NORTH CAROLINA DIVISION OF AIR QUALITY

Application Review

Issue Date:

<table>
<tr><td colspan="3"></td><td>Region: Raleigh Regional Office
County: Chatham
NC Facility ID: 1900134
Inspector's Name:
Date of Last Inspection:
Compliance Code:</td></tr>
<tr><td colspan="3">Facility Data

Applicant (Facility's Name): Duke Energy Progress, LLC - Cape Fear STAR Ash Beneficiation Process

Facility Address:
Duke Energy Progress, LLC - Cape Fear STAR Facility
500 C P and L Road
Moncure, NC 27559

SIC: 4911
NAICS: 221112

Facility Classification: Before: Permit/Registration Pending After: Title V
Fee Classification: Before: N/A After: Title V</td><td>Permit Applicability (this application only)

SIP: 02D .0515, 02D .0516, 02D .0521, 02D .0524, 02D .0540, 02D .1100, 02D .1111, 02Q .0504, 02Q .0711
NSPS: NSPS IIII
NESHAP: GACT ZZZZ
PSD: N/A
PSD Avoidance: N/A
NC Toxics: Yes
112(r): N/A
Other: N/A</td></tr>
<tr><td colspan="3">Contact Data</td><td rowspan="2">Application Data

Application Number: 1900134.18A
Date Received: 07/24/2018
Application Type: Greenfield Facility
Application Schedule: State
Existing Permit Data
Existing Permit Number: N/A
Existing Permit Issue Date: N/A
Existing Permit Expiration Date: N/A</td></tr>
<tr><td>Facility Contact

Steven Conner
Manager Environmental Services
(336) 597-6213
1700 Dunnaway Road
Semora, NC 27343</td><td>Authorized Contact

Jon Kerin
VP CCP Gov. & Op. Support
(919) 546-6760
410 South Wilmington Street
Raleigh, NC 27601</td><td>Technical Contact

Ann Quillian
Lead Environmental Specialist
(919) 546-6610
410 South Wilmington Street
Raleigh, NC 27601</td></tr>
<tr><td colspan="2">Review Engineer: Betty Gatano

Review Engineer's Signature: Date:</td><td colspan="2">Comments / Recommendations:
Issue 10583/R00
Permit Issue Date:
Permit Expiration Date:</td></tr>
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1. Purpose of Application

Duke Energy Progress LLC – Cape Fear STAR® Ash Beneficiation Process (aka Duke Energy or the Cape Fear STAR® facility) is a new greenfield facility to be located at the site of the Progress Energy Carolinas – Cape Fear Plant (Facility ID 1900063) in Moncure, Chatham County. A permit application for the Cape Fear STAR® facility was received on July 24, 2018. The Progress Energy Carolinas – Cape Fear Plant began operation in 1923 and was retired in March 2013. The facility's Title V air permit was subsequently rescinded on November 25, 2013. Therefore, the permit application for the Cape Fear STAR® facility is being submitted as a greenfield facility.

On November 9, 2018, the Cape Fear STAR® facility submitted an addendum to the permit application, which included the following activities:

- Add a ball mill classifier (ID No. I-24) and ball mill feed silo (ID No. I-25), both of which are considered insignificant activities under 15A NCAC 02Q .0102(h)(5)[1];
- Classify several other emission sources as insignificant activities;
- Update emission calculations; and
- Update air dispersion modeling.

The amended application requested all emission sources, with the exception of the STAR® system (ID No. ES-5), the external heat exchangers A and B (ID No. ES-8 and 9) and the diesel-fired engine on the crusher (ID No. ES-23), be considered insignificant activities. The DAQ disagrees and does not consider the FGD byproduct silo (ID No. ES-6), the FGD hydrate lime silo (ID No. ES-7), or the product storage dome (ID No. ES-11) to be insignificant activities because the precontrolled particulate matter (PM) emissions for each of these sources are greater than 5 tons per year.

2. Application Chronology

July 24, 2018	Permit Application No. 1900134.18A was received as a State modification for a greenfield facility.
July 28, 2018	Sent acknowledgment letter indicating the application was complete.
August 28, 2018	Nancy Jones of the Air Quality Analysis Branch (AQAB) issued a memorandum approving the air modeling submitted in support of the permit application.
October 2, 2018	Ann Quillian, Technical Contact for Duke Energy, called Betty Gatano and stated Duke Energy would be submitting a permit addendum for the Cape Fear STAR® facility. Among other items, the addendum would include additional sources and revised emissions based on updated site-specific ash analysis.
November 9, 2018	Permit addendum received. The permit addendum included revised air modeling. This date will be used as the completed permit application date.
December 3, 2018	Betty Gatano called Philip Crawford, consultant for Duke Energy, to discuss several questions, including the revised ash analysis and the calculation of particulate matter emissions from the silos. Mr. Crawford provided a written response via e-mail dated December 14, 2018.
December 4, 2018	Nancy Jones of the AQAB issued an updated memorandum approving the revised air modeling.
December 5, 2018	Draft permit and permit review forwarded for internal comments.
December 11, 2018	The Hearing Officer's report was issued for the permit adding a fly ash beneficiation project to Duke Energy Progress, LLC - H. F. Lee Steam

[1] The permit application references 15A NCAC 02Q .0508(3), which defines insignificant activities because of size or production rate for Title V permits. Because this permit is being issued as a State permit and not a Title V permit, the 15A NCAC 02Q .0500 rules are not applicable. The corresponding regulation for a non-Title V permit is 15A NCAC 02Q .0102(h)(5).

Electric Plant (H.F. Lee). The report was reviewed to ensure all the Hearing Officer's recommendations were implemented at Cape Fear STAR® facility.

December 12, 2018 — Comments received from Ed Martin, Permit Engineer for the beneficiation project at H.F. Lee.

December 13, 2018 — Comments received from Charles McEachern of the Raleigh Regional Office (RRO) of the DAQ. Mr. McEachern requested that testing for NO_x emissions from the STAR® reactor be added to the permit.

December 13, 2018 — Comments also received from Booker Pullen, Permitting Supervisor.

December 18, 2018 — Betty Gatano e-mailed Philip Crawford and Ann Quillian and requested that Duke Energy address hydrogen chloride (HCl) and hydrogen fluoride (HF) emissions from the Cape Fear STAR® facility. This request was based on the Hearing Officer's recommendations for H.F. Lee. All other recommendations had been addressed in the permit application or permit addendum.

January 3, 2019 — Information on HCl and HF emissions received from Philip Crawford.

January 9, 2019 — Draft permit and permit review forwarded to Duke Energy for comments.

January 28, 2019 — Comments from Ann Quillian received. The three main issues in their comments are the following:

- Inherent controls – Duke Energy contends the bin vent filters and bagfilters on silos and other emission sources should be considered inherent controls. The DAQ disagrees. See notes for February 20 and 25, 2019 below.
- SO_2 CEMS – Duke Energy indicated in their comments that they intend to install a CEMS for monitoring SO_2 emissions from the STAR®. However, there was no mention of CEMS in the permit application. The DAQ concurs.
- NO_x testing – The DAQ added NOx testing to the draft permit because potential NO_x emissions from the facility are ~220 tpy, near the PSD threshold limit of 250 tpy. Duke Energy objected to this testing. The DAQ does not agree, and NO_x testing will remain in the permit.

January 31, 2019 — Betty Gatano discussed the comments in a call with Ann Quillian. Ms. Quillian confirmed the Duke Energy intends to install a CEMs for SO_2 and she agreed to provide more information about the CEMs.

February 13, 2019 — Ann Quillian provided proposed permit language for the CEMS and updated the permit application for CAM. Duke Energy proposed a 30-day rolling average for the CEMS. The DAQ disagrees and has determined a 3-hour rolling average is more appropriate for compliance with 15A NCAC 02D .0516. In a phone call on February 27, 2019, Ms. Quillian indicated Duke Energy agreed with using a 3-hour rolling average.

Feb. 20 & 25, 2019	Betty Gatano spoke with Ann Quillian regarding the bin vent filters as inherent controls. It was agreed that the insignificant activities would be described as “with bin vent filters” rather than “inherent to the process.”
February 28, 2019	Second version of the draft permit and permit review forwarded to Duke Energy for comments.
March 4, 2019	Ann Quillian indicated via e-mail that Duke Energy had no additional comments.
March 22, 2019	Draft permit and review are sent to public notice.

3. Facility Description

The proposed facility located in Moncure, Chatham County will be a fly ash beneficiation process. The facility will be owned by Duke Energy Progress LLC but will be operated by a third party. Duke Energy plans to begin construction at the Cape Fear site in 2019 with operation of the facility expected to begin in 2020.

The Cape Fear STAR® facility is designed to process up to 400,000 tons per year of coal combustion fly ash with other ingredient materials to produce a high-quality class F fly ash for use in ready mix concrete or other commercial products. It uses a proprietary technology from the SEFA Group Inc. called Staged Turbulent Air Reactor (STAR®) to chemically and physically convert fly ash into a low-carbon material that meets the American Society for Testing and Materials (ASTM) Standard C618-08, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.” The low carbon class F fly ash must be no more than 6 percent by weight loss-on-ignition (LOI) content to be suitable for use in concrete.

The preparation of fly ash for beneficial use in the manner proposed by Duke Energy at the Cape Fear site is encouraged by the U.S. Environmental Protection Agency (EPA). EPA finds “this practice can produce positive environmental, economic, and product benefits such as reduced use of virgin resources, lower greenhouse gas emissions, reduced cost of coal ash disposal, and improved strength and durability of materials.”[2]

<u>STAR® Process</u>

Fly ash is first excavated from the ash ponds on the site and staged for dewatering. Dewatered fly ash is then screened and crushed to remove contaminants and produce a consistent chemical composition and a finely divided free-flowing ash. Excavation and processing of materials from the ash ponds to meet the STAR® system fly ash (ingredient) specifications will be under the control of the Cape Fear STAR® facility. All fly ash reclaimed from an ash pond delivered for use as an ingredient in the STAR® system must first undergo processing by the owner to be:

- Free of all but minimal contaminants (e. g., organic debris, slag);
- Finely-divided and free-flowing,
- Have consistent moisture content of less than or equal to 25 percent; and
- Have a consistent chemical composition, including organic content measured by loss on ignition.

Processed fly ash is then delivered to the beneficiation process via trucks. The wet fly ash can be unloaded from the trucks into the storage shed or unloaded from the trucks to a pile that is then

[2] U.S. EPA, Coal Ash Reuse, https://www.epa.gov/coalash/coal-ash-reuse; Accessed May 10, 2017

transferred to a storage shed by a front-end loader. The wet fly ash in the shed is transferred via front-end loader to a hopper at up to 70 wet tons per hour (tph). The fly ash is conveyed from the hopper to a de-lumper unit to reduce the "overs" material. The material is gravity discharged from the de-lumper into a fluidized external heat exchanger (EHE) that uses both pre-heated air and hot water to dry the fly ash.

Dried fly ash is discharged from the EHE either through a fixed height overflow weir or underflow discharge screw or rotary valves. Exhaust air from the EHE is routed to a high-efficiency bagfilter for feedstock recovery and PM control. The fly ash is discharged to the EHE transfer silo prior to being sent to the feed silo. From the feed silo, the fly ash is introduced into the STAR® reactor where it is physically and chemically converted into a high-quality class F fly ash for beneficial use in ready mix concrete or other specialty products.

During startup of the STAR® reactor, the combustion air is pre-heated via propane-fired auxiliary burners with a rated heat input of 60 million Btu per hour. Fuel and fly ash are then co-fired until the fly ash auto-ignition temperature (approximately 1,400 degrees ^{o}F) is reached. At this temperature, residual carbon in the fly ash becomes the heat input source in the reactor, which is rated at 140 million Btu per hour heat input capacity. However, auxiliary firing of propane may be needed to maintain proper operating temperature under certain conditions.

After exiting the reactor, the fly ash entrained in the flue gas passes through a hot cyclone where solids are returned to the reactor for temperature control. The fly ash and flue gas leaving the hot cyclone are conveyed to the air preheater and then pass through a gas cooler. The cooled flue gas and ash pass through a fabric filter baghouse, which is an integral part of the process for product capture, and then exhaust to a dry flue gas desulfurization (FGD) system used for control of sulfur dioxide (SO_2) emissions. The FGD exhaust is vented to the atmosphere through a stand-alone stack.

The FGD system consists of a circulating dry scrubbing system (CDS) and a fabric filter baghouse. Flue gas, hydrated lime, and water are mixed in the CDS to absorb SO_2. Particulate from the process is collected in the baghouse. The byproduct solids are discharged from the baghouse into a byproduct storage silo. The system is comprised of a three-day storage silo with a bin vent filter, fluidizing air stones, and dry unloading spouts. Dry dust unloading spouts are telescoping spouts equipped with small ventilation fans that recirculate displaced air back to the top of the byproduct storage silo. Each spout also has a compact filter module.

Once the ash leaves the reactor, it is collected in the product recovery baghouse and pneumatically transferred to either the storage dome or the loadout silo, each equipped with a bin vent filter. The truck loadout station uses telescoping chutes and a negative pressure ventilation system to reduce fugitive emissions.

The proposed facility involves installation of the following components:

<u>Fugitive Emission Sources</u>

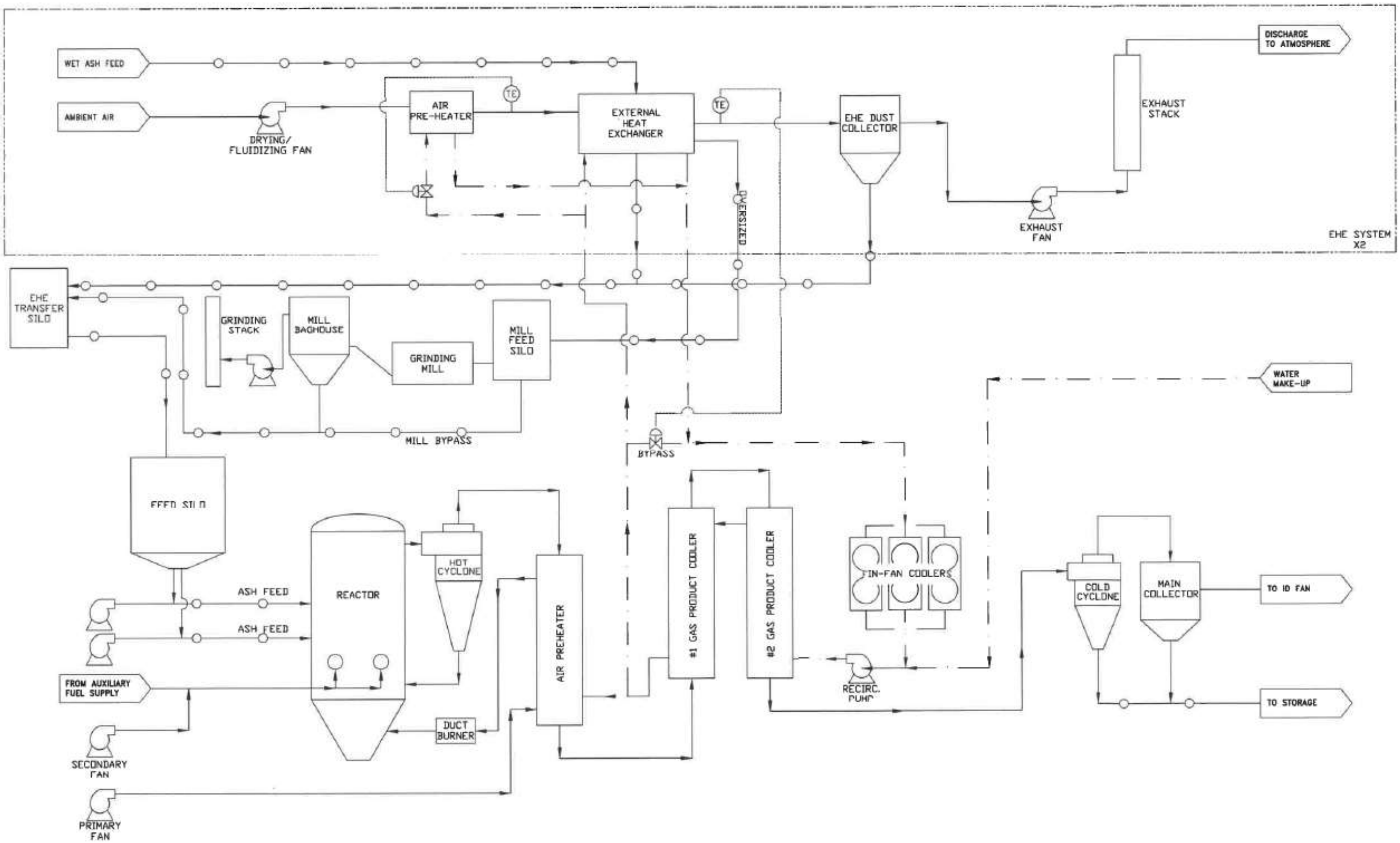
- Wet ash receiving (ID No. I-1) – Wet ash is transferred to storage shed at a rate up to 70 short tons per hour (tph) and then transferred to the feed hopper by a front-end loader.
- Unloading pile (ID No. I-3) – The unloading pile is 0.33 acres.
- Ash basin (ID No. I-15) – The ash basis is 174-acre site, and dust from the ash basin is generated by wind erosion.

- Ash handling (ID No. I-16) - Ash handling consists of several activities. Ash is excavated from its respective basin and placed in windrows in that basin. The windrowed ash is loaded into screener / crusher within its respective basin, and the screened and crushed ash is the placed in stockpile within its respective basin.
- Haul roads (ID No. I-21).

<u>Point Source Emission Units</u>

- Crusher (ID No. I-20) powered by a 300 hp diesel-fired engine (ID No. ES-23) – The crusher is designed to remove larger particles from up to 165 tph of feedstock.
- Screener (ID No. I-19) powered by a 91 hp diesel-fired engine (ID No. I-22) – The screener is designed to produce up to 165 tph of a finer free flowing feedstock suitable for the STAR® reactor.
- External heat exchangers A and B (ID No. ES-8 and 9) – The EHEs have a combined total operation not to exceed 8,760 hours per year drying a maximum of 70 tons per hour of fly ash suspended in transport air. Each EHE will be controlled by a felted filter baghouse (ID Nos. CD-8 and CD-9).
- EHE silo (ID No. I-10) – This silo with an associated bin vent filter is a transfer silo used to transfer material from the EHEs to the feed silo.
- Feed silo (ID No. I-4) – The ash feed silo with an associated bin vent filter is filled pneumatically at a rate of 125 tons per hour (tph) and unloaded at the rate of 75 tph.
- STAR® system (ID No. ES-5) – The STAR® system has a 140 million Btu/hour total maximum firing rate for processing feedstock (fly ash and other ingredient materials) into a variety of commercial products. It is equipped with propane-fired, low-NOx, auxiliary burners (60 million Btu/hour total capacity) for use during startup or when necessary to maintain the desired reactor temperature. The STAR® system is also equipped with an integral cyclone and baghouse for product recovery. A dry FGD scrubber and bagfilter are used of SO_2 control.
- FGD byproduct silo (ID No. ES-6) – Byproduct solids from the dry FGD system discharged from the fabric filter baghouse are stored in the silo. Material will be unloaded from the silo via gravity into trucks. It is equipped with a bin vent filter (ID No. CD-6) for control of particulate matter emissions.
- FGD hydrate lime silo (ID No. ES-7) – The silo stores absorbent (hydrated lime) used in the dry FGD system. It is equipped with a bin vent filter (ID No. CD-7) for control of particulate matter emissions.
- Product storage dome (ID No. ES-11) – Product from the STAR® system is stored in the storage dome. It is equipped with a bin vent filter (ID No. CD-11) for control of particulate matter emissions.
- Loadout silo (ID No. I-12) and 2 loadout spouts (ID Nos. I-13 and I-14), – The silo stores product, which is loaded into trucks via loadout spouts, each with an associated bin vent filter.
- Ball mill classifier (ID No. I-24) – Material from the ball mill feed silo is transferred to the conical ball mill. A baghouse inherent to the process will filter any remaining particles from the air stream and then send them to the EHE transfer silo.
- Ball mill feed silo (ID No. I-25) – Oversized material from EHE A and B are stored in the ball mill feed silo with an associated bin vent filter.

An overview of the ash beneficiation process is provided in the figures below.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GRINDING STACK
MILL BAGHOUSE
GRINDING MILL
MILL FEED SILO
MILL BYPASS
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FEED SILO
REACTOR
HOT CYCLONE
ASH FEED
ASH FEED
FROM AUXILIARY FUEL SUPPLY
SECONDARY FAN
PRIMARY FAN
DUCT BURNER
AIR PREHEATER
#1 GAS PRODUCT COOLER
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FIN-FAN COOLERS
RECIRC. PUMP
COLD CYCLONE
MAIN COLLECTOR
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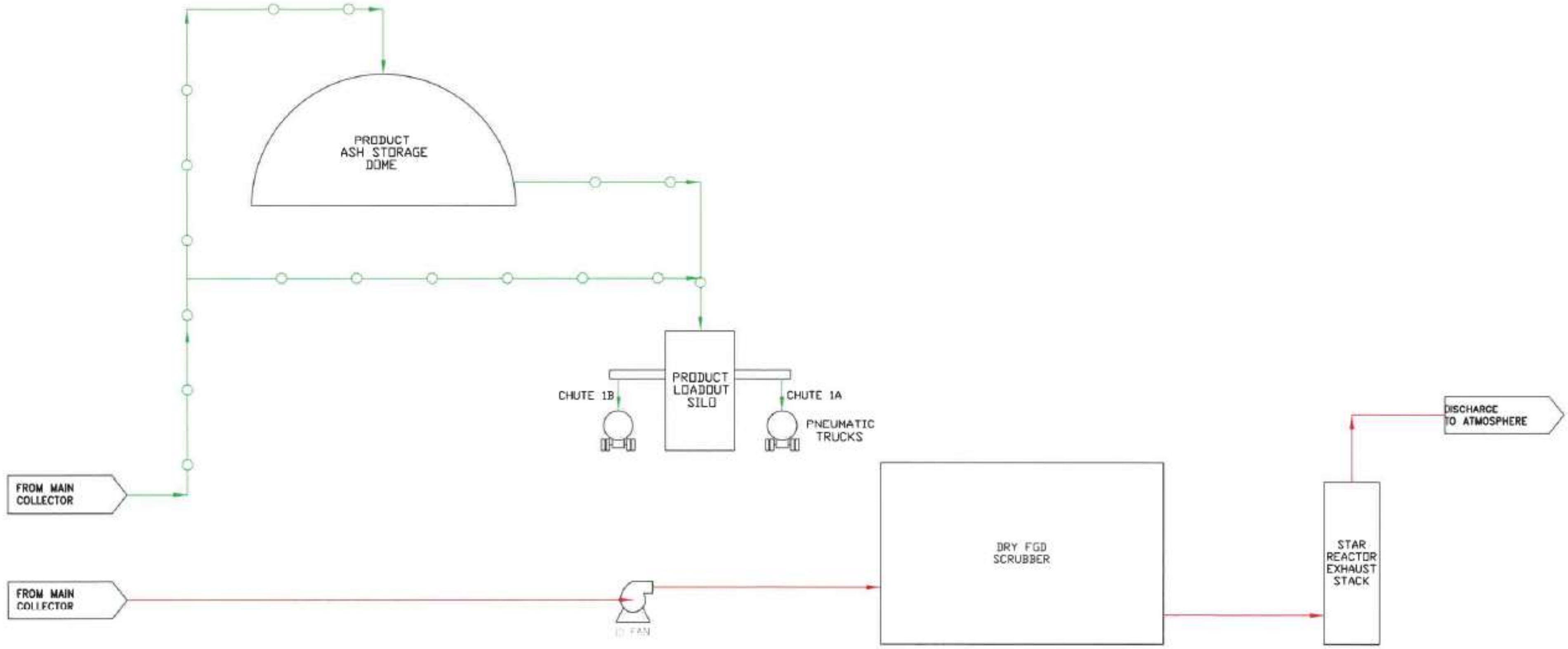
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FROM MAIN
COLLECTOR
FROM MAIN
COLLECTOR
DRY FGD
SCRUBBER
STAR
REACTOR
EXHAUST
STACK

4. Emissions

Emissions from the Cape Fear STAR® facility result from several sources as discussed in this section. The STAR® system will be a source of nitrogen oxides (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), particulate matter (PM/PM10/PM2.5), sulfur dioxide (SO_2), hazardous air pollutants (HAPs), toxic air pollutants (TAPs) and greenhouse gases (GHGs). Emissions result from the burning of propane during startup and the oxidation of the residual carbon and other constituents in the fly ash. Emissions associated with fuel combustion are also expected from the diesel-fired crusher and screener engines. Additionally, the handling of the fly ash and fly ash product are considered as a source of particulate matter and metals emissions.

Emissions of CO and VOCs

Emissions of CO and VOCs are associated with the STAR® system due to the incomplete oxidation of carbon in the fly ash and propane from the auxiliary burners. Complete combustion depends upon oxygen availability (excess air), flame temperature, residence time at flame temperature, combustion zone design, and turbulence. Turbulence within the reactor ensures thorough mixing of air (oxygen) and fuel for the desired oxidation to proceed. The crusher and screener engines have a potential to emit CO and VOCs because of the incomplete combustion of diesel fuel.

Emissions of NO_x

NO_x may be emitted from the STAR® system as the result of oxidation of nitrogen in the fly ash and auxiliary fuel. Thermal NO_x is not expected to contribute significantly to emissions because its formation begins at flame temperatures above 1,200 °C (~2,200 °F) and the STAR® system will operate at much lower temperatures. Low NO_x burners will minimize NO_x emissions associated with the auxiliary fuel. The three permitted STAR® systems (two in South Carolina and one in Maryland) have NO_x limits ranging from 0.05 to 0.34 pounds per million Btu.[3] Duke Energy estimated emissions from the Cape Fear STAR® system at 0.34 pounds of NO_x per million Btu. Additionally, NO_x will be emitted from the crusher and screener engines.

PM Emissions

PM emissions from the STAR® system consist of filterable and condensable PM resulting from ash, trace quantities of noncombustible metals and unburned carbon due to incomplete combustion, and the handling of fly ash and end product. A baghouse will reduce PM emissions from the STAR® system to approximately 0.025 grain per actual cubic foot (gr/acf).

PM emissions are also expected from fly ash handling, wind erosion from the fly ash basin and unloading pile, and fly ash and end product transfer and loading operations.

Emissions of SO_2

SO_2 forms from the oxidation of the sulfur in the fly ash. The fly ash is expected to contain 0.05 percent sulfur on average, but potential emissions were based on an assumed 0.10 percent sulfur content as a worst-case estimate. SO_2 formed within the STAR® system will be controlled by a dry scrubber that is designed to reduce SO_2 emissions by 95 percent.

[3] Kevin Godwin (05/10/2018) Permit review for Duke Energy Carolinas, LLC - Buck Combined Cycle Facility, Air Permit No. 03786T35.

SO_2 will also be emitted from the crusher and screener engines. The diesel fuel for these engines will be limited to no more than 0.0015 percent sulfur.

Emissions of CO_2

Carbon dioxide will be the primary GHG. It is a product of the complete oxidation of carbon in the fly ash and propane in the STAR® system and diesel fuel in the screener and crusher engines. Emissions of GHG are expressed as carbon dioxide equivalents or CO2e.

Emissions of TAPs and HAPs

TAP and HAP emissions will result from combustion of fly ash (STAR® reactor) and diesel (engines) and from fly ash handling. The largest TAP expected from the proposed facility is sulfuric acid mist from the STAR® reactor. Emissions of sulfuric acid mist were based on a SEFA stack test performed in September 2016, the results of which were then doubled as an overconservative estimate. The largest HAP expected from the proposed facility is formaldehyde from the diesel-fired engines. The largest TAP/HAP expected from fly ash handling is chromium. HAP and TAP emissions from metals associated with ash handling and the STAR® reactor were based on a site-specific ash analysis and EPRI PISCES Database (February 2003) Composition of Lime.

Emissions of HF and HCl were specifically addressed based on a recommendation from the Hearing Officer's report for the fly ash beneficiation project at Duke Energy Progress, LLC - H. F. Lee Steam Electric Plant. Section 7 below provides more detail on emission of HF, HCl, and other TAPs from the Cape Fear STAR® facility.

Potential Emissions

The applicant has calculated the maximum emissions based on the STAR® system operating continuously (i.e., 8760 hours per year) at a design rate of 140 million Btu per hour and the auxiliary burners operating continuously at the design rate of 60 million Btu per hour. The higher of the two maximum emission rates was used as the annual potential emissions of each pollutant. Potential emissions from the STAR® system are provided below in Table 1. Attachment 1 of this review contains an overview of the emission factors used to calculate emissions, and detailed emission calculations are contained in Appendix III of the addendum to permit application No. 1900134.18A. (The addendum was submitted on November 9, 2018).

Table 1. Potential Emissions from Cape Fear STAR® Process

Pollutant	Auxiliary Fuel (propane)		Fly Ash – As Controlled		Potential as Controlled
	lb/hour	ton/year	lb/hour	ton/year	tons/year
CO	4.97	21.8	22.4	98.1	98.1
NO_x	8.62	37.8	47.6	208.5	208.5
PM	0.464	2.03	16.1	70.4	70.4
PM10	0.464	2.03	14.8	64.8	64.8
PM2.5	0.464	2.03	8.52	37.3	37.3
SO_2	6.63E-03	2.90E-02	25.68	112.5	112.5
VOC	0.530	2.32	2.24	9.81	9.81
Lead	--	--	1.93E-06	8.45E-06	8.45E-06
Sulfuric Acid	--	--	0.10	0.438	0.438
Largest HAP	--	--	8.52E-05 lb/hr (manganese)	0.746 lb/yr (manganese)	0.746 lb/yr (manganese)

Table 1. Potential Emissions from Cape Fear STAR® Process					
Pollutant	Auxiliary Fuel (propane)		Fly Ash – As Controlled		Potential as Controlled
	lb/hour	ton/year	lb/hour	ton/year	tons/year
Total HAPs	--	--	1.17E-04 lb/hr	1.03 lb/yr	1.03 lb/yr
GHGs as CO2e	8,350	36,572	35,367	154,908	154,908

Notes:
Emissions from auxiliary gas (propane) were calculated assuming 8,760 hours of operation per year. These emissions were compared with emissions from the STAR® reaction, and the largest emissions from these two scenarios were selected to represent worst-case emissions from Cape Fear STAR® process. The STAR® reaction resulted in the largest emissions for all pollutants.

Other emission sources at Cape Fear include fly ash and product handling and the screen and crusher diesel engines. Potential facility-wide emissions for all sources including the STAR® system, the diesel engines, and the ash/product handling systems are provided below in Table 2 below. As noted previously, an overview of the emission factors used in emission calculations are provided in Attachment 1 of this review and detailed emission calculations are contained in Appendix III of the addendum to permit application No. 1900134.18A. HAP and TAP emissions from ash and product handling were based on a site-specific ash analysis conducted at the Cape Fear site. The results of the ash analysis are provided in Attachment 2 to this permit review.

Table 2. Potential Facility-Wide Emissions				
Pollutant	STAR® System (tpy)	Diesel Engines (tpy)	Ash/Product Handling and Fugitives (tpy)	Total (tpy)
CO	98.1	14.1	--	112.2
NO_x	208.5	13.2	--	221.7
PM	70.4	1.1	37.7	109.2
PM10	64.8	1.1	32.6	98.5
PM2.5	37.3	1.1	18.1	56.6
SO_2	112.5	0.02	--	112.5
VOC	9.81	4.31	--	14.1
Lead	8.45E-06	1.1E-04	1.6E-03	1.70E-03
Sulfuric acid mist	0.438	--	--	0.438
Largest HAP	0.746 lb/yr (manganese)	28.3 lb/yr (formaldehyde)	7.28 lb/yr (chromium)	28.3 lb/yr (formaldehyde)
Total HAPs	1.03 lb/yr	94.1 lb/yr	34.5 lb/yr	130 lb/yr
GHGs as CO2e	154,908	1,961	--	156,869

A major stationary source under Prevention of Significant Deterioration (PSD) rules is defined as any one of 28 named source categories in 40 CFR 51.166(b)(1)(i)(a) with the potential to emit 100 tons per year of any regulated pollutant or any other stationary source with the potential to emit 250 tons per year of any PSD regulated pollutant (other than GHG).

Because the beneficiation process is not one of the 100 named PSD sources, emissions from the Cape Fear STAR® facility must exceed the PSD major source level of 250 tons per year of a PSD pollutant for the facility to be major for PSD. As shown in Table 2 above, potential emissions of all pollutants are less than 250 tons per year. Therefore, the Cape Fear STAR® facility is a minor source under PSD, and no PSD review is required.

5. Regulatory Evaluation

The Cape Fear STAR® facility will be subject to the following regulations.

- 15A NCAC 02D .0515, Particulates from Miscellaneous Industrial Processes – Numerous emission sources at the Cape Fear STAR® facility are subject to 02D .0515. This regulation limits particulate emissions from any stack, vent, or outlet, resulting from any industrial process, for which no other emission control standard is applicable. Allowable emissions of PM are calculated from the following equation:

  $E = 4.10(P)^{0.67}$ For process weight rates less than or equal to 30 tons/hr
  $E = 55.0(P)^{0.11} - 40$ For process weight rates greater than 30 tons/hr

  For both equations:
  E = allowable emission limit for particulate matter in lb/hr; and
  P = process weight rate in tons/hr.

  Table 3 below shows the process rate, allowable PM emission rate and post-control filterable PM emissions rate for each propose emission source subject to this rule. Based on PM emission calculations provided in the permit application for the sources listed in the table, the control devices are sufficient to ensure compliance.

  To ensure compliance, Duke Energy will be required to conduct and complete testing on the STAR® reactor (ID No. ES-5) and one of the two external heat exchangers (ID Nos. ES-8 and 9) within 90 days of the initial startup of these units. The initial startup is considered to be after these units have been through commissioning and turned over to operations. Duke Energy will also be required to conduct monthly external inspections of the control devices and ductwork and annual internal inspections of the control devices to ensure compliance with 02D .0515.

Table 3. Allowable PM Emissions under 15A NCAC 02D .0515					
Emission Source	**Process Rate (tph)**	**Allowable PM Emissions (lb/hr)**	**Potential PM Emissions (lb/hr)**	**Compliance Expected?**	**Comments**
Feed silo[1] (ID No. I-4) Filling Unloading	 125 75	 53.5 48.4	 6.73E-03 4.04E-03	 YES YES	 AP-42, Section 13.2.4 and 99% bin vent filter control
STAR® reactor (ID No. ES-5)	75	48.4	16.1	YES	Throughput based on 400,000 tons/yr of fly ash. (Gas fuel is not considered part of the throughput.) PM emissions based on an outlet loading of 0.025 gr/scf and a flow rate of 75,000 scfm.
FGD byproduct silo (ID No. ES-6)	TBD	TBD	0.045	YES	PM emissions based on an outlet loading of 0.005 gr/acf and a flow rate of 1,050 acfm.
FGD absorbent silo[1] (ID No. ES-7)	25	35.4	0.045	YES	PM emissions based on an outlet loading of 0.005 gr/scf and a flow rate of 1,050 scfm.
EHE Unit A / B (ID No. ES8 / ES9)	70	47.8	6.86	YES	PM emissions based on an outlet loading of 0.025 gr/scf and a flow rate of 32,000 scfm. Each unit is rated at 70 tph.
Transfer silo[1] (ID No. I-10) Filling Unloading	 125 75	 53.5 48.4	 6.73E-03 4.04E-03	 YES YES	 AP-42, Section 13.2.4 and 99% bin vent filter control
Storage dome[1] (ID No. ES-11) Filling Unloading	 75 275	 48.4 62.0	 4.04E-03 1.48E-02	 YES YES	 AP-42, Section 13.2.4 and 99% bin vent filter control
Loadout Silo[1] (ID No. I-12) Filling Unloading	 75 100	 48.4 51.3	 4.04E-03 5.83E-04	 YES YES	 AP-42, Section 13.2.4 and 99% bin vent filter control The loadout silo has two loadout spouts, each with a 100 tph unloading rate.
Screener (ID No. I-19)	165	56.4	0.363	YES	Emission Factor based on AP-42 11.19.2-2 controlled screening with wet suppression. Note ash is wet, so this assumption is valid.
Crusher (ID No. I-20)	165	56.4	0.198	YES	Emission Factor based on AP-42 11.19.2-2 controlled screening with wet suppression. Note ash is wet, so this assumption is valid.
Ball mill classifier[2] (ID No. I-24)	10	19.2	0.796	YES	PM emissions based on an outlet loading of 0.010 gr/acf and a flow rate of 9,287 acfm.
Ball mill feed silo[1] (ID No. I-25) Filling Unloading	 15 15	 25.2 25.2	 8.07E-04 8.07E-04	 YES YES	 AP-42, Section 13.2.4 and 99% bin vent filter control

[1] This emission source can comply with the allowable PM emission limit under 15A NCAC 02D .0515 without the use of the control device.
[2] The baghouse on the ball mill classifier is inherent to the process and is not considered a control device.

- A NCAC 02D .0516, Sulfur Dioxide Emissions from Combustion Sources – The STAR® process (ID No. ES-5) and the engines (ID Nos. I-22 and ES-23) at the Cape Fear STAR® facility are subject to 02D .0516 and must not exceed 2.3 pounds of SO_2 per million Btu heat input. Compliance with 02D .0516 for these emission sources are discussed below.

  STAR® system
  The STAR® system is initially fueled by propane and then becomes self-sustained by burning fly ash. Sulfur dioxide forms when the sulfur contained in the fuel and fly ash is oxidized during combustion. When only propane is fired in the STAR® reactor, compliance is achieved without emissions control. When the STAR® reactor is fueled by fly ash, the dry FGD scrubber is required to reduce SO_2 emissions by at least 60 percent to achieve compliance. As designed, the scrubber is expected to reduce the amount of SO_2 in the flue gas by 95 percent.

  Duke Energy intends to install and operate a continuous emission monitoring system (CEMs) for SO_2 on the STAR®. Compliance with the SO_2 emission standard will be demonstrated based on a three-hour rolling average of SO_2 measured by the CEM systems. As shown in Table 4, compliance with 02D .0516 is anticipated.

Table 4. Compliance with 15A NCAC 02D .0516

STAR® System Fuel	Maximum Sulfur Content	Heat Input Rate (mmBtu/hr)	Potential SO_2 before control (lb/mmBtu)	Potential SO_2 after control (lb/mmBtu)	Emission Limit (lb/mmBtu)	Compliance?
Fly ash	0.10% by weight	140	3.7	0.18	2.3	Yes
Propane low-NOx burners	0.1 gr/100 cubic feet	60	<0.00011	<0.00011		Yes

Notes:
- mmBtu = million of British thermal units
- Sulfur content of propane from default value in the DAQ emissions calculation spreadsheet for LPG combustion.
- A conservative sulfur content of 0.10% by weight in the ash is assumed, but the value will be verified during initial performance testing.
- Compliance for SO_2 emissions was determined from the following equation:

$$SO_2\ EF\ \frac{lb}{MMBtu} = \frac{10^6 Btu}{MMBtu} \times \frac{1\ lb\ Carbon}{14{,}500\ Btu} \times \frac{100\ lb\ Ash}{3.76\ lb\ Carbon} \times \frac{0.10\ lb\ S}{100\ lb\ Ash} \times \frac{64\ lb\ SO_2}{32\ lb\ S} \times (1 - SO_2CE)$$

As shown in the equation above, the SO_2 emission rate is based on 3.76% LOI, 0.10% fly ash sulfur content, 14,500 Btu/lb carbon heat value, and 95% scrubber control efficiency.

Screen engine (ID No. I-22) and crusher engine (ID No. ES-23)
Rule 15A NCAC 02D .0516(b) states, “A source subject to an emission standard for sulfur dioxide in Rules .0524, .0527, .1110, .1111, .1205, .1206, .1210, or .1211 of this Subchapter shall meet the standard in that particular rule instead of the standard in Paragraph (a) of this Rule.” Although the diesel engines for the crusher and screener are subject to 02D .0524, NSPS Subpart IIII only limits the sulfur content of the fuel and does not have a specific SO_2 emission standard. Thus, these engines are subject to 02D .0516.

No monitoring, recordkeeping, or reporting (MRR) is required when firing diesel fuel in these engines because of the low sulfur content of the fuel. This fuel is inherently low enough in sulfur that continued compliance is expected.

- 15A NCAC 02D .0521, Control of Visible Emission – The emission sources cited below are subject to 02D .0521. The equipment was manufactured after July 1, 1971 and must not have visible emissions of more than 20 percent opacity when averaged over a six-minute period, except as specified in 15A NCAC 02D .0521(d).
  - STAR® ash beneficiation process equipped with propane low-NOx start-up burners controlled by a FGD scrubber (ID No. CD-5A) and a baghouse (ID No. CD-5B)
  - FGD byproduct silo (ID No. ES-6) with bin vent filter (ID No. CD-6)
  - FGD hydrate lime silo (ID No. ES-7) with bin vent filter (ID No. CD-7)
  - Two external heat exchangers A and B (ID Nos. ES-8 and ES-9) with baghouses (ID Nos. CD-8 and CD-9)
  - Storage dome (ID No. ES-11) with bin vent filter (ID No. CD-11).

  Duke Energy will ensure compliance by operating the emission sources with the appropriate control devices and conducting monthly visible emission observations and associated recordkeeping. Compliance is anticipated.

- 15A NCAC 02D .0524, New Source Performance Standards – The diesel-fired engines for the screener and crusher (ID Nos. I-22 and ES-23) are subject to "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines," 40 CFR 60, Subpart IIII (NSPS Subpart IIII). More discussion of NSPS is provided below in Section 6.

- 15A NCAC 02D .0540, Particulates from Fugitive Dust Emission Sources – This rule requires owners and operators to not cause or allow fugitive dust emissions to cause or contribute to substantive complaints or excess visible emissions beyond the property boundary. The applicant has identified five sources of fugitive dust emissions associated with the proposed fly ash processing facility, as shown below. A permit condition will be included denoting requirements under 02D .0540. Compliance is expected.

Table 5. Fugitive Dust Sources

Fugitive Emission Source	Size	PM Emissions (tpy)	Comments
Wet Ash Receiving – Transfer to Shed (ID No. I-1)	n/a	0.041	Wet ash has a low fugitive dust emissions potential.
Unloading Pile (ID No. I-3)	0.33 acres	0.0074	
Ash Basin (ID No. I-15)	174 acres	0.21	Strong winds will kick up dust but are not expected to cause excessive dust offsite.
Ash Handling (ID No. I-16)	n/a	0.087	Not expected to cause excessive dust offsite.
Haul Roads (ID No. I-21)	n/a	0.894	Trucks will kick up dust when transporting some ash to an offsite location but are not expected to cause excessive dust offsite.

- 15A NCAC 02D .1100, Control of Toxic Air Pollutants – Duke Energy has demonstrated compliance with the acceptable ambient levels (AALs) for arsenic, benzene, beryllium, and sulfuric acid via air modeling. A detailed discussion of the NC Air Toxics is found in Section 7.

- 15A NCAC 02D .1111, National Emissions Standards for Hazardous Air Pollutants – The diesel-fired engines for the screener and crusher (ID Nos. I-22 and ES-23) are subject to "NESHAP for Stationary Reciprocating Internal Combustion Engines," 40 CFR Part 63 Subpart ZZZZ (GACT Subpart ZZZZ). More discussion of GACT is provided below in Section 6.

- 15A NCAC 02Q .0504, Option for Obtaining Construction and Operation Permit – Duke Energy must submit a Title V permit application within one year beginning operation of any of the permitted emission sources.

- 15A NCAC 02Q .0711, Emission Rates Requiring a Permit – The facility is subject for specific TAPs as discussed below in Section 7.

6. NSPS, NESHAP/MACT, NSR/PSD, 112(r), CAM

NSPS

The proposed facility's applicability to the following New Source Performance Standards (NSPS) is discussed below.

NSPS Subpart IIII

The screener diesel-fired engine (ID No. I-22) and the crusher diesel-fired engine (ID No. ES-23) are subject to "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines," 40 CFR 60, Subpart IIII (NSPS Subpart IIII). This regulation applies to owners and operators that commence construction of their compression ignition internal combustion engines after July 11, 2005, where the engines were manufactured after July 1, 2006, per 40 CFR 60.4200(a)(2)(ii). To comply with the emission standards for these engines, Duke Energy must purchase engines for the model year 2009 and later, certified to meet the emission standards for the same model year and maximum engine power in 40 CFR 89.112. The facility is expected to be in compliance with NSPS Subpart IIII for these engines

Furthermore, Duke Energy must operate the proposed engines per the manufacturer's instructions and burn only low-sulfur fuel with no more than 0.0015 percent sulfur. Compliance with all applicable emission limitations, monitoring, recordkeeping and reporting is anticipated for the engines.

NSPS Subpart CCCC

This rule establishes standards of performance for commercial and industrial solid waste incineration units (CISWI). In June 2015, DAQ determined STAR® reactors, such as the one to be built at Cape Fear, would not be subject to CISWI. The fly ash from a coal-fired power plant's particulate collection infrastructure and well as fly ash received from coal ash landfills or ponds, when used as an ingredient product in the reactor in accordance with 40 CFR 241.3(b)(4), is considered a non-hazardous secondary material (NHSM) and not a solid waste.[4]

[4] Letter from DAQ to the SEFA Group (June 10, 2015) Retrieved from https://files.nc.gov/ncdeq/Air%20Quality/permits/memos/NHSM_Determination_for_The_SEFA_Group-2015-06-10.pdf

NESHAPS/MACT

The Cape Fear STAR® facility will be a minor source of HAPs, with potential emissions (after controls and limitations) less than 10 tons per year for the largest HAP and less than 25 tons per year for total HAPs. The facility is subject to the following Generally Available Control Technology (GACT) standard as discussed below.

GACT Subpart ZZZZ

The screener diesel-fired engine (ID No. I-22) and the crusher diesel-fired engine (ID No. ES-23) are subject to the "NESHAP for Stationary Reciprocating Internal Combustion Engines, 40 CFR Part 63," GACT Subpart ZZZZ. They are considered new under GACT Subpart ZZZZ because they will be constructed on or after June 12, 2006. Per 40 CFR 63.590(c)(1), a new engine located at an area source of HAPs complies with GACT Subpart ZZZZ by meeting the applicable requirements of NSPS Subpart IIII. Compliance is expected.

NSR/PSD

A major stationary source under PSD rules is defined as any one of 28 named source categories in 40 CFR 51.166(b)(1)(i)(a) that has the potential to emit 100 tons per year of any regulated pollutant or any other stationary source that has the potential to emit 250 tons per year of any PSD regulated pollutant (other than GHG).

Fly ash beneficiation is not one of the 28 named source categories. Therefore, potential emissions of PSD regulated pollutants must exceed 250 tons per year for the Cape Fear STAR® facility to be considered a major PSD source. As shown above in Table 2, emissions of all PSD regulated pollutants (other than GHG) are below the new major source threshold. Although GHG emissions exceed the PSD threshold of 100,000 tons per year, the June 23, 2014 Supreme Court Decision in "Utility Air Regulatory Group v. EPA" indicates that EPA may not treat GHGs as an air pollutant for the specific purpose of determining whether a source is required to obtain a PSD permit. Therefore, the Cape Fear STAR® facility will be a minor source under PSD.

NO_x emissions from the facility are estimated at 221.7 tons per year or 88.7% of the PSD threshold of 250 tons per year. Most of these emissions are expected from the STAR® reactor. Because of the margin of compliance, Duke Energy will be required to conduct emission testing of NO_x from the STAR® reactor to verify compliance with PSD.

112(r)

The facility is not subject to Section 112(r) of the Clean Air Act because it does not store any of the regulated substances in quantities greater than the thresholds in 112(r).

CAM

The CAM rule (40 CFR 64; 15A NCAC 02D .0614) applies to each pollutant specific emissions unit (PSEU) at major TV facilities that meets all three following criteria:

- the unit is subject to any (non-exempt: e.g. pre November 15, 1990, Section 111 or Section 112 standard) emission limitation or standard for the applicable regulated pollutant.
- the unit uses any control device to achieve compliance with any such emission limitation or standard.

- The unit has potential pre-control device emissions of the applicable regulated air pollutant that are equal to or greater than 100 percent of the amount, in tons per year, required for a source to be classified as a major source (i.e., 100 tpy for criteria pollutants or 10/25 tpy for HAPs).

The STAR® system is subject to 02D .0516, is vented to a dry FGD scrubber to comply with this rule, and its potential pre-control SO_2 emissions are 2,249 tons per year, with an assumed 95% control efficiency. Because pre-controlled emissions are above 100 tons per year, the unit is subject to CAM for SO_2 emissions. Duke Energy intends to install a CEMs for SO_2 on the STAR® system to ensure compliance with 15A NCAC 02D .0516. In accordance with 40 CFR 64.2(b), CAM is not required for an emission standard for which a permit specifies a continuous compliance determination method, such as CEMs. The CEMs is considered sufficient monitoring such that a CAM plan is not required for this pollutant.

The STAR® system and other emission sources subject to 15A NCAC 02D .0515 and using PM controls for compliance were also evaluated for CAM. As shown in Table 6 below, the STAR system and the EHE Units A and B have pre-controlled emissions of PM above 100 tons per year, making these units subject to CAM for PM. CAM plans for these emission sources are required to be submitted with the application at the first renewal of the Title V operating permit.

Table 6. Evaluation of PM Emission Sources for Applicability to CAM

Emission Source	PM Emissions before Control		PM Emissions after Control		
	lb/hr	ton/yr	lb/hr	ton/yr	Comments
STAR® reactor (ID No. ES-5)	16,100	70,518	16.1	70.5	PM emissions based on an outlet loading of 0.025 gr/scf and a flow rate of 75,000 scfm. Control efficiency of baghouse is 99.9%.
EHE Unit A (ID No. ES8)	13,720	60,094	6.86	30.0	PM emissions based on an outlet loading of 0.025 gr/scf and a flow rate of 32,000 scfm. Control efficiency is 99.95%.
EHE Unit B (ID No. ES9)	13,720	60,094	6.86	30.0	PM emissions based on an outlet loading of 0.025 gr/scf and a flow rate of 32,000 scfm. Control efficiency is 99.95%.

Notes:
Other PM emission sources do not require controls to meet the allowable PM emission limit under 15A NCAC 02D .0515.

7. Facility Wide Air Toxics

As required by 15A NCAC 02Q .0704, new facilities that emit air toxics must be evaluated to ensure compliance with NC Air Toxics. Potential facility-wide TAPs emissions from the proposed fly ash processing facility and their associated (TPERs) are provided in Table 7.

Table 7. Potential TAP Emissions and Associated TPER

TAPs	Potential Emissions			TPER			Modeling Required?
	lb/hr	lb/day	lb/yr	lb/hr	lb/day	lb/yr	
Acetaldehyde	2.1E-03	5.04E-02	18.4	6.8			N
Acrolein	2.53E-04	6.08E-03	22.2	0.02			N
Arsenic	4.62E-04	1.11E-02	**4.03**			0.053	Y
Benzene	2.55E-03	6.13E-02	**22.4**			8.1	Y
Benzo(a)Pyrene	5.15E-07	1.23E-05	4.51E-03			2.2	N

Table 7. Potential TAP Emissions and Associated TPER							
TAPs	**Potential Emissions**			**TPER**			**Modeling Required?**
	lb/hr	**lb/day**	**lb/yr**	**lb/hr**	**lb/day**	**lb/yr**	
Beryllium	1.04E-04	2.50E-03	**0.91**			0.28	Y
1,3-Butadiene	1.07E-04	2.57E-03	9.37E-01			11	N
Cadmium	3.60E-05	8.64E-04	3.14E-01			0.37	N
Soluble chromate compounds	9.19E-05	2.20E-03	8.01E-01		0.013		N
Formaldehyde	3.23E-03	7.75E-02	28.3	0.04			N
Hydrogen chloride	1.41E-01	3.38	1,235	0.18			N
Hydrogen fluoride	7.56E-03	1.81E-01	66.2	0.064	0.63		N
Manganese	9.31E-04	2.23E-02	8.12		0.63		N
Mercury	1.03E-05	2.48E-04	9.03E-02		0.013		N
Nickel	7.77E-04	1.87E-02	6.78		0.13		N
Sulfuric Acid	**0.10**	**2.40**	876	0.025	0.25		Y
Toluene	1.12E-03	2.69E-02	9.81	14.4	98		N
Xylene (Mixed Isomers)	7.80E-04	1.87E-02	6.83	16.4	57		N

HCl and HF Emissions

Emissions of HF and HCl were specifically addressed based on a recommendation from the Hearing Officer’s report for the fly ash beneficiation project at Duke Energy Progress, LLC - H. F. Lee Steam Electric Plant. Coal combustion typically results in emissions of HCl and HF from chlorine and fluorine in the coal, and a portion of the HCl and HF could be absorbed in the fly ash. Although the fly ash analysis from the Cape Fear site did not indicate the presence of chlorides or fluorides (See Attachment 2), emissions of HCl and HF from the beneficiation process were estimated. The methodology used to calculate HCl and HF emissions is provided below:

Methodology for Estimating HCl Emissions

Parameter	**Value**	**Reference**
Cl concentration	10.933 mg/kg	Chloride concentration in fly ash at H.F. Lee site. Although no chloride was present in the fly ash at Cape Fear, this concentration is being used as a conservative estimate.
Cl molecular weight	35.45 g/mol	
HCl molecular weight	36.46 g/mol	
HCl Emission Factor	EF = (10.933 mg Cl /kg ash) * (1 kg/1E6 g) * (36.46 g HCl /mol)/(35.45 g Cl/ mol) EF = 1.12E-5 g HCl / g ash = 1.12E-5 lb HCl/ lb ash	
Throughput	125 ton/hr	This value is overly conservative. The designed process feedstock is 75 tons per hour, and the permitted process reactor rate will be 400,000 ton per year of fly ash (45.6 tons per hour).
Control efficiency	95 %	The control efficiency of the FGD is estimated at 95%, based on control efficiency for SO_2. The reactivity of calcium hydroxide (lime) is much greater for HCl than SO_2, so this percentage is a conservative estimate.
Emissions	E_{HCl} = (1.12E-5 lb HCl/lb ash) * (125 ton/hr) * (2000 lb/1ton) * (1-0.95) E_{HCL} = 0.14 lb/hr	

Methodology for Estimating HF Emissions

Parameter	Value	Reference
Cl concentration in fly ash	10.933 mg/kg	Chloride concentration in fly ash at H.F. Lee site. Although no chloride was present in the fly ash at Cape Fear, this concentration is being used as a conservative estimate.
Cl concentration in coal	1468 mg/kg	Chloride concentration in coal based on historical data from EPA's 1999 Mercury ICR
% Cl retained in fly ash	% = 10.933 mg/kg/ 1468 mg/kg = 0.74%	
F concentration in coal	77 mg/kg	Fluoride concentration in coal (EPRI)
F concentration in fly ash	Assuming fluoride is retained in fly ash in the same ratio as chloride: F_{Conc} = 77 mg/kg * 0.74/100 F_{Conc} = 0.57 mg/kg	
F molecular weight	18.998 g/mol	
HF molecular weight	20.0 g/mol	
HF Emission Factor	EF = (0.57 mg F /kg ash) * (1 kg/1E6 g) * (20.0 g HF /mol)/(18.998 g F/ mol) EF = 6.04E-7 g HF / g ash = 6.04E-7 lb HF /lb ash	
Throughput	125 ton/hr	This value is overly conservative. The designed process feedstock is 75 tons per hour, and the permitted process reactor rate will be 400,000 ton per year of fly ash (45.6 tons per hour).
Control efficiency	95 %	The control efficiency of the FGD is estimated at 95%, based on control efficiency for SO_2. The reactivity of calcium hydroxide (lime) is much greater for HF than SO_2, so this percentage is a conservative estimate.
Emissions	E_{HF} = (6.04E-7 lb HF/lb ash) * (125 ton/hr) * (2000 lb/1ton) * (1-0.95) E_{HF} = 0.0076 lb /hr	

Emissions of HCl and HF are below their respective TPERs, and no additional evaluation is required for these TAPs.

<u>Air Modeling</u>
As shown in Table 7 above, facility-wide emissions of four TAPs exceed their TPERs as listed in 15A NCAC 02Q .0711, and modeling was required for these TAPs. Facility-wide air modeling was conducted for arsenic, benzene, beryllium, and sulfuric acid. Although 15A NCAC 02Q .0702(a)(27) specifically exempts emission sources subject to 40 CFR Part 63 and those subject to a case-by-case MACT permit requirement, the Duke Energy elected to include these emission sources in its facility-wide modeling.

The air modeling was reviewed and approved by Nancy Jones of the AQAB in a memorandum dated December 4, 2018. As indicated in the memorandum, the modeling adequately demonstrates compliance, on a source-by-source basis, for all TAPs. The maximum impacts and the optimized impacts as a percentage of the acceptable ambient levels (AAL) are provided in Table 8 below. The optimized emission rates, which are included in Table 9 below, will be included as emissions limit under 15A NCAC 02Q .1100 in the air permit.

Table 8. Modeled Concentration and Optimized Modeled Impacts						
Pollutant	**Averaging Period**	**AAL ($\mu g/m^3$)**	**Maximum Impacts**		**Optimized Maximum Impacts**	
			Max. Conc. ($\mu g/m^3$)	**% of AAL**	**Max. Conc. ($\mu g/m^3$)**	**% of AAL**
Arsenic	Annual	2.1E-3	9.09E-5	4	2.06E-3	98
Benzene	Annual	0.12	1.69E-3	1	0.117	98
Beryllium	Annual	4.1E-3	2.04E-5	<1	4.01E-3	98
Sulfuric Acid	1-hour	100	6.36E-2	<1	98	98
	24-hour	12	3.11E-2	<1	11.8	98

Table 9. Permitted Limits of TAPs		
Emission Source	**Toxic Air Pollutant**	**Emission Limit**
Feed silo (ID No. I-4)	Arsenic	0.115 lb/yr
	Beryllium	0.212 lb/yr
STAR® process (ID No. ES-5)	Arsenic	0.606 lb/yr
	Beryllium	0.751 lb/yr
	Sulfuric Acid	154 lb/hr
		909 lb/day
FGD Byproduct Silo (ID No. ES-6)	Arsenic	1.70E-03 lb/yr
	Beryllium	2.09E-03 lb/yr
FGD hydrated lime silo (ID No. ES-7)	Arsenic	1.70E-02 lb/yr
	Beryllium	2.09E-02 lb/yr
EHE A (ID No. ES-8)	Arsenic	73 lb/yr
	Beryllium	135 lb/yr
EHE A (ID No. ES-9)	Arsenic	73 lb/yr
	Beryllium	135 lb/yr
EHE Silo (ID No. I-10)	Arsenic	0.115 lb/yr
	Beryllium	0.212 b/yr
Product Storage Dome (ID No. ES-11)	Arsenic	0.200 lb/yr
	Beryllium	0.371 lb/yr
Loadout Silo (ID No. I-12)	Arsenic	4.30E-02 lb/yr
	Beryllium	7.93E-02 lb/yr
Loadout silo spouts (ID No. ES-13 and ES-14, combined)	Arsenic	0.115 lb/yr
	Beryllium	0.213 lb/yr
Screener diesel-fired engine (ID No. I-22)	Arsenic	0.505 lb/yr
	Benzene	362 lb/yr
	Beryllium	3.30 lb/yr
Crusher diesel-fired engine (ID No. ES-23)	Arsenic	1.67 lb/yr
	Benzene	1,189 lb/yr
	Beryllium	10.8 lb/yr
Wet Ash Transfer (ID No. I-1)	Arsenic	0.152 lb/yr
	Beryllium	0.280 lb/yr
Unloading Pile (ID No. I-3)	Arsenic	1.79E-03 lb/yr
	Beryllium	3.30E-03 lb/yr
Ash Basin (ID No. I-15)	Arsenic	0.509 lb/yr
	Beryllium	0.946 lb/yr

Table 9. Permitted Limits of TAPs		
Emission Source	**Toxic Air Pollutant**	**Emission Limit**
Ash handling (ID No. I-16) (includes windrows, screener/crusher drop and screener/crusher stock pile)	Arsenic	0.213 lb/yr
	Beryllium	0.392 lb/yr
Screener (ID No. I-19)	Arsenic	3.87 lb/yr
	Beryllium	7.16 lb/yr
Crusher (ID No. I-20)	Arsenic	2.11 lb/yr
	Beryllium	3.90 lb/yr
Ball mall classifier (ID No. I-24)	Arsenic	8.48 lb/yr
	Beryllium	15.7 lb/yr
Ball mall feed silo (ID No. I-25)	Arsenic	1.72E-02 lb/yr
	Beryllium	3.18E-02 lb/yr

For the TAPs other than arsenic, benzene, beryllium, and sulfuric acid, Duke Energy made a demonstration that facility-wide actual emissions do not exceed the TPERs listed in 15A NCAC 02Q .0711(a). A condition will be included in the permit indicating Duke Energy must operate and maintain the Cape Fear STAR® facility in such a manner that emissions of these TAPs, including fugitive emissions, will not exceed TPERs listed in 15A NCAC 02Q .0711.

8. Facility Emissions Review

The proposed facility has not been constructed or operated. Potential emissions are provided in Table 10 below, and detailed emission calculations are contained in Appendix III of the addendum to permit application No. 1900134.18A. (The addendum was submitted on November 9, 2018).

Table 10. Potential Emissions from the Cape Fear STAR® Facility	
Pollutant	**Potential Emissions (tpy)**
CO	112.2
NO_x	221.7
PM	109.2
PM10	98.5
PM2.5	56.6
SO_2	112.5
VOC	14.1
Lead	1.70E-03
Sulfuric acid mist	0.438
Largest HAP	28.3 lb/yr (formaldehyde)
Total HAPs	130 lb/yr
GHGs as CO2e	156,869

9. Compliance Status

The proposed facility has not been constructed or operated. Thus, the compliance status will be determined during the first inspection. Compliance is anticipated.

10. Public Notice

In accordance with SESSION LAW 2016-95, HOUSE BILL 630 **(**Coal Ash Management Act of 2014) §130A-309.203, the Department shall hold a public hearing and accept written comment on the draft permit decision for a period of not less than 30 or more than 60 days after the Department issues a draft permit decision.

A notice for the public hearing for the draft permit along with the draft permit and review will be placed on the DAQ website on March 22, 2019, to provide for a 30-day comment period in accordance with the public participation procedures in 15A NCAC 02Q .0307. This public notice requirement is for a construction and operating permit under the 15A NCAC 02Q .0300 procedures. The EPA and the public will both have a 30-day comment. Duke Energy is required to submit a Title V permit application on or before 12 months after commencing operation. At the time of resubmittal of this application, the EPA will have a 45-day review period and the public will have another 30-day comment period.

11. Public Comments

Comments from the public hearing and comment period will be addressed in this section.

12. Other Regulatory Considerations

- A P.E. seal is required and was included in the permit application.
- A zoning consistency determination is required and was included in the permit application.
- A permit fee is required for the greenfield application, which will be processed and State modification (Title V fee class, Title V facility classification, State Permit "R" revision). A permit fee of $9,751 was received with the permit application for modification on July 24, 2018.

13. Recommendations

The greenfield permit application for Duke Energy Progress LLC – Cape Fear STAR® Ash Beneficiation Process in Moncure, Chatham County, NC has been reviewed by DAQ to determine compliance with all procedures and requirements. DAQ has determined this facility is complying or will achieve compliance, as specified in the permit, with all requirements that are applicable to the affected sources. The DAQ recommends the issuance of Air Permit No. 10583R00.

ATTACHMENT 1

Overview of Emission Factors used in Determining Emissions from Cape Fear STAR® Facility

Emission Source		Emission Factors/References	
STAR® Reactor			
ID No.	**Emission Source Description**	**Pollutant**	**Emission Factors/References**
ES-5	STAR® Reactor (140 million Btu/hour firing rate)	PM, PM10, PM2.5	Gas flow of 75,000 acfm and loading rate of 0.025 gr/acf PM10 = 92% of Total PM and PM2.5 = 53% of Total PM (AP-42 Table 1.1-6, Bituminous and Subbituminous Coal Combustion)
		SO_2	SO_2 emission rate is based on 3.76% LOI, 0.10% fly ash sulfur content, 14,500 Btu/lb carbon heat value, and 95% scrubber control efficiency.
		NO_x	Based on SEFA operation experience
		CO	Based on SEFA operation experience
		VOC	Based on SEFA operation experience
		GHG CO2e	CO2e emission rate is based on 14,500 Btu/lb carbon heat value and an emission factor of CO of 0.16 lb/mm Btu as provided by the SEFA group.
		H_2SO4	Based on SEFA stack test performed September 2016. Sulfuric Acid Mist was 0.05 lb/hr for contingency was doubled to 0.1 lb/hr.
		Pb and Metal HAPs/TAPs	Lime composition from EPRI PISCES Database (February 2003) Composition of Lime, Median Value Byproduct composition based on 10% inerts from fresh lime. Most metal emissions from the STAR® reactor are from hydrated lime introduced in the FGD system.
	Propane low-NO_x startup burner (60 million Btu/hour)	All	Emissions from worst case startup fuel: propane: AP-42, Table 1.5-1
Material Handling Emissions (PM, PM10, PM2.5, Pb, HAPs/TAPs)			
I-4	Feed Silo	AP-42, Section 13.2.4 and 99% bin vent filter control Duke site-specific average ash analysis	
I-6	FGD Byproduct Silo	PM emissions based on an outlet loading of 0.005 gr/acf and a flow rate of 1,050 acfm. PM10 = 92% of Total PM and PM2.5 = 53% of Total PM (AP-42 Table 1.1-6, Bituminous and Subbituminous Coal Combustion) Byproduct composition based on 10% inerts from fresh lime. Most metal emissions from the FGD Byproduct Silo are from hydrated lime introduced in the FGD system.	
I-7	FGD hydrate lime silo	PM emissions based on an outlet loading of 0.005 gr/acf and a flow rate of 1,050 acfm.	

Emission Source		Emission Factors/References
		Lime composition from EPRI PISCES Database (February 2003) Composition of Lime, Median Value
ES-8 and ES-9	EHE A and B	PM emissions based on an outlet loading of 0.025 gr/scf and a flow rate of 32,000 dscfm PM10 = 92% of Total PM and PM2.5 = 53% of Total PM (AP-42 Table 1.1-6, Bituminous and Subbituminous Coal Combustion) Duke site-specific average ash analysis
I-10	EHE Silo	AP-42, Section 13.2.4 and 99% bin vent filter control Duke site-specific average ash analysis
I-11	Product storage dome	
I-12	Load silo and loadout spouts	
I-19	Screener	AP-42, Table 11.19.2-2 Duke site-specific average ash analysis
I-20	Crusher	
Engine Emissions		
I-22	Diesel-fired screener engine (91 HP)	AP-42 Chapter 3.3, Table 3.3-1 (Gasoline & Diesel Industrial Engines); NSPS IIII, §89.112(a), Table 1 37<=kW<75, Tier 3
ES-23	Diesel-fired crusher engine (300 HP)	
Fugitive Emissions (PM, PM10, PM2.5, Pb, HAPs/TAPs)		
I-1	Wet ash receiving transfer to shed	AP-42 Section 13.2-4 (Aggregate Handling and Storage Piles) Duke Energy Average Ash Analysis
I-3	Unloading pile	AP-42 Section 13.2.5 (Industrial Wind Erosion) Duke Energy Average Ash Analysis
I-15	Ash basin	
I-16	Ash handling	AP-42 Section 13.2.4 (Aggregate Handling and Storage Piles) Duke Energy Average Ash Analysis
I-21	Haul roads	AP-42 Section 13.2.2 (Unpaved Roads) No Pb emissions

ATTACHMENT 2

Site-Specific Ash-Analysis for the Cape Fear STAR® Facility

The site-specific ash analysis submitted with the permit application received on July 24, 2018 was conducted incorrectly for all pollutants, with the exception of mercury. Duke Energy submitted a revised site-specific ash analysis with the permit addendum received on November 9, 2018. The values in the table below reflect the revised ash analysis for all pollutants, except for mercury. Mercury was originally analyzed by a separate and correct method, and an updated analysis was not required. The results from the original analysis were used for mercury.

Compound	HAP	TAP	Updated 3052 Analysis (ppm)	Concentration Used in Revised Analysis (ppm)
Antimony	Y		5.44	5.44
Arsenic	Y		53.67	53.67
Barium			NRA	NRA
Beryllium	Y	Y	11.43	11.43
Cadmium	Y	Y	3.25	3.25
Chromium	Y		99.98	99.98
Chromium VI	Y	Y	NRA	11.00
Cobalt	Y		41.48	41.48
Copper			NRA	NRA
Lead	Y		43.48	43.48
Manganese	Y	Y	98.98	98.98
Mercury	Y	Y	NRA	0.25
Molybdenum			NRA	NRA
Nickel	Y	Y	91.11	91.11
Selenium	Y		12.82	12.82
Silver			NRA	NRA
Thallium			NRA	NRA
Vanadium			NRA	NRA
Zinc			NRA	NRA

Notes:
- NRA means "No Result Available."
- Duke used results of 3052 for all compounds except Hg and Cr VI.
- CrVI was assumed to be 11% of total chromium. EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI.
- Mercury was originally analyzed by separate method, and the results from the original analysis were used for mercury.