,315 cfs,[5] as well as the estimated percentage of time during which the corresponding dilution ratio is less than 3:1, based on the 2011-2016 period of record). The resulting calculated compliance temperatures are based on a range of potential intake temperatures, up to the proposed AELs and, in this example, use the maximum measured WCGS discharge temperature for each AEL time period, based on the period of record.

Because the Near-Field Thermal Compliance Model relies on the use of available dilution flow (*e.g.*, flow in the canal minus the actual circulating water flow rate of WCGS), when the available flow is equal to or less than the WCGS circulating water flow, there is no dilution available and the applicable temperature limit must be met end-of-pipe. There is no provision in the proposed AELs that would allow for any mixing under these circumstances, which is consistent with the original mixing zone provisions in Ill. Adm. Code Title 35, Subtitle C, Chapter I, Section 302.102(b)(10).

The Near-Field Thermal Compliance Model uses an hourly rolling 24-hour average antecedent canal flow in the compliance calculation. This reflects the reality that constantly changing, erratic, flow conditions in the canal system—which can vary dramatically within short periods of time—will tend to dampen the overall effect of short-term decreases in flow rate. Typically, a short period of low flows will end (or be cancelled out by a significant increase in flow) before any significant changes in waterway temperature will occur. Thus, there is no need to trigger rapid changes in

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[5] The 7Q10 flow for an artificially controlled system such as the CSSC has little biological or practical significance, as this flow was derived by the Illinois State Water Survey by adding up all of the maximum flows from the three major POTWs in the Chicago area that discharge into the canal system. Review of the flow data record shows that flows either at or below 7Q10 occur on a regular basis. (See page 7, *supra*). The concept of 7Q10 is more appropriately applied to natural waterways with typical seasonal variations, which can be negatively impacted when flows are naturally decreased due to drought and do not recover quickly.

station operations to effect compliance control in response to brief drops in flow. The Near-Field Thermal Compliance Model's flow averaging instead focuses protections on the sustained changes in waterway conditions that can produce tangible temperature effects.

During periods of prolonged low-flow conditions, the near-field compliance temperatures are monitored closely by WCGS personnel in order to ensure that any proactive measures (up to and including derating) that may be required to maintain compliance can be implemented on an as needed basis. Alarms are built in at set compliance temperature points to alert WCGS personnel when excursion hours are in use, and also when the temperature begins to approach the maximum limit, in order to allow for the implementation of timely control measures.

b. The equation in the chart for calculating the downstream temperature at the edge of the mixing zone is depicted as:

$$C_{DE} = (C_E\ Q_E + C_{US}\ Q_{US}) / (Q_E + Q_{US})$$

i. Q_{US} is denoted as "25% of the available receiving stream flow in cfs". Is Q_{US} equal to 25% of the "Upstream Canal Flow, cfs" depicted in the left column of the chart?

RESPONSE: No. Q_{US}, as defined below the referenced chart/table (difficult to read due to shading), is the available flow obtained by subtracting the circulating water flow from the Upstream Canal flow, and then multiplying by 0.25. This value defines a 75% zone of passage.

The values of Upstream Canal Flow (cfs) on the left-hand side of the table represent the 24-hour average antecedent flows used by the model to calculate near-field compliance. For the near-field model calculation, these upstream canal flow values have the circulating water flow rate subtracted from them and the result is multiplied by 0.25 to obtain Q_{US}.

ii. Since Midwest Gen has requested that the zone of passage be reduced from 75% to 50%, would Q_{US} change to 50% of the Upstream Canal Flow in the calculation?

RESPONSE: Yes, the 0.25 in the equation would be changed to 0.5 of Q_{US} (the available upstream flow) if the proposed AEL zone of passage provision is granted. The 0.5 dilution factor would define a 50% zone of passage.

If so, please describe how the calculated maximum downstream temperatures would change and the corresponding impact on potential excursion hours being displayed in the chart.

RESPONSE: Allowance for the use of a greater percentage of available upstream flow would result in lower overall calculated in-stream temperatures. Therefore, the result is that fewer potential excursion hours are used for a given set of conditions as compared to excursion hours used when a lower percentage of upstream flow is included in the calculation. (The charts in Attachment A illustrate the effect for each time period under the proposed AELs.[6]) However, as discussed above in the response to Question 2.a, if the 24-hour average available flow is equal to or less than the WCGS circulating water flow rate, then the applicable numeric thermal limits would be required to be met end-of-pipe. In this scenario, it is highly likely that a large number of excursion hours would be used in a short time while the WCGS simultaneously implements measures to cut back station load to avoid potential thermal noncompliance. Therefore, the ability to use up to 50% of the available canal flow does not eliminate the need for the requested excursion hours. But even with the requested increase in the allowed zone of passage as part of the proposed AELs, there remain inherent limitations on the WCGS thermal discharges under the proposed AELs that will continue to assure the protection and propagation of the waterbody's balanced, indigenous population.

iii. Are there any other parameters in the equation or model that would be affected by the proposed alternative thermal effluent limitations?

RESPONSE: No other parameters would change.

c. The highlighted calculated maximum downstream temperatures in the table show "Excursion hours are being used", which are based on the previous temperature standards for Secondary Contact and Indigenous Aquatic Life Use. Those standards covered a single time period: January – December at 93^{o}F. The proposed alternative thermal effluent limitations splits the temperature standards into eight time periods: (1) January-February 70^{o}F, (2) March 75^{o}F, (3) April 80^{o}F, (4) May 85^{o}F, (5) June – September 93^{o}F, (6) October 90^{o}F, (7) November 85^{o}F, and (8) December 75^{o}F.

Since the proposed alternative thermal effluent limitations split the temperature standards into eight time periods, please provide updated charts for each time period, similar to the one provided in Exh. 4, App. D, Exh. D, Att. 1. Please reflect the range of excursion hours during each time period for the associated proposed temperature standard. Additionally, please incorporate the change in Q_{US} to 50% of available receiving stream flow, as well as any other updates necessitated by the proposed alternative thermal effluent limitations.

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[6] But, as discussed below, these charts are not a means to account for the total number of excursion hours used, because they are just snapshots and cannot take into account how erratic changes in canal flow, as well as station operations, factor into how long calculated compliance temperatures in the excursion-hour range will last. The dynamic Near-Field Compliance Model uses the combination of all the real-time inputs, as well as the application of a rolling 24-hour average antecedent flow value, to account for the use of excursion hours in 15-minute increments.

RESPONSE: To respond to the Board's request, we have provided similar tables in Attachment A to this submittal to show the relative compliance values for the eight periods of the year that separate sets of thermal AELs have been proposed. Two versions of each table have been prepared, one using a 75% zone of passage and one with the proposed 50% zone of passage, in order to show comparable differences in calculated compliance temperature between the two for a single set of input parameter conditions. The requested example tables use the maximum measured end-of-pipe discharge temperature value from the associated AEL time period (month or months) from the same 2011-2016 period of record referenced in the Demonstration Report. The tables apply a range of possible intake temperatures up to the maximum numerical thermal limit allowed in each proposed period.[7]

But even with the added details presented in the tables, they are useful only for narrow purposes. The tables show when excursion hours would be used under such conditions, but do not show the total number of hours expected to be used, as this would depend on how long the concurrent set of conditions remained in effect. This is why a dynamic model is used by the WCGS to monitor compliance and track excursion hour use on a real-time basis—something that a static table cannot do.

d. Please explain the mechanics behind how Midwest Gen would demonstrate NPDES compliance with the 50% zone of passage under the proposed alternative thermal effluent limitations? Would Midwest Gen calculate, record, and report the specific percent zone of passage or simply indicate that it is greater than 50%?

RESPONSE: MWGen believes that IEPA's current NPDES permit for WCGS reflects a suitable mechanism for demonstrating compliance with the 50% zone of passage, once the Near-Field Thermal Compliance Model is updated to reflect the new AEL requirements.

WCGS's NPDES permit already allows for the use of the Near-Field Thermal Compliance Model to determine a calculated compliance temperature representative of the edge of the allowed mixing zone. The model includes a specified zone of passage percentage as part of its calculation. Therefore, the compliance values reported would reflect the percentage of the canal cross-section allowed for mixing (in this case, the proposed 50%). In point of fact, because the compliance calculation would use only 50% of the *available* upstream flow (Q_{US}), the actual cross-sectional area used for mixing in this case would be less than 50% of the total flow in the canal. The term "available" is used to describe the portion of the upstream flow utilized in the model because the upstream flow value used is not the entire upstream flow in the CSSC.

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[7] All of these values are for illustrative purposes only. As discussed above, the dynamic model captures every combination of parameters that may occur in real-time in order to calculate ongoing thermal compliance values, and it is not possible to show this in a table format.

Instead, the circulating water flow of the WCGS is subtracted from the upstream flow to determine the remaining volume of water to which the 50% allowance for mixing is applied.

The zone-of-passage information presented in the Demonstration Report is supported largely by prior field studies, as well as associated compliance calculations, similar to what is used by WCGS now. The Near-Field Thermal Compliance Model results will effectively determine when a 50% zone of passage will no longer provide sufficient mixing to avoid an exceedance of the proposed AELs, at which point appropriate actions would be taken by WCGS as necessary to ensure compliance with the proposed AEL temperatures (and any other requirements in the reissued NPDES permit.) Because the boundaries of a zone of passage constantly change in shape and extent in a waterway, it is not possible to continuously monitor the zone of passage unless perhaps one were to station several manned boats in the waterway to obtain continuous temperature readings at various locations at all times. Using the IEPA-approved Near-Field Thermal Compliance Model is the best available approach to such impractical in-stream, continuous zone of passage monitoring. Neither MWGen nor its consultant, EA, is aware of any precedent that requires a discharger to continuously determine the zone of passage.

As discussed in the Demonstration Report and pointed out by the Board's questions, under average flow and station operating conditions, a zone of passage at or above 75% would exist, even under the tighter standards provided by the proposed AEL. Therefore, the use of a 50% zone of passage versus a 75% zone of passage would not change WCGS's thermal compliance status under the proposed AELs under those circumstances. A zone of passage of less than 75% would only occur during atypical, sustained, periods of low flow and high ambient temperature conditions, when WCGS may be operating at higher megawatt loads. Use of a 50% zone of passage under such conditions would provide WCGS with necessary thermal compliance protection, while still maintaining an adequate zone of passage for aquatic. The information provided by the WCGS Near-Field Thermal Compliance Model on a continuous basis will assure that the minimum allowed zone of passage is maintained under all expected CSSC conditions.

3. 106.1130(g)(1) Requested Relief for the Alternative Thermal Effluent Limitation

Midwest Gen proposed alternative thermal effluent limitations language for the Board's order. Pet. at 25-26. Please comment on the revised language below:

> Under 35 Ill. Adm. Code 106.SubpartK and 35 Ill. Adm. Code 304.141(c), the Board determines that the following alternative thermal effluent limitations apply to Midwest Generation, LLC's Will County Generating Station.

Midwest Generation LLC

Will County Generating Station Alternative Thermal Effluent Limitation Demonstration

Questions for Petitioner

1. Temperature

   a. In lieu of the Chicago Area Waterway System Aquatic Life Use B (ALU B) thermal water quality standards in 35 Ill. Adm. Code 302.408(h), the following daily maximum temperature limits apply:

Months	Daily Maximum (°F)
January	70
February	70
March	75
April	80
May	85
June	93
July	93
August	93
September	93
October	90
November	85
December	75

   b. In lieu of the water temperature requirements of 35 Ill. Adm. Code 302.408(c), (d), (e), and (f), water temperature must not exceed the daily maximum temperature limits in paragraph (1)(a):

      i. By more than 5% of the hours (438 hours) in the 12-month period ending with any month; or

      ii. By more than 1.7°C (3°F) at any time.

   c. The alternative thermal effluent limitations in paragraphs (1)(a) and (1)(b) apply at the edge of the 26-acre mixing zone allowed in Will County Generating Station's NPDES permit.

2. Zone of Passage. In lieu of 35 Ill. Adm. Code 302.102(b)(8), the mixing zone identified in paragraph (1)(c) must allow for a zone of passage that includes at least 50% of the cross-sectional area and volume of flow of the Chicago Sanitary and Ship Canal.

3. Compliance. Midwest Generation, LLC must demonstrate compliance with paragraph (1) and (2) by modeling that is:

   a. Designed consistent with this opinion and order; and

b. Approved by the Illinois Environmental Protection Agency as a condition of Will County Generating Station's NPDES permit.

4. The Agency must expeditiously modify Midwest Generation's NPDES permit consistent with this opinion and order.

RESPONSE: MWGen is in general agreement with the alternate language provided by the Board to reflect the regulatory intent of the proposed thermal AELs, but suggests that the Board consider further the language included in its proposed subparagraph (1)(b)(i) and paragraph (3). As proposed in MWGen's Petition, MWGen requests that subparagraph (1)(b)(i) be revised to include the calendar-year basis for calculating allowed excursion hours. The justification for the calendar-year approach is provided below in response to the Board's specific questions concerning this request. MWGen also suggests that the Board consider deleting subparagraph 3(a) of the proposed alternate language that addresses the specific means by which compliance with the thermal AELs will be demonstrated.

Compliance monitoring or demonstration requirements for applicable standards are typically determined by the IEPA. In proposed subparagraph 3(a), the Board's suggested language creates a risk that the IEPA will not have the authority to revise or refine the modeling requirements used to demonstrate compliance as appropriate to reflect future developments both in terms of available data inputs for the approved model and in terms of potential improvements in thermal modeling generally.

For example, in proposed subparagraph 3(a), the language requires that the model used be "[d]esigned consistent with this opinion and order." If the Board's opinion and order describes the current Near-Field Thermal Compliance Model used by MWGen since 2015 and previously approved by IEPA, it seems that if any future updates to the model or enhancements to the model data inputs to better reflect thermal discharge conditions were proposed either by MWGen for IEPA's approval or by IEPA, a new Subpart K proceeding would need to be initiated by MWGen to obtain the Board's approval of these updates/enhancements because they may not be deemed "[d]esigned consistent with the [Board's] opinion and order."

An additional concern with the Board's suggested language is the inclusion of the term "designed," which may be interpreted to require a new model that is specifically "designed" consistent with the Board's opinion and order. As explained in the Petition, the Near-Field Thermal Compliance Model already has been designed and has been in used since 2015, with IEPA's approval.

MWGen is concerned that proposed subparagraph 3(a) threatens to unreasonably restrict the Agency's authority and ability to determine the appropriate means and methods for compliance monitoring with the Board-approved AEL. If the Board decides to retain paragraph 3, it should be sufficient to provide that "Midwest Generation, LLC must demonstrate compliance with paragraphs (1) and (2) by modeling that is approved by the

Illinois Environmental Protection Agency as a condition of Will County Generating Station's NPDES permit."

Please specifically address the following:

a. Section 302.408(f) limits the exceedance of the temperature limits during a 12-month period ending with any month. 35 Ill. Adm. Code 302.408(f). Midwest Gen proposes that its daily maximum excursions not exceed more that 5% of the time in a calendar year. Pet. at 25.

   i. Please explain if Section 302.408(f)'s any 12-month period is appropriate, or if it is more stringent than necessary and Midwest Gen's calendar year period should be granted.

RESPONSE: A calendar-year approach has been preferred in past non-General Use water quality standards because it provides a simplified approach to managing compliance implementation and accounting. For instance, a calendar accounting period was used to define the thermal limits for the "AS 96-10" adjusted standard that applies at the I-55 Bridge.[8] And the Exelon Dresden Station thermal AEL (approved March 2016) also relies on a calendar-based accounting methodology for excursion hours. (See IPCB 2015-204.) IEPA's monitoring and enforcement efforts would be aided by maintaining a consistent approach to implementing excursion-hour provisions in thermal AELs.

The calendar-year approach is also preferable because it limits the potential for arbitrary limitations on the use of excursion hours. For WCGS, historically, the use of excursion hours has been uncommon, aided in part since 2012 by more thermally-favorable ambient conditions in the CSSC. But even so, the extreme ambient conditions that can require their use generally cluster in summer and winter months. Thus, any system of rationing excursion hours over the course of a rolling 12-month period risks a scenario where one set of adverse weather and flow conditions is followed 11 months later by a second set of adverse conditions. And if the first period was severe enough to use the majority of available excursion hours (which is a realistic possibility), this could force WCGS to derate during the second period, even though the BIC would not require such a reduction in thermal discharge as the result of a period of excursion hours used 11 months earlier. The required deratings to meet the rolling accounting requirement in this case would be arbitrary and would provide no ecological benefit.

This scenario exists in the calendar-year approach, but it can only occur if there are several severe periods occurring within a single calendar year, which is possible, but does not occur frequently. But if a rolling 12-month period is used, the chances of unintended deratings that provide no environmental benefit become much more likely. (A hot July

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[8] This adjusted standard was originally approved by the Board in October 1996 and was transferred to MWGen in March 2000.

followed by a hot June the following year; a hot September followed by a hot August 11 months later; etc.)

ii. For the previously applicable Secondary Contact and Indigenous Aquatic Life temperature standards, identify all instances over the past five years when excursion hours were exceeded during a twelve-month calculation but would not have been under a calendar year calculation. During these times, were operations at the Will County Generating Station curtailed or did Midwest Gen take other measures to address the exceedance of excursion hours?

RESPONSE: A quantitative methodology for the accounting of near-field excursion hours was not officially in place until one was approved by IEPA in December 2014 and subsequently implemented in January 2015. (See Exh. 4, App. D, at Exh. D.) So although the Secondary Contact thermal standards contained an excursion-hours requirement for years, MWGen has no data on calculated excursion hours from before 2015.

In the CSSC, the excursion-hours cap is a provision that becomes critical only during times that see extreme weather and/or chronically low flow conditions. For the four-year time period between January 2015 and the present, there were no extreme weather conditions in the CSSC. Therefore, the number of excursion hours used between 93°F and 100°F (the Secondary Contact and also interim § 302.408(b) limits) were very limited, as summarized below:

2015: 0 hours
2016: 4 excursion hours used from June-September over 93°F
2017: 0 hours (WCGS did not run from March-December)
2018: 0 hours

But these numbers are misleading, because there are no available data for excursion hours during the 2012 heat wave/drought, which was the most recent year where extreme weather conditions of significant duration occurred in the CSSC. Review of the available discharge temperature and flow data from the summer of 2012 indicates that there may well have been a large number of excursion hours consumed during this critical period. (It also bears mentioning that more excursion hours would be used under the proposed AEL, which has significantly lower temperature limits in most months than was the case under the former Secondary Contact standards.)

The requested number of excursion hours and accounting methodology proposed in the WCGS Subpart K demonstration were selected to help preserve ongoing thermal compliance under extreme circumstances like those seen in 2012, when power demand is likely to be high. In the past, these circumstances would have been addressed by the request and granting of a provisional variance, but that is no longer an available regulatory option for infrequent and unpredictable thermal compliance challenges. As such, the excursion-hours cap (shown by past experience to be protective of the BIC) should be maintained at 5%, accounted for on a calendar-year basis, so that power supply can be maintained during those times when extremely challenging weather conditions with high energy demands occur.

iii. For the currently applicable temperature standards, identify all instances over the past five years when excursion hours would have been exceeded during a twelve-month calculation but would not have been under a calendar year calculation. If excursion hours reach near exceedance under the twelve-month calculation, what measures would Midwest Gen take that would not be necessary under the calendar year calculation?

RESPONSE: Excursion-hour usage was not documented prior to 2015. And back-calculation of excursion hours based on pre-2015 DMRs is not possible, due to the dynamic nature of the Near-Field Thermal Compliance Model, which constantly assesses the rolling 24-hour average antecedent canal flow in real time (requiring the analysis of variables that are not documented in the DMRs).

MWGen has gone back a total of four years (2015-2018) and reviewed near-field excursion-hour accumulation based on theoretical compliance with the Use B limitations. The following number of excursion hours would have been used if WCGS had been required to comply with the Use B thermal water quality standards (60^{o}F during the winter months of December-March; 90^{o}F from April through November):

2015: 169 hours
2016: 415 hours
2017: 14 hours (WCGS did not run from March-December)
2018: 0 hours

While many of these excursion hours would be expected to be used during the summer months, in 2016 there were a large number of hours during which the near-field compliance temperature would have been over the 60^{o}F Use B thermal standards in March (257), with an additional 138 hours accumulated over 90^{o}F in August and September of the same year. With the rolling 12-month excursion-hour accounting method, in this example, the 257 hours used in March 2016 would not again become available for use until March 2017, leaving only 181 excursion hours remaining for use during the summer months of 2016.

While this might not present an issue during most years, if the summer, fall or early winter of 2016 had been more extreme, there would have been an insufficient number of remaining excursion hours available for use, which would have then required WCGS to implement unit derating during critical power demand conditions, primarily due to the inadvertent impact of the rolling 12-month accounting method.

In contrast, use of the calendar method of excursion-hour accounting only covers a single year. While it is true that there could be adverse weather in both the spring and summer of a single year—thereby requiring the use of a larger number of excursion hours—there would be excursion hours remaining for use through the end of the year. The full complement of allowed excursion hours would again be available on January 1st of the following year, rather than gradually accruing them back over time, which would require more complicated accounting and the potential need to derate solely because a sufficient number of excursion hours are not available during a given month, strictly due to the accounting methodology, rather than a current identified need.

b. Is having the Board's order specify the method of demonstrating compliance appropriate or necessary?

RESPONSE: No. MWGen is unaware of any previous water quality standard where the Board has specified the manner in which compliance is to be determined. Doing so would be contrary to the division of labor between the Board and the IEPA: "The Board's principal function is to adopt regulations defining the requirements of the permit system. . . . The need for a technical staff capable of performing independent investigations dictates that the job of administering the permit system be entrusted to the Agency rather than the Board." *See Landfill, Inc. v. PCB*, 74 Ill.2d 541, 557 (Ill. 1978).

The structure of Subpart K suggests that compliance-monitoring methodologies are resolved by the IEPA after the Board approves the proposed AEL. This is why Subpart K does not require the petitioner to propose a compliance-monitoring methodology as part of the Petition. 35 Ill. Admin. Code 106.1130. Instead, Subpart K suggests that compliance monitoring will be resolved with the IEPA as part of permit modification under 35 Ill. Admin. Code 106.1170(a), after the Subpart K proceeding has ended. Note also that the Agency is not required to address compliance methodology in its recommendation to the Board, even though there are other specific requirements. *Id.* at 106.1145. Nor does Subpart K instruct the Agency how to fulfill its obligations to issue the revised permit using the Agency-specific procedures in 35 Ill Admin. Code 352.422.

Implementation of the proposed AELs, if granted, would be under the authority of IEPA. So the details of implementation/compliance assurance would become part of the WCGS NPDES permit special conditions. As such, having the Board's order specifying the method of demonstrating compliance is not necessary nor appropriate to include.

If so, is the revised language in paragraph (3) above sufficient?

RESPONSE: As suggested by MWGen in its response to the Board's question above concerning the proposed revised language, if paragraph 3 is to be included, subparagraph 3(a) should be eliminated and only the language of subparagraph 3(b) regarding IEPA approval of the compliance model retained.

4. 106.1130(g)(2) Requested Relief from Mixing Zone Regulations at 35 IAC 302.102—Zone of Passage

Midwest Gen uses a hydrothermal model as part of its Type II Predictive Demonstration. Exh. 4, App. B. The petition states, "The proposed AELs would provide sufficient limits on heated effluent such that the CSSC will maintain a zone of passage even under worst- case scenarios." Pet. at 21. The 316(a) Demonstration states, "Only under the worst-case condition, at the 7,00-foot downstream of the WCGS discharge location, was the zone of passage for the 90°F isotherm less than 75% of the water column. Although a zone of passage of less than 75% may affect some species in a limited fashion, the instances where the zone of passage downstream of the WCGS thermal discharge is less than 75% (but not less than 50%) are expected to be rare and limited in duration. Under these limited conditions, there would be only temporary and infrequent avoidance of the plume. Given the nature of the BIC in the CSSC, a temporary reduction in the extent of the zone of passage is unlikely to result in adverse harm." Exh. 4 at 5-2.

Under the worst-case winter scenario for the 70°F isotherm/proposed alternative thermal effluent limitation (January-February), the tables in Exh. 4, App. D show the zone of passage reaching 14% at the 180-foot transect, and 0% for the 7,000-foot transect (edge of the allowed 26-acre mixing zone) and 11,000-foot transect further downstream. For the 75°F isotherm, the zone of passage reached 66% at the 180-foot transect and 100% at the 7,000-foot transect. The worst-case winter scenario was modeled when temperatures were unseasonably warm and flow was near 7Q10 of 1315 cfs. Exh. 4, App. D at D-39 to D-40.

35 Ill. Adm. Code 302.102(b)(6) provides, "Mixing must allow for a zone of passage for aquatic life in which water quality standards are met."

a. Please elaborate on the duration of the worst-case winter scenario and the predicted 0% zone of passage for the 70°F isotherm/proposed alternative thermal effluent limitation (January-February).

RESPONSE: It is important to note that any modeling in the Demonstration Report showing the zone-of-passage becoming smaller than 50% is not truly representative of "real world conditions" because the hydrothermal model does not account for operational changes at WCGS that would be implemented to address such worst-case scenarios. As explained in more detail in Response 2, the Near-Field Thermal Compliance Model (used to determine temperatures at the edge of the mixing zone) includes adherence to a minimum required zone of passage.[9] The edge-of-mixing-zone temperature is constantly monitored, and station personnel will be required to take compliance actions—up to and including unit derating—when the water temperature is in danger of exceeding the proposed AELs. Because the modeled edge-of-zone temperature incorporates a specified zone-of-passage percentage, this means that the station would already be taking compliance actions before the zone of passage is reduced to less than 50%.

An additional limitation of the predicted zones of passage based on hydrothermal modeling is that they do not allow MWGen to plausibly answer questions about how long the modeled conditions will last. As with all the modeling results presented in the Thermal Demonstration, they represent only a snapshot in time during which the selected input parameters combine to produce a given result (*e.g.,* maximum temperature at a certain location, surface plume area, cross-sectional extent of an isotherm, etc.)

So, if duration is calculated using the assumption that the flow will be constant and that ambient temperatures will remain constant, then the 0% zone of passage will persist indefinitely. Of course, that assumption is unrealistic: A core characteristic of the CSSC is its extremely variable flow rate. Because of those unpredictable flows, the hydrothermal model results only provide a "snapshot" of cross-sectional area that does not have any duration associated with it.

Nor can MWGen consult historical data to provide a realistic prediction of the duration of the worst-case scenario, as this hypothetical scenario was developed based on a combination of selected parameter conditions to set the theoretical upper limit for the CSSC. This scenario has never actually occurred in the CSSC.

There is also a third, real-world, detail that the predicted zones of passage in Appendix D do not reflect. The model results show sub-50% zones of passage only when the AEL sets a 70°F limit. The WCGS "worst-case" winter scenario would be most expected to occur during the months of December and March (which have historically had the most interannual variability in terms of weather conditions, as well as longer durations of unseasonably warm weather)—however, the proposed AEL for those months is 75°F, not 70°F. And as the Board's question acknowledges, zones of passage well above 50% would be found if the worst-case scenario conditions recurred in December or March.

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[9] 75% currently, but IEPA will require that the Near-Field Thermal Compliance Model be modified to reflect a 50% zone-of-passage if the Board approves the proposed AEL.

So, the specific modeled conditions showing zones-of-passage below 50% would be seen only in a worst-case scenario occurring in January or February (which both have a proposed AEL of 70°F.) And the concurrent combination of unusually high air ambient temperatures and unusually low flow are relatively unlikely to occur in those months. Plus, this “worst case” scenario does not account for the fact that should such a combination of adverse conditions occur, WCGS personnel would be following established protocols for adjusting station operations based on the results of the Near-Field Thermal Compliance Model to ensure that the extreme results predicted by the worst-case scenario would not materialize.

b. Please indicate if the hydrothermal model would be able to calculate a zone of passage of 50% or more for an isotherm somewhere between 70°F and 75°F at the 180- and 7,000-foot transects. If so, what would that isotherm be? Given the 3°F allowable excursion above the daily maximum limits under the proposed alternative thermal effluent limitations (70°F + 3°F = 73°F), would a 50% zone of passage be achieved at the 180- and 7,000-foot transects at a temperature of 73°F?

RESPONSE: The model output provides a projected distribution of temperature at each given transect based on the input parameters applied. A zone of passage is assessed manually by analyzing the predicted temperature within a given transect cross-section and determining the cross-sectional area for each selected isotherm. Therefore, the model itself cannot determine what temperature would constitute a 50% zone of passage. However, based on review of the information provided in Tables D-25 and D-26, it appears that an isotherm of approximately 74°F would provide a zone of passage of approximately 50% at the 180-foot transect. At the 7,000-foot transect, the model output shows a consistent temperature of approximately 73°F (which would provide 100% zone of passage at 73°F, but 0% zone of passage at 74°F). MWGen is assuming that the Board wants the above question answered using the input parameters from the “worst case” scenario.

For WCGS winter “worst case” scenario, the results of the model run are depicted in the cross-sectional tables provided in Appendix D, Tables D-25 through D-27. These tables show that under the modeled conditions, a zone of passage of approximately 48% would be attained for a temperature of 73°F at the 180-foot transect, and a 100% zone of passage would be available at both the 7,000-foot and 11,000-foot transects under the same modeled conditions (using rounded numbers). Therefore, based on modeled results, a 50% zone of passage (or greater) could be achieved for a 73°F temperature at the 7,000-foot transect under the modeled “worst-case” winter conditions, and slightly less than 50% at the 180-foot transect under the same scenario.

Obviously, different combinations of flow, weather, and station operations would result in a greater-than-50% zone of passage at 73°F for 180-foot transect, but the “worst-case” modeling exercise was designed to provide information to bracket the maximum waterway temperatures that would be expected to occur under these extreme conditions and thus provided an upper boundary for the proposed winter AELs of 75°F. Even under the proposed winter AEL values of 70°F and 75°F to cover the winter months, there is no expectation of appreciable harm to the BIC of the CSSC because prior allowed temperatures higher than those requested for the winter AELs have not caused harm to the BIC, based on the long-term fisheries monitoring program.

c. Please indicate if there ever was a fish kill in the CSSC that was attributed to the WCGS thermal plume under the conditions in the worst-case winter scenario.

RESPONSE: Modeled results of the “worst-case” winter scenario were based on a specific combination of concurrent factors (weather, flow, and station operation) that might be expected to occur in the future, but do not represent the exact set of conditions that have occurred in the past. Therefore, the modeled results set the upper limit for what could be expected under the modeled combination of worst-case conditions. That said, there has never been, under any set of actual conditions, an observed winter fish kill near WCGS under both historical four-unit operation, or current single-unit operation.[10]

d. Does WCGS plan to do anything to assure the zone of passage does not drop below the requested 50%, such as derate at river flows below a certain level?

RESPONSE: As explained earlier in Response 4.a (and in even greater detail in Response 2), WCGS personnel use the Near-Field Thermal Compliance Model to constantly determine temperatures at the edge of the mixing zone. If the Model indicates that the 50% zone-of-passage requirement is in danger of not being met—or if the discharges risk violating any requirement in the proposed AEL and reissued NPDES permit—personnel are authorized to take actions to avoid violations, including derating.

e. Midwest Gen states, “Based on review of historical operating and canal flow data, it can be expected that a 75% or greater ZOP under the proposed thermal AELs would be available in the CSSC near WCGS most of the time. However, due to the frequency of erratic flow fluctuations, as well as low flow conditions where the dilution ratio may be less than 3:1, IEPA already allows for a reduced ZOP of 50%.” Exh. 4 at 3-8.

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[10] The Board’s question asks whether a past fish kill occurred under the worst-case conditions. But the modeled results use a hypothetical set of conditions to predict the upper limit for what could be expected under the modeled combination of worst-case conditions. These conditions have never actually been observed in the CSSC—they are simply the worst possible set of conditions that could plausibly occur in the future.

> In PCB 14-123 Exelon Generation LLC, Quad Cities Nuclear Generating Station, the Board granted an ATEL that included relief from the zone of passage requirements; however, the size of the zone of passage for the Quad Cities' ATEL was conditioned upon the quantity of flow in the receiving stream. The ATEL allowed a zone of passage of no less than 66% only when the flow in the receiving stream was less than 16,400 cfs. When the river flow was more than 16,400 cfs, the Station was required to provide a 75% zone of passage. See PCB 14-123, slip op. at 54-55 (September 18, 2014).
>
> Please address whether a similar condition to the one in PCB 14-123 should be included in the proposed ATEL. If not, explain why the conditions in this case are different from those in PCB 14-123. If including a similar condition is appropriate, what is the minimum flow where a 75% zone of passage would be provided under the modeled worst-case scenarios?

RESPONSE: MWGen's proposed AEL intentionally avoids zone-of-passage requirements like those found in the Quad Cities Station AEL and in § 302.102(b)(8). The general purpose of these kinds of bifurcated regulations is to require larger zones of passage under normal conditions and to tolerate smaller zones of passage only when the water available for dilution becomes unusually scarce—which is, for natural waterbodies, either a seasonal or unusual event. The idea is that this low trigger will provide additional relief to dischargers only under infrequent and chronic low flow conditions which are outside of their control.

The Demonstration Report establishes that the water conditions sought by bifurcated regulations are already a given under the continually changing and unpredictable CSSC flow conditions that exist at WCGS. The zone of passage remains above 75% except when the combination of high unit-load, high ambient air temperatures, and chronic decreases in canal flow rate occur simultaneously. (Exh. 4, at "3-8".) And if the Board adopts a simplified 50% zone-of-passage requirement, with no flow-rate trigger, this will have no adverse effect on the indigenous aquatic life of the CSSC, nor change the operational regime at WCGS. Unit 4 will continue to generate power in accordance with power demands and use the Near-Field Thermal Compliance Model to continually assess and maintain thermal compliance at the edge of the allowed mixing zone, which will continue to be protective of the balanced indigenous population of the CSSC under all potential flow conditions that are an inherent part of their overall environment.[11]

In addition to providing no ecological benefit, a flow-rate trigger provision for the CSSC would be very difficult to design, and even harder to implement. Unlike the CSSC, the receiving water used by the Quad Cities Station (the Mississippi River) has predictable flow conditions. It follows a seasonal flow cycle, and due to the large size of the Mississippi River, changes in flow occur much more gradually. These factors allow for

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[11] Even if WCGS Unit 3 were brought back on line, its operations would also be in maintained in compliance with the proposed AELs, including the same proposed zone of passage requirement.

the development of a trigger (as was done at part of Quad Cities AEL) to allow for a lesser zone of passage only when the stream flow is less than 16,400 cfs.

As has been discussed in the Demonstration Report, the CSSC is subject to frequent large-scale flow fluctuations, which are neither seasonal nor otherwise predictable. As has been shown in the table provided in the response to Board Question 1, a dilution ratio of less than 3:1 can occur any time of the year and can even occur on an hourly basis during any single day. Therefore, it would be extremely difficult to select a single trigger point at which a different zone of passage requirement would take precedence for WCGS thermal compliance purposes.

For all the above reasons, it is not necessary or feasible to associate a specific flow value or duration with the requested 50% zone of passage on a real-time basis for WCGS thermal compliance purposes. Maintenance of the zone of passage described in the MWGen Subpart K Petition (in conjunction with use of the Near-Field Thermal Compliance Model and the new AEL) will continue to assure the protection and propagation of the waterbody's balanced, indigenous population of shellfish, fish and wildlife.

5. 106.1103(g)(3) Any other relief sought - Excursion Hours

Midwest Gen requests an increase in excursion hours from 87.6 excursion hours (1% of 8,760 hours in a year) allowed under 35 Ill. Adm. Code 302.408(h) to 438 excursion hours (5% of 8,760 hours in a year) allowed under the previous Secondary Contact and Indigenous Aquatic Life standards. WCGS would use excursion hours when the temperature at the edge of the mixing zone exceeds the numerical limit up to 3°F over the limit. Pet. at 18. Midwest Gen states, "[T]he Demonstration Report shows that, because the species inhabiting the CSSC are generally tolerant and have the ability to sense and avoid areas of water temperatures outside of their preferred range, these temporary instances of increased thermal discharge temperatures will not fundamentally change the inhabitability of the CSSC." Pet. at 23-24. EA Engineering notes that most of the RIS can tolerate water temperatures above 95°F for extended periods of time (48-96 hours) at acclimation temperatures above 85°F. Exh. 4, App. B at B-30.

The hydrothermal analysis documents the historic number of hours and months with discharge temperatures greater than the proposed alternative thermal effluent limits from 2011 to 2016. Exh. 4, App. D, Tables D-3a to D-3c. EA Engineering writes,

Based on continuous temperatures from 2011-2016 recorded at the WCGS discharge, temperatures of the magnitude approaching those modeled for the "worst-case" scenario are expected in July and August from about one to 5% of the time (Appendix D; Table D-1). Discharge temperatures exceeding 33.9°C (93°F) can be expected up to 20% of the time within the summer period from June through September, based upon actual data from 2011-2016. Exh. 4, App. B at B-35.

a. Please specifically address whether the requested ***increase*** in excursion hours from 87.6 to 438 hours would cause appreciable harm to the BIC.

RESPONSE: Since regulation of heated discharges began in the 1970s, the CSSC has never had an excursion-hour limitation of less than 5%, and the proposed AEL's maintenance of a 5% standard will not "increase" the amount of heat encountered by the BIC.[12] The proposed AEL represents a significant tightening of the prior thermal standards (the Secondary Contact and Indigenous Aquatic Life Standards) and will preserve the decreased thermal loading that the waterway has experienced after the shutdowns of the Fisk and Crawford Generating Stations and WCGS's reduced unit operations.

The Demonstration Report documents that, even under the prior thermal regime, with higher temperature limits than requested here and with the same number of allowed excursion hours, there was no appreciable harm to the BIC. (Exh. 4 at "6-9", App. B at B-21 and App. C, at C-16.) Logically, it follows that there should be no new adverse effects on the BIC if the 5% excursion-hours component is maintained while the numerical thermal limits are tightened. Available data support the position that a provision allowing up to 438 excursion-hours in a calendar year will continue to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in the CSSC.

And under the proposed AELs, those excursion hours are now more essential: In the past, WCGS typically used excursion hours only in the summer months. Under the proposed AEL, WCGS (under extreme ambient conditions) now has the potential for winter exceedances and even, though somewhat less likely, exceedances in the transitional months. WCGS fully intends to comply with the proposed AELs. Based on historical operations, it is not expected that all 438 allowed excursion hours would be used except under the most extreme circumstances. But without the regulatory relief formerly available through the provisional variance process, the proposed AELs need to account for those extreme circumstances.

b.1. Please explain the effect on the BIC of the worst-case summer and winter scenarios (Exh. 4, App. D) if excursion hours are used 20% of the time within the summer period from June through September as in 2011-2016.

RESPONSE:

Excursion hours are required to address exceedances at the edge of the mixing zone. The "20%" value referenced in the Demonstration Report (Exh. 4, at "3-5") refers to how

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[12] On paper, the 1% excursion-hour limitation in 35 Ill. Adm. Code 302.408(f) became "effective to" the CSSC in July 2015. But, under Section 302.408(b), they did not become "applicable" until July 1, 2018. And application of the General Use narrative criteria to the MWGen Stations in the UDIP and to WCGS is currently stayed based on MWGen's pending TLWQS Petition that includes the WCGS and 415 ILCS 5/35(h)(3).

often WCGS end-of-pipe discharge temperatures (not edge of mixing zone) would be expected to exceed 93°F during certain summer months. In other words, if no mixing zone were allowed, the WCGS would potentially need to use excursion hours 20% of the time during the summer months under adverse weather/flow conditions. The calculated compliance temperature, which approximates the edge-of-mixing-zone value, would always be lower than the end-of-pipe temperature, with the exception of those limited, chronic low flow periods when no mixing is allowed, either by the existing mixing zone provision in Ill, Adm. Code Subtitle C, Chapter I, Section 302.102 (b)(10), or by the proposed AELs. The Demonstration Report was presenting the finding that, based on the worst-case situation, WCGS would be expected to use excursion hours 20% of the time only if there were no allowed mixing. The WCGS did not use excursion hours 20% of the time in the summer periods from 2011-2016.

As explained in the Demonstration Report, this 20% value should be considered as a very conservative estimate. (Exh. 4, at D-9 and D-10.) In fact, only a single month (July) had average end-of-pipe temperatures above 93°F more than 20% of the time. The remaining summer months had discharge temperatures in excess of the proposed summer AEL limit for less than 20% of the time. (Exh. 4, App. D, Table D-1a.)

MWGen does not have data on how many excursion hours would have been used if the proposed AEL had been in effect during the 2011-2016 time period. The edge-of-mixing-zone temperature depends, not only on the concurrent discharge temperature, but on station flow and the concurrent rolling 24-hr average antecedent CSSC flow. But as discussed below, the available biological data has shown that temperatures in the excursion-hour range have not had any adverse effects on the indigenous aquatic community under the prior Secondary Contact thermal standards and are not expected to do so in the future under the proposed AELs.

> b.2. Please explain the likelihood of the excursion hours occurring consecutively in periods exceeding 96 hours (the extended period EA Engineering noted that most RIS can tolerate water temperatures above 95°F.) (Exh. 4, App. B at B-30.).

RESPONSE:

The likelihood is low. While excursion-hour use was not quantified prior to January 2015, review of the actual end-of-pipe thermal data for July 2012 demonstrates that excursion-hour use, even under adverse conditions, would not be continuous for 96 hours, thereby providing a recovery period/increased areas of refugia, even during critical weather and flow conditions.

During July 2012, which is the most recent critical summer weather period on record, WCGS had end-of-pipe discharge temperatures exceeding 95°F for a maximum of

20 continuous hours. The average length of continuous time that the WCGS discharge was over 95°F in July 2012 was 9 hours. Lower temperatures occurred between each of these peak periods, which served to moderate conditions within the area of thermal influence. As noted in the Demonstration Report, WCGS did not derate during July 2012, so these end-of-pipe temperatures represent a worst-case condition—one which ultimately produced no observed immediate or long-term adverse effects in the BIC of the CSSC.

As discussed in Response 2.a, the availability of recovery periods is an important limit on the adverse effects of increased temperatures Aquatic life can tolerate water temperatures in the 93°F-96°F range for limited periods of time with no meaningful adverse effects. It is important to note that the July 2012 data discussed above represents end-of-pipe temperatures and not the compliance temperatures at the edge of the allowed mixing zone. The number of calculated excursion hours for this same period, based on the Near-Field Thermal Compliance Model calculation that uses a rolling 24-hour average antecedent canal flow would likely show a much lesser overall thermal influence within the main body of the CSSC. It is also important to recognize that fish will avoid high temperatures, and the modeling and plume studies show there will continue to be a zone of passage that will reduce the likelihood of any mortality due to temperature.

c. Address whether any fish kills have been documented that were associated with the thermal component of the WCGS discharge within the range of temperatures and excursion hours that would be allowed under the proposed alternative thermal effluent limitations.

RESPONSE:

No fish kills associated with the WCGS discharge have been documented. Based on historical operations with up to four units operating, temperatures rarely reached critical temperatures (Exh. 4, Table D-1a.) When WCGS was covered under a provisional variance for the AS 96-10 standards in 2011 and in 2012—which allowed sustained temperatures in excess of 93°F subject to the 5% limit on excursion hours—visual observations in the immediate discharge area during those periods did not show any adverse impacts to aquatic life. This was documented in the environmental condition reports submitted to IEPA in fulfillment of the provisional variance requirements. Routine fish monitoring in the CSSC near WCGS has also confirmed the lack of adverse effects related to its thermal discharge.

The proposed AEL would not cause fish kills during the winter, nor any sub-lethal impacts. Elevated winter temperatures under the former Secondary Contact thermal standards had no apparent effect on the BIC. The fish community showed consistent recruitment even during prior thermal regimes where all four WCGS units were in operation. (Exh. 4, at “6-9”.)

6. 106.1103(g)(3) Any other relief sought: 302.408(c) and (d) Temperature Fluctuations

In addition to relief from the thermal numeric water quality standards, the provision for excursion hours, and the zone of passage requirements, Midwest Gen also proposes that the alternative thermal effluent limitations would replace subsections (c), (d), and (e) of Section 302.408. 35 Ill. Adm. Code 302.408(c), (d), and (e).

Subsection (c) prohibits abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions. Subsection (d) requires maintaining the normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained. And subsection (e) requires that maximum temperature rise will not exceed 5°F above the natural temperatures.

a. Please explain how Sections 302.408(c), (d), and (e) are more stringent than necessary.

RESPONSE: The General Use narrative criteria are meant for General Use waterways. They exist because the Board and the IEPA cannot conduct extensive studies of every waterway in the state to create customized water quality standards for each. But once a waterway has been studied and given a designated use other than General Use, it is unusual for the General Use narrative criteria to still apply to that waterway. The General Use narrative criteria did not apply, for example, to any of the Secondary Contact waterways. Nor did the Board elect to apply the criteria to Bubbly Creek when that impaired waterway's standards were reviewed in 2015. 35 Ill. Adm. Code § 302.408(a).

In this case, the CSSC and the thermal requirements of its balanced, indigenous, population of aquatic life have been the subject of close examination (pursuant to an IEPA-approved Detailed Study Plan). The Demonstration Report concludes that the aquatic life will be protected by the numerical limits outlined in the Petition. If the Board shares IEPA's assessment that the Demonstration Report reaches the correct conclusion, there is no need for the additional, largely redundant, narrative provisions of the General Use criteria. The purpose of Subpart K is to determine when existing thermal standards are more stringent than what is necessary to protect the balanced, indigenous, population of aquatic life—the General Use narrative criteria are the types of requirements that should be removed in a Subpart K proceeding when replaced by alternative thermal limits that have been demonstrated to adequately protect the balanced, indigenous, aquatic population of the CSSC.

i. Subsection 302.408(c)

Subsection 302.408(c) of the narrative criteria prohibits abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions. The "abnormal temperature changes" provision offers no necessary environmental protection to the BIC. Ambient temperatures in the waterway are largely dictated by the POTW flow from the

MWRDGC Stickney treatment plant, which dominates the CSSC under dry weather conditions. As such, the ambient temperature profile reflects the POTW effluent, which is somewhat cooler in the summer and warmer in the winter than would be found in a natural waterway. In this regard, the entire CSSC is already subject to "abnormal temperatures." The addition of heat from the operation of WCGS does not constitute a large change in the overall temperature regime, especially outside of the allowed mixing zone. Most importantly, the Demonstration Report shows that, even during abnormal weather and flow conditions, the water temperature in the CSSC will remain at levels that do not adversely affect aquatic life. The proposed numeric criteria are sufficient to protect aquatic life from abnormal thermal conditions whether caused by "natural conditions" or "unnatural conditions" or both.

Also, the Board has previously noted that the only real potential for "abnormal temperature changes" in the CSSC would be a "cold shock" event. (Subdocket D, *Second Notice*, at p. 76 (Mar. 19, 2015).) Indeed, this may be the one context in which the prohibition serves a clear purpose, as numerical thermal limits do not, on their own, protect aquatic life from a potentially harmful *drop* in temperature. But, as the Board found during the UAA rulemaking, there has never been a documented "cold shock" in the CSSC. (Subdocket D, *First Notice*, at p. 213 (Sept. 18, 2014).) On this basis, the Board elected not to include any "cold shock" provisions in the water quality standards created by the UAA rulemaking. Accordingly, there is no need to include Section 302.408(c) to protect against cold shock.

Further, if included in the AEL, the "abnormal temperature changes" prohibition would be difficult to interpret or to apply to the CSSC. Subsection 302.408(c) excludes from this prohibition temperature changes due to "natural conditions," but this phrase has no clear meaning in the context of the CSSC. The temperature of this waterway is almost exclusively influenced by "non-natural conditions," such as POTW effluent discharges, CSOs, operation of the locks and dams, and commercial navigational traffic, but these are "natural conditions" for this man-made waterway. Hence, it is unclear whether temperature changes caused by these conditions would or would not be excluded under Subsection 302.408(c). But if these conditions were not excluded as "natural conditions" in the CSSC, then WCGS may face compliance issues that are largely contributed to by causes other than its thermal discharge, which are out of its control. This would be manifestly unfair and would give WCGS no ability to adjust its operations to conform to applicable water quality standards.

ii. Subsection (d)

Subsection 302.408(d) requires that the normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained. This consists of two requirements: One for "daily" temperature fluctuations, and another for "seasonal" fluctuations. While the CSSC has a discernable "daily" temperature fluctuation, it is far removed from what would be found in a natural system because the primary water source is treated wastewater from POTWs and operation of the system is managed for navigation and flood control. These non-natural influences do not follow predictable patterns, and so the CSSC has temperature fluctuations that are less consistent on a day-to-day basis than natural waterways (where the primary driver of daily fluctuations is solar radiation and time-of-day.) If Subsection 302.408(d) is applied to the CSSC, it would be unfair not only to WCGS, but to the IEPA, which will have the impossible task of (1) defining the CSSC's daily temperature fluctuations, (2) developing an enforceable standard of when that fluctuation has not been "maintained," and (3) determining which of the several non-natural thermal influences on the waterway is the cause of the violation. And, if the IEPA only reveals its standards in the Notice of Violation, this would raise serious due process concerns.

Subsection 302.408(d)'s second requirement—that thermal discharges maintain "seasonal temperature fluctuations which existed before the addition of heat due to other than natural causes"—is redundant to the proposed AEL. The month-to-month thermal standards in the proposed AEL already preserve those fluctuations. Indeed, the proposed standards are much more tailored to address seasonal changes than any past thermal standards in this waterway: They protect fluctuations in the "transitional months," where prior standards (and the General Use standards) focus on winter and summer conditions. An added general prohibition on "seasonal temperature fluctuations" will be duplicative and would only cause confusion. And it would be unfair if WCGS complied with the numeric criteria, but nonetheless found itself the target of an enforcement action or citizen's suit based on the much vaguer requirements of Subsection 302.408(d). Subjecting WCGS to such an unpredictable regulatory regime is not necessary to assure the protection and propagation of the waterbody's balanced, indigenous population of shellfish, fish and wildlife.

iii. Subsection (e)

Subsection (e) requires that maximum temperature rise will not exceed 5°F above the natural temperatures. As MWGen noted in its Subpart K Petition, Subsection 302.408(e)'s prohibition on temperature rises above the "natural" background is vague in the context of an unnatural waterway like the CSSC. Compliance with the thermal limits in the proposed AEL is a completely valid method for regulating thermal discharges, and that method is much more relevant and appropriate than the arbitrary "delta T" approach, which has no known scientific basis.

The proposed AEL reflects biothermal analysis of critical thermal limits for representative fish species in the CSSC and a retrospective analysis of long-term monitoring results under prior studies that found no detrimental effects to aquatic life due to waterway temperatures. The biothermal evaluation and monitoring results show that the proposed AELs will continue to support a BIC in the CSSC, as there is no evidence of prior adverse harm under less strict thermal limits. The proposed AELs protect against extreme exposures to high temperatures while recognizing that occasional and short-term exceedances of stress thresholds can be offset by periods of thermal relief. This is achieved by adhering to the proposed maximum criteria with reasonable exceedance allowances, which are expected to be utilized only under adverse weather and flow conditions that have historically been infrequent.

Moreover, the Demonstration Study's retrospective assessment showed that adverse harm to the balanced, indigenous, population has not occurred when up to four WCGS units were operating and were doing so under higher temperature limits. (Exh. 4, App. C.) The balanced, indigenous, population of aquatic life was adequately protected despite the fact that the then-applicable Secondary Contact standards did not have a 5°F delta T provision.

The scientific evidence supports a general conclusion that the most important factor in fish survival is whether the waterbody attains or exceeds temperatures that are known to be lethal. There is no known way for aquatic life to be harmed by tolerable water temperatures, merely because the water immediately upstream is somewhat cooler. Prior data has also shown that a zone of passage for aquatic life remains available with temperatures in a tolerable range, regardless of the application of a delta T requirement. In the absence of such harm, the 5°F delta T provision serves no biological purpose in the CSSC. Therefore, it is appropriate to remove this narrative criterion as part of the requested AEL relief.

Review of existing data shows that the absence of a 5°F delta T provision in the CSSC's past water quality standards did not cause adverse harm to the CSSC aquatic community. Subsection (e) was deleted from the proposed AEL because the proposed numeric limits are sufficient to preclude large swings in temperature that may be harmful. There is no scientific support for the 5°F delta T provision. The 5°F delta T provision is a "rule-of-thumb" that emanates from the FWPCA (1968) "Green Book" and National Academy of Sciences "Blue Book" (NAS 1973) with no supporting technical documentation about its ecological need or efficacy. States that have modernized their temperature criteria (*e.g.*, Ohio and Pennsylvania) have done so by dropping the delta provisions altogether. The multi-state Ohio River Valley Waste Sanitation Commission (ORSANCO)[13] detailed the rationale for dropping the 5°F delta T provision in 1984:

> *"The majority of states have not revised or updated their temperature criteria since the publication of the "blue book" (NAS/NAE 1973), thus most retain what are now regarded by some as outdated concepts. An example is the concept of an allowable rise in temperature above ambient, such as the "5°F rise" that remains in most state WQS. Brown (1974) first raised the issue that this criterion had little if any biological justification – it was quite simply a "rule-of-thumb". In a memo from Charles C. Coutant to Stanley I. Auerbach, Oak Ridge National Laboratory, in response to a question posed by ORSANCO, Coutant concluded that the 5°F rise had no biological justification and should be dropped. This explains its absence from the current ORSANCO temperature criteria and from*

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[13] Illinois is a member state of ORSANCO.

> *Ohio's WQS. These are two of the few states or entities that modernized their temperature criteria in the post "blue book" period. Coutant favored what ORSANCO adopted in 1984, fixed temperature values based on multiple tolerance endpoints for representative fish species that are seasonally varied to reflect normal ambient temperature changes. (Yoder et al. 2006)"*

Pennsylvania DEP (2009) offered the following rationale for dropping the 5°F delta T provision:

> *"Unlike the previous temperature criteria, which were single maximums applicable year-round, the revised criteria are monthly and semi-monthly values. They also eliminate the previous maximum allowable 5°F change in stream temperature, thereby eliminating the need to evaluate thermal effluent limits on this basis. "The previous requirement limiting temperature changes to a maximum of 5°F has been obviated by the seasonal nature of these criteria and has thus been dropped from regulation." Coutant (2015), commenting about the failure of states to adopt temperature criteria that reflect modern science, was especially critical of the 5°F Δ saying ". . . some states are enforcing ΔT rules that make no scientific sense for the particular water body."*

At the same time, there is broad support in the current literature adoption of temperature requirements that incorporate stress/recovery concepts. Such criteria protect against extreme exposures to high temperatures while recognizing that occasional and short-term exceedances of stress thresholds can be offset by periods of thermal relief. This is achieved by adhering to maximum criteria with reasonable exceedance allowances of the maximum, like those in the proposed AEL.

Supporting citations

Federal Water Pollution Control Administration (FWPCA). 1968. Industrial waste guide on thermal pollution. U.S. Dept. Interior, Pacific Northwest Water Lab. Corvallis, Oregon. 112 pp.

Brown, H.W. 1974. Handbook of the effects of temperature on some North American fishes. American Electric Power Service Corporation. 431 pp.

Coutant, C.C. 2015. Are we there yet? Section 2, in C. Lew and R. Goldstein (eds.). Proceedings: The Fourth Thermal Ecology and Regulation Workshop. 3002008550 Final Report, April 2016. 498 pp. www.epri.com.

Federal Water Pollution Control Administration (FWPCA). 1968. Industrial waste guide on thermal pollution. U.S. Dept. Interior, Pacific Northwest Water Lab. Corvallis, Oregon. 112 pp.

National Academy of Sciences (NAS). 1973. Water quality criteria 1972. A report to the committee on water quality criteria. U.S. EPA Pub. No. EPA-R3-73-033. Washington, D.C., 553 pp.

Pennsylvania Department of Environmental Protection. 2009. Implementation Guidance for Temperature Criteria. Doc. 391-2000-017. Volume 29, Tab 13. Bureau of Water Standards and Facility Regulation, Harrisburg. PA. 20 pp.

Yoder, C.O., E.T. Rankin, and B.J. Armitage. 2006. "Re-evaluation of the technical justification for existing Ohio River mainstem temperature criteria." Report to Ohio River Valley Water Sanitation Commission. Tech. Rept. MBI/05-05-2. Columbus, OH. 56 pp. + 4 appendices.

b. Please explain how the proposed alternative thermal effluent limitations replace or address these provisions.

RESPONSE: As discussed above, the General Use narrative criteria have never been applied to the CSSC, so there are no narrative criteria for the proposed AEL to "replace," at least not in any meaningful sense.[14] To satisfy its obligations under Subpart K, the Board *does* need to know whether the proposed AELs would be inadequate to assure the protection and propagation of a balanced, indigenous, population of aquatic life, because they lack one or more of the General Use narrative criteria. The Demonstration Report proposes a set of thermal limits (along with excursion hours and zone-of-passage requirements) that, according to field studies and predictive modeling, will fully protect the waterbody's balanced, indigenous population of shellfish, fish and wildlife. The Demonstration Report affirmatively proves that the General Use narrative criteria would provide no added benefit, as prior fish studies have established that the waterway's balanced, indigenous, aquatic population has never been adversely affected by the absence of the General Use narrative criteria. (Exh. 4, App. C.) As a general matter, the aquatic community has never been adversely affected by the waterway's thermal condition, even in the past when thermal discharges were much greater.

And as discussed above, each of the General Use narrative criteria is either subsumed by the proposed AELs or is not relevant to this waterway:

- The WCGS thermal discharge does not disrupt or negate daily thermal fluctuations—to the extent that such fluctuations exist in the effluent-dominated, erratically flowing, waters of the CSSC.

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[14] On paper, the General Use narrative criteria became "effective to" the CSSC in July 2015. But, under Subsection 302.408(b), they did not become "applicable" until July 1, 2018. And application of the General Use narrative criteria is currently stayed by operation of this proceeding and 415 ILCS 5/35(h)(3).

- The waterway's seasonal fluctuations are already protected by the proposed AEL, which provides month-by-month thermal standards, including tailored thermal standards for "transitional" months in the spring and fall. And, again, the WCGS does not distort normal temperature fluctuations.
- The General Use narrative criterion prohibiting abnormal temperature changes is another protection that makes little sense in an artificially influenced system such as the CSSC. The Demonstration Report shows that ambient winter temperatures in the CSSC are not low enough to produce "cold shock," even when sudden drops in temperature occur, such as when WCGS might shut down during winter operation. This dynamic is consistent with the Board's 2014 UAA proceeding finding that the CSSC has no history of cold shock.
- Finally, the 5°F delta T requirement is unenforceably vague, because the waterway has no "natural" background temperature to compare to the discharge. What's more, the 5°F delta T has come into significant question as a useful method for evaluating whether aquatic communities will be disrupted by thermal discharges. By contrast, the proposed AEL regulates the actual discharge temperatures encountered by the aquatic life and sets limits based on current field studies and predictive models.

Clean Water Act Section 316(a) Demonstration Elements

(Based on USEPA Technical Guidance Manual: "USEPA: "Interagency 316(a) Technical Guidance Manual and Guide for Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements (DRAFT)" (316(a) Manual), May 1, 1977)

7. **3.3.3 Habitat Formers**

The 316(a) Demonstration states that the State threatened "Banded Killifish were caught in ***unique*** habitat for a main channel border in the lower Lockport Pool due to the presence of shallow littoral zone areas with dense aquatic vegetation. Banded Killifish normally inhabit clear, glacial lakes with abundant aquatic vegetation. The area near WCGS does not provide this type of habitat, nor does most of the lower Lockport Pool (Appendices A, C, F and G)." Exh. 4 at 4-8 (emphasis added). IDNR noted that although the Banded Killifish is present in the vicinity, IDNR found that adverse impacts from the ATEL were unlikely. Rec. at 9.

In other places, the 316(a) Demonstration states, "The Lockport Pool does not provide ***unique*** or critical habitat for the survival and growth of any wildlife species." Exh. 4 at 6-14 (emphasis added). Later in the same page, the 316(a) Demonstration states, "***Unique*** or rare aquatic habitat that could be affected by operation of the cooling water system does not occur in the segment of the CSSC near WCGS." Exh. 4 at 4-8 (emphasis added).

The 316(a) Manual specifies, "There will be no destruction of ***unique*** or rare habitat without a detailed and convincing justification …" 316(a) Manual at 71 (emphasis added).

In the PCB 14-123 Thermal Demonstration for Exelon Generation's Quad Cities Nuclear Station, the US Fish and Wildlife Service required Exelon to work in collaboration to prepare a Habitat Conservation Plan to protect a federally endangered species. The habitat was considered "unique" but not rare. The US Fish and Wildlife Service designated the areas as "essential habitat" for the particular endangered species. PCB 14-123 Pet. Exh. 1 App. C at C-12; PCB 14-123 Pet. Exh. 4 at 17-18; PCB 14-23 slip op. at 12 (September 18, 2014).

In the Illinois Endangered Species Protection Act, "'Essential Habitat' means the specific ecological conditions required by an endangered or threatened species for its survival and propagation, or physical examples of these conditions." 520 ILCS 10/2.

Please clarify whether the characterization of the habitat where the State threatened Banded Killifish were caught as "unique" (Exh. 4 at 4-8) was meant to comport with the meaning of "unique" and "essential habitat" as used in the 316(a) Manual at 71 and the Illinois Endangered Species Protection Act at 520 ILCS 10/2. If so, please address whether a condition requiring a Conservation Plan be submitted to Illinois Department of Natural Resources is appropriate.

RESPONSE:

i. The proposed AEL will not destroy an essential habitat for the Banded Killifish.

MWGen understands why the Board raised a question concerning the meaning of the term "unique" in the following statement from the Demonstration Report: "Banded Killifish were caught in unique habitat for a main channel border in the lower Lockport Pool due to the presence of shallow littoral zone areas with dense aquatic vegetation." (Exh. 4, at "6-14".) The term "unique" could imply both that (1) the littoral zone areas are required for the survival of Banded Killifish, and (2) littoral zone areas are not found elsewhere in portions of UIW with Banded Killifish populations.[15]

But that implication was unintended. These areas (defined only by vegetation and depth) are far from uncommon—and are certainly not "unique" or "rare"—in the UIW as a whole.[16] They are simply, to use a more characteristic term, "atypical" for the lower Lockport Pool, and that was the only information MWGen was trying to convey by use of this term. As documented in the Demonstration Report, destruction of unique or rare habitat has not occurred because of the operation of WCGS and would not be caused by

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[15] The Board correctly notes that these interpretations would be in tension with the Demonstration Report's later claim that "Unique or rare aquatic habitat that could be affected by operation of the cooling water system does not occur in the segment of the CSSC near WCGS." The tension exists purely because of ambiguity in the first example. The latter statement (at Exh. 4, p. "4-8") is correct.

[16] Neither the 316(a) Guidance Manual, nor federal regulations, define "unique" or "rare." MWGen's use of the word "unique" was not intended to mirror the Manual's use of these terms. Nor would it be factual to say that shallow littoral areas are found only in the lower Lockport Pool. In fact, they are also found in the downstream portions of the UIW in much greater abundance than in the lower Lockport Pool.

the proposed AELs. (Exh. 4, at “4-8”.) There is no “essential habitat” for the Banded Killifish in the CSSC. IEPA and IDNR both agree that the proposed AEL is unlikely to adversely affect the Banded Killifish, and they could not have reached that conclusion if they believed that an essential habitat for Banded Killifish would be compromised.

Nor are the littoral zone areas in the lower Lockport Pool regarded as “essential habitat” for the Banded Killifish.[17] The IDNR has not specifically defined critical habitat for Banded Killifish, but they prefer to inhabit areas such as clear, glacial lakes with abundant aquatic vegetation. (Exh. 4, at “4-8”.) These preferred habitat characteristics are not found in the CSSC, including the lower Lockport Pool.

There is a strong indication that the Banded Killifish found in non-preferred habitats in the CSSC downstream of WCGS are actually the invasive subspecies, “Eastern Banded Killifish,” and not the state-threatened “Western Banded Killifish.” Per a new report (Willink et. al 2018),[18] overall Western Banded Killifish populations and distribution in Northern Illinois had remained unchanged from 1880 to 2000. Thus, the more recent population growth in the UIW would be unusual for the Western Banded Killifish, and so the report submits that Banded Killifish associated with the expansion into the UIW from Lake Michigan are an invasion of the Eastern subspecies *Fundulus. d. diaphanus*. This rapid expansion has prompted the IDNR to revisit its listing as a threatened species in Illinois.

ii. The Quad Cities AEL involved a dramatically different type of receiving water body.

The situation for WCGS is very different from the one that required Exelon Quad Cities to prepare a federal Habitat Conservation Plan to protect endangered species on the Mississippi River. The Mississippi River habitat in question was designated “essential habitat” for federally-listed endangered species known to occur near that discharge. This natural waterway included the kinds of backwaters and sloughs that make for especially good riparian habitat and often results in their designation as “essential habitat.”

In contrast, “the aquatic habitat in the CSSC upstream and downstream of WCGS is dominated by open, relatively deep channel with fine sediment substrate.” (Exh. 4, at “4-8”.) “Habitat quality in the CSSC ranks fair to very poor because of a lack of riffle/run habitat, lack of clean, hard substrates (*i.e.,* gravel/cobble), excessive siltation, channelization, poor riparian and floodplain areas, and lack of instream cover.” (Id.) Increasing numbers of Banded Killifish have been collected in areas more than two miles downstream of the WCGS, where there was suitable habitat for the species.

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[17] Unlike “unique” or “rare,” “essential habitat” is a term-of-art that has a statutory definition. *See* 520 ILCS 10/2 (defining “Essential Habitat” as the “specific ecological conditions required by an endangered or threatened species for its survival and propagation, or physical examples of these conditions”.) For federally-listed species, “critical or essential habitat” serves as the basis for developing conservation plans.

[18] Available at http://www.bioone.org/doi/full/10.1674/0003-0031-179.2.179.

Thus, a Habitat Conservation Plan is not warranted here. The proposed AELs will not result in increased thermal loading to the waterway and will be *more stringent* than the thermal standards that had previously applied to the waterway. Therefore, there is no threat to listed species related to the proposed AELs, which is why IDNR has not suggested that a Habitat Conservation Plan and associated Incidental Take Permit ("ITA") are necessary in this case. Since an ITA has not been recommended, there is no need for a Habitat Conservation Plan.

Reference:

Willink, P.W., T.A. Widloe, V.J. Santucci Jr., D. Makauskas, J.S. Tiemann, S.D. Hertel, J.T. Lamer, and J.L. Sherwood. 2018. Rapid expansion of Banded Killifish *Fundulus diaphanus* across northern Illinois: dramatic recovery or invasive species? The American Midland Naturalist: Vol. 179, Issue 2, pp. 179-190.
URL: http://www.bioone.org/doi/full/10.1674/0003-0031-179.2.179

8. 3.3.4 Shellfish/Macroinvertebrates

The 316(a) Demonstration states that the 7Q10 flow is 1315 cfs, and the design flow of the WCGS facility is 882 cfs, which is greater than 30% of the 7Q10 flow. *See* Exh. 4, App. D at D-13, D-30. Under Section 3.3.4 of the 316(a) Manual, for a demonstration to be "judged successful", the petitioner must demonstrate:

Discharge equal to 30% or more of the 7Q10 flow would be cause for concern unless invertebrates do not serve as a major forage for fish, food is not a limiting factor, and drifting invertebrate fauna is not harmed by passage through the thermal plume. 316(a) Manual at 24-25. *See also* Exh. 4 at 6-6.

Please specifically address these criteria.

RESPONSE: MWGen's Detailed Study Plan did not include new field surveys of drifting invertebrate fauna. Both the IEPA and the U.S. EPA were consulted in the development of the Detailed Study Plan and neither suggested that invertebrate fauna would require special attention or additional study. The lack of prior appreciable harm to the macroinvertebrate community in the CSSC has been documented in surveys as far back as 1993, and as recently as 2010. (Exh. 4, at "6-6".) The historical data shows that most of the benthic communities in WCGS's portion of the CSSC have been improving relative to upstream communities. This indicates that the drifting invertebrate fauna is not harmed by passage through the thermal plume.

That conclusion continues to be supported, indirectly, by the new fish studies MWGen conducted in preparing the Demonstration Report. The body condition of fish in the CSSC provides convincing evidence that lower trophic levels of the aquatic community have not been negatively impacted by the WCGS discharge, even with more units operating than would be operated under the requested AELs. As discussed at page "6-12" of the Demonstration Report, the "relative weight" (Wr) of fish, a measure of fish condition, shows that fish are growing and gaining weight at normal rates, with no apparent differences in mean Wr among the 4-unit (2000-2010), 2-unit (2011-2014), or 1-unit (2015-2016) monitoring periods. This finding is consistent with the stability of the benthic community that provides forage in the CSSC. Wr values for fish in the CSSC suggest that the fish community has nearly always been in average or better-than-average condition, and therefore, there do not appear to have been significant health, food availability, and/or feeding relationship problems within the in CSSC near WCGS.

Respectfully submitted,

Midwest Generation, LLC

By: /s/ Susan M. Franzetti
Susan M. Franzetti

Dated: January 11, 2018

Of Counsel:

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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

MIDWEST GENERATION, LLC	)	
Petitioner,	)	
	)	PCB 18-58 (Thermal Demonstration)
v.	)	
	)	
ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY	)	
Respondent.	)	

ATTACHMENT A TO PETITIONER MIDWEST GENERATION, LLC'S RESPONSE TO ILLINOIS POLLUTION CONTROL BOARD QUESTIONS

Enter mixing ratio: 0.25

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate:	0	gpm	Number of Pumps On:	0
Unit 2 Circ Water Pump Rate:	0	gpm	Number of Pumps On:	0
Unit 3 Circ Water Pump Rate:	0	gpm	Number of Pumps On:	0
Unit 4 Circ Water Pump Rate:	132000	gpm	Number of Pumps On:	3
Calculated Circ Water flow:	882	cfs		

Maximum Measured
Enter Circ Water discharge temp: 69.2 degrees F

January-February: 75% Zone of Passage
Proposed AEL: 70 degrees F

			Intake Temperature (°F)																			
Percentiles	CSSC Flow	Available Flow	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	64.0	65.0	66.0	67.0	68.0	69.0	70.0
1	938	56	68.9	68.9	68.9	68.9	68.9	69.0	69.0	69.0	69.0	69.0	69.0	69.1	69.1	69.1	69.1	69.1	69.1	69.2	69.2	69.2	69.2	69.2
5	1186	303	67.6	67.7	67.8	67.8	67.9	68.0	68.1	68.2	68.2	68.3	68.4	68.5	68.6	68.6	68.7	68.8	68.9	68.9	69.0	69.1	69.2	69.3
7Q10	1315	433	67.0	67.1	67.2	67.3	67.4	67.5	67.6	67.8	67.9	68.0	68.1	68.2	68.3	68.4	68.5	68.6	68.7	68.9	69.0	69.1	69.2	69.3
10	1321	438	67.0	67.1	67.2	67.3	67.4	67.5	67.6	67.7	67.9	68.0	68.1	68.2	68.3	68.4	68.5	68.6	68.7	68.8	69.0	69.1	69.2	69.3
15	1393	511	66.6	66.8	66.9	67.0	67.2	67.3	67.4	67.5	67.7	67.8	67.9	68.0	68.2	68.3	68.4	68.5	68.7	68.8	68.9	69.0	69.2	69.3
20	1460	578	66.4	66.5	66.6	66.8	66.9	67.1	67.2	67.3	67.5	67.6	67.8	67.9	68.0	68.2	68.3	68.5	68.6	68.7	68.9	69.0	69.2	69.3
25	1514	631	66.1	66.3	66.4	66.6	66.7	66.9	67.0	67.2	67.3	67.5	67.7	67.8	68.0	68.1	68.3	68.4	68.6	68.7	68.9	69.0	69.2	69.3
30	1561	678	65.9	66.1	66.3	66.4	66.6	66.7	66.9	67.1	67.2	67.4	67.6	67.7	67.9	68.0	68.2	68.4	68.5	68.7	68.8	69.0	69.2	69.3
35	1619	737	65.7	65.9	66.1	66.2	66.4	66.6	66.7	66.9	67.1	67.3	67.4	67.6	67.8	68.0	68.1	68.3	68.5	68.6	68.8	69.0	69.2	69.3
40	1671	788	65.5	65.7	65.9	66.1	66.2	66.4	66.6	66.8	67.0	67.2	67.3	67.5	67.7	67.9	68.1	68.3	68.4	68.6	68.8	69.0	69.2	69.3
45	1759	877	65.2	65.4	65.6	65.8	66.0	66.2	66.4	66.6	66.8	67.0	67.2	67.4	67.6	67.8	68.0	68.2	68.4	68.6	68.8	69.0	69.2	69.4
50	1826	944	64.9	65.1	65.4	65.6	65.8	66.0	66.2	66.4	66.6	66.8	67.0	67.3	67.5	67.7	67.9	68.1	68.3	68.5	68.7	68.9	69.2	69.4
55	1938	1055	64.5	64.8	65.0	65.2	65.5	65.7	65.9	66.2	66.4	66.6	66.9	67.1	67.3	67.5	67.8	68.0	68.2	68.5	68.7	68.9	69.2	69.4
60	2057	1174	64.2	64.4	64.7	64.9	65.2	65.4	65.7	65.9	66.2	66.4	66.7	66.9	67.2	67.4	67.7	67.9	68.2	68.4	68.7	68.9	69.2	69.4
65	2178	1296	63.8	64.0	64.3	64.6	64.8	65.1	65.4	65.7	65.9	66.2	66.5	66.7	67.0	67.3	67.5	67.8	68.1	68.3	68.6	68.9	69.1	69.4
70	2335	1453	63.3	63.6	63.9	64.2	64.5	64.8	65.1	65.4	65.6	65.9	66.2	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.6	68.9	69.1	69.4
75	2527	1644	62.8	63.1	63.4	63.7	64.1	64.4	64.7	65.0	65.3	65.6	66.0	66.3	66.6	66.9	67.2	67.5	67.9	68.2	68.5	68.8	69.1	69.5
80	2758	1875	62.2	62.5	62.9	63.2	63.6	63.9	64.3	64.6	65.0	65.3	65.7	66.0	66.4	66.7	67.0	67.4	67.7	68.1	68.4	68.8	69.1	69.5
85	3076	2194	61.5	61.8	62.2	62.6	63.0	63.4	63.8	64.1	64.5	64.9	65.3	65.7	66.1	66.4	66.8	67.2	67.6	68.0	68.4	68.7	69.1	69.5
90	3751	2869	60.1	60.6	61.0	61.5	61.9	62.4	62.8	63.3	63.7	64.2	64.6	65.1	65.5	66.0	66.4	66.9	67.3	67.8	68.2	68.7	69.1	69.6
95	4732	3850	58.7	59.2	59.7	60.2	60.7	61.3	61.8	62.3	62.8	63.4	63.9	64.4	64.9	65.4	66.0	66.5	67.0	67.5	68.1	68.6	69.1	69.6
99	6419	5536	56.9	57.5	58.1	58.7	59.3	59.9	60.5	61.1	61.7	62.4	63.0	63.6	64.2	64.8	65.4	66.0	66.6	67.2	67.9	68.5	69.1	69.7
100	7877	6995	55.8	56.4	57.1	57.8	58.4	59.1	59.8	60.4	61.1	61.8	62.4	63.1	63.7	64.4	65.1	65.7	66.4	67.1	67.7	68.4	69.1	69.7

NOTE TO THE ILLINOIS POLLUTION CONTROL BOARD:

▨ Shaded area indicates compliance temperatures higher than discharge temperature--an artifact of the model calculation which would not occur when using the dynamic model on a real-time basis.

Enter mixing ratio: 0.5

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 69.2 degrees F

January-February: 50% Zone of Passage
Proposed AEL: 70 degrees F

			Intake Temperature (°F)																					
Percentiles	CSSC Flow	Available Flow	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	64.0	65.0	66.0	67.0	68.0	69.0	70.0
1	938	56	68.6	68.6	68.6	68.7	68.7	68.7	68.8	68.8	68.8	68.9	68.9	68.9	68.9	69.0	69.0	69.0	69.1	69.1	69.1	69.2	69.2	69.2
5	1186	303	66.2	66.4	66.5	66.7	66.8	67.0	67.1	67.3	67.4	67.6	67.7	67.8	68.0	68.1	68.3	68.4	68.6	68.7	68.9	69.0	69.2	69.3
7Q10	1315	433	65.2	65.4	65.6	65.8	66.0	66.2	66.4	66.6	66.8	67.0	67.2	67.4	67.6	67.8	68.0	68.2	68.4	68.6	68.8	69.0	69.2	69.4
10	1321	438	65.2	65.4	65.6	65.8	66.0	66.2	66.4	66.6	66.8	67.0	67.2	67.4	67.6	67.8	68.0	68.2	68.4	68.6	68.8	69.0	69.2	69.4
15	1393	511	64.7	64.9	65.1	65.3	65.6	65.8	66.0	66.2	66.5	66.7	66.9	67.1	67.4	67.6	67.8	68.0	68.3	68.5	68.7	68.9	69.2	69.4
20	1460	578	64.2	64.5	64.7	65.0	65.2	65.4	65.7	65.9	66.2	66.4	66.7	66.9	67.2	67.4	67.7	67.9	68.2	68.4	68.7	68.9	69.2	69.4
25	1514	631	63.9	64.1	64.4	64.7	64.9	65.2	65.5	65.7	66.0	66.2	66.5	66.8	67.0	67.3	67.6	67.8	68.1	68.4	68.6	68.9	69.1	69.4
30	1561	678	63.6	63.9	64.1	64.4	64.7	65.0	65.3	65.5	65.8	66.1	66.4	66.6	66.9	67.2	67.5	67.8	68.0	68.3	68.6	68.9	69.1	69.4
35	1619	737	63.2	63.5	63.8	64.1	64.4	64.7	65.0	65.3	65.6	65.9	66.2	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.6	68.8	69.1	69.4
40	1671	788	63.0	63.3	63.6	63.9	64.2	64.5	64.8	65.1	65.4	65.7	66.0	66.4	66.7	67.0	67.3	67.6	67.9	68.2	68.5	68.8	69.1	69.4
45	1759	877	62.5	62.8	63.2	63.5	63.8	64.2	64.5	64.8	65.1	65.5	65.8	66.1	66.5	66.8	67.1	67.5	67.8	68.1	68.5	68.8	69.1	69.5
50	1826	944	62.2	62.5	62.9	63.2	63.6	63.9	64.3	64.6	64.9	65.3	65.6	66.0	66.3	66.7	67.0	67.4	67.7	68.1	68.4	68.8	69.1	69.5
55	1938	1055	61.6	62.0	62.4	62.8	63.1	63.5	63.9	64.3	64.6	65.0	65.4	65.8	66.1	66.5	66.9	67.3	67.6	68.0	68.4	68.8	69.1	69.5
60	2057	1174	61.1	61.5	61.9	62.3	62.7	63.1	63.5	63.9	64.3	64.7	65.1	65.5	65.9	66.3	66.7	67.1	67.5	67.9	68.3	68.7	69.1	69.5
65	2178	1296	60.6	61.1	61.5	61.9	62.3	62.8	63.2	63.6	64.0	64.5	64.9	65.3	65.7	66.2	66.6	67.0	67.4	67.8	68.3	68.7	69.1	69.5
70	2335	1453	60.1	60.5	61.0	61.4	61.9	62.3	62.8	63.2	63.7	64.1	64.6	65.0	65.5	65.9	66.4	66.9	67.3	67.8	68.2	68.7	69.1	69.6
75	2527	1644	59.5	59.9	60.4	60.9	61.4	61.9	62.4	62.8	63.3	63.8	64.3	64.8	65.2	65.7	66.2	66.7	67.2	67.7	68.1	68.6	69.1	69.6
80	2758	1875	58.8	59.3	59.8	60.3	60.9	61.4	61.9	62.4	62.9	63.4	63.9	64.5	65.0	65.5	66.0	66.5	67.0	67.6	68.1	68.6	69.1	69.6
85	3076	2194	58.0	58.6	59.1	59.7	60.2	60.8	61.3	61.9	62.4	63.0	63.5	64.1	64.7	65.2	65.8	66.3	66.9	67.4	68.0	68.5	69.1	69.6
90	3751	2869	56.7	57.3	57.9	58.5	59.2	59.8	60.4	61.0	61.6	62.3	62.9	63.5	64.1	64.7	65.4	66.0	66.6	67.2	67.8	68.5	69.1	69.7
95	4732	3850	55.3	56.0	56.7	57.4	58.1	58.8	59.5	60.1	60.8	61.5	62.2	62.9	63.6	64.3	64.9	65.6	66.3	67.0	67.7	68.4	69.1	69.7
99	6419	5536	53.9	54.6	55.4	56.2	56.9	57.7	58.4	59.2	59.9	60.7	61.5	62.2	63.0	63.7	64.5	65.3	66.0	66.8	67.5	68.3	69.0	69.8
100	7877	6995	53.1	53.9	54.7	55.5	56.3	57.1	57.9	58.7	59.5	60.3	61.1	61.9	62.7	63.5	64.2	65.0	65.8	66.6	67.4	68.2	69.0	69.8

NOTE TO THE ILLINOIS POLLUTION CONTROL BOARD:

▨ Shaded area indicates compliance temperatures higher than discharge temperature--an artifact of the model calculation which would not occur when using the dynamic model on a real-time basis.

Enter mixing ratio: 0.25

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

Maximum Measured
Enter Circ Water discharge temp: 74.7 degrees F

March: 75% Zone of Passage
Proposed AEL: 75 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1	1186	303	73.1	73.1	73.2	73.3	73.4	73.5	73.5	73.6	73.7	73.8	73.9	73.9	74.0	74.1	74.2	74.2	74.3	74.4	74.5	74.6	74.6	74.7
7Q10	1315	433	72.4	72.5	72.7	72.8	72.9	73.0	73.1	73.2	73.3	73.4	73.5	73.6	73.7	73.9	74.0	74.1	74.2	74.3	74.4	74.5	74.6	74.7
5	1429	546	71.9	72.1	72.2	72.3	72.5	72.6	72.7	72.9	73.0	73.1	73.3	73.4	73.5	73.7	73.8	73.9	74.1	74.2	74.3	74.5	74.6	74.7
10	1556	674	71.4	71.5	71.7	71.9	72.0	72.2	72.3	72.5	72.7	72.8	73.0	73.1	73.3	73.5	73.6	73.8	73.9	74.1	74.3	74.4	74.6	74.7
15	1613	730	71.2	71.3	71.5	71.7	71.8	72.0	72.2	72.4	72.5	72.7	72.9	73.0	73.2	73.4	73.6	73.7	73.9	74.1	74.2	74.4	74.6	74.8
20	1699	817	70.8	71.0	71.2	71.4	71.6	71.7	71.9	72.1	72.3	72.5	72.7	72.9	73.1	73.3	73.4	73.6	73.8	74.0	74.2	74.4	74.6	74.8
25	1782	899	70.5	70.7	70.9	71.1	71.3	71.5	71.7	71.9	72.1	72.3	72.5	72.7	72.9	73.1	73.3	73.5	73.7	73.9	74.2	74.4	74.6	74.8
30	1912	1029	70.0	70.3	70.5	70.7	70.9	71.2	71.4	71.6	71.8	72.1	72.3	72.5	72.7	73.0	73.2	73.4	73.6	73.9	74.1	74.3	74.5	74.8
35	2045	1163	69.6	69.8	70.1	70.3	70.6	70.8	71.1	71.3	71.6	71.8	72.0	72.3	72.5	72.8	73.0	73.3	73.5	73.8	74.0	74.3	74.5	74.8
40	2117	1235	69.3	69.6	69.9	70.1	70.4	70.6	70.9	71.1	71.4	71.7	71.9	72.2	72.4	72.7	73.0	73.2	73.5	73.7	74.0	74.3	74.5	74.8
45	2201	1319	69.1	69.3	69.6	69.9	70.2	70.4	70.7	71.0	71.2	71.5	71.8	72.1	72.3	72.6	72.9	73.1	73.4	73.7	74.0	74.2	74.5	74.8
50	2385	1503	68.5	68.8	69.1	69.4	69.7	70.0	70.3	70.6	70.9	71.2	71.5	71.8	72.1	72.4	72.7	73.0	73.3	73.6	73.9	74.2	74.5	74.8
55	2561	1679	68.0	68.3	68.7	69.0	69.3	69.6	70.0	70.3	70.6	70.9	71.3	71.6	71.9	72.2	72.5	72.9	73.2	73.5	73.8	74.2	74.5	74.8
60	2749	1866	67.5	67.9	68.2	68.6	68.9	69.3	69.6	70.0	70.3	70.7	71.0	71.3	71.7	72.0	72.4	72.7	73.1	73.4	73.8	74.1	74.5	74.8
65	2915	2033	67.1	67.5	67.9	68.2	68.6	69.0	69.3	69.7	70.1	70.4	70.8	71.2	71.5	71.9	72.3	72.6	73.0	73.3	73.7	74.1	74.4	74.8
70	3117	2234	66.7	67.1	67.5	67.8	68.2	68.6	69.0	69.4	69.8	70.2	70.6	70.9	71.3	71.7	72.1	72.5	72.9	73.3	73.7	74.0	74.4	74.8
75	3298	2416	66.3	66.7	67.1	67.5	67.9	68.3	68.7	69.1	69.5	69.9	70.4	70.8	71.2	71.6	72.0	72.4	72.8	73.2	73.6	74.0	74.4	74.8
80	3555	2673	65.8	66.2	66.6	67.1	67.5	67.9	68.4	68.8	69.2	69.7	70.1	70.5	71.0	71.4	71.8	72.2	72.7	73.1	73.5	74.0	74.4	74.8
85	4082	3200	64.9	65.3	65.8	66.3	66.8	67.2	67.7	68.2	68.7	69.1	69.6	70.1	70.6	71.0	71.5	72.0	72.5	72.9	73.4	73.9	74.4	74.8
90	4425	3543	64.3	64.8	65.3	65.8	66.3	66.8	67.3	67.8	68.3	68.8	69.3	69.8	70.3	70.8	71.3	71.8	72.3	72.8	73.3	73.8	74.3	74.9
95	4760	3877	63.9	64.4	64.9	65.4	66.0	66.5	67.0	67.5	68.1	68.6	69.1	69.6	70.1	70.7	71.2	71.7	72.2	72.8	73.3	73.8	74.3	74.9
99	7848	6966	61.0	61.6	62.3	63.0	63.6	64.3	64.9	65.6	66.3	66.9	67.6	68.3	68.9	69.6	70.3	70.9	71.6	72.2	72.9	73.6	74.2	74.9
100	9080	8197	60.2	60.9	61.6	62.3	63.0	63.7	64.4	65.1	65.8	66.5	67.2	67.9	68.6	69.3	70.0	70.7	71.4	72.1	72.8	73.5	74.2	74.9

NOTE TO THE ILLINOIS POLLUTION CONTROL BOARD:

▨ Shaded area indicates compliance temperatures higher than discharge temperature--an artifact of the model calculation which would not occur when using the dynamic model on a real-time basis.

Enter mixing ratio: 0.5

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate:	0 gpm	Number of Pumps On:	0
Unit 2 Circ Water Pump Rate:	0 gpm	Number of Pumps On:	0
Unit 3 Circ Water Pump Rate:	0 gpm	Number of Pumps On:	0
Unit 4 Circ Water Pump Rate:	132000 gpm	Number of Pumps On:	3
Calculated Circ Water flow:	882 cfs		

🟧 < 7Q10
🟨 < 3:1 Dilution
🟨 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 74.7 degrees F

March: 50% Zone of Passage
Proposed AEL: 75 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1	1186	303	71.7	71.8	72.0	72.1	72.2	72.4	72.5	72.7	72.8	73.0	73.1	73.3	73.4	73.6	73.7	73.9	74.0	74.2	74.3	74.5	74.6	74.7
7Q10	1315	433	70.6	70.8	71.0	71.2	71.4	71.6	71.8	72.0	72.2	72.4	72.6	72.8	73.0	73.2	73.4	73.6	73.8	74.0	74.2	74.4	74.6	74.8
5	1429	546	69.8	70.0	70.3	70.5	70.8	71.0	71.2	71.5	71.7	71.9	72.2	72.4	72.6	72.9	73.1	73.4	73.6	73.8	74.1	74.3	74.5	74.8
10	1556	674	69.0	69.3	69.5	69.8	70.1	70.4	70.6	70.9	71.2	71.5	71.7	72.0	72.3	72.6	72.8	73.1	73.4	73.7	74.0	74.2	74.5	74.8
15	1613	730	68.6	68.9	69.2	69.5	69.8	70.1	70.4	70.7	71.0	71.3	71.6	71.9	72.2	72.4	72.7	73.0	73.3	73.6	73.9	74.2	74.5	74.8
20	1699	817	68.1	68.5	68.8	69.1	69.4	69.7	70.0	70.4	70.7	71.0	71.3	71.6	71.9	72.3	72.6	72.9	73.2	73.5	73.8	74.2	74.5	74.8
25	1782	899	67.7	68.0	68.4	68.7	69.1	69.4	69.7	70.1	70.4	70.8	71.1	71.4	71.8	72.1	72.4	72.8	73.1	73.5	73.8	74.1	74.5	74.8
30	1912	1029	67.1	67.4	67.8	68.2	68.5	68.9	69.3	69.7	70.0	70.4	70.8	71.1	71.5	71.9	72.2	72.6	73.0	73.3	73.7	74.1	74.4	74.8
35	2045	1163	66.5	66.9	67.3	67.7	68.1	68.5	68.9	69.3	69.7	70.1	70.4	70.8	71.2	71.6	72.0	72.4	72.8	73.2	73.6	74.0	74.4	74.8
40	2117	1235	66.2	66.6	67.0	67.4	67.8	68.2	68.6	69.1	69.5	69.9	70.3	70.7	71.1	71.5	71.9	72.4	72.8	73.2	73.6	74.0	74.4	74.8
45	2201	1319	65.8	66.3	66.7	67.1	67.6	68.0	68.4	68.8	69.3	69.7	70.1	70.6	71.0	71.4	71.8	72.3	72.7	73.1	73.5	74.0	74.4	74.8
50	2385	1503	65.2	65.6	66.1	66.6	67.0	67.5	67.9	68.4	68.9	69.3	69.8	70.2	70.7	71.2	71.6	72.1	72.5	73.0	73.5	73.9	74.4	74.8
55	2561	1679	64.6	65.1	65.6	66.1	66.6	67.0	67.5	68.0	68.5	69.0	69.5	70.0	70.5	70.9	71.4	71.9	72.4	72.9	73.4	73.9	74.4	74.8
60	2749	1866	64.1	64.6	65.1	65.6	66.1	66.6	67.1	67.7	68.2	68.7	69.2	69.7	70.2	70.7	71.3	71.8	72.3	72.8	73.3	73.8	74.3	74.9
65	2915	2033	63.6	64.2	64.7	65.2	65.8	66.3	66.8	67.4	67.9	68.4	69.0	69.5	70.0	70.6	71.1	71.6	72.2	72.7	73.3	73.8	74.3	74.9
70	3117	2234	63.1	63.7	64.3	64.8	65.4	65.9	66.5	67.0	67.6	68.2	68.7	69.3	69.8	70.4	71.0	71.5	72.1	72.6	73.2	73.8	74.3	74.9
75	3298	2416	62.7	63.3	63.9	64.5	65.0	65.6	66.2	66.8	67.4	67.9	68.5	69.1	69.7	70.3	70.8	71.4	72.0	72.6	73.1	73.7	74.3	74.9
80	3555	2673	62.2	62.8	63.4	64.0	64.6	65.2	65.8	66.4	67.0	67.7	68.3	68.9	69.5	70.1	70.7	71.3	71.9	72.5	73.1	73.7	74.3	74.9
85	4082	3200	61.4	62.0	62.6	63.3	63.9	64.6	65.2	65.9	66.5	67.2	67.8	68.4	69.1	69.7	70.4	71.0	71.7	72.3	73.0	73.6	74.2	74.9
90	4425	3543	60.9	61.5	62.2	62.9	63.6	64.2	64.9	65.6	66.2	66.9	67.6	68.2	68.9	69.6	70.2	70.9	71.6	72.2	72.9	73.6	74.2	74.9
95	4760	3877	60.5	61.2	61.8	62.5	63.2	63.9	64.6	65.3	66.0	66.7	67.3	68.0	68.7	69.4	70.1	70.8	71.5	72.2	72.8	73.5	74.2	74.9
99	7848	6966	58.2	59.0	59.8	60.6	61.4	62.2	63.0	63.8	64.6	65.4	66.2	67.0	67.8	68.6	69.4	70.2	70.9	71.7	72.5	73.3	74.1	74.9
100	9080	8197	57.7	58.5	59.3	60.1	61.0	61.8	62.6	63.4	64.2	65.1	65.9	66.7	67.5	68.4	69.2	70.0	70.8	71.7	72.5	73.3	74.1	74.9

NOTE TO THE ILLINOIS POLLUTION CONTROL BOARD:

▨ Shaded area indicates compliance temperatures higher than discharge temperature--an artifact of the model calculation which would not occur when using the dynamic model on a real-time basis.

Enter mixing ratio: 0.25

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 83.1 degrees F

April: 75% Zone of Passage
Proposed AEL: 80 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	59.0	60.0	61.0	62.0	63.0	64.0	65.0	66.0	67.0	68.0	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0
1	1140	258	81.5	81.5	81.6	81.7	81.7	81.8	81.9	81.9	82.0	82.1	82.1	82.2	82.3	82.3	82.4	82.5	82.5	82.6	82.7	82.8	82.8	82.9
7Q10	1315	433	80.5	80.6	80.7	80.8	80.9	81.0	81.1	81.2	81.3	81.5	81.6	81.7	81.8	81.9	82.0	82.1	82.2	82.3	82.4	82.5	82.7	82.8
5	1336	453	80.4	80.5	80.6	80.7	80.8	80.9	81.0	81.2	81.3	81.4	81.5	81.6	81.7	81.8	82.0	82.1	82.2	82.3	82.4	82.5	82.6	82.7
10	1524	642	79.4	79.5	79.7	79.9	80.0	80.2	80.3	80.5	80.6	80.8	80.9	81.1	81.2	81.4	81.5	81.7	81.9	82.0	82.2	82.3	82.5	82.6
15	1630	748	78.9	79.1	79.2	79.4	79.6	79.8	79.9	80.1	80.3	80.5	80.6	80.8	81.0	81.2	81.3	81.5	81.7	81.9	82.0	82.2	82.4	82.6
20	1733	851	78.4	78.6	78.8	79.0	79.2	79.4	79.6	79.8	80.0	80.2	80.4	80.6	80.7	80.9	81.1	81.3	81.5	81.7	81.9	82.1	82.3	82.5
25	1815	932	78.1	78.3	78.5	78.7	78.9	79.1	79.3	79.5	79.7	79.9	80.2	80.4	80.6	80.8	81.0	81.2	81.4	81.6	81.8	82.0	82.2	82.5
30	1898	1016	77.7	77.9	78.2	78.4	78.6	78.8	79.1	79.3	79.5	79.7	79.9	80.2	80.4	80.6	80.8	81.1	81.3	81.5	81.7	82.0	82.2	82.4
35	2002	1119	77.3	77.5	77.8	78.0	78.3	78.5	78.7	79.0	79.2	79.5	79.7	79.9	80.2	80.4	80.7	80.9	81.1	81.4	81.6	81.9	82.1	82.4
40	2143	1261	76.8	77.0	77.3	77.5	77.8	78.1	78.3	78.6	78.9	79.1	79.4	79.7	79.9	80.2	80.4	80.7	81.0	81.2	81.5	81.8	82.0	82.3
45	2250	1368	76.4	76.6	76.9	77.2	77.5	77.8	78.0	78.3	78.6	78.9	79.2	79.4	79.7	80.0	80.3	80.6	80.8	81.1	81.4	81.7	82.0	82.2
50	2379	1497	75.9	76.2	76.5	76.8	77.1	77.4	77.7	78.0	78.3	78.6	78.9	79.2	79.5	79.8	80.1	80.4	80.7	81.0	81.3	81.6	81.9	82.2
55	2439	1557	75.7	76.0	76.3	76.6	76.9	77.3	77.6	77.9	78.2	78.5	78.8	79.1	79.4	79.7	80.0	80.3	80.6	80.9	81.2	81.5	81.8	82.2
60	2519	1636	75.5	75.8	76.1	76.4	76.7	77.0	77.4	77.7	78.0	78.3	78.6	79.0	79.3	79.6	79.9	80.2	80.5	80.9	81.2	81.5	81.8	82.1
65	2703	1821	74.9	75.2	75.6	75.9	76.3	76.6	76.9	77.3	77.6	78.0	78.3	78.6	79.0	79.3	79.7	80.0	80.3	80.7	81.0	81.4	81.7	82.0
70	2942	2059	74.2	74.6	75.0	75.3	75.7	76.1	76.4	76.8	77.2	77.5	77.9	78.3	78.6	79.0	79.4	79.7	80.1	80.5	80.9	81.2	81.6	82.0
75	3419	2537	73.0	73.4	73.9	74.3	74.7	75.1	75.5	75.9	76.4	76.8	77.2	77.6	78.0	78.5	78.9	79.3	79.7	80.1	80.5	81.0	81.4	81.8
80	3773	2891	72.2	72.7	73.1	73.6	74.0	74.5	74.9	75.4	75.9	76.3	76.8	77.2	77.7	78.1	78.6	79.0	79.5	79.9	80.4	80.8	81.3	81.7
85	4154	3271	71.5	72.0	72.5	72.9	73.4	73.9	74.4	74.9	75.4	75.8	76.3	76.8	77.3	77.8	78.2	78.7	79.2	79.7	80.2	80.6	81.1	81.6
90	5233	4350	69.8	70.3	70.9	71.5	72.0	72.6	73.1	73.7	74.2	74.8	75.3	75.9	76.4	77.0	77.5	78.1	78.6	79.2	79.7	80.3	80.8	81.4
95	6536	5654	68.3	68.9	69.5	70.1	70.7	71.3	72.0	72.6	73.2	73.8	74.4	75.0	75.7	76.3	76.9	77.5	78.1	78.7	79.3	80.0	80.6	81.2
99	16483	15601	63.4	64.3	65.1	65.9	66.7	67.5	68.3	69.2	70.0	70.8	71.6	72.4	73.2	74.0	74.9	75.7	76.5	77.3	78.1	78.9	79.8	80.6
100	17121	16239	63.3	64.1	64.9	65.8	66.6	67.4	68.2	69.1	69.9	70.7	71.5	72.3	73.2	74.0	74.8	75.6	76.4	77.3	78.1	78.9	79.7	80.6

Enter mixing ratio: 0.5

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 83.1 degrees F

April: 50% Zone of Passage
Proposed AEL: 80 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	59.0	60.0	61.0	62.0	63.0	64.0	65.0	66.0	67.0	68.0	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0
1	1140	258	80.0	80.2	80.3	80.4	80.5	80.7	80.8	80.9	81.0	81.2	81.3	81.4	81.6	81.7	81.8	81.9	82.1	82.2	82.3	82.4	82.6	82.7
7Q10	1315	433	78.4	78.6	78.7	78.9	79.1	79.3	79.5	79.7	79.9	80.1	80.3	80.5	80.7	80.9	81.1	81.3	81.5	81.7	81.9	82.1	82.3	82.5
5	1336	453	78.2	78.4	78.6	78.8	79.0	79.2	79.4	79.6	79.8	80.0	80.2	80.4	80.6	80.8	81.0	81.2	81.4	81.6	81.9	82.1	82.3	82.5
10	1524	642	76.7	76.9	77.2	77.5	77.7	78.0	78.3	78.5	78.8	79.1	79.3	79.6	79.9	80.1	80.4	80.7	80.9	81.2	81.5	81.7	82.0	82.3
15	1630	748	75.9	76.2	76.5	76.8	77.1	77.4	77.7	78.0	78.3	78.6	78.9	79.2	79.5	79.8	80.1	80.4	80.7	81.0	81.3	81.6	81.9	82.2
20	1733	851	75.3	75.6	75.9	76.2	76.6	76.9	77.2	77.5	77.9	78.2	78.5	78.8	79.2	79.5	79.8	80.1	80.5	80.8	81.1	81.4	81.8	82.1
25	1815	932	74.8	75.1	75.5	75.8	76.2	76.5	76.8	77.2	77.5	77.9	78.2	78.6	78.9	79.3	79.6	80.0	80.3	80.6	81.0	81.3	81.7	82.0
30	1898	1016	74.3	74.7	75.0	75.4	75.8	76.1	76.5	76.9	77.2	77.6	77.9	78.3	78.7	79.0	79.4	79.8	80.1	80.5	80.9	81.2	81.6	82.0
35	2002	1119	73.7	74.1	74.5	74.9	75.3	75.7	76.1	76.5	76.9	77.2	77.6	78.0	78.4	78.8	79.2	79.6	80.0	80.3	80.7	81.1	81.5	81.9
40	2143	1261	73.1	73.5	73.9	74.3	74.7	75.1	75.6	76.0	76.4	76.8	77.2	77.6	78.1	78.5	78.9	79.3	79.7	80.1	80.6	81.0	81.4	81.8
45	2250	1368	72.6	73.0	73.5	73.9	74.3	74.8	75.2	75.6	76.1	76.5	76.9	77.4	77.8	78.3	78.7	79.1	79.6	80.0	80.4	80.9	81.3	81.7
50	2379	1497	72.0	72.5	73.0	73.4	73.9	74.3	74.8	75.3	75.7	76.2	76.6	77.1	77.5	78.0	78.5	78.9	79.4	79.8	80.3	80.8	81.2	81.7
55	2439	1557	71.8	72.3	72.7	73.2	73.7	74.1	74.6	75.1	75.6	76.0	76.5	77.0	77.4	77.9	78.4	78.8	79.3	79.8	80.2	80.7	81.2	81.6
60	2519	1636	71.5	72.0	72.5	72.9	73.4	73.9	74.4	74.9	75.4	75.8	76.3	76.8	77.3	77.8	78.2	78.7	79.2	79.7	80.2	80.6	81.1	81.6
65	2703	1821	70.9	71.4	71.9	72.4	72.9	73.4	73.9	74.4	74.9	75.4	75.9	76.4	77.0	77.5	78.0	78.5	79.0	79.5	80.0	80.5	81.0	81.5
70	2942	2059	70.1	70.7	71.2	71.7	72.3	72.8	73.4	73.9	74.4	75.0	75.5	76.0	76.6	77.1	77.7	78.2	78.7	79.3	79.8	80.4	80.9	81.4
75	3419	2537	68.9	69.5	70.1	70.7	71.2	71.8	72.4	73.0	73.6	74.2	74.8	75.4	76.0	76.6	77.1	77.7	78.3	78.9	79.5	80.1	80.7	81.3
80	3773	2891	68.1	68.8	69.4	70.0	70.6	71.2	71.9	72.5	73.1	73.7	74.3	75.0	75.6	76.2	76.8	77.4	78.1	78.7	79.3	79.9	80.6	81.2
85	4154	3271	67.4	68.1	68.7	69.4	70.0	70.7	71.3	72.0	72.6	73.3	73.9	74.6	75.2	75.9	76.5	77.2	77.8	78.5	79.1	79.8	80.4	81.1
90	5233	4350	66.0	66.7	67.4	68.1	68.8	69.5	70.2	70.9	71.6	72.4	73.1	73.8	74.5	75.2	75.9	76.6	77.3	78.0	78.8	79.5	80.2	80.9
95	6536	5654	64.7	65.5	66.3	67.0	67.8	68.5	69.3	70.1	70.8	71.6	72.4	73.1	73.9	74.6	75.4	76.2	76.9	77.7	78.5	79.2	80.0	80.7
99	16483	15601	61.4	62.3	63.2	64.1	65.0	65.9	66.8	67.7	68.6	69.5	70.4	71.3	72.2	73.1	74.0	74.9	75.8	76.7	77.6	78.5	79.4	80.3
100	17121	16239	61.4	62.3	63.2	64.1	65.0	65.9	66.8	67.7	68.6	69.5	70.4	71.3	72.2	73.1	74.0	74.9	75.8	76.7	77.6	78.5	79.4	80.3

Enter mixing ratio: 0.25

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 96.1 degrees F

May: 75% Zone of Passage
Proposed AEL: 85 degrees F

`			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	64.0	65.0	66.0	67.0	68.0	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0	81.0	82.0	83.0	84.0	85
1	1229	347	93.2	93.3	93.4	93.5	93.6	93.7	93.8	93.9	93.9	94.0	94.1	94.2	94.3	94.4	94.5	94.6	94.7	94.7	94.8	94.9	95.0	95.1
7Q10	1315	433	92.6	92.7	92.8	92.9	93.0	93.1	93.2	93.4	93.5	93.6	93.7	93.8	93.9	94.0	94.1	94.2	94.3	94.5	94.6	94.7	94.8	94.9
5	1491	608	91.4	91.5	91.7	91.8	92.0	92.1	92.3	92.4	92.6	92.7	92.9	93.0	93.1	93.3	93.4	93.6	93.7	93.9	94.0	94.2	94.3	94.5
10	1656	773	90.3	90.5	90.7	90.9	91.0	91.2	91.4	91.6	91.8	91.9	92.1	92.3	92.5	92.7	92.8	93.0	93.2	93.4	93.6	93.7	93.9	94.1
15	1775	893	89.6	89.8	90.0	90.2	90.4	90.6	90.8	91.0	91.2	91.4	91.6	91.8	92.0	92.2	92.4	92.6	92.8	93.1	93.3	93.5	93.7	93.9
20	1854	972	89.2	89.4	89.6	89.8	90.0	90.2	90.5	90.7	90.9	91.1	91.3	91.5	91.8	92.0	92.2	92.4	92.6	92.8	93.1	93.3	93.5	93.7
25	2061	1178	88.1	88.3	88.6	88.8	89.1	89.3	89.6	89.8	90.1	90.3	90.6	90.8	91.1	91.3	91.6	91.8	92.1	92.3	92.6	92.8	93.1	93.3
30	2165	1283	87.5	87.8	88.1	88.3	88.6	88.9	89.1	89.4	89.7	89.9	90.2	90.5	90.7	91.0	91.3	91.5	91.8	92.1	92.3	92.6	92.9	93.1
35	2364	1481	86.6	86.9	87.2	87.5	87.8	88.1	88.4	88.7	89.0	89.3	89.6	89.9	90.2	90.5	90.7	91.0	91.3	91.6	91.9	92.2	92.5	92.8
40	2473	1591	86.1	86.4	86.7	87.1	87.4	87.7	88.0	88.3	88.6	88.9	89.2	89.5	89.9	90.2	90.5	90.8	91.1	91.4	91.7	92.0	92.3	92.7
45	2568	1686	85.7	86.0	86.4	86.7	87.0	87.3	87.7	88.0	88.3	88.6	89.0	89.3	89.6	89.9	90.2	90.6	90.9	91.2	91.5	91.9	92.2	92.5
50	2685	1803	85.2	85.6	85.9	86.3	86.6	86.9	87.3	87.6	88.0	88.3	88.6	89.0	89.3	89.6	90.0	90.3	90.7	91.0	91.3	91.7	92.0	92.3
55	2772	1890	84.9	85.3	85.6	86.0	86.3	86.6	87.0	87.3	87.7	88.0	88.4	88.7	89.1	89.4	89.8	90.1	90.5	90.8	91.2	91.5	91.9	92.2
60	2982	2100	84.1	84.5	84.9	85.2	85.6	86.0	86.4	86.7	87.1	87.5	87.9	88.2	88.6	89.0	89.3	89.7	90.1	90.5	90.8	91.2	91.6	92.0
65	3294	2411	83.1	83.5	83.9	84.3	84.7	85.1	85.5	85.9	86.3	86.7	87.1	87.5	87.9	88.3	88.8	89.2	89.6	90.0	90.4	90.8	91.2	91.6
70	3601	2719	82.1	82.6	83.0	83.4	83.9	84.3	84.7	85.2	85.6	86.0	86.5	86.9	87.4	87.8	88.2	88.7	89.1	89.5	90.0	90.4	90.8	91.3
75	3815	2933	81.5	82.0	82.4	82.9	83.3	83.8	84.3	84.7	85.2	85.6	86.1	86.5	87.0	87.4	87.9	88.3	88.8	89.2	89.7	90.2	90.6	91.1
80	4418	3535	80.0	80.5	81.0	81.5	82.0	82.5	83.0	83.5	84.0	84.5	85.0	85.5	86.0	86.5	87.0	87.5	88.0	88.5	89.0	89.5	90.0	90.5
85	5027	4144	78.8	79.3	79.8	80.4	80.9	81.5	82.0	82.5	83.1	83.6	84.2	84.7	85.2	85.8	86.3	86.9	87.4	87.9	88.5	89.0	89.6	90.1
90	5491	4609	77.9	78.5	79.1	79.6	80.2	80.8	81.3	81.9	82.5	83.0	83.6	84.2	84.7	85.3	85.8	86.4	87.0	87.5	88.1	88.7	89.2	89.8
95	6720	5838	76.1	76.7	77.3	78.0	78.6	79.2	79.8	80.5	81.1	81.7	82.3	82.9	83.6	84.2	84.8	85.4	86.1	86.7	87.3	87.9	88.6	89.2
99	9272	8389	73.5	74.2	74.9	75.6	76.3	77.0	77.7	78.4	79.1	79.8	80.5	81.2	82.0	82.7	83.4	84.1	84.8	85.5	86.2	86.9	87.6	88.3
100	12962	12080	71.3	72.0	72.8	73.6	74.4	75.1	75.9	76.7	77.4	78.2	79.0	79.8	80.5	81.3	82.1	82.9	83.6	84.4	85.2	86.0	86.7	87.5

Enter mixing ratio: 0.5

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm   Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm   Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm   Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm   Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

May: 50% Zone of Passage

Maximum Measured
Enter Circ Water discharge temp: 96.1 degrees F

Proposed AEL: 85 degrees F

`			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	64.0	65.0	66.0	67.0	68.0	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0	81.0	82.0	83.0	84.0	85
1	1229	347	90.8	91.0	91.2	91.3	91.5	91.7	91.8	92.0	92.1	92.3	92.5	92.6	92.8	93.0	93.1	93.3	93.5	93.6	93.8	93.9	94.1	94.3
7Q10	1315	433	89.8	90.0	90.2	90.4	90.6	90.8	91.0	91.2	91.4	91.6	91.7	91.9	92.1	92.3	92.5	92.7	92.9	93.1	93.3	93.5	93.7	93.9
5	1491	608	87.9	88.1	88.4	88.6	88.9	89.2	89.4	89.7	89.9	90.2	90.4	90.7	90.9	91.2	91.5	91.7	92.0	92.2	92.5	92.7	93.0	93.3
10	1656	773	86.3	86.6	86.9	87.2	87.5	87.8	88.1	88.5	88.8	89.1	89.4	89.7	90.0	90.3	90.6	90.9	91.2	91.5	91.8	92.1	92.4	92.7
15	1775	893	85.3	85.7	86.0	86.3	86.7	87.0	87.3	87.7	88.0	88.3	88.7	89.0	89.3	89.7	90.0	90.4	90.7	91.0	91.4	91.7	92.0	92.4
20	1854	972	84.7	85.1	85.4	85.8	86.1	86.5	86.8	87.2	87.5	87.9	88.2	88.6	89.0	89.3	89.7	90.0	90.4	90.7	91.1	91.4	91.8	92.2
25	2061	1178	83.2	83.6	84.0	84.4	84.8	85.2	85.6	86.0	86.4	86.9	87.3	87.7	88.1	88.5	88.9	89.3	89.7	90.1	90.5	90.9	91.3	91.7
30	2165	1283	82.6	83.0	83.4	83.9	84.3	84.7	85.1	85.5	86.0	86.4	86.8	87.2	87.6	88.1	88.5	88.9	89.3	89.7	90.2	90.6	91.0	91.4
35	2364	1481	81.4	81.9	82.4	82.8	83.3	83.7	84.2	84.6	85.1	85.6	86.0	86.5	86.9	87.4	87.8	88.3	88.8	89.2	89.7	90.1	90.6	91.0
40	2473	1591	80.9	81.4	81.8	82.3	82.8	83.3	83.7	84.2	84.7	85.1	85.6	86.1	86.6	87.0	87.5	88.0	88.5	88.9	89.4	89.9	90.4	90.8
45	2568	1686	80.4	80.9	81.4	81.9	82.4	82.9	83.3	83.8	84.3	84.8	85.3	85.8	86.3	86.8	87.3	87.7	88.2	88.7	89.2	89.7	90.2	90.7
50	2685	1803	79.9	80.4	80.9	81.4	81.9	82.4	82.9	83.4	83.9	84.4	84.9	85.4	85.9	86.4	87.0	87.5	88.0	88.5	89.0	89.5	90.0	90.5
55	2772	1890	79.5	80.0	80.5	81.1	81.6	82.1	82.6	83.1	83.6	84.2	84.7	85.2	85.7	86.2	86.7	87.3	87.8	88.3	88.8	89.3	89.8	90.4
60	2982	2100	78.7	79.2	79.7	80.3	80.8	81.4	81.9	82.5	83.0	83.5	84.1	84.6	85.2	85.7	86.3	86.8	87.4	87.9	88.4	89.0	89.5	90.1
65	3294	2411	77.6	78.1	78.7	79.3	79.9	80.5	81.0	81.6	82.2	82.8	83.3	83.9	84.5	85.1	85.6	86.2	86.8	87.4	88.0	88.5	89.1	89.7
70	3601	2719	76.6	77.2	77.8	78.5	79.1	79.7	80.3	80.9	81.5	82.1	82.7	83.3	83.9	84.5	85.1	85.7	86.3	86.9	87.5	88.2	88.8	89.4
75	3815	2933	76.1	76.7	77.3	77.9	78.6	79.2	79.8	80.4	81.1	81.7	82.3	82.9	83.6	84.2	84.8	85.4	86.0	86.7	87.3	87.9	88.5	89.2
80	4418	3535	74.7	75.4	76.0	76.7	77.4	78.0	78.7	79.4	80.0	80.7	81.4	82.0	82.7	83.4	84.0	84.7	85.4	86.0	86.7	87.4	88.0	88.7
85	5027	4144	73.6	74.3	75.0	75.7	76.4	77.1	77.8	78.5	79.2	79.9	80.6	81.3	82.0	82.7	83.4	84.1	84.8	85.5	86.2	86.9	87.6	88.3
90	5491	4609	72.9	73.6	74.3	75.1	75.8	76.5	77.2	77.9	78.7	79.4	80.1	80.8	81.6	82.3	83.0	83.7	84.5	85.2	85.9	86.6	87.4	88.1
95	6720	5838	71.5	72.2	73.0	73.8	74.5	75.3	76.1	76.8	77.6	78.4	79.1	79.9	80.7	81.4	82.2	83.0	83.7	84.5	85.3	86.0	86.8	87.6
99	9272	8389	69.6	70.4	71.2	72.1	72.9	73.7	74.5	75.4	76.2	77.0	77.8	78.7	79.5	80.3	81.1	82.0	82.8	83.6	84.5	85.3	86.1	86.9
100	12962	12080	68.1	69.0	69.8	70.7	71.6	72.5	73.3	74.2	75.1	75.9	76.8	77.7	78.6	79.4	80.3	81.2	82.1	82.9	83.8	84.7	85.5	86.4

Enter mixing ratio: 0.25

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm — Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm — Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm — Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm — Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟨 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 103 degrees F

June-September: 75% Zone of Passage
Proposed AEL: 93 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
7Q10	1315	433	99.6	99.7	99.8	99.9	100.1	100.2	100.3	100.4	100.5	100.6	100.7	100.8	100.9	101.0	101.1	101.3	101.4	101.5	101.6	101.7	101.8	101.9
1	1342	460	99.4	99.5	99.7	99.8	99.9	100.0	100.1	100.2	100.3	100.5	100.6	100.7	100.8	100.9	101.0	101.2	101.3	101.4	101.5	101.6	101.7	101.8
5	1605	723	97.7	97.9	98.1	98.2	98.4	98.6	98.7	98.9	99.1	99.3	99.4	99.6	99.8	99.9	100.1	100.3	100.4	100.6	100.8	101.0	101.1	101.3
10	1816	933	96.5	96.7	96.9	97.1	97.4	97.6	97.8	98.0	98.2	98.4	98.6	98.8	99.0	99.2	99.4	99.7	99.9	100.1	100.3	100.5	100.7	100.9
15	1959	1077	95.8	96.0	96.2	96.5	96.7	96.9	97.2	97.4	97.6	97.9	98.1	98.3	98.6	98.8	99.0	99.3	99.5	99.7	100.0	100.2	100.4	100.7
20	2087	1205	95.1	95.4	95.6	95.9	96.1	96.4	96.6	96.9	97.1	97.4	97.7	97.9	98.2	98.4	98.7	98.9	99.2	99.4	99.7	99.9	100.2	100.5
25	2195	1313	94.6	94.9	95.1	95.4	95.7	95.9	96.2	96.5	96.8	97.0	97.3	97.6	97.8	98.1	98.4	98.7	98.9	99.2	99.5	99.7	100.0	100.3
30	2277	1395	94.2	94.5	94.8	95.1	95.4	95.6	95.9	96.2	96.5	96.8	97.1	97.3	97.6	97.9	98.2	98.5	98.8	99.0	99.3	99.6	99.9	100.2
35	2421	1539	93.6	93.9	94.2	94.5	94.8	95.1	95.4	95.7	96.0	96.3	96.6	96.9	97.2	97.5	97.8	98.1	98.4	98.7	99.1	99.4	99.7	100.0
40	2508	1625	93.2	93.5	93.9	94.2	94.5	94.8	95.1	95.4	95.7	96.1	96.4	96.7	97.0	97.3	97.6	98.0	98.3	98.6	98.9	99.2	99.5	99.8
45	2589	1707	92.9	93.2	93.5	93.9	94.2	94.5	94.9	95.2	95.5	95.8	96.2	96.5	96.8	97.1	97.5	97.8	98.1	98.4	98.8	99.1	99.4	99.7
50	2680	1798	92.5	92.9	93.2	93.5	93.9	94.2	94.6	94.9	95.2	95.6	95.9	96.2	96.6	96.9	97.3	97.6	97.9	98.3	98.6	98.9	99.3	99.6
55	2815	1933	92.0	92.4	92.7	93.1	93.4	93.8	94.2	94.5	94.9	95.2	95.6	95.9	96.3	96.6	97.0	97.3	97.7	98.0	98.4	98.8	99.1	99.5
60	2974	2092	91.5	91.8	92.2	92.6	93.0	93.3	93.7	94.1	94.4	94.8	95.2	95.6	95.9	96.3	96.7	97.0	97.4	97.8	98.2	98.5	98.9	99.3
65	3134	2251	90.9	91.3	91.7	92.1	92.5	92.9	93.3	93.7	94.0	94.4	94.8	95.2	95.6	96.0	96.4	96.8	97.2	97.5	97.9	98.3	98.7	99.1
70	3325	2443	90.3	90.7	91.1	91.5	92.0	92.4	92.8	93.2	93.6	94.0	94.4	94.8	95.2	95.6	96.0	96.5	96.9	97.3	97.7	98.1	98.5	98.9
75	3591	2709	89.5	90.0	90.4	90.8	91.3	91.7	92.1	92.6	93.0	93.4	93.9	94.3	94.7	95.2	95.6	96.1	96.5	96.9	97.4	97.8	98.2	98.7
80	3886	3004	88.7	89.2	89.7	90.1	90.6	91.0	91.5	92.0	92.4	92.9	93.3	93.8	94.3	94.7	95.2	95.6	96.1	96.6	97.0	97.5	97.9	98.4
85	4287	3405	87.8	88.3	88.8	89.3	89.7	90.2	90.7	91.2	91.7	92.2	92.7	93.2	93.7	94.2	94.7	95.1	95.6	96.1	96.6	97.1	97.6	98.1
90	4693	3811	86.9	87.4	87.9	88.5	89.0	89.5	90.0	90.5	91.1	91.6	92.1	92.6	93.1	93.7	94.2	94.7	95.2	95.7	96.3	96.8	97.3	97.8
95	5839	4957	84.9	85.5	86.1	86.6	87.2	87.8	88.4	89.0	89.6	90.1	90.7	91.3	91.9	92.5	93.1	93.7	94.2	94.8	95.4	96.0	96.6	97.2
99	11413	10530	79.8	80.5	81.3	82.0	82.8	83.5	84.3	85.0	85.8	86.5	87.3	88.0	88.8	89.5	90.3	91.0	91.8	92.5	93.3	94.0	94.8	95.5
100	14015	13132	78.6	79.4	80.1	80.9	81.7	82.5	83.3	84.1	84.9	85.7	86.4	87.2	88.0	88.8	89.6	90.4	91.2	92.0	92.8	93.5	94.3	95.1

Enter mixing ratio: 0.5

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 103 degrees F

June-September: 50% Zone of Passage
Proposed AEL: 93 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
7Q10	1315	433	96.9	97.1	97.3	97.5	97.7	97.9	98.1	98.3	98.5	98.7	98.9	99.1	99.3	99.5	99.7	99.8	100.0	100.2	100.4	100.6	100.8	101.0
1	1342	460	96.6	96.8	97.0	97.2	97.4	97.6	97.8	98.0	98.2	98.5	98.7	98.9	99.1	99.3	99.5	99.7	99.9	100.1	100.3	100.5	100.7	100.9
5	1605	723	94.0	94.3	94.6	94.9	95.2	95.4	95.7	96.0	96.3	96.6	96.9	97.2	97.5	97.8	98.1	98.4	98.6	98.9	99.2	99.5	99.8	100.1
10	1816	933	92.3	92.6	93.0	93.3	93.7	94.0	94.4	94.7	95.0	95.4	95.7	96.1	96.4	96.8	97.1	97.5	97.8	98.2	98.5	98.8	99.2	99.5
15	1959	1077	91.3	91.6	92.0	92.4	92.8	93.1	93.5	93.9	94.3	94.7	95.0	95.4	95.8	96.2	96.6	96.9	97.3	97.7	98.1	98.5	98.8	99.2
20	2087	1205	90.4	90.8	91.2	91.6	92.0	92.5	92.9	93.3	93.7	94.1	94.5	94.9	95.3	95.7	96.1	96.5	96.9	97.3	97.7	98.1	98.5	98.9
25	2195	1313	89.8	90.2	90.6	91.1	91.5	91.9	92.3	92.8	93.2	93.6	94.0	94.5	94.9	95.3	95.7	96.2	96.6	97.0	97.5	97.9	98.3	98.7
30	2277	1395	89.3	89.8	90.2	90.6	91.1	91.5	92.0	92.4	92.8	93.3	93.7	94.2	94.6	95.1	95.5	95.9	96.4	96.8	97.3	97.7	98.1	98.6
35	2421	1539	88.6	89.0	89.5	90.0	90.4	90.9	91.4	91.8	92.3	92.8	93.2	93.7	94.1	94.6	95.1	95.5	96.0	96.5	96.9	97.4	97.9	98.3
40	2508	1625	88.1	88.6	89.1	89.6	90.1	90.5	91.0	91.5	92.0	92.5	92.9	93.4	93.9	94.4	94.8	95.3	95.8	96.3	96.8	97.2	97.7	98.2
45	2589	1707	87.8	88.2	88.7	89.2	89.7	90.2	90.7	91.2	91.7	92.2	92.7	93.2	93.7	94.1	94.6	95.1	95.6	96.1	96.6	97.1	97.6	98.1
50	2680	1798	87.4	87.9	88.4	88.9	89.4	89.9	90.4	90.9	91.4	91.9	92.4	92.9	93.4	93.9	94.4	94.9	95.4	95.9	96.4	96.9	97.4	98.0
55	2815	1933	86.8	87.3	87.8	88.4	88.9	89.4	89.9	90.5	91.0	91.5	92.0	92.5	93.1	93.6	94.1	94.6	95.2	95.7	96.2	96.7	97.2	97.8
60	2974	2092	86.2	86.7	87.3	87.8	88.4	88.9	89.4	90.0	90.5	91.1	91.6	92.2	92.7	93.2	93.8	94.3	94.9	95.4	95.9	96.5	97.0	97.6
65	3134	2251	85.6	86.2	86.7	87.3	87.9	88.4	89.0	89.5	90.1	90.7	91.2	91.8	92.3	92.9	93.5	94.0	94.6	95.2	95.7	96.3	96.8	97.4
70	3325	2443	85.0	85.6	86.2	86.7	87.3	87.9	88.5	89.1	89.6	90.2	90.8	91.4	92.0	92.5	93.1	93.7	94.3	94.9	95.5	96.0	96.6	97.2
75	3591	2709	84.2	84.8	85.4	86.0	86.6	87.3	87.9	88.5	89.1	89.7	90.3	90.9	91.5	92.1	92.7	93.3	93.9	94.5	95.1	95.7	96.3	96.9
80	3886	3004	83.5	84.1	84.7	85.4	86.0	86.6	87.3	87.9	88.5	89.1	89.8	90.4	91.0	91.7	92.3	92.9	93.6	94.2	94.8	95.4	96.1	96.7
85	4287	3405	82.6	83.2	83.9	84.6	85.2	85.9	86.5	87.2	87.9	88.5	89.2	89.8	90.5	91.1	91.8	92.5	93.1	93.8	94.4	95.1	95.8	96.4
90	4693	3811	81.8	82.5	83.2	83.9	84.5	85.2	85.9	86.6	87.3	88.0	88.6	89.3	90.0	90.7	91.4	92.1	92.7	93.4	94.1	94.8	95.5	96.2
95	5839	4957	80.1	80.9	81.6	82.4	83.1	83.8	84.6	85.3	86.0	86.8	87.5	88.3	89.0	89.7	90.5	91.2	91.9	92.7	93.4	94.2	94.9	95.6
99	11413	10530	76.4	77.3	78.2	79.0	79.9	80.7	81.6	82.4	83.3	84.2	85.0	85.9	86.7	87.6	88.4	89.3	90.2	91.0	91.9	92.7	93.6	94.4
100	14015	13132	75.7	76.6	77.4	78.3	79.2	80.1	81.0	81.8	82.7	83.6	84.5	85.4	86.3	87.1	88.0	88.9	89.8	90.7	91.5	92.4	93.3	94.2

Enter mixing ratio: 0.25

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 90.9 degrees F

October: 75% Zone of Passage
Proposed AEL: 90 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0	81.0	82.0	83.0	84.0	85.0	86.0	87.0	88.0	89.0	90
1	811	-71	91.4	91.3	91.3	91.3	91.3	91.2	91.2	91.2	91.2	91.2	91.1	91.1	91.1	91.1	91.1	91.0	91.0	91.0	91.0	91.0	90.9	90.9
5	1149	267	89.4	89.4	89.5	89.6	89.6	89.7	89.8	89.9	89.9	90.0	90.1	90.1	90.2	90.3	90.3	90.4	90.5	90.6	90.6	90.7	90.8	90.8
10	1240	357	88.9	89.0	89.1	89.2	89.3	89.3	89.4	89.5	89.6	89.7	89.8	89.9	90.0	90.1	90.2	90.3	90.4	90.4	90.5	90.6	90.7	90.8
7Q10	1315	433	88.5	88.6	88.7	88.8	88.9	89.1	89.2	89.3	89.4	89.5	89.6	89.7	89.8	89.9	90.0	90.1	90.3	90.4	90.5	90.6	90.7	90.8
15	1342	460	88.4	88.5	88.6	88.7	88.8	89.0	89.1	89.2	89.3	89.4	89.5	89.6	89.8	89.9	90.0	90.1	90.2	90.3	90.5	90.6	90.7	90.8
20	1443	560	87.9	88.0	88.2	88.3	88.4	88.6	88.7	88.9	89.0	89.1	89.3	89.4	89.5	89.7	89.8	90.0	90.1	90.2	90.4	90.5	90.6	90.8
25	1543	661	87.4	87.6	87.8	87.9	88.1	88.2	88.4	88.6	88.7	88.9	89.0	89.2	89.3	89.5	89.7	89.8	90.0	90.1	90.3	90.4	90.6	90.8
30	1616	733	87.1	87.3	87.5	87.6	87.8	88.0	88.2	88.3	88.5	88.7	88.9	89.0	89.2	89.4	89.5	89.7	89.9	90.1	90.2	90.4	90.6	90.7
35	1670	788	86.9	87.1	87.3	87.4	87.6	87.8	88.0	88.2	88.4	88.5	88.7	88.9	89.1	89.3	89.5	89.6	89.8	90.0	90.2	90.4	90.6	90.7
40	1754	871	86.6	86.8	87.0	87.2	87.4	87.6	87.8	88.0	88.1	88.3	88.5	88.7	88.9	89.1	89.3	89.5	89.7	89.9	90.1	90.3	90.5	90.7
45	1793	910	86.4	86.6	86.8	87.0	87.2	87.4	87.6	87.8	88.0	88.3	88.5	88.7	88.9	89.1	89.3	89.5	89.7	89.9	90.1	90.3	90.5	90.7
50	1851	969	86.2	86.4	86.6	86.8	87.0	87.3	87.5	87.7	87.9	88.1	88.3	88.6	88.8	89.0	89.2	89.4	89.6	89.8	90.1	90.3	90.5	90.7
55	1931	1049	85.9	86.1	86.3	86.6	86.8	87.0	87.3	87.5	87.7	87.9	88.2	88.4	88.6	88.9	89.1	89.3	89.5	89.8	90.0	90.2	90.5	90.7
60	1988	1106	85.7	85.9	86.2	86.4	86.6	86.9	87.1	87.3	87.6	87.8	88.1	88.3	88.5	88.8	89.0	89.3	89.5	89.7	90.0	90.2	90.4	90.7
65	2175	1293	85.0	85.3	85.6	85.8	86.1	86.4	86.6	86.9	87.2	87.4	87.7	88.0	88.2	88.5	88.8	89.1	89.3	89.6	89.9	90.1	90.4	90.7
70	2286	1403	84.7	85.0	85.2	85.5	85.8	86.1	86.4	86.7	86.9	87.2	87.5	87.8	88.1	88.4	88.7	88.9	89.2	89.5	89.8	90.1	90.4	90.6
75	2446	1564	84.2	84.5	84.8	85.1	85.4	85.7	86.0	86.3	86.6	86.9	87.2	87.6	87.9	88.2	88.5	88.8	89.1	89.4	89.7	90.0	90.3	90.6
80	2696	1814	83.5	83.8	84.1	84.5	84.8	85.2	85.5	85.8	86.2	86.5	86.9	87.2	87.5	87.9	88.2	88.6	88.9	89.2	89.6	89.9	90.3	90.6
85	2843	1961	83.1	83.4	83.8	84.1	84.5	84.9	85.2	85.6	85.9	86.3	86.6	87.0	87.4	87.7	88.1	88.4	88.8	89.1	89.5	89.9	90.2	90.6
90	3085	2203	82.5	82.9	83.3	83.6	84.0	84.4	84.8	85.2	85.6	85.9	86.3	86.7	87.1	87.5	87.9	88.2	88.6	89.0	89.4	89.8	90.2	90.6
95	3586	2704	81.4	81.8	82.3	82.7	83.1	83.6	84.0	84.4	84.9	85.3	85.7	86.2	86.6	87.0	87.5	87.9	88.3	88.8	89.2	89.6	90.1	90.5
99	8750	7868	75.8	76.5	77.2	77.9	78.5	79.2	79.9	80.6	81.3	82.0	82.7	83.4	84.1	84.8	85.4	86.1	86.8	87.5	88.2	88.9	89.6	90.3
100	11309	10426	74.5	75.3	76.0	76.8	77.5	78.3	79.0	79.8	80.5	81.3	82.0	82.8	83.5	84.3	85.0	85.7	86.5	87.2	88.0	88.7	89.5	90.2

Enter mixing ratio: 0.5

🟧 < 7Q10
🟨 < 3:1 Dilution
🟧 Excursion
🟥 De-Rate

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate:	0	gpm	Number of Pumps On:	0
Unit 2 Circ Water Pump Rate:	0	gpm	Number of Pumps On:	0
Unit 3 Circ Water Pump Rate:	0	gpm	Number of Pumps On:	0
Unit 4 Circ Water Pump Rate:	132000	gpm	Number of Pumps On:	3
Calculated Circ Water flow:	882	cfs		

October: 50% Zone of Passage

Enter Circ Water discharge temp: Maximum Measured 90.9 degrees F

Proposed AEL: 90 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0	81.0	82.0	83.0	84.0	85.0	86.0	87.0	88.0	89.0	90
1	811	-71	91.8	91.8	91.7	91.7	91.7	91.6	91.6	91.5	91.5	91.4	91.4	91.4	91.3	91.3	91.2	91.2	91.1	91.1	91.1	91.0	91.0	90.9
5	1149	267	88.0	88.2	88.3	88.4	88.5	88.7	88.8	88.9	89.1	89.2	89.3	89.5	89.6	89.7	89.9	90.0	90.1	90.3	90.4	90.5	90.7	90.8
10	1240	357	87.2	87.4	87.5	87.7	87.9	88.1	88.2	88.4	88.6	88.7	88.9	89.1	89.2	89.4	89.6	89.7	89.9	90.1	90.2	90.4	90.6	90.7
7Q10	1315	433	86.6	86.8	87.0	87.2	87.4	87.6	87.8	88.0	88.2	88.4	88.6	88.8	89.0	89.1	89.3	89.5	89.7	89.9	90.1	90.3	90.5	90.7
15	1342	460	86.4	86.6	86.8	87.0	87.2	87.4	87.6	87.8	88.0	88.2	88.4	88.6	88.9	89.1	89.3	89.5	89.7	89.9	90.1	90.3	90.5	90.7
20	1443	560	85.6	85.9	86.1	86.3	86.6	86.8	87.1	87.3	87.5	87.8	88.0	88.3	88.5	88.8	89.0	89.2	89.5	89.7	90.0	90.2	90.4	90.7
25	1543	661	84.9	85.2	85.5	85.8	86.0	86.3	86.6	86.8	87.1	87.4	87.7	87.9	88.2	88.5	88.7	89.0	89.3	89.6	89.8	90.1	90.4	90.7
30	1616	733	84.5	84.8	85.1	85.4	85.6	85.9	86.2	86.5	86.8	87.1	87.4	87.7	88.0	88.3	88.6	88.9	89.2	89.5	89.8	90.0	90.3	90.6
35	1670	788	84.1	84.4	84.8	85.1	85.4	85.7	86.0	86.3	86.6	86.9	87.2	87.5	87.8	88.2	88.5	88.8	89.1	89.4	89.7	90.0	90.3	90.6
40	1754	871	83.7	84.0	84.3	84.7	85.0	85.3	85.6	86.0	86.3	86.6	87.0	87.3	87.6	88.0	88.3	88.6	88.9	89.3	89.6	89.9	90.3	90.6
45	1793	910	83.4	83.8	84.1	84.5	84.8	85.1	85.5	85.8	86.2	86.5	86.9	87.2	87.5	87.9	88.2	88.6	88.9	89.2	89.6	89.9	90.3	90.6
50	1851	969	83.1	83.5	83.8	84.2	84.6	84.9	85.3	85.6	86.0	86.3	86.7	87.0	87.4	87.7	88.1	88.5	88.8	89.2	89.5	89.9	90.2	90.6
55	1931	1049	82.7	83.1	83.5	83.9	84.2	84.6	85.0	85.3	85.7	86.1	86.5	86.8	87.2	87.6	88.0	88.3	88.7	89.1	89.4	89.8	90.2	90.6
60	1988	1106	82.5	82.8	83.2	83.6	84.0	84.4	84.8	85.2	85.5	85.9	86.3	86.7	87.1	87.5	87.9	88.2	88.6	89.0	89.4	89.8	90.2	90.6
65	2175	1293	81.6	82.1	82.5	82.9	83.3	83.8	84.2	84.6	85.0	85.4	85.9	86.3	86.7	87.1	87.6	88.0	88.4	88.8	89.3	89.7	90.1	90.5
70	2286	1403	81.2	81.6	82.1	82.5	83.0	83.4	83.9	84.3	84.7	85.2	85.6	86.1	86.5	87.0	87.4	87.8	88.3	88.7	89.2	89.6	90.1	90.5
75	2446	1564	80.6	81.1	81.5	82.0	82.5	83.0	83.4	83.9	84.4	84.8	85.3	85.8	86.2	86.7	87.2	87.7	88.1	88.6	89.1	89.5	90.0	90.5
80	2696	1814	79.8	80.3	80.8	81.3	81.8	82.3	82.8	83.3	83.9	84.4	84.9	85.4	85.9	86.4	86.9	87.4	87.9	88.4	88.9	89.4	89.9	90.4
85	2843	1961	79.4	79.9	80.4	81.0	81.5	82.0	82.5	83.1	83.6	84.1	84.6	85.2	85.7	86.2	86.7	87.3	87.8	88.3	88.8	89.4	89.9	90.4
90	3085	2203	78.7	79.3	79.9	80.4	81.0	81.5	82.1	82.6	83.2	83.7	84.3	84.8	85.4	86.0	86.5	87.1	87.6	88.2	88.7	89.3	89.8	90.4
95	3586	2704	77.6	78.3	78.9	79.5	80.1	80.7	81.3	81.9	82.5	83.1	83.7	84.3	84.9	85.5	86.1	86.7	87.3	87.9	88.5	89.1	89.8	90.4
99	8750	7868	73.0	73.8	74.6	75.5	76.3	77.1	77.9	78.7	79.5	80.4	81.2	82.0	82.8	83.6	84.4	85.3	86.1	86.9	87.7	88.5	89.3	90.2
100	11309	10426	72.2	73.0	73.9	74.7	75.6	76.4	77.3	78.2	79.0	79.9	80.7	81.6	82.4	83.3	84.1	85.0	85.9	86.7	87.6	88.4	89.3	90.1

Enter mixing ratio: 0.25

Enter Circ Water Pump Rating in gpm and number of pumps on:
Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟡 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 85.5 degrees F

November: 75% Zone of Passage
Proposed AEL: 85 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	64.0	65.0	66.0	67.0	68.0	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0	81.0	82.0	83.0	84.0	85
1	849	-34	85.7	85.7	85.7	85.7	85.7	85.7	85.6	85.6	85.6	85.6	85.6	85.6	85.6	85.6	85.6	85.6	85.6	85.5	85.5	85.5	85.5	85.5
5	948	66	85.1	85.1	85.1	85.2	85.2	85.2	85.2	85.2	85.3	85.3	85.3	85.3	85.3	85.3	85.4	85.4	85.4	85.4	85.4	85.5	85.5	85.5
10	1073	190	84.4	84.5	84.5	84.6	84.6	84.7	84.7	84.8	84.8	84.9	84.9	85.0	85.0	85.1	85.1	85.2	85.2	85.3	85.3	85.4	85.4	85.5
15	1179	296	83.8	83.9	84.0	84.1	84.1	84.2	84.3	84.4	84.5	84.5	84.6	84.7	84.8	84.8	84.9	85.0	85.1	85.2	85.2	85.3	85.4	85.5
20	1260	378	83.4	83.5	83.6	83.7	83.8	83.9	84.0	84.1	84.2	84.3	84.4	84.5	84.6	84.7	84.8	84.9	85.0	85.1	85.2	85.3	85.4	85.5
7Q10	1315	433	83.2	83.3	83.4	83.5	83.6	83.7	83.8	83.9	84.0	84.1	84.2	84.4	84.5	84.6	84.7	84.8	84.9	85.0	85.1	85.2	85.3	85.4
25	1332	449	83.1	83.2	83.3	83.4	83.5	83.6	83.7	83.9	84.0	84.1	84.2	84.3	84.4	84.5	84.7	84.8	84.9	85.0	85.1	85.2	85.3	85.4
30	1399	517	82.8	82.9	83.0	83.1	83.3	83.4	83.5	83.6	83.8	83.9	84.0	84.2	84.3	84.4	84.5	84.7	84.8	84.9	85.1	85.2	85.3	85.4
35	1453	571	82.5	82.6	82.8	82.9	83.1	83.2	83.3	83.5	83.6	83.8	83.9	84.0	84.2	84.3	84.5	84.6	84.7	84.9	85.0	85.2	85.3	85.4
40	1486	604	82.4	82.5	82.7	82.8	82.9	83.1	83.2	83.4	83.5	83.7	83.8	84.0	84.1	84.3	84.4	84.6	84.7	84.8	85.0	85.1	85.3	85.4
45	1543	661	82.1	82.3	82.4	82.6	82.7	82.9	83.1	83.2	83.4	83.5	83.7	83.8	84.0	84.2	84.3	84.5	84.6	84.8	84.9	85.1	85.3	85.4
50	1662	779	81.6	81.8	82.0	82.2	82.3	82.5	82.7	82.9	83.1	83.2	83.4	83.6	83.8	84.0	84.1	84.3	84.5	84.7	84.9	85.0	85.2	85.4
55	1776	894	81.2	81.4	81.6	81.8	82.0	82.2	82.4	82.6	82.8	83.0	83.2	83.4	83.6	83.8	84.0	84.2	84.4	84.6	84.8	85.0	85.2	85.4
60	1914	1031	80.6	80.9	81.1	81.3	81.5	81.8	82.0	82.2	82.4	82.7	82.9	83.1	83.4	83.6	83.8	84.0	84.3	84.5	84.7	84.9	85.2	85.4
65	2089	1206	80.0	80.3	80.5	80.8	81.0	81.3	81.6	81.8	82.1	82.3	82.6	82.8	83.1	83.3	83.6	83.8	84.1	84.4	84.6	84.9	85.1	85.4
70	2208	1326	79.6	79.9	80.2	80.4	80.7	81.0	81.3	81.5	81.8	82.1	82.4	82.6	82.9	83.2	83.5	83.7	84.0	84.3	84.5	84.8	85.1	85.4
75	2381	1499	79.1	79.4	79.7	80.0	80.3	80.6	80.9	81.2	81.5	81.8	82.1	82.4	82.7	83.0	83.3	83.6	83.9	84.2	84.5	84.8	85.1	85.4
80	2599	1716	78.5	78.8	79.1	79.4	79.8	80.1	80.4	80.8	81.1	81.4	81.7	82.1	82.4	82.7	83.0	83.4	83.7	84.0	84.4	84.7	85.0	85.3
85	2964	2081	77.5	77.9	78.3	78.6	79.0	79.4	79.8	80.1	80.5	80.9	81.2	81.6	82.0	82.3	82.7	83.1	83.5	83.8	84.2	84.6	84.9	85.3
90	3522	2639	76.3	76.7	77.2	77.6	78.0	78.4	78.9	79.3	79.7	80.2	80.6	81.0	81.4	81.9	82.3	82.7	83.1	83.6	84.0	84.4	84.9	85.3
95	4092	3209	75.3	75.7	76.2	76.7	77.2	77.6	78.1	78.6	79.1	79.5	80.0	80.5	81.0	81.5	81.9	82.4	82.9	83.4	83.8	84.3	84.8	85.3
99	5732	4849	73.1	73.6	74.2	74.8	75.4	76.0	76.5	77.1	77.7	78.3	78.8	79.4	80.0	80.6	81.2	81.7	82.3	82.9	83.5	84.1	84.6	85.2
100	6711	5829	72.1	72.7	73.4	74.0	74.6	75.2	75.8	76.5	77.1	77.7	78.3	79.0	79.6	80.2	80.8	81.5	82.1	82.7	83.3	83.9	84.6	85.2

Enter mixing ratio: 0.5

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate	0 gpm	Number of Pumps On:	0
Unit 2 Circ Water Pump Rate	0 gpm	Number of Pumps On:	0
Unit 3 Circ Water Pump Rate	0 gpm	Number of Pumps On:	0
Unit 4 Circ Water Pump Rate	132000 gpm	Number of Pumps On:	3
Calculated Circ Water flow:	882 cfs		

🟧 < 7Q10
🟨 < 3:1 Dilution
🟨 Excursion
🟥 De-Rate

Maximum Measured

Enter Circ Water discharge temp: 85.5 degrees F

November: 50% Zone of Passage

Proposed AEL: 85 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	64.0	65.0	66.0	67.0	68.0	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0	81.0	82.0	83.0	84.0	85
1	849	-34	85.9	85.9	85.9	85.9	85.8	85.8	85.8	85.8	85.8	85.7	85.7	85.7	85.7	85.7	85.6	85.6	85.6	85.6	85.6	85.5	85.5	85.5
5	948	66	84.7	84.8	84.8	84.8	84.9	84.9	84.9	85.0	85.0	85.1	85.1	85.1	85.2	85.2	85.2	85.3	85.3	85.3	85.4	85.4	85.4	85.5
10	1073	190	83.4	83.5	83.6	83.7	83.8	83.9	84.0	84.1	84.2	84.3	84.4	84.5	84.6	84.7	84.8	84.9	85.0	85.1	85.2	85.3	85.4	85.5
15	1179	296	82.4	82.6	82.7	82.8	83.0	83.1	83.3	83.4	83.6	83.7	83.8	84.0	84.1	84.3	84.4	84.6	84.7	84.9	85.0	85.1	85.3	85.4
20	1260	378	81.7	81.9	82.1	82.2	82.4	82.6	82.8	82.9	83.1	83.3	83.5	83.6	83.8	84.0	84.2	84.4	84.5	84.7	84.9	85.1	85.2	85.4
7Q10	1315	433	81.3	81.5	81.7	81.9	82.1	82.3	82.4	82.6	82.8	83.0	83.2	83.4	83.6	83.8	84.0	84.2	84.4	84.6	84.8	85.0	85.2	85.4
25	1332	449	81.1	81.3	81.5	81.7	81.9	82.2	82.4	82.6	82.8	83.0	83.2	83.4	83.6	83.8	84.0	84.2	84.4	84.6	84.8	85.0	85.2	85.4
30	1399	517	80.6	80.9	81.1	81.3	81.5	81.8	82.0	82.2	82.4	82.7	82.9	83.1	83.3	83.6	83.8	84.0	84.3	84.5	84.7	84.9	85.2	85.4
35	1453	571	80.2	80.5	80.7	81.0	81.2	81.5	81.7	82.0	82.2	82.4	82.7	82.9	83.2	83.4	83.7	83.9	84.2	84.4	84.6	84.9	85.1	85.4
40	1486	604	80.0	80.3	80.5	80.8	81.0	81.3	81.5	81.8	82.1	82.3	82.6	82.8	83.1	83.3	83.6	83.8	84.1	84.4	84.6	84.9	85.1	85.4
45	1543	661	79.6	79.9	80.2	80.5	80.7	81.0	81.3	81.5	81.8	82.1	82.4	82.6	82.9	83.2	83.5	83.7	84.0	84.3	84.5	84.8	85.1	85.4
50	1662	779	78.9	79.2	79.5	79.8	80.1	80.4	80.8	81.1	81.4	81.7	82.0	82.3	82.6	82.9	83.2	83.5	83.8	84.1	84.4	84.7	85.0	85.3
55	1776	894	78.3	78.6	78.9	79.3	79.6	80.0	80.3	80.6	81.0	81.3	81.6	82.0	82.3	82.6	83.0	83.3	83.7	84.0	84.3	84.7	85.0	85.3
60	1914	1031	77.6	77.9	78.3	78.7	79.0	79.4	79.8	80.2	80.5	80.9	81.3	81.6	82.0	82.4	82.7	83.1	83.5	83.8	84.2	84.6	84.9	85.3
65	2089	1206	76.8	77.2	77.6	78.0	78.4	78.8	79.2	79.6	80.0	80.4	80.8	81.2	81.6	82.0	82.5	82.9	83.3	83.7	84.1	84.5	84.9	85.3
70	2208	1326	76.3	76.7	77.1	77.6	78.0	78.4	78.8	79.3	79.7	80.1	80.6	81.0	81.4	81.9	82.3	82.7	83.1	83.6	84.0	84.4	84.9	85.3
75	2381	1499	75.6	76.1	76.5	77.0	77.5	77.9	78.4	78.8	79.3	79.8	80.2	80.7	81.1	81.6	82.1	82.5	83.0	83.4	83.9	84.4	84.8	85.3
80	2599	1716	74.9	75.4	75.9	76.4	76.9	77.4	77.9	78.4	78.8	79.3	79.8	80.3	80.8	81.3	81.8	82.3	82.8	83.3	83.8	84.3	84.8	85.3
85	2964	2081	73.9	74.4	74.9	75.5	76.0	76.6	77.1	77.7	78.2	78.7	79.3	79.8	80.4	80.9	81.4	82.0	82.5	83.1	83.6	84.1	84.7	85.2
90	3522	2639	72.6	73.2	73.8	74.4	75.0	75.6	76.2	76.8	77.4	78.0	78.6	79.2	79.8	80.4	81.0	81.6	82.2	82.8	83.4	84.0	84.6	85.2
95	4092	3209	71.6	72.3	72.9	73.6	74.2	74.9	75.5	76.1	76.8	77.4	78.1	78.7	79.4	80.0	80.7	81.3	82.0	82.6	83.2	83.9	84.5	85.2
99	5732	4849	69.7	70.5	71.2	71.9	72.7	73.4	74.1	74.9	75.6	76.3	77.1	77.8	78.5	79.3	80.0	80.7	81.5	82.2	82.9	83.7	84.4	85.1
100	6711	5829	69.0	69.8	70.5	71.3	72.1	72.8	73.6	74.4	75.1	75.9	76.7	77.4	78.2	79.0	79.7	80.5	81.3	82.0	82.8	83.6	84.3	85.1

Enter mixing ratio: 0.25

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

▨ < 7Q10
▨ < 3:1 Dilution
▨ Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 78 degrees F

December: 75% Zone of Passage
Proposed AEL: 75 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1	882	0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
5	1110	228	76.5	76.6	76.7	76.7	76.8	76.8	76.9	77.0	77.0	77.1	77.2	77.2	77.3	77.3	77.4	77.5	77.5	77.6	77.6	77.7	77.8	77.8
10	1192	310	76.1	76.1	76.2	76.3	76.4	76.5	76.5	76.6	76.7	76.8	76.9	76.9	77.0	77.1	77.2	77.3	77.4	77.4	77.5	77.6	77.7	77.8
15	1242	360	75.8	75.9	76.0	76.1	76.1	76.2	76.3	76.4	76.5	76.6	76.7	76.8	76.9	77.0	77.1	77.2	77.3	77.4	77.4	77.5	77.6	77.7
7Q10	1315	433	75.4	75.5	75.6	75.7	75.8	75.9	76.0	76.1	76.3	76.4	76.5	76.6	76.7	76.8	76.9	77.0	77.1	77.2	77.3	77.5	77.6	77.7
20	1328	446	75.3	75.4	75.5	75.6	75.8	75.9	76.0	76.1	76.2	76.3	76.4	76.5	76.7	76.8	76.9	77.0	77.1	77.2	77.3	77.4	77.6	77.7
25	1382	500	75.0	75.1	75.3	75.4	75.5	75.6	75.8	75.9	76.0	76.1	76.3	76.4	76.5	76.6	76.8	76.9	77.0	77.1	77.3	77.4	77.5	77.6
30	1412	530	74.9	75.0	75.1	75.3	75.4	75.5	75.7	75.8	75.9	76.0	76.2	76.3	76.4	76.6	76.7	76.8	77.0	77.1	77.2	77.3	77.5	77.6
35	1467	585	74.6	74.7	74.9	75.0	75.2	75.3	75.4	75.6	75.7	75.9	76.0	76.2	76.3	76.4	76.6	76.7	76.9	77.0	77.1	77.3	77.4	77.6
40	1524	642	74.3	74.5	74.6	74.8	74.9	75.1	75.2	75.4	75.5	75.7	75.8	76.0	76.2	76.3	76.5	76.6	76.8	76.9	77.1	77.2	77.4	77.5
45	1567	685	74.1	74.3	74.4	74.6	74.8	74.9	75.1	75.2	75.4	75.6	75.7	75.9	76.1	76.2	76.4	76.5	76.7	76.9	77.0	77.2	77.4	77.5
50	1607	724	73.9	74.1	74.3	74.4	74.6	74.8	74.9	75.1	75.3	75.4	75.6	75.8	76.0	76.1	76.3	76.5	76.6	76.8	77.0	77.1	77.3	77.5
55	1699	816	73.5	73.7	73.9	74.1	74.2	74.4	74.6	74.8	75.0	75.2	75.4	75.6	75.7	75.9	76.1	76.3	76.5	76.7	76.9	77.1	77.2	77.4
60	1772	890	73.2	73.4	73.6	73.8	74.0	74.2	74.4	74.6	74.8	75.0	75.2	75.4	75.6	75.8	76.0	76.2	76.4	76.6	76.8	77.0	77.2	77.4
65	1892	1010	72.7	72.9	73.1	73.3	73.6	73.8	74.0	74.2	74.4	74.7	74.9	75.1	75.3	75.6	75.8	76.0	76.2	76.4	76.7	76.9	77.1	77.3
70	2002	1119	72.2	72.5	72.7	72.9	73.2	73.4	73.7	73.9	74.1	74.4	74.6	74.9	75.1	75.4	75.6	75.8	76.1	76.3	76.6	76.8	77.0	77.3
75	2243	1361	71.3	71.6	71.9	72.2	72.4	72.7	73.0	73.3	73.5	73.8	74.1	74.4	74.7	74.9	75.2	75.5	75.8	76.1	76.3	76.6	76.9	77.2
80	2655	1772	70.0	70.3	70.6	71.0	71.3	71.6	72.0	72.3	72.7	73.0	73.3	73.7	74.0	74.3	74.7	75.0	75.3	75.7	76.0	76.3	76.7	77.0
85	3359	2477	68.1	68.5	68.9	69.3	69.8	70.2	70.6	71.0	71.4	71.8	72.2	72.6	73.1	73.5	73.9	74.3	74.7	75.1	75.5	75.9	76.4	76.8
90	3906	3024	66.9	67.4	67.8	68.3	68.8	69.2	69.7	70.2	70.6	71.1	71.5	72.0	72.5	72.9	73.4	73.8	74.3	74.8	75.2	75.7	76.2	76.6
95	4874	3992	65.3	65.8	66.3	66.9	67.4	67.9	68.4	69.0	69.5	70.0	70.6	71.1	71.6	72.2	72.7	73.2	73.8	74.3	74.8	75.3	75.9	76.4
99	6637	5755	63.1	63.7	64.4	65.0	65.6	66.2	66.8	67.5	68.1	68.7	69.3	69.9	70.6	71.2	71.8	72.4	73.0	73.7	74.3	74.9	75.5	76.1
100	9310	8427	61.1	61.8	62.5	63.2	63.9	64.6	65.3	66.0	66.7	67.4	68.1	68.8	69.5	70.2	71.0	71.7	72.4	73.1	73.8	74.5	75.2	75.9

Enter mixing ratio: 0.5

Enter Circ Water Pump Rating in gpm and number of pumps on:

Unit 1 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 2 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 3 Circ Water Pump Rate: 0 gpm Number of Pumps On: 0
Unit 4 Circ Water Pump Rate: 132000 gpm Number of Pumps On: 3
Calculated Circ Water flow: 882 cfs

🟧 < 7Q10
🟨 < 3:1 Dilution
🟡 Excursion
🟥 De-Rate

Maximum Measured
Enter Circ Water discharge temp: 78 degrees F

December: 50% Zone of Passage
Proposed AEL: 75 degrees F

			Intake Temperature (°F)																					
Percentile	CSSC Flow	Available Flow	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1	882	0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
5	1110	228	75.3	75.4	75.5	75.6	75.7	75.8	75.9	76.1	76.2	76.3	76.4	76.5	76.6	76.7	76.9	77.0	77.1	77.2	77.3	77.4	77.5	77.7
10	1192	310	74.4	74.6	74.7	74.9	75.0	75.2	75.3	75.5	75.6	75.8	75.9	76.1	76.2	76.4	76.5	76.7	76.8	77.0	77.1	77.3	77.4	77.6
15	1242	360	73.9	74.1	74.3	74.4	74.6	74.8	75.0	75.1	75.3	75.5	75.6	75.8	76.0	76.1	76.3	76.5	76.6	76.8	77.0	77.2	77.3	77.5
7Q10	1315	433	73.3	73.5	73.7	73.9	74.1	74.3	74.5	74.7	74.8	75.0	75.2	75.4	75.6	75.8	76.0	76.2	76.4	76.6	76.8	77.0	77.2	77.4
20	1328	446	73.2	73.4	73.6	73.8	74.0	74.2	74.4	74.6	74.8	75.0	75.2	75.4	75.6	75.8	76.0	76.2	76.4	76.6	76.8	77.0	77.2	77.4
25	1382	500	72.7	72.9	73.1	73.4	73.6	73.8	74.0	74.2	74.5	74.7	74.9	75.1	75.4	75.6	75.8	76.0	76.2	76.5	76.7	76.9	77.1	77.3
30	1412	530	72.5	72.7	72.9	73.2	73.4	73.6	73.8	74.1	74.3	74.5	74.8	75.0	75.2	75.5	75.7	75.9	76.2	76.4	76.6	76.8	77.1	77.3
35	1467	585	72.0	72.3	72.5	72.8	73.0	73.3	73.5	73.8	74.0	74.3	74.5	74.8	75.0	75.3	75.5	75.8	76.0	76.3	76.5	76.8	77.0	77.3
40	1524	642	71.6	71.9	72.1	72.4	72.7	72.9	73.2	73.5	73.7	74.0	74.3	74.5	74.8	75.1	75.3	75.6	75.9	76.1	76.4	76.7	76.9	77.2
45	1567	685	71.3	71.6	71.8	72.1	72.4	72.7	73.0	73.2	73.5	73.8	74.1	74.4	74.6	74.9	75.2	75.5	75.8	76.0	76.3	76.6	76.9	77.2
50	1607	724	71.0	71.3	71.6	71.9	72.2	72.5	72.8	73.1	73.3	73.6	73.9	74.2	74.5	74.8	75.1	75.4	75.7	76.0	76.3	76.5	76.8	77.1
55	1699	816	70.4	70.7	71.0	71.4	71.7	72.0	72.3	72.6	72.9	73.3	73.6	73.9	74.2	74.5	74.8	75.2	75.5	75.8	76.1	76.4	76.7	77.1
60	1772	890	70.0	70.3	70.6	71.0	71.3	71.6	72.0	72.3	72.6	73.0	73.3	73.6	74.0	74.3	74.6	75.0	75.3	75.7	76.0	76.3	76.7	77.0
65	1892	1010	69.3	69.6	70.0	70.4	70.7	71.1	71.4	71.8	72.2	72.5	72.9	73.3	73.6	74.0	74.4	74.7	75.1	75.5	75.8	76.2	76.5	76.9
70	2002	1119	68.7	69.1	69.5	69.8	70.2	70.6	71.0	71.4	71.8	72.2	72.6	73.0	73.3	73.7	74.1	74.5	74.9	75.3	75.7	76.1	76.4	76.8
75	2243	1361	67.5	68.0	68.4	68.9	69.3	69.7	70.2	70.6	71.0	71.5	71.9	72.3	72.8	73.2	73.6	74.1	74.5	75.0	75.4	75.8	76.3	76.7
80	2655	1772	66.0	66.5	67.0	67.5	68.0	68.5	69.0	69.5	70.0	70.5	71.0	71.5	72.0	72.5	73.0	73.5	74.0	74.5	75.0	75.5	76.0	76.5
85	3359	2477	64.0	64.6	65.2	65.7	66.3	66.9	67.5	68.1	68.7	69.2	69.8	70.4	71.0	71.6	72.2	72.7	73.3	73.9	74.5	75.1	75.7	76.2
90	3906	3024	62.8	63.5	64.1	64.7	65.4	66.0	66.6	67.3	67.9	68.5	69.2	69.8	70.4	71.1	71.7	72.3	72.9	73.6	74.2	74.8	75.5	76.1
95	4874	3992	61.4	62.1	62.7	63.4	64.1	64.8	65.5	66.2	66.9	67.6	68.3	69.0	69.7	70.4	71.1	71.8	72.5	73.1	73.8	74.5	75.2	75.9
99	6637	5755	59.6	60.4	61.2	61.9	62.7	63.5	64.2	65.0	65.8	66.5	67.3	68.1	68.8	69.6	70.3	71.1	71.9	72.6	73.4	74.2	74.9	75.7
100	9310	8427	58.2	59.0	59.8	60.6	61.5	62.3	63.1	63.9	64.8	65.6	66.4	67.3	68.1	68.9	69.7	70.6	71.4	72.2	73.0	73.9	74.7	75.5