DOE/EA-1642S

Draft Supplemental Environmental Assessment for University of Kentucky

Small-Scale Pilot Plant for the Gasification of Coal and Coal-Biomass Blends and Conversion of Derived Syngas to Liquid Fuels via Fischer-Tropsch Synthesis

Lexington, KY

December 2013

Prepared for:
Department of Energy
National Energy Technology Laboratory

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Cover Sheet

Proposed Action:

The United States (U.S.) Department of Energy (DOE) proposes, through a cooperative agreement with the University of Kentucky (UK) Center for Applied Energy Research (CAER), to partially fund the completion of the design, construction, and operation of a small-scale pilot plant for research related to the gasification of coal and coal-biomass blends and conversion of derived syngas to liquid fuels via Fischer-Tropsch (FT) synthesis. Previously, under the terms of a different cooperative agreement, DOE provided funding for the project in support of planning, preliminary design, and construction of a new building to house the small-scale pilot plant. To support DOE's decision to grant the previous amount of co-funding, UK and DOE prepared and issued an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) in 2009 and a Supplemental Analysis in 2010. This EA and FONSI expressly covered only the first phase of the project and lacked coverage of the breadth of processes, equipment, feed and waste streams, accident scenarios, and safety issues. Based on continued project planning and design work under a new cooperative agreement, UK and DOE now intend to amend the existing EA to cover the remainder of the project. The facility would be located at the existing UK's CAER, on a parcel of land within an existing 125-acre research park near Lexington, Kentucky. This facility would support the research of coal- and coal-biomass to liquid (CBTL) fuel production, along with the costs and process impacts of carbon dioxide (CO_2) control.

Type of Statement: Draft Supplemental Environmental Assessment

Lead Agency: U.S. Department of Energy; National Energy Technology Laboratory

Location: University of Kentucky Center for Applied Energy Research, Fayette County Kentucky

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Abstract:

DOE prepared this Supplemental Environmental Assessment (SEA) to the 2009 EA/FONSI and 2010 Supplemental Analysis for the *Design and Construction of an Early Lead Mini Fischer-Tropsch Refinery at the University of Kentucky Center for Applied Energy Research, near Lexington, Kentucky* (DOE/EA-1642) to assess the potential for impacts to the human and natural environment of its proposed action of providing financial assistance to the UK CAER under a cooperative agreement. An SEA was necessary due to the updated project design, which resulted in changes to the upstream gasification and acid gas cleanup components of the facility. Additionally, the proposed project would involve construction of additional concrete pads and framework for equipment and operation of the FT Process Development Unit (PDU) Facility, also called the FT PDU Facility, at UK CAER north of Lexington in Fayette County, Kentucky.

If approved, DOE would provide an additional \$1.3 million in co-funding from National Energy Technology Laboratory's (NETL) Coal and Coal-Biomass to Liquids and Gasification Systems Programs (under DOE's Coal Program) to pay for additional equipment and further design work. The funding from DOE would advance the construction and establishment of a small-scale pilot plant for the gasification of coal and coal-biomass blends and conversion of derived syngas to liquid fuels via FT synthesis. This proposed project is intended to evaluate the commercial and technical viability of advanced technologies for the production of FT transportation fuels and other transportation fuels from domestic coal (42 United States Code [USC] 15801 Section 417).

Public Participation:
DOE encourages public participation in the National Environmental Policy Act (NEPA) process. This SEA is being released for public review and comment. The public is invited to provide oral, written, or e-mail comments on this Draft SEA to DOE by the close of the comment period on XX. Copies of this Draft SEA are also being distributed to cognizant agencies. Comments received by the close of the comment period will be considered in preparing the Final SEA for the proposed DOE action. This Draft SEA as well as the original EA are also available on the DOE website at http://www.netl.doe.gov/publications/others/nepa/ea.html.

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ACRONYMS

Acronym	Definition
BTU/hr*ft^2	British thermal units per hour per square foot
CAER	Center for Applied Energy Research
CBTL	coal-biomass to liquid
CEQ	Council on Environmental Quality
CFA	Coal Fuel Alliance
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CO_2-eq	carbon dioxide-equivalent
CTL	coal-to-liquid
DOE	U.S. Department of Energy
EA	Environmental Assessment
EHS	Environmental Health and Safety
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
FT	Fischer-Tropsch
GHG	greenhouse gases
H_2S	hydrogen sulfide
KDAQ	Kentucky Department of Environmental Protection Division for Air Quality
LFUCG	Lexington-Fayette Urban County Government
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Administration
PDU	Process Development Unit
RMP	Risk Management Program
SBCR	Slurry Bubble Column Reactor
SEA	Supplemental Environmental Assessment
syngas	synthesis gas
TSDF	treatment, storage, and disposal facility
UK	University of Kentucky
U.S.	United States
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WHPP	Wellhead Protection Program

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1.0 INTRODUCTION

The United States (U.S.) Department of Energy (DOE) National Energy Technology Laboratory (NETL) prepared this Supplemental Environmental Assessment (SEA) to analyze the potential environmental impacts of partially funding a proposed small-scale pilot plant for the gasification of coal and coal-biomass blends and conversion of derived synthesis gas (syngas) to liquid fuels via Fischer-Tropsch (FT) synthesis, also referred to as the FT Process Development Unit (PDU) Facility or FT PDU Facility. The facility would be located at the existing University of Kentucky (UK) Center for Applied Energy Research (CAER) park near Lexington, Kentucky.

In accordance with DOE and National Environmental Policy Act (NEPA) implementing regulations, DOE is required to evaluate the potential environmental impacts of any proposed federal action that has the potential to cause impacts.

In 2009, DOE issued an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the *Design and Construction of an Early Lead Mini Fischer-Tropsch Refinery at the University of Kentucky Center for Applied Energy Research, near Lexington, Kentucky* (DOE/EA-1642) (DOE 2009). In 2010, DOE issued a Supplemental Analysis to enlarge the footprint and slightly change the location of the facility. The proposed project evaluated in this SEA involves revising the original project to incorporate changes in the syngas production; changing from a natural gas auto-thermal reactor to a system with coal gasification for the supply of syngas.

The proposed project maintains the plant configuration for all the downstream process units evaluated in the original EA (water-gas shift, FT synthesis, fluid catalytic cracking, hydrocracking, dehydrogenation, and alkylation) and would be implemented in areas that were analyzed in the 2009 EA and 2010 Supplemental Analysis. Thus, the 2009 EA/FONSI and 2010 Supplemental Analysis are incorporated in their entirety into this SEA by reference, and to the fullest extent possible, this SEA tiers off the descriptions of the affected environment and the potential environmental impact assessments presented in the original EA and Supplemental Analysis.

1.1 Background

Section 417 of the Energy Policy Act of 2005 authorized DOE to carry out a program to evaluate the commercial and technical viability of advanced technologies for the production of transportation fuels manufactured from Illinois basin coal using the FT process. The FT process is an indirect process for converting coal-to-liquid (CTL) fuels. The process was discovered by German scientists in the early part of the 20th century and was used extensively to make fuels during World War II. The FT reaction involves the use of catalysts, substances that change the rate at which a chemical reaction takes place but are not being chemically changed in the reactions. The catalysts commonly used in the FT process are iron or cobalt.

Congress also authorized DOE to enter into agreements for capital modifications and construction of new facilities at the Southern Illinois University Coal Research Center, the UK CAER, and the Energy Center at Purdue University. The universities subsequently entered into a Memorandum of Understanding with each other to form the Coal Fuel Alliance (CFA) to support complementary and joint research focusing on applied and developmental needs for CTL fuels.

During its planning, the CFA identified one early lead foundational capability that was critically needed to support the other universities; that being, the development of a "Mini FT Refinery" to be constructed at UK CAER. In 2009, after required NEPA review (DOE 2009), DOE approved the proposed Mini FT Refinery, considered to be the "workhorse" of the CFA and is intended to produce research quantities of FT liquids and finished fuels for subsequent testing by the other universities; for example, in Purdue's extensive engine test stands sponsored by Rolls Royce, Caterpillar, and Cummins Engines.

1.2 Purpose and Need for Department of Energy Action

DOE's proposed action, providing incremental funding to complete the design, construction, and operation of the FT PDU Facility, serves the purpose of accelerating the availability of transportation fuels derived from coal and coal-biomass blends. The use of such fuels would lessen the U.S. dependence on imported oil and reduce carbon dioxide (CO_2) emissions from the transportation sector. Through the proposed action, DOE NETL would continue research, development, and demonstration of coal-biomass to liquid (CBTL) fuels with the objective of reducing costs and improving the performance of these fuels, along with investigating the costs and process impacts of CO_2 control.

On an on-going basis, the facility is intended to produce research quantities of FT liquids and finished fuels for subsequent testing. The research associated with the facility is expected to be a key benefit, which can be used as test beds for new technologies and concepts at a level of expenditure that is affordable. It would provide open-access facilities and information in the public domain to aid the wider scientific and industrial community, and a means to independently review vendor claims and validate fuel performance and quality.

With respect to on-going research, environmental considerations, particularly how to manage and reduce CO_2 emissions from CBTL facilities and from use of the fuels, would be a primary research objective. In addition, research at this new CBTL facility would focus on the following technical areas: feed preparation, characteristics and quality; coal and biomass gasification; gas cleanup/conditioning; gas conversion by FT synthesis; product work-up and refining; systems analysis and integration; and scale-up and demonstration.

1.3 National Environmental Policy Act and Related Procedures

DOE prepared this SEA in accordance with NEPA, as amended (42 United States Code [USC] 4321), the President’s Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and DOE’s implementing procedures for compliance with NEPA (10 CFR 1021). This statute and the implementing regulations require that DOE, as a federal agency:

- assess the environmental impacts of its proposed action;
- identify any adverse environmental effects that cannot be avoided, should the proposed action be implemented;
- evaluate alternatives to the proposed action, including a no action alternative; and
- describe the cumulative impacts of the proposed action together with other past, present, and reasonably foreseeable future actions.

These provisions must be addressed before a final decision is made to proceed with any proposed federal action that has the potential to cause impacts to the natural or human environment, including providing federal funding to a project. This SEA is intended to meet DOE’s regulatory requirements under NEPA and provide DOE with the information needed to make an informed decision about providing financial assistance.

In accordance with the above regulations, this SEA allows for public input into the federal decision-making process; provides federal decision-makers with an understanding of potential environmental effects of their decisions before making these decisions; and documents the NEPA process.

1.4 Agency Coordination

Coordination with the Kentucky Heritage Council/State Historic Preservation Office was initiated per requirements of Section 106 of the National Historic Preservation Act. A response from the Kentucky Heritage Council was received on November 4, 2013 stating that no effect to historic properties would result from the proposed project. Copies of the agency response letters are included in Appendix A1 of this SEA.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Department of Energy's Proposed Action

DOE proposes, through a cooperative agreement with UK CAER, to complete the construction and establishment of a small-scale pilot plant for research related to gasification of coal and coal-biomass blends and conversion of derived syngas to liquid fuels via FT synthesis. Previously, under the terms of a different cooperative agreement, DOE provided funding for the project in support of planning, preliminary design, and construction of a new building to house the small-scale pilot plant. To support DOE's decision to grant the previous amount of co-funding, UK and DOE prepared and issued an EA/FONSI (DOE 2009) and Supplemental Analysis (DOE 2010). This EA/FONSI and Supplemental Analysis expressly covered only the first phase of the project and lacked coverage of the breadth of processes, equipment, feed and waste streams, accident scenarios, and safety issues. Based on continued project planning and design work under a new cooperative agreement, UK and DOE now intend to amend the existing EA to cover the remainder of the project. The facility would be located at the UK CAER north of Lexington in Fayette County, Kentucky. If approved, DOE would provide an additional $1.3 million in co-funding from NETL's Coal and Coal-Biomass to Liquids and Gasification Systems Programs (under DOE's Coal Program) to pay for additional equipment and further design work.

2.2 No Action Alternative

Under the no action alternative, DOE would not provide funding for the proposed action. For the purposes of this SEA, it is assumed that the no action alternative means the upstream process for gasification of coal and coal-biomass blends would not be constructed nor operated at CAER, and thus there would be no impacts to the human or natural environment. If DOE funding is not provided, it is possible that CFA would secure funding from non-federal sources and proceed with the project either as currently planned or with some reduction in scope. Project cancellation would mean that the dedicated research facility would not be available to provide the desired research results that would accelerate the development of CBTL fuels for transportation and the deployment of infrastructure to make these fuels. This would most likely result in the continued use of fuels derived for petroleum as the primary transportation fuel used in the U.S.

2.3 University of Kentucky's Proposed Project

The UK proposes to continue the previously initiated project under a cooperative agreement with DOE to complete the design of a mini FT PDU Facility at CAER. The original project scope and design were analyzed in the 2009 EA (DOE 2009), as discussed in Section 1.0. The original project involved the reformation of natural gas into liquid fuels. The current design, which is the topic of this SEA, would involve the redesigned "upstream" equipment and processes to produce syngas onsite from coal and coal-biomass blends to replace the natural gas component of the original design. The current design would replace the steam methane reformer (proposed in the original EA) with a small coal-fueled gasifier and acid gas cleanup system. The change to coal gasification and acid gas cleanup technologies was made at the request of DOE, so as to provide true/real syngas from coal and true/real coal-derived liquids and fuels for research and development purposes. The interest is in bringing these technologies to maturation, as opposed to relatively proven natural gas reforming/methanation processes.

The proposed action for this SEA encompasses the design, construction, and operation of the "upstream" components of the FT PDU Facility, specifically, the coal handling, gasification, and acid gas cleanup components. The proposed project would involve the construction of associated equipment platforms, installation of coal handling, gasification, and acid gas cleanup equipment at the existing PDU building, and operation of the FT PDU Facility at UK CAER.

The updated design does not involve changes in what is referred to herein as the "downstream" units and processes, including the water-gas shift, FT synthesis, fluid catalytic cracking, hydrocracking, dehydrogenation, and alkylation; which were analyzed in the original EA.

The facility is sized as a small-scale pilot CBTL plant that would produce research quantities of FT liquid fuels at a rate of approximately 8 barrels per run. Operation of the FT PDU Facility involves the following research objectives:

- Compare the composition of FT liquid fuels produced from coal-derived syngas with those produced from syngas derived from a coal-biomass mixture, whereby biomass in the amount of up to 10 percent (torrefied basis) would be added to the pulverized coal.
- Address the environmental considerations such as how to manage and reduce CO_2 emissions from CBTL facilities and from use of the fuels.
- Assess the economics of the process to compare the cost of adding biomass to coal for the purpose of limiting net CO_2 emissions to the environment.
- Investigate feed handling and preparation, with an emphasis on torrified biomass.
- Supply DOE with at least a 1-liter sample of the liquid fuels produced from the process.

The facility would provide open-access facilities and information in the public domain to aid the wider scientific and industrial community in testing and evaluating the commercial viability of FT technology. These facilities would provide a means to independently review vendor claims and validate fuel performance and quality.

2.3.1 Location

The project site would be located within the UK's existing 125-acre research park near Lexington, Kentucky. The research park includes CAER's Laboratory No. 1 and 2, along with associated buildings, and facilities for the Asphalt Institute, Council of State Governments, the Kentucky Geological Survey, and the Ky-Argonne Battery Manufacturing Research and Development Center. The equipment for the proposed action would be installed outside and inside the existing approximately 6,000-square foot FT PDU building located adjacent to CAER's Laboratory 1 as shown in Figure 1. The PDU building was constructed in 2012 after completion of the NEPA process for the original EA (DOE 2009) and the Supplemental Analysis (DOE 2010). The PDU building is currently empty, and will house the upstream and downstream components of the FT PDU Facility.

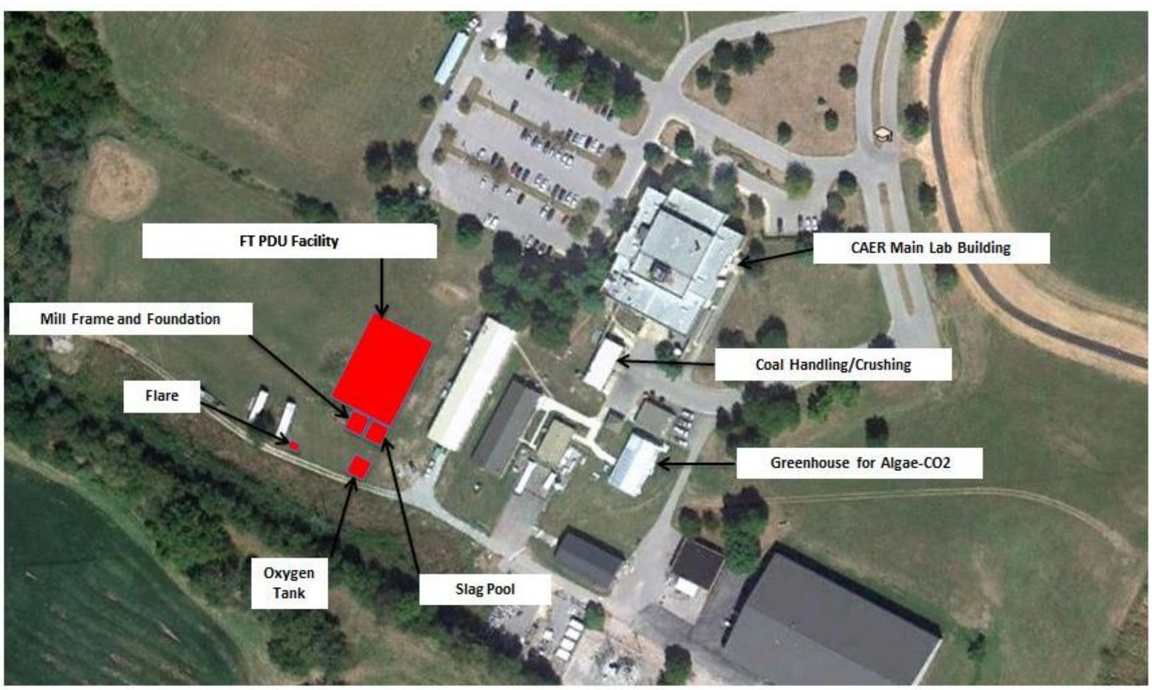

Figure 1. Location of FT PDU Facility at UK CAER

2.3.2 General Description of Technology

The CBTL process of the FT PDU Facility would involve upstream and downstream processing units. Figure 2 depicts a simplified block diagram of the major components of the CBTL process. The upstream components primarily consist of the syngas production and the downstream process involves the FT synthesis. The upstream syngas production process is the portion of the FT PDU Facility that was redesigned after publication of the original EA/FONSI (DOE 2009). The downstream FT synthesis processing units (i.e., balance of the process) was not redesigned and remains consistent with the analysis in the original EA.

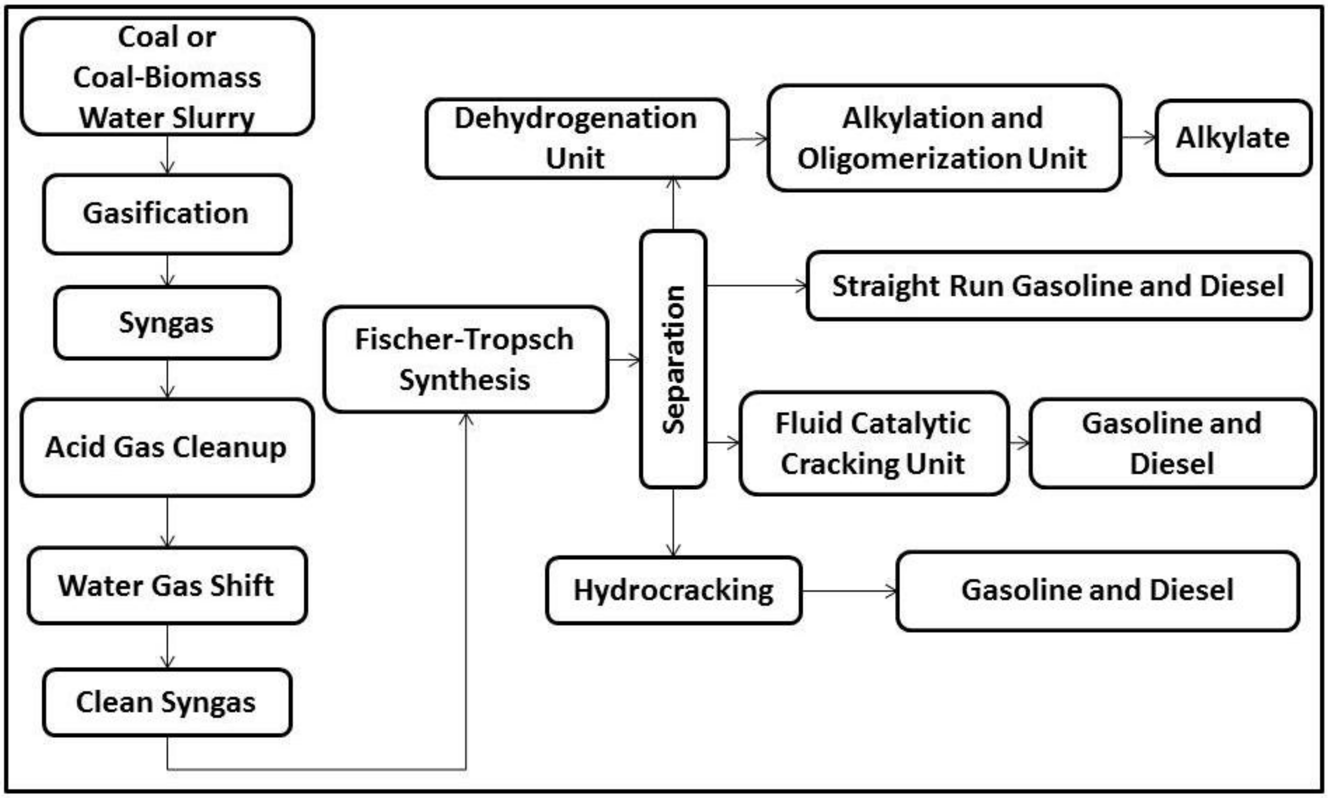

Figure 2. Simplified Block Flow Diagram of the CBTL Process

<u>Upstream Syngas Production</u>

In general, the CBTL process would involve coal or coal-biomass and water to create a coal water slurry that would enter the gasifier to be converted to a syngas. The syngas is then sent to the acid gas cleanup to remove all sulfur and a substantial amount of CO_2. The acid gas is then sent to the flare for disposal while the clean gas is sent downstream to the FT and other downstream fuel processing units (which were analyzed in the previous EA).

<u>Gasification</u>

The gasifier is made of stainless-steel and has two parts, which are the gasification chamber and quench chamber. The gasification chamber contains a refractory wall inside to reduce the heat loss. Oxygen and the coal water slurry are fed into the gasification chamber through four symmetric opposed dual-channel burners. Oxygen is fed through the outer channel of burners from the oxygen cylinder and measured by mass flow meters. The coal water slurry is fed through the inner channel of burners by slurry pumps. Syngas generated in the gasification chamber then goes down through the quench chamber and cooled with quench water from the slag pool. Slag and ash come out through the quench chamber and are then caught in the slag pool and collected regularly. Syngas from the gasifier would be further cleaned in the water scrubber to remove the last particulates and is then sent to the acid gas cleanup section.

Acid Gas Cleanup

The acid gas cleanup system using an aqueous amine solution would remove most of the CO_2 and sulfur compounds from the syngas. The clean gas would then be passed on to the FT process in order to produce fuel products. It is important to remove these compounds prior to the downstream FT process because they can damage the FT catalysts and also reduce efficiency of the FT unit.

Typical amine scrubbing processes include an absorber unit and a regenerator (also called stripper) unit as well as some auxiliary equipment. In the absorber column, the down flowing amine solvent absorbs hydrogen sulfide (H_2S) and CO_2 from the up flowing syngas to produce a clean gas stream. The resultant amine solution leaving the absorber is referred to as “rich” due to containing all the absorbed gases (mainly CO_2 and H_2S). This rich solution is sent to the stripper in order to regenerate the solvent so that it can be reused. However, the gas relinquished by the amine solvent in the stripper is a concentrated stream consisting of mostly CO_2 and H_2S.The amine scrubbing process employed at the UK CAER, while similar to the typical amine scrubbing system described above, also includes some notable enhancements. These enhancements include mainly the fixed bed sulfur polishers on both stream outlets to further clean the gas streams, advanced amine solvent for improved capture, and heat exchangers for energy recovery. The coal-derived syngas enters the absorber tower where most of the CO_2 and H_2S are removed using the aqueous amine solvent. The treated syngas leaving the top of the absorber is then sent to an hydrolysis reactor where carbonyl sulfide is converted to H_2S and then the H_2S is subsequently removed by a fixed bed polisher. Finally, clean syngas is then sent downstream for processing into a fuel product. Meanwhile, the rich solvent from the absorber is sent to the stripper where the acid gas is liberated and the solvent is also regenerated. The acid gas vents out to a sulfur polishing unit and then is sent to the flare. The lean solvent regenerated in the stripper is sent back to the absorber where the cycle begins again.

Downstream FT Synthesis

Downstream processing units that were analyzed in the original EA include the water-gas shift, FT synthesis, fluid catalytic cracking, hydrocracking, dehydrogenation, and alkylation. The FT synthesis would occur in a slurry bubble column reactor (SBCR) containing iron or cobalt catalysts. The SBCR would convert the syngas into FT liquids and off gases. The SBCR would be small, measuring approximately 5 inches in diameter with a height of approximately 12.5 feet. The expected yield of FT liquids is approximately 5 grams of hydrocarbon per gram of catalyst per hour. The SBCR would be designed to operate continuously producing approximately 1 barrel of hydrocarbons per day. Because of the research nature of the intended operations, CAER anticipates operating the SBCR about four times per year for a duration of about one month each time. CAER researchers anticipate that the SBCR would run continuously during the process runs for periods not expected to exceed 20 consecutive days. The remaining time during a one-month test would be used for start-up, shutdown, and maintenance, and would include changing out the catalyst in the SBCR. Other processes would operate in a batch mode.

2.3.3 Construction

The proposed action would involve construction of additional concrete pads and the erection of framework for the equipment. The small concrete pads would be constructed for the following:

- Coal hopper/grinder [11 feet, 6 inches by 18 feet, 6 inches],
- Slag Pool [9 feet, 0 inches by 19 feet, 6 inches], and
- Oxygen Tank [13 feet, 0 inches by 18 feet, 0 inches with a 12 foot by 12 foot spill pad]

The flare is designed to be self-supported, but if necessary, a small pad (2 feet x 2 feet) could be incorporated during construction. Construction activities and laydown would take place within the approximately 0.5-acre footprint utilized for construction of the PDU building in 2012 and evaluated in the original NEPA analysis (DOE 2009 and DOE 2010). Construction would only occur during normal business hours and is anticipated to last approximately 3 to 4 weeks for construction of the concrete pads and framework for equipment. Approximately 15 to 20 construction workers would be needed for drivers, equipment operators, and skilled trades. Construction traffic would include approximately 1 to 3 truck trips per day. Additional construction activities would occur for unloading and rigging of equipment, but would be handled by UK staff members and would not require heavy duty equipment.

2.3.4 Operations

Operation of the FT PDU Facility (including the upstream component analyzed herein) would involve 4 runs per year with a maximum of 30 days per run. The facility would operate continuously (i.e., 24 hours, 7 days per week) during each 30-day run. Delivery of process input materials (i.e., coal, oxygen, catalyst, and solvents) would occur before each run and result in approximately 4 trucks per run. Waste removal would require 1 pickup every over run which would align with the normal non-hazardous waste pickup schedule at UK CAER. Each continuous run campaign would require approximately 12 new employees including 1 engineer and 2 technicians per 8-hour shift with 4 shifts (to accommodate some reasonable alternating leave time for shift personnel on evenings and weekends).

Operational activities associated with the cooperative agreement with DOE are limited to the following:

- A planned shakedown and commissioning period of the individual unit process and equipment (e.g., gasifier, acid gas cleanup) of 9 to 12 months.
- Two integrated and continuous process runs of 30-days duration of the entire upstream syngas production units (e.g., gasifier, acid gas cleanup) and downstream units for water-gas shift, FT synthesis, and hydrocracking are planned for the last 9 to 12 months of the project.

Operation of the FT PDU Facility would have the capability to produce approximately 1 barrel per day of mixed hydrocarbon fuels and feed stocks ranging from diesel, gasoline, naptha, waxes, and light gases, depending on the upgrading processes employed downstream. However, UK's operation contemplates production and recovery mainly of the diesel fraction, and accounting for startup, shutdown, and approximately 20 days of actual runtime, the FT PDU Facility is anticipated to produce a maximum of 8 barrels of diesel per run.

Each barrel would equate to a standard 55 gallon drum. The barrels would be stored on spill plates or in a diked area to prevent accidental releases of product. The barrels would be transported to researchers at Purdue University and Southern Illinois University for testing. Transport of the barrels would be provided by approved carriers that meet all regulatory requirements. Additionally, a minimum of a 1-liter sample would be supplied to DOE for applicable research. It is anticipated that the facility would operate under the UK CAER's existing operating permits as a small quantity hazardous waste generator, minor source of air emissions, and under the existing solid waste disposal permits. CAER has a long and established track record (over 30 years) of operating similar equipment and technologies at bench, pilot, and slip-stream scales, ranging from facilities for coal cleaning, combustion, gas cleanup and emissions control, fuels and chemicals, ash management, advanced carbon materials and biomass. The change to gasification and acid gas removal does not represent new technologies and operations for CAER.

2.4 Alternatives Considered

The proposed action and the no action alternative are the only alternatives specifically addressed in this SEA. The proposed action alternative is to implement the proposed project detailed in Sections 2.1 and 2.3. However, as discussed in the previous EA (DOE 2009), DOE considered an upstream plant configuration with a natural gas auto-thermal reactor. The change in upstream design was made at the request of DOE, in order to provide a true syngas from coal to produce true/real coal-derived liquids and fuels for research and development purposes and to fulfill the objectives outlined in Section 2.3. In addition, a previous alternative was considered and discussed in the prior EA (DOE 2009). The alternative involved the possibility of providing syngas (hydrogen and carbon monoxide) via standard commercial gas suppliers or tube trailers. This alternative was dismissed since it would involve extensive truck travel for refills.

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3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter of the SEA evaluates the potential environmental impacts associated with the updated project design since the completion of the existing NEPA documents (DOE 2009 and DOE 2010). See Section 1.0 for details about the existing NEPA documents and Section 2.3 for details about the design change.

Table 1 presents the characteristics of the existing environment that essentially remain unchanged since the 2009 EA and the 2010 Supplemental Analysis and reiterates or summarizes the descriptions found in those earlier EAs. For these resources, the anticipated impacts from the proposed action are generally bounded by the impacts reported in the existing NEPA documents and are therefore screened from further analysis in this SEA. The resource areas where impacts from the proposed action may not be adequately bounded by or fully discussed in the original NEPA documents, are analyzed in more detail in Section 3.2.

Table 1. Technical Resource Areas Screened from Further Analysis

Technical Area	Rationale
Aesthetics	The proposed project would be located within and adjacent to the existing PDU building at the UK CAER research park. The PDU building was constructed in 2012 and is consistent with the visual characteristics of the existing infrastructure at the research park, which is primarily research and laboratory facilities and corporate offices. There are no aesthetically sensitive areas within the viewshed of the FT PDU Facility; therefore, no impacts to visual and aesthetic resources are anticipated, and this resource was not analyzed further.
Biological Resources (vegetation, wildlife, threatened and endangered species)	The description of biological resources presented in the 2009 EA remains current and is summarized below. Refer to Section 3.4 and 4.4 of the original EA for the detailed analysis (DOE 2009). The proposed project site is located in the Broadleaved Forests, Continental Province within the Hot Continental Division of the Humid Temperate Domain, which is dominated by broadleaf deciduous forest and oak-hickory forest. Such forests provide an abundant food source for wildlife, which is detailed in Section 3.4.2 of the original EA (DOE 2009). Construction of the concrete pads and equipment framework for the proposed project would utilize the same construction footprint analyzed in the original EA (DOE 2009). The land within the construction footprint was previously developed for existing UK CAER operations and used during construction of the PDU building in 2012. Some loss of grass (lawn) may occur but no impacts to vegetation and wildlife are anticipated. The U.S. Fish and Wildlife Service (USFWS) identified four federally-listed endangered species in Fayette County. Consultation with the USFWS for the original EA determined that impacts to federally-listed threatened, endangered, or candidate species are not anticipated. Since the proposed project would not involve land outside of the footprint analyzed in the original EA, the determination of negligible impacts remains unchanged, and this resource was not analyzed further. Results of the consultation are in Appendix A of the original EA (DOE 2009).
Community Services	No effects to community services are expected to occur due to the proposed action. There would be a temporary increase of construction workers during the construction period; however, this increase is temporary and negligible, and would not affect community services such as law enforcement, fire protection, medical care, schools, family support services, shopping, or recreation facilities. Operation of the FT PDU Facility would require 12 new employees, which could cause a slight increase in demand for community services. The public service infrastructure of the region could adequately handle the marginal increase in population due to the project. The local emergency services, healthcare services, and school systems are not expected to be impacted since the demand would not exceed available capacity of existing services. Since negligible impacts are anticipated, this resource was not analyzed further.
Cultural Resources	The changes in project design would remain within the scope of analysis performed in the original EA. A summary of the affected environment and potential impacts are provided below. Refer to Sections 3.1 and 4.1 of the original EA for the detailed analysis (DOE 2009). The currently proposed project would not exceed the approximately 0.5-acre construction footprint analyzed in the original EA. Analysis in the original EA determined that no historical sites, federal or state historic places, or Native American reservations occur within the project area. Additionally, no impacts would occur to nearby potentially significant properties. Nearby significant properties include Hurricane Hall which is a National Register of Historic Places (NRHP) property located approximately 7,000 feet west of the project site and Spindletop Hall, located approximately 2,000 feet southeast of the proposed project, which may be eligible for future listing on the NRHP. Consultation with the Kentucky Heritage Council (i.e., State Historic Preservation Office) for the original EA determined that archeological sites are known to exist in proximity to the project site but no known or suspected archeological sites are within the project footprint (see Appendix A-1 of the original EA, DOE 2009). Since construction of the updated design and currently proposed

Technical Area	Rationale
	project would not extend beyond the approximately 0.5-acre footprint analyzed in the original EA, no impacts to cultural resources are anticipated, and this resource was not analyzed further. Additionally, communication with the Kentucky Heritage Council regarding the currently proposed project was initiated on October 22, 2013. A response was received on November 4, 2013, which stated that the Kentucky Heritage Council determined that the newly proposed project would result in no effect to historic properties; therefore, no further consultation would be required.
Geography, Topography, and Soils	The changes in project design would remain within the scope of analysis performed in the original EA. A summary of the affected environment and potential impacts are provided below. Refer to Sections 3.1 and 4.1 of the original EA for the detailed analysis (DOE 2009). The project area lies within the Inner Blue Grass Physiographic Region of Kentucky in the northern part of Fayette County. The Inner Blue Grass Region is characterized by gently rolling hills and rich, fertile soils. These features are underlain by deep thick-bedded limestone formations. The fertile soils in the area result from the phosphate minerals (e.g., apatite) contained in the Ordovician limestones (DOE 2009). The project site is located in an area dominated by deep well-drained soils of the Maury series, typical to the Inner Blue Grass Region of Kentucky. The proposed action would occur on land that has been previously disturbed. The concrete pads and coal-handling equipment would be located on adjacent property to the existing PDU building but would remain within the approximately 0.5-acre construction footprint analyzed in the original EA (DOE 2009). Construction laydown areas for the proposed project would also remain within the previously analyzed construction footprint. No impacts to the geologic and soil resources are anticipated, and therefore, this resource was not analyzed further.
Land Use	The proposed project would not affect land use planning or zoning. The proposed project would be located at the recently constructed PDU building within the existing UK research park. The approximately 6,000-square foot PDU building was constructed in 2012 after NEPA review (DOE 2009). For the proposed project, additional parcels of land outside of the existing PDU building would be required for concrete pads and coal-handling equipment, but all project areas are within the approximately 0.5-acre project footprint analyzed in the original EA (DOE 2009). The 0.5-acre project site is within the existing 125-acre research park, which is designated for university research facilities. Adjacent property to the research park includes a portion of the Lexington Legacy Trail, which is a greenway bike and walking trail that connects downtown Lexington with area neighborhoods, parks, and historic sites as it follows a northward course to the Kentucky Horse Park. The proposed project would not diminish current or future uses of this land used for recreation. No changes to land use or land use designations would result from implementing the proposed project, and therefore, this resource was not analyzed further.
Noise	Construction activities would produce noise associated with excavation and grading, pouring of footers and slabs, installation of structural elements, and assembly of pre-fabricated materials. These activities would be consistent with normal light construction and would be conducted during normal business hours. Operational noise would result from transportation for delivery and product pick-up, which are similar to existing site activities and would occur at ground level where propagation offsite would not be expected to occur. The closest residence to the proposed site is located in Spindletop Estates approximately 2,000 feet to the west-northwest. At this distance, due to natural noise attenuation (reduction), construction or operational noise from the project would be indiscernible from existing ambient noise levels. Because noise impacts would minor to negligible, this resource was not analyzed further.
Socioeconomics (economy, population, housing, employment, Protection of Children, Environmental Justice)	Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly population and economic activity. The changes in project design would remain within the scope of analysis in regard to socioeconomics as performed in the original EA. A summary of the affected environment and potential impacts are provided below. Refer to Sections 3.8 and 4.8 of the original EA for the detailed analysis (DOE 2009). Local population has increased since the analysis was conducted for the original EA. The total population of Fayette County as of the 2010 Census was 295,803 (Census 2013). Construction of the currently proposed project would result in similar impacts described in the original EA (DOE 2009). Since only a small amount of construction workers would be required (approximately 15 to 20) over 3 to 4 weeks, short-term, negligible impacts to socioeconomics would occur. Operation of the proposed FT PDU Facility would require an additional 12 permanent employees and could thus result in a minor beneficial impact to the socioeconomics of the region. Further, research conducted under the proposed project could result in successful advancement of FT technology, expedite the commercial availability of this technology, and contribute to the development of a sustainable coal synfuels program in Kentucky. Because the proposed project would not result in adverse impacts to socioeconomics, this resource was not analyzed further.

Technical Area	Rationale
Transportation and Parking	The proposed project would result in increased truck traffic due to approximately 1 to 3 deliveries per day during construction. Operations would require approximately 4 truck deliveries of input materials per run and 1 pickup every other run for removal of non-hazardous wastes. Additionally, researchers from Purdue and Southern Illinois Universities would pickup research quantities of the FT fuel for testing. This would result in only a few additional trucks accessing the site per month. Transport would be via approved carriers meeting Department of Transportation requirements for placards, safety systems, etc. The addition of 12 new operational workers would not require new parking spots or result in a significant increase in local traffic. Impacts to local traffic patterns or transportation routes are not anticipated, and this resource was not analyzed further.

3.1 No Action Alternative

As discussed in Section 2.2, it is assumed that the no action alternative means the upstream process for gasification of coal and coal-biomass blends would not be constructed nor operated at CAER, and thus there would be no impacts to the human or natural environment.

3.2 Proposed Action

Section 3.2 includes impact analyses for the environmental resource areas carried through for further consideration. The resource areas that are analyzed further include air quality, water resources, human health and safety, and materials and wastes.

This section includes descriptions of the affected environments and any changes since release of the original EA. This section analyzes the impacts from construction and operation of the new proposed upstream components, in addition to collective potential impacts associated with the complete system, involving both the updated upstream syngas production design and the unchanged downstream processing units as addressed in the original EA.

As discussed in Section 1.0, an EA/FONSI and a Supplemental Analysis were published in 2009 and 2010, respectively, and are incorporated in their entirety into this SEA by reference. To the fullest extent possible, this SEA tiers off the descriptions of the affected environment and the potential environmental impact assessments presented in the original EA and Supplemental Analysis.

3.2.1 Air Quality and Greenhouse Gas

Existing Environment

The U.S. Environmental Protection Agency (USEPA) Region 4 and the Kentucky Department of Environmental Protection Division for Air Quality (KDAQ) regulate air quality in the Commonwealth of Kentucky. Detailed descriptions of the existing air quality at the CAER facility are provided in the original EA (Section 3.3; DOE 2009). These descriptions address the national ambient air quality standards (USEPA 2013) and the Kentucky ambient air quality standards (KAR 2013a) (Section 3.3.1); class I and II areas (Section 3.3.2); local ambient air quality (Section 3.3.3); regional emissions (Section 3.3.4); and greenhouse gases (GHGs) and global warming (Section 3.3.5). These descriptions remain generally current and are summarized or updated below.

The national and state air quality standards set upper concentration limits for six air pollutants called the criteria pollutants. The criteria pollutants include carbon monoxide, nitrogen oxides, ozone, particulate matter, sulfur dioxide, and lead. The particulate matter is further subdivided into classifications called fine particulate matter (solid particles and liquid droplets that have an aerodynamic diameter of 2.5 microns or smaller), and coarse particulate matter (solid particles and liquid droplets that have an aerodynamic diameter of 10 microns for smaller). When the ambient air of a region meets these standards, it is referred to as being in attainment. The location of the proposed CBTL facility at the UK CAER lies entirely within the Bluegrass Intrastate Air Quality Control Region, which is in attainment for all criteria pollutants as designated by the USEPA and KDAQ. The closest designated Class I area is Mammoth Cave National Park, located 108.2 miles away.

The CAER campus has numerous stationary sources of air emissions, including: boilers, water heaters, generators, and various laboratory and research project facilities. This section of the SEA, analyzes the air quality impacts of the proposed coal gasification and acid gas cleanup technologies, including the construction activities as well as the stationary sources of air emissions during operations.

Impacts of Proposed Action

Construction would cause a temporary increase in emissions of criteria pollutants from off-road construction equipment exhaust used to build the three concrete pads, erect the framework, and install the equipment for the proposed upstream coal gasification and acid gas cleanup components of the FT PDU Facility. Construction activities for the pads would involve some excavation and grading that would generate localized intermittent fugitive dust emissions from the disturbed soils. UK's contractors would be required to take measures to control fugitive dust during construction. Given the small footprint of the newly proposed infrastructures, the proximity to paved roads, and the anticipated short duration of the construction, potential impacts would be temporary, minor, and localized to the immediate project area.

Operation of the FT PDU Facility would result in a minor impact to air quality due to emissions from the processing of coal and biomass into liquid fuels. The estimated emissions that are new to the facility design as a result of the proposed gasification and acid gas cleanup processes are nitrogen and CO_2 as discussed in the following bullet list.

- *Nitrogen* is non-hazardous and used as a purging gas. It would be produced on demand from a nitrogen generator. Nitrogen would be used to protect the flame monitoring system when the system is running. During shutdown, it would be used to clear out all other gases in the gasifier for a safe shutdown. Afterward, the nitrogen would be sent to the flare along with the other vented gases.
- *Carbon dioxide* is non-hazardous and would be generated as a product of the gasification process. It would be removed from the syngas in the amine scrubbing process (in the absorber) and then liberated from the amine solvent in the regenerator, and finally sent to the flare along with the other vented gases.

Table 2 presents the estimated emissions of nitrogen and CO_2 from the proposed processes. The *maximum* levels listed in the table include emissions during startup and shutdown modes, when the entire output of the gasifier would be sent to the flare until downstream units can be safely brought on stream or taken off-line during shutdown. Additionally, in the event of an emergency, all airborne combustion products would be sent to the flare. *Normal* levels listed in the table refer to the emissions of CO_2 emitted during conventional production runs when the output of the gasifier is sent to downstream units. The make of fuels and feed stocks in these downstream production units reduces the make and emissions of CO_2 when running on a *normal* basis.

Table 2. Estimated Emissions from Coal Gasification and Acid Gas Cleanup Processes (Proposed Project Components)

Chemical	Emissions (pounds per hour)	Emissions (pounds per 30-day run)	Emissions (tons per year, 4 runs/yr)
Nitrogen (N_2)	5.5	3,967	7.9
Carbon Dioxide (CO_2) (maximum)[a]	98.1	70,632	141.3
Carbon Dioxide (CO_2) (normal)[b]	72	51,840	103.7

a. Maximum CO_2 emissions include emissions during startup and shutdown modes.
b. Normal CO_2 emissions include emissions during conventional production runs of good product fuel and feedstocks.

The CAER is presently classified as a minor air emissions source within the UK's Title V permit and is classified as not needing a separate air permit due to the small amount of emissions produced. The CAER, however, is presently required to register each emissions source and list each as a line item under the University's Title V permit. According to Kentucky Air Regulations, a permit is not required if the source's potential to emit is less than 25 tons per year for any non-hazardous regulated air pollutant, and less than 2 tons per year of combined hazardous air pollutants (KAR 2013b). The operation of this facility - has the potential to cause the emissions of CO_2 for the CAER to exceed the non-hazardous regulated air pollutant threshold identified above. Therefore, after consultation with both the UK Environmental Health and Safety (EHS) officials and personnel of the state air quality agency, CAER will likely require a new air quality permit separate from UK's Title V permit, and if required and considering future research purposes of the facility, will seek to permit the entire output/volume of the gasifer and downstream units. This SEA will be distributed for review to the state air quality agency (and others), which will identify permit requirements for the proposed facility and for which UK and CAER will obtain as necessary to operate the facility.

Greenhouse Gases and Climate Change

The proposed project is not expected to emit discernible quantities of GHGs. Table 3 presents the total amount of CO_2-equivalent (CO_2-eq) generated by the new upstream gasification and acid cleanup components. CO_2-equivalent is a quantity that describes, for a given mixture and amount of GHG, the amount of CO_2 that would have the same global warming potential for the given period of time. Global-warming potential is a relative measure of how much heat a GHG traps in the atmosphere. The total amount of CO_2-eq released to the atmosphere per year from this FT PDU Facility (as shown in Table 3) would not result in exceedances of any current or proposed federal or state regulation.

Table 3. Greenhouse Gas Emissions from Fischer-Tropsch Process Development Unit Facility

Greenhouse Gases	Emissions (tons per year)	Global Warming Potential[a]	Emissions in CO_2-eq (tons per year)
Coal Gasification and Acid Cleanup Processes (see Table 2)			
Carbon Dioxide (CO_2) (maximum)[b]	141.3	1	141.3

a. 40 CFR 98
b. As presented in Table 2 above. Includes emissions during startup and shutdown modes.
CFR = Code of Federal Regulations; CO_2-eq = carbon dioxide-equivalent

Because climate change is considered a cumulative global phenomenon, it is generally accepted that any successful strategy to address climate change must rest on a global approach to controlling GHG emissions. Current scientific methods do not enable an evaluation of the relationship of increases or reductions in GHG emissions from a specific source to a particular change in either local or global climate. Thus, the potential impact of the proposed project on climate change is discussed in Section 3.2.5, Cumulative Impacts.

3.2.2 Water Resources

Existing Environment

The description of water resources found in the original EA remains current and is summarized below.

Three surface waterbodies are located within 0.5 mile of the project site. These include two unnamed ponds and Cane Run. The two small unnamed ponds are manmade ponds which are located approximately 600 feet to the north and 1,380 feet to the west. The two ponds are identified as the closest wetlands to the proposed project site. Cane Run is an intermittent stream that is included on the 2009 State of Kentucky 303(d) list of impaired waterbodies. Cane Run is impaired for fecal coliform, nutrient/eutrophication biological indicators, and organic enrichment (sewage) biological indicators (USEPA 2010). The Kentucky Water Resources Research Institute developed total maximum daily loads for Cane Run released on July 26, 2013. The Base Flood Elevation for the 100-year floodplain associated with Cane Run is approximately 860 feet above sea level approximately 500 feet upstream and also 500 feet downstream from the site. Review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) confirmed that the project site is located adjacent to but outside of the 100-year floodplain (FEMA 2013). Additionally, product and waste storage is also outside of and adjacent to the 100-year floodplain.

Fayette County is in the Bluegrass Region where groundwater is hard to very hard and may contain salt or H_2S, which are the two most common natural constituents that make water in the Bluegrass Region objectionable for domestic use. The area around UK CAER is underlain by the groundwater basin for Royal Spring, which is a source of drinking water for the Georgetown Municipal Water and Sewer Service. The 1986 amendments to the Safe Drinking Water Act established requirements for states to develop a Wellhead Protection Program (WHPP) to protect drinking water wells and drinking water recharge areas. The USEPA approved Kentucky's WHPP in 1993 and the final WHPP for Royal Spring was prepared in 2003, which includes the project site. Other environmental stewardship measures for Royal Spring include the Lexington-Fayette County's Rural Service Area Land Management Plan, Special Plan Elements – Protection of the Royal Spring Aquifer. The plan identifies protection practices and guidelines for land use to prevent contamination of water supply wells and springs. Conservation planting and stream protection measures have been incorporated along Cane Run. Additionally, conservation improvements in the direct vicinity of the project site include a geo-thermal well field, bio-swales for control of runoff, tree and native vegetation plantings and other watershed improvements.

Impacts of the Proposed Action

Construction of the concrete pads and framework for equipment is not anticipated to result in impacts to water resources. Construction activities would have the potential to release liquids (e.g., oils and fuel) due to the increased presence and use of construction-related hazardous substances and wastes. Best management practices typical to small construction projects would be used to control the potential release of liquids to nearby waters (i.e., surface water runoff, groundwater pollution).

UK CAER anticipates the FT PDU Facility would generate approximately 8 barrels of diesel and 10 barrels of process water containing light hydrocarbons per run. The product would be stored onsite in 55-gallon barrels on spill pallets within an existing dedicated and secured storage area on the UK CAER property until transported to the other universities. The process water would be stored in 55-gallon barrels onsite in the hazardous waste accumulation area and disposed offsite at a certified hazardous waste treatment, storage, and disposal facility (TSDF).

Operation of the proposed project is not anticipated to result in discharges to Cane Run or other surface waters since equipment and process units are diked or bermed or otherwise include spill prevention countermeasures. The product storage area would be paved and diked and include spill pallets to prevent accidental releases of product from reaching adjacent surface waters. Other storage areas for coal drying, coal storage, waste storage, excess storage, etc. include similar spill prevention measures such as containment walls, concrete pads, diked areas, and spill pallets, as necessary. Although transport of materials and wastes between the storage areas and the FT PDU Facility would have the potential for spills, since the storage areas are relatively close to the FT PDU Facility, spills due to transport are anticipated to be rare and minimal.

Operation of the proposed project would have negligible impacts on water demand. Process and drinking water is provided by the private utility, Kentucky American Water Company, which has established water lines to UK CAER. Process water and cooling water would be used during operations. Process water would be used to cool and clean the high temperature syngas from the gasifier and process water would also be used in the slag pool. Cooling water would be used to cool the burner as well as the flame monitoring system. Water would feed into the cooling chambers and route to the drain, since cooling water would not contact process materials. Lexington's water utility has adequate infrastructure and recently expanded pumping stations and trunk lines.

> The **slag pool** would be used to separate slag and ash from the process water such that the water can be reused in the process. The approximately 4,400-gallon slag pool would be segmented into three sections. Each of the three sections allows for slag and ash to settle and separate from the water. The water gets progressively cleaner through each of the three sections, resulting in water that can be reused during the process. At the end of each run, water would be treated and sent to the drain while the slag and ash would be placed in drums for removal as non-hazardous waste.

Sanitary wastewater from UK CAER is discharged to the Kentucky Horse Park's Treatment Plant, which is permitted by the Lexington-Fayette Urban County Government (LFUCG) under Industrial User Permit, No. 0801-0401-00, encompassing the Horse Park and the Spindletop Research Park. The LFUCG Division of Water Quality, accompanied by personnel of the Kentucky Horse Park, conducted an Annual Pretreatment Inspection of the UK CAER's facilities on June 11, 2013. LFUCG found the UK CAER to be in compliance with pretreatment regulations and that best practical technology are being used to capture and recover pollutants of concern before discharge to the sanitary sewer system. Given the research proposed for the new facility mentioned above, which is similar in nature and scope as CAER's historic research programs, UK expects that this facility and CAER would continue to be in compliance with applicable pretreatment regulations. Additionally, the UK EHS, Environmental Management Department reviewed the anticipated wastewater discharge associated with the proposed project and confirmed that UK CAER would remain in compliance with the conditions of the Kentucky Horse Park permit (see Appendix A2). Furthermore, CAER's wastewater effluent is continuously monitored by local and state regulatory agencies by downstream water sampling equipment.

Since the proposed FT PDU Facility would produce bulk quantities of finished product that would be stored and transported, UK CAER would evaluate the potential need to prepare a Groundwater Protection Plan in accordance with 401 Kentucky Administrative Regulation 5:037. The plan would identify and document practices designed to minimize the potential for releasing product during storage and transport. Historically, previous projects within and around the project site did not require the preparation of a Groundwater Protection Plan, but UK CAER would evaluate the potential need for this proposed project.

No impacts are anticipated for the two nearby wetlands since runoff from the proposed site should not flow in their direction. Since the proposed project site and associated product storage is located outside of the 100-year floodplain, no impacts to the Cane Run floodplain are anticipated.

3.2.3 Human Health and Safety

Existing Environment

The description of human health and safety protocols discussed in the original EA remains current and is summarized below.

Primary concerns to human health and safety for current activities at the CAER include exposure of personnel to chemicals in use at the facility and exposure to high temperatures and pressures. Activities at the CAER are conducted under the auspices of the UK EHS Office. UK has a fully compliant EHS program that includes a chemical hygiene program to protect lab personnel from accidental exposure to lab chemicals and other hazardous substances, such as industrial gases.

Impacts of the Proposed Action

Primary concerns to human health and safety would include accidental exposure to chemicals stored onsite; accidental injuries during construction and operation; exposure to air pollutants and noise levels that would be harmful to humans; and explosive or fire hazards.

Prevention is the first step in dealing with incidents where equipment, the environment, or personnel may be harmed by errors or accidents. For this reason, the minimum requirements of the Occupational Safety and Health Association (OSHA) standards would be met or exceeded in the design of equipment, buildings, and access. Safety training shall also be given to employees and visitors.

Potential occupational health and safety risks during construction are expected to be typical of risks for any other industrial/commercial construction sites. These include, but are not limited to: the movement of heavy objects, including construction equipment; slips, trips, and falls; the risk of fire or explosion from general construction activities; and spills and exposures related to the storage and handling of the chemicals and disposal of hazardous waste. The health and safety of construction workers would be protected by adherence to accepted work standards and regulations set forth by OSHA (29 CFR 1910)

During construction, safety measures such as providing fencing around the construction site, establishing contained storage areas, and controlling the movement of construction equipment and personnel would reduce the potential for accidents to occur.

Storage of Materials

The proposed project would store a limited number of materials and chemicals that could potentially pose a health and safety risk primarily to employees and individuals in the immediate vicinity of the facility. Onsite storage areas for hazardous materials and waste would be surrounded by secure fencing to prevent unauthorized access and protect public health and safety. UK would ensure that all restricted areas are clearly marked to indicate that access is restricted and that unauthorized presence within the area constitutes a breach of security. All of the input compounds and wastes from the gasification process are non-hazardous, however, the fuel products produced from the FT PDU Facility would be treated as hazardous. Should a spill happen it would immediately be reported to the jurisdictional authorities and technically qualified HAZMAT responders.

Air Quality

As described in Section 3.2.1, future air emissions from the proposed project will be within ambient air quality standards that represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare within a reasonable margin of safety.

Worker Safety

There are no new hazards or hazardous activities unfamiliar to site personnel, or outside of the established environmental, health and safety procedures. CAER has a long and established track record (over 30 years) of operating similar equipment and technologies at bench, pilot, and slip-stream scales, ranging from facilities for coal cleaning, combustion, gas cleanup and emissions control, fuels and chemicals, ash management, advanced carbon materials, and biomass. The change to gasification and acid gas removal does not represent new technologies and operations for CAER.

The UK CAER has a formal and well documented safety program. Operations are subject to audit by both the University EHS office and state and federal regulators. Training requirements for personnel are established, and completion of required training is tracked and subject to audit. Personnel would be required to attend a variety of routing training and certification courses including: OSHA 511 (OSHA 2013), use of forklifts, respirators, cylinders, fire extinguishers, as well as general chemical hygiene and lab safety. Personnel would be required to wear safety glasses, lab coats, closed toed shoes, and hard hats at all times in the high bay and analytical labs as applicable.

The FT PDU Facility operations would abide by protocols stipulated in the following CAER publications to assure human health and safety for the workers and the public:

- Laboratory Chemical Hygiene Plan
- Building Emergency Action Plan
- CO_2 Capture Pilot Plant Operating Procedures
- Pilot Plant Safety Training Plan
- Material Safety Data Sheets for each chemical used in the FT PDU processes (see Section 3.2.4 for discussion of materials and waste)

Process Safety Features

Safety features are integrated into the design of the gasifier and gas cleanup systems of the proposed project. Among other features, the FT PDU system has numerous gas leak detection monitors and the facility has large fans that can quickly vent the entire building to remove unsafe gases should a leak occur. The fans and gas monitors are incorporated into the control system to create a safe operating environment. Table 4 presents a list of potential safety problems that could occur in the gasifier and gas cleanup systems, along with the designed solution for each potential event. Immediate implementation of the proposed solution would serve to prevent unsafe consequences.

Table 4. Safety Features

Warning Condition	Problem	Solution
Safety Features - Gasifier		
Gasifier high temperature	Two of three thermal couples indicate the temperature is over 1500°C.	Interlock with control system to turn down coal and oxygen supply. Cool with nitrogen feed.
Gasifier high pressure	Pressure detector in gasifier indicates the pressure is over 0.25 MPa	Interlock with control system to shut down coal and oxygen supply. Open the system outlet valve to vent/flare.
Syngas leaking from the gasifier	Carbon monoxide gas sensors located in the frame detect concentrated carbon monoxide.	If the sensors alarm, open or keep running the building fans, alert operators for manual shutdown, and clear personnel from hazardous areas.
Power outage		Automatic valves interlocked to close, and system performs safe shutdown.
Safety Features – Gas Cleanup		
Compressor overheat	Thermocouple in compressor indicates too high temperature.	Send gas to flare and let compressor cool down.
Pressure differential on filter too high	Filter is clogged or restricted and pressure differential indicates problem.	Vent gas to flare and replace or clean filter.
Absorber high pressure warning	Pressure sensor in absorber indicates pressure too high.	Relief valve will vent to flare in order to release pressure. Gas feed will be vented to flare until absorber under control.
Stripper high temperature warning	Thermocouple in stripper indicates temperature is above safe operating range.	Turn off hot-oil system and start to send feed gas to flare until stripper temperature moderates.
Pressure differential in sulfur bed too high	Sulfur bed is clogged or restricted.	Cut off flow to the sulfur bed and send feed gas to the flare.

°C = degrees Celsius; MPa = million Pascal

Potential Impact from Flare

The flare system would be a self-supporting structure, made up of three primary components: the flare stack, the flare tip, and the ignition system. The flare stack height is designed to be 15 feet with a 3 inch diameter flare. The flare manufacturer, GBA-Corona, Inc., designed the stack height based primarily on thermal radiation at grade elevation, such that the thermal intensity would be insufficient to cause discomfort for long exposures to people at any distance from the flare at ground level (GBA-Corona 2013). Assuming a wind speed of 20 miles per hour, the thermal radiation would unlikely ever exceed 350 British thermal units per hour per square foot (BTU/hr*ft^2) at ground level, which is well below the human-discomfort threshold of 500 BTU/hr*ft^2 recommended by the American Petroleum Institute Standard 521 (Optima 2013). Further, for safety purposes, the flare system includes a detonation arrestor to protect the header in the event of a flashback within the flare stack.

Hydrogen sulfide levels would be below those that would pose a risk to human health; however, odors could be detectable on occasion. The potential for odors would be minimized by the height of the flare, the combustion, as well as the open air dispersion.

Potential Accident Scenario from Release of Liquid Oxygen

Oxygen would be required for the gasification process. A quantity of 1500 gallons of liquid oxygen would be delivered once per run via a cryogenic tanker truck and stored in a cryogenic oxygen tank located on a concrete pad with spill protection, as shown in Figure 1. The tank would have leak monitors placed around the tank itself as well as inside the building where the oxygen enters the process, to make sure flammable oxygen is not leaking. If oxygen is leaking inside the building, the alarms integrated with the control system would open the fans and vents and shut the process down safely. The leak would be fixed before restarting the system. If the leak occurs outside, it would trigger an alarm to evacuate the area. Then the control system would manually be shut down in order to assess the problem.

Liquid oxygen is oxygen gas that has been purified and cooled to become a cryogenic liquid. Oxygen is classified as hazardous under OSHA's Hazard Communication Standard, 29 CFR 1910.1200, but is not listed as a regulated toxic gas or liquid subject to the USEPA Risk Management Program (USEPA 2009).

The potential hazards from contact with liquid oxygen include the following (Airgas 2011):

- Oxygen is a strong oxidizer and is incompatible with organic materials including hydrocarbons (i.e., could result in a reaction that causes fire or explosion).
- Contact with combustible materials can cause fire or explosion.
- Oxygen is non-flammable, but can accelerate combustion of other materials including clothing or asphalt.
- Contact with skin, eyes, or ingestion can result in severe frostbite or freezing of tissues.
- Release of liquid oxygen from a tank results in rapid expansion to a large volume of gas, which can allow pressure to build-up if the gas leak occurs in a confined area.

The frequency of an accident involving liquid oxygen tanks is considered to be extremely unlikely (1.4×10^{-6} per year) based on a 1997 survey of 11,760 tank years at production sites, and 712,000 tank years at customer sites for liquid oxygen, nitrogen, and argon tanks in Europe (EIGA 2004). A review of tank failures concluded that ductile tearing is more likely than collapse, corrosion, excessive deformation, or brittle fracture. A tear in the tank is likely to result in a leak, rather than failure of an entire tank wall. The oxygen tank for the proposed project would be located outdoors, such that an accidental oxygen release would dissipate quickly. Using calculations presented in the European Industrial Gases Association report (EIGA 2004), and scaled to the size of the proposed project, estimated consequences related to accidental release of liquid oxygen from the storage tank (or tanker truck) and associated exposure would be limited to workers within the immediate vicinity of the tank, and therefore, no offsite consequences would occur.

Potential Accident Scenario from Release of Hydrogen Sulfide

As described in Section 2.3.2, the coal-derived syngas enters the absorber tower where most of the CO_2 and H_2S are removed using the aqueous amine solvent. The treated syngas leaving the top of the absorber is then sent to an hydrolysis reactor where carbonyl sulfide is converted to H_2S and then the H_2S is subsequently removed by a fixed bed polisher.

Hydrogen sulfide is a toxic and flammable colorless gas having a foul odor similar to rotten eggs. Exposure to low concentrations of H_2S may cause irritation to the eyes, nose, and throat, and may cause difficulty in breathing for some asthmatics. Brief exposures to high concentrations of H_2S (greater than 500 parts per million) can cause a loss of consciousness and possibly death (CDC 2013).

DOE reviewed the potential for human health-related impacts from the accidental release of H_2S from the absorber tower using the USEPA software model, Risk Management Program (RMP)*Comp Ver. 1.07. This software is a screening tool developed by the USEPA to determine worst-case toxic endpoint distances for chemical releases. Based on DOE's analysis, worst-case endpoint distances would be less than the smallest distance detectable by RMP*Comp. However, a release of H_2S would occur within the facility building and contained until the facility exhaust fans were activated. It is expected that exhausted gases from such a release would be quickly dispersed, mixed, and diluted in the atmosphere below harmful concentrations.

<u>*Conclusion of Potential Impacts to Human Health and Safety*</u>

As shown in Table 4, there are numerous safety features within the FT PDU Facility and related infrastructure to help prevent catastrophic health and safety consequences, including sensors, alarms, fans, automatic and manual shutdown protocols, etc. In the very unlikely event of a catastrophic accident occurring at the site, emergency response would be focused on rescue and medical attention for surviving workers, and control of the fire at the plant site. Medical response and fire response would be within the capacity of the regional Lexington hospitals and fire stations.

Overall, impacts to human health and safety from construction and operation of the FT PDU Facility are predicted to be negligible to minor.

3.2.4 Materials and Waste Management

<u>Existing Environment</u>

The UK CAER is normally a registered small quantity generator of hazardous waste (ID# KYD086193141), but occasionally is considered a temporary large quantity generator because of the decommissioning and clean-out of moth-balled facilities. CAER recently exceeded limits of its small generator status due to a clean-out and decommissioning of equipment. Therefore, CAER recently made an application for large generator status, but will likely revert back to small generator status once normal levels of hazardous waste disposal are reestablished. As discussed in Section 3.5 of the original EA (DOE 2009), the facility uses a variety of hazardous materials in research-related activities. The facility generates approximately 2,500 pounds of hazardous waste annually (sometimes more depending on circumstances as previously described). Hazardous waste is managed onsite in accordance with applicable standards, and is manifested and transported to a permitted disposal facility through a licensed hazardous waste handler.

Within the state of Kentucky, there are four permitted hazardous waste TSDFs (ENVCAP 2013). In addition, there are over 90 TSDFs located within the states immediately surrounding Kentucky (Illinois, Indiana, Ohio, West Virginia, Virginia, North Carolina, Tennessee, Arkansas, and Missouri) (ENVCAP 2013).

In addition, UK CAER generates various types of non-hazardous solid wastes. Solid wastes are disposed of offsite at a permitted facility within Kentucky. Within the state of Kentucky, there are 26 municipal solid waste landfills and 10 landfills that are permitted to receive construction and demolition debris (KYDEP 2012a). In 2012, approximately 5.1 million tons of municipal solid waste was disposed of in landfills located within the state of Kentucky (KYDEP 2012b).

<u>Impacts of the Proposed Action</u>

This section discusses potential impacts related to material use and waste generation that could result from construction and operation of the proposed project (i.e., installing and operating the redesigned upstream equipment and associated concrete pads and framework). The section also briefly summarizes materials and waste-related impacts for the entire project, including downstream components, using information presented in the original EA (DOE 2009).

Construction of the proposed project would involve construction of concrete pads for the coal hopper/grinder, oxygen tank, slag pool, and potentially for the flare as well. Construction would also involve the installation of framework for the process equipment and the delivery, unloading, and assembly of the equipment. A small quantity of materials would be required to construct the concrete pads and framework for equipment, and negligible to minor quantities of construction waste could be generated as a result. Additionally, short-term impacts during construction would occur due to hazardous materials involved in construction equipment (i.e., fuel, oils, solvents, lubricants, etc.) and the resulting potential generation of hazardous wastes. But such wastes would be minimal and managed by construction personnel according to UK CAER's standard hazardous waste management practices and in accordance with applicable regulations.

Operation of the upstream components of the FT PDU Facility would require the use of various process materials, and would result in the generation of minor amounts of non-hazardous wastes. Coal would be the process input required in the greatest amounts, and slag/ash would be the primary waste generated. Table 5 summarizes the types and quantities of materials that would be used in the process, while Table 6 summarizes the types and quantities of wastes that would be generated. In addition, the system would require cooling water and process water and would generate wastewater; this is discussed further in Section 3.2.2 Water Resources.

Table 5. Process Inputs for the Upstream Components of the FT PDU Facility

Process Inputs[a]	Description	Quantity Per Run	Quantity Per Year[b]
Coal	Feeding material to syngas generation process	66,000 lbs	264,000 lbs
Torrefied Wood	A minimally used feeding material to syngas generation process	6,000 lbs	24,000 lbs
Zinc Oxide	Catalyst used to remove hydrogen sulfide from syngas and from gases vented to flare	4,500 lbs	18,000 lbs
Monoethanol Amine	Scrubbing solvent used to remove sulfur from syngas stream	1,000 lbs	4,000 lbs
Sodium Naphthalene Sulfonate, Formaldehyde Condensate	Additives used to produce the coal slurry to be used in the syngas process	317 lbs	1,268 lbs
Tramfloc 550	Flocculant used to remove particulates from spent process water prior to discharge	1 lb	4 lbs
Lime	Used to adjust pH and remove dissolved ions from process water prior to discharge	92 lbs	368 lbs
Oxygen	Feeding material to syngas generation process, consumed in the process	170,000 scf	680,000 scf
Nitrogen	Purging gas, protects flame monitoring system during operation and clears out other gases to ensure safe shutdown; vented to flare	2,280 scf	9,120 scf
Natural gas	Used to keep the flare pilot flame lit during operation	72,000 scf	288,000 scf

a. All process input materials are considered non-hazardous.
b. Assuming four runs per year.
FT = Fischer-Tropsch; lb = pound; PDU = Process Development Unit; scf = square feet

Most materials would be delivered by truck as needed; however, nitrogen would be produced onsite and natural gas would be delivered via pipeline. Oxygen would be delivered via cryogenic tanker-truck and would be stored in a cryogenic tank located adjacent to the FT PDU Facility on a concrete pad. Leak monitors would be used to detect any possible leaks of oxygen from the storage tank.

As shown in the Table 6, the process would not generate significant quantities of waste. In addition, none of the wastes generated are anticipated to be hazardous. However, the wastes would be tested prior to disposal and if hazardous, would be managed appropriately. The UK EHS, Environmental Management Department reviewed the anticipated waste streams associated with the proposed project and confirmed that UK CAER would remain in compliance and would have no effect on the facility’s current hazardous waste generator status (see Appendix A2). Additionally, the amounts of waste generated from the upstream process units of the FT PDU Facility would not impact local and regional waste treatment and disposal capacity.

Table 6. Wastes from the Upstream Components of the FT PDU Facility

Waste Material	Description	Hazardous Waste?	Quantity Per Run (lbs)	Quantity Per Year (lbs)[a]
Slag/ash	Waste from syngas generation process, collected in the slag pool and disposed of as solid waste	No	13,062	52,248
Zinc Sulfide	Spent catalyst after removal of hydrogen sulfide, collected and stored in 55-gallon barrels prior to disposal offsite	No	4,542	18,168
Monoethanol Amine	Spent scrubbing solvent, collected and stored in 55-gallon barrels prior to disposal offsite	No	2,200[b]	8,800[b]
Salts	Salts (mostly inorganic) removed from wastewater prior to discharge	No	Negligible	Negligible

a. Assuming four runs per year.
b. Includes water for dilution.
FT = Fischer-Tropsch; lbs = pounds; PDU = Process Development Unit

The original EA (DOE 2009) discusses impacts from the downstream processes within the FT PDU Facility. Those impacts would remain unchanged by the redesign of the upstream components (i.e., coal gasification and acid gas cleanup). The primary impact discussed in the original EA related to the generation of 8 barrels of diesel per run, or approximately 32 barrels of fuel per year. The FT fuel is a combustible liquid and therefore subject to hazardous material storage regulations. UK CAER would be required to register with the LFUCG and provide, within 30 days of commencement of operations, an inventory of hazardous materials present onsite. UK CAER would also be required to report a discharge of more than 10 gallons of petroleum fuel, or any discharge that results in a visible sheen or film on surface water, to the LFUCG. Finally, UK CAER would be required to develop and maintain a Spill Prevention and Control Plan.

Some additional wastes would also be generated from downstream processes once the FT PDU Facility becomes operational. These would include used catalysts contaminated with light hydrocarbons, lab chemicals, and process wastewater contaminated with minor amounts of light hydrocarbons. Approximately 10 barrels of process wastewater would be generated per run; other wastes would not be generated in significant quantities. These wastes are expected to be non-hazardous but would be tested and managed appropriately if they meet any of the criteria for hazardous waste. Refer to Section 3.5 of the original EA for discussion of the downstream wastes (DOE 2009).

Overall, impacts to material use and waste generation from construction and operation of the FT PDU Facility would be negligible to minor.

3.2.5 Cumulative Impacts

Cumulative impacts are the sum of all direct and indirect impacts, both adverse and positive, that result from the Proposed Action when combined with past, present, and future actions regardless of the source. There are no known reasonably foreseeable projects at UK CAER to consider for cumulative analysis. Section 4.9 of the original EA (DOE 2009) provides a detailed cumulative analysis regarding the potential impacts of commercial product of FT fuels.

As discussed in Section 3.2.1, because climate change is considered a cumulative global phenomenon, it is generally accepted that any successful strategy to address climate change must rest on a global approach to controlling GHG emissions. Part of the purpose and need of the research proposed in this project is geared toward development of technologies and liquid fuels derived from domestic coal and biomass, which would have a lower life-cycle footprint than currently used petroleum-based fuels. Advancement of these technologies and fuels would be beneficial in reducing the rate and magnitude of climate change.

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4.0 REFERENCES

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5.0 LIST OF PREPARERS

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M.A., Science Writing
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B.S., English Literature
27 years experience in environmental engineering, science writing, and NEPA documentation and analysis.

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B.S., Business Management
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6.0 DISTRIBUTION LIST

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Lexington Public Library
Northside Branch
1733 Russell Cave Road
Lexington, Kentucky 40505

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Appendix A

Agency and Other Coordination

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A1. Kentucky Heritage Council

STEVEN L. BESHEAR
GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL

BOB STEWART
SECRETARY

THE STATE HISTORIC PRESERVATION OFFICE
300 WASHINGTON STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
FAX (502) 564-5820
www.heritage.ky.gov

CRAIG A. POTTS
EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

November 4, 2013

Donald J. Challman
Associate Director & General Manager
University of Kentucky Center for Applied Research
2624 Research Park Drive
Lexington, KY 40511

RE: Newly Proposed Construction Related Activities; Proposed Retrofit at 2624 Research Park Drive in Lexington, Fayette County, Kentucky (Facilities Management inventory #30581001)

Dear Mr. Challman,

The State Historic Preservation Office received additional information on October 22, 2013 pertaining to the above referenced project in Lexington, Fayette County, Kentucky. This office reviewed and commented upon the undertaking on March 3, 2009 (archaeology) and May 4, 2009 (historic structures). Each of those reviews resulted in a determination of No Effect to Historic Properties.

It is understood that additional concrete pads are now proposed to accommodate a coal hopper/grinder, slag pool, and oxygen tank. The previous reviews that have taken place covered the areas where these pads are proposed. It is therefore the determination of this office that the newly proposed construction related activities at 2624 Research Park Drive will result in No Effect to Historic Properties. No further consultation with this office will therefore be required.

Thank you for coordinating with this office. If you have any questions regarding these comments, please contact me at 502-564-7005 x 111.

Sincerely,

Craig A. Potts, Director
Kentucky Heritage Council and
State Historic Preservation Officer

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Melissa Sanford

From:	Challman, Don J <don.challman@uky.edu>
Sent:	Tuesday, October 22, 2013 5:24 PM
To:	Placido, Andrew J; 'yvonne.sherrick@ky.gov'; 'craig.potts@ky.gov'
Subject:	RE: SHPO Review of 2540 Research Park Drive Proposed Construction
Attachments:	Spindletop Adm Bldg SHPO Clearance.pdf

Hi Craig and Yvonne: Further to Andy's analysis of the several approvals that have come from your office before, the SHPO also issued its approval in May 2009 for construction and other improvements of a new 38,500 sq. ft. laboratory, large geothermal well field and bio swale on adjacent property to the refinery building and the Spindletop Office Building [also see that letter attached].

We're asking for your concurrence of very modest building construction consisting of additional and small concrete pads for a coal hopper/grinder [11'6" x 18'6"], Slag Pool [9'0" x 19'6"], and Oxygen Tank [13'0" x 18'0" with 12' x 12' spill pad]. Of course, the main reason we are seeking this approval is because our source of funding is federal funds, and thus this EA Supplement.

Thank you for your attention to this matter.

Sincerely,
Don Challman

PLEASE NOTE THAT MY EMAIL ADDRESS HAS CHANGED TO don.challman@uky.edu
Donald J. Challman
Associate Director & General Manager
University of Kentucky Center for Applied Energy Research
2624 Research Park Drive
Lexington, KY 40511
Office: 859.257.0222
Fax: 859.257.0220
Cell 859.221.0211
www.caer.uky.edu

From: Placido, Andrew J
Sent: Tuesday, October 22, 2013 3:05 PM
To: yvonne.sherrick@ky.gov; craig.potts@ky.gov
Cc: Challman, Don J
Subject: SHPO Review of 2540 Research Park Drive Proposed Construction

Craig and Yvonne,

Back in 2009, the University of Kentucky Center for Applied Energy Research got a grant from DOE to construct and operate a coal to liquids facility on our research campus at **2540 research park drive Lexington, ky 40511 (UK Center for Applied Energy Research, Fayette County, Kentucky)**. As part of this grant and NEPA regulations, an environmental assessment was performed on the process and the proposed construction. The original building was going to be 2700 sq

1

ft and we contacted your office and got approval to construct the building. Mark Dennen in a letter dated March 3, 2009 gave the approval (it is attached to this email for your reference). Then in 2010 we changed the size of the building from 2700 sq ft to 5800 sq ft and moved it slightly within the same geographic area. Once again we received approval for this from your office.
Now, we have once again have changed the process a small amount and therefore DOE is requiring another supplement to the original EA. With that being said they have requested that we consult with your office regarding the construction of some small concrete pads that will be outside the original building that was approved by your office in 2010. These pads are within the "limits of construction" of the aforementioned building so we don't think it should be a problem but wanted to consult with your office and make sure. A figure showing the limits of construction of the building is provided below for your reference. Lastly, I have also attached a figure titled site map so you can see where the "new concrete pads" will be in relation to the already constructed building and the previously mentioned limits of construction. The point of interest on the site map is the CTL Mini Fischer-Tropsch PDU (which was constructed from the 2010 approval provided by your office) and the red squares are proposed new concrete slabs. Approximate sizes are as follows: Mill Frame and Foundation [11'6" x 18'6"], Slag Pool [9'0" x 19'6"], Oxygen Tank [13'0" x 18'0"] and flare [2'0" x 2'0"].

As you can see the pads are very small compared to the already constructed building (not to mention other buildings previously constructed at the site) and they will reside within the limits of construction of said building. Having provided your office with all the facts, it is our belief that there is no cause for concern for this latest construction and subsequently we are requesting a response from the Kentucky State Preservation Office for your approval for this construction. In an effort to be thorough I will once again guarantee that all proposed construction is within the "extent of construction" of the already constructed building and therefore we will not be disturbing any new ground.

Could you please review the information and make sure the proposed construction is acceptable to your office and if this is indeed acceptable then could you please email a statement back to me stating something to that affect? We would also accept a formal letter such as the one attached below if that would be better for your department.

If anything is unclear or you need more information please do not hesitate to ask.
Thanks for your help and I look forward to your response.
Andy

Andy Placido
Engineer Associate II
University of Kentucky
Center for Applied Energy Research
2540 Research Park Dr.
Lexington, KY 40511
(859)257-0223
andy.placido@uky.edu

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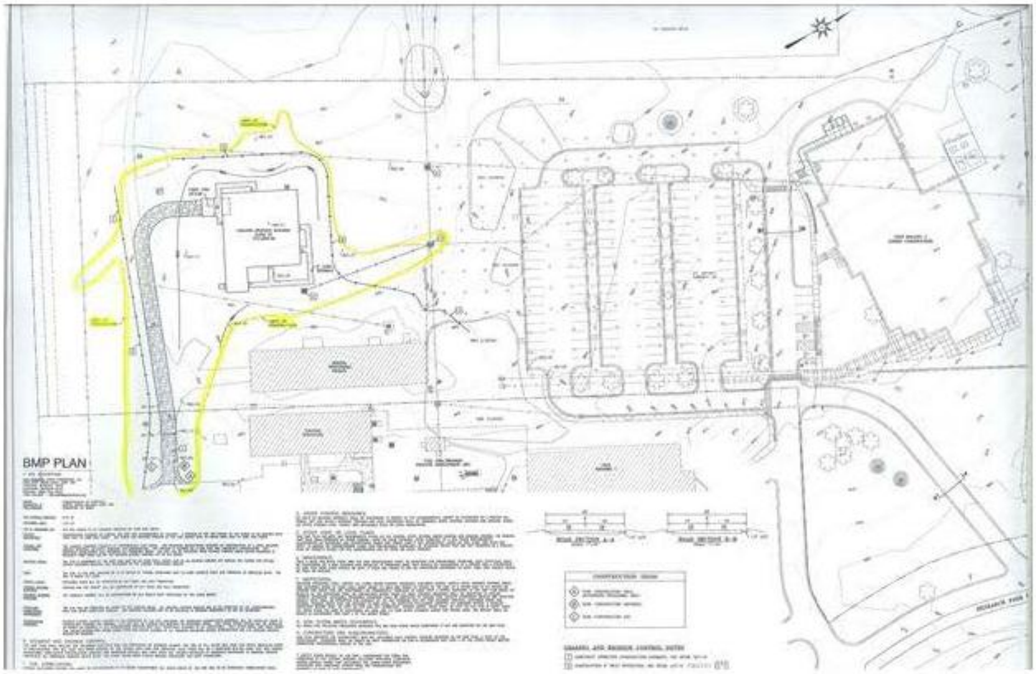
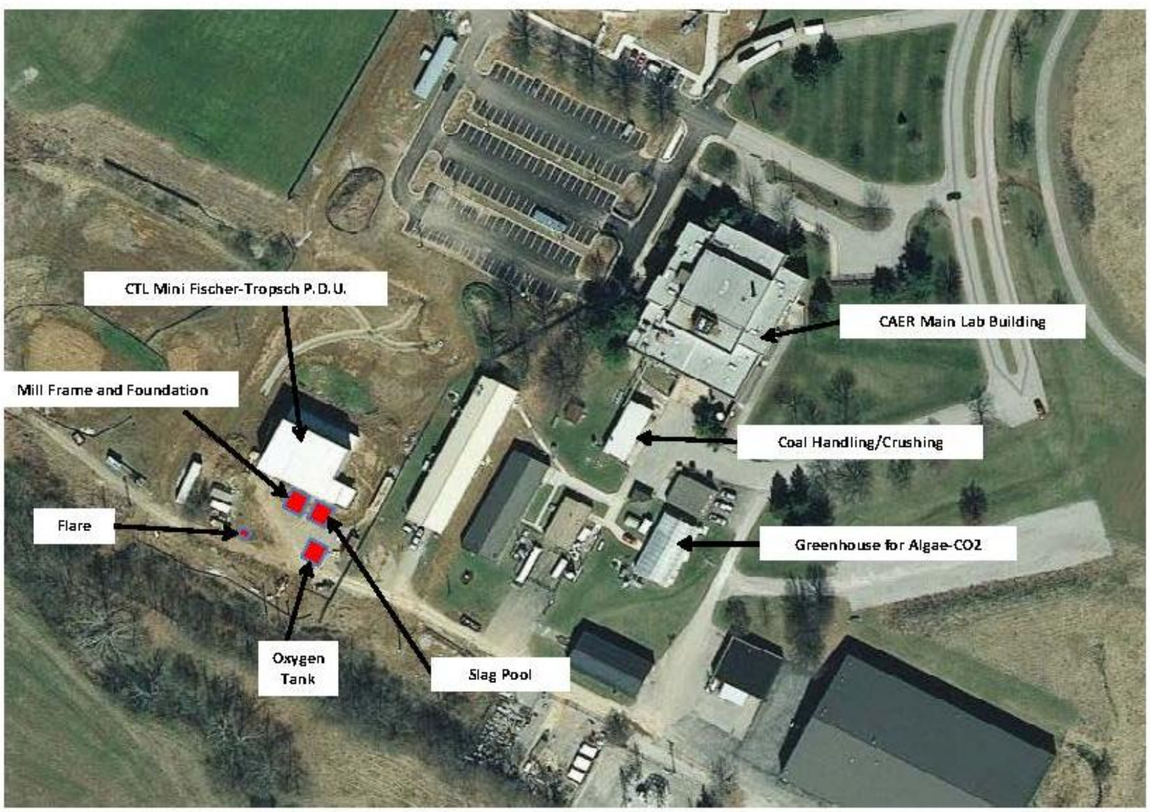

BMP PLAN


CTL Mini Fischer-Tropsch P.D.U.
CAER Main Lab Building
Mill Frame and Foundation
Coal Handling/Crushing
Flare
Greenhouse for Algae-CO2
Oxygen Tank
Slag Pool

A2. University of Kentucky Environmental Health and Safety

UK
UNIVERSITY OF
KENTUCKY

Environmental Health and Safety
Environmental Management
355 Cooper Drive
Lexington, KY 40506-0490
(859) 323-6280
Fax: (859) 323-6274

November 19, 2013

Andy Placido
Center for Applied Energy Research (CAER)
2540 Research Park Drive
Lexington, KY 40511
Attention: Mr. Andy Placido

Subject: Fischer-Tropsch Process Development Unit

Dear Andy,

The University of Kentucky Environmental Management Department has evaluated the solid waste and wastewater implications resulting from the subject process and communicated through your e-mail correspondence and a follow up meeting. The evaluation was in order to provide documentation relative to the permit or registration effect of this process for the *environmental assessment* necessary for the ongoing development of this project.

Our determination has shown that the resulting waste streams you described would be considered *Non-RCRA Regulated Waste* and, therefore, would be in compliance with and have no effect on the facility's current Notification of Hazardous Waste Activity with the Kentucky Division of Waste Management as a Small Quantity Generator. These waste streams and their quantities communicated were:

Monoethanolamine – 8,800 pounds per year
Zinc Sulfide spent catalyst – 18,000 pounds per year
Slag / Ash – 52,000 pounds per year

The CAER is included in the facilities contributing wastewater to the Kentucky Horse Park, Spindletop Research Park's outfall which is permitted by the Lexington Fayette Urban County Government Our determination has shown that the wastewater discharge from the CAER and the additional contribution from the subject process described as non-potable, noncontact water at the rate of 30,000 gallons will be in compliance with the conditions of the Kentucky Horse Park permit.

Should you have any questions regarding this evaluation, please feel free to contact me at 859-257-3285, robert.kjelland@uky.edu or Ron Taylor at 859-257-3129, ron.taylor@uky.edu.

Sincerely,

Robert Kjelland, Director
Environmental Management Department

cc: Don Challman, Courtney Fisk, Ruthann Chaplin, David Hibbard, Ron Taylor

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