ENVIRONMENTAL ANALYSIS SUPPORT

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INTRODUCTION

Activities in environmental analysis support included assistance to the National Energy Technology Laboratory (NETL) at Morgantown and Pittsburgh in reviewing and preparing documents required by the National Environmental Policy Act (NEPA) for projects selected for the Clean Coal Technology (CCT) Program and for the Low Emission Boiler System (LEBS) Program. An important activity for the CCT Program was the preparation of an Environmental Impact Statement (EIS) for a project to demonstrate the integration of a direct ironmaking process with the production of electricity at Geneva Steel's existing plant in Vineyard, Utah. An important activity for the LEBS Program was the preparation of an EIS for integrated coal-fired technologies for electric power generation at the proof-of-concept scale adjacent to the Turris Coal Company's existing underground coal mine near Elkhart, Illinois.

ENVIRONMENTAL SUPPORT TO THE CLEAN COAL TECHNOLOGY PROGRAM

Work for the National Energy Technology Laboratory (NETL) during this period included the preparation of an Environmental Impact Statement (EIS) to evaluate the potential environmental effects associated with constructing and operating a project selected by DOE under the Clean Coal Technology (CCT) Program. The project would demonstrate the integration of a direct ironmaking process with the production of electricity using coal in an efficient and environmentally responsible manner. Direct ironmaking eliminates the intermediate step of producing coke from coal. The EIS will be used by DOE in making a decision on whether or not to provide cost-shared funding to design, construct, and demonstrate the HIsmelt (High Intensity smelting) technology proposed by the CPICOR Management Company at Geneva Steel's existing plant in Vineyard, Utah. CPICOR is an acronym for Clean Power from Integrated Coal/Ore Reduction. The site is located immediately west of Orem, Utah, about 5 miles northwest of Provo, Utah, and about 35 miles south-southeast of Salt Lake City. The proposed project would be demonstrated during a 2- to 4-year period starting in late 2004.

The overall objective of the project is to demonstrate the feasibility of the HIsmelt technology at a size large enough to allow the ironmaking industry to make decisions regarding commercialization of the technology. The new HIsmelt facility would use iron ore and coal to produce about 3,300 tons of molten

iron per day. Consequently, the existing blast furnace No. 3 would be placed in standby status (i.e., it would not operate whenever the HIsmelt facility is operating), while blast furnaces No. 1 and No. 2 would be available to continue in operation without modification. Offgas from the HIsmelt facility would be used as a fuel in the existing boilers to produce steam for in-plant use by Geneva Steel and to generate up to 300 MW of electricity using a combination of new and existing turbines. Not only would the electricity satisfy internal process needs at the Geneva Steel plant, but the remainder would be available for export to the existing power grid. The project is expected to provide Geneva Steel and offsite consumers with a low-cost, efficient, and environmentally sound source of additional electric generating capacity.

The HIsmelt technology produces molten iron directly from iron ore and coal in a single integrated operation, which eliminates the intermediate step of producing coke from coal. Iron ore, coal, fluxes (i.e., limestone, dolomite, lime, and/or dolime) and oxygen-enriched hot air are injected into a closed molten-bath reactor. The metal bath is the primary reaction medium in which carbon from the coal reduces iron ore to iron. The fluxes keep the materials molten in the reactor. Molten iron that collects in the bottom of the bath is continuously tapped from the reactor vessel to maintain a constant level of iron inside the vessel. Slag (the molten by-product generated from coal ash, fluxes, iron oxide, and other impurities) is tapped periodically and used to coat and control the internal cooling system and reduce heat loss.

The reactor vessel is aligned vertically in the HIsmelt technology. The coal is injected into the bath where carbon in the coal dissolves rapidly. The dissolved carbon reacts with oxygen from the injected iron ore to form carbon monoxide and iron. The high-temperature reactions release large quantities of buoyant coal gases (e.g., carbon monoxide and hydrogen) that create a large liquid fountain as they entrain and propel droplets of slag and molten iron upward into the post-combustion zone of the vessel. The result is strong mixing within the metal bath, which provides thermal uniformity. Because the iron reduction reaction in the molten bath is endothermic, additional heat must be generated and returned to the bath to sustain the reduction process and maintain an acceptable hot metal temperature. This additional heat is generated in the post-combustion zone by combusting the carbon monoxide and hydrogen released from the bath with oxygen-enriched hot air blast (2,200°F) that is injected down through piping from the top of the vessel. This reaction heats the metal and slag droplets in the post-combustion zone which, in turn, heat the bath after gravity returns them to the bath. Oxygen enrichment of the hot air blast increases the productivity of the process. Reacted gases, mainly nitrogen, carbon dioxide, carbon monoxide, hydrogen, and water vapor exit the vessel. After scrubbing the reacted gases, the cleaned gases can be combusted to generate electricity. The cleaned gases can also be used to pre-heat and partially pre-reduce the incoming iron ore.

The HIsmelt process possesses several advantages over conventional processes. Because it uses a high-temperature reactor vessel (up to 5,000°F) and eliminates the intermediate step of producing coke from coal, many of the air emissions and solid waste streams associated with traditional coke plant operations are eliminated. The high temperature breaks down and destroys hydrocarbons (e.g., toluene, benzene, and phenols) to minimize hazardous air pollutants typically emitted by coke ovens at temperatures less than 2,800°F. Because the high temperature of the reactor vessel exceeds the threshold for condensation of alkalis, problems in blast furnaces associated with alkaline iron ores and coals from the western United States are eliminated. The process is responsive to short-term operational problems because it can be shut down rapidly and easily restarted. Process efficiency is improved by capturing and recycling particulate matter.

Work on the EIS has included the initial evaluation of environmental issues that could result from construction and operation of the proposed project. During the scoping process at the beginning of work on the EIS, local residents were encouraged to express their concerns about potential effects. The issue of most concern was the potential impact to air quality from the proposed project's emissions. Other concerns that were expressed during the scoping process were the proposed project's use of coal; potential effects of the project on human health; potential impacts of the project on the water quality of the nearby Utah Lake; potential effects on wetlands; transportation, handling, and use of hazardous materials; issues associated with emergency preparedness and response; changes in the types and number of jobs associated with the proposed project; a possible decline in housing values; and potential visual impacts. The public input obtained during the scoping process was used to add to the list of issues requiring assessment. Issues are analyzed in the EIS in accordance with their level of importance. The most detailed analyses focus on issues associated with air quality impacts.

In addition to the proposed project, the no-action alternative (including two reasonably foreseeable scenarios) is being considered in the EIS. Under the no-action alternative, DOE would not provide funding to demonstrate the integration of the HIsmelt direct ironmaking process with the production of electricity. In the absence of DOE funding, there are two options that Geneva Steel could reasonably pursue: (1) Geneva Steel could continue to operate the blast furnaces without modification; and (2) Geneva Steel could modernize the existing blast furnaces to lessen the requirements for coke and install new cokemaking facilities with state-of-the-art pollution controls that are needed to comply with the National Emissions Standards for Hazardous Air Pollutants.

ENVIRONMENTAL SUPPORT TO THE LOW EMISSION BOILER SYSTEM PROGRAM

Work for the National Energy Technology Laboratory (NETL) during this period included the preparation of an Environmental Impact Statement (EIS) to evaluate the potential environmental effects associated with constructing and demonstrating a new coal-fired Low Emission Boiler System (LEBS) for electric power generation at the proof-of-concept scale. The EIS will be used by DOE in making a decision on whether or not to provide cost-shared funding to design, construct, and demonstrate the integrated technologies proposed by a team headed by D.B. Riley, a private sector participant in the LEBS Program. The goal of the LEBS Program is to provide the U.S. power industry with a reliable, economic, highly efficient, and environmentally preferred alternative to current coal utilization technologies.

The proposed project would demonstrate the technologies using a new 91-MW coal-fired power plant to be built adjacent to an existing underground coal mine owned and operated by Turris Coal Company, a member of the project team. The site is situated in central Illinois, about 2 miles southeast of the town of Elkhart and about 17 miles northeast of Springfield. The project would incorporate the following technologies: (1) a slagging combustor, which is U-shaped to increase the combustion reaction time; (2) low oxides of nitrogen (low-NO_x) burners, staged combustion, and coal reburning (injecting about 10–15% of the coal higher in the combustor) for NO_x control during combustion, in combination with a selective catalytic reduction (SCR) post-combustion NO_x control system; (3) a wet limestone scrubbing system for sulfur dioxide (SO_2) capture; and (4) an electrostatic precipitator for particulate removal from the flue gas. The technologies are expected to capture at least 96% of SO_2 emissions, decrease NO_x emissions by 85%, and remove 99.8% of particulate matter.

The proposed project would be demonstrated during a 6-month period in 2004. The facility would be fueled with coal from the adjacent mine, and electricity generated by the facility would be provided to the mine and to the local power grid. The captured SO_2 would be converted to commercial-grade gypsum, which would be marketed as feedstock for wallboard production. Bottom ash from coal combustion would be marketed for commercial applications such as a road base or construction material.

Potential impacts to environmental resources, including air quality, groundwater, and land availability, that could result from construction and operation of the proposed project were analyzed. Key findings include that emissions from the proposed facility would not exceed National Ambient Air Quality Standards (NAAQS) or Prevention of Significant Deterioration (PSD) increments. For the latter set of standards, the emissions would be less than 20% of the allowable degradation. The contribution of

emissions from the proposed facility to acidic deposition and to global climate change is expected to be negligible.

Initial results indicate that the aquifer may be capable of supporting the additional requirements of groundwater withdrawal during facility operation, but declines in groundwater levels may occur in nearby water supply wells, including the village of Elkhart municipal water well, located approximately 1 mile west of the proposed site. In addition, the relatively large additional consumption could degrade water quality in the aquifer, resulting in increased total dissolved solids, heavy metals, and dissolved minerals. However, the effects of drawdown and groundwater quality degradation can be mitigated somewhat by using multiple wells for groundwater withdrawal with sufficient separation from the village of Elkhart well. In addition, the use of field drainage runoff that passes through the Turris property is being pursued as a mitigation measure that could supplement groundwater withdrawal.

With the construction of a new coal combustion waste disposal area at the adjacent mine, sufficient disposal capacity would be available to accommodate all solid wastes generated by the proposed facility during its 30-year commercial operation, even if no bottom ash or gypsum were sold or used. If the proposed waste disposal area is not constructed, the Turris Coal Company would have other options to dispose of the material, including (1) reducing the current level of coal combustion ash received from offsite customers, and (2) transporting solid waste off the site to a permitted landfill.

Impacts to other resource areas would be minor. Flooding at the site is not anticipated, and floodplain encroachment would not occur. There are no significant wetland resources near the proposed site. No appreciable impacts on terrestrial or aquatic ecosystems are expected. There are no historic or archaeological resources known to occur on the project site. Construction and operation of the proposed facility are anticipated to have only minimal impacts on socioeconomic factors in the surrounding area, and no environmental justice impacts are expected. With respect to aesthetic resources, construction of the proposed project would produce slight short-term visual impacts, but visual characteristics would not differ appreciably over the long term from those at the site now. No appreciable impacts are expected with regard to noise, traffic, land use, and human health including worker safety.