Summary of PSD Permits Issued to Non-Electric Generating Units Addressing GHGs

Permit Seeker, Issuing Agency, & Date of Issuance	Type of Facility & Location	New or Existing Facility	GHG BACT Limits and Technologies Chosen	Technologies Eliminated	Additional Notes
Indiana Gasification Project[1] (Indiana Gasification, LLC) Indiana Department of Environmental Management (December 15, 2011 – Draft)	300-MW IGCC coal gasification plant (Rockport plant) Indiana	New	• Acid Gas Recovery (AGR) Vents not exceed: – 4,690,000 tons CO_2 during first 12 mos. – 6,430,000 tons CO_2 during second 12 mos. – 1,290,000 tons CO_2 per 12 month rolling period • Wet Sulfuric Acid (WSA) plant: 474,000 tons CO2 per 12 month rolling period • Total potential CO_2e emissions: 1,875,448 tons/year from year 3 on. • Additional BACT limits for auxiliary boilers, Gasifier Preheat Burners, emergency generators, etc.	• Sequestration – technically infeasible • Conventional thermal oxidizer • Recycling or capturing WSA tailgas – not commercially or technically feasible • Post combustion capture for auxiliary boilers – not technically feasible	• Will produce SNG and liquefied CO_2 • Anticipate selling CO_2 to Gulf Coast EOR market • First permit to assume use of carbon capture in determining GHG limits • CO_2 limits vary over time to allow time for delays in getting CO_2 to EOR fields (pipeline construction, permitting, etc.) • Will use Illinois Basin coal and pet coke • Power primarily used to meet on-site needs
Shell Oil[2] EPA Region 10 (September 19, 2011 – Final)	Drillship Discoverer (oil exploration) Alaska (Beaufort Sea)	New	• 70,000 tons CO_2e based on rolling 12-month basis (includes emissions from units that combust fuel or incinerate waste, and from mud off-gassing) • Limit on fuel combustion (6,346,493 gallons aggregate 12-month rolling limit) • Limit on waste combustion (1,657,440 pounds aggregate 12-month rolling limit)	• N/A	• Shell requested the CO_2e emissions limit, which is: – Greater than expected emissions from the project – Designed to ensure source does not trigger PSD 75,000-ton threshold for GHG permitting requirements • CO_2e emissions limit applies to entire drilling operation (source-wide), not to specific technologies • BACT analysis for GHGs not required • 120 days/year operation limit
Hyperion Energy Center[3] South Dakota Department of Environment and Natural Resources (September 15, 2011 – Final)	Petroleum refinery & IGCC power plant South Dakota	New	• Process heaters: 33 tons CO_2e/1000 barrels crude oil received based on 365-day rolling avg. (4.8 MMT/year) • Power island acid gas removal system: 58.6 tons CO_2e/1000 barrels crude oil received based on a 365-day rolling average (8.5 MMT/year) • Combined cycle gas turbines: 23.9 tons CO_2e/1000 barrels crude oil received based on a 365-day rolling average (3.5 MMT/year) • Small combustion sources: 0.2 tons CO_2e/1000 barrels crude oil received based on a 365-day rolling average (22,213 tons/year) • Facility-wide limit, not unit basis	• CCS ("adverse environmental, energy and associated costs of the system") • Natural gas (not technically feasible; would redefine design/source • Purchased power (not available) • SCR	• CO_2e emissions limit greater than expected emissions • No suitable CO_2 storage near site • CCS projected to cost between $43-$101/ton of CO_2 sequestered • Eliminating SCRs would increase NO_x emissions • Compliance with limits for delayed cokers based on emission calculations under EPA mandatory GHG reporting program • Total annual GHG limit: ~17 MMT (16,875,059) • Although BACT analysis for GHGs was not initially required (permitting process began in 2009), operator assumed CO_2 subject to BACT requirement
Lafarge Building Materials[4] New York Department of Environmental Conservation (July 19, 2011 – Final)	Cement plant New York	Existing	• 1900 lb (0.95 tons) CO_2e/ton of clinker based on rolling 12-month basis for kiln system emissions • Plant design optimization – conversion of plant to new system is BACT • Reducing clinker content – maximize use of additives	• Alternative fuels (natural gas, biomass) – technical infeasibility and cost • Waste heat recovery system – currently infeasible due to cost;	• Plant being expanded and modernized – total emissions from kiln will increase (from 1.8 to 2.57 million short tons/year) but emissions intensity will decrease (from 1.04 to 0.92 tons CO_2e/ton of clinker); 6% lower than industry average

			based on cost, availability and standard specifications • Use of coal as primary fuel • Electrical systems optimization (high efficiency motors and fans, vertical roller mill, soft starts, variable voltage and frequency drives) • Waste heat recovery system (6 MW)	may be implemented in Phase II of projects if economically justified • CCS (not commercially available or technically feasible)	• CO_2e emissions limit greater than expected emissions of 0.92 tons CO_2e/ton of clinker for kiln; company sought the higher limit since no operating data available • Total emissions estimate of 0.94 tons CO_2e/ton of clinker for plant includes emissions from off-site electricity, waste generation and transportation • Will increase emissions >75,000 tons; GHG BACT req'd
Consolidated Environmental Management (Nucor Corp.)[5] Louisiana Department of Environmental Quality (January 27, 2011 – Final)	Direct reduction iron plant Louisiana	New (co-located with existing facility)	• Good combustion practices • Acid gas separation system – removes CO_2 from spent gas • Energy integration	None (All identified control strategies were found to be technically feasible and are part of the permit conditions)	• Captured CO_2 may be sold to offsite customers but not required • LNB will increase CO_2 emissions

BACT – Best Available Control Technology
CCS – carbon capture and storage
CO_2e – carbon dioxide (CO_2) equivalent
FGD – flue gas desulfurization
GHG – greenhouse gas
LNB – low Nox burner
MMT – million metric tons
PSD – Prevention of Significant Deterioration
SCR – selective catalytic reduction

[1] Includes GHG BACT limits for: Auxiliary boilers – 88,167 tons CO_2 per 12 consecutive month period plus use of NG or SNG and energy efficient boiler design; Gasifier Preheat Burners – 6,438 tons CO_2 per 12 consecutive month period plus use of NG or SNG and use of good engineering design; Zero Liquid Discharge Spray Dryer – 2,884 tons CO2 per 12 consecutive month period, plus use of NG or SNG and good engineering design; Emergency generators and firewater pump engines – 84 tons CO_2 per 12 consecutive month period from non-emergency operation; Use of fully enclosed pressurized SF6 circuit breakers; Syngas Hydrocarbon and Acid Gas flares – Flare Minimization Plan.

[2] A final PSD permit with an identical Owner Requested Limit (ORL) for GHG emissions of 70,000 tons CO_2e based on rolling 12-month basis was issued to Shell on the same date for the Discoverer drilling operation in the Chukchi Sea. Permits were originally issued on March 31 and April 9, 2010, and overturned by EAB in December 2010. EAB did not address the argument that the original permits should have contained requirements for GHGs, but instead instructed EPA Region 10 to "apply all applicable standards in effect at the time of issuance of the new permit on remand." EAB subsequently clarified that EPA has discretion to determine when a specific standard is "applicable" on remand. EPA Region 10 issued revised draft permits in July 2011. On October 24, 2011, environmental groups filed a challenge to these 2 permits before the EAB. Separately, on October 21, 2011, a final PSD permit with an ORL GHG limit of 80,000 tons CO_2e based on rolling 12-month basis was issued to Shell for the Kulluk drilling operation in the Beaufort Sea. The GHG limit is designed to ensure source does not exceed PSD threshold for GHG permitting requirements (100,000 tons/year). Draft permit issued to ConocoPhillips for drilling operations in the Chukchi Sea with GHG limit of 39,800 tons CO_2e based on rolling 12-month basis, but company withdrew its permit application on September 26, 2011.

[3] Included GHG BACT limit for Delayed Coker 1 & 2 (9,320 lb CO_2e/drum per cycle), and requirements for use of good combustion practices, low-carbon fuels, energy efficient design, proper design of acid gas separation system, and work design practice standard for coke drum steam vents, equipment leaks. Original PSD permit issued August 2009 and expired February 2011. Hyperion filed to extend permit, necessitating GHG BACT analysis. Amended draft permit issued February 2011 and expires August 2012. Hyperion draft permit notes that the use of good combustion practices, low-carbon fuels and energy efficient design are part of the baseline condition, as is proper design of acid gas separation system. The BACT analysis prepared for Hyperion by RTP Environmental Associates, which was accepted by the South Dakota DENR, cites projected costs for CCS of \$43/ton of CO_2 sequestered for CO_2 vents and \$101/ton of CO_2 sequestered for combustion turbines and process heaters (pp. 11, 20); it also estimates a \$10/ton credit for EOR, which would reduce the costs to \$33 and \$91/ton of CO_2 sequestered, respectively. Citing the \$43/ton figure, the DENR Statement of Basis for a Construction Deadline Extension Request on this permit notes the following: "it appears that the studies referenced [in Hyperion's CCS cost analysis] are underestimating the cost of these systems." CO_2 emissions for this facility come from pet coke gasification process (50%), combustion turbines (26%) and process heaters (24%).

[4] CCS technologies fond not to be commercially available or technically feasible), included: Pre- and post-combustion capture (ammonia-based, dry and membrane-based); Oxy-combustion; Chemical looping; Compression and transport; Storage; Terrestrial and algae sequestration

[5] Nucor permit notes that energy integration has the most potential for reducing fuel consumption, and that minimizing the use of natural gas is the primary method to reduce GHGs. Permit also notes that the use of LNB will result in increased CO_2 emissions by reducing the efficiency of the unit but that BACT is designed to maintain low levels of fuel consumption by LNB.