DUKE ENERGY.

410 South Wilmington Street
Raleigh, NC 27601

Mailing Address:
PO Box 1551
Raleigh, NC 27602-1551

November 9, 2018

Mr. William Willets, Section Chief
Division of Air Quality
North Carolina Department of Environmental Quality
1641 Mail Service Center
Raleigh, North Carolina 27699-1641

Subject: Addendum to Air Quality Permit Application No. 1900134.18A
Duke Energy Progress, LLC
Cape Fear STAR® Ash Beneficiation Process
Moncure, Chatham County, North Carolina

Dear Mr. Willets:

Duke Energy Progress, LLC (Duke Energy) has enclosed for the North Carolina Division of Air Quality's (NC DAQ) review three copies of an Air Quality Permit Application Addendum (Application No. 1900134.18A) for the Cape Fear STAR® Ash Beneficiation Process.

Duke Energy is proposing to install and operate two additional insignificant activities at its proposed fly ash beneficiation facility in Moncure, NC: a Ball Mill Classifier and a Ball Mill Feed Silo.

Large or oversized material from the External Heat Exchanger (EHE) unit(s) will be pneumatically conveyed to the Ball Mill Feed Silo equipped with a high efficiency bin vent filter. From the mill feed silo, material will be transferred to the conical ball mill classifier via a rotary valve. Any oversized particles will be recirculated back to the mill via the primary classifier. A baghouse will then filter the remaining particulates from the air stream which shall then be conveyed to the EHE transfer silo.

The additional emission sources are insignificant activities per 15 NCAC 02Q .0503(8) as emissions from the Ball Mill Classifier and the Ball Mill Feed Silo are each less than five tons per year.

Duke Energy has also revised the toxic pollutant emission rate (TPER) analysis to include these new sources and to incorporate the results of a new ash analysis. Additionally, several sources originally classified as permitted equipment on Form A2 have been moved to the insignificant activities list on Form D4.

The permit application addendum package includes updated application forms (Attachment I), a revised Prevention of Significant Deterioration (PSD) applicability summary table (Attachment II), revised emission calculations (Attachment III), updated process flow diagrams and facility plot plan (Attachment IV), and an air dispersion modeling analysis with a facility-wide toxics pollutant emission rate analysis (Attachment V).

If you have any questions or need additional information, please contact Ms. Ann Quillian at (919) 546-6610 or ann.quillian@duke-energy.com.

Certification by Responsible Official:
"Based on information and belief formed after reasonable inquiry, I certify that the statements and information contained in this document are true, accurate and complete."

Sincerely,

Jon P. Kerin
Vice President - CCP Governance & Operational Support

Enclosures

Attachment I

Revised Permit Application Forms

(Replaces Appendix A of Air Permit Application 1900134.18A)

FORM A

GENERAL FACILITY INFORMATION

REVISED 09/22/16 | NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate | A

NOTE- APPLICATION WILL NOT BE PROCESSED WITHOUT THE FOLLOWING:

- ☑ Local Zoning Consistency Determination (new or modification only)
- ☑ Appropriate Number of Copies of Application
- ☑ Application Fee (If required)
- ☑ Responsible Official/Authorized Contact Signature
- ☑ P.E. Seal (if required)

Note: Zoning Consistency Determination and Application Fee were submitted with the July 2018 Permit Application No. 1900134.18A.

Received
NOV 09 2018
Air Permits Section

GENERAL INFORMATION

Legal Corporate/Owner Name: Duke Energy Progress LLC

Site Name: Cape Fear STAR® Ash Beneficiation Process

Site Address (911 Address) Line 1: 500 C P and L Road

Site Address Line 2:

City: Moncure | State: NC

Zip Code: 27559 | County: Chatham

CONTACT INFORMATION

Responsible Official/Authorized Contact:	***Invoice Contact:***
Name/Title: Jon Kerin / VP CCP Governance & Operational Support	Name/Title: Cynthia Winston / Manager - Permitting and Compliance
Mailing Address Line 1: 410 S. Wilmington Street	Mailing Address Line 1: 410 S. Wilmington Street
Mailing Address Line 2:	Mailing Address Line 2:
City: Raleigh State: NC Zip Code: 27601	City: Raleigh State: NC Zip Code: 27601
Primary Phone No.: (919) 546-6760 Fax No.:	Primary Phone No.: (919) 546-5538 Fax No.: (919) 546-6302
Secondary Phone No.:	Secondary Phone No.:
Email Address: Jon.Kerin@duke-energy.com	Email Address: Cynthia.Winston@duke-energy.com
Facility/Inspection Contact:	***Permit/Technical Contact:***
Name/Title: Steven Conner/Manager Environmental Services	Name/Title: Ann Quillian/Lead Environmental Specialist
Mailing Address Line 1: Duke Energy Progress, 1700 Dunnaway Road	Mailing Address Line 1: 410 S. Wilmington Street
Mailing Address Line 2:	Mailing Address Line 2:
City: Semora State: NC Zip Code: 27343	City: Raleigh State: NC Zip Code: 27601
Primary Phone No.: (336) 597-6213 Fax No.:	Primary Phone No.: (919) 546-6610 Fax No.: (919) 546-6302
Secondary Phone No.:	Secondary Phone No.:
Email Address: Steven.Conner@duke-energy.com	Email Address: Ann.Quillian@duke-energy.com

APPLICATION IS BEING MADE FOR

- ☑ New Non-permitted Facility/Greenfield
- ☐ Modification of Facility (permitted)
- ☐ Renewal Title V
- ☐ Renewal Non-Title V
- ☐ Name Change
- ☐ Ownership Change
- ☐ Administrative Amendment
- ☐ Renewal with Modification

FACILITY CLASSIFICATION AFTER APPLICATION (Check Only One)

- ☐ General
- ☐ Small
- ☐ Prohibitory Small
- ☐ Synthetic Minor
- ☑ Title V

FACILITY (Plant Site) INFORMATION

Describe nature of (plant site) operation(s): Coal ash beneficiation process

Facility ID No.: - NA New Facility

Primary SIC/NAICS Code: 4911 | Current/Previous Air Permit No.: NA | Expiration Date: NA

Facility Coordinates: Latitude: 35.587899 | Longitude: -79.033311

Does this application contain confidential data? ☐ YES ☑ NO ******If yes, please contact the DAQ Regional Office prior to submitting this application.***** **(See Instructions)**

PERSON OR FIRM THAT PREPARED APPLICATION

Person Name: Amy M. Marshall, PE | Firm Name: AECOM Technical Services of North Carolina

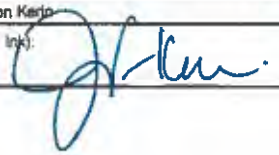
Mailing Address Line 1: 1600 Perimeter Park Drive | Mailing Address Line 2: Suite 400

City: Morrisville | State: NC | Zip Code: 27560 | County: Wake

Phone No.: (919) 461-1251 | Fax No.: (919) 461-1415 | Email Address: Amy.Marshall@aecom.com

SIGNATURE OF RESPONSIBLE OFFICIAL/AUTHORIZED CONTACT

Name (typed): Jon Kerin | Title: VP CCP Governance & Operational Support

X Signature(Blue Ink):  | Date: 11/09/18

Attach Additional Sheets As Necessary

FORMs A2, A3

EMISSION SOURCE LISTING FOR THIS APPLICATION - A2

112r APPLICABILITY INFORMATION - A3

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **A2**

EMISSION SOURCE LISTING: New, Modified, Previously Unpermitted, Replaced, Deleted

EMISSION SOURCE ID NO.	EMISSION SOURCE DESCRIPTION	CONTROL DEVICE ID NO.	CONTROL DEVICE DESCRIPTION
Equipment To Be ADDED By This Application (New, Previously Unpermitted, or Replacement)			
ES-5	STAR® Ash Beneficiation	CD-5A & CD-5B	Flue Gas Desulfurization Scrubber and Baghouse
ES-8	EHE - External Heat Exchanger A	CD-8	Baghouse
ES-9	EHE - External Heat Exchanger B	CD-9	Baghouse
ES-23	Crusher Diesel Engine	NA	NA
All remaining sources previously listed on Form A2 in Air Permit Application 1900134.18A are insignificant sources and have been moved to Form D4			
Existing Permitted Equipment To Be MODIFIED By This Application			
NA - New Facility			
Equipment To Be DELETED By This Application			
NA - New Facility			

112(r) APPLICABILITY INFORMATION **A 3**

Is your facility subject to 40 CFR Part 68 "Prevention of Accidental Releases" - Section 112(r) of the Federal Clean Air Act? ☐ Yes ☑ No

If No, please specify in detail how your facility avoided applicability: Facility does not use, store or handle any regulated substances above their respective threshold quantity.

If your facility is Subject to 112(r), please complete the following:

A. Have you already submitted a Risk Management Plan (RMP) to EPA Pursuant to 40 CFR Part 68.10 or Part 68.150?

☐ Yes ☐ No Specify required RMP submittal date: _____ If submitted, RMP submittal date: _____

B. Are you using administrative controls to subject your facility to a lesser 112(r) program standard?

☐ Yes ☐ No If yes, please specify: _____

C. List the processes subject to 112(r) at your facility:

PROCESS DESCRIPTION	PROCESS LEVEL (1, 2, or 3)	HAZARDOUS CHEMICAL	MAXIMUM INTENDED INVENTORY (LBS)

Attach Additional Sheets As Necessary

FORM B

SPECIFIC EMISSION SOURCE INFORMATION (REQUIRED FOR ALL SOURCES)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B**

EMISSION SOURCE DESCRIPTION: STAR® Ash Beneficiation	EMISSION SOURCE ID NO: ES-5
	CONTROL DEVICE ID NO(S): CD-5A & CD-5B
OPERATING SCENARIO 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-5

DESCRIBE IN DETAILTHE EMISSION SOURCE PROCESS (ATTACH FLOW DIAGRAM):
The STAR® Ash Beneficiation Process will process feedstock (of any carbon content) like flyash (wet or dry) along with other ingredient materials into a variety of commercial products.

TYPE OF EMISSION SOURCE (CHECK AND COMPLETE APPROPRIATE FORM B1-B9 ON THE FOLLOWING PAGES):

☐ Coal,wood,oil, gas, other burner (Form B1)	☐ Woodworking (Form B4)	☐ Manuf. of chemicals/coatings/inks (Form B7)
☐ Int.combustion engine/generator (Form B2)	☐ Coating/finishing/printing (Form B5)	☐ Incineration (Form B8)
☐ Liquid storage tanks (Form B3)	☐ Storage silos/bins (Form B6)	☑ Other (Form B9)

START CONSTRUCTION DATE: 2019	DATE MANUFACTURED: 2019
MANUFACTURER / MODEL NO.: TBD	EXPECTED OP. SCHEDULE: 24 HR/DAY 7 DAY/WK 52 WK/YR
IS THIS SOURCE SUBJECT TO? ☐ NSPS (SUBPARTS?):	☐ NESHAP (SUBPARTS?):
PERCENTAGE ANNUAL THROUGHPUT (%): DEC-FEB 25 MAR-MAY 25 JUN-AUG 25 SEP-NOV 25	

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

AIR POLLUTANT EMITTED	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
PARTICULATE MATTER (PM)	Worst Case: Propane Firing (AP-42) & Fly Ash (Manufacturer)	1.61E+01	7.04E+01	N/A	N/A	1.61E+01	7.04E+01
PARTICULATE MATTER<10 MICRONS (PM_{10})		1.48E+01	6.48E+01	NA	NA	1.48E+01	6.48E+01
PARTICULATE MATTER<2.5 MICRONS ($PM_{2.5}$)		8.52E+00	3.73E+01	NA	NA	8.52E+00	3.73E+01
SULFUR DIOXIDE (SO2)		2.57E+01	1.12E+02	5.14E+02	2.25E+03	2.57E+01	1.12E+02
NITROGEN OXIDES (NOx)		4.76E+01	2.08E+02	NA	NA	4.76E+01	2.08E+02
CARBON MONOXIDE (CO)		2.24E+01	9.81E+01	NA	NA	2.24E+01	9.81E+01
VOLATILE ORGANIC COMPOUNDS (VOC)		2.24E+00	9.81E+00	NA	NA	2.24E+00	9.81E+00
LEAD		1.93E-06	8.45E-06	NA	NA	1.93E-06	8.45E-06
H2SO4		1.00E-01	4.38E-01	NA	NA	1.00E-01	4.38E-01
CO2e		3.54E+04	1.55E+05	NA	NA	3.54E+04	1.55E+05

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

HAZARDOUS AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
Antimony	7440-36-0	Manufacturer Estimates and Compositional Analysis	5.46E-07	2.39E-06	NA	NA	5.46E-07	2.39E-06
Arsenic	7440-38-2		3.05E-06	1.34E-05	NA	NA	3.05E-06	1.34E-05
Beryllium	7440-41-7		4.34E-07	1.90E-06	NA	NA	4.34E-07	1.90E-06
Cadmium	7440-43-9		6.59E-07	2.89E-06	NA	NA	6.59E-07	2.89E-06
Chromium	7440-47-3		1.22E-05	5.35E-05	NA	NA	1.22E-05	5.35E-05
Cobalt	7440-48-4		3.21E-06	1.41E-05	NA	NA	3.21E-06	1.41E-05
Lead	7439-92-1		1.93E-06	8.45E-06	NA	NA	1.93E-06	8.45E-06
Manganese	7439-96-5		8.52E-05	3.73E-04	NA	NA	8.52E-05	3.73E-04
Mercury	7439-97-6		1.61E-08	7.04E-08	NA	NA	1.61E-08	7.04E-08
Nickel	7440-02-0		7.71E-06	3.38E-05	NA	NA	7.71E-06	3.38E-05
Selenium	7782-49-2		2.09E-06	9.15E-06	NA	NA	2.09E-06	9.15E-06

TOXIC AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

TOXIC AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS lb/hr	lb/day	lb/yr
H2SO4	7664-93-9	Manufacturer Estimates and Compositional Analysis	1.00E-01	2.40E+00	8.76E+02
Arsenic	7440-38-2		3.05E-06	7.33E-05	2.67E-02
Beryllium	7440-41-7		4.34E-07	1.04E-05	3.80E-03
Cadmium	7440-43-9		6.59E-07	1.58E-05	5.77E-03
Manganese	7439-96-5		8.52E-05	2.04E-03	7.46E-01
Mercury	7439-97-6		1.61E-08	3.86E-07	1.41E-04
Nickel	7440-02-0		7.71E-06	1.85E-04	6.76E-02

Attachments: (1) emissions calculations and supporting documentation; (2) indicate all requested state and federal enforceable permit limits (e.g. hours of operation, emission rates) and describe how these are monitored and with what frequency; and (3) describe any monitoring devices, gauges, or test ports for this source.

COMPLETE THIS FORM AND COMPLETE AND ATTACH APPROPRIATE B1 THROUGH B9 FORM FOR EACH SOURCE

Attach Additional Sheets As Necessary

FORM B9
EMISSION SOURCE (OTHER)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B9**

EMISSION SOURCE DESCRIPTION: STAR® Ash Beneficiation	EMISSION SOURCE ID NO: ES-5
	CONTROL DEVICE ID NO(S): CD-5A & CD-5B
OPERATING SCENARIO: 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-5

DESCRIBE IN DETAIL THE PROCESS (ATTACH FLOW DIAGRAM): The STAR® Ash Beneficiation Process will process feedstock (of any carbon content) like flyash (wet or dry) along with other ingredient materials into a variety of commercial products. The fly ash is not a fuel and does not undergo combustion. The propane burners are only used for startup or to maintain temperature in the reactor should the fly ash not contain enough carbon to be self-sustaining. These startup burners have a combined heating capacity of 60 million British thermal units per hour and are low-NOx burners.

MATERIALS ENTERING PROCESS - CONTINUOUS PROCESS		MAX. DESIGN	REQUESTED CAPACITY
TYPE	UNITS	CAPACITY (UNIT/HR)	LIMITATION(UNIT/HR)
Reactor - Feed Ash	MMBtu	140.0	NA
Propane	MMBtu	60	NA

MATERIALS ENTERING PROCESS - BATCH OPERATION		MAX. DESIGN	REQUESTED CAPACITY
TYPE	UNITS	CAPACITY (UNIT/BATCH)	LIMITATION (UNIT/BATCH)

MAXIMUM DESIGN (BATCHES / HOUR):	
REQUESTED LIMITATION (BATCHES / HOUR):	(BATCHES/YR):
FUEL USED: Propane	TOTAL MAXIMUM FIRING RATE (MILLION BTU/HR): 140
MAX. CAPACITY HOURLY FUEL USE: 663 gal/hr	REQUESTED CAPACITY ANNUAL FUEL USE: NA

COMMENTS:

Attach Additional Sheets as Necessary

FORM C9
CONTROL DEVICE (OTHER)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **C9**

CONTROL DEVICE ID NO: CD-5A	CONTROLS EMISSIONS FROM WHICH EMISSION SOURCE ID NO(S): ES-5
EMISSION POINT (STACK) ID NO(S): EP-5	POSITION IN SERIES OF CONTROLS: NO. 1 OF 2 UNITS
OPERATING SCENARIO:	
1 OF 1	P.E. SEAL REQUIRED (PER 2Q .0112)? ☑ YES ☐ NO

DESCRIBE CONTROL SYSTEM: Dry scrubber for SO2 removal

POLLUTANT(S) COLLECTED:	SO2			
BEFORE CONTROL EMISSION RATE (LB/HR):	513.6			
CAPTURE EFFICIENCY:	NA %	%	%	%
CONTROL DEVICE EFFICIENCY:	95 %	%	%	%
CORRESPONDING OVERALL EFFICIENCY:	NA %	%	%	%
EFFICIENCY DETERMINATION CODE:	2			
TOTAL AFTER CONTROL EMISSION RATE (LB/HR):	2.57E+01			

PRESSURE DROP (IN. H_20): 4 MIN 10 MAX	BULK PARTICLE DENSITY (LB/FT^3): 150
INLET TEMPERATURE (^oF): 300 MIN 400 MAX	OUTLET TEMPERATURE (^oF): 150 MIN 225 MAX
INLET AIR FLOW RATE (ACFM): 68,000 acfm op. (90,000 acfm design)	OUTLET AIR FLOW RATE (ACFM): 61,500 acfm op. (77,000 acfm design)
INLET AIR FLOW VELOCITY (FT/SEC):	OUTLET AIR FLOW VELOCITY (FT/SEC):
INLET MOISTURE CONTENT (%): 28.2% op. (25% design)	☑ FORCED AIR ☐ INDUCED AIR
COLLECTION SURFACE AREA (FT^2): NA	FUEL USED: NA / FUEL USAGE RATE: NA

DESCRIBE MAINTENANCE PROCEDURES: Maintenance to be performed as per manufacturing guidelines.

DESCRIBE ANY AUXILIARY MATERIALS INTRODUCED INTO THE CONTROL SYSTEM: None

DESCRIBE ANY MONITORING DEVICES, GAUGES, TEST PORTS, ETC: Typical for this type of installation.

ATTACH A DIAGRAM OF THE RELATIONSHIP OF THE CONTROL DEVICE TO ITS EMISSION SOURCE(S):

COMMENTS:

Attach manufacturer's specifications, schematics, and all other drawings necessary to describe this control.

Attach Additional Sheets As Necessary

FORM C1

CONTROL DEVICE (FABRIC FILTER)

REVISED 09/22/16 — **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** — **C1**

CONTROL DEVICE ID NO: CD-5B	CONTROLS EMISSIONS FROM WHICH EMISSION SOURCE ID NO(S): ES-5
EMISSION POINT (STACK) ID NO(S): EP-5	POSITION IN SERIES OF CONTROLS NO. 2 OF 2 UNITS
OPERATING SCENARIO:	
1 OF 1	P.E. SEAL REQUIRED (PER 2q .0112)? |✓| YES | | NO

DESCRIBE CONTROL SYSTEM:
A baghouse for particulate control on the STAR® Ash Beneficiation Process.

POLLUTANTS COLLECTED:	PM	PM10	PM2.5	
BEFORE CONTROL EMISSION RATE (LB/HR):	NA	NA	NA	
CAPTURE EFFICIENCY:	100 %	100 %	100 %	%
CONTROL DEVICE EFFICIENCY:	>99.9 %	>99.9 %	>99.9 %	%
CORRESPONDING OVERALL EFFICIENCY:	<=0.025 gr/acf %	<=0.025 gr/acf %	<=0.025 gr/acf %	%
EFFICIENCY DETERMINATION CODE:	2	2	2	
TOTAL AFTER CONTROL EMISSION RATE (LB/HR):	1.61E+01	1.48E+01	8.52E+00	

PRESSURE DROP (IN H_2O): MIN: MAX: Avg: 4-12 wc GAUGE? |✓|YES | | NO		
BULK PARTICLE DENSITY (LB/FT^3): 30	INLET TEMPERATURE (^{o}F): MIN: 180	MAX: 200 (400 design excursion)
POLLUTANT LOADING RATE: | | LB/HR |✓| GR/FT^3 371 (design)	OUTLET TEMPERATURE (^{o}F) MIN: 175	MAX: 195 (400 design excursion)
INLET AIR FLOW RATE (ACFM): 75,000 ACFM (Exhaust stack outlet flow rate)	FILTER OPERATING TEMP (^{o}F): 191	

NO. OF COMPARTMENTS: 4	NO. OF BAGS PER COMPARTMENT: 169	LENGTH OF BAG (IN.): 315
NO. OF CARTRIDGES:	FILTER SURFACE AREA PER CARTRIDGE (FT^2):	DIAMETER OF BAG (IN.): 6
TOTAL FILTER SURFACE AREA (FT^2): 26,790	AIR TO CLOTH RATIO: 2.87	
DRAFT TYPE: |✓| INDUCED/NEGATIVE |✓| FORCED/POSITIVE	FILTER MATERIAL: | | WOVEN |✓| FELTED	

DESCRIBE CLEANING PROCEDURES:

\|✓\| AIR PULSE — \| \| SONIC
\| \| REVERSE FLOW — \| \| SIMPLE BAG COLLAPSE
\| \| MECHANICAL/SHAKER — \| \| RING BAG COLLAPSE
\| \| OTHER:

DESCRIBE INCOMING AIR STREAM: The FGD byproduct entrained in the flue gas passes through baghouse for particulate control

PARTICLE SIZE DISTRIBUTION

SIZE (MICRONS)	WEIGHT % OF TOTAL	CUMULATIVE %
0-1		
1-10		
10-25		
25-50		
50-100		
>100		
	TOTAL = 100	

See attached jpeg.

ON A SEPARATE PAGE, ATTACH A DIAGRAM SHOWING THE RELATIONSHIP OF THE CONTROL DEVICE TO ITS EMISSION SOURCE(S):

COMMENTS:

Operating pollutant loading rate: 330 gr/ft^3

Attach Additional Sheets As Necessary

FORM B

SPECIFIC EMISSION SOURCE INFORMATION (REQUIRED FOR ALL SOURCES)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B**

EMISSION SOURCE DESCRIPTION: EHE - External Heat Exchanger A	EMISSION SOURCE ID NO: ES-8
	CONTROL DEVICE ID NO(S): CD-8
OPERATING SCENARIO 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-8

DESCRIBE IN DETAILTHE EMISSION SOURCE PROCESS (ATTACH FLOW DIAGRAM):
Process heat exchanger uses preheated air and hot water to dry ash.
Note: The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented below represent EHE-A operating at 70 TPH for 8,760 hours per year. The facility-wide total emissions in Form D1 include only one EHE unit operating at 70 TPH for 8,760 hours per year to avoid double counting.

TYPE OF EMISSION SOURCE (CHECK AND COMPLETE APPROPRIATE FORM B1-B9 ON THE FOLLOWING PAGES):

☐ Coal,wood,oil, gas, other burner (Form B1)	☐ Woodworking (Form B4)	☐ Manuf. of chemicals/coatings/inks (Form B7)
☐ Int.combustion engine/generator (Form B2)	☐ Coating/finishing/printing (Form B5)	☐ Incineration (Form B8)
☐ Liquid storage tanks (Form B3)	☐ Storage silos/bins (Form B6)	☑ Other (Form B9)

START CONSTRUCTION DATE: 2019 DATE MANUFACTURED: 2019

MANUFACTURER / MODEL NO.: NA EXPECTED OP. SCHEDULE: 24 HR/DAY 7 DAY/WK 52 WK/YR

IS THIS SOURCE SUBJECT TO? ☐ NSPS (SUBPARTS?): ☐ NESHAP (SUBPARTS?):

PERCENTAGE ANNUAL THROUGHPUT (%): DEC-FEB 25 MAR-MAY 25 JUN-AUG 25 SEP-NOV 25

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

AIR POLLUTANT EMITTED	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
PARTICULATE MATTER (PM)	Vendor/ AP-42	6.86E+00	3.00E+01	N/A	N/A	6.86E+00	3.00E+01
PARTICULATE MATTER<10 MICRONS (PM_{10})		6.31E+00	2.76E+01	N/A	N/A	6.31E+00	2.76E+01
PARTICULATE MATTER<2.5 MICRONS ($PM_{2.5}$)		3.63E+00	1.59E+01	N/A	N/A	3.63E+00	1.59E+01
SULFUR DIOXIDE (SO2)		N/A	N/A	N/A	N/A	N/A	N/A
NITROGEN OXIDES (NOx)		N/A	N/A	N/A	N/A	N/A	N/A
CARBON MONOXIDE (CO)		N/A	N/A	N/A	N/A	N/A	N/A
VOLATILE ORGANIC COMPOUNDS (VOC)		N/A	N/A	N/A	N/A	N/A	N/A
LEAD	Ash Analysis	2.98E-04	1.31E-03	N/A	N/A	2.98E-04	1.31E-03
OTHER		N/A	N/A	N/A	N/A	N/A	N/A

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

HAZARDOUS AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
Antimony	7440-36-0	Ash Analysis	3.73E-05	1.63E-04	N/A	N/A	3.73E-05	1.63E-04
Arsenic	7440-38-2		3.68E-04	1.61E-03	N/A	N/A	3.68E-04	1.61E-03
Beryllium	7440-41-7		7.84E-05	3.43E-04	N/A	N/A	7.84E-05	3.43E-04
Cadmium	7440-43-9		2.23E-05	9.75E-05	N/A	N/A	2.23E-05	9.75E-05
Chromium	7440-47-3		6.86E-04	3.00E-03	N/A	N/A	6.86E-04	3.00E-03
Chromium VI	SolCR6		7.54E-05	3.30E-04	N/A	N/A	7.54E-05	3.30E-04
Cobalt	7440-48-4		2.84E-04	1.25E-03	N/A	N/A	2.84E-04	1.25E-03
Lead	7439-92-1		2.98E-04	1.31E-03	N/A	N/A	2.98E-04	1.31E-03
Manganese	7439-96-5		6.79E-04	2.97E-03	N/A	N/A	6.79E-04	2.97E-03
Mercury	7439-97-6		1.71E-06	7.51E-06	N/A	N/A	1.71E-06	7.51E-06
Nickel	7440-02-0		6.25E-04	2.74E-03	N/A	N/A	6.25E-04	2.74E-03
Selenium	7782-49-2		8.79E-05	3.85E-04	N/A	N/A	8.79E-05	3.85E-04

TOXIC AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

TOXIC AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS lb/hr	lb/day	lb/yr
Arsenic	7440-38-2	Ash Analysis	3.68E-04	8.83E-03	3.22E+00
Beryllium	7440-41-7		7.84E-05	1.88E-03	6.86E-01
Cadmium	7440-43-9		2.23E-05	5.34E-04	1.95E-01
Chromium VI	SolCR6		7.54E-05	1.81E-03	6.61E-01
Manganese	7439-96-5		6.79E-04	1.63E-02	5.95E+00
Mercury	7439-97-6		1.71E-06	4.11E-05	1.50E-02
Nickel	7440-02-0		6.25E-04	1.50E-02	5.47E+00

Attachments: (1) emissions calculations and supporting documentation; (2) indicate all requested state and federal enforceable permit limits (e.g. hours of operation, emission rates) and describe how these are monitored and with what frequency; and (3) describe any monitoring devices, gauges, or test ports for this source.

COMPLETE THIS FORM AND COMPLETE AND ATTACH APPROPRIATE B1 THROUGH B9 FORM FOR EACH SOURCE

Attach Additional Sheets As Necessary

FORM B9
EMISSION SOURCE (OTHER)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B9**

EMISSION SOURCE DESCRIPTION: EHE - External Heat Exchanger A	EMISSION SOURCE ID NO: ES-8
	CONTROL DEVICE ID NO(S): CD-8
OPERATING SCENARIO: 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-8

DESCRIBE IN DETAIL THE PROCESS (ATTACH FLOW DIAGRAM): Process heat exchanger uses preheated air and hot water to dry ash.

MATERIALS ENTERING PROCESS - CONTINUOUS PROCESS		MAX. DESIGN	REQUESTED CAPACITY
TYPE	UNITS	CAPACITY (UNIT/HR)	LIMITATION(UNIT/HR)
Fly Ash	Tons	70.0	N/A

MATERIALS ENTERING PROCESS - BATCH OPERATION		MAX. DESIGN	REQUESTED CAPACITY
TYPE	UNITS	CAPACITY (UNIT/BATCH)	LIMITATION (UNIT/BATCH)

MAXIMUM DESIGN (BATCHES / HOUR):	
REQUESTED LIMITATION (BATCHES / HOUR):	(BATCHES/YR):
FUEL USED: NA	TOTAL MAXIMUM FIRING RATE (MILLION BTU/HR): NA
MAX. CAPACITY HOURLY FUEL USE: NA	REQUESTED CAPACITY ANNUAL FUEL USE: NA

COMMENTS: The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Each EHE unit will normally operate at 35 TPH.

Attach Additional Sheets as Necessary

FORM C1

CONTROL DEVICE (FABRIC FILTER)

REVISED 09/22/16 | **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** | **C1**

CONTROL DEVICE ID NO: CD-8	CONTROLS EMISSIONS FROM WHICH EMISSION SOURCE ID NO(S): ES-8
EMISSION POINT (STACK) ID NO(S): EP-8	POSITION IN SERIES OF CONTROLS NO. 1 OF 1 UNITS
OPERATING SCENARIO:	
1 OF 1	P.E. SEAL REQUIRED (PER 2q .0112)? |✓| YES | | NO

DESCRIBE CONTROL SYSTEM:
Baghouse for particulate control on EHE - External Heat Exchanger A.

POLLUTANTS COLLECTED:	PM	PM10	PM2.5	
BEFORE CONTROL EMISSION RATE (LB/HR):	NA	NA	NA	
CAPTURE EFFICIENCY:	NA %	NA %	NA %	%
CONTROL DEVICE EFFICIENCY:	99.95 %	99.95 %	99.95 %	%
CORRESPONDING OVERALL EFFICIENCY:	<=0.025 gr/dscf %	<=0.025 gr/dscf %	<=0.025 gr/dscf %	%
EFFICIENCY DETERMINATION CODE:	2	2	2	
TOTAL AFTER CONTROL EMISSION RATE (LB/HR):	6.86E+00	6.31E+00	3.63E+00	

PRESSURE DROP (IN H_20): MIN:	MAX: 10	GAUGE? |✓| YES | |NO	
BULK PARTICLE DENSITY (LB/FT^3): 60		INLET TEMPERATURE (^{o}F):	MIN: 180 MAX: 325
POLLUTANT LOADING RATE: NA | | LB/HR	| |GR/FT^3	OUTLET TEMPERATURE (^{o}F)	MIN: 150 MAX: 300
INLET AIR FLOW RATE (ACFM): 32,000 scfm		FILTER OPERATING TEMP (^{o}F): 250	
NO. OF COMPARTMENTS: 1	NO. OF BAGS PER COMPARTMENT: 528		LENGTH OF BAG (IN.): 26.25 Ft
NO. OF CARTRIDGES:	FILTER SURFACE AREA PER CARTRIDGE (FT^2):		DIAMETER OF BAG (IN.): 6
TOTAL FILTER SURFACE AREA (FT^2): 20,925	AIR TO CLOTH RATIO: 3:1		
DRAFT TYPE: |✓| INDUCED/NEGATIVE	| |FORCED/POSITIVE	FILTER MATERIAL:	| |WOVEN |✓| FELTED

DESCRIBE CLEANING PROCEDURES:

- ☑ AIR PULSE
- ☐ REVERSE FLOW
- ☐ MECHANICAL/SHAKER
- ☐ OTHER:
- ☐ SONIC
- ☐ SIMPLE BAG COLLAPSE
- ☐ RING BAG COLLAPSE

DESCRIBE INCOMING AIR STREAM: Air stream will contain fly ash.

PARTICLE SIZE DISTRIBUTION

SIZE (MICRONS)	WEIGHT % OF TOTAL	CUMULATIVE %
0-1		
1-10		
10-25		
25-50		
50-100		
>100		
	TOTAL = 100	

Particle Size Distribution 0-100 micron with an average of 20

ON A SEPARATE PAGE, ATTACH A DIAGRAM SHOWING THE RELATIONSHIP OF THE CONTROL DEVICE TO ITS EMISSION SOURCE(S):

COMMENTS:

Attach Additional Sheets As Necessary

FORM B

SPECIFIC EMISSION SOURCE INFORMATION (REQUIRED FOR ALL SOURCES)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B**

EMISSION SOURCE DESCRIPTION: EHE - External Heat Exchanger B	EMISSION SOURCE ID NO: ES-9
	CONTROL DEVICE ID NO(S): CD-9
OPERATING SCENARIO 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-9

DESCRIBE IN DETAILTHE EMISSION SOURCE PROCESS (ATTACH FLOW DIAGRAM):
Process heat exchanger uses preheated air and hot water to dry ash.
Note: The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented below represent EHE-B operating at 70 TPH for 8,760 hours per year. The facility-wide total emissions in Form D1 include only one EHE unit operating at 70 TPH for 8,760 hours per year to avoid double counting.

TYPE OF EMISSION SOURCE (CHECK AND COMPLETE APPROPRIATE FORM B1-B9 ON THE FOLLOWING PAGES):

- ☐ Coal,wood,oil, gas, other burner (Form B1)
- ☐ Int.combustion engine/generator (Form B2)
- ☐ Liquid storage tanks (Form B3)
- ☐ Woodworking (Form B4)
- ☐ Coating/finishing/printing (Form B5)
- ☐ Storage silos/bins (Form B6)
- ☐ Manuf. of chemicals/coatings/inks (Form B7)
- ☐ Incineration (Form B8)
- ☑ Other (Form B9)

START CONSTRUCTION DATE: 2019	DATE MANUFACTURED: 2019
MANUFACTURER / MODEL NO.: NA	EXPECTED OP. SCHEDULE: 24 HR/DAY 7 DAY/WK 52 WK/YR
IS THIS SOURCE SUBJECT TO? ☐ NSPS (SUBPARTS?):	☐ NESHAP (SUBPARTS?):
PERCENTAGE ANNUAL THROUGHPUT (%): DEC-FEB 25 MAR-MAY 25 JUN-AUG 25 SEP-NOV 25	

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

AIR POLLUTANT EMITTED	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
PARTICULATE MATTER (PM)	Vendor/ AP-42	6.86E+00	3.00E+01	N/A	N/A	6.86E+00	3.00E+01
PARTICULATE MATTER<10 MICRONS (PM_{10})		6.31E+00	2.76E+01	N/A	N/A	6.31E+00	2.76E+01
PARTICULATE MATTER<2.5 MICRONS ($PM_{2.5}$)		3.63E+00	1.59E+01	N/A	N/A	3.63E+00	1.59E+01
SULFUR DIOXIDE (SO2)		N/A	N/A	N/A	N/A	N/A	N/A
NITROGEN OXIDES (NOx)		N/A	N/A	N/A	N/A	N/A	N/A
CARBON MONOXIDE (CO)		N/A	N/A	N/A	N/A	N/A	N/A
VOLATILE ORGANIC COMPOUNDS (VOC)		N/A	N/A	N/A	N/A	N/A	N/A
LEAD	Ash Analysis	2.98E-04	1.31E-03	N/A	N/A	2.98E-04	1.31E-03
OTHER		N/A	N/A	N/A	N/A	N/A	N/A

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

HAZARDOUS AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
Antimony	7440-36-0	Ash Analysis	3.73E-05	1.63E-04	N/A	N/A	3.73E-05	1.63E-04
Arsenic	7440-38-2		3.68E-04	1.61E-03	N/A	N/A	3.68E-04	1.61E-03
Beryllium	7440-41-7		7.84E-05	3.43E-04	N/A	N/A	7.84E-05	3.43E-04
Cadmium	7440-43-9		2.23E-05	9.75E-05	N/A	N/A	2.23E-05	9.75E-05
Chromium	7440-47-3		6.86E-04	3.00E-03	N/A	N/A	6.86E-04	3.00E-03
Chromium VI	SolCR6		7.54E-05	3.30E-04	N/A	N/A	7.54E-05	3.30E-04
Cobalt	7440-48-4		2.84E-04	1.25E-03	N/A	N/A	2.84E-04	1.25E-03
Lead	7439-92-1		2.98E-04	1.31E-03	N/A	N/A	2.98E-04	1.31E-03
Manganese	7439-96-5		6.79E-04	2.97E-03	N/A	N/A	6.79E-04	2.97E-03
Mercury	7439-97-6		1.71E-06	7.51E-06	N/A	N/A	1.71E-06	7.51E-06
Nickel	7440-02-0		6.25E-04	2.74E-03	N/A	N/A	6.25E-04	2.74E-03
Selenium	7782-49-2		8.79E-05	3.85E-04	N/A	N/A	8.79E-05	3.85E-04

TOXIC AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

TOXIC AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS lb/hr	lb/day	lb/yr
Arsenic	7440-38-2	Ash Analysis	3.68E-04	8.83E-03	3.22E+00
Beryllium	7440-41-7		7.84E-05	1.88E-03	6.86E-01
Cadmium	7440-43-9		2.23E-05	5.34E-04	1.95E-01
Chromium VI	SolCR6		7.54E-05	1.81E-03	6.61E-01
Manganese	7439-96-5		6.79E-04	1.63E-02	5.95E+00
Mercury	7439-97-6		1.71E-06	4.11E-05	1.50E-02
Nickel	7440-02-0		6.25E-04	1.50E-02	5.47E+00

Attachments: (1) emissions calculations and supporting documentation; (2) indicate all requested state and federal enforceable permit limits (e.g. hours of operation, emission rates) and describe how these are monitored and with what frequency; and (3) describe any monitoring devices, gauges, or test ports for this source.

COMPLETE THIS FORM AND COMPLETE AND ATTACH APPROPRIATE B1 THROUGH B9 FORM FOR EACH SOURCE

Attach Additional Sheets As Necessary

FORM B9
EMISSION SOURCE (OTHER)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B9**

EMISSION SOURCE DESCRIPTION: EHE - External Heat Exchanger B	EMISSION SOURCE ID NO: ES-9
	CONTROL DEVICE ID NO(S): CD-9
OPERATING SCENARIO: 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-9

DESCRIBE IN DETAIL THE PROCESS (ATTACH FLOW DIAGRAM): Process heat exchanger uses preheated air and hot water to dry ash.

MATERIALS ENTERING PROCESS - CONTINUOUS PROCESS		MAX. DESIGN	REQUESTED CAPACITY
TYPE	UNITS	CAPACITY (UNIT/HR)	LIMITATION(UNIT/HR)
Fly Ash	Tons	70.0	N/A

MATERIALS ENTERING PROCESS - BATCH OPERATION		MAX. DESIGN	REQUESTED CAPACITY
TYPE	UNITS	CAPACITY (UNIT/BATCH)	LIMITATION (UNIT/BATCH)

MAXIMUM DESIGN (BATCHES / HOUR):	
REQUESTED LIMITATION (BATCHES / HOUR):	(BATCHES/YR):
FUEL USED: NA	TOTAL MAXIMUM FIRING RATE (MILLION BTU/HR): NA
MAX. CAPACITY HOURLY FUEL USE: NA	REQUESTED CAPACITY ANNUAL FUEL USE: NA

COMMENTS: The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Each EHE unit will normally operate at 35 TPH.

Attach Additional Sheets as Necessary

FORM C1

CONTROL DEVICE (FABRIC FILTER)

REVISED 09/22/16 | **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** | **C1**

CONTROL DEVICE ID NO: CD-9	CONTROLS EMISSIONS FROM WHICH EMISSION SOURCE ID NO(S): ES-9
EMISSION POINT (STACK) ID NO(S): EP-9	POSITION IN SERIES OF CONTROLS NO. 1 OF 1 UNITS
OPERATING SCENARIO:	
1 OF 1	P.E. SEAL REQUIRED (PER 2q .0112)? |✓|YES | |NO

DESCRIBE CONTROL SYSTEM:
Baghouse for particulate control on EHE - External Heat Exchanger B.

POLLUTANTS COLLECTED:	PM	PM10	PM2.5	
BEFORE CONTROL EMISSION RATE (LB/HR):	NA	NA	NA	
CAPTURE EFFICIENCY:	NA %	NA %	NA %	%
CONTROL DEVICE EFFICIENCY:	99.95 %	99.95 %	99.95 %	%
CORRESPONDING OVERALL EFFICIENCY:	<=0.025 gr/dscf %	<=0.025 gr/dscf %	<=0.025 gr/dscf %	%
EFFICIENCY DETERMINATION CODE:	2	2	2	
TOTAL AFTER CONTROL EMISSION RATE (LB/HR):	6.86E+00	6.31E+00	3.63E+00	

PRESSURE DROP (IN H_20): MIN:	MAX: 10	GAUGE? |✓| YES | |NO	
BULK PARTICLE DENSITY (LB/FT^3): 60		INLET TEMPERATURE (^oF):	MIN: 180 MAX: 325
POLLUTANT LOADING RATE: NA LB/HR	GR/FT^3	OUTLET TEMPERATURE (^oF)	MIN: 150 MAX: 300
INLET AIR FLOW RATE (ACFM): 32,000 scfm		FILTER OPERATING TEMP (^oF): 250	
NO. OF COMPARTMENTS: 1	NO. OF BAGS PER COMPARTMENT: 528		LENGTH OF BAG (IN.): 26.25 Ft
NO. OF CARTRIDGES:	FILTER SURFACE AREA PER CARTRIDGE (FT^2):		DIAMETER OF BAG (IN.): 6
TOTAL FILTER SURFACE AREA (FT^2): 20,925	AIR TO CLOTH RATIO: 3:1		
DRAFT TYPE: |✓|INDUCED/NEGATIVE | FORCED/POSITIVE		FILTER MATERIAL:	| |WOVEN |✓| FELTED

DESCRIBE CLEANING PROCEDURES:

\|✓\| AIR PULSE | \| SONIC
\| \|REVERSE FLOW | \| SIMPLE BAG COLLAPSE
\| \|MECHANICAL/SHAKER | \| RING BAG COLLAPSE
\| \|OTHER:

DESCRIBE INCOMING AIR STREAM: Air stream will contain fly ash.

PARTICLE SIZE DISTRIBUTION

SIZE (MICRONS)	WEIGHT % OF TOTAL	CUMULATIVE %
0-1		
1-10		
10-25		
25-50		
50-100		
>100		
	TOTAL = 100	

Particle Size Distribution 0-100 micron with an average of 20

ON A SEPARATE PAGE, ATTACH A DIAGRAM SHOWING THE RELATIONSHIP OF THE CONTROL DEVICE TO ITS EMISSION SOURCE(S):

COMMENTS:

Attach Additional Sheets As Necessary

FORM B

SPECIFIC EMISSION SOURCE INFORMATION (REQUIRED FOR ALL SOURCES)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B**

EMISSION SOURCE DESCRIPTION: Crusher Diesel Engine	EMISSION SOURCE ID NO: ES-23
	CONTROL DEVICE ID NO(S): NA
OPERATING SCENARIO 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-23

DESCRIBE IN DETAILTHE EMISSION SOURCE PROCESS (ATTACH FLOW DIAGRAM):
Diesel-fired crusher engine. Expected to operate 365 hours per year, however emissions presented below are on 8,760 hour per year operating basis.

TYPE OF EMISSION SOURCE (CHECK AND COMPLETE APPROPRIATE FORM B1-B9 ON THE FOLLOWING PAGES):

- ☐ Coal,wood,oil, gas, other burner (Form B1)
- ☑ Int.combustion engine/generator (Form B2)
- ☐ Liquid storage tanks (Form B3)
- ☐ Woodworking (Form B4)
- ☐ Coating/finishing/printing (Form B5)
- ☐ Storage silos/bins (Form B6)
- ☐ Manuf. of chemicals/coatings/inks (Form B7)
- ☐ Incineration (Form B8)
- ☐ Other (Form B9)

START CONSTRUCTION DATE: 2019	DATE MANUFACTURED: 2019
MANUFACTURER / MODEL NO.: TBD	EXPECTED OP. SCHEDULE: 1 HR/DAY 7 DAY/WK 52 WK/YR
IS THIS SOURCE SUBJECT TO? ☑ NSPS (SUBPARTS?): IIII	☑ NESHAP (SUBPARTS?): ZZZZ

PERCENTAGE ANNUAL THROUGHPUT (%): DEC-FEB 25 MAR-MAY 25 JUN-AUG 25 SEP-NOV 25

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

AIR POLLUTANT EMITTED	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
PARTICULATE MATTER (PM)	NSPS IIII	1.97E-01	8.64E-01	N/A	N/A	1.97E-01	8.64E-01
PARTICULATE MATTER<10 MICRONS (PM_{10})	NSPS IIII	1.97E-01	8.64E-01	N/A	N/A	1.97E-01	8.64E-01
PARTICULATE MATTER<2.5 MICRONS ($PM_{2.5}$)	NSPS IIII	1.97E-01	8.64E-01	N/A	N/A	1.97E-01	8.64E-01
SULFUR DIOXIDE (SO2)	AP-42	3.18E-03	1.39E-02	N/A	N/A	3.18E-03	1.39E-02
NITROGEN OXIDES (NOx)	NSPS IIII	2.32E+00	1.02E+01	N/A	N/A	2.32E+00	1.02E+01
CARBON MONOXIDE (CO)	NSPS IIII	2.47E+00	1.08E+01	N/A	N/A	2.47E+00	1.08E+01
VOLATILE ORGANIC COMPOUNDS (VOC)	AP-42	7.54E-01	3.30E+00	N/A	N/A	7.54E-01	3.30E+00
LEAD	AP-42	1.89E-05	8.28E-05	N/A	N/A	1.89E-05	8.28E-05
CO2e	GHGRP	3.44E+02	1.50E+03	N/A	N/A	3.44E+02	1.50E+03

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

HAZARDOUS AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) lb/hr	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS) tons/yr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) lb/hr	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITS) tons/yr
1,3-BUTADIENE	106-99-0	AP-42	8.21E-05	3.60E-04	N/A	N/A	8.21E-05	3.60E-04
ACETALDEHYDE	75-07-0	AP-42	1.61E-03	7.05E-03	N/A	N/A	1.61E-03	7.05E-03
ACROLEIN	107-02-8	AP-42	1.94E-04	8.51E-04	N/A	N/A	1.94E-04	8.51E-04
BENZENE	71-43-2	AP-42	1.96E-03	8.58E-03	N/A	N/A	1.96E-03	8.58E-03
FORMALDEHYDE	50-00-0	AP-42	2.48E-03	1.09E-02	N/A	N/A	2.48E-03	1.09E-02
TOLUENE	108-88-3	AP-42	8.59E-04	3.76E-03	N/A	N/A	8.59E-04	3.76E-03
XYLENE (MIXED ISOMERS)	1330-20-7	AP-42	5.99E-04	2.62E-03	N/A	N/A	5.99E-04	2.62E-03
ANTHRACENE	120-12-7	AP-42	3.93E-06	1.72E-05	N/A	N/A	3.93E-06	1.72E-05
ACENAPHTHYLENE	208-96-8	AP-42	1.06E-05	4.65E-05	N/A	N/A	1.06E-05	4.65E-05
ACENAPHTHENE	83-32-9	AP-42	2.98E-06	1.31E-05	N/A	N/A	2.98E-06	1.31E-05
FLUORENE	86-73-7	AP-42	6.13E-05	2.69E-04	N/A	N/A	6.13E-05	2.69E-04
PYRENE	129-00-0	AP-42	1.00E-05	4.40E-05	N/A	N/A	1.00E-05	4.40E-05

TOXIC AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

TOXIC AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS lb/hr	lb/day	lb/yr
1,3-BUTADIENE	106-99-0	AP-42	8.21E-05	1.97E-03	7.19E-01
ACETALDEHYDE	75-07-0	AP-42	1.61E-03	3.87E-02	1.41E+01
ACROLEIN	107-02-8	AP-42	1.94E-04	4.66E-03	1.70E+00
BENZENE	71-43-2	AP-42	1.96E-03	4.70E-02	1.72E+01
FORMALDEHYDE	50-00-0	AP-42	2.48E-03	5.95E-02	2.17E+01
TOLUENE	108-88-3	AP-42	8.59E-04	2.06E-02	7.52E+00
XYLENE (MIXED ISOMERS)	1330-20-7	AP-42	5.99E-04	1.44E-02	5.24E+00

Attachments: (1) emissions calculations and supporting documentation; (2) indicate all requested state and federal enforceable permit limits (e.g. hours of operation, emission rates) and describe how these are monitored and with what frequency; and (3) describe any monitoring devices, gauges, or test ports for this source.

COMPLETE THIS FORM AND COMPLETE AND ATTACH APPROPRIATE B1 THROUGH B9 FORM FOR EACH SOURCE

Attach Additional Sheets As Necessary

FORM B (Cont.)

SPECIFIC EMISSION SOURCE INFORMATION (REQUIRED FOR ALL SOURCES)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B**

EMISSION SOURCE DESCRIPTION: Crusher Diesel Engine	EMISSION SOURCE ID NO: ES-23
	CONTROL DEVICE ID NO(S): NA
OPERATING SCENARIO 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-23

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

HAZARDOUS AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL (AFTER CONTROLS / LIMITS)		POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITS)		(AFTER CONTROLS / LIMITS)	
			lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
BENZO(G,H,I)PERYLENE	191-24-2	AP-42	1.03E-06	4.50E-06	N/A	N/A	1.03E-06	4.50E-06
NAPHTHALENE	91-20-3	AP-42	1.78E-04	7.80E-04	N/A	N/A	1.78E-04	7.80E-04
PHENANTHRENE	85-01-8	AP-42	6.17E-05	2.70E-04	N/A	N/A	6.17E-05	2.70E-04
BENZ(A)ANTHRACENE	56-55-3	AP-42	3.53E-06	1.55E-05	N/A	N/A	3.53E-06	1.55E-05
BENZO(A)PHENANTHRENE (CHRYSENE)	218-01-9	AP-42	7.41E-07	3.25E-06	N/A	N/A	7.41E-07	3.25E-06
BENZO(A)PYRENE	50-32-8	AP-42	3.95E-07	1.73E-06	N/A	N/A	3.95E-07	1.73E-06
BENZO(B)FLUORANTHENE	205-99-2	AP-42	2.08E-07	9.12E-07	N/A	N/A	2.08E-07	9.12E-07
BENZO(J,K)FLUORENE (FLUORANTHENE)	206-44-0	AP-42	1.60E-05	7.00E-05	N/A	N/A	1.60E-05	7.00E-05
BENZO(K)FLUORANTHENE	207-08-9	AP-42	3.26E-07	1.43E-06	N/A	N/A	3.26E-07	1.43E-06
DIBENZO(A,H)ANTHRACENE	53-70-3	AP-42	1.22E-06	5.36E-06	N/A	N/A	1.22E-06	5.36E-06
INDENO(1,2,3-CD)PYRENE	193-39-5	AP-42	7.88E-07	3.45E-06	N/A	N/A	7.88E-07	3.45E-06
ARSENIC	7440-38-2	AP-42	8.40E-06	3.68E-05	N/A	N/A	8.40E-06	3.68E-05
BERYLLIUM	7440-41-7	AP-42	6.30E-06	2.76E-05	N/A	N/A	6.30E-06	2.76E-05
CADMIUM	7440-43-9	AP-42	6.30E-06	2.76E-05	N/A	N/A	6.30E-06	2.76E-05
CHROMIUM	SolCR6	AP-42	6.30E-06	2.76E-05	N/A	N/A	6.30E-06	2.76E-05
LEAD	7439-92-1	AP-42	1.89E-05	8.28E-05	N/A	N/A	1.89E-05	8.28E-05
MANGANESE	7439-96-5	AP-42	1.26E-05	5.52E-05	N/A	N/A	1.26E-05	5.52E-05
MERCURY	7439-97-6	AP-42	6.30E-06	2.76E-05	N/A	N/A	6.30E-06	2.76E-05
NICKEL	7440-02-0	AP-42	6.30E-06	2.76E-05	N/A	N/A	6.30E-06	2.76E-05
SELENIUM	7782-49-2	AP-42	3.15E-05	1.38E-04	N/A	N/A	3.15E-05	1.38E-04

TOXIC AIR POLLUTANT EMISSIONS INFORMATION FOR THIS SOURCE

TOXIC AIR POLLUTANT	CAS NO.	SOURCE OF EMISSION FACTOR	EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS		
			lb/hr	lb/day	lb/yr
BENZO(A)PYRENE	50-32-8	AP-42	3.95E-07	9.48E-06	3.46E-03
ARSENIC	7440-38-2	AP-42	8.40E-06	2.02E-04	7.36E-02
BERYLLIUM	7440-41-7	AP-42	6.30E-06	1.51E-04	5.52E-02
CADMIUM	7440-43-9	AP-42	6.30E-06	1.51E-04	5.52E-02
CHROMIUM VI	SolCR6	AP-42	6.30E-06	1.51E-04	5.52E-02
MANGANESE	7439-96-5	AP-42	1.26E-05	3.02E-04	1.10E-01
MERCURY	7439-97-6	AP-42	6.30E-06	1.51E-04	5.52E-02
NICKEL	7440-02-0	AP-42	6.30E-06	1.51E-04	5.52E-02

Attachments: (1) emissions calculations and supporting documentation; (2) indicate all requested state and federal enforceable permit limits (e.g. hours of operation, emission rates) and describe how these are monitored and with what frequency; and (3) describe any monitoring devices, gauges, or test ports for this source.

COMPLETE THIS FORM AND COMPLETE AND ATTACH APPROPRIATE B1 THROUGH B9 FORM FOR EACH SOURCE

Attach Additional Sheets As Necessary

FORM B2

EMISSION SOURCE (INTERNAL COMBUSTION ENGINES/TURBINES/GENERATORS)

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **B2**

EMISSION SOURCE DESCRIPTION: Crusher Diesel Engine	EMISSION SOURCE ID NO: ES-23
	CONTROL DEVICE ID NO(S): NA
OPERATING SCENARIO: 1 OF 1	EMISSION POINT (STACK) ID NO(S): EP-23

ENGINE SERVICE (CHECK ALL THAT APPLY) | ☐ EMERGENCY | ☐ PEAK SHAVER | ☐ SPACE HEAT | ☑ OTHER (DESCRIBE): Crusher operation | ☐ ELECTRICAL GENERATION

GENERATOR OUTPUT (KW):	ANTICIPATED ACTUAL HOURS OF OPERATION (HRS/YR): 365
ENGINE OUTPUT (HP): 300 bhp	

TYPE ICE: ☐ GASOLINE ENGINE | ☑ DIESEL ENGINE UP TO 600 HP | ☐ DIESEL ENGINE GREATER THAN 600 HP | ☐ DUAL FUEL ENGINE
☐ OTHER (DESCRIBE): _____ (complete below)

ENGINE TYPE | ☐ RICH BURN | ☐ LEAN BURN

EMISSION REDUCTION MODIFICATIONS | ☐ INJECTION TIMING RETARD | ☐ PREIGNITION CHAMBER COMBUSTION | ☐ OTHER _____

OR ☐ STATIONARY GAS TURBINE (complete below) | ☐ NATURAL GAS PIPELINE COMPRESSOR OR TURBINE (complete below)

FUEL: ☐ NATURAL GAS | ☐ OIL | ☐ OTHER (DESCRIBE):_____

CYCLE: ☐ COGENERATION | ☐ SIMPLE | ☐ REGENERATIVE | ☐ COMBINED

CONTROLS: ☐ WATER-STEAM INJECTION | ☐ UNCONTROLLED | ☐ LEAN-PREMIX | ☐ OTHER (SPECIFY):_____

ENGINE TYPE: ☐ 2-CYCLE LEAN BURN | ☐ 4-CYCLE LEAN | ☐ TURBINE | ☐ 4-CYCLE RICH BURN | ☐ OTHER (DESCRIBE): _____

CONTROLS: ☐ COMBUSTION MODIFICATIONS (DESCRIBE): _____
☐ NONSELECTIVE CATALYTIC REDUCTION ☐ SELECTIVE CATALYTIC REDUCTION
☐ CLEAN BURN AND PRECOMBUSTION CHAMBER | ☐ UNCONTROLLED

FUEL USAGE (INCLUDE STARTUP/BACKUP FUEL)

FUEL TYPE	UNITS	MAXIMUM DESIGN CAPACITY (UNIT/HR)	REQUESTED CAPACITY LIMITATION (UNIT/HR)
Diesel	gallons		NA

FUEL CHARACTERISTICS (COMPLETE ALL THAT ARE APPLICABLE)

FUEL TYPE	BTU/UNIT	UNITS	SULFUR CONTENT (% BY WEIGHT)
Diesel	19,300	pounds	0.0015%

MANUFACTURER'S SPECIFIC EMISSION FACTORS (IF AVAILABLE)

POLLUTANT	NOX	CO	PM	PM10	VOC	OTHER
EMISSION FACTOR LB/UNIT						
UNIT						

DESCRIBE METHODS TO MINIMIZE VISIBLE EMISSIONS DURING IDLING, OR LOW LOAD OPERATIONS:

COMMENTS:

Attach Additional Sheets As Necessary

FORM D1

FACILITY-WIDE EMISSIONS SUMMARY

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **D1**

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

	EMISSIONS (AFTER CONTROLS / LIMITATIONS)	**POTENTIAL EMISSIONS** (BEFORE CONTROLS / LIMITATIONS)	**POTENTIAL EMISSIONS** (AFTER CONTROLS / LIMITATIONS)
AIR POLLUTANT EMITTED	tons/yr	tons/yr	tons/yr
PARTICULATE MATTER (PM)	109	NA	109
PARTICULATE MATTER < 10 MICRONS (PM_{10})	98	NA	98
PARTICULATE MATTER < 2.5 MICRONS ($PM_{2.5}$)	56.6	NA	56.6
SULFUR DIOXIDE (SO_2)	112	NA	112
NITROGEN OXIDES (NOx)	222	NA	222
CARBON MONOXIDE (CO)	112	NA	112
VOLATILE ORGANIC COMPOUNDS (VOC)	14.1	NA	14.1
LEAD	1.70E-03	NA	1.70E-03
GREENHOUSE GASES (GHG) (SHORT TONS - CO2e)	156,869	NA	156,869
OTHER (SULFURIC ACID)	4.38E-01	NA	4.38E-01

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

		EMISSIONS (AFTER CONTROLS / LIMITATIONS)	**POTENTIAL EMISSIONS** (BEFORE CONTROLS / LIMITATIONS)	**POTENTIAL EMISSIONS** (AFTER CONTROLS / LIMITATIONS)
HAZARDOUS AIR POLLUTANT EMITTED	CAS NO.	tons/yr	tons/yr	tons/yr
1,3-Butadiene	106-99-0	4.69E-04	NA	4.69E-04
Acetaldehyde	75-07-0	9.19E-03	NA	9.19E-03
Acrolein	107-02-8	1.11E-03	NA	1.11E-03
Benzene	71-43-2	1.12E-02	NA	1.12E-02
Formaldehyde	50-00-0	1.41E-02	NA	1.41E-02
Toluene	108-88-3	4.90E-03	NA	4.90E-03
Xylene (Mixed Isomers)	1330-20-7	3.42E-03	NA	3.42E-03
Anthracene	120-12-7	2.24E-05	NA	2.24E-05

TOXIC AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

INDICATE REQUESTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS. EMISSIONS ABOVE THE TOXIC PERMIT EMISSION RATE (TPER) IN 15A NCAC 2Q .0711 MAY REQUIRE AIR DISPERSION MODELING. USE NETTING FORM D2 IF NECESSARY.

					Modeling Required ?		
TOXIC AIR POLLUTANT EMITTED	CAS NO.	lb/hr	lb/day	lb/year	Yes	No	
H2SO4	7664-93-9	1.00E-01	2.40E+00	8.76E+02	X		
1,3-Butadiene	106-99-0	1.07E-04	2.57E-03	9.37E-01		X	
Acetaldehyde	75-07-0	2.10E-03	5.04E-02	1.84E+01		X	
Acrolein	107-02-8	2.53E-04	6.08E-03	2.22E+00		X	
Benzene	71-43-2	2.55E-03	6.13E-02	2.24E+01	X		
Formaldehyde	50-00-0	3.23E-03	7.75E-02	2.83E+01		X	
Toluene	108-88-3	1.12E-03	2.69E-02	9.81E+00		X	
Xylene (Mixed Isomers)	1330-20-7	7.80E-04	1.87E-02	6.83E+00		X	
Benzo(a)Pyrene	50-32-8	5.15E-07	1.23E-05	4.51E-03		X	

COMMENTS:

The facility-wide total emissions in this Form include emissions from only one EHE unit operating at 70 TPH for 8,760 hours per year to avoid double counting.

Attach Additional Sheets As Necessary

FORM D1 (Cont.)
FACILITY-WIDE EMISSIONS SUMMARY

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **D1**

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

		EMISSIONS (AFTER CONTROLS / LIMITATIONS)	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITATIONS)	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITATIONS)
HAZARDOUS AIR POLLUTANT EMITTED	CAS NO.	tons/yr	tons/yr	tons/yr
Acenaphthylene	208-96-8	6.07E-05	NA	6.07E-05
Acenaphthene	83-32-9	1.70E-05	NA	1.70E-05
Fluorene	86-73-7	3.50E-04	NA	3.50E-04
Pyrene	129-00-0	5.73E-05	NA	5.73E-05
Benzo(g,h,i)Perylene	191-24-2	5.86E-06	NA	5.86E-06
Naphthalene	91-20-3	1.02E-03	NA	1.02E-03
Phenanthrene	85-01-8	3.52E-04	NA	3.52E-04
Benz(a)Anthracene	56-55-3	2.01E-05	NA	2.01E-05
Benzo(a)Phenanthrene (Chrysene)	218-01-9	4.23E-06	NA	4.23E-06
Benzo(a)Pyrene	50-32-8	2.25E-06	NA	2.25E-06
Benzo(b)Fluoranthene	205-99-2	1.19E-06	NA	1.19E-06
Benzo(j,k)Fluorene (Fluoranthene)	206-44-0	9.12E-05	NA	9.12E-05
Benzo(k)Fluoranthene	207-08-9	1.86E-06	NA	1.86E-06
Dibenzo(a,h)Anthracene	53-70-3	6.99E-06	NA	6.99E-06
Indeno(1,2,3-CD)Pyrene	193-39-5	4.50E-06	NA	4.50E-06
Antimony	7440-36-0	2.01E-04	NA	2.01E-04
Arsenic	7440-38-2	2.02E-03	NA	2.02E-03
Beryllium	7440-41-7	4.54E-04	NA	4.54E-04
Cadmium	7440-43-9	1.57E-04	NA	1.57E-04
Chromium	7440-47-3	3.73E-03	NA	3.73E-03
Chromium VI	SolCR6	4.00E-04	NA	4.00E-04
Cobalt	7440-48-4	1.52E-03	NA	1.52E-03
Lead	7439-92-1	1.70E-03	NA	1.70E-03
Manganese	7439-96-5	4.06E-03	NA	4.06E-03
Mercury	7439-97-6	4.51E-05	NA	4.51E-05
Nickel	7440-02-0	3.39E-03	NA	3.39E-03
Selenium	7782-49-2	6.56E-04	NA	6.56E-04

TOXIC AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

INDICATE REQUESTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS. EMISSIONS ABOVE THE TOXIC PERMIT EMISSION RATE (TPER) IN 15A NCAC 2Q .0711 MAY REQUIRE AIR DISPERSION MODELING. USE NETTING FORM D2 IF NECESSARY.

					Modeling Required ?		
TOXIC AIR POLLUTANT EMITTED	CAS NO.	lb/hr	lb/day	lb/year	Yes	No	
Arsenic	7440-38-2	4.62E-04	1.11E-02	4.03E+00	X		
Beryllium	7440-41-7	1.04E-04	2.50E-03	9.08E-01	X		
Cadmium	7440-43-9	3.60E-05	8.64E-04	3.14E-01		X	
Chromium VI	SolCR6	1.00E-04	2.40E-03	8.73E-01		X	
Manganese	7439-96-5	9.31E-04	2.23E-02	8.12E+00		X	
Mercury	7439-97-6	1.03E-05	2.48E-04	9.03E-02		X	
Nickel	7440-02-0	7.77E-04	1.87E-02	6.78E+00		X	

COMMENTS:

For the TPER analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

The facility-wide total emissions in this Form include emissions from only one EHE unit operating at 70 TPH for 8,760 hours per year to avoid double counting.

Attach Additional Sheets As Necessary

FORM D4

EXEMPT AND INSIGNIFICANT ACTIVITIES SUMMARY

ACTIVITIES EXEMPTED PER 2Q .0102 OR
INSIGNIFICANT ACTIVITIES PER 2Q .0503 FOR TITLE V SOURCES

DESCRIPTION OF EMISSION SOURCE	SIZE OR PRODUCTION RATE	BASIS FOR EXEMPTION OR INSIGNIFICANT ACTIVITY
1. I-1: Wet Ash Receiving (Transfer to Shed and Hopper) - Transfer of ash to storage shed (EP-1) and hopper (EP-2).	70 TPH	15A NCAC 02Q .0503(8)
2. I-3. Unloading Pile - windblown fugitive dust emissions (Unloading pile is not expected to be utilized; however, including as a permitted source for conservatism and flexibility in operations.)	0.33 acres	15A NCAC 02Q .0503(8)
3. I-4: Feed Silo - Ash feed silo is filled pneumatically and equipped with a bin vent filter capture device.	76,000 ft^3	15A NCAC 02Q .0503(8)
4. I-6: FGD Byproduct Silo - The byproduct solids from the dry FGD system are discharged from the fabric filter baghouse (CD-2B) into a byproduct storage silo.	3,192 ft^3	15A NCAC 02Q .0503(8)
5. I-7: FGD Hydrated Lime Silo - Storage of absorbent (hydrated lime) used in the dry FGD system.	6,000 ft^3	15A NCAC 02Q .0503(8)
6. I-10: EHE Silo - Transfer silo equipped with a bin vent product capture device.	125 TPH Fill Rate	15A NCAC 02Q .0503(8)
7. I-11: Product Storage Dome - Product storage dome equipped with a bin vent product capture device.	75 TPH Fill Rate	15A NCAC 02Q .0503(8)
8. I-12: Loadout Silo - Product loadout silo equipped with bin vent filer.	48,058 ft^3	15A NCAC 02Q .0503(8)
9. I-15: Ash Basin - Dust may be generated by wind erosion of exposed area within the ash basin.	174 acres	15A NCAC 02Q .0503(8)
10. I-16: Ash Handling - Emission sources (1) Ash is excavated and placed in windrows; (2) Windrowed ash is loaded into screener/crusher; (3) Screened and crushed ash is placed in stockpile within basin.	165 TPH	15A NCAC 02Q .0503(8)
11. I-19: Screener - Ash is screened to produce free flowing feedstock suitable for the STAR® Ash Beneficiation Process.	165 TPH	15A NCAC 02Q .0503(8)
12. I-20: Crusher - Ash is crushed to remove large particles and produce free flowing feedstock suitable for the STAR® Ash Beneficiation Process.	165 TPH	15A NCAC 02Q .0503(8)
13. I-21: Haul Roads - Ash is hauled from the basin to the STAR® Ash Beneficiation Process via trucks. Particulate emissions are generated from the haul roads from the force of the wheels on the road surface. This force causes pulverization of the surface material. The particles are lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents, which generate airborne particulate emissions.	Loaded truck: 50 tons Unloaded truck: 25 tons	15A NCAC 02Q .0503(8)
14. I-22 - Screener Diesel Engine - Expected to operate 2,600 hours per year, however emissions calculated based on 8,760 hour per year operating basis.	91 bhp	15A NCAC 02Q .0503(8)
15. I-24: Ball Mill Classifier - From the Ball Mill Feed Silo, material will be transferred to the conical ball mill (10 tph) via a rotary valve. Any oversized particles will be recirculated back to the mill via the primary classifier. The baghouse will then filter the remaining particulates from the air stream which shall then be conveyed to the EHE transfer silo.	10 TPH	15A NCAC 02Q .0503(8)
16. I-25: Ball Mill Feed Silo - Large or oversized material from the EHE unit(s) will be pneumatically conveyed at 15 tph to the Ball Mill Feed Silo equipped with a high efficiency bin vent filter.	15 TPH	15A NCAC 02Q .0503(8)

FORM D5

TECHNICAL ANALYSIS TO SUPPORT PERMIT APPLICATION

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **D5**

PROVIDE DETAILED TECHNICAL CALCULATIONS TO SUPPORT ALL EMISSION, CONTROL, AND REGULATORY DEMONSTRATIONS MADE IN THIS APPLICATION. INCLUDE A COMPREHENSIVE PROCESS FLOW DIAGRAM AS NECESSARY TO SUPPORT AND CLARIFY CALCULATIONS AND ASSUMPTIONS. ADDRESS THE FOLLOWING SPECIFIC ISSUES ON SEPARATE PAGES:

A **SPECIFIC EMISSIONS SOURCE (EMISSION INFORMATION) (FORM B and B1 through B9) -** SHOW CALCULATIONS USED, INCLUDING EMISSION FACTORS, MATERIAL BALANCES, AND/OR OTHER METHODS FROM WHICH THE POLLUTANT EMISSION RATES IN THIS APPLICATION WERE DERIVED. INCLUDE CALCULATION OF POTENTIAL BEFORE AND, WHERE APPLICABLE, AFTER CONTROLS. CLEARLY STATE ANY ASSUMPTIONS MADE AND PROVIDE ANY REFERENCES AS NEEDED TO SUPPORT MATERIAL BALANCE CALCULATIONS.

B **SPECIFIC EMISSION SOURCE (REGULATORY INFORMATION)(FORM E2 - TITLE V ONLY) -** PROVIDE AN ANALYSIS OF ANY REGULATIONS APPLICABLE TO INDIVIDUAL SOURCES AND THE FACILITY AS A WHOLE. INCLUDE A DISCUSSION OUTING METHODS (e.g. FOR TESTING AND/OR MONITORING REQUIREMENTS) FOR COMPLYING WITH APPLICABLE REGULATIONS, PARTICULARLY THOSE REGULATIONS LIMITING EMISSIONS BASED ON PROCESS RATES OR OTHER OPERATIONAL PARAMETERS. PROVIDE JUSTIFICATION FOR AVOIDANCE OF ANY FEDERAL REGULATIONS (PREVENTION OF SIGNIFICANT DETERIORATION (PSD), NEW SOURCE PERFORMANCE STANDARDS (NSPS), NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAPS), TITLE V), INCLUDING EXEMPTIONS FROM THE FEDERAL REGULATIONS WHICH WOULD OTHERWISE BE APPLICABLE TO THIS FACILITY. SUBMIT ANY REQUIRED INFORMATION TO DOCUMENT COMPLIANCE WITH ANY REGULATIONS. INCLUDE EMISSION RATES CALCULATED IN ITEM "A" ABOVE, DATES OF MANUFACTURE, CONTROL EQUIPMENT, ETC. TO SUPPORT THESE CALCULATIONS.

C **CONTROL DEVICE ANALYSIS (FORM C and C1 through C9) -** PROVIDE A TECHNICAL EVALUATION WITH SUPPORTING REFERENCES FOR ANY CONTROL EFFICIENCIES LISTED ON SECTION C FORMS, OR USED TO REDUCE EMISSION RATES IN CALCULATIONS UNDER ITEM "A" ABOVE. INCLUDE PERTINENT OPERATING PARAMETERS (e.g. OPERATING CONDITIONS, MANUFACTURING RECOMMENDATIONS, AND PARAMETERS AS APPLIED FOR IN THIS APPLICATION) CRITICAL TO ENSURING PROPER PERFORMANCE OF THE CONTROL DEVICES). INCLUDE AND LIMITATIONS OR MALFUNCTION POTENTIAL FOR THE PARTICULAR CONTROL DEVICES AS EMPLOYED AT THIS FACILITY. DETAIL PROCEDURES FOR ASSURING PROPER OPERATION OF THE CONTROL DEVICE INCLUDING MONITORING SYSTEMS AND MAINTENANCE TO BE PERFORMED.

D **PROCESS AND OPERATIONAL COMPLIANCE ANALYSIS - (FORM E3 - TITLE V ONLY)** - SHOWING HOW COMPLIANCE WILL BE ACHIEVED WHEN USING PROCESS, OPERATIONAL, OR OTHER DATA TO DEMONSTRATE COMPLIANCE. REFER TO COMPLIANCE REQUIREMENTS IN THE REGULATORY ANALYSIS IN ITEM "B" WHERE APPROPRIATE. LIST ANY CONDITIONS OR PARAMETERS THAT CAN BE MONITORED AND REPORTED TO DEMONSTRATE COMPLIANCE WITH THE APPLICABLE REGULATIONS.

E **PROFESSIONAL ENGINEERING SEAL -** PURSUANT TO 15A NCAC 2Q .0112 "APPLICATION REQUIRING A PROFESSIONAL ENGINEERING SEAL," A PROFESSIONAL ENGINEER REGISTERED IN NORTH CAROLINA SHALL BE REQUIRED TO SEAL TECHNICAL PORTIONS OF THIS APPLICATION FOR NEW SOURCES AND MODIFICATIONS OF EXISTING SOURCES. (SEE INSTRUCTIONS FOR FURTHER APPLICABILITY).

I, *Amy M. Marshall, P.E.* *attest that this application for* *the Cape Fear STAR® Facility* *has been reviewed by me and is accurate, complete and consistent with the information supplied in the engineering plans, calculations, and all other supporting documentation to the best of my knowledge. I further attest that to the best of my knowledge the proposed design has been prepared in accordance with the applicable regulations. Although certain portions of this submittal package may have been developed by other professionals, inclusion of these materials under my seal signifies that I have reviewed this material and have judged it to be consistent with the proposed design. Note: In accordance with NC General Statutes 143-215.6A and 143-215.6B, any person who knowingly makes any false statement, representation, or certification in any application shall be guilty of a Class 2 misdemeanor which may include a fine not to exceed $10,000 as well as civil penalties up to $25,000 per violation.*

(PLEASE USE BLUE INK TO COMPLETE THE FOLLOWING)

NAME: *Amy M. Marshall, P.E.*

DATE:

COMPANY: *AECOM Technical Services of NC, Inc.*

ADDRESS: *1600 Perimeter Park Dr., Morrisville NC 27560*

TELEPHONE: *919-461-1251*

SIGNATURE:

PAGES CERTIFIED: *Appendix A & Appendix B*

(IDENTIFY ABOVE EACH PERMIT FORM AND ATTACHMENT THAT IS BEING CERTIFIED BY THIS SEAL)

PLACE NORTH CAROLINA SEAL HERE

Attachment II

Revised Prevention of Significant Deterioration Applicability Summary Table

(Replaces Table 3-1 on page 3-3 of Air Permit Application 1900134.18A)

Table 3-1
PSD Applicability Summary

	Emissions, tpy									
	CO	NOx	SO_2	PM[1]	PM10[2]	PM2.5[3]	VOC	Pb	H_2SO4	CO2e
Potential Emissions	112	222	112	109	98	57	14.1	1.70E-03	4.38E-01	156,869
New Major Stationary Source Threshold	250	250	250	250	250	250	250	250	250	NA[4]
PSD Review Required	NO	NO	NO	NO	NO	NO	NO	NO	No	NA[4]

1. PM = PM (filterable)
2. PM_{10} (total) =PM(condensable) + PM_{10} (filterable)
3. $PM_{2.5}$ (total) =PM(condensable) + $PM_{2.5}$ (filterable)
4. Per the June 23, 2014 Supreme Court decision in Utility Air Regulatory Group v. EPA, 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.

Attachment III

Revised Project Emissions Calculations

(Replaces Appendix B of Air Permit Application 1900134.18A)

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Potential Emissions

Pollutant	HAP	TAP	Ash Basin (I-15, EP-15)				Unloading Pile (I-3, EP-3)				Screener (I-19, EP-19)				Screener Diesel Engine[1] (I-22, EP-22)			
			lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr
Criteria Pollutants																		
PM			4.78E-02	1.15E+00	4.19E+02	2.09E-01	1.68E-04	4.03E-03	1.47E+00	7.35E-04	3.63E-01	8.71E+00	3.18E+03	1.59E+00	5.98E-02	1.44E+00	5.24E+02	2.62E-01
PM10			2.39E-02	5.74E-01	2.09E+02	1.05E-01	8.39E-05	2.01E-03	7.35E-01	3.67E-04	1.22E-01	2.93E+00	1.07E+03	5.35E-01	5.98E-02	1.44E+00	5.24E+02	2.62E-01
PM2.5			3.59E-03	8.61E-02	3.14E+01	1.57E-02	1.26E-05	3.02E-04	1.10E-01	5.51E-05	8.25E-03	1.98E-01	7.23E+01	3.61E-02	5.98E-02	1.44E+00	5.24E+02	2.62E-01
CO															7.48E-01	1.80E+01	6.55E+03	3.28E+00
NOx															7.03E-01	1.69E+01	6.16E+03	3.08E+00
SO2															9.65E-04	2.32E-02	8.45E+00	4.23E-03
Lead	H		2.08E-06	4.99E-05	1.82E-02	9.11E-06	7.29E-09	1.75E-07	6.39E-05	3.19E-08	1.58E-05	3.79E-04	1.38E-01	6.91E-05	5.73E-06	1.38E-04	5.02E-02	2.51E-05
VOC															2.29E-01	5.49E+00	2.00E+03	1.00E+00
Greenhouse Gases																		
CO2															1.04E+02	2.49E+03	9.10E+05	4.55E+02
Methane															4.21E-03	1.01E-01	3.69E+01	1.85E-02
N2O															8.43E-04	2.02E-02	7.38E+00	3.69E-03
CO2e															1.04E+02	2.50E+03	9.13E+05	4.56E+02
Inorganic, Non-metal Compounds																		
H2SO4		T																
Organic Compounds																		
1,3-Butadiene	H	T													2.49E-05	5.98E-04	2.18E-01	1.09E-04
Acetaldehyde	H	T													4.89E-04	1.17E-02	4.28E+00	2.14E-03
Acrolein	H	T													5.89E-05	1.41E-03	5.16E-01	2.58E-04
Benzene	H	T													5.94E-04	1.43E-02	5.21E+00	2.60E-03
Formaldehyde	H	T													7.52E-04	1.80E-02	6.58E+00	3.29E-03
Toluene	H	T													2.61E-04	6.25E-03	2.28E+00	1.14E-03
Xylene (Mixed Isomers)	H	T													1.82E-04	4.36E-03	1.59E+00	7.95E-04
PAH/POM																		
Anthracene	H														1.19E-06	2.86E-05	1.04E-02	5.22E-06
Acenaphthylene	H														3.22E-06	7.74E-05	2.82E-02	1.41E-05
Acenaphthene	H														9.05E-07	2.17E-05	7.92E-03	3.96E-06
Fluorene	H														1.86E-05	4.46E-04	1.63E-01	8.15E-05
Pyrene	H														3.04E-06	7.31E-05	2.67E-02	1.33E-05
Benzo(g,h,i)Perylene	H														3.11E-07	7.48E-06	2.73E-03	1.36E-06
Naphthalene	H														5.40E-05	1.30E-03	4.73E-01	2.37E-04
Phenanthrene	H														1.87E-05	4.49E-04	1.64E-01	8.20E-05
Benz(a)Anthracene	H														1.07E-06	2.57E-05	9.37E-03	4.69E-06
Benzo(a)Phenanthrene (Chrysene)	H														2.25E-07	5.40E-06	1.97E-03	9.85E-07
Benzo(a)Pyrene	H	T													1.20E-07	2.87E-06	1.05E-03	5.25E-07
Benzo(b)Fluoranthene	H														6.31E-08	1.52E-06	5.53E-04	2.76E-07
Benzo(j,k)Fluorene (Fluoranthene)	H														4.85E-06	1.16E-04	4.25E-02	2.12E-05
Benzo(k)Fluoranthene	H														9.87E-08	2.37E-06	8.65E-04	4.32E-07
Dibenzo(a,h)Anthracene	H														3.71E-07	8.91E-06	3.25E-03	1.63E-06
Indeno(1,2,3-CD)Pyrene	H														2.39E-07	5.73E-06	2.09E-03	1.05E-06
Metals																		
Antimony	H		2.60E-07	6.25E-06	2.28E-03	1.14E-06	9.13E-10	2.19E-08	7.99E-06	4.00E-09	1.98E-06	4.74E-05	1.73E-02	8.65E-06				
Arsenic	H	T	2.57E-06	6.16E-05	2.25E-02	1.12E-05	9.00E-09	2.16E-07	7.89E-05	3.94E-08	1.95E-05	4.68E-04	1.71E-01	8.53E-05	2.55E-06	6.12E-05	2.23E-02	1.12E-05
Beryllium	H	T	5.47E-07	1.31E-05	4.79E-03	2.39E-06	1.92E-09	4.60E-08	1.68E-05	8.39E-09	4.15E-06	9.96E-05	3.63E-02	1.82E-05	1.91E-06	4.59E-05	1.67E-02	8.37E-06
Cadmium	H	T	1.55E-07	3.73E-06	1.36E-03	6.80E-07	5.45E-10	1.31E-08	4.77E-06	2.39E-09	1.18E-06	2.83E-05	1.03E-02	5.16E-06	1.91E-06	4.59E-05	1.67E-02	8.37E-06
Chromium	H		4.78E-06	1.15E-04	4.19E-02	2.09E-05	1.68E-08	4.02E-07	1.47E-04	7.35E-08	3.63E-05	8.71E-04	3.18E-01	1.59E-04	1.91E-06	4.59E-05	1.67E-02	8.37E-06
Chromium VI	H	T	5.26E-07	1.26E-05	4.61E-03	2.30E-06	1.84E-09	4.43E-08	1.62E-05	8.08E-09	3.99E-06	9.58E-05	3.50E-02	1.75E-05				
Cobalt	H		1.98E-06	4.76E-05	1.74E-02	8.69E-06	6.96E-09	1.67E-07	6.09E-05	3.05E-08	1.51E-05	3.61E-04	1.32E-01	6.59E-05				
Lead	H		2.08E-06	4.99E-05	1.82E-02	9.11E-06	7.29E-09	1.75E-07	6.39E-05	3.19E-08	1.58E-05	3.79E-04	1.38E-01	6.91E-05	5.73E-06	1.38E-04	5.02E-02	2.51E-05
Manganese	H	T	4.73E-06	1.14E-04	4.15E-02	2.07E-05	1.66E-08	3.98E-07	1.45E-04	7.27E-08	3.59E-05	8.62E-04	3.15E-01	1.57E-04	3.82E-06	9.17E-05	3.35E-02	1.67E-05
Mercury	H	T	1.20E-08	2.87E-07	1.05E-04	5.24E-08	4.19E-11	1.01E-09	3.67E-07	1.84E-10	9.08E-08	2.18E-06	7.95E-04	3.97E-07	1.91E-06	4.59E-05	1.67E-02	8.37E-06
Nickel	H	T	4.36E-06	1.05E-04	3.82E-02	1.91E-05	1.53E-08	3.67E-07	1.34E-04	6.69E-08	3.31E-05	7.94E-04	2.90E-01	1.45E-04	1.91E-06	4.59E-05	1.67E-02	8.37E-06
Selenium	H		6.13E-07	1.47E-05	5.37E-03	2.69E-06	2.15E-09	5.16E-08	1.88E-05	9.42E-09	4.65E-06	1.12E-04	4.08E-02	2.04E-05	9.56E-06	2.29E-04	8.37E-02	4.19E-05
Maximum Individual HAP			4.78E-06	1.15E-04	4.19E-02	2.09E-05	1.68E-08	4.02E-07	1.47E-04	7.35E-08	3.63E-05	8.71E-04	3.18E-01	1.59E-04	7.52E-04	1.80E-02	6.58E+00	3.29E-03
Total HAP Emissions			2.26E-05	5.43E-04	1.98E-01	9.91E-05	7.93E-08	1.90E-06	6.95E-04	3.47E-07	1.72E-04	4.12E-03	1.50E+00	7.52E-04	2.50E-03	6.00E-02	2.19E+01	1.09E-02

1 - In the TPER Analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

2 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide total calculation to avoid double counting.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Potential Emissions

Pollutant	HAP	TAP	Crusher (I-20, EP-20)				Crusher Diesel Engine[1] (ES-23, EP-23)				Haul Roads (Loaded) (I-21, EP-21)				Haul Roads (Unloaded) (I-21, EP-21)			
			lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr
Criteria Pollutants																		
PM			1.98E-01	4.75E+00	1.73E+03	8.67E-01	1.97E-01	4.73E+00	1.73E+03	8.64E-01	1.18E-01	2.83E+00	1.03E+03	5.16E-01	8.62E-02	2.07E+00	7.55E+02	3.78E-01
PM10			8.91E-02	2.14E+00	7.81E+02	3.90E-01	1.97E-01	4.73E+00	1.73E+03	8.64E-01	3.04E-02	7.29E-01	2.66E+02	1.33E-01	2.22E-02	5.34E-01	1.95E+02	9.74E-02
PM2.5			1.65E-02	3.96E-01	1.45E+02	7.23E-02	1.97E-01	4.73E+00	1.73E+03	8.64E-01	3.04E-03	7.30E-02	2.67E+01	1.33E-02	2.23E-03	5.35E-02	1.95E+01	9.76E-03
CO							2.47E+00	5.92E+01	2.16E+04	1.08E+01								
NOx							2.32E+00	5.56E+01	2.03E+04	1.02E+01								
SO2							3.18E-03	7.64E-02	2.79E+01	1.39E-02								
Lead	H		8.61E-06	2.07E-04	7.54E-02	3.77E-05	1.89E-05	4.54E-04	1.66E-01	8.28E-05								
VOC							7.54E-01	1.81E+01	6.61E+03	3.30E+00								
Greenhouse Gases																		
CO2							3.42E+02	8.22E+03	3.00E+06	1.50E+03								
Methane							1.39E-02	3.33E-01	1.22E+02	6.08E-02								
N2O							2.78E-03	6.67E-02	2.43E+01	1.22E-02								
CO2e							3.44E+02	8.25E+03	3.01E+06	1.50E+03								
Inorganic, Non-metal Compounds																		
H2SO4		T																
Organic Compounds																		
1,3-Butadiene	H	T					8.21E-05	1.97E-03	7.19E-01	3.60E-04								
Acetaldehyde	H	T					1.61E-03	3.87E-02	1.41E+01	7.05E-03								
Acrolein	H	T					1.94E-04	4.66E-03	1.70E+00	8.51E-04								
Benzene	H	T					1.96E-03	4.70E-02	1.72E+01	8.58E-03								
Formaldehyde	H	T					2.48E-03	5.95E-02	2.17E+01	1.09E-02								
Toluene	H	T					8.59E-04	2.06E-02	7.52E+00	3.76E-03								
Xylene (Mixed Isomers)	H	T					5.99E-04	1.44E-02	5.24E+00	2.62E-03								
PAH/POM																		
Anthracene	H						3.93E-06	9.42E-05	3.44E-02	1.72E-05								
Acenaphthylene	H						1.06E-05	2.55E-04	9.31E-02	4.65E-05								
Acenaphthene	H						2.98E-06	7.16E-05	2.61E-02	1.31E-05								
Fluorene	H						6.13E-05	1.47E-03	5.37E-01	2.69E-04								
Pyrene	H						1.00E-05	2.41E-04	8.79E-02	4.40E-05								
Benzo(g,h,i)Perylene	H						1.03E-06	2.46E-05	9.00E-03	4.50E-06								
Naphthalene	H						1.78E-04	4.27E-03	1.56E+00	7.80E-04								
Phenanthrene	H						6.17E-05	1.48E-03	5.41E-01	2.70E-04								
Benz(a)Anthracene	H						3.53E-06	8.47E-05	3.09E-02	1.55E-05								
Benzo(a)Phenanthrene (Chrysene)	H						7.41E-07	1.78E-05	6.49E-03	3.25E-06								
Benzo(a)Pyrene	H	T					3.95E-07	9.48E-06	3.46E-03	1.73E-06								
Benzo(b)Fluoranthene	H						2.08E-07	4.99E-06	1.82E-03	9.12E-07								
Benzo(j,k)Fluorene (Fluoranthene)	H						1.60E-05	3.84E-04	1.40E-01	7.00E-05								
Benzo(k)Fluoranthene	H						3.26E-07	7.81E-06	2.85E-03	1.43E-06								
Dibenzo(a,h)Anthracene	H						1.22E-06	2.94E-05	1.07E-02	5.36E-06								
Indeno(1,2,3-CD)Pyrene	H						7.88E-07	1.89E-05	6.90E-03	3.45E-06								
Metals																		
Antimony	H		1.08E-06	2.59E-05	9.44E-03	4.72E-06												
Arsenic	H	T	1.06E-05	2.55E-04	9.31E-02	4.65E-05	8.40E-06	2.02E-04	7.36E-02	3.68E-05								
Beryllium	H	T	2.26E-06	5.43E-05	1.98E-02	9.91E-06	6.30E-06	1.51E-04	5.52E-02	2.76E-05								
Cadmium	H	T	6.43E-07	1.54E-05	5.63E-03	2.82E-06	6.30E-06	1.51E-04	5.52E-02	2.76E-05								
Chromium	H		1.98E-05	4.75E-04	1.73E-01	8.67E-05	6.30E-06	1.51E-04	5.52E-02	2.76E-05								
Chromium VI	H	T	2.18E-06	5.23E-05	1.91E-02	9.54E-06												
Cobalt	H		8.21E-06	1.97E-04	7.19E-02	3.60E-05												
Lead	H		8.61E-06	2.07E-04	7.54E-02	3.77E-05	1.89E-05	4.54E-04	1.66E-01	8.28E-05								
Manganese	H	T	1.96E-05	4.70E-04	1.72E-01	8.58E-05	1.26E-05	3.02E-04	1.10E-01	5.52E-05								
Mercury	H	T	4.95E-08	1.19E-06	4.34E-04	2.17E-07	6.30E-06	1.51E-04	5.52E-02	2.76E-05								
Nickel	H	T	1.80E-05	4.33E-04	1.58E-01	7.90E-05	6.30E-06	1.51E-04	5.52E-02	2.76E-05								
Selenium	H		2.54E-06	6.09E-05	2.22E-02	1.11E-05	3.15E-05	7.56E-04	2.76E-01	1.38E-04								
Maximum Individual HAP			1.98E-05	4.75E-04	1.73E-01	8.67E-05	2.48E-03	5.95E-02	2.17E+01	1.09E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HAP Emissions			9.36E-05	2.25E-03	8.20E-01	4.10E-04	8.24E-03	1.98E-01	7.22E+01	3.61E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

1 - In the TPER Analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

2 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide total calculation to avoid double counting.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Potential Emissions

Pollutant	HAP	TAP	Ash Handling (I-16, EP-16, 17, 18)				Wet Ash Receiving (Transfer to Shed and Hopper) (I1, EP-1 & EP-2)				Feed Silo (I-4, EP-4)				STAR® Propane Firing (ES-5, EP-5)			
			lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr
Criteria Pollutants																		
PM			1.99E-02	4.78E-01	1.74E+02	8.72E-02	1.42E-02	3.42E-01	8.13E+01	4.07E-02	1.08E-02	2.58E-01	4.30E+01	2.15E-02	4.64E-01	1.11E+01	4.07E+03	2.03E+00
PM10			9.42E-03	2.26E-01	8.25E+01	4.13E-02	6.73E-03	1.62E-01	3.85E+01	1.92E-02	5.09E-03	1.22E-01	2.04E+01	1.02E-02	4.64E-01	1.11E+01	4.07E+03	2.03E+00
PM2.5			1.43E-03	3.42E-02	1.25E+01	6.25E-03	1.02E-03	2.45E-02	5.82E+00	2.91E-03	7.71E-04	1.85E-02	3.08E+00	1.54E-03	4.64E-01	1.11E+01	4.07E+03	2.03E+00
CO															4.97E+00	1.19E+02	4.36E+04	2.18E+01
NOx															8.62E+00	2.07E+02	7.55E+04	3.78E+01
SO2															6.63E-03	1.59E-01	5.81E+01	2.90E-02
Lead	H		8.66E-07	2.08E-05	7.58E-03	3.79E-06	6.19E-07	1.49E-05	3.54E-03	1.77E-06	4.68E-07	1.12E-05	1.87E-03	9.36E-07				
VOC															5.30E-01	1.27E+01	4.65E+03	2.32E+00
Greenhouse Gases																		
CO2															8.32E+03	2.00E+05	7.29E+07	3.64E+04
Methane															3.97E-01	9.52E+00	3.48E+03	1.74E+00
N2O															7.94E-02	1.90E+00	6.95E+02	3.48E-01
CO2e															8.35E+03	2.00E+05	7.31E+07	3.66E+04
Inorganic, Non-metal Compounds																		
H2SO4		T																
Organic Compounds																		
1,3-Butadiene	H	T																
Acetaldehyde	H	T																
Acrolein	H	T																
Benzene	H	T																
Formaldehyde	H	T																
Toluene	H	T																
Xylene (Mixed Isomers)	H	T																
PAH/POM																		
Anthracene	H																	
Acenaphthylene	H																	
Acenaphthene	H																	
Fluorene	H																	
Pyrene	H																	
Benzo(g,h,i)Perylene	H																	
Naphthalene	H																	
Phenanthrene	H																	
Benz(a)Anthracene	H																	
Benzo(a)Phenanthrene (Chrysene)	H																	
Benzo(a)Pyrene	H	T																
Benzo(b)Fluoranthene	H																	
Benzo(j,k)Fluorene (Fluoranthene)	H																	
Benzo(k)Fluoranthene	H																	
Dibenzo(a,h)Anthracene	H																	
Indeno(1,2,3-CD)Pyrene	H																	
Metals																		
Antimony	H		1.08E-07	2.60E-06	9.49E-04	4.75E-07	7.74E-08	1.86E-06	4.42E-04	2.21E-07	5.86E-08	1.41E-06	2.34E-04	1.17E-07				
Arsenic	H	T	1.07E-06	2.57E-05	9.36E-03	4.68E-06	7.64E-07	1.83E-05	4.36E-03	2.18E-06	5.78E-07	1.39E-05	2.31E-03	1.16E-06				
Beryllium	H	T	2.28E-07	5.46E-06	1.99E-03	9.97E-07	1.63E-07	3.90E-06	9.29E-04	4.65E-07	1.23E-07	2.95E-06	4.92E-04	2.46E-07				
Cadmium	H	T	6.46E-08	1.55E-06	5.66E-04	2.83E-07	4.62E-08	1.11E-06	2.64E-04	1.32E-07	3.49E-08	8.39E-07	1.40E-04	6.99E-08				
Chromium	H		1.99E-06	4.78E-05	1.74E-02	8.72E-06	1.42E-06	3.41E-05	8.13E-03	4.07E-06	1.08E-06	2.58E-05	4.30E-03	2.15E-06				
Chromium VI	H	T	2.19E-07	5.26E-06	1.92E-03	9.59E-07	1.57E-07	3.76E-06	8.94E-04	4.47E-07	1.18E-07	2.84E-06	4.73E-04	2.37E-07				
Cobalt	H		8.26E-07	1.98E-05	7.24E-03	3.62E-06	5.90E-07	1.42E-05	3.37E-03	1.69E-06	4.46E-07	1.07E-05	1.79E-03	8.93E-07				
Lead	H		8.66E-07	2.08E-05	7.58E-03	3.79E-06	6.19E-07	1.49E-05	3.54E-03	1.77E-06	4.68E-07	1.12E-05	1.87E-03	9.36E-07				
Manganese	H	T	1.97E-06	4.73E-05	1.73E-02	8.63E-06	1.41E-06	3.38E-05	8.05E-03	4.02E-06	1.07E-06	2.56E-05	4.26E-03	2.13E-06				
Mercury	H	T	4.98E-09	1.19E-07	4.36E-05	2.18E-08	3.56E-09	8.54E-08	2.03E-05	1.02E-08	2.69E-09	6.46E-08	1.08E-05	5.38E-09				
Nickel	H	T	1.81E-06	4.35E-05	1.59E-02	7.95E-06	1.30E-06	3.11E-05	7.41E-03	3.70E-06	9.81E-07	2.35E-05	3.92E-03	1.96E-06				
Selenium	H		2.55E-07	6.13E-06	2.24E-03	1.12E-06	1.82E-07	4.38E-06	1.04E-03	5.21E-07	1.38E-07	3.31E-06	5.52E-04	2.76E-07				
Maximum Individual HAP			1.99E-06	4.78E-05	1.74E-02	8.72E-06	1.42E-06	3.41E-05	8.13E-03	4.07E-06	1.08E-06	2.58E-05	4.30E-03	2.15E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HAP Emissions			9.42E-06	2.26E-04	8.25E-02	4.12E-05	6.73E-06	1.62E-04	3.85E-02	1.92E-05	5.09E-06	1.22E-04	2.04E-02	1.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

1 - In the TPER Analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

2 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide total calculation to avoid double counting.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Potential Emissions

Pollutant	HAP	TAP	STAR® Ash Beneficiation (ES-5, EP-5)				STAR® Worst Case (Ash Beneficiation and Propane Firing) (ES-5, EP-5)				FGD Byproduct Silo (I-6, EP-6)				FGD Hydrated Lime (I-7, EP-7)			
			lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr
Criteria Pollutants																		
PM			1.61E+01	3.86E+02	1.41E+05	7.04E+01	1.61E+01	3.86E+02	1.41E+05	7.04E+01	4.50E-02	1.08E+00	3.94E+02	1.97E-01	4.50E-02	1.08E+00	3.94E+02	1.97E-01
PM10			1.48E+01	3.55E+02	1.30E+05	6.48E+01	1.48E+01	3.55E+02	1.30E+05	6.48E+01	4.14E-02	9.94E-01	3.63E+02	1.81E-01	4.14E-02	9.94E-01	3.63E+02	1.81E-01
PM2.5			8.52E+00	2.04E+02	7.46E+04	3.73E+01	8.52E+00	2.04E+02	7.46E+04	3.73E+01	2.39E-02	5.72E-01	2.09E+02	1.04E-01	2.39E-02	5.72E-01	2.09E+02	1.04E-01
CO			2.24E+01	5.38E+02	1.96E+05	9.81E+01	2.24E+01	5.38E+02	1.96E+05	9.81E+01								
NOx			4.76E+01	1.14E+03	4.17E+05	2.08E+02	4.76E+01	1.14E+03	4.17E+05	2.08E+02								
SO2			2.57E+01	6.16E+02	2.25E+05	1.12E+02	2.57E+01	6.16E+02	2.25E+05	1.12E+02								
Lead	H		1.93E-06	4.63E-05	1.69E-02	8.45E-06	1.93E-06	4.63E-05	1.69E-02	8.45E-06	5.40E-09	1.30E-07	4.73E-05	2.37E-08	5.40E-08	1.30E-06	4.73E-04	2.37E-07
VOC			2.24E+00	5.38E+01	1.96E+04	9.81E+00	2.24E+00	5.38E+01	1.96E+04	9.81E+00								
Greenhouse Gases																		
CO2			3.54E+04	8.49E+05	3.10E+08	1.55E+05	3.54E+04	8.49E+05	3.10E+08	1.55E+05								
Methane							3.97E-01	9.52E+00	3.48E+03	1.74E+00								
N2O							7.94E-02	1.90E+00	6.95E+02	3.48E-01								
CO2e			3.54E+04	8.49E+05	3.10E+08	1.55E+05	3.54E+04	8.49E+05	3.10E+08	1.55E+05								
Inorganic, Non-metal Compounds																		
H2SO4		T	1.00E-01	2.40E+00	8.76E+02	4.38E-01	1.00E-01	2.40E+00	8.76E+02	4.38E-01								
Organic Compounds																		
1,3-Butadiene	H	T																
Acetaldehyde	H	T																
Acrolein	H	T																
Benzene	H	T																
Formaldehyde	H	T																
Toluene	H	T																
Xylene (Mixed Isomers)	H	T																
PAH/POM																		
Anthracene	H																	
Acenaphthylene	H																	
Acenaphthene	H																	
Fluorene	H																	
Pyrene	H																	
Benzo(g,h,i)Perylene	H																	
Naphthalene	H																	
Phenanthrene	H																	
Benz(a)Anthracene	H																	
Benzo(a)Phenanthrene (Chrysene)	H																	
Benzo(a)Pyrene	H	T																
Benzo(b)Fluoranthene	H																	
Benzo(j,k)Fluorene (Fluoranthene)	H																	
Benzo(k)Fluoranthene	H																	
Dibenzo(a,h)Anthracene	H																	
Indeno(1,2,3-CD)Pyrene	H																	
Metals																		
Antimony	H		5.46E-07	1.31E-05	4.79E-03	2.39E-06	5.46E-07	1.31E-05	4.79E-03	2.39E-06	1.53E-09	3.67E-08	1.34E-05	6.70E-09	1.53E-08	3.67E-07	1.34E-04	6.70E-08
Arsenic	H	T	3.05E-06	7.33E-05	2.67E-02	1.34E-05	3.05E-06	7.33E-05	2.67E-02	1.34E-05	8.55E-09	2.05E-07	7.49E-05	3.74E-08	8.55E-08	2.05E-06	7.49E-04	3.74E-07
Beryllium	H	T	4.34E-07	1.04E-05	3.80E-03	1.90E-06	4.34E-07	1.04E-05	3.80E-03	1.90E-06	1.22E-09	2.92E-08	1.06E-05	5.32E-09	1.22E-08	2.92E-07	1.06E-04	5.32E-08
Cadmium	H	T	6.59E-07	1.58E-05	5.77E-03	2.89E-06	6.59E-07	1.58E-05	5.77E-03	2.89E-06	1.85E-09	4.43E-08	1.62E-05	8.08E-09	1.85E-08	4.43E-07	1.62E-04	8.08E-08
Chromium	H		1.22E-05	2.93E-04	1.07E-01	5.35E-05	1.22E-05	2.93E-04	1.07E-01	5.35E-05	3.42E-08	8.21E-07	3.00E-04	1.50E-07	3.42E-07	8.21E-06	3.00E-03	1.50E-06
Chromium VI	H	T																
Cobalt	H		3.21E-06	7.71E-05	2.82E-02	1.41E-05	3.21E-06	7.71E-05	2.82E-02	1.41E-05	9.00E-09	2.16E-07	7.88E-05	3.94E-08	9.00E-08	2.16E-06	7.88E-04	3.94E-07
Lead	H		1.93E-06	4.63E-05	1.69E-02	8.45E-06	1.93E-06	4.63E-05	1.69E-02	8.45E-06	5.40E-09	1.30E-07	4.73E-05	2.37E-08	5.40E-08	1.30E-06	4.73E-04	2.37E-07
Manganese	H	T	8.52E-05	2.04E-03	7.46E-01	3.73E-04	8.52E-05	2.04E-03	7.46E-01	3.73E-04	2.39E-07	5.72E-06	2.09E-03	1.04E-06	2.39E-06	5.72E-05	2.09E-02	1.04E-05
Mercury	H	T	1.61E-08	3.86E-07	1.41E-04	7.04E-08	1.61E-08	3.86E-07	1.41E-04	7.04E-08	4.50E-11	1.08E-09	3.94E-07	1.97E-10	4.50E-10	1.08E-08	3.94E-06	1.97E-09
Nickel	H	T	7.71E-06	1.85E-04	6.76E-02	3.38E-05	7.71E-06	1.85E-04	6.76E-02	3.38E-05	2.16E-08	5.18E-07	1.89E-04	9.46E-08	2.16E-07	5.18E-06	1.89E-03	9.46E-07
Selenium	H		2.09E-06	5.01E-05	1.83E-02	9.15E-06	2.09E-06	5.01E-05	1.83E-02	9.15E-06	5.85E-09	1.40E-07	5.12E-05	2.56E-08	5.85E-08	1.40E-06	5.12E-04	2.56E-07
Maximum Individual HAP			8.52E-05	2.04E-03	7.46E-01	3.73E-04	8.52E-05	2.04E-03	7.46E-01	3.73E-04	2.39E-07	5.72E-06	2.09E-03	1.04E-06	2.39E-06	5.72E-05	2.09E-02	1.04E-05
Total HAP Emissions			1.17E-04	2.81E-03	1.03E+00	5.13E-04	1.17E-04	2.81E-03	1.03E+00	5.13E-04	3.28E-07	7.87E-06	2.87E-03	1.44E-06	3.28E-06	7.87E-05	2.87E-02	1.44E-05

1 - In the TPER Analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

2 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide total calculation to avoid double counting.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Potential Emissions

Pollutant	HAP	TAP	EHE - External Heat Exchanger A[2] (ES-8, EP-8)				EHE - External Heat Exchanger B[2] (ES-9, EP-9)				EHE Silo (I-10, EP-10)				Product Storage Dome (I-11, EP-11)			
			lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr
Criteria Pollutants																		
PM			6.86E+00	1.65E+02	6.01E+04	3.00E+01	6.86E+00	1.65E+02	6.01E+04	3.00E+01	1.08E-02	2.58E-01	4.30E+01	2.15E-02	1.88E-02	4.52E-01	4.30E+01	2.15E-02
PM10			6.31E+00	1.51E+02	5.53E+04	2.76E+01	6.31E+00	1.51E+02	5.53E+04	2.76E+01	5.09E-03	1.22E-01	2.04E+01	1.02E-02	8.91E-03	2.14E-01	2.04E+01	1.02E-02
PM2.5			3.63E+00	8.72E+01	3.18E+04	1.59E+01	3.63E+00	8.72E+01	3.18E+04	1.59E+01	7.71E-04	1.85E-02	3.08E+00	1.54E-03	1.35E-03	3.24E-02	3.08E+00	1.54E-03
CO																		
NOx																		
SO2																		
Lead	H		2.98E-04	7.16E-03	2.61E+00	1.31E-03	2.98E-04	7.16E-03	2.61E+00	1.31E-03	4.68E-07	1.12E-05	1.87E-03	9.36E-07	8.19E-07	1.97E-05	1.87E-03	9.36E-07
VOC																		
Greenhouse Gases																		
CO2																		
Methane																		
N2O																		
CO2e																		
Inorganic, Non-metal Compounds																		
H2SO4		T																
Organic Compounds																		
1,3-Butadiene	H	T																
Acetaldehyde	H	T																
Acrolein	H	T																
Benzene	H	T																
Formaldehyde	H	T																
Toluene	H	T																
Xylene (Mixed Isomers)	H	T																
PAH/POM																		
Anthracene	H																	
Acenaphthylene	H																	
Acenaphthene	H																	
Fluorene	H																	
Pyrene	H																	
Benzo(g,h,i)Perylene	H																	
Naphthalene	H																	
Phenanthrene	H																	
Benz(a)Anthracene	H																	
Benzo(a)Phenanthrene (Chrysene)	H																	
Benzo(a)Pyrene	H	T																
Benzo(b)Fluoranthene	H																	
Benzo(j,k)Fluorene (Fluoranthene)	H																	
Benzo(k)Fluoranthene	H																	
Dibenzo(a,h)Anthracene	H																	
Indeno(1,2,3-CD)Pyrene	H																	
Metals																		
Antimony	H		3.73E-05	8.95E-04	3.27E-01	1.63E-04	3.73E-05	8.95E-04	3.27E-01	1.63E-04	5.86E-08	1.41E-06	2.34E-04	1.17E-07	1.02E-07	2.46E-06	2.34E-04	1.17E-07
Arsenic	H	T	3.68E-04	8.83E-03	3.22E+00	1.61E-03	3.68E-04	8.83E-03	3.22E+00	1.61E-03	5.78E-07	1.39E-05	2.31E-03	1.16E-06	1.01E-06	2.43E-05	2.31E-03	1.16E-06
Beryllium	H	T	7.84E-05	1.88E-03	6.86E-01	3.43E-04	7.84E-05	1.88E-03	6.86E-01	3.43E-04	1.23E-07	2.95E-06	4.92E-04	2.46E-07	2.15E-07	5.17E-06	4.92E-04	2.46E-07
Cadmium	H	T	2.23E-05	5.34E-04	1.95E-01	9.75E-05	2.23E-05	5.34E-04	1.95E-01	9.75E-05	3.49E-08	8.39E-07	1.40E-04	6.99E-08	6.11E-08	1.47E-06	1.40E-04	6.99E-08
Chromium	H		6.86E-04	1.65E-02	6.01E+00	3.00E-03	6.86E-04	1.65E-02	6.01E+00	3.00E-03	1.08E-06	2.58E-05	4.30E-03	2.15E-06	1.88E-06	4.52E-05	4.30E-03	2.15E-06
Chromium VI	H	T	7.54E-05	1.81E-03	6.61E-01	3.30E-04	7.54E-05	1.81E-03	6.61E-01	3.30E-04	1.18E-07	2.84E-06	4.73E-04	2.37E-07	2.07E-07	4.97E-06	4.73E-04	2.37E-07
Cobalt	H		2.84E-04	6.83E-03	2.49E+00	1.25E-03	2.84E-04	6.83E-03	2.49E+00	1.25E-03	4.46E-07	1.07E-05	1.79E-03	8.93E-07	7.81E-07	1.87E-05	1.79E-03	8.93E-07
Lead	H		2.98E-04	7.16E-03	2.61E+00	1.31E-03	2.98E-04	7.16E-03	2.61E+00	1.31E-03	4.68E-07	1.12E-05	1.87E-03	9.36E-07	8.19E-07	1.97E-05	1.87E-03	9.36E-07
Manganese	H	T	6.79E-04	1.63E-02	5.95E+00	2.97E-03	6.79E-04	1.63E-02	5.95E+00	2.97E-03	1.07E-06	2.56E-05	4.26E-03	2.13E-06	1.86E-06	4.47E-05	4.26E-03	2.13E-06
Mercury	H	T	1.71E-06	4.11E-05	1.50E-02	7.51E-06	1.71E-06	4.11E-05	1.50E-02	7.51E-06	2.69E-09	6.46E-08	1.08E-05	5.38E-09	4.71E-09	1.13E-07	1.08E-05	5.38E-09
Nickel	H	T	6.25E-04	1.50E-02	5.47E+00	2.74E-03	6.25E-04	1.50E-02	5.47E+00	2.74E-03	9.81E-07	2.35E-05	3.92E-03	1.96E-06	1.72E-06	4.12E-05	3.92E-03	1.96E-06
Selenium	H		8.79E-05	2.11E-03	7.70E-01	3.85E-04	8.79E-05	2.11E-03	7.70E-01	3.85E-04	1.38E-07	3.31E-06	5.52E-04	2.76E-07	2.41E-07	5.80E-06	5.52E-04	2.76E-07
Maximum Individual HAP			6.86E-04	1.65E-02	6.01E+00	3.00E-03	6.86E-04	1.65E-02	6.01E+00	3.00E-03	1.08E-06	2.58E-05	4.30E-03	2.15E-06	1.88E-06	4.52E-05	4.30E-03	2.15E-06
Total HAP Emissions			3.24E-03	7.78E-02	2.84E+01	1.42E-02	3.24E-03	7.78E-02	2.84E+01	1.42E-02	5.09E-06	1.22E-04	2.04E-02	1.02E-05	8.91E-06	2.14E-04	2.04E-02	1.02E-05

1 - In the TPER Analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

2 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide total calculation to avoid double counting.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Potential Emissions

Pollutant	HAP	TAP	Loadout Silo (I-12, EP-12)				Loadout Silo Spouts (I-12, EP-13 &14)				Ball Mill Classifier Raw Material Recovery Baghouse (I-24, EP-24)				Ball Mill Feed Silo (I-25, EP-25)			
			lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr	lb/hr	lb/day	lb/yr	ton/yr
Criteria Pollutants																		
PM			4.04E-03	9.69E-02	2.15E+01	1.08E-02	1.08E-02	2.58E-01	2.15E+01	1.08E-02	7.96E-01	1.91E+01	6.97E+03	3.49E+00	1.61E-03	3.87E-02	9.58E+00	4.79E-03
PM10			1.91E-03	4.58E-02	1.02E+01	5.09E-03	5.09E-03	1.22E-01	1.02E+01	5.09E-03	7.32E-01	1.76E+01	6.42E+03	3.21E+00	7.64E-04	1.83E-02	4.53E+00	2.27E-03
PM2.5			2.89E-04	6.94E-03	1.54E+00	7.71E-04	7.71E-04	1.85E-02	1.54E+00	7.71E-04	4.22E-01	1.01E+01	3.70E+03	1.85E+00	1.16E-04	2.77E-03	6.86E-01	3.43E-04
CO																		
NOx																		
SO2																		
Lead	H		1.75E-07	4.21E-06	9.36E-04	4.68E-07	4.68E-07	1.12E-05	9.36E-04	4.68E-07	3.46E-05	8.31E-04	3.03E-01	1.52E-04	7.02E-08	1.68E-06	4.16E-04	2.08E-07
VOC																		
Greenhouse Gases																		
CO2																		
Methane																		
N2O																		
CO2e																		
Inorganic, Non-metal Compounds																		
H2SO4		T																
Organic Compounds																		
1,3-Butadiene	H	T																
Acetaldehyde	H	T																
Acrolein	H	T																
Benzene	H	T																
Formaldehyde	H	T																
Toluene	H	T																
Xylene (Mixed Isomers)	H	T																
PAH/POM																		
Anthracene	H																	
Acenaphthylene	H																	
Acenaphthene	H																	
Fluorene	H																	
Pyrene	H																	
Benzo(g,h,i)Perylene	H																	
Naphthalene	H																	
Phenanthrene	H																	
Benz(a)Anthracene	H																	
Benzo(a)Phenanthrene (Chrysene)	H																	
Benzo(a)Pyrene	H	T																
Benzo(b)Fluoranthene	H																	
Benzo(j,k)Fluorene (Fluoranthene)	H																	
Benzo(k)Fluoranthene	H																	
Dibenzo(a,h)Anthracene	H																	
Indeno(1,2,3-CD)Pyrene	H																	
Metals																		
Antimony	H		2.20E-08	5.27E-07	1.17E-04	5.86E-08	5.86E-08	1.41E-06	1.17E-04	5.86E-08	4.33E-06	1.04E-04	3.79E-02	1.90E-05	8.78E-09	2.11E-07	5.21E-05	2.61E-08
Arsenic	H	T	2.17E-07	5.20E-06	1.16E-03	5.78E-07	5.78E-07	1.39E-05	1.16E-03	5.78E-07	4.27E-05	1.03E-03	3.74E-01	1.87E-04	8.66E-08	2.08E-06	5.14E-04	2.57E-07
Beryllium	H	T	4.61E-08	1.11E-06	2.46E-04	1.23E-07	1.23E-07	2.95E-06	2.46E-04	1.23E-07	9.10E-06	2.18E-04	7.97E-02	3.98E-05	1.84E-08	4.43E-07	1.09E-04	5.47E-08
Cadmium	H	T	1.31E-08	3.14E-07	6.99E-05	3.49E-08	3.49E-08	8.39E-07	6.99E-05	3.49E-08	2.58E-06	6.20E-05	2.26E-02	1.13E-05	5.24E-09	1.26E-07	3.11E-05	1.55E-08
Chromium	H		4.04E-07	9.68E-06	2.15E-03	1.08E-06	1.08E-06	2.58E-05	2.15E-03	1.08E-06	7.96E-05	1.91E-03	6.97E-01	3.49E-04	1.61E-07	3.87E-06	9.58E-04	4.79E-07
Chromium VI	H	T	4.44E-08	1.07E-06	2.37E-04	1.18E-07	1.18E-07	2.84E-06	2.37E-04	1.18E-07	8.75E-06	2.10E-04	7.67E-02	3.83E-05	1.78E-08	4.26E-07	1.05E-04	5.27E-08
Cobalt	H		1.67E-07	4.02E-06	8.93E-04	4.46E-07	4.46E-07	1.07E-05	8.93E-04	4.46E-07	3.30E-05	7.92E-04	2.89E-01	1.45E-04	6.70E-08	1.61E-06	3.97E-04	1.99E-07
Lead	H		1.75E-07	4.21E-06	9.36E-04	4.68E-07	4.68E-07	1.12E-05	9.36E-04	4.68E-07	3.46E-05	8.31E-04	3.03E-01	1.52E-04	7.02E-08	1.68E-06	4.16E-04	2.08E-07
Manganese	H	T	3.99E-07	9.59E-06	2.13E-03	1.07E-06	1.07E-06	2.56E-05	2.13E-03	1.07E-06	7.88E-05	1.89E-03	6.90E-01	3.45E-04	1.60E-07	3.83E-06	9.48E-04	4.74E-07
Mercury	H	T	1.01E-09	2.42E-08	5.38E-06	2.69E-09	2.69E-09	6.46E-08	5.38E-06	2.69E-09	1.99E-07	4.78E-06	1.74E-03	8.72E-07	4.04E-10	9.69E-09	2.39E-06	1.20E-09
Nickel	H	T	3.68E-07	8.82E-06	1.96E-03	9.81E-07	9.81E-07	2.35E-05	1.96E-03	9.81E-07	7.25E-05	1.74E-03	6.35E-01	3.18E-04	1.47E-07	3.53E-06	8.73E-04	4.36E-07
Selenium	H		5.17E-08	1.24E-06	2.76E-04	1.38E-07	1.38E-07	3.31E-06	2.76E-04	1.38E-07	1.02E-05	2.45E-04	8.94E-02	4.47E-05	2.07E-08	4.97E-07	1.23E-04	6.14E-08
Maximum Individual HAP			4.04E-07	9.68E-06	2.15E-03	1.08E-06	1.08E-06	2.58E-05	2.15E-03	1.08E-06	7.96E-05	1.91E-03	6.97E-01	3.49E-04	1.61E-07	3.87E-06	9.58E-04	4.79E-07
Total HAP Emissions			1.91E-06	4.58E-05	1.02E-02	5.09E-06	5.09E-06	1.22E-04	1.02E-02	5.09E-06	3.76E-04	9.03E-03	3.30E+00	1.65E-03	7.63E-07	1.83E-05	4.53E-03	2.26E-06

1 - In the TPER Analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

2 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide total calculation to avoid double counting.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Potential Emissions

Pollutant	HAP	TAP	Facility Total[2]			
			lb/hr	lb/day	lb/yr	ton/yr
Criteria Pollutants						
PM			25.0	599	218,428	109
PM10			22.5	540	196,907	98
PM2.5			12.9	310	113,145	56.6
CO			25.6	615	224,379	112
NOx			50.6	1,215	443,442	222
SO2			25.7	616	224,981	112
Lead	H		3.90E-04	9.36E-03	3.40	1.70E-03
VOC			3.22	77.4	28,234	14.1
Greenhouse Gases						
CO2			35,813	859,521	313,725,181	156,863
Methane			4.15E-01	10.0	3,635	1.82
N2O			8.30E-02	1.99	727	3.63E-01
CO2e			35814.9	859,558	313,738,596	156,869
Inorganic, Non-metal Compounds						
H2SO4		T	1.00E-01	2.40	876	4.38E-01
Organic Compounds						
1,3-Butadiene	H	T	1.07E-04	2.57E-03	9.37E-01	4.69E-04
Acetaldehyde	H	T	2.10E-03	5.04E-02	18.4	9.19E-03
Acrolein	H	T	2.53E-04	6.08E-03	2.22	1.11E-03
Benzene	H	T	2.55E-03	6.13E-02	22.4	1.12E-02
Formaldehyde	H	T	3.23E-03	7.75E-02	28.3	1.41E-02
Toluene	H	T	1.12E-03	2.69E-02	9.81	4.90E-03
Xylene (Mixed Isomers)	H	T	7.80E-04	1.87E-02	6.83	3.42E-03
PAH/POM						
Anthracene	H		5.12E-06	1.23E-04	4.48E-02	2.24E-05
Acenaphthylene	H		1.38E-05	3.32E-04	1.21E-01	6.07E-05
Acenaphthene	H		3.89E-06	9.33E-05	3.40E-02	1.70E-05
Fluorene	H		7.99E-05	1.92E-03	7.00E-01	3.50E-04
Pyrene	H		1.31E-05	3.14E-04	1.15E-01	5.73E-05
Benzo(g,h,i)Perylene	H		1.34E-06	3.21E-05	1.17E-02	5.86E-06
Naphthalene	H		2.32E-04	5.57E-03	2.03	1.02E-03
Phenanthrene	H		8.05E-05	1.93E-03	7.05E-01	3.52E-04
Benz(a)Anthracene	H		4.60E-06	1.10E-04	4.03E-02	2.01E-05
Benzo(a)Phenanthrene (Chrysene)	H		9.66E-07	2.32E-05	8.46E-03	4.23E-06
Benzo(a)Pyrene	H	T	5.15E-07	1.23E-05	4.51E-03	2.25E-06
Benzo(b)Fluoranthene	H		2.71E-07	6.51E-06	2.38E-03	1.19E-06
Benzo(j,k)Fluorene (Fluoranthene)	H		2.08E-05	5.00E-04	1.82E-01	9.12E-05
Benzo(k)Fluoranthene	H		4.24E-07	1.02E-05	3.72E-03	1.86E-06
Dibenzo(a,h)Anthracene	H		1.60E-06	3.83E-05	1.40E-02	6.99E-06
Indeno(1,2,3-CD)Pyrene	H		1.03E-06	2.46E-05	8.99E-03	4.50E-06
Metals						
Antimony	H		4.60E-05	1.10E-03	4.01E-01	2.01E-04
Arsenic	H	T	4.62E-04	1.11E-02	4.03	2.02E-03
Beryllium	H	T	1.04E-04	2.50E-03	9.08E-01	4.54E-04
Cadmium	H	T	3.60E-05	8.64E-04	3.14E-01	1.57E-04
Chromium	H		8.56E-04	2.05E-02	7.46	3.73E-03
Chromium VI	H	T	9.19E-05	2.20E-03	8.01E-01	4.00E-04
Cobalt	H		3.50E-04	8.39E-03	3.05	1.52E-03
Lead	H		3.90E-04	9.36E-03	3.40	1.70E-03
Manganese	H	T	9.31E-04	2.23E-02	8.12	4.06E-03
Mercury	H	T	1.03E-05	2.48E-04	9.03E-02	4.51E-05
Nickel	H	T	7.77E-04	1.87E-02	6.78	3.39E-03
Selenium	H		1.50E-04	3.61E-03	1.31	6.56E-04
Maximum Individual HAP			4.15E-03	9.97E-02	36.3	1.82E-02
Total HAP Emissions			1.48E-02	3.55E-01	130	6.48E-02

1 - In the TPER Analysis, chromium emissions from fuel firing are classified as soluble chromate compounds, as chromium (VI) equivalent.

2 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide total calculation to avoid double counting.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Criteria Pollutant Potential Emissions

Pollutant	Total Emissions (tpy)	Exceeds 250 tpy?
PM	109	No
PM10	98	No
PM2.5	57	No
SO2	112	No
NOx	222	No
CO	112	No
VOC	14.1	No
Lead	1.70E-03	No
Sulfuric Acid Mist	4.38E-01	No
CO2e[1]	156,869	NA[1]

1 - Per the June 23, 2014 Supreme Court decision in Utility Air Regulatory Group v. EPA, 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.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Facility-Wide Throughputs

Global

8,760	hr/yr, Potential Operating Hours per Year
4.85	mph, Average 2013-2017 wind speed (IGX Chapel Hill)

Ash

429,000	ton/yr, Excavated Ash
15%	Ash Moisture Content (conservative estimate)

Wet Ash Transfer to Shed and Hopper

70	ton/hr
400,000	ton/yr

Feed Silo

125	ton/hr, filling rate
75	ton/hr, unloading rate
400,000	ton/yr
6,600	scfm, air flow rate

STAR Reactor (Exhaust Stack)

140	MMBtu/hr, max heat input
14,500	Btu/lb, heating value of carbon
3.76%	loss on ignition (LOI), min value for conservative overestimate of emissions.
0.10%	feed ash sulfur content, average (0.05%) multiplied by a safety factor of 2.
75,000	acfm, gas flow rate
0.025	gr/acf, emission loading rate

STAR Propane Start-Up Burner

60	MMBtu/hr, max heat input
90,500	Btu/gal, heating value of propane
0.10	gr/100 scf, sulfur content of propane

Ball Mill Feed Silo

15	ton/hr, filling rate
15	ton/hr, unloading rate
89,000	ton/yr
955	acfm

Ball Mill Classifier Raw Material Recovery Baghouse

11,081	acfm, air flow rate
0.010	gr/scf, emission loading rate

FGD Byproduct and Hydrated Lime Silos Bin Vents

1,050	acfm, air flow rate
0.005	gr/scf, emission loading rate

EHE A and B Dust Collectors

32,000	scfm, air flow rate, per dust collector
0.025	gr/scf, emission loading rate

EHE Silo

125	ton/hr, filling rate
75	ton/hr, unloading rate
400,000	ton/yr
6,500	acfm, air flow rate

Product Storage Dome

75	ton/hr, filling rate
275	ton/hr, unloading rate
400,000	ton/yr
6,000	scfm, air flow rate

Loadout Silo

75	ton/hr, filling rate
100	ton/hr, unloading rate
400,000	ton/yr
6,000	scfm, air flow rate

Screener Diesel Engine

8,760	Hours of Operation
165	Tons per hour throughput
91	hp, Engine Output
640,000	btu/hr, Max Heat Input

Crusher Diesel Engine

8,760	Hours of Operation
165	Tons per hour throughput
300	hp, Engine Output
2,100,000	btu/hr, Max Heat Input

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Ash Basin

Source ID: I-15
Emission Point ID: EP-15

Dust may be generated by wind erosion of exposed area within an industrial facility. Section 13.2.5 of the U.S. EPA's AP-42 document was used to estimate emissions.

The first step is to calculate a height-to-base ratio to determine if Equation (4) can be used to determine the friction velocity (u*):

174	acres, Total Area of Ash Basin
4,046.9	m^2/acre, Conversion Factor
704,155.4	m^2, Typical Active Area

Assuming a square area, this active area yields an approximate length as follows:

839.1	m, Linear Dimension of Active Area
3.3	ft/m, Conversion Factor
2753.1	ft, Linear Dimension of Active Area

15	ft, Approximate Mean Elevation of the Active Area (Above Grade)

Per page 13.2.5-5 of AP-42, if the height to base ratio is less than 0.2 then Equation (4) can be used to calculate the friction velocity (u*).

0.005	Calculated Height to Base Ratio

Therefore equation (4) from AP-42 13.2.5 can be used for calculation of the friction velocity.

Per the following website: http://www.nc-climate.ncsu.edu (maintained by the North Carolina State Climate Office), the anemometer height for the fastest mile data is:

10	m, Anemometer Height

Since the reported fastest wind speeds are from an anemometer of height 10 m, using equation (5) on page 13.2.5-6 is not necessary:

When the calculated friction velocity (u*) exceeds the threshold friction velocity (u_t*), emissions from wind erosion occur. As shown in Equation 3 of AP-42, if $u^* \leq u_t^*$, emissions are zero.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Ash Basin

From Table 13.2.5-2 threshold friction velocity (ut*) is as follows. The most conservative value presented in AP-42 has been used.

0.43	m/s, u_t* Threshold Friction Velocity

Therefore, in order to generate emissions, the following wind speed must be exceeded.

3,600	sec/hr, Conversion Factor
1,609.3	m/mile, Conversion Factor

18.15	mph, u_{10}^+
8.11	m/s, u_{10}^+
0.43	m/s, u*

AERMOD allows users to account for the variability of wind speed when determining offsite impacts. The scalars below are used based on the respective wind speed range. (AERMOD User Guide 3.3.4. Using Variable Emission Rates). There are zero wind based emissions in classes 1 thru 4 because the threshold friction velocity is not exceeded (ut*). The scalar for Class 5 is determined as the ratio of emission factors for Class 5 and Class 6. Emission factor derivation follows.

Wind Speed Range Class	1	2	3	4	5	6
Scalar	0	0	0	0	0.11	1.00

where:

Class 1 = 0 - 3.4 mph
Class 2 = 3.4 - 6.8 mph
Class 3 = 6.8 - 11.3 mph
Class 4 = 11.3 - 18.1 mph
Class 5 = 18.1 - 23.8 mph
Class 6 = greater than 23.8 mph

The emissions rate (which is dependent on the friction velocity (u*)) varies linearly with wind speed. For Class 5, emissions will increase linearly as wind speed increases. AERMOD does not facilitate the variable emission rates based on wind speed. Therefore, the friction velocity for Class 5 is determined using the upper end wind speed of 23.8 mph. Using Equation (4) on page 13.2.5-5, the equivalent friction velocity (u*) may be calculated.

$$u^* = 0.053 u_{10}^+$$

	23.8	mph, u_{10}^+
	10.64	m/s, u_{10}^+
Class 5	0.56	m/s, u*, Class 5 Wind Speed Range

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Ash Basin

The friction velocity for Class 6 is determined using the average of the maximum daily wind gusts for each month.

	46.00	mph, u_{10}^{+}	Maximum daily wind gust for IGX April 2014-April 2018. Taken from http://www.nc-climate.ncsu.edu .
	20.56	m/s, u_{10}^{+}	
Class 6	1.09	m/s, u*, Class 6 Wind Speed Range	

Emission factors for Class 5 and Class 6 are determined using AP-42 Section 13.2.5 Equation (3) which is shown below:

$$PM\left(\frac{g}{m^2}\right) = 58\,(u^* - u_t^*)^2 + 25\,(u^* - u_t^*)$$

Equation (3) from AP-42 13.2.5

Where: u* is the friction velocity (m/s)
u^*_t is the threshold friction velocity (m/s)

Class 5	4.39	g/m^2 (of Disturbed Area), Class 5 Wind Speed Range
Class 6	41.75	g/m^2 (of Disturbed Area), Class 6 Wind Speed Range

As stated in AP-42, on page 13.2.5-2, emissions generated by wind erosion are also dependent on the frequency of disturbance of the erodible surface because each time that a surface is disturbed, its erosion potential is restored. A disturbance is defined as an action that results in the exposure of fresh surface material. Only a fraction of the active area is disturbed each day. This disturbed area is used to calculate the potential daily emission rate.

	10	acres, Working Area			
	6%	Fraction of Active Area Disturbed Daily		94%	Fraction of Inactive Area
	40,468.70	m^2, Average Area Disturbed Daily		663,686.68	m^2, Average Inactive Area
	453.6	g/lb, Conversion Factor		453.6	g/lb, Conversion Factor
Class 5	391.4	lb/day	*Class 5*	6419.2	lb/day
Class 6	3725.1	lb/day	*Class 6*	61091.0	lb/day

The facility will implement mitigation to suppress dust emissions. Control efficiencies are based on engineering judgment and supported by *WRAP Fugitive Dust Handbook, September 7, 2006.* The controlled emission rates for Class 5 and Class 6 emissions are as follows:

	61%	Apply Water every 3.2 hours to disturbed areas		80%	Inherent Moisture and Watering
*Class 5***	152.7	lb/day	*Class 5*	1283.8	lb/day
*Class 6***	1452.8	lb/day	*Class 6*	12218.2	lb/day

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Ash Basin

For the purposes of determining potential emissions for permitting, wind data has been applied as shown below.

Total Class 5 Emissions	1436.5	lb/day
Total Class 6 Emissions	13671.0	lb/day
Fraction of time in Class 5	0.0008	(approximately 7 hours in Class 5)
Fraction of time in Class 6	0.0000	(0 hours in Class 6)

Time fraction spent in Class 5 and Class 6 determined by analyzing hourly wind speeds for the 5 year period required to be modeled 2013-2017 from DAQ Approved Met Data. The worst case year (year with the most hours) was used to determine the time fraction. For Class 5 it was 2015. No Class 6 hours were identified.

Total emissions per day	1.15	lb/day

Emissions from the ash pond will only occur when Class 5 and Class 6 wind speed conditions are met. AERMOD will utilize meteorological data to determine when these conditions occur. For the purposes of the PSD analysis, permitting, and TPER evaluation, it is conservatively assumed that Class 6 condition occur year round.

Compound	Avg Ash Analysis (ppm)	Emissions lb/hr	Emissions lb/day	Emissions lb/year	Emissions tons/year
PM	1.00 **	4.78E-02	1.15	418.98	2.09E-01
PM10	0.50 **	2.39E-02	5.74E-01	209.49	1.05E-01
PM2.5	0.08 **	3.59E-03	8.61E-02	31.42	1.57E-02
Lead	43.48	2.08E-06	4.99E-05	1.82E-02	9.11E-06
Arsenic	53.67	2.57E-06	6.16E-05	2.25E-02	1.12E-05
Antimony	5.44	2.60E-07	6.25E-06	2.28E-03	1.14E-06
Beryllium	11.43	5.47E-07	1.31E-05	4.79E-03	2.39E-06
Cadmium	3.25	1.55E-07	3.73E-06	1.36E-03	6.80E-07
Chromium	99.98	4.78E-06	1.15E-04	4.19E-02	2.09E-05
Chromium VI	11.00	5.26E-07	1.26E-05	4.61E-03	2.30E-06
Cobalt	41.48	1.98E-06	4.76E-05	1.74E-02	8.69E-06
Manganese	98.98	4.73E-06	1.14E-04	4.15E-02	2.07E-05
Mercury	0.25	1.20E-08	2.87E-07	1.05E-04	5.24E-08
Nickel	91.11	4.36E-06	1.05E-04	3.82E-02	1.91E-05
Selenium	12.82	6.13E-07	1.47E-05	5.37E-03	2.69E-06

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI
** PM distribution factors (k value) taken from AP-42 Page 13.2.5-3 All other values in ppm.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Ash Handling

Source ID: I-16
Emission Point ID: EP-16, 17, 18

Section 13.2.4 (Aggregate Handling and Storage Piles) of U.S. EPA's AP-42 document is used to estimate emissions from the handling of material at an industrial site. The "Drop Equation" is shown below:

$$E = k\,(0.0032)\,\frac{(U/5)^{1.3}}{(M/2)^{1.4}}$$

Where:
E is the emission factor in [lb/ton]
K is the particle size multiplier [dimensionless]
U is the average wind speed [mph]
M is the average moisture content [%]

Constant	$PM_{2.5}$	PM_{10}	PM
k	0.053	0.35	0.74

4.85	mph, Average Wind Speed
15	%, Moisture

Wind data from IGX Chapel Hill Airport, 2013-2017

Expected ash moisture: 20% +/- 5%
Expected Drop Points

Drop Point 1 (EP-16) Ash is excavated from it's respective basin and placed in windrows in that basin
Drop Point 2 (EP-17) Windrowed ash is loaded into screener / crusher within it's respective basin
Drop Point 3 (EP-18) Screened and crushed ash is placed in stockpile within it's respective basin

The HAP and TAP emissions are derived from the PM estimate based on the average trace element analysis:
Emissions are calculated assuming a maximum throughput of ash:

429,000	ton/yr, Potential Ash Throughput
3	Number of Drop Points

Ash Trace Element Analysis	Average Ash Concentration (ppm)	Emission Factor (lb/ton)	Emissions			
			lbs/hr	lbs/day	lbs/year	tons/year
PM	--	1.36E-04	1.99E-02	4.78E-01	1.74E+02	8.72E-02
PM10	--	6.41E-05	9.42E-03	2.26E-01	8.25E+01	4.13E-02
PM2.5	--	9.71E-06	1.43E-03	3.42E-02	1.25E+01	6.25E-03
Antimony	5.44	7.37E-10	1.08E-07	2.60E-06	9.49E-04	4.75E-07
Arsenic	53.67	7.27E-09	1.07E-06	2.57E-05	9.36E-03	4.68E-06
Beryllium	11.43	1.55E-09	2.28E-07	5.46E-06	1.99E-03	9.97E-07
Cadmium	3.25	4.40E-10	6.46E-08	1.55E-06	5.66E-04	2.83E-07
Chromium	99.98	1.36E-08	1.99E-06	4.78E-05	1.74E-02	8.72E-06
Chromium VI	11.00	1.49E-09	2.19E-07	5.26E-06	1.92E-03	9.59E-07
Cobalt	41.48	5.62E-09	8.26E-07	1.98E-05	7.24E-03	3.62E-06
Lead	43.48	5.89E-09	8.66E-07	2.08E-05	7.58E-03	3.79E-06
Manganese	98.98	1.34E-08	1.97E-06	4.73E-05	1.73E-02	8.63E-06
Mercury	0.25	3.39E-11	4.98E-09	1.19E-07	4.36E-05	2.18E-08
Nickel	91.11	1.23E-08	1.81E-06	4.35E-05	1.59E-02	7.95E-06
Selenium	12.82	1.74E-09	2.55E-07	6.13E-06	2.24E-03	1.12E-06

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Unloading Pile

Source ID: I-3
Emission Point ID: EP-3

Dust may be generated by wind erosion of exposed area within an industrial facility. Section 13.2.5 of the U.S. EPA's AP-42 document was used to estimate emissions.

The first step is to calculate a height-to-base ratio to determine if Equation (4) can be used to determine the friction velocity (u*):

0.33	acres, Total Area of Unloading Pile
4,046.9	m^2/acre, Conversion Factor
1,335.5	m^2, Typical Active Area

Assuming a square area, this active area yields an approximate length as follows:

36.5	m, Linear Dimension of Active Area
3.3	ft/m, Conversion Factor
119.9	ft, Linear Dimension of Active Area

4	ft, Approximate Mean Elevation of the Active Area (Above Grade)

Per page 13.2.5-5 of AP-42, if the height to base ratio is less than 0.2 then Equation (4) can be used to calculate the friction velocity (u*).

0.033	Calculated Height to Base Ratio

Therefore equation (4) from AP-42 13.2.5 can be used for calculation of the friction velocity.

Per the following website: http://www.nc-climate.ncsu.edu (maintained by the North Carolina State Climate Office), the anemometer height for the fastest mile data is:

10	m, Anemometer Height

Since the reported fastest wind speeds are from an anemometer of height 10 m, using equation (5) on page 13.2.5-6 is not necessary:

When the calculated friction velocity (u*) exceeds the threshold friction velocity (u_t*), emissions from wind erosion occur. As shown in Equation 3 of AP-42, if $u^* \leq u_t^*$, emissions are zero.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Unloading Pile

From Table 13.2.5-2 threshold friction velocity (ut*) is as follows. The most conservative value presented in AP-42 has been used.

0.43	m/s, u_t* Threshold Friction Velocity

Therefore, in order to generate emissions, the following wind speed must be exceeded.

3,600	sec/hr, Conversion Factor
1,609.3	m/mile, Conversion Factor

18.15	mph, u_{10}^+
8.11	m/s, u_{10}^+
0.43	m/s, u*

AERMOD allows users to account for the variability of wind speed when determining offsite impacts. The scalars below are used based on the respective wind speed range. (AERMOD User Guide 3.3.4. Using Variable Emission Rates). There are zero wind based emissions in classes 1 thru 4 because the threshold friction velocity is not exceeded (ut*). The scalar for Class 5 is determined as the ratio of emission factors for Class 5 and Class 6. Emission factor derivation follows.

Wind Speed Range Class	1	2	3	4	5	6
Scalar	0	0	0	0	0.11	1.00

where:

Class 1 = 0 - 3.4 mph
Class 2 = 3.4 - 6.8 mph
Class 3 = 6.8 - 11.3 mph
Class 4 = 11.3 - 18.1 mph
Class 5 = 18.1 - 23.8 mph
Class 6 = greater than 23.8 mph

The emissions rate (which is dependent on the friction velocity (u*)) varies linearly with wind speed. For Class 5, emissions will increase linearly as wind speed increases. AERMOD does not facilitate the variable emission rates based on wind speed. Therefore, the friction velocity for Class 5 is determined using the upper end wind speed of 23.8 mph. Using Equation (4) on page 13.2.5-5, the equivalent friction velocity (u*) may be calculated.

$$u^* = 0.053 u_{10}^+$$

	23.8	mph, u_{10}^+
	10.64	m/s, u_{10}^+
Class 5	0.56	m/s, u*, Class 5 Wind Speed Range

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Unloading Pile

The friction velocity for Class 6 is determined using the average of the maximum daily wind gusts for each month.

	46.00	mph, u_{10}^{+}	Maximum daily wind gust for IGX April 2014-April 2018. Taken from http://www.nc-climate.ncsu.edu .
	20.56	m/s, u_{10}^{+}	
Class 6	1.09	m/s, u*, Class 6 Wind Speed Range	

Emission factors for Class 5 and Class 6 are determined using AP-42 Section 13.2.5 Equation (3) which is shown below:

$$PM\left(\frac{g}{m^2}\right) = 58\,(u^* - u_t^*)^2 + 25\,(u^* - u_t^*)$$

Equation (3) from AP-42 13.2.5

Where: u* is the friction velocity (m/s)
u^*_t is the threshold friction velocity (m/s)

Class 5	4.39	g/m^2 (of Disturbed Area), Class 5 Wind Speed Range
Class 6	41.75	g/m^2 (of Disturbed Area), Class 6 Wind Speed Range

As stated in AP-42, on page 13.2.5-2, emissions generated by wind erosion are also dependent on the frequency of disturbance of the erodible surface because each time that a surface is disturbed, its erosion potential is restored. A disturbance is defined as an action that results in the exposure of fresh surface material. Only a fraction of the active area is disturbed each day. This disturbed area is used to calculate the potential daily emission rate.

	0.33	acres, Working Area		
	100%	Fraction of Active Area Disturbed Daily	0%	Fraction of Inactive Area
	1,335.47	m^2, Average Area Disturbed Daily	0.00	m^2, Average Inactive Area
	453.6	g/lb, Conversion Factor	453.6	g/lb, Conversion Factor

Class 5	12.9	lb/day	*Class 5*	0.0 lb/day
Class 6	122.9	lb/day	*Class 6*	0.0 lb/day

The facility will implement mitigation to suppress dust emissions. Control efficiencies are based on engineering judgment and supported by *WRAP Fugitive Dust Handbook, September 7, 2006.* The controlled emission rates for Class 5 and Class 6 emissions are as follows:

	61%	Apply Water every 3.2 hours to disturbed areas	80%	Inherent Moisture and Watering
*Class 5***	5.0	lb/day	*Class 5*	0.0 lb/day
*Class 6***	47.9	lb/day	*Class 6*	0.0 lb/day

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Unloading Pile

For the purposes of determining potential emissions for permitting, wind data has been applied as shown below.

Total Class 5 Emissions	5.0	lb/day
Total Class 6 Emissions	47.9	lb/day
Fraction of time in Class 5	0.0008	(approximately 7 hours in Class 5)
Fraction of time in Class 6	0.0000	(0 hours in Class 6)

Time fraction spent in Class 5 and Class 6 determined by analyzing hourly wind speeds for the 5 year period required to be modeled 2013-2017 from DAQ Approved Met Data. The worst case year (year with the most hours) was used to determine the time fraction. For Class 5 it was 2015. No Class 6 hours were identified.

Total emissions per day	4.03E-03	lb/day

Emissions from the ash pond will only occur when Class 5 and Class 6 wind speed conditions are met. AERMOD will utilize meteorological data to determine when these conditions occur. For the purposes of the PSD analysis, permitting, and TPER evaluation, it is conservatively assumed that Class 6 condition occur year round.

Compound	Avg Ash Analysis (ppm)	Emissions lb/hr	Emissions lb/day	Emissions lb/year	Emissions tons/year
PM	1.00 **	1.68E-04	4.03E-03	1.47E+00	7.35E-04
PM_{10}	0.50 **	8.39E-05	2.01E-03	7.35E-01	3.67E-04
$PM_{2.5}$	0.08 **	1.26E-05	3.02E-04	1.10E-01	5.51E-05
Antimony	5.44	9.13E-10	2.19E-08	7.99E-06	4.00E-09
Arsenic	53.67	9.00E-09	2.16E-07	7.89E-05	3.94E-08
Beryllium	11.43	1.92E-09	4.60E-08	1.68E-05	8.39E-09
Cadmium	3.25	5.45E-10	1.31E-08	4.77E-06	2.39E-09
Chromium	99.98	1.68E-08	4.02E-07	1.47E-04	7.35E-08
Chromium VI	11.00	1.84E-09	4.43E-08	1.62E-05	8.08E-09
Cobalt	41.48	6.96E-09	1.67E-07	6.09E-05	3.05E-08
Lead	43.48	7.29E-09	1.75E-07	6.39E-05	3.19E-08
Manganese	98.98	1.66E-08	3.98E-07	1.45E-04	7.27E-08
Mercury	0.25	4.19E-11	1.01E-09	3.67E-07	1.84E-10
Nickel	91.11	1.53E-08	3.67E-07	1.34E-04	6.69E-08
Selenium	12.82	2.15E-09	5.16E-08	1.88E-05	9.42E-09

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.

EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

** PM distribution factors (k value) taken from AP-42 Page 13.2.5-3 All other values in ppm.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Wet Ash Receiving (Transfer to Shed and Hopper)

Source ID: I-1
Emission Point ID: EP-1 & EP-2

Section 13.2.4 (Aggregate Handling and Storage Piles) of U.S. EPA's AP-42 document is used to estimate emissions from the handling of material at an industrial site. The "Drop Equation" is shown below:

$$E = k\,(0.0032)\,\frac{(U/5)^{1.3}}{(M/2)^{1.4}}$$

Where:
E is the emission factor in [lb/ton]
K is the particle size multiplier [dimensionless]
U is the average wind speed [mph]
M is the average moisture content [%]

Constant	$PM_{2.5}$	PM_{10}	PM
k	0.053	0.35	0.74

4.85	mph, Average Wind Speed
15	%, Moisture

Wind data from IGX Chapel Hill Airport, 2013-2017

Expected ash moisture: 20% +/- 5%
Expected Drop Points

Drop Point 1 — Ash is transported from it's respective basin to the STAR feedstock building
Assumed 50% control as a result of 3-sided enclosure
Drop Point 2 — Ash is loaded into feed hopper.

The HAP and TAP emissions are derived from the PM estimate based on the average trace element analysis:
Emissions are calculated assuming a maximum throughput of ash:

70	ton/hr
400,000	ton/yr, Potential Ash Throughput
1.5	Number of Drop Points

Ash Trace Element Analysis	Average Ash Concentration (ppm)	Emission Factor (lb/ton)	Emissions			
			lbs/hr	lbs/day	lbs/year	tons/year
PM	--	1.36E-04	1.42E-02	3.42E-01	8.13E+01	4.07E-02
PM10	--	6.41E-05	6.73E-03	1.62E-01	3.85E+01	1.92E-02
PM2.5	--	9.71E-06	1.02E-03	2.45E-02	5.82E+00	2.91E-03
Antimony	5.44	7.37E-10	7.74E-08	1.86E-06	4.42E-04	2.21E-07
Arsenic	53.67	7.27E-09	7.64E-07	1.83E-05	4.36E-03	2.18E-06
Beryllium	11.43	1.55E-09	1.63E-07	3.90E-06	9.29E-04	4.65E-07
Cadmium	3.25	4.40E-10	4.62E-08	1.11E-06	2.64E-04	1.32E-07
Chromium	99.98	1.36E-08	1.42E-06	3.41E-05	8.13E-03	4.07E-06
Chromium VI	11.00	1.49E-09	1.57E-07	3.76E-06	8.94E-04	4.47E-07
Cobalt	41.48	5.62E-09	5.90E-07	1.42E-05	3.37E-03	1.69E-06
Lead	43.48	5.89E-09	6.19E-07	1.49E-05	3.54E-03	1.77E-06
Manganese	98.98	1.34E-08	1.41E-06	3.38E-05	8.05E-03	4.02E-06
Mercury	0.25	3.39E-11	3.56E-09	8.54E-08	2.03E-05	1.02E-08
Nickel	91.11	1.23E-08	1.30E-06	3.11E-05	7.41E-03	3.70E-06
Selenium	12.82	1.74E-09	1.82E-07	4.38E-06	1.04E-03	5.21E-07

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Screener

Source ID: I-19
Emission Point ID: EP-19

Capacity, ton/yr	429,000
Hours of operation, hr/yr	8,760
Hours of operation, hr/day	24
Capacity, ton/hr	165

Pollutant	Emission Factor [1]	Potential Emission Rates			
	lb/ton	lb/hr	lb/day	lb/year	tons/year
PM	2.20E-03	3.63E-01	8.71E+00	3.18E+03	1.59E+00
PM_{10}	7.40E-04	1.22E-01	2.93E+00	1.07E+03	5.35E-01
$PM_{2.5}$	5.00E-05	8.25E-03	1.98E-01	7.23E+01	3.61E-02

Pollutant	Ash Conc.	Emission Factor [2]	Potential Emission Rates			
	ppm	lb/ton	lb/hr	lb/day	lb/year	tons/year
Antimony	5.44	1.20E-08	1.98E-06	4.74E-05	1.73E-02	8.65E-06
Arsenic	53.67	1.18E-07	1.95E-05	4.68E-04	1.71E-01	8.53E-05
Beryllium	11.43	2.51E-08	4.15E-06	9.96E-05	3.63E-02	1.82E-05
Cadmium	3.25	7.14E-09	1.18E-06	2.83E-05	1.03E-02	5.16E-06
Chromium	99.98	2.20E-07	3.63E-05	8.71E-04	3.18E-01	1.59E-04
Chromium VI	11.00	2.42E-08	3.99E-06	9.58E-05	3.50E-02	1.75E-05
Cobalt	41.48	9.13E-08	1.51E-05	3.61E-04	1.32E-01	6.59E-05
Lead	43.48	9.57E-08	1.58E-05	3.79E-04	1.38E-01	6.91E-05
Manganese	98.98	2.18E-07	3.59E-05	8.62E-04	3.15E-01	1.57E-04
Mercury	0.25	5.50E-10	9.08E-08	2.18E-06	7.95E-04	3.97E-07
Nickel	91.11	2.00E-07	3.31E-05	7.94E-04	2.90E-01	1.45E-04
Selenium	12.82	2.82E-08	4.65E-06	1.12E-04	4.08E-02	2.04E-05

1. Emission Factor for Screening operation from AP-42, Table 11.19.2-2. Factor is based on controlled screening with wet suppression, as ash is screened after dewatering but prior to drying.

2. HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Screener Diesel Engine

Source ID: I-22
Emission Point ID: EP-22

Potential emissions from diesel-fired engine used to operate screener

Emission Factor Conversions (for emission factors published in only one set of units)

$$EF\,\frac{lb}{hp-hr} = EF\,\frac{lb}{MMbtu} \times \frac{7000\ Btu}{hp-hr} \times \frac{MMBtu}{10^6\ Btu}$$

$$EF\,\frac{lb}{MMBtu} = EF\,\frac{lb}{hp-hr} \times \frac{hp-hr}{7000\ Btu} \times \frac{10^6\ Btu}{MMBtu}$$

Fuel:	*Diesel*	
Unit Rating:	68	kW
	91	bhp
Sulfur Content:	0.0015	%
Operating Hours:	8,760	hr/yr

Emissions Calculations

$$Emissions\ \frac{lb}{hr} = EF\,\frac{lb}{hp-hr} \times \frac{hp-hr}{1\ hr} \qquad Emissions\ \frac{lb}{day} = Emissions\,\frac{lb}{hr} \times \frac{24\ hr}{day}$$

$$Emissions\ \frac{lb}{year} = Emissions\,\frac{lb}{hr} \times \frac{Operating\ hr}{year} \qquad Emissions\ \frac{ton}{year} = Emissions\,\frac{lb}{year} \times \frac{1\ ton}{2000\ lb}$$

CAS #	Compound					Emission Factors (lb/MMBtu) [1] IC Engines (≤447 KW, 600 HP) Emission Factor (lb/MMBtu)	Emission Factor (lb/hp-hr)	Hourly Emissions	Daily Emissions	Annual Emissions		Emission Factor Reference
Greenhouse Gas Pollutants						(lb/MMBtu)	(lb/hp-hr)	(lb/hr)	(lb/day)	(lb/yr)	(ton/yr)	
CO_2	CARBON DIOXIDE					1.63E+02	1.14E+00	1.04E+02	2.49E+03	9.10E+05	4.55E+02	2
CH_4	METHANE					6.61E-03	4.63E-05	4.21E-03	1.01E-01	3.69E+01	1.85E-02	3
N_2O	NITROUS OXIDE					1.32E-03	9.26E-06	8.43E-04	2.02E-02	7.38E+00	3.69E-03	3
CO_2e	GREENHOUSE GAS					1.64E+02	1.15E+00	1.04E+02	2.50E+03	9.13E+05	4.56E+02	4
Criteria Pollutants						(lb/MMBtu)	(lb/hp-hr)	(lb/hr)	(lb/day)	(lb/yr)	(ton/yr)	
CO	CARBON MONOXIDE (CO)					1.17E+00	8.22E-03	7.48E-01	1.80E+01	6.55E+03	3.28E+00	5
NO_x	NITROGEN OXIDES (NO_x)					1.10E+00	7.73E-03	7.03E-01	1.69E+01	6.16E+03	3.08E+00	5
PM	PARTICULATE MATTER (PM)					9.39E-02	6.58E-04	5.98E-02	1.44E+00	5.24E+02	2.62E-01	5
PM_{10}	PARTICULATE MATTER<10 MICRONS (PM_{10})					9.39E-02	6.58E-04	5.98E-02	1.44E+00	5.24E+02	2.62E-01	5
$PM_{2.5}$	PARTICULATE MATTER<2.5 MICRONS ($PM_{2.5}$)					9.39E-02	6.58E-04	5.98E-02	1.44E+00	5.24E+02	2.62E-01	5
SO_2	SULFUR DIOXIDE (SO_2)					1.52E-03	1.06E-05	9.65E-04	2.32E-02	8.45E+00	4.23E-03	6
PBC	LEAD					9.00E-06	6.30E-08	5.73E-06	1.38E-04	5.02E-02	2.51E-05	7
VOC	VOLATILE ORGANIC COMPOUNDS (VOC)					3.60E-01	2.51E-03	2.29E-01	5.49E+00	2.00E+03	1.00E+00	8
Organic Compounds		***TAP***	***HAP***	***PAH***	***POM***	(lb/MMBtu)	(lb/hp-hr)	(lb/hr)	(lb/day)	(lb/yr)	(ton/yr)	
106-99-0	1,3-BUTADIENE	*Y*	*Y*			3.91E-05	2.74E-07	2.49E-05	5.98E-04	2.18E-01	1.09E-04	9
75-07-0	ACETALDEHYDE	*Y*	*Y*			7.67E-04	5.37E-06	4.89E-04	1.17E-02	4.28E+00	2.14E-03	9
107-02-8	ACROLEIN	*Y*	*Y*			9.25E-05	6.48E-07	5.89E-05	1.41E-03	5.16E-01	2.58E-04	9
71-43-2	BENZENE	*Y*	*Y*			9.33E-04	6.53E-06	5.94E-04	1.43E-02	5.21E+00	2.60E-03	9
50-00-0	FORMALDEHYDE	*Y*	*Y*			1.18E-03	8.26E-06	7.52E-04	1.80E-02	6.58E+00	3.29E-03	9
108-88-3	TOLUENE	*Y*	*Y*			4.09E-04	2.86E-06	2.61E-04	6.25E-03	2.28E+00	1.14E-03	9
1330-20-7	XYLENE (MIXED ISOMERS)	*Y*	*Y*			2.85E-04	2.00E-06	1.82E-04	4.36E-03	1.59E+00	7.95E-04	9
Polycyclic Aromatic Hydrocarbons (PAH) & Polycyclic Organic Matter (POM)		***TAP***	***HAP***	***PAH***	***POM***	(lb/MMBtu)	(lb/hp-hr)	(lb/hr)	(lb/day)	(lb/yr)	(ton/yr)	
PAH	**TOTAL**		*Y*	*Y*	*Y*	1.68E-04	1.18E-06	1.07E-04	2.57E-03	9.37E-01	4.69E-04	9
120-12-7	ANTHRACENE		*Y*	*Y*	*Y*	1.87E-06	1.31E-08	1.19E-06	2.86E-05	1.04E-02	5.22E-06	9
208-96-8	ACENAPHTHYLENE		*Y*	*Y*	*Y*	5.06E-06	3.54E-08	3.22E-06	7.74E-05	2.82E-02	1.41E-05	9
83-32-9	ACENAPHTHENE		*Y*	*Y*	*Y*	1.42E-06	9.94E-09	9.05E-07	2.17E-05	7.92E-03	3.96E-06	9
86-73-7	FLUORENE		*Y*	*Y*	*Y*	2.92E-05	2.04E-07	1.86E-05	4.46E-04	1.63E-01	8.15E-05	9
129-00-0	PYRENE		*Y*	*Y*	*Y*	4.78E-06	3.35E-08	3.04E-06	7.31E-05	2.67E-02	1.33E-05	9
191-24-2	BENZO(G,H,I)PERYLENE		*Y*	*Y*	*Y*	4.89E-07	3.42E-09	3.11E-07	7.48E-06	2.73E-03	1.36E-06	9
91-20-3	NAPHTHALENE		*Y*	*Y*	*Y*	8.48E-05	5.94E-07	5.40E-05	1.30E-03	4.73E-01	2.37E-04	9
85-01-8	PHENANTHRENE		*Y*	*Y*	*Y*	2.94E-05	2.06E-07	1.87E-05	4.49E-04	1.64E-01	8.20E-05	9
56-55-3	BENZ(A)ANTHRACENE		*Y*	*Y*	*Y*	1.68E-06	1.18E-08	1.07E-06	2.57E-05	9.37E-03	4.69E-06	9
218-01-9	BENZO(A)PHENANTHRENE (CHRYSENE)		*Y*	*Y*	*Y*	3.53E-07	2.47E-09	2.25E-07	5.40E-06	1.97E-03	9.85E-07	9
50-32-8	BENZO(A)PYRENE	*Y*	*Y*	*Y*	*Y*	1.88E-07	1.32E-09	1.20E-07	2.87E-06	1.05E-03	5.25E-07	9
205-99-2	BENZO(B)FLUORANTHENE		*Y*	*Y*	*Y*	9.91E-08	6.94E-10	6.31E-08	1.52E-06	5.53E-04	2.76E-07	9
206-44-0	BENZO(J,K)FLUORENE (FLUORANTHENE)		*Y*	*Y*	*Y*	7.61E-06	5.33E-08	4.85E-06	1.16E-04	4.25E-02	2.12E-05	9
207-08-9	BENZO(K)FLUORANTHENE		*Y*	*Y*	*Y*	1.55E-07	1.09E-09	9.87E-08	2.37E-06	8.65E-04	4.32E-07	9
53-70-3	DIBENZO(A,H)ANTHRACENE		*Y*	*Y*	*Y*	5.83E-07	4.08E-09	3.71E-07	8.91E-06	3.25E-03	1.63E-06	9
193-39-5	INDENO(1,2,3-CD)PYRENE		*Y*	*Y*	*Y*	3.75E-07	2.63E-09	2.39E-07	5.73E-06	2.09E-03	1.05E-06	9
Metals		***TAP***	***HAP***	***PAH***	***POM***	(lb/MMBtu)	(lb/hp-hr)	(lb/hr)	(lb/day)	(lb/yr)	(ton/yr)	
ASC	ARSENIC	*Y*	*Y*			4.00E-06	2.80E-08	2.55E-06	6.12E-05	2.23E-02	1.12E-05	7
BEC	BERYLLIUM	*Y*	*Y*			3.00E-06	2.10E-08	1.91E-06	4.59E-05	1.67E-02	8.37E-06	7
7440-43-9	CADMIUM	*Y*	*Y*			3.00E-06	2.10E-08	1.91E-06	4.59E-05	1.67E-02	8.37E-06	7
SolCR6	CHROMIUM	*Y*	*Y*			3.00E-06	2.10E-08	1.91E-06	4.59E-05	1.67E-02	8.37E-06	7,10
PBC	LEAD		*Y*			9.00E-06	6.30E-08	5.73E-06	1.38E-04	5.02E-02	2.51E-05	7
MNC	MANGANESE	*Y*	*Y*			6.00E-06	4.20E-08	3.82E-06	9.17E-05	3.35E-02	1.67E-05	7
HGC	MERCURY	*Y*	*Y*			3.00E-06	2.10E-08	1.91E-06	4.59E-05	1.67E-02	8.37E-06	7
7440-02-0	NICKEL	*Y*	*Y*			3.00E-06	2.10E-08	1.91E-06	4.59E-05	1.67E-02	8.37E-06	7
SEC	SELENIUM		*Y*			1.50E-05	1.05E-07	9.56E-06	2.29E-04	8.37E-02	4.19E-05	7
							Total HAP	2.50E-03	6.00E-02	2.19E+01	1.09E-02	

1. An average brake-specific fuel consumption of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr.
2. Emission factor derived from Table C-1 to 40 CFR Part 98, Subpart C, converted to lb/mmbtu basis using 2.20462 pounds per kilogram.
3. Emission factor derived from Table C-2 to 40 CFR Part 98, Subpart C, converted to lb/mmbtu basis using 2.20462 pounds per kilogram.
4. GWP values from Table A-1 to 40 CFR Part 98, Subpart A
5. Emission factor from NSPS IIII, §89.112(a), Table 1 37<=kW<75, Tier 3. Converted from g/kW-hr to lb/hp-hr using 453.593 grams per pounds and 1.341 hp per kW.
6. US EPA AP-42 Table 3.4-1 (10/96)
7. US EPA AP-42 Table 1.3-10 (5/10).
8. US EPA AP-42 AP-42, Table 3.3-1 (10/96)
9. US EPA AP-42 AP-42, Table 3.3-2 (10/96)
10. Chromium VI equivalents estimated based on Chromium emitted as Chromic Acid (see 1999 NCDENR memo from Lori Cherry RE: Updated Guidelines for Implementing Acceptable Ambient Levels (AALs) for Chromium (VI) Compounds.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Crusher

Source ID: I-20
Emission Point ID: EP-20

Capacity, ton/yr	1,445,400
Hours of operation, hr/yr	8,760
Hours of operation, hr/day	24
Capacity, ton/hr	165

Pollutant	Emission Factor [1]	Potential Emission Rates			
	lb/ton	lb/hr	lb/day	lb/year	tons/year
PM	1.20E-03	1.98E-01	4.75E+00	1.73E+03	8.67E-01
PM_{10}	5.40E-04	8.91E-02	2.14E+00	7.81E+02	3.90E-01
$PM_{2.5}$	1.00E-04	1.65E-02	3.96E-01	1.45E+02	7.23E-02

Pollutant	Ash Conc.	Emission Factor [2]	Potential Emission Rates			
	ppm	lb/ton	lb/hr	lb/day	lb/year	tons/year
Antimony	5.44	6.53E-09	1.08E-06	2.59E-05	9.44E-03	4.72E-06
Arsenic	53.67	6.44E-08	1.06E-05	2.55E-04	9.31E-02	4.65E-05
Beryllium	11.43	1.37E-08	2.26E-06	5.43E-05	1.98E-02	9.91E-06
Cadmium	3.25	3.90E-09	6.43E-07	1.54E-05	5.63E-03	2.82E-06
Chromium	99.98	1.20E-07	1.98E-05	4.75E-04	1.73E-01	8.67E-05
Chromium VI	11.00	1.32E-08	2.18E-06	5.23E-05	1.91E-02	9.54E-06
Cobalt	41.48	4.98E-08	8.21E-06	1.97E-04	7.19E-02	3.60E-05
Lead	43.48	5.22E-08	8.61E-06	2.07E-04	7.54E-02	3.77E-05
Manganese	98.98	1.19E-07	1.96E-05	4.70E-04	1.72E-01	8.58E-05
Mercury	0.25	3.00E-10	4.95E-08	1.19E-06	4.34E-04	2.17E-07
Nickel	91.11	1.09E-07	1.80E-05	4.33E-04	1.58E-01	7.90E-05
Selenium	12.82	1.54E-08	2.54E-06	6.09E-05	2.22E-02	1.11E-05

1. Emission Factor for Crushing operation from AP-42, Table 11.19.2-2. Factor is based on controlled crushing with wet suppression, as ash is crushed after dewatering but prior to drying.

2. HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Crusher Diesel Engine

Source ID: ES-23
Emission Point ID: EP-23

Potential emissions from diesel-fired engine used to operate screener

Emission Factor Conversions (for emission factors published in only one set of units)

$$EF\,\frac{lb}{hp-hr} = EF\,\frac{lb}{MMbtu} \times \frac{7000\ Btu}{hp-hr} \times \frac{MMBtu}{10^6\ Btu}$$

$$EF\,\frac{lb}{MMBtu} = EF\,\frac{lb}{hp-hr} \times \frac{hp-hr}{7000\ Btu} \times \frac{10^6\ Btu}{MMBtu}$$

Fuel:	*Diesel*	
Unit Rating:	224	kW
	300	bhp
Sulfur Content:	0.0015	%
Operating Hours:	8,760	hr/yr

Emissions Calculations

$$Emissions\ \frac{lb}{hr} = EF\,\frac{lb}{hp-hr} \times \frac{hp-hr}{1\ hr} \qquad Emissions\ \frac{lb}{day} = Emissions\,\frac{lb}{hr} \times \frac{24\ hr}{day}$$

$$Emissions\ \frac{lb}{year} = Emissions\,\frac{lb}{hr} \times \frac{Operating\ hr}{year} \qquad Emissions\ \frac{ton}{year} = Emissions\,\frac{lb}{year} \times \frac{1\ ton}{2000\ lb}$$

CAS #	Compound					Emission Factors (lb/MMBtu) [1] IC Engines (≤447 KW, 600 HP) Emission Factor (lb/MMBtu)	Emission Factor (lb/hp-hr)	Hourly Emissions	Daily Emissions	Annual Emissions		Emission Factor Reference
Greenhouse Gas Pollutants						**(lb/MMBtu)**	**(lb/hp-hr)**	**(lb/hr)**	**(lb/day)**	**(lb/yr)**	**(ton/yr)**	
CO_2	CARBON DIOXIDE					1.63E+02	1.14E+00	3.42E+02	8.22E+03	3.00E+06	1.50E+03	2
CH_4	METHANE					6.61E-03	4.63E-05	1.39E-02	3.33E-01	1.22E+02	6.08E-02	3
N_2O	NITROUS OXIDE					1.32E-03	9.26E-06	2.78E-03	6.67E-02	2.43E+01	1.22E-02	3
CO_2e	GREENHOUSE GAS					1.64E+02	1.15E+00	3.44E+02	8.25E+03	3.01E+06	1.50E+03	4
Criteria Pollutants						**(lb/MMBtu)**	**(lb/hp-hr)**	**(lb/hr)**	**(lb/day)**	**(lb/yr)**	**(ton/yr)**	
CO	CARBON MONOXIDE (CO)					1.17E+00	8.22E-03	2.47E+00	5.92E+01	2.16E+04	1.08E+01	5
NO_x	NITROGEN OXIDES (NO_x)					1.10E+00	7.73E-03	2.32E+00	5.56E+01	2.03E+04	1.02E+01	5
PM	PARTICULATE MATTER (PM)					9.39E-02	6.58E-04	1.97E-01	4.73E+00	1.73E+03	8.64E-01	5
PM_{10}	PARTICULATE MATTER<10 MICRONS (PM_{10})					9.39E-02	6.58E-04	1.97E-01	4.73E+00	1.73E+03	8.64E-01	5
$PM_{2.5}$	PARTICULATE MATTER<2.5 MICRONS ($PM_{2.5}$)					9.39E-02	6.58E-04	1.97E-01	4.73E+00	1.73E+03	8.64E-01	5
SO_2	SULFUR DIOXIDE (SO_2)					1.52E-03	1.06E-05	3.18E-03	7.64E-02	2.79E+01	1.39E-02	6
PBC	LEAD					9.00E-06	6.30E-08	1.89E-05	4.54E-04	1.66E-01	8.28E-05	7
VOC	VOLATILE ORGANIC COMPOUNDS (VOC)					3.60E-01	2.51E-03	7.54E-01	1.81E+01	6.61E+03	3.30E+00	8
Organic Compounds		***TAP***	***HAP***	***PAH***	***POM***	**(lb/MMBtu)**	**(lb/hp-hr)**	**(lb/hr)**	**(lb/day)**	**(lb/yr)**	**(ton/yr)**	
106-99-0	1,3-BUTADIENE	*Y*	*Y*			3.91E-05	2.74E-07	8.21E-05	1.97E-03	7.19E-01	3.60E-04	9
75-07-0	ACETALDEHYDE	*Y*	*Y*			7.67E-04	5.37E-06	1.61E-03	3.87E-02	1.41E+01	7.05E-03	9
107-02-8	ACROLEIN	*Y*	*Y*			9.25E-05	6.48E-07	1.94E-04	4.66E-03	1.70E+00	8.51E-04	9
71-43-2	BENZENE	*Y*	*Y*			9.33E-04	6.53E-06	1.96E-03	4.70E-02	1.72E+01	8.58E-03	9
50-00-0	FORMALDEHYDE	*Y*	*Y*			1.18E-03	8.26E-06	2.48E-03	5.95E-02	2.17E+01	1.09E-02	9
108-88-3	TOLUENE	*Y*	*Y*			4.09E-04	2.86E-06	8.59E-04	2.06E-02	7.52E+00	3.76E-03	9
1330-20-7	XYLENE (MIXED ISOMERS)	*Y*	*Y*			2.85E-04	2.00E-06	5.99E-04	1.44E-02	5.24E+00	2.62E-03	9
Polycyclic Aromatic Hydrocarbons (PAH) & Polycyclic Organic Matter (POM)		***TAP***	***HAP***	***PAH***	***POM***	**(lb/MMBtu)**	**(lb/hp-hr)**	**(lb/hr)**	**(lb/day)**	**(lb/yr)**	**(ton/yr)**	
PAH	**TOTAL**		*Y*	*Y*	*Y*	1.68E-04	1.18E-06	3.53E-04	8.47E-03	3.09E+00	1.55E-03	9
120-12-7	ANTHRACENE		*Y*	*Y*	*Y*	1.87E-06	1.31E-08	3.93E-06	9.42E-05	3.44E-02	1.72E-05	9
208-96-8	ACENAPHTHYLENE		*Y*	*Y*	*Y*	5.06E-06	3.54E-08	1.06E-05	2.55E-04	9.31E-02	4.65E-05	9
83-32-9	ACENAPHTHENE		*Y*	*Y*	*Y*	1.42E-06	9.94E-09	2.98E-06	7.16E-05	2.61E-02	1.31E-05	9
86-73-7	FLUORENE		*Y*	*Y*	*Y*	2.92E-05	2.04E-07	6.13E-05	1.47E-03	5.37E-01	2.69E-04	9
129-00-0	PYRENE		*Y*	*Y*	*Y*	4.78E-06	3.35E-08	1.00E-05	2.41E-04	8.79E-02	4.40E-05	9
191-24-2	BENZO(G,H,I)PERYLENE		*Y*	*Y*	*Y*	4.89E-07	3.42E-09	1.03E-06	2.46E-05	9.00E-03	4.50E-06	9
91-20-3	NAPHTHALENE		*Y*	*Y*	*Y*	8.48E-05	5.94E-07	1.78E-04	4.27E-03	1.56E+00	7.80E-04	9
85-01-8	PHENANTHRENE		*Y*	*Y*	*Y*	2.94E-05	2.06E-07	6.17E-05	1.48E-03	5.41E-01	2.70E-04	9
56-55-3	BENZ(A)ANTHRACENE		*Y*	*Y*	*Y*	1.68E-06	1.18E-08	3.53E-06	8.47E-05	3.09E-02	1.55E-05	9
218-01-9	BENZO(A)PHENANTHRENE (CHRYSENE)		*Y*	*Y*	*Y*	3.53E-07	2.47E-09	7.41E-07	1.78E-05	6.49E-03	3.25E-06	9
50-32-8	BENZO(A)PYRENE	*Y*	*Y*	*Y*	*Y*	1.88E-07	1.32E-09	3.95E-07	9.48E-06	3.46E-03	1.73E-06	9
205-99-2	BENZO(B)FLUORANTHENE		*Y*	*Y*	*Y*	9.91E-08	6.94E-10	2.08E-07	4.99E-06	1.82E-03	9.12E-07	9
206-44-0	BENZO(J,K)FLUORENE (FLUORANTHENE)		*Y*	*Y*	*Y*	7.61E-06	5.33E-08	1.60E-05	3.84E-04	1.40E-01	7.00E-05	9
207-08-9	BENZO(K)FLUORANTHENE		*Y*	*Y*	*Y*	1.55E-07	1.09E-09	3.26E-07	7.81E-06	2.85E-03	1.43E-06	9
53-70-3	DIBENZO(A,H)ANTHRACENE		*Y*	*Y*	*Y*	5.83E-07	4.08E-09	1.22E-06	2.94E-05	1.07E-02	5.36E-06	9
193-39-5	INDENO(1,2,3-CD)PYRENE		*Y*	*Y*	*Y*	3.75E-07	2.63E-09	7.88E-07	1.89E-05	6.90E-03	3.45E-06	9
Metals		***TAP***	***HAP***	***PAH***	***POM***	**(lb/MMBtu)**	**(lb/hp-hr)**	**(lb/hr)**	**(lb/day)**	**(lb/yr)**	**(ton/yr)**	
ASC	ARSENIC	*Y*	*Y*			4.00E-06	2.80E-08	8.40E-06	2.02E-04	7.36E-02	3.68E-05	7
BEC	BERYLLIUM	*Y*	*Y*			3.00E-06	2.10E-08	6.30E-06	1.51E-04	5.52E-02	2.76E-05	7
7440-43-9	CADMIUM	*Y*	*Y*			3.00E-06	2.10E-08	6.30E-06	1.51E-04	5.52E-02	2.76E-05	7
SolCR6	CHROMIUM	*Y*	*Y*			3.00E-06	2.10E-08	6.30E-06	1.51E-04	5.52E-02	2.76E-05	7,10
PBC	LEAD		*Y*			9.00E-06	6.30E-08	1.89E-05	4.54E-04	1.66E-01	8.28E-05	7
MNC	MANGANESE	*Y*	*Y*			6.00E-06	4.20E-08	1.26E-05	3.02E-04	1.10E-01	5.52E-05	7
HGC	MERCURY	*Y*	*Y*			3.00E-06	2.10E-08	6.30E-06	1.51E-04	5.52E-02	2.76E-05	7
7440-02-0	NICKEL	*Y*	*Y*			3.00E-06	2.10E-08	6.30E-06	1.51E-04	5.52E-02	2.76E-05	7
SEC	SELENIUM		*Y*			1.50E-05	1.05E-07	3.15E-05	7.56E-04	2.76E-01	1.38E-04	7
							Total HAP	8.24E-03	1.98E-01	7.22E+01	3.61E-02	

1. An average brake-specific fuel consumption of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr.
2. Emission factor derived from Table C-1 to 40 CFR Part 98, Subpart C, converted to lb/mmbtu basis using 2.20462 pounds per kilogram.
3. Emission factor derived from Table C-2 to 40 CFR Part 98, Subpart C, converted to lb/mmbtu basis using 2.20462 pounds per kilogram.
4. GWP values from Table A-1 to 40 CFR Part 98, Subpart A
5. Emission factor from NSPS IIII, §89.112(a), Table 1 37<=kW<75, Tier 3. Converted from g/kW-hr to lb/hp-hr using 453.593 grams per pounds and 1.341 hp per kW.
6. US EPA AP-42 Table 3.4-1 (10/96)
7. US EPA AP-42 Table 1.3-10 (5/10).
8. US EPA AP-42 AP-42, Table 3.3-1 (10/96)
9. US EPA AP-42 AP-42, Table 3.3-2 (10/96)

10. Chromium VI equivalents estimated based on Chromium emitted as Chromic Acid (see 1999 NCDENR memo from Lori Cherry RE: Updated Guidelines for Implementing Acceptable Ambient Levels (AALs) for Chromium (VI) Compounds.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Haul Roads - Loaded

Source ID: I-21
Emission Point ID: EP-21

Ash is delivered to the process via trucks. Particulate emissions are generated from the haul roads from the force of the wheels on the road surface. This force causes pulverization of the surface material. The particles are lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents, which generate airborne particulate emissions.

The methodology presented below is taken from Section 13.2.2 (Unpaved Roads) of the U.S. EPA's AP-42 document and is based on the vehicle miles traveled (VMT) at the site.

$$E = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$

Where: E is the size-specific emission factor (lb/VMT)
s is the surface material silt content (%)
W is the mean vehicle weight (tons)
k, a, and b are empirical constants

Equation 1a of AP-42 Section 13.2.2 for vehicles traveling on unpaved surfaces at industrial sites

Constant	Industrial Roads		
	$PM_{2.5}$	PM_{10}	PM
k	0.15	1.5	4.9
a	0.9	0.9	0.7
b	0.45	0.45	0.45

5.1	%, Average Silt Content of Plant Roads at a Coal Mining Site (Table 13.2.2-1)
50	tons, Mean Vehicle Loaded Weight (Fleet Average)

0.25	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Road Silt Portion)
2.46	lb/VMT, Calculated PM_{10} Emission Factor (Road Silt Portion)
9.55	lb/VMT, Calculated PM Emission Factor (Road Silt Portion)

Emissions associated with the exhaust, brake wear, and tire wear must be added to the values calculated above. The values shown below were taken from Table 13.2.2-4.

Particle Size	$PM_{2.5}$	PM_{10}	PM
lb/VMT "adder"	0.00036	0.00047	0.00047

0.25	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Total, No natural mitigation)
2.46	lb/VMT, Calculated PM_{10} Emission Factor (Total, No natural mitigation)
9.55	lb/VMT, Calculated PM Emission Factor (Total, No natural mitigation)

All roads are subject to natural mitigation because of rainfall and other precipitation. The following equation accounts for reductions in the emission factor due to natural mitigation.

$$E_{EXT} = E\left[\frac{(365 - P)}{365}\right]$$

Where: E_{EXT} is the adjusted emission factor accounting for natural mitigation
E is emission factor from Equation 1a
P is the number of days per year with at least 0.01 inches of precipitation

120	days, Precipitation Greater than 0.01 inches at Plant Location (Figure 13.2.2-1)

0.17	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Total, With natural mitigation)
1.65	lb/VMT, Calculated PM_{10} Emission Factor (Total, With natural mitigation)
6.41	lb/VMT, Calculated PM Emission Factor (Total, With natural mitigation)

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Haul Roads - Loaded

Source ID: I-21
Emission Point ID: EP-21

In addition to natural mitigation, the following mitigation will be implemented at the site. Control efficiencies taken from the *WRAP Fugitive Dust Handbook, September 7, 2006.*

57%	Limit on-site vehicle speeds (on unpaved roads) to 15 mph.
84%	Application of Gravel on Dirt Surfaces
90%	Implement watering for industrial unpaved road.

0.04	lb/VMT, Calculated PM Emission Factor (Total, With natural mitigation, and water sprays)
0.01	lb/VMT, Calculated PM_{10} Emission Factor (Total, With natural mitigation, and water sprays)
0.001	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Total, With natural mitigation, and water sprays)

23,400	miles/year, "Loaded Truck VMT"
2000	lb/ton, Conversion Factor

5.16E-01	tpy, PM Emissions
1.33E-01	tpy, PM_{10} Emissions
1.33E-02	tpy, $PM_{2.5}$ Emissions

1.18E-01	lb/hr, PM Emissions	2.83E+00	lb/day, PM Emissions
3.04E-02	lb/hr, PM_{10} Emissions	7.29E-01	lb/day, PM_{10} Emissions
3.04E-03	lb/hr, $PM_{2.5}$ Emissions	7.30E-02	lb/day, $PM_{2.5}$ Emissions

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Haul Roads - Unloaded

Source ID: I-21
Emission Point ID: EP-21

Ash is delivered to the process via trucks. Particulate emissions are generated from the haul roads from the force of the wheels on the road surface. This force causes pulverization of the surface material. The particles are lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents, which generate airborne particulate emissions.

The methodology presented below is taken from Section 13.2.2 (Unpaved Roads) of the U.S. EPA's AP-42 document and is based on the vehicle miles traveled (VMT) at the site.

$$E = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$

Where: E is the size-specific emission factor (lb/VMT)
s is the surface material silt content (%)
W is the mean vehicle weight (tons)
k, a, and b are empirical constants

Equation 1a of AP-42 Section 13.2.2 for vehicles traveling on unpaved surfaces at industrial sites

Constant	Industrial Roads		
	$PM_{2.5}$	PM_{10}	PM
k	0.15	1.5	4.9
a	0.9	0.9	0.7
b	0.45	0.45	0.45

5.1	%, Average Silt Content of Plant Roads at a Coal Mining Site (Table 13.2.2-1)
25	tons, Mean Vehicle Empty Weight (Fleet Average)

0.18	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Road Silt Portion)
1.80	lb/VMT, Calculated PM_{10} Emission Factor (Road Silt Portion)
6.99	lb/VMT, Calculated PM Emission Factor (Road Silt Portion)

Emissions associated with the exhaust, brake wear, and tire wear must be added to the values calculated above. The values shown below were taken from Table 13.2.2-4.

Particle Size	$PM_{2.5}$	PM_{10}	PM
lb/VMT "adder"	0.00036	0.00047	0.00047

0.18	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Total, No natural mitigation)
1.80	lb/VMT, Calculated PM_{10} Emission Factor (Total, No natural mitigation)
6.99	lb/VMT, Calculated PM Emission Factor (Total, No natural mitigation)

All roads are subject to natural mitigation because of rainfall and other precipitation. The following equation accounts for reductions in the emission factor due to natural mitigation.

$$E_{EXT} = E\left[\frac{(365 - P)}{365}\right]$$

Where: E_{EXT} is the adjusted emission factor accounting for natural mitigation
E is emission factor from Equation 1a
P is the number of days per year with at least 0.01 inches of precipitation

120	days, Precipitation Greater than 0.01 inches at Plant Location (Figure 13.2.2-1)

0.12	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Total, With natural mitigation)
1.21	lb/VMT, Calculated PM_{10} Emission Factor (Total, With natural mitigation)
4.69	lb/VMT, Calculated PM Emission Factor (Total, With natural mitigation)

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Haul Roads - Unloaded

Source ID: I-21
Emission Point ID: EP-21

In addition to natural mitigation, the following mitigation will be implemented at the site. Control efficiencies taken from the *WRAP Fugitive Dust Handbook, September 7, 2006.*

57%	Limit on-site vehicle speeds (on unpaved roads) to 15 mph.
84%	Application of Gravel on Dirt Surfaces
90%	Implement watering for industrial unpaved road.

0.03	lb/VMT, Calculated PM Emission Factor (Total, With natural mitigation, and water sprays)
0.008	lb/VMT, Calculated PM_{10} Emission Factor (Total, With natural mitigation, and water sprays)
0.0008	lb/VMT, Calculated $PM_{2.5}$ Emission Factor (Total, With natural mitigation, and water sprays)

23,400	miles/day, One-way Vehicle Distance from Source to Offsite
2000	lb/ton, Conversion Factor

3.78E-01	tpy, PM Emissions
9.74E-02	tpy, PM_{10} Emissions
9.76E-03	tpy, $PM_{2.5}$ Emissions

8.62E-02	lb/hr, PM Emissions	2.07E+00	lb/day, PM Emissions
2.22E-02	lb/hr, PM_{10} Emissions	5.34E-01	lb/day, PM_{10} Emissions
2.23E-03	lb/hr, $PM_{2.5}$ Emissions	5.35E-02	lb/day, $PM_{2.5}$ Emissions

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Haul Roads - Vehicle Miles Traveled

	Ash Trucked (ton/yr)	Truck Capacity (ton/truck)	Truck Loads/Year	Route Distance[1] (miles)	Total Miles Traveled VMT/yr	Total VMT/yr
Empty Trucks to Loading Area	429,000	25.00	17,160	1.36	23,400	46,800
Loaded Trucks to Process				1.36	23,400	

1 - Route distance based on longest potential haul route (7,200 ft).

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Feed Silo

Source ID: I-4
Emission Point ID: EP-4

Section 13.2.4 (Aggregate Handling and Storage Piles) is used to estimate emissions from the handling of material at an industrial site. The "Drop Equation" is shown below:

$$E = k\,(0.0032)\,\frac{(U/5)^{1.3}}{(M/2)^{1.4}}$$

Where:
E is the emission factor in [lb/ton]
K is the particle size multiplier [dimensionless]
U is the average wind speed [mph]
M is the average moisture content [%]

Constant	PM2.5	PM10	PM
k	0.053	0.35	0.74

14.5	mph, 2013-2017 Average Wind Speed (4.85 mph) multiplied by a safety factor of 3.
3	%, Moisture
99%	Control from Bin vent

	I-4	I-4
	Silo Filling	Silo Unloading
Ton/hr	125	75
Ton/yr	400,000	400,000

AshTrace Element Analysis	Ash Concentration (ppm)	Calculated Emission Factor	I-4 Silo Filling	I-4 Silo Unloading	I-4 Silo Filling	I-4 Silo Unloading
		(lb/ton)	lb/hr	lb/hr	lb/yr	lb/yr
PM	--	5.38E-05	6.73E-03	4.04E-03	2.15E+01	2.15E+01
PM10	--	2.55E-05	3.18E-03	1.91E-03	1.02E+01	1.02E+01
PM2.5	--	3.85E-06	4.82E-04	2.89E-04	1.54E+00	1.54E+00
Antimony	5.44	2.93E-10	3.66E-08	2.20E-08	1.17E-04	1.17E-04
Arsenic	53.67	2.89E-09	3.61E-07	2.17E-07	1.16E-03	1.16E-03
Beryllium	11.43	6.15E-10	7.69E-08	4.61E-08	2.46E-04	2.46E-04
Cadmium	3.25	1.75E-10	2.18E-08	1.31E-08	6.99E-05	6.99E-05
Chromium	99.98	5.38E-09	6.73E-07	4.04E-07	2.15E-03	2.15E-03
Chromium VI	11.00	5.92E-10	7.40E-08	4.44E-08	2.37E-04	2.37E-04
Cobalt	41.48	2.23E-09	2.79E-07	1.67E-07	8.93E-04	8.93E-04
Lead	43.48	2.34E-09	2.92E-07	1.75E-07	9.36E-04	9.36E-04
Manganese	98.98	5.33E-09	6.66E-07	3.99E-07	2.13E-03	2.13E-03
Mercury	0.25	1.35E-11	1.68E-09	1.01E-09	5.38E-06	5.38E-06
Nickel	91.11	4.90E-09	6.13E-07	3.68E-07	1.96E-03	1.96E-03
Selenium	12.82	6.90E-10	8.62E-08	5.17E-08	2.76E-04	2.76E-04

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Component	Total Emissions			
	lbs/hr	lbs/day (lb/hr * 24 hrs)	lbs/year	tons/year (lb/yr / 2000)
PM	1.08E-02	2.58E-01	4.30E+01	2.15E-02
PM10	5.09E-03	1.22E-01	2.04E+01	1.02E-02
PM2.5	7.71E-04	1.85E-02	3.08E+00	1.54E-03
Antimony	5.86E-08	1.41E-06	2.34E-04	1.17E-07
Arsenic	5.78E-07	1.39E-05	2.31E-03	1.16E-06
Beryllium	1.23E-07	2.95E-06	4.92E-04	2.46E-07
Cadmium	3.49E-08	8.39E-07	1.40E-04	6.99E-08
Chromium	1.08E-06	2.58E-05	4.30E-03	2.15E-06
Chromium VI	1.18E-07	2.84E-06	4.73E-04	2.37E-07
Cobalt	4.46E-07	1.07E-05	1.79E-03	8.93E-07
Lead	4.68E-07	1.12E-05	1.87E-03	9.36E-07
Manganese	1.07E-06	2.56E-05	4.26E-03	2.13E-06
Mercury	2.69E-09	6.46E-08	1.08E-05	5.38E-09
Nickel	9.81E-07	2.35E-05	3.92E-03	1.96E-06
Selenium	1.38E-07	3.31E-06	5.52E-04	2.76E-07

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: STAR® Propane Start-Up Burner

Source ID: ES-5
Emission Point ID: EP-5

Emission Factor Conversions (for emission factors published in only one set of units)

$$EF\,\frac{lb}{MMBtu} = EF\,\frac{lb}{1000\ gal} \times \frac{1000\ gal}{MMBtu\ (Propane)}$$

Fuel:	*Propane*	
Unit Rating:	60.0	MMBtu/hr
	90.5	MMBtu/10^3 gal (Propane)
	663	gal/hr (Propane)
Sulfur Content:	0.10	gr/100 ft^3 gas
Operating Hours:	8,760	hr/yr
Number of Units in Operation:	1	
Annual Fuel Consumption:	5,807,735	gal/yr
Controls:	LNB	*No control efficiency claimed*

Emissions Calculations

$$Emissions\ \frac{lb}{hr} = EF\,\frac{lb}{MMBtu} \times \frac{MMBtu}{hr} \qquad Emissions\ \frac{lb}{day} = Emissions\,\frac{lb}{hr} \times \frac{24\ hr}{day}$$

$$Emissions\ \frac{lb}{year} = Emissions\,\frac{lb}{hr} \times \frac{Operating\ hr}{year} \qquad Emissions\ \frac{ton}{year} = Emissions\,\frac{lb}{year} \times \frac{1\ ton}{2000\ lb}$$

CAS #	Compound	Emission Factors (lb/MMBtu) Propane Fired Boiler		Hourly Emissions	Daily Emissions	Annual Emissions		Emission Factor Reference
		Emission Factor (lb/MMBtu)	Emission Factor					
Greenhouse Gas Pollutants		**(lb/MMBtu)**	**(lb/10^3 gal)**	**(lb/hr)**	**(lb/day)**	**(lb/yr)**	**(ton/yr)**	
CO_2	CARBON DIOXIDE	1.39E+02	1.25E+04	8.32E+03	2.00E+05	7.29E+07	3.64E+04	1
CH_4	METHANE	6.61E-03	5.99E-01	3.97E-01	9.52E+00	3.48E+03	1.74E+00	2
N_2O	NITROUS OXIDE	1.32E-03	1.20E-01	7.94E-02	1.90E+00	6.95E+02	3.48E-01	2
CO_2e	GREENHOUSE GAS	1.39E+02	1.26E+04	8.35E+03	2.00E+05	7.31E+07	3.66E+04	3
Criteria Pollutants		**(lb/MMBtu)**	**(lb/10^3 gal)**	**(lb/hr)**	**(lb/day)**	**(lb/yr)**	**(ton/yr)**	
CO	CARBON MONOXIDE (CO)	8.29E-02	7.50E+00	4.97E+00	1.19E+02	4.36E+04	2.18E+01	4
NO_x	NITROGEN OXIDES (NO_x)	1.44E-01	1.30E+01	8.62E+00	2.07E+02	7.55E+04	3.78E+01	4
PM	PARTICULATE MATTER (PM)	7.73E-03	7.00E-01	4.64E-01	1.11E+01	4.07E+03	2.03E+00	4
PM_{10}	PARTICULATE MATTER<10 MICRONS (PM_{10})	7.73E-03	7.00E-01	4.64E-01	1.11E+01	4.07E+03	2.03E+00	4
$PM_{2.5}$	PARTICULATE MATTER<2.5 MICRONS ($PM_{2.5}$)	7.73E-03	7.00E-01	4.64E-01	1.11E+01	4.07E+03	2.03E+00	4
SO_2	SULFUR DIOXIDE (SO_2)	1.10E-04	1.00E-02	6.63E-03	1.59E-01	5.81E+01	2.90E-02	4
VOC	VOLATILE ORGANIC COMPOUNDS (VOC)	8.84E-03	8.00E-01	5.30E-01	1.27E+01	4.65E+03	2.32E+00	4

1. Emission factor derived form Table C-1 to 40 CFR Part 98, Subpart C, converted to lb/mmbtu basis using 2.20462 pounds per kilogram.
2. Emission factor derived form Table C-2 to 40 CFR Part 98, Subpart C, converted to lb/mmbtu basis using 2.20462 pounds per kilogram.
3. GWP values from Table A-1 to 40 CFR Part 98, Subpart A
4. US EPA AP-42, Table 1.5-1 (07/08) Duke Energy calculates emissions using only the propane emission factors in US EPA AP-42 Table 1.5-1. Duke Energy does not estimate emissions of HAP or TAP using natural gas equivalent factors.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: STAR® Reactor (exhaust stack) Emissions from Ash Beneficiation

Source ID: ES-5
Emission Point ID: EP-5

Total Potential Operating Hours:	8,760	
Maximum Capacity (MMBtu/hr):	140	
Loss on Ignition (% LOI):	3.76%	*min value for conservative overestimate of emissions.*
Heating Value of Carbon (Btu/lb):	14,500	
Feed Ash Sulfur Content (%)	0.10%	*average (0.05%) multiplied by a safety factor of 2.*
Inlet Air Flow Rate (acfm):	75,000	
Emission Loading Rate (gr/scf):	0.025	
Conversion Factor (gr/lb):	7,000	
SO_2 Control Efficiency (%):	95%	

Example Calculation for SO2 and CO2 Emission Factor

$$SO_2\ EF\ \frac{lb}{hr} = \frac{140\ MMBtu}{hr} \times \frac{10^6 Btu}{MMBtu} \times \frac{1\ lb\ Carbon}{14{,}500\ Btu} \times \frac{100\ lb\ Ash}{9.15\ lb\ Carbon} \times \frac{0.05\ lb\ S}{100\ lb\ Ash} \times \frac{64\ lb\ SO_2}{32\ lb\ S} \times (1 - SO_2CE)$$

$$CO_2\ EF\ \frac{lb}{MMBtu} = \left(\frac{1\ lb\ Carbon}{14{,}500\ Btu} \times \frac{10^6\ Btu}{MMBtu} - \frac{.16\ lb\ CO}{MMBtu} \times \frac{12\ lb\ Carbon}{28\ lb\ CO}\right)$$

Estimated Emissions

Compounds	Emission Factor	Units	Emissions				Reference
			lbs/hr	lb/day	lbs/year	ton/year	
SO2	25.68	lb/hr	25.68	616	224,945	112.5	See Example
NOx	3.40E-01	lb/MMBtu	47.6	1,142	416,976	208.5	Emission Factor based on information provided by the SEFA Group
VOC	1.60E-02	lb/MMBtu	2.24	53.76	19,622	9.81	Emission Factor based on information provided by the SEFA Group
CO	1.60E-01	lb/MMBtu	22.4	538	196,224	98.1	Emission Factor based on information provided by the SEFA Group
H2SO4	1.00E-01	lb/hr	0.10	2	876	0.4	Emission Factor based on information provided by the SEFA Group
CO2	2.53E+02	lb/MMBtu	35,367	848,810	309,815,786	154,908	See Example

1 - Based on SEFA stack test performed September 2016. Sulfuric acid mist was 0.05 lb/hr, doubled for contingency.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: STAR® Reactor (exhaust stack) Emissions from Ash Beneficiation

Source ID: ES-5
Emission Point ID: EP-5

A sample calculation for the bagfilter is provided below:

$$\frac{grains\ PM}{scf} * \frac{scf}{hour} * \frac{lb}{7000\ grains} = \frac{lb\ PM}{hour}$$

0.025	gr/acf, Manufacturer's Guaranteed Emission Rate
75,000	acfm, inlet air flow rate
7000	gr/lb, Conversion Factor

16.07	lb PM/hr, Calculated Emission Factor for Bagfilter
140,786	lb PM/yr, Calculated Emission Factor for Bagfilter

Estimated Emissions

Expected By-Product Composition	Average By-Product Concentration* (ppm)	Emissions			
		lbs/hr	lbs/day	lbs/year	tons/year
PM	1.00	1.61E+01	3.86E+02	1.41E+05	7.04E+01
PM10	0.92	1.48E+01	3.55E+02	1.30E+05	6.48E+01
PM2.5	0.53	8.52E+00	2.04E+02	7.46E+04	3.73E+01
Antimony	3.40E-02	5.46E-07	1.31E-05	4.79E-03	2.39E-06
Arsenic	1.90E-01	3.05E-06	7.33E-05	2.67E-02	1.34E-05
Beryllium	2.70E-02	4.34E-07	1.04E-05	3.80E-03	1.90E-06
Cadmium	4.10E-02	6.59E-07	1.58E-05	5.77E-03	2.89E-06
Chromium	7.60E-01	1.22E-05	2.93E-04	1.07E-01	5.35E-05
Cobalt	2.00E-01	3.21E-06	7.71E-05	2.82E-02	1.41E-05
Lead	1.20E-01	1.93E-06	4.63E-05	1.69E-02	8.45E-06
Manganese	5.30E+00	8.52E-05	2.04E-03	7.46E-01	3.73E-04
Mercury	1.00E-03	1.61E-08	3.86E-07	1.41E-04	7.04E-08
Nickel	4.80E-01	7.71E-06	1.85E-04	6.76E-02	3.38E-05
Selenium	1.30E-01	2.09E-06	5.01E-05	1.83E-02	9.15E-06

**Cumulative PM mass fractions from AP-42, Table 1.1-6 (09/98)*

Byproduct composition based on 10% inerts from fresh lime. The majority of metals emissions from the STAR® reactor is from hydrated lime introduced in the FGD system. In the process, product ash is removed in the Product Baghouse upstream of the FGD. The Product Baghouse has a removal efficiency of >99%; therefore, any ash carryover into the scrubber and exhaust point EP-5 is minimal.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: FGD Byproduct Silo

Source ID: I-6
Emission Point ID: EP-6

A sample calculation for the bin vent is provided below:

$$\frac{grains\ PM}{scf} * \frac{scf}{hour} * \frac{lb}{7000\ grains} = \frac{lb\ PM}{hour}$$

0.005	gr/scf, Manufacturer's Guaranteed Emission Rate
1,050	acfm, gas flow rate (*assumes difference between actual and standard conditions is negligible)*
7000	gr/lb, Conversion Factor

4.50E-02	lb PM/hr, Calculated Emission Factor for Bagfilter
394	lb PM/yr, Calculated Emission Factor for Bagfilter

Expected By-Product Composition	Average By-Product Concentration* (ppm)	Emissions			
		lbs/hr	lbs/day	lbs/year	tons/year
PM	1.00	4.50E-02	1.08E+00	3.94E+02	1.97E-01
PM10	0.92	4.14E-02	9.94E-01	3.63E+02	1.81E-01
PM2.5	0.53	2.39E-02	5.72E-01	2.09E+02	1.04E-01
Antimony	3.40E-02	1.53E-09	3.67E-08	1.34E-05	6.70E-09
Arsenic	1.90E-01	8.55E-09	2.05E-07	7.49E-05	3.74E-08
Beryllium	2.70E-02	1.22E-09	2.92E-08	1.06E-05	5.32E-09
Cadmium	4.10E-02	1.85E-09	4.43E-08	1.62E-05	8.08E-09
Chromium	7.60E-01	3.42E-08	8.21E-07	3.00E-04	1.50E-07
Cobalt	2.00E-01	9.00E-09	2.16E-07	7.88E-05	3.94E-08
Lead	1.20E-01	5.40E-09	1.30E-07	4.73E-05	2.37E-08
Manganese	5.30	2.39E-07	5.72E-06	2.09E-03	1.04E-06
Mercury	1.00E-03	4.50E-11	1.08E-09	3.94E-07	1.97E-10
Nickel	4.80E-01	2.16E-08	5.18E-07	1.89E-04	9.46E-08
Selenium	1.30E-01	5.85E-09	1.40E-07	5.12E-05	2.56E-08

**Cumulative PM mass fractions from AP-42, Table 1.1-6 (09/98)*

Byproduct composition based on 10% inerts from fresh lime. The majority of metals emissions from the FGD Byproduct Silo is from hydrated lime introduced in the FGD system. In the process, product ash is removed in the Product Baghouse upstream of the FGD. The Product Baghouse has a removal efficiency of >99%; therefore, any ash carryover into the scrubber and Byproduct Silo is minimal.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: FGD Hydrated Lime Silo

Source ID: I-7
Emission Point ID: EP-7

A sample calculation for the bin vent is provided below:

$$\frac{grains\ PM}{scf} * \frac{scf}{hour} * \frac{lb}{7000\ grains} = \frac{lb\ PM}{hour}$$

0.005	gr/scf, Manufacturer's Guaranteed Emission Rate
1,050	acfm, gas flow rate (*assumes difference between actual and standard conditions is negligible)*
7000	gr/lb, Conversion Factor

4.50E-02	lb PM/hr, Calculated Emission Factor for Bin Vent
394	lb PM/yr, Calculated Emission Factor for Bin Vent

LimeTrace Element Analysis	Average Lime Concentration* (ppm)	Emissions			
		lbs/hr	lbs/day	lbs/year	tons/year
PM	1.00	4.50E-02	1.08E+00	3.94E+02	1.97E-01
PM10	0.92	4.14E-02	9.94E-01	3.63E+02	1.81E-01
PM2.5	0.53	2.39E-02	5.72E-01	2.09E+02	1.04E-01
Antimony	3.40E-01	1.53E-08	3.67E-07	1.34E-04	6.70E-08
Arsenic	1.90	8.55E-08	2.05E-06	7.49E-04	3.74E-07
Beryllium	2.70E-01	1.22E-08	2.92E-07	1.06E-04	5.32E-08
Cadmium	4.10E-01	1.85E-08	4.43E-07	1.62E-04	8.08E-08
Chromium	7.60	3.42E-07	8.21E-06	3.00E-03	1.50E-06
Cobalt	2.00	9.00E-08	2.16E-06	7.88E-04	3.94E-07
Lead	1.20	5.40E-08	1.30E-06	4.73E-04	2.37E-07
Manganese	53.0	2.39E-06	5.72E-05	2.09E-02	1.04E-05
Mercury	1.00E-02	4.50E-10	1.08E-08	3.94E-06	1.97E-09
Nickel	4.80	2.16E-07	5.18E-06	1.89E-03	9.46E-07
Selenium	1.30	5.85E-08	1.40E-06	5.12E-04	2.56E-07

**Cumulative PM mass fractions from AP-42, Table 1.1-6 (09/98)*

Lime composition from EPRI PISCES Database (February, 2003) Composition of Lime, Median Value

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: EHE A External Heat Exchanger A

Source ID: ES-8
Emission Point ID: EP-8

A sample calculation for the bagfilter is provided below:

$$\frac{grains\ PM}{scf} * \frac{scf}{hour} * \frac{lb}{7000\ grains} = \frac{lb\ PM}{hour}$$

Note: The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Each EHE unit will normally operate at a rate of 35 TPH. Emissions are calculated below for ES-8 assuming the maximum process rate of 70 TPH, or 32,000 scfm for 8,760 hours per year.

0.025	gr/scf, Manufacturer's Guaranteed Emission Rate
32,000	scfm, inlet air flow rate
7000	gr/lb, Conversion Factor

6.86	lb PM/hr, Calculated Emission Factor for Bagfilter
60,069	lb PM/yr, Calculated Emission Factor for Bagfilter

Ash Trace Element Analysis	Average Ash Concentration* (ppm)	Emissions			
		lbs/hr	lbs/day	lbs/year	tons/year
PM	1.00	6.86E+00	1.65E+02	6.01E+04	3.00E+01
PM10	0.92	6.31E+00	1.51E+02	5.53E+04	2.76E+01
PM2.5	0.53	3.63E+00	8.72E+01	3.18E+04	1.59E+01
Antimony	5.44	3.73E-05	8.95E-04	3.27E-01	1.63E-04
Arsenic	53.67	3.68E-04	8.83E-03	3.22E+00	1.61E-03
Beryllium	11.43	7.84E-05	1.88E-03	6.86E-01	3.43E-04
Cadmium	3.25	2.23E-05	5.34E-04	1.95E-01	9.75E-05
Chromium	99.98	6.86E-04	1.65E-02	6.01E+00	3.00E-03
Chromium VI	11.00	7.54E-05	1.81E-03	6.61E-01	3.30E-04
Cobalt	41.48	2.84E-04	6.83E-03	2.49E+00	1.25E-03
Lead	43.48	2.98E-04	7.16E-03	2.61E+00	1.31E-03
Manganese	98.98	6.79E-04	1.63E-02	5.95E+00	2.97E-03
Mercury	0.25	1.71E-06	4.11E-05	1.50E-02	7.51E-06
Nickel	91.11	6.25E-04	1.50E-02	5.47E+00	2.74E-03
Selenium	12.82	8.79E-05	2.11E-03	7.70E-01	3.85E-04

**Cumulative PM mass fractions from AP-42, Table 1.1-6 (09/98)*

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.

EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: EHE B External Heat Exchanger B

Source ID: ES-9
Emission Point ID: EP-9

A sample calculation for the bagfilter is provided below:

$$\frac{grains\ PM}{scf} * \frac{scf}{hour} * \frac{lb}{7000\ grains} = \frac{lb\ PM}{hour}$$

Note: The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Each EHE unit will normally operate at a rate of 35 TPH. Emissions are calculated below for ES-9 assuming the maximum process rate of 70 TPH, or 32,000 scfm for 8,760 hours per year.

0.025	gr/scf, Manufacturer's Guaranteed Emission Rate
32,000	scfm, inlet air flow rate
7000	gr/lb, Conversion Factor

6.86	lb PM/hr, Calculated Emission Factor for Bagfilter
60,069	lb PM/yr, Calculated Emission Factor for Bagfilter

Ash Trace Element Analysis	Average Ash Concentration* (ppm)	Emissions			
		lbs/hr	lbs/day	lbs/year	tons/year
PM	1.00	6.86E+00	1.65E+02	6.01E+04	3.00E+01
PM10	0.92	6.31E+00	1.51E+02	5.53E+04	2.76E+01
PM2.5	0.53	3.63E+00	8.72E+01	3.18E+04	1.59E+01
Antimony	5.44	3.73E-05	8.95E-04	3.27E-01	1.63E-04
Arsenic	53.67	3.68E-04	8.83E-03	3.22E+00	1.61E-03
Beryllium	11.43	7.84E-05	1.88E-03	6.86E-01	3.43E-04
Cadmium	3.25	2.23E-05	5.34E-04	1.95E-01	9.75E-05
Chromium	99.98	6.86E-04	1.65E-02	6.01E+00	3.00E-03
Chromium VI	11.00	7.54E-05	1.81E-03	6.61E-01	3.30E-04
Cobalt	41.48	2.84E-04	6.83E-03	2.49E+00	1.25E-03
Lead	43.48	2.98E-04	7.16E-03	2.61E+00	1.31E-03
Manganese	98.98	6.79E-04	1.63E-02	5.95E+00	2.97E-03
Mercury	0.25	1.71E-06	4.11E-05	1.50E-02	7.51E-06
Nickel	91.11	6.25E-04	1.50E-02	5.47E+00	2.74E-03
Selenium	12.82	8.79E-05	2.11E-03	7.70E-01	3.85E-04

**Cumulative PM mass fractions from AP-42, Table 1.1-6 (09/98)*

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.

EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: EHE Silo

Source ID: I-10
Emission Point ID: EP-10

Section 13.2.4 (Aggregate Handling and Storage Piles) is used to estimate emissions from the handling of material at an industrial site. The "Drop Equation" is shown below:

$$E = k\,(0.0032)\,\frac{(U/5)^{1.3}}{(M/2)^{1.4}}$$

Where:
E is the emission factor in [lb/ton]
K is the particle size multiplier [dimensionless]
U is the average wind speed [mph]
M is the average moisture content [%]

Constant	PM2.5	PM10	PM
k	0.053	0.35	0.74

14.5	mph, 2013-2017 Average Wind Speed (4.85 mph) multiplied by a safety factor of 3.
3	%, Moisture
99%	Control from Bin vent

	I-10 Silo Filling	I-10 Silo Unloading
Ton/hr	125	75
Ton/yr	400,000	400,000

AshTrace Element Analysis	Ash Concentration (ppm)	Calculated Emission Factor	I-10 Silo Filling	I-10 Silo Unloading	I-10 Silo Filling	I-10 Silo Unloading
		(lb/ton)	lb/hr	lb/hr	lb/yr	lb/yr
PM	--	5.38E-05	6.73E-03	4.04E-03	2.15E+01	2.15E+01
PM10	--	2.55E-05	3.18E-03	1.91E-03	1.02E+01	1.02E+01
PM2.5	--	3.85E-06	4.82E-04	2.89E-04	1.54E+00	1.54E+00
Antimony	5.44	2.93E-10	3.66E-08	2.20E-08	1.17E-04	1.17E-04
Arsenic	53.67	2.89E-09	3.61E-07	2.17E-07	1.16E-03	1.16E-03
Beryllium	11.43	6.15E-10	7.69E-08	4.61E-08	2.46E-04	2.46E-04
Cadmium	3.25	1.75E-10	2.18E-08	1.31E-08	6.99E-05	6.99E-05
Chromium	99.98	5.38E-09	6.73E-07	4.04E-07	2.15E-03	2.15E-03
Chromium VI	11.00	5.92E-10	7.40E-08	4.44E-08	2.37E-04	2.37E-04
Cobalt	41.48	2.23E-09	2.79E-07	1.67E-07	8.93E-04	8.93E-04
Lead	43.48	2.34E-09	2.92E-07	1.75E-07	9.36E-04	9.36E-04
Manganese	98.98	5.33E-09	6.66E-07	3.99E-07	2.13E-03	2.13E-03
Mercury	0.25	1.35E-11	1.68E-09	1.01E-09	5.38E-06	5.38E-06
Nickel	91.11	4.90E-09	6.13E-07	3.68E-07	1.96E-03	1.96E-03
Selenium	12.82	6.90E-10	8.62E-08	5.17E-08	2.76E-04	2.76E-04

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Component	Total Emissions			
	lbs/hr	lbs/day *(lb/hr * 24 hrs)*	lbs/year	tons/year *(lb/yr / 2000)*
PM	1.08E-02	2.58E-01	4.30E+01	2.15E-02
PM10	5.09E-03	1.22E-01	2.04E+01	1.02E-02
PM2.5	7.71E-04	1.85E-02	3.08E+00	1.54E-03
Antimony	5.86E-08	1.41E-06	2.34E-04	1.17E-07
Arsenic	5.78E-07	1.39E-05	2.31E-03	1.16E-06
Beryllium	1.23E-07	2.95E-06	4.92E-04	2.46E-07
Cadmium	3.49E-08	8.39E-07	1.40E-04	6.99E-08
Chromium	1.08E-06	2.58E-05	4.30E-03	2.15E-06
Chromium VI	1.18E-07	2.84E-06	4.73E-04	2.37E-07
Cobalt	4.46E-07	1.07E-05	1.79E-03	8.93E-07
Lead	4.68E-07	1.12E-05	1.87E-03	9.36E-07
Manganese	1.07E-06	2.56E-05	4.26E-03	2.13E-06
Mercury	2.69E-09	6.46E-08	1.08E-05	5.38E-09
Nickel	9.81E-07	2.35E-05	3.92E-03	1.96E-06
Selenium	1.38E-07	3.31E-06	5.52E-04	2.76E-07

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Product Storage Dome

Source ID: I-11
Emission Point ID: EP-11

Section 13.2.4 (Aggregate Handling and Storage Piles) is used to estimate emissions from the handling of material at an industrial site. The "Drop Equation" is shown below:

$$E = k\,(0.0032)\,\frac{(U/5)^{1.3}}{(M/2)^{1.4}}$$

Where:
E is the emission factor in [lb/ton]
K is the particle size multiplier [dimensionless]
U is the average wind speed [mph]
M is the average moisture content [%]

Constant	PM2.5	PM10	PM
k	0.053	0.35	0.74

14.5	mph, 2013-2017 Average Wind Speed (4.85 mph) multiplied by a safety factor of 3.
3	%, Moisture
99%	Control from Bin vent

	I-11 Silo Filling	I-11 Silo Unloading
Ton/hr	75	275
Ton/yr	400,000	400,000

AshTrace Element Analysis	Ash Concentration (ppm)	Calculated Emission Factor	I-11 Silo Filling	I-11 Silo Unloading	I-11 Silo Filling	I-11 Silo Unloading
		(lb/ton)	lb/hr	lb/hr	lb/yr	lb/yr
PM	--	5.38E-05	4.04E-03	1.48E-02	2.15E+01	2.15E+01
PM10	--	2.55E-05	1.91E-03	7.00E-03	1.02E+01	1.02E+01
PM2.5	--	3.85E-06	2.89E-04	1.06E-03	1.54E+00	1.54E+00
Antimony	5.44	2.93E-10	2.20E-08	8.05E-08	1.17E-04	1.17E-04
Arsenic	53.67	2.89E-09	2.17E-07	7.94E-07	1.16E-03	1.16E-03
Beryllium	11.43	6.15E-10	4.61E-08	1.69E-07	2.46E-04	2.46E-04
Cadmium	3.25	1.75E-10	1.31E-08	4.80E-08	6.99E-05	6.99E-05
Chromium	99.98	5.38E-09	4.04E-07	1.48E-06	2.15E-03	2.15E-03
Chromium VI	11.00	5.92E-10	4.44E-08	1.63E-07	2.37E-04	2.37E-04
Cobalt	41.48	2.23E-09	1.67E-07	6.14E-07	8.93E-04	8.93E-04
Lead	43.48	2.34E-09	1.75E-07	6.43E-07	9.36E-04	9.36E-04
Manganese	98.98	5.33E-09	3.99E-07	1.46E-06	2.13E-03	2.13E-03
Mercury	0.25	1.35E-11	1.01E-09	3.70E-09	5.38E-06	5.38E-06
Nickel	91.11	4.90E-09	3.68E-07	1.35E-06	1.96E-03	1.96E-03
Selenium	12.82	6.90E-10	5.17E-08	1.90E-07	2.76E-04	2.76E-04

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Component	Total Emissions			
	lbs/hr	lbs/day *(lb/hr * 24 hrs)*	lbs/year	tons/year *(lb/yr / 2000)*
PM	1.88E-02	4.52E-01	4.30E+01	2.15E-02
PM10	8.91E-03	2.14E-01	2.04E+01	1.02E-02
PM2.5	1.35E-03	3.24E-02	3.08E+00	1.54E-03
Antimony	1.02E-07	2.46E-06	2.34E-04	1.17E-07
Arsenic	1.01E-06	2.43E-05	2.31E-03	1.16E-06
Beryllium	2.15E-07	5.17E-06	4.92E-04	2.46E-07
Cadmium	6.11E-08	1.47E-06	1.40E-04	6.99E-08
Chromium	1.88E-06	4.52E-05	4.30E-03	2.15E-06
Chromium VI	2.07E-07	4.97E-06	4.73E-04	2.37E-07
Cobalt	7.81E-07	1.87E-05	1.79E-03	8.93E-07
Lead	8.19E-07	1.97E-05	1.87E-03	9.36E-07
Manganese	1.86E-06	4.47E-05	4.26E-03	2.13E-06
Mercury	4.71E-09	1.13E-07	1.08E-05	5.38E-09
Nickel	1.72E-06	4.12E-05	3.92E-03	1.96E-06
Selenium	2.41E-07	5.80E-06	5.52E-04	2.76E-07

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Product Loadout Silo

Source ID: I-12
Emission Point ID: EP-12 (Bin Vent) & EP-13, 14 (Loadout Spouts)

Section 13.2.4 (Aggregate Handling and Storage Piles) is used to estimate emissions from the handling of material at an industrial site. The "Drop Equation" is shown below:

$$E = k\,(0.0032)\,\frac{(U/5)^{1.3}}{(M/2)^{1.4}}$$

Where:
E is the emission factor in [lb/ton]
K is the particle size multiplier [dimensionless]
U is the average wind speed [mph]
M is the average moisture content [%]

Constant	PM2.5	PM10	PM
k	0.053	0.35	0.74

14.5	mph, 2013-2017 Average Wind Speed (4.85 mph) multiplied by a safety factor of 3.
3	%, Moisture
99%	Control from Bin vent

	I-12	I-12
	Silo Filling	Silo Unloading
Ton/hr	75	100
Ton/yr	400,000	400,000

AshTrace Element Analysis	Ash Concentration (ppm)	Calculated Emission Factor	I-12 Silo Filling	I-12 Silo Unloading (Spout A)	I-12 Silo Unloading (Spout B)	I-12 Silo Filling	I-12 Silo Unloading
		(lb/ton)	lb/hr	lb/hr	lb/hr	lb/yr	lb/yr
PM	--	5.38E-05	4.04E-03	5.38E-03	5.38E-03	2.15E+01	2.15E+01
PM10	--	2.55E-05	1.91E-03	2.55E-03	2.55E-03	1.02E+01	1.02E+01
PM2.5	--	3.85E-06	2.89E-04	3.85E-04	3.85E-04	1.54E+00	1.54E+00
Antimony	5.44	2.93E-10	2.20E-08	2.93E-08	2.93E-08	1.17E-04	1.17E-04
Arsenic	53.67	2.89E-09	2.17E-07	2.89E-07	2.89E-07	1.16E-03	1.16E-03
Beryllium	11.43	6.15E-10	4.61E-08	6.15E-08	6.15E-08	2.46E-04	2.46E-04
Cadmium	3.25	1.75E-10	1.31E-08	1.75E-08	1.75E-08	6.99E-05	6.99E-05
Chromium	99.98	5.38E-09	4.04E-07	5.38E-07	5.38E-07	2.15E-03	2.15E-03
Chromium VI	11.00	5.92E-10	4.44E-08	5.92E-08	5.92E-08	2.37E-04	2.37E-04
Cobalt	41.48	2.23E-09	1.67E-07	2.23E-07	2.23E-07	8.93E-04	8.93E-04
Lead	43.48	2.34E-09	1.75E-07	2.34E-07	2.34E-07	9.36E-04	9.36E-04
Manganese	98.98	5.33E-09	3.99E-07	5.33E-07	5.33E-07	2.13E-03	2.13E-03
Mercury	0.25	1.35E-11	1.01E-09	1.35E-09	1.35E-09	5.38E-06	5.38E-06
Nickel	91.11	4.90E-09	3.68E-07	4.90E-07	4.90E-07	1.96E-03	1.96E-03
Selenium	12.82	6.90E-10	5.17E-08	6.90E-08	6.90E-08	2.76E-04	2.76E-04

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Total Silo Filling Emissions

Component	Total Emissions			
	lbs/hr	lbs/day (lb/hr * 24 hrs)	lbs/year	tons/year (lb/yr / 2000)
PM	4.04E-03	9.69E-02	2.15E+01	1.08E-02
PM10	1.91E-03	4.58E-02	1.02E+01	5.09E-03
PM2.5	2.89E-04	6.94E-03	1.54E+00	7.71E-04
Antimony	2.20E-08	5.27E-07	1.17E-04	5.86E-08
Arsenic	2.17E-07	5.20E-06	1.16E-03	5.78E-07
Beryllium	4.61E-08	1.11E-06	2.46E-04	1.23E-07
Cadmium	1.31E-08	3.14E-07	6.99E-05	3.49E-08
Chromium	4.04E-07	9.68E-06	2.15E-03	1.08E-06
Chromium VI	4.44E-08	1.07E-06	2.37E-04	1.18E-07
Cobalt	1.67E-07	4.02E-06	8.93E-04	4.46E-07
Lead	1.75E-07	4.21E-06	9.36E-04	4.68E-07
Manganese	3.99E-07	9.59E-06	2.13E-03	1.07E-06
Mercury	1.01E-09	2.42E-08	5.38E-06	2.69E-09
Nickel	3.68E-07	8.82E-06	1.96E-03	9.81E-07
Selenium	5.17E-08	1.24E-06	2.76E-04	1.38E-07

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Product Loadout Silo

Source ID: I-12
Emission Point ID: EP-12 (Bin Vent) & EP-13, 14 (Loadout Spouts)

Total Loadout Spout Emissions Estimate

Component	Total Emissions			
	lbs/hr	lbs/day *(lb/hr * 24 hrs)*	lbs/year	tons/year *(lb/yr / 2000)*
PM	1.08E-02	2.58E-01	2.15E+01	1.08E-02
PM10	5.09E-03	1.22E-01	1.02E+01	5.09E-03
PM2.5	7.71E-04	1.85E-02	1.54E+00	7.71E-04
Antimony	5.86E-08	1.41E-06	1.17E-04	5.86E-08
Arsenic	5.78E-07	1.39E-05	1.16E-03	5.78E-07
Beryllium	1.23E-07	2.95E-06	2.46E-04	1.23E-07
Cadmium	3.49E-08	8.39E-07	6.99E-05	3.49E-08
Chromium	1.08E-06	2.58E-05	2.15E-03	1.08E-06
Chromium VI	1.18E-07	2.84E-06	2.37E-04	1.18E-07
Cobalt	4.46E-07	1.07E-05	8.93E-04	4.46E-07
Lead	4.68E-07	1.12E-05	9.36E-04	4.68E-07
Manganese	1.07E-06	2.56E-05	2.13E-03	1.07E-06
Mercury	2.69E-09	6.46E-08	5.38E-06	2.69E-09
Nickel	9.81E-07	2.35E-05	1.96E-03	9.81E-07
Selenium	1.38E-07	3.31E-06	2.76E-04	1.38E-07

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Ball Mill Classifier Raw Material Recovery Baghouse

Source ID: I-24
Emission Point ID: EP-24

$$\frac{grains\ PM}{scf} * \frac{scf}{hour} * \frac{lb}{7000\ grains} = \frac{lb\ PM}{hour}$$

11,081	acfm, air flow rate
9,287	dscf, air flow rate
0.010	gr/scf, emission loading rate
7000	gr/lb, Conversion Factor

0.80	lb PM/hr, Calculated Emission Factor for Bagfilter
6,973	lb PM/yr, Calculated Emission Factor for Bagfilter

Ash Trace Element Analysis	Average Ash Concentration* (ppm)	Emissions			
		lbs/hr	lbs/day	lbs/year	tons/year
PM	1.00	7.96E-01	1.91E+01	6.97E+03	3.49E+00
PM10	0.92	7.32E-01	1.76E+01	6.42E+03	3.21E+00
PM2.5	0.53	4.22E-01	1.01E+01	3.70E+03	1.85E+00
Antimony	5.44	4.33E-06	1.04E-04	3.79E-02	1.90E-05
Arsenic	53.67	4.27E-05	1.03E-03	3.74E-01	1.87E-04
Beryllium	11.43	9.10E-06	2.18E-04	7.97E-02	3.98E-05
Cadmium	3.25	2.58E-06	6.20E-05	2.26E-02	1.13E-05
Chromium	99.98	7.96E-05	1.91E-03	6.97E-01	3.49E-04
Chromium VI	11.00	8.75E-06	2.10E-04	7.67E-02	3.83E-05
Cobalt	41.48	3.30E-05	7.92E-04	2.89E-01	1.45E-04
Lead	43.48	3.46E-05	8.31E-04	3.03E-01	1.52E-04
Manganese	98.98	7.88E-05	1.89E-03	6.90E-01	3.45E-04
Mercury	0.25	1.99E-07	4.78E-06	1.74E-03	8.72E-07
Nickel	91.11	7.25E-05	1.74E-03	6.35E-01	3.18E-04
Selenium	12.82	1.02E-05	2.45E-04	8.94E-02	4.47E-05

**Cumulative PM mass fractions from AP-42, Table 1.1-6 (09/98)*

HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.

EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Duke Energy Progress, LLC
Cape Fear STAR® Project

Emissions Estimate: Ball Mill Feed Silo

Source ID: I-25
Emission Point ID: EP-25

Section 13.2.4 (Aggregate Handling and Storage Piles) is used to estimate emissions from the handling of material at an industrial site. The "Drop Equation" is shown below:

$$E = k\,(0.0032)\frac{\left(U/5\right)^{1.3}}{\left(M/2\right)^{1.4}}$$

Where:
E is the emission factor in [lb/ton]
K is the particle size multiplier [dimensionless]
U is the average wind speed [mph]
M is the average moisture content [%]

Constant	PM2.5	PM10	PM
k	0.053	0.35	0.74

14.5	mph, 2013-2017 Average Wind Speed (4.85 mph) multiplied by a safety factor of 3.
3	%, Moisture
99%	Control from Bin vent

	I-25 Silo Filling	I-25 Silo Unloading
Ton/hr	15	15
Ton/yr	89,000	89,000

AshTrace Element Analysis	Ash Concentration (ppm)	Calculated Emission Factor	I-25 Silo Filling	I-25 Silo Unloading	I-25 Silo Filling	I-25 Silo Unloading
		(lb/ton)	lb/hr	lb/hr	lb/yr	lb/yr
PM	--	5.38E-05	8.07E-04	8.07E-04	4.79E+00	4.79E+00
PM10	--	2.55E-05	3.82E-04	3.82E-04	2.27E+00	2.27E+00
PM2.5	--	3.85E-06	5.78E-05	5.78E-05	3.43E-01	3.43E-01
Antimony	5.44	2.93E-10	4.39E-09	4.39E-09	2.61E-05	2.61E-05
Arsenic	53.67	2.89E-09	4.33E-08	4.33E-08	2.57E-04	2.57E-04
Beryllium	11.43	6.15E-10	9.22E-09	9.22E-09	5.47E-05	5.47E-05
Cadmium	3.25	1.75E-10	2.62E-09	2.62E-09	1.55E-05	1.55E-05
Chromium	99.98	5.38E-09	8.07E-08	8.07E-08	4.79E-04	4.79E-04
Chromium VI	11.00	5.92E-10	8.88E-09	8.88E-09	5.27E-05	5.27E-05
Cobalt	41.48	2.23E-09	3.35E-08	3.35E-08	1.99E-04	1.99E-04
Lead	43.48	2.34E-09	3.51E-08	3.51E-08	2.08E-04	2.08E-04
Manganese	98.98	5.33E-09	7.99E-08	7.99E-08	4.74E-04	4.74E-04
Mercury	0.25	1.35E-11	2.02E-10	2.02E-10	1.20E-06	1.20E-06
Nickel	91.11	4.90E-09	7.35E-08	7.35E-08	4.36E-04	4.36E-04
Selenium	12.82	6.90E-10	1.03E-08	1.03E-08	6.14E-05	6.14E-05

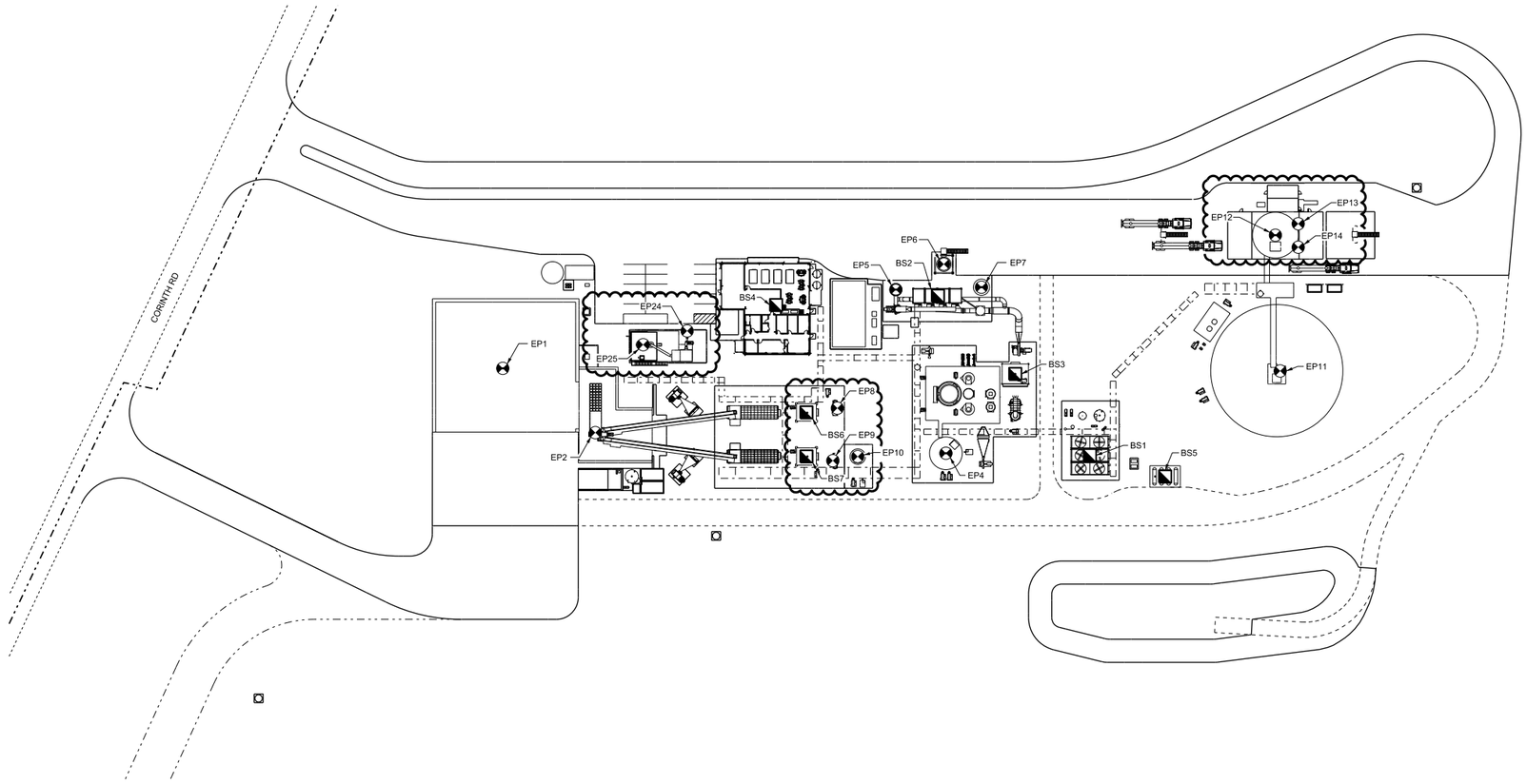
HAP/TAP emission factors for the fly ash are based on site-specific ash analysis, except Cr VI.
EPA-453/R-98-004a states 11% of Total Cr from coal is Cr VI

Component	Total Emissions			
	lbs/hr	lbs/day (lb/hr * 24 hrs)	lbs/year	tons/year (lb/yr / 2000)
PM	1.61E-03	3.87E-02	9.58E+00	4.79E-03
PM10	7.64E-04	1.83E-02	4.53E+00	2.27E-03
PM2.5	1.16E-04	2.77E-03	6.86E-01	3.43E-04
Antimony	8.78E-09	2.11E-07	5.21E-05	2.61E-08
Arsenic	8.66E-08	2.08E-06	5.14E-04	2.57E-07
Beryllium	1.84E-08	4.43E-07	1.09E-04	5.47E-08
Cadmium	5.24E-09	1.26E-07	3.11E-05	1.55E-08
Chromium	1.61E-07	3.87E-06	9.58E-04	4.79E-07
Chromium VI	1.78E-08	4.26E-07	1.05E-04	5.27E-08
Cobalt	6.70E-08	1.61E-06	3.97E-04	1.99E-07
Lead	7.02E-08	1.68E-06	4.16E-04	2.08E-07
Manganese	1.60E-07	3.83E-06	9.48E-04	4.74E-07
Mercury	4.04E-10	9.69E-09	2.39E-06	1.20E-09
Nickel	1.47E-07	3.53E-06	8.73E-04	4.36E-07
Selenium	2.07E-08	4.97E-07	1.23E-04	6.14E-08

Attachment IV

Updated Process Flow Diagrams and Facility Plot Plan

(Replaces pages 2-6, 2-7, and Appendix F of Air Permit Application 1900134.18A)



PLAN

N TRUE

PLANT N

60 0 30 60 90 120

SCALE
IN FEET

LEGEND

- ⊗ - EMISSION POINT LOCATION
- ◪ - BUILDINGS AND STRUCTURES LOCATION
- EPXX - EMISSION POINT NUMBER
- BSX - BUILDINGS AND STRUCTURES NUMBER

NOT A CERTIFIED DOCUMENT

PRELIMINARY
AS OF 10/11/2018
NOT FOR CONSTRUCTION

FUGITIVE EMISSIONS / EMISSIONS POINT LOCATIONS

LOCATION NUMBER	DESCRIPTION	APPROXIMATE DIMENSIONS	BASE ELEVATION	HEIGHT	NAD83 (2011) NORTHING	NAD83 (2011) EASTING
EP1	WET ASH RECEIVING - TRANSFER TO SHED	133' x 121'	198'-0"	5'-0"	N 668973.95	E 1990170.52
EP2	WET ASH RECEIVING - TRANSFER TO HOPPER	10' x 50'	188'-0"	15'-0"	N 668889.96	E 1990112.15
EP3	NOT USED	N/A	N/A	N/A		
EP4	FEED SILO BIN VENT	30' Ø	194'-0"	135'-6"	N 668571.81	E 1990093.43
EP5	STAR REACTOR (EXHAUST STACK)	7'-6" Ø	193'-6"	140'-0"	N 668617.23	E 1990241.99
EP6	FGD BYPRODUCT SILO BIN VENT	13' Ø	193'-6"	76'-0"	N 668573.68	E 1990265.10
EP7	FGD HYDRATED LIME SILO BIN VENT	15' Ø	193'-6"	80'-0"	N 668539.54	E 1990244.17
EP8	EHE A (EXHAUST STACK)	3'-6" Ø	193'-6"	95'-6"	N 668670.33	E 1990134.37
EP9	EHE B (EXHAUST STACK)	3'-6" Ø	193'-6"	95'-6"	N 668674.44	E 1990086.70
EP10	EHE SILO BIN VENT	14' Ø	193'-6"	91'-6"	N 668651.81	E 1990090.43
EP11	PRODUCT STORAGE DOME BIN VENT	120' Ø	193'-6"	137'-6"	N 668268.44	E 1990168.14
EP12	LOAD OUT SILO BIN VENT	38'-8" Ø	193'-6"	104'-0"	N 668272.81	E 1990291.43
EP13	LOAD OUT SILO SPOUT A	40' x 43' (COMBINED)	193'-6"	28'-0"	N 668252.07	E 1990301.82
EP14	LOAD OUT SILO SPOUT B	40' x 43' (COMBINED)	193'-6"	28'-0"	N 668252.07	E 1990280.48
EP24	GRINDING CIRCUIT DISCHARGE STACK	22" Ø	193'-0"	58'-0"	N 668806.62	E 1990204.48
EP25	MILL FEED HOPPER	8'-6" Ø	193'-0"	51'-0"	N 668846.54	E 1990191.98

BUILDINGS AND STRUCTURES

LOCATION NUMBER	DESCRIPTION	APPROXIMATE DIMENSIONS	ELEVATION	HEIGHT	NAD83 (2011) NORTHING	NAD83 (2011) EASTING
BS1	FIN FANS	35' x 35'	193'-6"	19'-0"	N 668441.20	E 1990091.54
BS2	CDS BAG HOUSE	15' x 44'	193'-6"	95'-0"	N 668579.78	E 1990236.42
BS3	BAG HOUSE (MAIN COLLECTOR)	20' x 25'	193'-6"	115'-0"	N 668508.88	E 1990165.44
BS4	ADMIN/CONTROL ROOM	81' x 83'	193'-6"	20'-0"	N 668725.06	E 1990224.68
BS5	PROPANE STATION	20' x 28'	193'-0"	6'-0"	N 668372.89	E 1990072.37
BS6	EHE A (DUST COLLECTOR)	15' x 18'	193'-6"	82'-0"	N 668698.40	E 1990130.53
BS7	EHE B (DUST COLLECTOR)	15' x 18'	193'-6"	82'-0"	N 668698.40	E 1990090.53

NO.	REVISION	DATE	DR/DNR	CR/ENG	TSCK	ENGCK

DUKE ENERGY®

OWNER'S DRAWING NUMBER | SHEET | REV

ZACHRY

ZACHRY ENGINEERING CORPORATION • 355 EAST HEBRON STREET, CHARLOTTE, NC 28273
NORTH CAROLINA BOARD OF EXAMINERS FOR ENGINEERS LICENSE #C-1171
ZACHRY GROUP • 527 LOGWOOD AVENUE, SAN ANTONIO, TX 78221

DUKE CAPE FEAR BENEFICIAL ASH
EMISSION POINTS SKETCH

DRAWN/DESIGNER	ORIGINATING ENG	TECH SERV CHECKED	SR ENG CHECKED
LEAD DISCIPLINE ENG	DRAWING NUMBER	SHEET	REV
PROJECT MANAGER	SKETCH 10/11/18		

WET ASH FEED

AMBIENT AIR

DRYING/
FLUIDIZING FAN

AIR
PRE-HEATER

TE

EXTERNAL
HEAT
EXCHANGER

TE

OVERSIZED

EHE DUST
COLLECTOR

EXHAUST
FAN

EXHAUST
STACK

DISCHARGE
TO ATMOSPHERE

EHE SYSTEM
X2

EHE
TRANSFER
SILO

GRINDING
STACK

MILL
BAGHOUSE

GRINDING
MILL

MILL
FEED
SILO

MILL BYPASS

BYPASS

WATER
MAKE-UP

FEED SILO

ASH FEED

ASH FEED

REACTOR

HOT
CYCLONE

AIR PREHEATER

#1 GAS PRODUCT COOLER

#2 GAS PRODUCT COOLER

FIN-FAN COOLERS

RECIRC.
PUMP

COLD
CYCLONE

MAIN
COLLECTOR

TO ID FAN

TO STORAGE

FROM AUXILIARY
FUEL SUPPLY

DUCT
BURNER

SECONDARY
FAN

PRIMARY
FAN

PRELIMINARY

REV.	DESCRIPTION	DRW.	DATE	CHK.	DATE

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
1/8
1° BEND ± .01
.001

PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF THE SEFA GROUP. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF THE SEFA GROUP IS PROHIBITED.

	NAME	DATE
DRAWN	BMK	04/19/17
CHECKED	TW	04/19/17
ENG APPR.	ADS	04/19/17
MFG APPR.		
Q.A.		
COMMENTS:		

SEFA
www.sefagroup.com 217 Cedar Road | Lexington, SC 29073

TITLE:
DUKE STAR II
SIMPLIFIED
PROCESS FLOW DIAGRAM

SIZE	DWG. NO.	REV
D	LAB-17027-00-PFD-108	B

SCALE: NTS | WT: N/A | SHEET 1 OF 1

PRODUCT
ASH STORAGE
DOME

PRODUCT
LOADOUT
SILO

CHUTE 1B

CHUTE 1A

PNEUMATIC
TRUCKS

FROM MAIN
COLLECTOR

FROM MAIN
COLLECTOR

ID FAN

DRY FGD
SCRUBBER

DISCHARGE
TO ATMOSPHERE

STAR
REACTOR
EXHAUST
STACK

PRELIMINARY

Figure 2-3 Process Flow Diagram

REV.	DESCRIPTION	DRW.	DATE	CHK.	DATE

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
1/8
1° BEND ± .01
.XX ±
.XXX ±

PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF THE SEFA GROUP. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF THE SEFA GROUP IS PROHIBITED.

	NAME	DATE
DRAWN	BMK	04/19/17
CHECKED	TV	04/19/17
ENG APPR.	ADS	04/19/17
MFG APPR.		
Q.A.		

COMMENTS:

THE SEFA GROUP
ENGINEERING & CONSTRUCTION

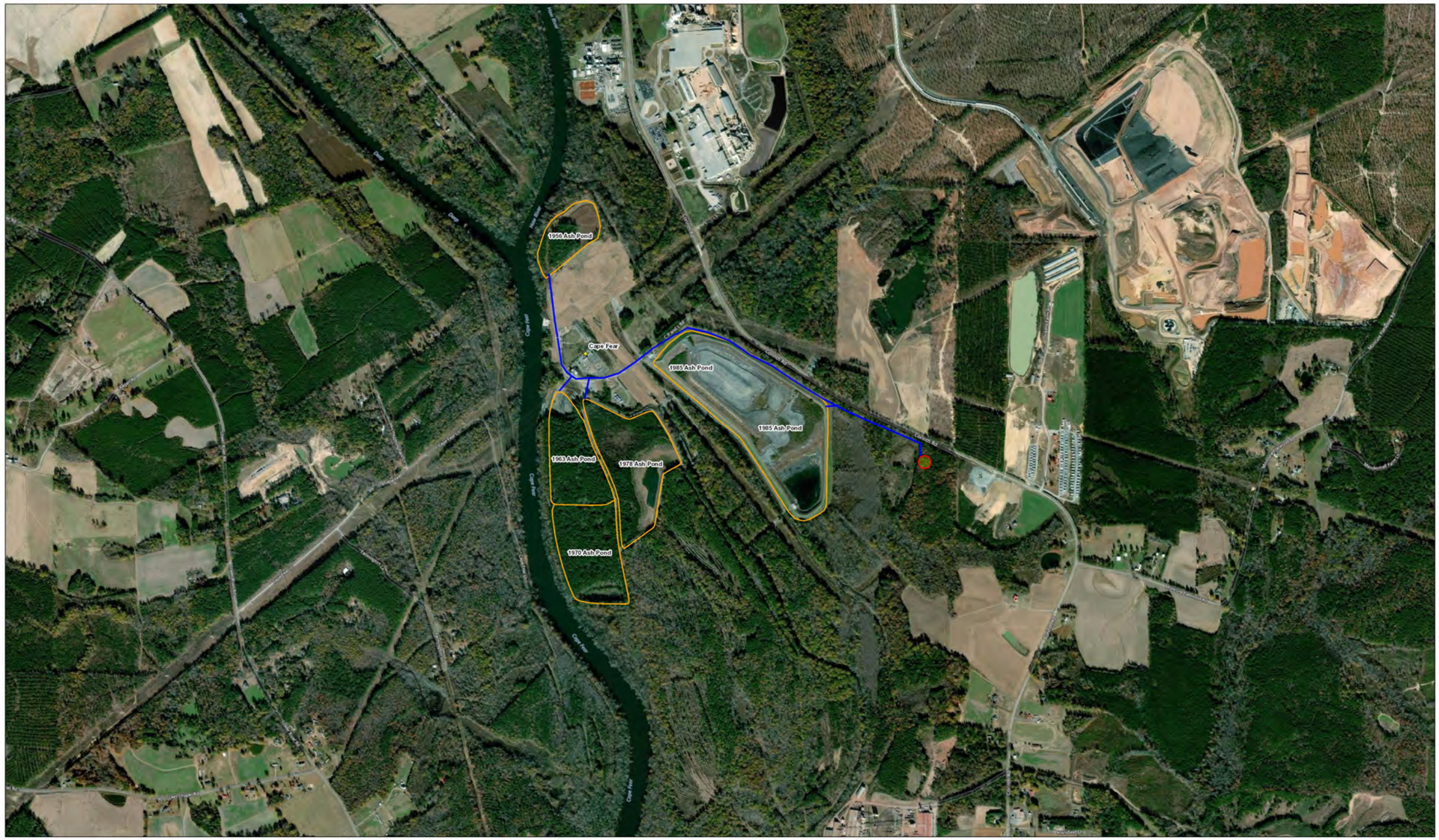
TITLE:
DUKE STAR II
SIMPLIFIED
PROCESS FLOW DIAGRAM

SIZE	DWG. NO.	REV
D	LAB-17027-00-PFD-109	A

SCALE: NTS | WT: N/A | SHEET 1 OF 1

Duke Energy Carolinas, LLC
Cape Fear STAR Project

Emissions Estimate: Haul Roads - Vehicle Miles Traveled



July 17, 2018

polylineLayer
Override 1

polygonLayer
Override 1
CCP Site Contacts

NC CCR Boundaries
<all other values>
Active Basin
Currently Being Excavated
Inactive
Lay of Land Area
Unknown, Eng. Wetlands, Landfill, Other

SC CCR Boundaries
<all other values>
Active Basin
Currently Being Excavated
Inactive
Lay of Land Area
Unknown, Eng. Wetlands, Landfill, Other

Duke Service Area
Duke Energy
Piedmont Natural Gas

1:9,028
0 0.1 0.2 0.4 mi
0 0.175 0.35 0.7 km

GIS Mapping Operations

Attachment V

Updated Air Quality Modeling Analysis and Revised Facility-Wide Toxics Pollutant Emission Rate (TPER) Analysis and Modeling Evaluation Results

(Replaces Section 5.0, Appendix C, and Appendix D of Air Permit Application 1900134.18A)

AIR QUALITY PERMIT APPLICATION ADDENDUM

UPDATED AIR QUALITY MODELING ANALYSIS

FOR THE DUKE ENERGY

CAPE FEAR STAR® FACILITY

NOVEMBER 2018

Prepared for:

Duke Energy Progress, LLC
410 S. Wilmington Street
Raleigh, NC 27601

Prepared by:

AECOM Technical Services of North Carolina, Inc.
1600 Perimeter Park Drive, Suite 400
Morrisville, NC 27560

TABLE OF CONTENTS

List of Figures

List of Appendices

AIR QUALITY MODELING ANALYSIS

1.0 INTRODUCTION

Duke Energy Progress, LLC (Duke Energy) proposes to construct the Cape Fear STAR® facility at the site of the former Cape Fear Steam Electric Plant in Moncure, Chatham County, North Carolina. The fly ash beneficiation facility will produce a quality fly ash that meets ASTM C618 specifications for use in the concrete market. The STAR® system is a patented technology developed by The SEFA Group Inc. (SEFA) to process feedstock (of any carbon content) like fly ash (wet or dry) along with other ingredient materials into a variety of commercial products including a partial cement replacement.

Duke Energy included a facility-wide modeling demonstration for the proposed facility in the original application (1900134.18A) which was submitted to the North Carolina Division of Air Quality (NC DAQ) on July 20, 2018. Duke Energy is proposing to install and operate two additional sources at the facility: a Ball Mill Classifier and a Ball Mill Feed Silo. This modeling analysis includes the two newly proposed sources, in additional to incorporating the results of a new ash analysis.

Certain TAP emissions from the Cape Fear STAR® facility are expected to exceed the 15A NCAC 2Q .0711 emission rates requiring a permit; therefore, a revised facility-wide air toxics analysis was performed.

As shown in Attachment III, a toxic pollutant emission rate (TPER) analysis indicates the following:

- Arsenic and Inorganic Arsenic Compounds (ASC) – Annual TPER exceeded;
- Benzene (71-43-2) – Annual TPER exceeded;
- Beryllium (7440-41-7) – Annual TPER exceeded;
- Sulfuric Acid (7664-93-9) – Daily and hourly TPER exceeded.

Facility-wide modeling was conducted for the compounds listed above and the resulting modeled concentrations were compared to the applicable Acceptable Ambient Levels (AAL). The modeling methodology and assumptions are provided in the following sections.

2.0 BACKGROUND

The Environmental Management Commission (EMC) instituted a health-based toxic air pollutant control program on May 1, 1990. NCDAQ implements this program that regulates emissions of 105 toxic air pollutants. Under this program, facilities must demonstrate compliance with 15A NCAC 2D .1104, “Toxic Air Pollutant Guidelines.”

3.0 AREA DESCRIPTION

The proposed Cape Fear STAR® facility will be located at the site of the former Cape Fear Steam Electric Plant in Moncure, Chatham County, North Carolina. The plant site is approximately two miles southeast of Moncure. The approximate UTM coordinates are Zone 17, 678.183 km east and 3940.022 km north at an elevation of approximately 193 feet above mean sea level. The largest city near the site is Sanford, North Carolina. The site is located in the Piedmont region of North Carolina and the terrain surrounding the site can be considered gently rolling.

4.0 AIR QUALITY ANALYSIS APPROACH

The analysis was based on requirements and recommendations contained in the NCDAQ's *Guidelines for Evaluating the Air Quality Impacts of Toxic Pollutants in North Carolina*. A modeling protocol checklist is included as Appendix A to this document.

The following sections describe in detail the dispersion model selection, the meteorological data, the GEP building wake effect/downwash analysis, the modeling receptor grids, the emission sources, and the results of the modeling analysis.

4.1 Air Dispersion Model Selection

AERMOD Modeling System (version 15181)

Air emissions from the Cape Fear STAR® facility will occur from multiple source locations; thus, the modeling analysis was performed using the AERMOD computer dispersion model. The AERMOD model was used to model the separated sources and predict maximum ambient concentrations. The AERMOD modeling was conducted using regulatory default options.

4.2 Meteorological Data

A five-year meteorological data set (2013-2017) of surface meteorological data from the Chapel Hill-Horace Williams Airport (Station No. 93785) and upper-air sounding data also recorded at the Piedmont Triad International Airport in Greensboro, NC (Station No. 13723) were used in the modeling analysis. The meteorological data files were obtained from the NCDAQ.

The meteorological data set consisted of 8,760 hourly observations (8,784 hourly observations in 2012 and 2016) of the following parameters:

- wind speed;
- wind direction;
- ambient temperature;
- atmospheric stability; and
- mixing heights.

These data were used to calculate hourly plume rise and concentrations at downwind receptor locations for a period up to a year. Each year was processed individually and maximum predicted concentrations

for the worst-case year are reported in the modeling results for comparison to the North Carolina toxic air pollutant AAL's.

4.3 Good Engineering Practice (GEP) Stack Height Analysis

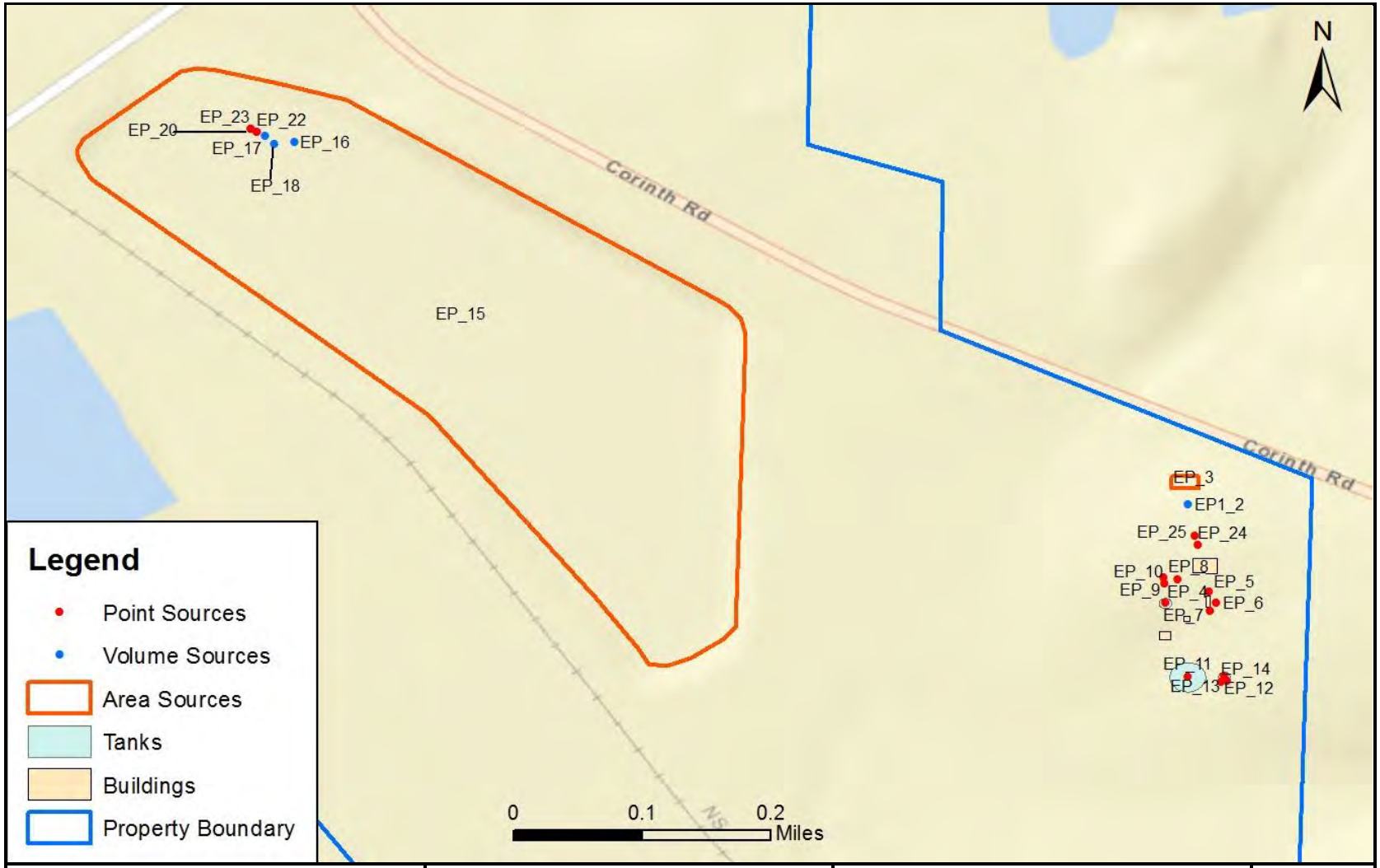
A Good Engineering Practice (GEP) stack height analysis was performed for all emission sources subject to a modeling analysis in order to determine if wake effects and downwash options need to be selected in the computer model. The GEP analysis was performed following the procedures outlined in the EPA documents *Guideline For Determination of Good Engineering Practice Stack Height (Technical Support Document For the Stack Height Regulations)* Revised (EPA-450/4-80-023R), the *User's Guide to the Building Profile Input Program* (October 1993), and the most recent version of the Oris Solutions "GEP-BPIP Prime" program.

The building wake and downwash effect analysis was applied to each emission source. For each building, an area of wake and downwash effects extends outward to a distance of five times "L" (the lesser of the maximum projected width or height of the building) directly downwind from the leeward side of the building. Wake effects were assumed to occur if the emission source is located within a rectangle composed of two lines perpendicular to the wind direction, one at 5L downwind of the building and the other at 2L upwind of the building, and by two lines parallel to the wind direction, each at 0.5L away from each side of the building.

As the wind direction rotates, the wake and downwash effect region of influence changes and is combined to form a GEP 5L region of influence in all wind directions. Any emission source within the region of influence is affected by wake and downwash effects. For buildings close to an emission source, wake and downwash effects were considered where the distance between the emission source and the nearest part of the building is less than or equal to 5L. Wake and downwash effects from buildings that are closer than the greater of either building's maximum projected width or height are considered to have one region of influence.

When an emission source height is less than the GEP height and is located within the region of influence, direction-specific building dimensions are included in the modeling analysis and either the Schulman-Scire or the Huber-Snyder equations are used for calculating the wake and downwash concentrations.

The GEP analysis was performed for proposed Cape Fear STAR® facility using the latest version of the Oris Solutions GEP program to demonstrate compliance with stack height regulations (40 CFR Part 51) and to determine which emission sources are impacted by building wake and downwash effects. The building heights and projected widths were input into the model for each ten degrees of wind direction. These building heights and projected widths are the same as are used for the GEP stack height calculation. Figure 1-1 presents the proposed Cape Fear STAR® facility layout.

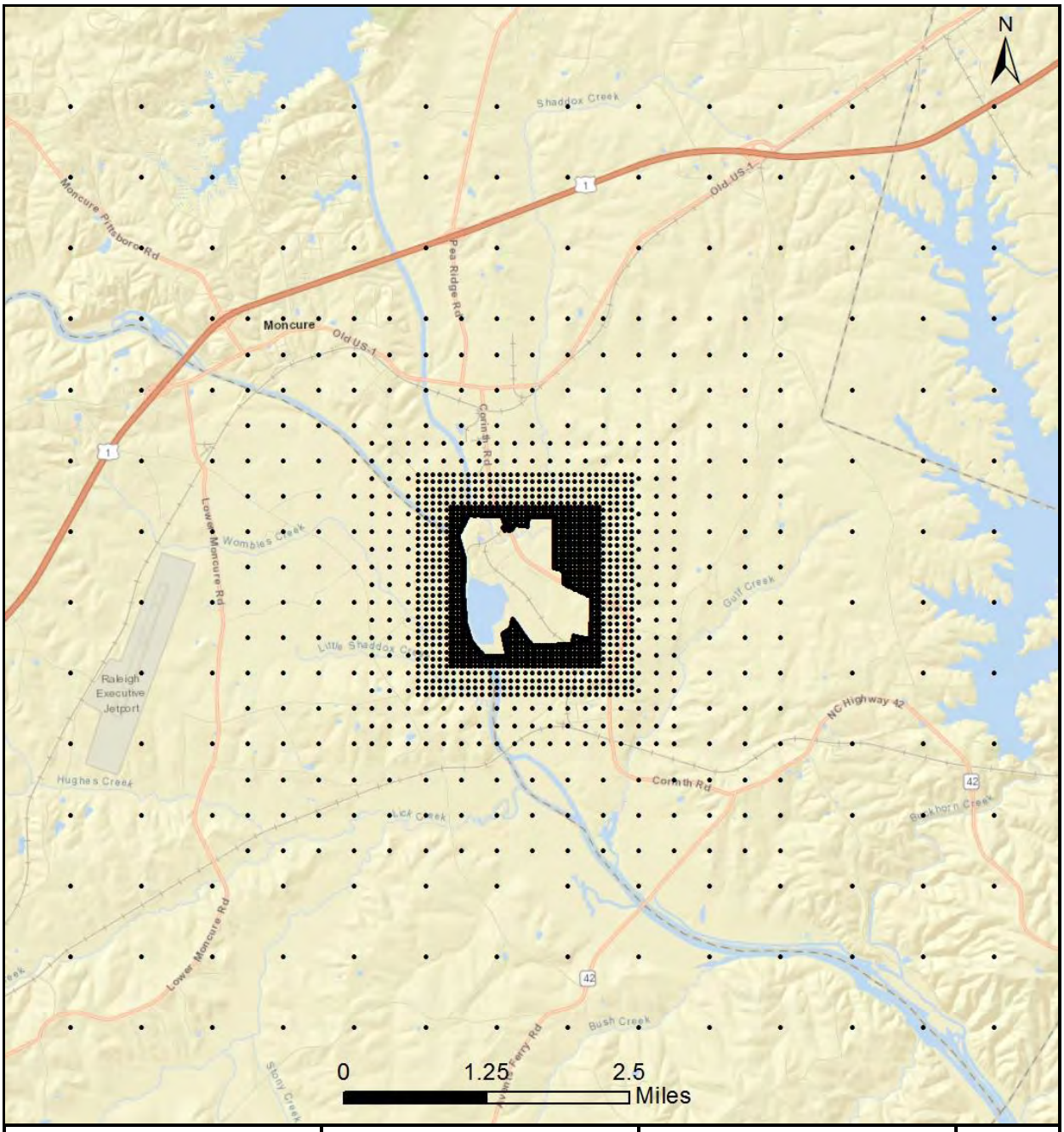


DUKE ENERGY PROGRESS, LLC CAPE FEAR STAR® FACILITY MONCURE, NORTH CAROLINA	AECOM *1600 Perimeter Park Drive, Suite 400* *Morrisville, North Carolina 27560* *Telephone 919-461-1100*	**EMISSION SOURCES AND BUILDING LAYOUT**	PROJECT NO. 60563150 FIG. NO. 4-1

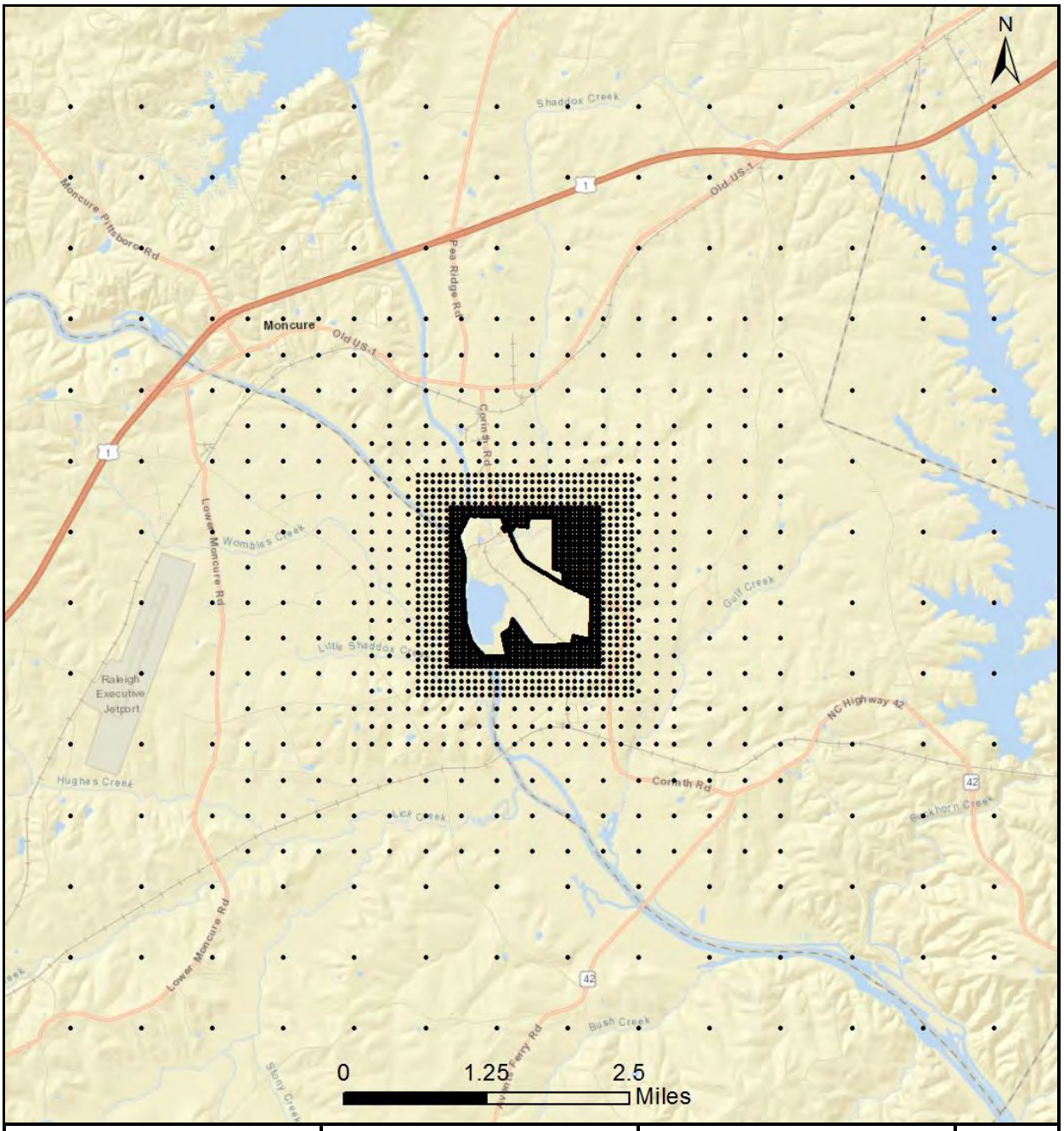
4.4 Receptors

The dispersion modeling receptor grids were developed following procedures outlined in the *New Source Review Workshop Manual* (October 1990) and the revised *North Carolina Air Toxics Modeling Guidelines* (February 2014). A detailed discrete receptor grid system was created to assess air quality impacts in all directions to a distance of up to 4 km from the Cape Fear STAR® facility emission sources.

Discrete receptors were placed along the property line at 25-meter intervals. A 50-meter grid spacing was used from the property line out to a distance of approximately 100 meters. Receptors with an increasing grid spacing of 100, 250, 500 and 1,000 meters extend out to a distance of approximately 5,000 meters. Receptors were also place along Corinth Road for the short-term modeling grid. Figures 1-2 and 1-3 present the long-term and short- term modeling receptor grids. All receptor coordinates are expressed in UTM coordinates.



DUKE ENERGY PROGRESS, LLC CAPE FEAR STAR® FACILITY MONCURE, NORTH CAROLINA	AECOM *1600 Perimeter Park Drive, Suite 400* *Morrisville, North Carolina 27560* *Telephone 919-461-1100*	**LONG-TERM MODELING RECEPTOR GRID**	PROJECT NO. 60563150 FIG. NO. 4-2



DUKE ENERGY PROGRESS, LLC CAPE FEAR STAR® FACILITY MONCURE, NORTH CAROLINA	AECOM *1600 Perimeter Park Drive, Suite 400* *Morrisville, North Carolina 27560* *Telephone 919-461-1100*	**SHORT-TERM MODELING RECEPTOR GRID**	PROJECT NO. 60563150 FIG. NO. 4-3

4.5 Sources

The Cape Fear STAR® facility will have multiple emission sources. The following sections describe the sources modeled.

4.5.1 Point Sources

The AERMOD model uses a steady-state Gaussian plume equation to model emissions from point sources such as stacks and vents. All point sources were modeled using nominal stack exhaust parameters. The following parameters were used for modeling the point sources: emission rates (grams/sec), stack height (m), stack diameter (m), stack exit velocity (m/sec), stack exhaust temperature (K), and direction-specific building dimensions (m). All point sources with rain caps or horizontal stacks were modeled with a default exit velocity of 0.01 m/s. Point sources include the ball mill feed silo, ball mill classifier, EHE dust collector stacks, EHE transfer silo, reactor feed silo, product loadout silo, FGD absorbent silo, FGD byproduct silo, and the STAR® reactor exhaust stack.

4.5.2 Area Sources

The AERMOD model was used to simulate the effects of emissions from the ash basin as an area source. Modeling was performed by spreading emissions (grams per second) equally over the entire surface of the ash basin. Appendix D contains the area source parameters associated with the ash basin.

4.5.3 Volume Sources

The AERMOD model was used to simulate the effects of emissions from various volume sources including the unloading pile, wet ash handling and transfer, the screener, and the crusher. For each volume source modeled, an initial lateral (σ_{y0}) and vertical (σ_{z0}) dimension was calculated based on the physical dimensions of the source. As an example, the volume source parameters for the wet ash transfer were calculated as follows:

Fugitive Emissions from Wet Ash Transfer

Release Height = 1.5 m (X.X ft)
σ_{y0} = length of side/4.3 = 3.05 m/4.3 = 0.71 m (10 ft)
σ_{z0} = vertical dimension of source/2.15 = 3.08 m/2.15 = 1.43 m (10 ft)

5.0 MODELING RESULTS

The modeling analysis followed the NCDAQ's *Guideline on Air Toxics Modeling* (as a default in lieu of county-specific guidelines); a copy of the modeling protocol checklist is included as Appendix A to this document. Potential emissions were modeled for comparison to the respective AALs. Emission rates for all the potential model runs were multiplied by 1,000 to ensure a non-zero modeling concentration was obtained. Based on the resulting concentrations from the potential model run, the emission rates were then increased to an optimized rate such that modeled allowable emission rates result in ambient concentrations that are 98 percent of the AAL. Optimizing the emission rates provides the Cape Fear STAR® facility with additional operational flexibility, and should reduce the need for future TAP modeling analyses for these sources at the facility. Attachment III presents a summary of the maximum modeling

results for arsenic, benzene, beryllium, and sulfuric acid. A complete listing of all modeled emission rates is provided in Attachment III.

The TAP modeling analysis demonstrates that the maximum optimized TAP emissions of arsenic, benzene, beryllium, and sulfuric acid from the facility do not result in predicted ambient concentrations that exceed the respective AALs.

Appendix A

Facility-Wide Toxic Pollutant Emission Rate (TPER) Analysis and Modeling Evaluation Results

(Replaces Appendix D of Air Permit Application 1900134.18A

Duke Energy Progress, LLC
Cape Fear STAR® Project

Toxic Pollutant Emission Rate (TPER) Analysis (In Accordance with 15A NCAC 02Q.0711)

CAS #	Compound	Toxic Pollutant Emission Rates (TPER)				Cape Fear Plant[1]							
		Carcinogens	Chronic Toxicants	Acute System Toxicants	Acute Irritants	Carcinogens	Exceed	Chronic Toxicants	Exceed	Acute Systemic Toxicants	Exceed	Acute Irritants	Exceed
		(lb/yr)	(lb/day)	(lb/hr)	(lb/hr)	(lb/yr)	TPER	(lb/day)	TPER	(lb/hr)	TPER	(lb/hr)	TPER
Inorganic, Non-metal Compounds													
7664-93-9	Sulfuric acid		2.50E-01	2.50E-02				2.40	*Yes*	1.00E-01	*Yes*		
Organic Compounds													
106-99-0	1,3-Butadiene	11				9.37E-01	No						
75-07-0	Acetaldehyde				6.80							2.10E-03	No
107-02-8	Acrolein				2.00E-02							2.53E-04	No
71-43-2	Benzene	8.10				22.37	*Yes*						
50-00-0	Formaldehyde				4.00E-02							3.23E-03	No
110-54-3	N-Hexane		23					0.00	No				
108-88-3	Toluene		98		14.4			2.69E-02	No			1.12E-03	No
1330-20-7	Xylene		57		16.4			1.87E-02	No			7.80E-04	No
50-32-8	Benzo(a)Pyrene	2.20				4.51E-03	No						
Metal Compounds													
ASC	Arsenic and Inorganic Arsenic Compounds	5.30E-02				4.03	*Yes*						
7440-41-7	Beryllium	2.80E-01				9.08E-01	*Yes*						
7440-43-9	Cadmium	3.70E-01				3.14E-01	No						
SolCR6	Soluble Chromate Compounds, as Chromium (VI) Equivalent		1.30E-02					2.40E-03	No				
MNC	Manganese and Compounds		6.30E-01					2.23E-02	No				
7439-97-6	Mercury, Vapor		1.30E-02					2.48E-04	No				
7440-02-0	Nickel Metal		1.30E-01					1.87E-02	No				

Notes: Per NCDAQ guidance in an email dated June 6, 2005, for emission factors where the exact form of the metal is not specified
(including combustion of coal), the following is the preferred way to code metals:

Arsenic - ASC-Other as a component of ASC
Beryllium - Beryllium metal as a component of BEC
Cadmium - Cadmium metal as a component of CDC
Chromium - Chromic Acid (VI) as a component of SolCR6, as Chromium VI equivalents
Manganese - MNC-Other as a component of MNC
Mercury - Mercury, Vapor as a component of HGC
Nickel - Nickel metal as a component of NIC

1 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide TPER evaluation to avoid double counting., however; each unit was individually modeled at the conservative maximum 70 TPH production rate.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Toxic Air Pollutant Potential Emissions (lb/yr)

Toxic Air Pollutant	Ash Basin	Unloading Pile	Screener	Screener Diesel Engine	Crusher	Crusher Diesel Engine	Ash Handling	Wet Ash Receiving	Feed Silo	STAR® Ash Firing
	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr
Inorganic, Non-metal Compounds										
H2SO4										8.76E+02
Organic Compounds										
1,3-Butadiene				2.18E-01		7.19E-01				
Acetaldehyde				4.28E+00		1.41E+01				
Acrolein				5.16E-01		1.70E+00				
Benzene				5.21E+00		1.72E+01				
Formaldehyde				6.58E+00		2.17E+01				
N-Hexane										
Toluene				2.28E+00		7.52E+00				
Xylene (Mixed Isomers)				1.59E+00		5.24E+00				
Benzo(a)Pyrene				1.05E-03		3.46E-03				
Metal Compounds										
Arsenic	2.25E-02	7.89E-05	1.71E-01	2.23E-02	9.31E-02	7.36E-02	9.36E-03	4.36E-03	2.31E-03	2.67E-02
Beryllium	4.79E-03	1.68E-05	3.63E-02	1.67E-02	1.98E-02	5.52E-02	1.99E-03	9.29E-04	4.92E-04	3.80E-03
Cadmium	1.36E-03	4.77E-06	1.03E-02	1.67E-02	5.63E-03	5.52E-02	5.66E-04	2.64E-04	1.40E-04	5.77E-03
Chromium VI	4.61E-03	1.62E-05	3.50E-02	1.67E-02	1.91E-02	5.52E-02	1.92E-03	8.94E-04	4.73E-04	
Manganese	4.15E-02	1.45E-04	3.15E-01	3.35E-02	1.72E-01	1.10E-01	1.73E-02	8.05E-03	4.26E-03	7.46E-01
Mercury	1.05E-04	3.67E-07	7.95E-04	1.67E-02	4.34E-04	5.52E-02	4.36E-05	2.03E-05	1.08E-05	1.41E-04
Nickel	3.82E-02	1.34E-04	2.90E-01	1.67E-02	1.58E-01	5.52E-02	1.59E-02	7.41E-03	3.92E-03	6.76E-02

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Toxic Air Pollutant Potential Emissions (lb/yr)

Toxic Air Pollutant	FGD Byproduct Silo	FGD Hydrated Lime Silo	EHE A - External Heat Exchanger A[1]	EHE B - External Heat Exchanger B[1]	EHE Silo	Product Storage Dome	Loadout Silo Bin Vent	Loadout Silo Spouts	Ball Mill Classifier	Ball Mill Feed Silo
	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr
Inorganic, Non-metal Compounds										
H2SO4										
Organic Compounds										
1,3-Butadiene										
Acetaldehyde										
Acrolein										
Benzene										
Formaldehyde										
N-Hexane										
Toluene										
Xylene (Mixed Isomers)										
Benzo(a)Pyrene										
Metal Compounds										
Arsenic	7.49E-05	7.49E-04	3.22E+00	3.22E+00	2.31E-03	2.31E-03	1.16E-03	1.16E-03	3.74E-01	5.14E-04
Beryllium	1.06E-05	1.06E-04	6.86E-01	6.86E-01	4.92E-04	4.92E-04	2.46E-04	2.46E-04	7.97E-02	1.09E-04
Cadmium	1.62E-05	1.62E-04	1.95E-01	1.95E-01	1.40E-04	1.40E-04	6.99E-05	6.99E-05	2.26E-02	3.11E-05
Chromium VI			6.61E-01	6.61E-01	4.73E-04	4.73E-04	2.37E-04	2.37E-04	7.67E-02	1.05E-04
Manganese	2.09E-03	2.09E-02	5.95E+00	5.95E+00	4.26E-03	4.26E-03	2.13E-03	2.13E-03	6.90E-01	9.48E-04
Mercury	3.94E-07	3.94E-06	1.50E-02	1.50E-02	1.08E-05	1.08E-05	5.38E-06	5.38E-06	1.74E-03	2.39E-06
Nickel	1.89E-04	1.89E-03	5.47E+00	5.47E+00	3.92E-03	3.92E-03	1.96E-03	1.96E-03	6.35E-01	8.73E-04

1 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide TPER evaluation to avoid double counting., however; each unit was individually modeled at the conservative maximum 70 TPH production rate.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Toxic Air Pollutant Potential Emissions (lb/day)

Toxic Air Pollutant	Ash Basin	Unloading Pile	Screener	Screener Diesel Engine	Crusher	Crusher Diesel Engine	Ash Handling	Wet Ash Receiving	Feed Silo	STAR® Ash Firing
	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Inorganic, Non-metal Compounds										
H2SO4										2.40E+00
Organic Compounds										
1,3-Butadiene				5.98E-04		1.97E-03				
Acetaldehyde				1.17E-02		3.87E-02				
Acrolein				1.41E-03		4.66E-03				
Benzene				1.43E-02		4.70E-02				
Formaldehyde				1.80E-02		5.95E-02				
N-Hexane										
Toluene				6.25E-03		2.06E-02				
Xylene (Mixed Isomers)				4.36E-03		1.44E-02				
Benzo(a)Pyrene				2.87E-06		9.48E-06				
Metal Compounds										
Arsenic	6.16E-05	2.16E-07	4.68E-04	6.12E-05	2.55E-04	2.02E-04	2.57E-05	1.83E-05	1.39E-05	7.33E-05
Beryllium	1.31E-05	4.60E-08	9.96E-05	4.59E-05	5.43E-05	1.51E-04	5.46E-06	3.90E-06	2.95E-06	1.04E-05
Cadmium	3.73E-06	1.31E-08	2.83E-05	4.59E-05	1.54E-05	1.51E-04	1.55E-06	1.11E-06	8.39E-07	1.58E-05
Chromium VI	1.26E-05	4.43E-08	9.58E-05	4.59E-05	5.23E-05	1.51E-04	5.26E-06	3.76E-06	2.84E-06	
Manganese	1.14E-04	3.98E-07	8.62E-04	9.17E-05	4.70E-04	3.02E-04	4.73E-05	3.38E-05	2.56E-05	2.04E-03
Mercury	2.87E-07	1.01E-09	2.18E-06	4.59E-05	1.19E-06	1.51E-04	1.19E-07	8.54E-08	6.46E-08	3.86E-07
Nickel	1.05E-04	3.67E-07	7.94E-04	4.59E-05	4.33E-04	1.51E-04	4.35E-05	3.11E-05	2.35E-05	1.85E-04

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Toxic Air Pollutant Potential Emissions (lb/day)

Toxic Air Pollutant	FGD Byproduct Silo	FGD Hydrated Lime Silo	EHE A - External Heat Exchanger A[1]	EHE B - External Heat Exchanger B[1]	EHE Silo	Product Storage Dome	Loadout Silo Bin Vent	Loadout Silo Spouts	Ball Mill Classifier	Ball Mill Feed Silo
	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Inorganic, Non-metal Compounds										
H2SO4										
Organic Compounds										
1,3-Butadiene										
Acetaldehyde										
Acrolein										
Benzene										
Formaldehyde										
N-Hexane										
Toluene										
Xylene (Mixed Isomers)										
Benzo(a)Pyrene										
Metal Compounds										
Arsenic	2.05E-07	2.05E-06	8.83E-03	8.83E-03	1.39E-05	2.43E-05	5.20E-06	1.39E-05	1.03E-03	2.08E-06
Beryllium	2.92E-08	2.92E-07	1.88E-03	1.88E-03	2.95E-06	5.17E-06	1.11E-06	2.95E-06	2.18E-04	4.43E-07
Cadmium	4.43E-08	4.43E-07	5.34E-04	5.34E-04	8.39E-07	1.47E-06	3.14E-07	8.39E-07	6.20E-05	1.26E-07
Chromium VI			1.81E-03	1.81E-03	2.84E-06	4.97E-06	1.07E-06	2.84E-06	2.10E-04	4.26E-07
Manganese	5.72E-06	5.72E-05	1.63E-02	1.63E-02	2.56E-05	4.47E-05	9.59E-06	2.56E-05	1.89E-03	3.83E-06
Mercury	1.08E-09	1.08E-08	4.11E-05	4.11E-05	6.46E-08	1.13E-07	2.42E-08	6.46E-08	4.78E-06	9.69E-09
Nickel	5.18E-07	5.18E-06	1.50E-02	1.50E-02	2.35E-05	4.12E-05	8.82E-06	2.35E-05	1.74E-03	3.53E-06

1 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide TPER evaluation to avoid double counting., however; each unit was individually modeled at the conservative maximum 70 TPH production rate.

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Toxic Air Pollutant Potential Emissions (lb/hr)

Toxic Air Pollutant	Ash Basin	Unloading Pile	Screener	Screener Diesel Engine	Crusher	Crusher Diesel Engine	Ash Handling	Wet Ash Receiving	Feed Silo	STAR® Ash Firing
	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Inorganic, Non-metal Compounds										
H2SO4										1.00E-01
Organic Compounds										
1,3-Butadiene				2.49E-05		8.21E-05				
Acetaldehyde				4.89E-04		1.61E-03				
Acrolein				5.89E-05		1.94E-04				
Benzene				5.94E-04		1.96E-03				
Formaldehyde				7.52E-04		2.48E-03				
N-Hexane										
Toluene				2.61E-04		8.59E-04				
Xylene (Mixed Isomers)				1.82E-04		5.99E-04				
Benzo(a)Pyrene				1.20E-07		3.95E-07				
Metal Compounds										
Arsenic	2.57E-06	9.00E-09	1.95E-05	2.55E-06	1.06E-05	8.40E-06	1.07E-06	7.64E-07	5.78E-07	3.05E-06
Beryllium	5.47E-07	1.92E-09	4.15E-06	1.91E-06	2.26E-06	6.30E-06	2.28E-07	1.63E-07	1.23E-07	4.34E-07
Cadmium	1.55E-07	5.45E-10	1.18E-06	1.91E-06	6.43E-07	6.30E-06	6.46E-08	4.62E-08	3.49E-08	6.59E-07
Chromium VI	5.26E-07	1.84E-09	3.99E-06	1.91E-06	2.18E-06	6.30E-06	2.19E-07	1.57E-07	1.18E-07	
Manganese	4.73E-06	1.66E-08	3.59E-05	3.82E-06	1.96E-05	1.26E-05	1.97E-06	1.41E-06	1.07E-06	8.52E-05
Mercury	1.20E-08	4.19E-11	9.08E-08	1.91E-06	4.95E-08	6.30E-06	4.98E-09	3.56E-09	2.69E-09	1.61E-08
Nickel	4.36E-06	1.53E-08	3.31E-05	1.91E-06	1.80E-05	6.30E-06	1.81E-06	1.30E-06	9.81E-07	7.71E-06

Duke Energy Progress, LLC
Cape Fear STAR® Project

Summary of Facility-Wide Toxic Air Pollutant Potential Emissions (lb/hr)

Toxic Air Pollutant	FGD Byproduct Silo	FGD Hydrated Lime Silo	EHE A - External Heat Exchanger A[1]	EHE B - External Heat Exchanger B[1]	EHE Silo	Product Storage Dome	Loadout Silo Bin Vent	Loadout Silo Spouts	Ball Mill Classifier	Ball Mill Feed Silo
	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Inorganic, Non-metal Compounds										
H2SO4										
Organic Compounds										
1,3-Butadiene										
Acetaldehyde										
Acrolein										
Benzene										
Formaldehyde										
N-Hexane										
Toluene										
Xylene (Mixed Isomers)										
Benzo(a)Pyrene										
Metal Compounds										
Arsenic	8.55E-09	8.55E-08	3.68E-04	3.68E-04	5.78E-07	1.01E-06	2.17E-07	5.78E-07	4.27E-05	8.66E-08
Beryllium	1.22E-09	1.22E-08	7.84E-05	7.84E-05	1.23E-07	2.15E-07	4.61E-08	1.23E-07	9.10E-06	1.84E-08
Cadmium	1.85E-09	1.85E-08	2.23E-05	2.23E-05	3.49E-08	6.11E-08	1.31E-08	3.49E-08	2.58E-06	5.24E-09
Chromium VI			7.54E-05	7.54E-05	1.18E-07	2.07E-07	4.44E-08	1.18E-07	8.75E-06	1.78E-08
Manganese	2.39E-07	2.39E-06	6.79E-04	6.79E-04	1.07E-06	1.86E-06	3.99E-07	1.07E-06	7.88E-05	1.60E-07
Mercury	4.50E-11	4.50E-10	1.71E-06	1.71E-06	2.69E-09	4.71E-09	1.01E-09	2.69E-09	1.99E-07	4.04E-10
Nickel	2.16E-08	2.16E-07	6.25E-04	6.25E-04	9.81E-07	1.72E-06	3.68E-07	9.81E-07	7.25E-05	1.47E-07

1 - The total maximum throughput for the EHE system is 70 TPH which can be sustained by either EHE A (ES-8) or EHE B (ES-9). Emissions presented for each EHE unit represent each unit operating at 70 TPH for 8,760 hours per year. Only one unit is included in the facility-wide TPER evaluation to avoid double counting., however; each unit was individually modeled at the conservative maximum 70 TPH production rate.

Source Parameters - Potential
Duke Energy Progress, LLC
Cape Fear STAR® Project

Point Sources

Source ID	Emission Point ID	Source Description	Easting (X)	Northing (Y)	Base Elevation	Stack Height	Temperature	Exit Velocity	Stack Diameter	H_2SO_4	Benzene	Arsenic	Beryllium
			(m)	(m)	(m)	(m)	(K)	(m/s)	(m)	(g/s)	(g/s)	(g/s)	(g/s)
I-4	EP_4	Feed Silo Bin Vent	678183.1	3939922.9	59.1	41.3	366.5	7.62E-01	2.55			7.28E-08	1.55E-08
ES-5	EP_5	STAR® Reactor Exhaust	678227.9	3939937.9	59.0	42.7	367.6	17.60	1.60	1.26E-02		3.85E-07	5.47E-08
I-6	EP_6	FGD Byproduct Silo Bin Vent	678235.4	3939924.8	59.0	23.2	360.9	6.86	0.55			1.08E-09	1.53E-10
I-7	EP_7	FGD Hydrated Lime Silo Bin Vent	678229.1	3939914.0	59.0	24.4	0.0	6.86	0.55			1.08E-08	1.53E-09
ES-8	EP_8	EHE A (Dust Collector)	678194.9	3939953.3	59.0	29.1	394.3	22.72	1.07			4.64E-05	9.87E-06
ES-9	EP_9	EHE B (Dust Collector)	678180.2	3939954.8	59.0	29.1	394.3	22.72	1.07			4.64E-05	9.87E-06
I-10	EP_10	EHE Silo Bin Vent	678181.4	3939947.5	59.0	27.9	366.5	7.62E-01	2.26			7.28E-08	1.55E-08
I-11	EP_11	Product Storage Dome Bin Vent	678207.9	3939831.2	59.0	41.9	441.5	7.62E-01	2.67			1.27E-07	2.71E-08
I-12	EP_12	Loadout Silo Bin Vent	678245.1	3939832.9	59.0	31.7	441.5	7.62E-01	2.67			2.73E-08	5.81E-09
I-12	EP_13	Loadout Silo Spout A	678248.1	3939826.8	59.0	8.5	441.5	7.62E-01	2.67			3.64E-08	7.75E-09
I-12	EP_14	Loadout Silo Spout B	678241.6	3939826.3	59.0	8.5	441.5	7.62E-01	2.67			3.64E-08	7.75E-09
I-22	EP_22	Screener Diesel Engine	677243.0	3940492.0	51.8	1.22	699.8	41.40	0.08		7.49E-05	3.21E-07	2.41E-07
ES-23	EP_23	Crusher Diesel Engine	677236.0	3940496.0	51.8	2.29	699.8	41.52	0.15		2.47E-04	1.06E-06	7.94E-07
I-24	EP_24	Ball Mill Classifier	678215.2	3939995.6	58.8	17.68	349.8	21.32	0.56			5.38E-06	1.15E-06
I-25	EP_25	Ball Mill Feed Silo	678211.1	3940007.4	58.8	15.54	394.3	18.44	0.25			1.09E-08	2.32E-09

Volume Sources

Source ID	Emission Point ID	Source Description	Easting (X)	Northing (Y)	Base Elevation	Release Height	Init. Horizontal Dimension	Initial Vert. Dimension	H_2SO_4	Benzene	Arsenic	Beryllium
			(m)	(m)	(m)	(m)	(m)	(m)	(g/s)	(g/s)	(g/s)	(g/s)
I-16	EP-16	Ash Handling - Windrows	677281.0	3940481.0	51.8	1.52	0.71	1.43			4.49E-08	9.56E-09
I-16	EP-17	Ash Handling - Screener/Crusher Drop	677251.0	3940487.0	51.8	1.52	0.71	1.43			4.49E-08	9.56E-09
I-16	EP-18	Ash Handling - Screener/Crusher Stock Pile	677261.0	3940478.0	51.8	1.52	0.71	1.43			4.49E-08	9.56E-09
I-1	EP-1, EP-2	Wet Ash Receiving	678204.0	3940046.2	58.8	1.52	0.71	1.43			9.62E-08	2.05E-08
I-19	EP-19	Screener	677243.0	3940492.0	51.8	1.52	0.71	1.43			2.45E-06	5.23E-07
I-20	EP-20	Crusher	677236.0	3940496.0	51.8	1.52	0.71	1.43			1.34E-06	2.85E-07

Source ID	Emission Point ID	Source Description	Base Elevation	Release Height	Number of Vertices	H_2SO_4	Benzene	Arsenic	Beryllium
			(m)	(m)		(g/s)	(g/s)	(g/s)	(g/s)
I-15	EP-15	Ash Basin	51.8	2.04	23			3.23E-07	6.89E-08
I-3	EP-3	Unloading Pile	58.8	1.22	5			1.13E-09	2.41E-10

Summary of Modeling Analysis - Baseline
Duke Energy Progress, LLC
Cape Fear STAR® Project

Compound	Year	Averaging Period	Maximum Concentration (ug/m^3)	AAL (ug/m^3)	Percent of AAL (%)	Opt Factor
Arsenic	2013	Annual	9.09E-05	2.10E-03	4.33%	22.6
Benzene	2016	Annual	1.69E-03	0.12	1.41%	69.5
Beryllium	2013	Annual	2.04E-05	4.10E-03	0.498%	197
Sulfuric Acid	2017	1 - Hour	6.36E-02	100	0.064%	1,542
	2015	24 - Hour	3.11E-02	12	0.259%	379

Summary of Arsenic Modeling Analysis - Baseline
Duke Energy Progress, LLC
Cape Fear STAR® Project

Year	Averaging Period	Maximum Concentration (ug/m^3)	UTM Coordinates		AAL (ug/m^3)	Percent of AAL (%)
			Easting (m)	Northing (m)		
2013	Annual	9.09E-05	678300.00	3940100.00	2.10E-03	4.33%
2014	Annual	6.34E-05	677805.40	3940488.10	2.10E-03	3.02%
2015	Annual	8.55E-05	678307.60	3940093.10	2.10E-03	4.07%
2016	Annual	6.38E-05	678400.00	3940150.00	2.10E-03	3.04%
2017	Annual	7.08E-05	678400.00	3940150.00	2.10E-03	3.37%

Summary of Benzene Modeling Analysis - Baseline
Duke Energy Progress, LLC
Cape Fear STAR® Project

Year	Averaging Period	Maximum Concentration (ug/m^3)	UTM Coordinates		AAL (ug/m^3)	Percent of AAL (%)
			Easting (m)	Northing (m)		
2013	Annual	1.30E-03	677805.70	3940636.00	0.12	1.08%
2014	Annual	1.48E-03	677805.70	3940636.00	0.12	1.23%
2015	Annual	1.43E-03	677805.70	3940636.00	0.12	1.19%
2016	Annual	1.69E-03	677805.70	3940636.00	0.12	1.41%
2017	Annual	1.63E-03	677805.60	3940611.30	0.12	1.36%

Summary of Beryllium Modeling Analysis - Baseline
Duke Energy Progress, LLC
Cape Fear STAR® Project

Year	Averaging Period	Maximum Concentration (ug/m^3)	UTM Coordinates		AAL (ug/m^3)	Percent of AAL (%)
			Easting (m)	Northing (m)		
2013	Annual	2.04E-05	678300.00	3940100.00	4.10E-03	0.50%
2014	Annual	1.62E-05	677805.40	3940488.10	4.10E-03	0.40%
2015	Annual	1.92E-05	678307.60	3940093.10	4.10E-03	0.47%
2016	Annual	1.64E-05	677805.40	3940488.10	4.10E-03	0.40%
2017	Annual	1.76E-05	677805.40	3940488.10	4.10E-03	0.43%

Summary of H2SO4 1-Hour Modeling Analysis - Baseline
Duke Energy Progress, LLC
Cape Fear STAR® Project

Year	Averaging Period	Maximum Concentration (ug/m^3)	UTM Coordinates		AAL (ug/m^3)	Percent of AAL (%)
			Easting (m)	Northing (m)		
2013	1-hour	6.31E-02	678350.00	3940150.00	100	0.06%
2014	1-hour	5.25E-02	678150.00	3940450.00	100	0.05%
2015	1-hour	6.28E-02	678400.00	3940050.00	100	0.06%
2016	1-hour	4.80E-02	678150.00	3940450.00	100	0.05%
2017	1-hour	6.36E-02	678400.00	3940050.00	100	0.06%

Summary of H2SO4 24-Hour Modeling Analysis - Baseline
Duke Energy Progress, LLC
Cape Fear STAR® Project

Year	Averaging Period	Maximum Concentration (ug/m^3)	UTM Coordinates		AAL (ug/m^3)	Percent of AAL (%)
			Easting (m)	Northing (m)		
2013	24-hour	2.03E-02	678450.00	3940100.00	12	0.17%
2014	24-hour	1.75E-02	678800.00	3939700.00	12	0.15%
2015	24-hour	3.11E-02	677954.60	3939400.70	12	0.26%
2016	24-hour	1.62E-02	678700.00	3939800.00	12	0.14%
2017	24-hour	1.72E-02	678450.00	3940100.00	12	0.14%

Summary of Optimized Toxic Air Pollutant Modeling Results
Duke Energy Progress LLC
Cape Fear STAR® Project

TAP	Averaging Period	Maximum Concentration (mg/m3)	Year	AAL (mg/m3)	Percent of AAL (%)
Arsenic	Annual	2.06E-03	2013	2.10E-03	98%
Benzene	Annual	0.117	2016	0.12	98%
Beryllium	Annual	4.01E-03	2013	4.10E-03	98%
Sulfuric Acid	1 - Hour 24 - Hour	98.0 11.8	2017 2015	100 12	98% 98%

Source Parameters - Optimized
Duke Energy Progress, LLC
Cape Fear STAR® Project

Point Sources

Source ID	Emission Point ID	Source Description	Easting (X)	Northing (Y)	Base Elevation	Stack Height	Temperature	Exit Velocity	Stack Diameter	1-hr H_2SO_4	24-hr H_2SO_4	Benzene	Arsenic	Beryllium
			(m)	(m)	(m)	(m)	(K)	(m/s)	(m)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)
I-4	EP-4	Feed Silo Bin Vent	678183.1	3939922.9	59.1	41.3	366.5	7.62E-01	2.55				1.65E-06	3.05E-06
ES-5	EP-5	STAR® Reactor Exhaust	678227.9	3939937.9	59.0	42.7	367.6	17.6	1.60	1.94E+01	4.77E+00		8.71E-06	1.08E-05
I-6	EP-6	FGD Byproduct Silo Bin Vent	678235.4	3939924.8	59.0	23.2	360.9	6.86	5.49E-01				2.44E-08	3.01E-08
I-7	EP-7	FGD Hydrated Lime Silo Bin Vent	678229.1	3939914.0	59.0	24.4	0.0	6.86	5.49E-01				2.44E-07	3.01E-07
ES-8	EP-8	EHE A (Dust Collector)	678194.9	3939953.3	59.0	29.1	394.3	22.7	1.07				1.05E-03	1.94E-03
ES-9	EP-9	EHE B (Dust Collector)	678180.2	3939954.8	59.0	29.1	394.3	22.7	1.07				1.05E-03	1.94E-03
I-10	EP-10	EHE Silo Bin Vent	678181.4	3939947.5	59.0	27.9	366.5	7.62E-01	2.26				1.65E-06	3.05E-06
I-11	EP-11	Product Storage Dome Bin Vent	678207.9	3939831.2	59.0	41.9	441.5	7.62E-01	2.67				2.88E-06	5.34E-06
I-12	EP-12	Loadout Silo Bin Vent	678245.1	3939832.9	59.0	31.7	441.5	7.62E-01	2.67				6.18E-07	1.14E-06
I-12	EP-13	Loadout Silo Spouts	678248.1	3939826.8	59.0	8.5	441.5	7.62E-01	2.67				8.24E-07	1.53E-06
I-12	EP-14	Loadout Silo Spouts	678241.6	3939826.3	59.0	8.5	441.5	7.62E-01	2.67				8.24E-07	1.53E-06
I-22	EP-22	Screener Diesel Engine	677243.0	3940492.0	51.8	1.2	699.8	41.4	7.62E-02			5.20E-03	7.27E-06	4.74E-05
ES-23	EP-23	Crusher Diesel Engine	677236.0	3940496.0	51.8	2.3	699.8	41.5	1.50E-01			1.71E-02	2.40E-05	1.56E-04
I-24	EP-24	Ball Mill Classifier	678215.2	3939995.6	58.8	17.7	349.8	21.3	5.59E-01				1.22E-04	2.26E-04
I-25	EP-25	Ball Mill Feed Silo	678211.1	3940007.4	58.8	15.5	394.3	18.4	2.54E-01				2.47E-07	4.58E-07

Volume Sources

Source ID	Emission Point ID	Source Description	Easting (X)	Northing (Y)	Base Elevation	Release Height	Init. Horizontal Dimension	Initial Vert. Dimension	1-hr H_2SO_4	24-hr H_2SO_4	Benzene	Arsenic	Beryllium
			(m)	(m)	(m)	(m)	(m)	(m)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)
I-16	EP-16	Ash Handling - Windrows	677281.0	3940481.0	51.8	1.52	0.71	1.43				1.02E-06	1.88E-06
I-16	EP-17	Ash Handling - Screener/Crusher Drop	677251.0	3940487.0	51.8	1.52	0.71	1.43				1.02E-06	1.88E-06
I-16	EP-18	Ash Handling - Screener/Crusher Stock Pile	677261.0	3940478.0	51.8	1.52	0.71	1.43				1.02E-06	1.88E-06
I-1	EP-1, EP-2	Wet Ash Receiving	678204.0	3940046.2	58.8	1.52	0.71	1.43				2.18E-06	4.03E-06
I-19	EP-19	Screener	677243.0	3940492.0	51.8	1.52	0.71	1.43				5.56E-05	1.03E-04
I-20	EP-20	Crusher	677236.0	3940496.0	51.8	1.52	0.71	1.43				3.03E-05	5.61E-05

Source ID	Emission Point ID	Source Description	Base Elevation	Release Height	Number of Vertices	1-hr H_2SO_4	24-hr H_2SO_4	Benzene	Arsenic	Beryllium
			(m)	(m)		(g/s)	(g/s)	(g/s)	(g/s)	(g/s)
I-15	EP-15	Ash Basin	51.8	2.04	23				7.32E-06	1.36E-05
I-3	EP-3	Unloading Pile	58.8	1.22	5				2.57E-08	4.75E-08

Appendix B

Toxics Modeling Checklist

(Replaces Appendix C of Air Permit Application 1900134.18A

A.1
North Carolina Modeling Protocol Checklist

The North Carolina Modeling Protocol Checklist may be used in lieu of developing the traditional written modeling plan for North Carolina toxics and criteria pollutant modeling. The protocol checklist is designed to provide the same level of information as requested in a modeling protocol as discussed in Chapter 2 of the *Guideline for Evaluating the Air Quality Impacts of Toxic Pollutants in North Carolina*. The modeling protocol checklist is submitted with the modeling analysis.

Although most of the information requested in the modeling protocol checklist is self explanatory, additional comments are provided, where applicable, and are discussed in greater detail in the toxics modeling guidelines referenced above. References to sections, tables, figures, appendices, etc., in the protocol checklist are found in the toxics modeling guidelines.

INSTRUCTIONS: The modeling report supporting the compliance demonstration should include most of the information listed below. As appropriate, answer the following questions or indicate by check mark the information provided or action taken is reflected in your report.

FACILITY INFORMATION	
Name: Duke Energy Progress, LLC Cape Fear STAR® Ash Beneficiation Process **Facility ID:** NA – New Facility **Address:** 500 CP and L Rd Moncure, NC 27559	**Consultant (if applicable):** **AECOM** 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560
Contact Name: Ms. Ann Quillian	**Contact Name:** Mr. Mark Yoder
Phone Number: (919) 546-6610 **Email:** Ann.Quillian@duke-energy.com	**Phone Number:** (919) 461-1441 **Email:** Mark.Yoder@aecom.com

GENERAL

Description of New Source or Source / Process Modification: provide a short description of the new or modified source(s) and a brief discussion of how this change affects facility production or process operation.	✓
Source / Pollutant Identification: provide a table of the affected pollutants, by source, which identifies the source type (point, area, or volume), maximum pollutant emission rates over the applicable averaging period(s), and, for point sources, indicate if the stack is capped or non-vertical (C/N).	✓
Pollutant Emission Rate Calculations: indicate how the pollutant emission rates were derived (e.g., AP-42, mass balance, etc.) and where applicable, provide the calculations.	✓
Site / Facility Diagram: provide a diagram or drawing showing the location of all existing and proposed emission sources, buildings or structures, public right-of-ways, and the facility property (toxics) / fence line (criteria pollutants) boundaries. The diagram should also include a scale, true north indicator, and the UTM or latitude/longitude of at least one point.	✓
Certified Plat or Signed Survey: a certified plat (map) from the County Register of Deeds or a signed survey must be submitted to validate property boundaries modeled.	✓
Topographic Map: A topographic map covering approximately 5km around the facility must be submitted. The facility boundaries should be annotated on the map as accurately as possible.	✓
Cavity Impact Analysis: No cavity analysis is required if using AERMOD. *See Section 4.2*	**N/A**

Background Concentrations (criteria pollutant analyses only**)**: Background concentrations must be determined for each pollutant for each averaging period evaluated. The averaged background value used (e.g., high, high-second-high, high-third-high, etc.) is based on the pollutant and averaging period evaluated. The background concentrations are added to the modeled concentrations, which are then compared to the applicable air quality standard to determine compliance.	**N/A**
Offsite Source Inventories (criteria pollutant analyses only**)**: Offsite source inventories must be developed and modeled for all pollutants for which onsite sources emissions are modeled in excess of the specific pollutant significant impact levels (SILs) as defined in the PSD New Source Review Workshop Manual. The DAQ AQAB must approve the inventories. An initial working inventory can be requested from the AQAB.	**N/A**

SCREEN LEVEL MODELING

Model: The latest version of the AERSCREEN model must be used. The use of other screening models should be approved by NCDAQ prior to submitting the modeling report.	**N/A**
Source / Source emission parameters: Provide a table listing the sources modeled and the applicable source emission parameters. See NC Form 3 – Appendix A.	**N/A**
Merged Sources: Identify merged sources and show all appropriate calculations. See Section 3.3	**N/A**
GEP Analysis: See Section 3.2 and NC Form 1 – Appendix A	**N/A**
Terrain: Indicate the terrain modeled: simple (Section 4.4), and complex (Section 4.5 and NC Form 4 – Appendix A). If complex terrain is within 5 kilometers of the facility, complex terrain must be evaluated. Simple terrain must include terrain elevations if any terrain is greater than the stack base of any source modeled. Simple: **N/A** Complex: **N/A**	
Meteorology: Refer to Section 4.1 for AERSCREEN inputs.	**N/A**
Receptors: AERSCREEN – use shortest distance to property boundary for each source modeled and use sufficient range to find maximum (See Section 4.1 (i) and (j)). Terrain above stack base must be evaluated.	**N/A**
Modeling Results: For each affected pollutant, modeling results should be summarized, converted to the applicable averaging period (See Table 3), and presented in tabular format indicating compliance status with the applicable AAL, SIL, or NAAQS. See NC Form S5 – Appendix A.	**N/A**
Modeling Files: Either electronic or hard copies of AERSCREEN output must be submitted.	**N/A**

REFINED LEVEL MODELING

Model: The latest version of AERMOD should be used, and may be found at http://www.epa.gov/scram001/dispersion_prefrec.htm. The use of other refined models must be approved by NCDAQ prior to submitting the modeling report.	✓
Source / Source emission parameters: Provide a table listing the sources modeled and the applicable source emission parameters. See NC Form 3 - Appendix A.	✓
GEP Analysis: Use BPIP-Prime with AERMOD.	✓
Cavity Impact Analysis: No separate cavity analysis is required when using AERMOD as long as receptors are placed in cavity susceptible areas. See Section 4.2 and 5.2.	**N/A**
Terrain: Use digital elevation data from the USGS NED database (http://seamless.usgs.gov/index.php). Use of other sources of terrain elevations or the non-regulatory Flat Terrain option will require prior approval from DAQ AQAB.	✓
Coordinate System: Specify the coordinate system used (e.g., NAD27, NAD83, etc.) to identify the source, building, and receptor locations. Note: Be sure to specify in the AERMAP input file the correct base datum (NADA) to be used for identifying source input data locations. Clearly note in both the protocol checklist and the modeling report which datum was used.	**NAD 83**
Receptors: The receptor grid should be of sufficient size and resolution to identify the maximum pollutant impact. See Section 5.3.	✓