TENTATIVE DECISION TO GRANT A VARIANCE ESTABLISHING ALTERNATIVE EFFLUENT LIMITATIONS FOR GASIFICATION WASTEWATER

In the matter of:

Fundamentally Different Factors Variance Application for the Duke Energy Indiana, LLC Edwardsport IGCC Station

I. SUMMARY

In a letter dated April 27, 2016, Duke Energy Indiana, LLC (Duke Energy), which owns and operates the Edwardsport Integrated Gasification Combined Cycle (IGCC) Station (Edwardsport), submitted a request for a fundamentally different factors (FDF) variance from the effluent limitations specified for certain parameters in Title 40 of the Code of Federal Regulations (40 CFR) 423.13(j)(1)(i) for gasification wastewater. EPA published effluent limitations guidelines and standards (ELGs) for the Steam Electric Power Generating Point Source Category on November 3, 2015 (80 FR 67838). Duke Energy submitted the FDF variance request to the U.S. EPA and the Indiana Department of Environmental Management (IDEM) on April 27, 2016, within the time frame specified by Clean Water Act (CWA) §301(n)(2) and 40 CFR 122.21(m)(1).

EPA is proposing to grant a variance from the effluent limitations for mercury and total dissolved solids (TDS) for gasification wastewater at Edwardsport because Duke Energy's request satisfies the criteria in CWA §301(n) and 40 CFR 125.31. Specifically, EPA finds that the operation of vapor scrubbers and a barometric condenser at the Edwardsport IGCC plant is a fundamentally different factor not accounted for during the development of the effluent guidelines. In its application for a variance, Duke Energy requested alternative effluent limitations for discharges of arsenic, mercury, and TDS in gasification wastewater. Duke Energy did not request alternative limits for other parameters regulated by 40 CFR 423.13, nor for other wastestreams regulated by 40 CFR Part 423. EPA is proposing a variance that would establish the following alternative effluent limitations for mercury and TDS in discharges of gasification wastewater:

Mercury, total:

Daily Maximum Effluent Limitation:	28 ng/L
Monthly Average Effluent Limitation:	11 ng/L

TDS:

Daily Maximum Effluent Limitation:	82 mg/L
Monthly Average Effluent Limitation:	38 mg/L

Based on a thorough evaluation of Duke Energy's application and effluent data collected by Edwardsport since commencing operation, EPA is proposing not to establish alternative effluent limitations for arsenic, because all applicable data reflecting normal operation of the gasification system demonstrate compliance with the ELG limitations at 40 CFR 423.13. Although the ELG for gasification wastewater also includes limits for selenium, Duke Energy did not request alternative limitations for that pollutant. Thus, the BAT effluent limitations for arsenic and selenium at 40 CFR 423.13(j)(1)(i) would continue to apply to discharges of gasification wastewater at Edwardsport. These effluent limitations are:

Arsenic, total:

Daily Maximum Effluent Limitation:	4 ug/L

Selenium, total:

Daily Maximum Effluent Limitation:	453 ug/L
Monthly Average Effluent Limitation:	227 ug/L

BPT effluent limitations for total suspended solids (TSS) and oil and grease at 40 CFR 423.12(b)(11) also continue to apply to discharges of gasification wastewater at Edwardsport.

This document summarizes the statutory requirements and federal regulations with respect to FDF variances, describes the purported basis for Duke Energy's request, describes the data and analyses supporting EPA's proposed variance establishing alternative effluent limitations for mercury and TDS, and explains EPA's proposed denial of alternative effluent limitations for arsenic.

2. BACKGROUND

2.1 Effluent Limitations Guidelines and Standards (ELGs)

Congress, through the 1972 amendments to the Federal Water Pollution Control Act (the CWA), directed EPA to promulgate ELGs that reflect pollutant reductions achievable by categories or subcategories of industrial point sources through the implementation of available pollutant control and prevention technologies. ELGs are based on specific technologies (including process changes) that EPA identifies as meeting the statutorily prescribed level of control (see CWA §301(b)(2), §304(b), §306, §307(b), and §307(c)). Unlike water quality-based CWA pollution control criteria, ELGs are national in scope and establish pollutant control requirements for all facilities that discharge wastewater within an industrial category or subcategory. In establishing these controls, EPA assesses: (1) the performance and availability of the pollutant control technologies or prevention practices for an industrial category or subcategory; (2) the economic achievability of those technologies, which can include consideration of the affordability of achieving the reduction in pollutant discharge; (3) the cost of achieving effluent reductions; (4) non-water quality environmental impacts (including energy requirements); and (5) such other factors as the EPA Administrator deems appropriate (CWA §304(b)(2)(B)). The limitations for direct dischargers are incorporated into National Pollutant Discharge Elimination System (NPDES) permits issued by States, Tribes, and EPA regional offices under §402 of the CWA. The standards for indirect dischargers are authorized through local pretreatment programs under §307 of the CWA.

On November 3, 2015, EPA published ELGs for the Steam Electric Power Generating Point Source Category (80 FR 67838). The revised regulation establishes new or additional requirements for wastestreams from the following processes and byproducts at existing sources: flue gas desulfurization (FGD), fly ash, bottom ash, flue gas mercury control, and gasification of fuels such as coal and petroleum coke. The regulation specifically establishes limitations and standards for arsenic, mercury, selenium, and TDS applicable to discharges of gasification wastewater (as defined in 40 CFR 423.11(q)).

2.2 FDF Variances

The CWA requires application of national effluent limitations or categorical pretreatment standards established pursuant to CWA §301 to all direct and indirect dischargers. However, the statute provides for alternative requirements from these national requirements in limited circumstances. Under CWA §301(n), the Agency may establish, with the concurrence of the state, an alternative requirement under §304(b)(2) or §307(b) of the CWA for a facility if that facility is fundamentally different with respect to factors (other than cost) specified in CWA §304(b) or §304(g) and considered by the Administrator in establishing such national effluent limitation guidelines or categorical pretreatment standards. Such an alternative requirement is known as an FDF variance. Under CWA §301(n)(1)(B), the FDF variance application must be based: (1) solely on information and supporting data submitted to the Administrator during the rulemaking for establishment of the applicable national effluent limitation guidelines or categorical pretreatment standards specifically raising the factors that are fundamentally different for such facility; or (2) on information and supporting data referred to in clause (1) and information and supporting data the applicant did not have a reasonable opportunity to submit during such rulemaking.

EPA regulations at 40 CFR Parts 124 and 125 and 40 CFR 403.13 contain provisions authorizing the Administrator to establish alternative limitations to those contained in the ELGs. The provisions explicitly authorize modification of the otherwise applicable Best Available Technology Economically Achievable (BAT) effluent limitations or pretreatment standards, if a discharger's facilities, equipment, processes or other factors related to the discharger are fundamentally different from the factors considered by EPA in development of the national limits (see 40 CFR 125.30(a)).

EPA regulations at 40 CFR 125.31 further detail the substantive criteria used to evaluate FDF variance requests for direct dischargers. EPA applied these criteria during its evaluation of Duke Energy's FDF variance request. Alternative limitations are appropriate when factors relating to the discharger's facilities, equipment, processes or other factors related to the discharger are fundamentally different from the factors considered by EPA in development of the national limits (see 40 CFR 125.30(a)). In determining whether factors concerning the discharger are fundamentally different, EPA will consider, where relevant, the applicable development document for the national limits, associated technical and economic data collected for use in developing each respective national limit, records of legal proceedings, and written and printed documentation including records of communication relevant to the development of respective limits which are kept on public file by EPA (see comment at 40 CFR 125.31(d)(1)).

Under 40 CFR 125.31(a), EPA may establish alternative limitations if: (1) there is an applicable national limit which is applied in the permit and specifically controls the pollutant for which alternative effluent limitations or standards have been requested; (2) factors relating to the discharge controlled by the permit are fundamentally different from those considered by EPA in establishing the national limits; and (3) the request for alternative effluent limitations or standards is made in accordance with the procedural requirements of 40 CFR Part 124. Under 40

CFR 125.31(b), and consistent with CWA §§301(n)(1)(C) and (D), a request for the establishment of effluent limitations less stringent than those required by the national ELGs shall only be approved if:

1) The alternative effluent limitation or standard requested is no less stringent than justified by the fundamental difference; and
2) The alternative effluent limitation or standard will ensure compliance with §208(e) and §301(b)(1)(C) of the CWA; and
3) Compliance with the national limits (either by using the technologies upon which the ELGs are based or by other control alternatives) would result in:
    i. A removal cost wholly out of proportion to the removal cost considered during development of the national limits; or
    ii. A non-water quality environmental impact (including energy requirements) fundamentally more adverse than the impact considered during the development of the national standards.

The burden is on the applicant requesting the variance to explain that the facility is fundamentally different with respect to the factors EPA considered in establishing the national limits, the alternative limitations requested are justified by the alleged fundamental difference, and the appropriate requirements of the statute and federal regulations have been met (see 40 CFR 125.32). Other provisions relating to application deadlines and procedures for processing variances are contained in 40 CFR 122.21(m) and Part 124 Subpart D.

3. EDWARDSPORT IGCC STATION

3.1 Plant Description

Edwardsport is an IGCC electric power generating plant located at 15424 East State Road 358, Edwardsport, Indiana. The IGCC unit consists of two parallel gasification/power generation trains. Both gasifiers are oxygen-blown, coal slurry-fed, refractory-lined, and accompanied by a radiant syngas cooler (RSC) for heat recovery. Each gasification train produces syngas to fuel a combustion turbine, which can also be fueled by natural gas. Saturated steam generated in the RSCs and additional flash tanks used to cool the quench water from the RSCs is transferred to a steam turbine to generate additional power. The plant also operates a heat recovery steam generator (HRSG) that uses the hot combusted syngas to heat water into steam. The steam generated in the HRSG is also sent to the steam turbine to generate additional power. The IGCC plant has a total net capacity of 618 megawatts (MW) and is primarily fueled by Illinois Basin coal. The plant utilizes a gasification technology under license from General Electric and began commercial operation in June 2013 [Duke Energy, 2016; ERG, 2013].

Gasification wastewater ("grey water") is generated by the process during the initial cooling and cleaning of raw syngas from the gasifiers and associated RSCs. Raw syngas is cooled and cleaned prior to use as a fuel in the combustion turbines (where the volume of gas is less and the contaminant concentrations are higher compared to the raw syngas, resulting in higher removal efficiencies). The initial cooling of syngas occurs as quench water ("black water") is brought into direct contact with raw syngas in the RSCs. Quench water leaving the

RSCs is treated to remove the solid particulates from the wastestream. After the solids are removed, some of the grey water is transferred back to the RSCs and used as quench water to scrub the raw syngas. However, Edwardsport continually blows down a portion of the grey water from the grey water holding tank to maintain dissolved solids; this blowdown is the influent to the grey water treatment system (GWTS).

Edwardsport utilizes a complex GWTS designed to remove contaminants from the wastestream (e.g., ammonium chloride, formate, and trace levels of metals). A diagram of the Edwardsport GWTS is included in Attachment 1.[1] The following is a description of the grey water treatment process operations, as described by Duke Energy [Duke Energy, 2016]:

> *The grey water from Edwardsport IGCC's gasification process is first run through a mechanical vapor recompression (MVR) concentrator system.[2] The vapor produced by the concentrator is scrubbed, sent through two sequential compressor units, and then condensed in a forced circulation heat exchanger and the condensate is routed through additional cooling units to the RO feed tank. Uncondensed vapor from the heat exchanger is routed to a barometric condenser.*
>
> *The concentrated brine liquid from the MVR concentrator is blown down to a CoLD® crystallizer employing forced circulation. Brine concentrate slurry from the crystallizer is pumped to a pressure filter for dewatering of solids prior to disposal. Filtrate is recycled back to the crystallizer.*
>
> *Vapor generated by the CoLD® crystallizer is scrubbed prior to being piped to an air-cooled condenser. Spent scrubber water from both the MVR scrubber and the CoLD® crystallizer scrubber is recycled for reuse in the respective scrubbers. Blowdown from the two scrubbers is pumped to a second crystallizer, the Formate Crystallizer, for further concentration. The concentrated slurry from this second crystallizer is dewatered in a pressure filter and the filter cake is disposed and filtrate is returned to the crystallizer. Vapor produced by the Formate Crystallizer is also routed to the air-cooled condenser, along with the scrubbed vapor from the CoLD® crystallizer. Uncondensed vapor from the air-cooled condenser is conveyed to the barometric condenser where it combines with uncondensed vapor from the MVR concentrator's heat exchanger. Condensate streams from the air-cooled condenser and from the barometric condenser are routed to the RO feed tank along with the condensate stream from the MVR concentrator's heat exchanger.*
>
> *The combined condensate stream is then processed through the two-stage RO system. The reject from the first stage of the RO system is recycled to the input to the MVR concentrator. The RO permeate is routed through tankage for an unused cyanide destruction system to the final effluent point from the grey water treatment system. This treated stream is then reused in the gasification process cooling system to reduce demand*

---

[1] The diagram presented in Attachment 1 was submitted as part of Appendix 2 (Duke Energy Technical Memorandum on Edwardsport IGCC – Fundamentally Different Factors Request (April 2016)) of Duke Energy's request for an FDF variance.

[2] A second MVR concentrator can be brought online to supplement the first concentrator when high chloride levels in the grey water require the blowdown of grey water at a rate exceeding the capacity of a single concentrator.

for makeup water or discharged to the final settling ponds for additional polishing and discharge. Non-condensable gases exiting the barometric condenser are routed to the Sulfur Recovery Unit.

As noted in the GWTS process description, most of the effluent from the GWTS is recycled back to the recirculating gasification process cooling water system as makeup water. However, under certain circumstances, the effluent can be routed to settling ponds for additional polishing prior to commingling with other waste streams and ultimate discharge from Outfall 002 to the West Fork of the White River [Duke Energy, 2016].

Duke Energy, which owns and operates Edwardsport, holds an NPDES permit that authorizes Edwardsport to directly discharge treated effluent and specifies the effluent limitations Edwardsport is required to meet. This NPDES permit (IN0002780), issued by IDEM on March 30, 2016, incorporates the BAT effluent limitations for gasification wastewater established by the most recent ELG revisions, including limits for arsenic, mercury, selenium, and TDS. The BAT limitations are applied directly to the output of Edwardsport's GWTS at a designated internal outfall [Duke Energy, 2016]. However, the new BAT effluent limitations do not go into effect until April 1, 2021. From April 1, 2016 through March 31, 2021, Edwardsport is only required to monitor and report the arsenic, mercury, selenium, and TDS concentrations twice per month.

3.2 **<u>FDF Variance Request</u>**

In a letter dated April 27, 2016, Duke Energy submitted an FDF variance request to EPA and IDEM seeking alternative effluent limitations from those established for the Steam Electric Power Generating Point Source Category. Specifically, Duke Energy requested the following alternative BAT effluent limitations for arsenic, mercury, and TDS in treated gasification wastewater:

Arsenic, total:	
Daily Maximum Effluent Limitation:	8.0 μg/L
Mercury, total:	
Daily Maximum Effluent Limitation:	30.0 ng/L
Monthly Average Effluent Limitation:	12.4 ng/L
TDS:	
Daily Maximum Effluent Limitation:	78 mg/L
Monthly Average Effluent Limitation:	36 mg/L

The otherwise applicable BAT limitations for arsenic, mercury, and TDS in gasification wastewater are listed at 40 CFR 423.13(j)(1)(i) and are:[3]

[3] In accordance with 40 CFR 423.13(j)(1)(i), the quantity of pollutants in gasification wastewater shall not exceed the quantity determined by multiplying the flow of gasification wastewater times the concentrations listed. Dischargers are required to meet the effluent limitations for gasification wastewater by a date determined by the permitting authority that is as soon as possible beginning November 1, 2018, but no later than December 31, 2023.

Arsenic, total:

Daily Maximum Effluent Limitation:	4.0 µg/L
Monthly Average Effluent Limitation:	---

Mercury, total:

Daily Maximum Effluent Limitation:	1.8 ng/L
Monthly Average Effluent Limitation:	1.3 ng/L

TDS:

Daily Maximum Effluent Limitation:	38 mg/L
Monthly Average Effluent Limitation:	22 mg/L

Duke Energy requested the alternative effluent limitations, claiming that the nature of the fuel and the engineering aspects of the design and configuration of both the IGCC process and GWTS at Edwardsport are fundamentally different from the systems used by EPA to establish the BAT effluent limitations for the final rule, Tampa Electric Company's Polk IGCC Power Station (Polk) and Wabash River IGCC Repowering Plant (Wabash) (see Section 3 of Duke Energy's FDF Request for more information). Therefore, Duke Energy claims that the gasification wastewater characteristics at Edwardsport are also fundamentally different from the gasification wastewater characteristics EPA considered during the rulemaking. Specifically, and as described in more detail below in Sections 3.2.1 through 3.3.3, Duke Energy's asserted bases for claiming Edwardsport is fundamentally different include [Duke Energy, 2016]:

- *The higher content of ash, chlorine and mercury in coal used to fuel the Edwardsport IGCC as compared to fuel used by Polk Station are fundamental differences resulting in higher pollutant loadings of mercury and TDS in Edwardsport IGCC's grey water. The same is suspected regarding fuel used at Wabash but Duke Energy was unable to obtain fuel analyses for Wabash.*
- *The greater contact of grey water and its precursor, black water, with raw syngas in the initial syngas cooling and cleaning processes at Edwardsport IGCC, as compared to Polk Station, is a fundamental difference resulting in higher pollutant loadings of mercury and TDS in Edwardsport IGCC's grey water.*
- *The inclusion in Edwardsport IGCC's grey water treatment system of scrubbers for vapors produced by the initial MVR evaporator and the CoLD crystallizer, which will extract more contaminants from those vapor streams prior to being condensed, in contrast to Polk Station and Wabash, is a fundamental difference affecting the pollutant loading in the condensates resulting from the evaporative processes employed to treat grey water.*
- *The inclusion in the Edwardsport IGCC's grey water treatment system of a second crystallizer (the Formate crystallizer) will result in further concentration of contaminants in the spent scrubber water from the two scrubbers for eventual disposal. However, use of this Formate crystallizer may, at the same time, provide another opportunity for more volatile contaminants, such as mercury, to be volatilized as constituents of the vapor stream produced by this crystallizer. These differences from the Polk and Wabash's treatment systems are fundamental differences affecting the pollutant loadings in the vapor streams prior to the condensing units.*

- *The inclusion in the Edwardsport IGCC's grey water treatment system of a secondary, barometric condenser to extract even more potential condensable substances from the vapor streams resulting from the various evaporative units of the grey water treatment system appears to be a source of increased mercury loading to the final combined condensate stream that is the input to the RO system. This is a fundamental difference affecting the pollutant loadings in the combined condensate stream resulting from the evaporative processes used for grey water treatment.*
- *Polk manages and utilizes the condensate stream from its initial falling film evaporator separately from the condensate from the crystallizer, while Edwardsport IGCC, in marked contrast, combines condensate streams from its initial MVR evaporator, its two crystallizers, and the barometric condenser into a single intermixed condensate stream that is sent to the RO units for final treatment prior to reuse or discharge. This difference in the manner in which Polk Station and Edwardsport IGCC configure the various condensate streams as outputs from their respective grey water treatment systems, is a fundamental difference in the engineering of the respective grey water treatment systems that affects the composition and final effluent quality for Gasification Wastewater produced by each facility.*

Duke Energy asserted that these purported fundamental differences between Edwardsport and the other IGCC systems evaluated by EPA for the rule result in significantly higher mercury and TDS concentrations in the effluent. Thus, "Duke Energy anticipates that it would be required to incur significant additional capital costs to retrofit supplemental treatment equipment in its existing grey water treatment system to achieve capability to comply with the ELG limits for mercury and TDS in Gasification Wastewater." Furthermore, Duke Energy states that "such additional costs would be wholly disproportionate to the capital costs – *i.e.*, zero – considered by EPA as required for compliance with the Gasification Wastewater ELGs in the Steam Electric ELG rulemaking" [Duke Energy, 2016]. The general arguments and assertions presented in Duke Energy's application for an FDF variance are summarized in the remainder of this section.

3.2.1 Fuels Used in the Gasification Process

In Section 5.2 of the application, Duke Energy asserts that the type and source of fuel used by an IGCC facility can impact operations, efficiencies, byproducts, wastes, and costs associated with these factors.

In Table 5-2 of the variance application, Duke Energy presents data purporting to show that the fuel utilized by Edwardsport has higher ash, chlorine, and mercury content than the fuels utilized by Polk.[4] Duke Energy claims that these differences in fuel composition will result in differences in pollutant content and volume of gasification waters between the two IGCC systems. Specifically, Duke Energy asserts the following [Duke Energy, 2016]:

[4] "Although Duke Energy did not locate fuel analyses for Wabash near the time of sampling for the ELG development, a report of testing of pet coke by Wabash in November 1997 indicates the pet coke used in the test exhibited very low ash content - less than 1% dry weight. Such fuel would be very low in ash content as compared to the coal used by Edwardsport" [Duke Energy, 2016].

- *Edwardsport will generate around 2.5 times more ash than Polk per ton of fuel gasified by each facility when Edwardsport uses high sulfur coal. Even with medium sulfur coal, Edwardsport IGCC will produce slightly more than twice the ash produced by Polk for each ton of fuel gasified by each facility… The increase in ash content directly impacts slag and grey water operations… Given the significantly higher rate of ash generated by Edwardsport IGCC's operation due to its different fuel, Edwardsport will incur higher content of particulate solids and dissolved solids in its grey water in comparison to Polk Station.*
- *The chlorine content in Edwardsport's fuel (for high sulfur) of 0.04 percent by dry weight, is twice Polk's fuel content of 0.02 percent by dry weight… However, given that Edwardsport's chloride concentration target for its grey water treatment system is only 71% of that for the Polk treatment system, the Edwardsport recirculating grey water system will need to blow down to the treatment system at an even higher rate, compared to Polk, than would be indicated by the 86% greater chlorine content of the Edwardsport fuel. Consequently, even if the Polk and Edwardsport IGCC facilities were designed to process fuel at the same rate, the Edwardsport IGCC would be expected to generate grey water for treatment at roughly twice the rate as Polk.*
- *The higher mercury content in Edwardsport's fuel (for high sulfur coal) of 0.126 ppm on a dry weight basis, is more than four times that of Polk's fuel of 0.03 ppm… When the difference in moisture content of the respective fuels is taken into account, it is seen that the gasification of Edwardsport's high sulfur coal will release 3.9 times more mercury (0.098 g) per ton of fuel than will the Polk fuel (0.025 g).*

3.2.2 Preliminary Cooling and Cleaning of Syngas

In Section 5.3 of its FDF variance request, Duke Energy states Edwardsport is fundamentally different from Polk with respect to the approach used by each facility to accomplish the preliminary cooling and cleaning of raw syngas, and that these differences are likely to affect the quality of the grey water generated at each facility. Specifically, Duke Energy asserts that Edwardsport's "syngas cleaning process involves considerably more direct contact of water with the syngas stream than does that used at Polk Station and, as a result, captures a greater amount of fine fly ash from the gas stream" [Duke Energy, 2016]. Edwardsport utilizes water to quench the raw syngas in the RSCs. Some of this quench water accumulating in the bottom of the gasifiers/RSCs ("black water") is used to transport slag from the bottom of the gasifier and is then routed to a solids settler. Overflow from this solid settler is considered grey water and is routed to the grey water tank. In contrast, Polk utilizes a non-contact heat exchanger to remove heat from the syngas, instead of a water quench. Thus, there is no contact by the syngas with a water stream during the cooling and initial cooling (i.e., prior to the scrubber) process. Duke Energy points out that the syngas cooling process in place at Wabash "appears to resemble Edwardsport IGCC more closely than the Polk facility" because it also utilizes a quench process in the gasifier and subsequently provides for scrubbing of the syngas for particulate removal; however, Duke Energy notes that Wabash has a hot/dry filter on the second stage of the gasifier.

Duke Energy states that the increase in particulate matter captured in the grey water results in increased pollutant mass and blowdown rates from the grey water tank to the GWTS at

Edwardsport. Duke Energy also claims that the removal rate of volatilized substances (e.g., mercury, chloride, and fluoride) from the syngas stream can be affected by the temperature of the syngas as it enters the scrubber. Duke Energy claims that "[a]s a result of the differences in cooling processes used by Polk and Edwardsport, Polk's syngas has been found to enter the syngas scrubber at about double the temperature (700 °F to 800 °F)" of Edwardsport. Further, Duke Energy states that this syngas temperature difference, "along with the increased syngas/water contact at Edwardsport IGCC relative to Polk, suggest that Edwardsport IGCC will be more effective in capturing mercury volatized during gasification with quench and scrubber water" [Duke Energy, 2016].

3.2.3 Type and Configuration of Evaporative Process Employed

Duke Energy asserts that the Edwardsport GWTS, which utilizes two stages of evaporative treatment, is fundamentally different than the evaporative systems in place at Polk and Wabash. Duke Energy describes the Edwardsport GWTS as "considerably more complicated and robust" than the treatment system at either Polk or Wabash. As part of the variance request, Duke Energy included a table (shown below as Table 1) highlighting the differences between the Edwardsport treatment system and the Polk treatment system (see Table 5-4 of the FDF variance request). No comparison of the Wabash treatment system is presented; Duke Energy simply describes the Wabash treatment system as even less robust than the Polk treatment system which they call "markedly less robust" than what is installed at Edwardsport [Duke Energy, 2016].

Table 1. Duke Energy's Comparison of the Edwardsport and Polk Grey Water Treatment Systems

Significant Differences in Grey Water Treatment		
Item	**Edwardsport IGCC**	**Polk Station**
Evaporator Type	All evaporators use forced circulation technology	Only the crystallizer uses forced circulation design. The preliminary brine concentrator is a falling film evaporator
Scrubbers	Vapor streams from the MVR evaporator and CoLD crystal-lizer are scrubbed to reduce pollutant carryover	No scrubbing of vapor streams from the evaporators is performed
Scrubber Water Concentrator	Pollutants in scrubber water are further concentrated in Formate Crystallizer	Not applicable - no scrubbers
Secondary Condenser (Barometric)	Uncondensed vapors from MVR scrubber, CoLD crystallizer scrubber, and Formate Crystallizer are run through barometric condenser	No secondary condensers are used for uncondensed vapors
Reverse Osmosis Final Polishing	Combined condensate treated with two-stage RO system	No RO provided

Source: Duke Energy, 2016

Duke Energy asserts that "[t]he engineering and design differences of the grey water treatment system used at Edwardsport IGCC, reflected in the complexity and configuration of Edwardsport's treatment system, as compared to those employed by Polk and Wabash, has a substantial impact on the quality of the condensates produced by the treatment system" [Duke Energy, 2016].[5]

In addition, Duke Energy claims that Edwardsport handles the condensate streams generated by the evaporative system significantly differently from Polk. Edwardsport combines condensate from the evaporator, two crystallizers, and barometric condenser into one commingled stream which is routed to the reverse osmosis system for final polishing prior to recycle or discharge. Polk manages condensate from the two evaporative processes separately; condensate from the preliminary vapor compression evaporator is used for pump seal water and for instrument tap purges and condensate from the crystallizer is used for fuel slurry preparation. Duke Energy claims that the data used by EPA to establish ELGs for gasification wastewater are based solely on effluent from Polk's preliminary vapor compression evaporator and that "EPA ultimately decided against use of data characterizing the condensate from the crystallizer, based on concerns whether the crystallizer was functioning properly." As a result, Duke Energy claims that "the ELGs for Gasification Wastewater cannot be said to be representative of and should not be applicable to the fundamentally different Gasification Wastewater of Edwardsport IGCC that includes condensate from multiple evaporators of different types, including crystallizers, as well as condensate from a barometric condenser" [Duke Energy, 2016].

4. EPA's Review of Duke Energy's Application

As discussed in Section 2.2 of this document, EPA's review followed the requirements of CWA §301(n) and 40 CFR Parts 124 and 125. In this section, EPA first addresses the general procedural requirements for an application and then discusses its review of the specific criteria as applied to Duke's FDF variance request.

Information Submission. As part of its variance application, Duke Energy submitted information regarding the performance of the GWTS that was not submitted during the rulemaking. EPA has tentatively determined that Duke Energy did not have a reasonable opportunity to provide this information before the close of the public comment period (September 20, 2013) for the proposed Steam Electric ELGs (78 FR 34432).[6]

After reviewing the variance request submitted by Duke Energy, EPA requested additional information on November 18, 2016 (see Attachment 2). Duke Energy responded to EPA's information request on December 9, 2016 (see Attachment 3). Following review of the December 2016 information, EPA sent additional questions to Duke Energy on January 5, 2017

[5] Based on concentration data submitted by Duke Energy as part of this FDF variance request, Duke Energy points out that mercury concentrations in condensate streams from the barometric condenser, which is unique to Edwardsport, are greater than mercury concentrations in other condensates resulting from the evaporation units at Edwardsport [Duke Energy, 2016].

[6] Edwardsport IGCC Station began commercial operation in June 2013 and the facility "experienced substantial operational variability during the first year of operation" [Duke Energy, 2016]. Based on the information submitted with Duke Energy's variance application, EPA determined that data collected in 2013 do not represent normal operation of the Edwardsport gasification process and treatment system.

(see Attachment 4) and January 9, 2017 (see Attachment 5). Duke Energy provided information responding to EPA's January 2017 information requests on January 24, 2017 (see Attachments 6-11). On July 18, 2016, Duke Energy provided information to IDEM regarding the methodology and data set for the calculation of the alternative limits requested in their FDF application (see Attachment 12).

Applicable National Limit. EPA identified that a national limit, 40 CFR 423.13(j)(1)(i), is applicable in the NPDES permit for Edwardsport and that this national limit specifically controls the pollutants for which alternative effluent limitations or standards have been requested.

Fundamentally Different Factors. EPA reviewed the information in the rulemaking record and information submitted with Duke Energy's application for an FDF variance to evaluate the request with respect to the criteria listed in 40 CFR 125.31(d). Section 4.1 discusses EPA's evaluation of whether Edwardsport is fundamentally different with respect to the age, size, land availability, and configuration as they relate to the discharger's equipment or facilities; processes employed; process changes; and engineering aspects of the application of control technology and cost of compliance with the required control technology, as alleged in Duke Energy's variance request.

Procedural Requirements. EPA tentatively determined that Duke Energy's request for alternative effluent limitations was timely under 40 CFR 125.32(a).[7] EPA received written concurrence from IDEM on Duke Energy's FDF application as required by 40 CFR 124.62(e). EPA has identified the applicable procedures for appealing the final decision once issued as required by 40 CFR 124.62(f).

Request for Less Stringent Effluent Limitations. EPA reviewed the information in the rulemaking record and information submitted with Duke Energy's application for an FDF variance to evaluate the request with respect to the criteria listed in 40 CFR 125.31(b). Section 4.2 discusses EPA's evaluation of these requirements for establishing alternative effluent limitations less stringent than the national limits.

4.1 <u>Evaluation of Factors Which Duke Energy Asserts Are Fundamentally Different</u>

In accordance with 40 CFR 125.32(b), Duke Energy bears the burden of demonstrating that Edwardsport is fundamentally different with respect to the factors considered by EPA in establishing the effluent limitations for gasification wastewater in the ELGs, and that the alternative limitations requested are justified by the alleged fundamental difference. Duke Energy asserts that Edwardsport is fundamentally different from the Polk and Wabash facilities in "several respects relative to the Section 304(b)(2) factors that are pertinent to EPA's development of ELGs for Gasification Wastewater." Specifically, Duke Energy claims that these differences, summarized above in Section 3.2 and presented in more detail in Section 5 of Duke Energy's variance request, affect the nature and pollutant loading to, and the nature and performance of, the grey water treatment system at Edwardsport compared to other facilities.

[7] Duke Energy submitted the application, dated April 27, 2016, within 180 days after publication of the final rule.

Although EPA disagrees in part with Duke Energy's assertions regarding alleged differences at Edwardsport, EPA does find that the operation of vapor scrubbers and a barometric condenser at Edwardsport IGCC Station is a fundamentally different factor not accounted for during the development of the effluent guidelines. EPA is proposing to grant a variance from certain effluent limitations for gasification wastewater at Edwardsport because Duke Energy's request satisfies the criteria in CWA §301(n) and 40 CFR 125.31. Specifically, this proposed variance would establish alternative effluent limitations for mercury and TDS in discharges of gasification wastewater.

In its application for a variance, Duke Energy requested alternative effluent limitations for discharges of arsenic, mercury, and total dissolved solids (TDS) in gasification wastewater. Duke Energy did not request alternative limits for other parameters regulated by 40 CFR 423.13, nor for other wastestreams regulated by 40 CFR 423. Based on a thorough evaluation of Duke Energy's application and effluent data collected by Edwardsport since commencing operation, EPA tentatively determined that alternative effluent limitations for arsenic are not warranted because all applicable data reflecting normal operation of the gasification system demonstrate compliance with the ELG limitations at 40 CFR 423.13. (See Section 4.2.1.) Similarly, although Duke Energy did not request alternative limitations for selenium, the Edwardsport data also demonstrate that alternative selenium limitations would not be warranted.

EPA's evaluation of Duke Energy's alleged fundamental differences is discussed below in Sections 4.1.1 through 4.1.3.

4.1.1 Duke Energy's Assertions Regarding Fundamental Differences in Fuels Used

Duke Energy states that the differences in fuel composition for Polk and Edwardsport lead to corresponding differences in pollutant content and volume of gasification wastewater. In support of this assertion, Duke Energy states that differences in ash content will directly impact the slag and grey water operations and result in greater amounts of particulates and dissolved solids in the grey water at Edwardsport, and these higher amounts of dissolved solids will lead to a greater blowdown rate to the Edwardsport grey water treatment system. Duke Energy also highlights differences in the chlorine content of the fuel used at Polk and Edwardsport, stating that because of the higher chlorine fuel used at Edwardsport and material design limitations to prevent equipment corrosion, the grey water blowdown rate at Edwardsport will be higher than at Polk. Another difference cited by Duke Energy is the amount of mercury present in the fuel, which the company claims releases 3.9 times more mercury per ton than the fuel used at Polk.

EPA evaluated these assertions regarding fuel composition and wastewater volumes. Based on the information reviewed, EPA does not agree that the difference in wastewater volumes between the IGCC plants represents a fundamentally different factor. In the analyses for the ELGs, EPA determined that each of the IGCC plants was operating a thermal evaporation system properly sized to accommodate the volume of wastewater generated. To the extent that EPA's analyses concluded that none of the IGCC plants would need to upgrade their existing treatment systems, any difference in flowrates is immaterial.

EPA also evaluated how the differences in fuels affect the pollutant characteristics of the untreated grey water at the IGCC plants. As illustrated by Table 2, the differences cited by Duke

Energy do not result in fundamental differences in concentrations of the regulated pollutants in the grey water blowdown sent to the treatment system. Both the maximum pollutant concentration and average pollutant concentration for selenium and TDS at Edwardsport are lower than the concentrations observed for Polk and Wabash. The average concentration for arsenic at Edwardsport is comparable to the average concentration at Polk and although the maximum concentration is higher at Edwardsport than at Polk, a review of the grey water data show that most observed values at Edwardsport are lower than Polk's average arsenic concentration. The concentrations of mercury in grey water at Edwardsport are not fundamentally different from the concentrations observed at Polk. After excluding three extreme outlier values obtained during a 4-day period (4/5/2016-4/8/2016), both the range of pollutant concentrations and the average concentration for grey water samples collected over a 12-month period at Edwardsport are comparable to the values for Polk.

Table 2. Influent Pollutant Concentrations for the Grey Water Treatment System

Plant Name	Fuel Type	Arsenic (ug/L)	Mercury (ng/L)	Selenium (ug/L)	TDS (mg/L)
Polk	Coal/Pet Coke Blend	220 - 340 (avg. 280)	17.0 92.7 (avg. 70.4)	720 - 1,800 (avg. 1,278)	4,500 4,600 (avg. 4,575)
Wabash	Pet Coke	4.0 - 5.0 (avg. 4.5)	5.0 – 9.9 (avg. 8.7)	800 - 1,100 (avg. 920)	3,600 – 4,500 (avg. 4,225)
Edwardsport	Coal	31 - 1,100 (avg. 221)	*All data:* 6.5 – 6,200 (avg. 447) *Excluding outliers:* 6.5 – 59.5 (avg. 22)	33 – 320 (avg. 134)	570 - 4,200 (avg. 2,006)

Sources: U.S. EPA, 2015a and Attachment 7.

4.1.2 Duke Energy's Assertions Regarding Fundamental Differences in Preliminary Cooling and Cleaning of Syngas

Duke Energy describes differences between the syngas cooling and cleaning processes at the IGCC plants and asserts that these differences are likely to affect the quality of the grey water generated at each facility. For example, Duke Energy states that the Edwardsport syngas cleaning process will capture a greater amount of fly ash because it has more direct contact of water with the syngas stream than at Polk, and that this leads to a greater blowdown rate and an increased pollutant mass load to the Edwardsport grey water treatment system. Duke Energy also suggests that Edwardsport will be more effective than Polk at capturing volatile fuel constituents such as mercury during the syngas cooling and scrubbing processes because of differences in the cooling processes used at the facilities.

EPA considered the arguments presented by Duke Energy about these differences in the syngas cooling and cleaning processes, along with the grey water monitoring data for Edwardsport. Based on this information, EPA tentatively determined that Duke Energy's assertions about fundamental differences in this regard are not supported by the information provided.

As described above in Section 4.1.1, the potential differences in blowdown rates between IGCC plants does not represent a fundamentally different factor. In the analyses for the ELGs, EPA determined that each of the IGCC plants was operating a thermal evaporation system properly sized to accommodate the volume of wastewater generated. To the extent that EPA's analyses concluded that none of the IGCC plants would need to upgrade their existing treatment systems, any difference in flowrates is immaterial.

EPA also evaluated how differences in the syngas cooling and cleaning processes affect the pollutant characteristics of the untreated grey water at the IGCC plants. Table 2 above shows that the differences alleged by Duke Energy are either not demonstrated by the available grey water data, or that they are not significant enough to affect the treatability of the grey water and therefore do not represent a fundamentally different factor warranting alternative effluent limitations. As described above in Section 4.1.1, the Edwardsport grey water data do not portray fundamental differences in concentrations of the regulated pollutants in the grey water blowdown sent to the treatment system, relative to the pollutant concentrations observed for Polk and Wabash. Pollutant concentrations for selenium and TDS at Edwardsport are lower than the concentrations observed for Polk and Wabash, and the concentrations for arsenic and mercury at Edwardsport are comparable to the pollutant concentrations observed at Polk.

4.1.3 Duke Energy's Assertions Regarding Fundamental Differences in the Type and Configuration of the Evaporative Processes Employed in Treatment of Gasification Wastewater

Duke Energy asserts that the Edwardsport grey water treatment system, which utilizes two stages of evaporative treatment and includes additional equipment to enhance recovery of pollutants present in vapors produced during the treatment process, is fundamentally different than the evaporative treatment systems in place at Polk and Wabash. In particular, Duke Energy highlights the vapor recovery practices and the manner in which condensate streams are managed at Edwardsport.

Duke Energy asserts that Edwardsport's practice of combining the condensate from all evaporators (i.e., preliminary concentrator and the two crystallizers) and the barometric condenser results in a combined effluent stream that Duke Energy believes would contain higher pollutant concentrations than observed in EPA's sampling data for the condensate from the initial evaporation stage at Polk.[8] To support this assertion, Duke Energy states that condensate produced by crystallizers in the evaporative process "will be expected to contain higher concentrations of such contaminants than condensate resulting from the preliminary concentrator since the input stream to the crystallizers will inherently contain higher concentrations of these contaminants than the raw grey water input to the preliminary concentrator" [Duke Energy, 2016].

Edwardsport includes scrubbers on the vapor streams from the MVR evaporator and CoLD crystallizer to reduce pollutant carryover or release to atmosphere. The water from these

[8] EPA collected samples of the condensate from both stages of evaporation for Polk's gasification wastewater treatment system; however, EPA rejected using data from the second stage because it was operating abnormally and allowing carryover of pollutants to the condensate effluent stream.

vapor scrubbers is sent to the formate crystallizer; condensate from the formate crystallizer combines with other condensate streams for processing through the reverse osmosis unit. Uncondensed vapors from the formate crystallizer and the CoLD crystallizer, along with uncondensed vapor from the MVR concentrator, are routed to the barometric condenser which in turn generates another condensate stream. Duke Energy contends that these processes capture pollutants that otherwise would be released to atmosphere, increasing the pollutant concentration and loading of the combined condensate wastestream.

Duke Energy lacks support for its unconditional statement that crystallizer condensate has higher pollutant concentrations than the concentrator condensate, and in fact is contradicted by data included in Appendix 4 of the FDF application [Duke Energy, 2016]. Duke Energy provided EPA with mercury data for the concentrator condensate and crystallizer process condensate from Edwardsport's grey water treatment system, based on three days of sampling conducted by the company in April 2016. These data (reproduced below in Table 3) allow for a direct comparison of the concentrator condensate and crystallizer condensate, and show that mercury concentrations in the second stage crystallizer process condensate are *lower* than the concentrations in the first stage concentrator condensate on all three days. This is directly contrary to Duke Energy's assertion that the crystallizer condensate inherently has higher pollutant concentrations than the concentrator condensate.

Table 3. Comparison of Mercury Concentration Data for Concentrator and Crystallizer Condensate Streams, ng/L

Stream	4/5/2016	4/6/2016	4/8/2016	Average
Concentrator Condensate	7.03	7.25	1.72	5.33
Crystallizer Process Condensate	3.31	1.34	1.15	1.93

EPA, however, has tentatively determined that the vapor scrubbers and the barometric condenser were not considered in the development of the ELGs for gasification wastewater. The condensate associated with these unit processes is a significant additional contribution to the overall mercury loadings in the gasification wastewater discharge at Edwardsport and appears to also contribute to increased concentrations of TDS. The operation of the vapor scrubbers and barometric condenser represent a fundamentally different factor and, based on evaluation of the data for the grey water treatment system, warrants establishing alternative effluent limitations for mercury and TDS. EPA's evaluation of the grey water treatment system data found that alternative effluent limitations are not warranted for arsenic and selenium.

According to Duke Energy, "[t]he Barometric Condenser system is designed to pressurize vapor streams to enhance condensation of vaporized substances before the vapor streams are utilized in the sulfur recovery unit (SRU) in the gasification block. Relevant vapor streams [consist] of uncondensed vapors from Concentrator Heater and the Air Cooled Condenser, the latter having received scrubbed vapors from the CoLD^{TM} Crystallizer and the vapor stream (unscrubbed) from the Formate Crystallizer" [Duke Energy, 2016]. The Edwardsport plant is the only IGCC plant that operates a barometric condenser. At Polk and Wabash, the uncondensed vapors from the concentrators and crystallizers (Polk only) are vented to the atmosphere. As such, the Edwardsport IGCC plant is reducing air pollutant emissions through the operation of the barometric condenser. The pollutants are transferred from the vapor phase to the barometric condenser condensate, and this condensate subsequently combines with other condensate streams from the grey water treatment process, increasing the pollutant concentrations and loadings in the gasification wastewater effluent. See Attachment 13 for a process flow diagram of the Edwardsport GWTS highlighting the portions of the system that differ significantly from the systems at Polk and Wabash.

In Appendix 4 of the variance application, Duke Energy provided mercury concentration data for each of the individual condensate streams collected over three days in April 2016 [Duke Energy, 2016]:

Table 4. Edwardsport Mercury Concentration Data for Individual Condensate Streams, ng/L

Stream	4/5/2016	4/6/2016	4/8/2016	Average
Concentrator Condensate	7.03	7.25	1.72	5.33
Crystallizer Steam Condensate	<0.50	<0.50	0.59	0.53
Crystallizer Process Condensate	3.31	1.34	1.15	1.93
Barometric Condenser Condensate	350	104	89.0	181
Combined Condensate (prior to reverse osmosis unit)	15.6	16.3	8.88	13.6
Final Greywater Treatment Effluent (after treatment by reverse osmosis)	4.74	8.39	3.09	5.41

As shown in Table 4, the mercury concentrations for the barometric condenser condensate are two orders of magnitude higher than the mercury concentrations for other condensate streams and contributes to Edwardsport not being able to meet the BAT effluent limitations for mercury and TDS.

Edwardsport already operates a treatment system that, by including two-stage reverse osmosis polishing of the combined condensate produced by the evaporation stages, is beyond the BAT technology basis for the ELGs. As part of its review of Duke Energy's variance, EPA evaluated what additional treatment steps would be necessary for the plant to meet the BAT effluent limitations in the ELGs. Although the effluent data for Edwardsport shows that the plant is able to comply with the ELG limitations for arsenic and selenium, EPA anticipates that Edwardsport would incur costs to install additional treatment to enable it to meet ELG effluent limitations for mercury and TDS. The need for additional treatment, and the associated capital and O&M costs, were not contemplated during development of the ELGs. EPA's evaluation of the costs for potential additional treatment is presented below in Section 4.2.3.

4.2 Evaluation of Criteria for Effluent Limitations Less Stringent Than National Limits

For the reasons discussed in Section 4.1, Duke Energy has demonstrated that Edwardsport is fundamentally different with respect to the factors considered by the Administrator in establishing the national guidelines. As such, alternative effluent limitations are warranted and justified by 40 CFR 125.31(a)(2). However, 40 CFR 125.31(b), also described in

Section 2.2, states that a request for the establishment of effluent limitations less stringent than those required by national limits guidelines shall be approved only if:

1) The alternative effluent limitation is no less stringent than justified by the fundamental difference;
2) The alternative effluent limitation or standard will ensure compliance with §208(e) and §301(b)(1)(C) of the CWA;[9] and
3) Compliance with the national limits (either by using the technologies upon which the national limits are based or by other control alternatives) would result in:
   i. A removal cost wholly out of proportion to the removal cost considered during development of the national limits; or
   ii. A non-water quality environmental impact (including energy requirements) fundamentally more adverse than the impact considered during development of the national limits.

The following subsections describe EPA's evaluation of the three requirements in 40 CFR 125.31(b) to establish effluent limitations that are less stringent than national limits.

4.2.1 Limitations No Less Stringent Than Justified by Differences

Based on EPA's evaluation of the alternative effluent limitations requested by Duke Energy, EPA has tentatively determined that the limitations for arsenic and mercury requested by Duke Energy are less stringent than justified by the fundamental difference. EPA's evaluation tentatively determined that the limitations for TDS requested by Duke Energy are more stringent than justified by the fundamental difference. As explained below, this is due to the dataset used and to errors in the methodology Duke Energy and its consultant used to calculate requested limits.

EPA is proposing to grant a variance establishing alternative effluent limitations for mercury and TDS, as explained below. These alternative effluent limitations are based on long-term monitoring of treatment system effluent quality by Duke Energy, following the methodology used by EPA to establish BAT effluent limitations for the ELGs, and are no less stringent than justified by the fundamental differences identified at Edwardsport. The technology basis for these alternative limitations is thermal evaporation followed by reverse osmosis filtration.[10] EPA is not proposing alternative effluent limitations for arsenic for the reasons

---

[9] CWA §208(e) provides that NPDES permits shall not conflict with a water quality management plans issued under §208. CWA §301(b)(1)(C) of the CWA requires compliance with any WQBELs or other limits required by state or federal law that are more stringent than nationally applicable effluent limitations.

[10] This treatment technology is more advanced than the BAT technology basis for the ELGs, due to reverse osmosis filtration of the condensate produced from the thermal evaporation process. The Edwardsport facility also has treatment technology in place after the reverse osmosis system to remove cyanide from gasification wastewater; however, Duke Energy has not found it necessary to operate the equipment. The cyanide destruction system includes a series of chemical addition steps that would affect effluent quality, most notably by increasing the TDS of treated gasification wastewater above the levels produced by the evaporation and reverse osmosis stages. The alternative effluent limitations presented in this document are based on data collected when the cyanide destruction system was not being used and, as a result, may not reflect the effluent quality attained when the process is in operation.

explained below. In addition, Duke Energy did not request alternative effluent limitations for selenium; therefore, EPA is not proposing limitations for that parameter. EPA's derivation of alternative effluent limitations is summarized below. For additional details, see the memorandum titled "Alternative effluent limitations for gasification wastewater at Edwardsport IGCC Station," hereafter referred to as the "Limits Memo" [Westat, 2017].

Arsenic

In its application for a variance providing alternative effluent limitations, Duke Energy seeks a daily maximum limit of 8 ug/L for arsenic, claiming that the 4 ug/L limit in the ELGs "is unduly restrictive" [Duke Energy's variance request, Section 7.2]. The ELGs do not include a monthly average limit for arsenic. Based on a thorough evaluation of Duke Energy's application and effluent data collected by Edwardsport since commencing operation, EPA tentatively determined that alternative effluent limitations for arsenic are not warranted because all applicable data reflecting normal operation of the gasification system demonstrate compliance with the ELG limitations at 40 CFR 423.13. Furthermore, EPA disagrees with the methodology Duke Energy suggests should be used to establish alternative effluent limitation for arsenic, on the basis that it is arbitrary and the selection of specific values may bias the outcome.

Duke Energy submitted effluent data for arsenic collected on 38 days (40 total measurements) during the period 5/9/2013 through 10/1/2016. As explained in the Limits Memo, EPA excluded certain data from its final analyses because they do not represent normal operation of the gasification process and associated wastewater treatment system, due to abnormal operational variability and laboratory results that do not reflect sufficiently sensitive quantitation levels to adequately characterize effluent quality and treatment system performance. The resulting dataset for the treatment system effluent provides observations for 25 days. Each of these effluent observations for arsenic were reported as non-detect with a quantitation limit of either 1 ug/L or 2 ug/L *i.e.*, either one-quarter or half of the daily limit of 4.0 ug/L. Quantitation limits for more than 90 percent of the effluent observations are equal to 1.0 ug/L. These effluent data show that the concentration of arsenic in Edwardsport treatment system effluent is much lower than the ELG daily maximum limit of 4.0 ug/L and alternative effluent limitations for the parameter are not warranted. Furthermore, 40 CFR 125.31(b) states, in part, that a request for establishment of effluent limitations less stringent than those required by national limits guidelines shall be approved only if the alternative effluent limitations is no less stringent than justified by the fundamental difference. The arsenic data for Edwardsport demonstrates that a less stringent effluent limit is not justified.

In Section 7 of its FDF variance request, Duke Energy explains that it attempted to follow EPA's statistical methodology for the ELG limitations while developing Duke Energy's requested alternative effluent limitations for mercury and TDS. However, in requesting an alternative limitation for arsenic, Duke Energy put forth a new approach that is not consistent with the methodology EPA used to establish the BAT limitation. For arsenic, Duke Energy ignored the effluent data for Edwardsport. Instead of using the actual data for arsenic, Duke

Energy arbitrarily selected four values lower than the ELG limitation of 4 ug/L, and requested an alternative daily maximum limit of 8 ug/L based on its statistical analysis of these four values.[11]

As EPA described in Section 5.6 of the Statistical Support Document, in situations where there are too few detected results, the statistical models are not appropriate for use in obtaining the effluent limits since reliable estimates could not be calculated from the model. In such instances, EPA established the daily maximum ELG limits based on a detection limit (or more precisely, quantitation limit) relevant to the observed data. Also, the monthly average ELG limit is not established when the daily maximum limit is based on the detection limit. This is reflected in the arsenic limits for gasification wastewater in the ELGs.

Duke Energy's selection of four hypothetical observations below the quantitation limit and calculating the daily maximum limit from those observations is arbitrary. Those hypothetical observations could be selected to obtain a daily limit that is greater than the quantitation limit or less than the quantitation limit. Using the values selected by Duke Energy, and rounding the limit upward to the nearest integer, would result in a limit of 8 ug/L.[12] However, there is no valid basis for using the values selected by Duke Energy and substituting different values would produce different effluent limits. Furthermore, it would be more appropriate to select values that more closely reflect the actual sampling data for Edwardsport. Since all valid observations for the treatment system effluent are lower than 2 ug/L, and more than 90 percent of these observations are in fact are lower than 1 ug/L, Duke Energy's approach whereby 75 percent of the hypothetical values are *higher* than the actual monitoring data lacks technical merit.

Since EPA has tentatively determined that alternative limits for arsenic are not warranted, the BAT limit for arsenic at 40 CFR 423.13(j)(1) would continue to apply to gasification wastewater discharges at Edwardsport. The data submitted by Duke Energy confirms that a variance is not needed for the arsenic, with all valid observations providing non-detect results at quantitation levels lower than the ELG limit. For comparison of the Edwardsport effluent data to the ELG limit of 4 ug/L, see the Limits Memo.

<u>*Mercury*</u>

Table 5 provides the long-term average (LTA), variability factors, and alternative effluent limitations for mercury at Edwardsport. Duke Energy requested alternative effluent limits for mercury (30.0 ng/L daily maximum; 12.4 ng/L monthly average) based on observations for 15 days collected during the period 7/22/2013 through 10/15/2015. The dataset used by EPA to establish alternative effluent limitations for Edwardsport differs from Duke Energy's dataset in the following ways: (1) EPA's limits are based on observations for 25 days rather than 15 days; (2) EPA's dataset includes additional data collected by Edwardsport for the period 4/5/2016 - 10/1/2016; and (3) EPA excluded data collected on 3 days in 2013 and 1 day in 2015, for reasons explained in the Limits Memo.

---

[11] For its analysis, Duke Energy used the following values: 1 ug/L, 2 ug/L, 3 ug/L, and 3.5 ug/L.

[12] Arguably, using these arbitrarily selected values in EPA's statistical model would also produce a monthly average effluent limitation of 4 ng/L.

Table 5. Long-Term Average, Variability Factors, and Alternative Effluent Limitations for Mercury (ng/L)

Number of Daily Observations[1]	LTA (ng/L)	Daily Variability Factor	Monthly Variability Factor	Limits (ng/L)	
				Daily Maximum	Monthly Average
25 (D=23, ND=2)	5.528	4.906	1.959	28	11

[1] D = detected and ND = non-detected.

Total Dissolved Solids

Table 6 provides the long-term average (LTA), variability factors, and alternative effluent limitations for TDS at Edwardsport. Duke Energy requested alternative effluent limits for TDS (78 mg/L daily maximum; 36 mg/L monthly average) based on observations for 11 days collected during the period 9/8/2015 through 10/15/2015.[13] The dataset used by EPA to establish alternative effluent limitations for Edwardsport differs from Duke Energy's dataset in the following ways: (1) EPA's limits are based on observations for 26 days rather than 11 days; and (2) EPA's dataset includes additional data collected by Edwardsport for the period 4/5/2016 – 10/1/2016. See the Limits Memo for additional information.

Table 6. Long-Term Average, Variability Factors, and Alternative Effluent Limitations for TDS (mg/L)

N[1]	LTA (mg/L)	Daily Variability Factor	Monthly Variability Factor	Limits (mg/L)	
				Daily Maximum	Monthly Average
26 (D=15, ND=11)	22.511	3.637	1.679	82	38

[1] D = detected and ND = non-detected.

Selenium

Duke Energy did not request alternative effluent limitations for selenium. Because of this, the BAT limits for selenium at 40 CFR 423.13(j)(1) continue to apply for gasification wastewater discharges at Edwardsport. The data submitted by Duke Energy confirms that a variance is not needed for the selenium, with all observations substantially lower than the both the daily maximum and monthly average ELG limits (453 ug/L and 227 ug/L, respectively). The mean concentration for selenium at Edwardsport is also much lower than the long-term average (147 ug/L) upon which the ELG limits are based. For comparison, see the Limits Memo and the Statistical Support Document.

[13] Duke Energy excluded a 12th daily observation, collected on 10/13/2015, stating that it was an outlier due to "likely treatment system upset or lab error" (See Attachment 12). EPA similarly excluded the observation for 10/13/2015.

4.2.2 Compliance with §208(e) and §301(b)(1)(C) of the CWA

In a letter to the Acting Regional Administrator for EPA Region 5, IDEM notified EPA that the alternative effluent limitations requested in Duke Energy's application would comply with §208(e) and §301(b)(1)(C) of the CWA. EPA will seek concurrence on the alternative limitations presented in this document prior to issuing the final decision.

4.2.3 Removal Costs and Non-Water Quality Environmental Impacts

As discussed in Section 4.1, EPA evaluated what additional treatment steps may be necessary for the plant to meet the BAT effluent limitations in the ELGs. Edwardsport is already operating the technology identified as the BAT technology basis for gasification wastewater effluent limitations, as well as additional reverse osmosis filtration of the combined condensate streams from the grey water treatment system. Based on the data provided by Duke Energy, mercury is the primary constituent for which additional treatment would be needed for Edwardsport to comply with the BAT effluent limitations in the ELGs although, depending on the technology selected to enhance mercury removal, additional treatment specifically for TDS may also be necessary to comply with the ELGs. EPA evaluated zero-valent iron (ZVI) technology as a potential polishing step to remove the additional increment of mercury in the Edwardsport gasification wastewater to meet the BAT effluent limitations. ZVI technology has been used to treat FGD wastewater in pilot tests and has demonstrated good removals of mercury. EPA does not have data demonstrating that it would reduce mercury concentrations down to the level necessary to comply with the ELGs; nevertheless, evaluating the cost of such treatment provides a useful benchmark for the purposes of evaluating the variance application. Based on information obtained during the ELG rulemaking regarding ZVI treatment of FGD wastewater, EPA estimates that the capital costs to procure and install a ZVI system to treat gasification wastewater at Edwardsport would exceed $5 million. EPA estimates that operation and maintenance (O&M) costs for a ZVI treatment unit would exceed $1.7 million per year [Farina, 2017]. In its analyses for the final ELGs, EPA projected that Edwardsport and the other operating IGCC plants would not incur capital costs to comply with the BAT effluent limitations; however, they were estimated to incur annual O&M costs of $192,000 for compliance monitoring [U.S. EPA, 2015b].

Edwardsport already operates a treatment system that, by including two-stage reverse osmosis polishing of the combined condensate, is beyond the BAT technology basis for the ELGs. In addition, EPA estimates the cost for Edwardsport to comply with the ELG effluent limitations for mercury and TDS would require additional treatment and incur capital costs not contemplated during development of the ELGs. Annual O&M costs for such additional treatment would be at least an order of magnitude greater than EPA considered when developing the ELGs for gasification wastewater. Therefore, EPA tentatively determined that the estimated costs that would be incurred by Edwardsport to install additional treatment to comply with the BAT effluent limitations are wholly out of proportion to the removal costs considered during development of the national limits for gasification wastewater.

5. TENTATIVE DECISION OF THE REGIONAL ADMINISTRATOR

Based on the evaluation of Duke Energy's request and the administrative record for the Steam Electric Power Generating ELGs, EPA proposes to grant an FDF variance providing alternative effluent limitations for mercury and TDS in discharges of gasification wastewater for Duke Energy's Edwardsport IGCC Plant. Duke Energy demonstrated that the factors at Edwardsport are fundamentally different from those considered by EPA in developing the national limitations set forth in 40 CFR 423.13(j)(1)(i). EPA proposes not to establish alternative effluent limitations for arsenic, because all applicable data reflecting normal operation of the gasification system demonstrate compliance with the ELG limitations at 40 CFR 423.13(j)(1)(i).

Robert A. Kaplan
Acting Regional Administrator

8/7/17
Date

6. References

1. Duke Energy. 2016. Duke Energy Indiana, LLC. Fundamentally Different Factors Variance Application. (27 April).
2. ERG. 2013. Eastern Research Group, Inc. Non-CBI Final Edwardsport Site Visit Report. (18 March).
3. Farina, Phil. 2017. Telephone communication with Phil Farina, Groundwater Treatment and Technology, and Elizabeth Gentile, ERG. "ZVI Blue™ - Reactive Media Technology." (February).
4. U.S. EPA. 2015a. U.S. Environmental Protection Agency. Statistical Support Document: Effluent Limitations for FGD Wastewater, Gasification Wastewater, and Combustion Residual Leachate for the Final Steam Electric Power Generating Effluent Limitations Guidelines and Standards. Washington, D.C. (30 September).
5. U.S. EPA. 2015b. U.S. Environmental Protection Agency. Technical Development Document for Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category (TDD). Washington, D.C. (30 September).
6. Westat. 2017. Memorandum to Ron Jordan, EPA and Brian Schnitker, EPA: "Alternative effluent limitations for gasification wastewater at Edwardsport IGCC Station." (10 July).