EA-575; Environmental Assessment and (FONSI) for Fundamental Fluidization Research Project

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FUNDAMENTAL FLUIDIZATION RESEARCH PROJECT

DOE/E-0575

ENVIRONMENTAL ASSESSMENT

JANUARY 1994

Prepared by

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FUNDAMENTAL FLUIDIZATION RESEARCH PROJECT

ENVIRONMENTAL ASSESSMENT

This Environmental Assessment (EA) has been prepared by the Department of Energy (DOE) in compliance with the requirements of the National Environmental Policy Act of 1969 (NEPA). It has been prepared in accordance with the President's Council of Environmental Quality (CEQ) regulations implementing NEPA and the DOE Guidelines for compliance with NEPA (10 CFR Part 1021).

As required by Section 1508.9 of the CEQ regulations, the sections contained within this EA include the following:

1.0 Purpose and Need for DOE Action.
2.0 Alternatives Including the Proposed Action.
3.0 Environmental Impacts of the Proposed Action and the No Action Alternative.
4.0 List of Agencies and Persons Contacted.

1.0 PURPOSE AND NEED FOR DOE ACTION

The U.S. Department of Energy's Morgantown Energy Technology

Center (METC) proposes to design, construct, and operate a 2-foot diameter, 50-foot high pressurized fluidized-bed unit to explore the fundamentals of fluidization with particular emphasis on operation in the circulating mode. For fossil energy applications, operation of a pressurized fluidized-bed combustor (PFBC) in a circulating mode has potential advantages over operation in a bubbling-bed mode. For example, the circulating PFBC operates at gas velocities (three to five times) higher than bubbling bed which results in a smaller cross sectional bed area and a fewer number of coal feed points. In addition, the circulating PFBC may have better success in removing sulfur using limestone in the bed. In other words, about half the amount of limestone will be required to remove the same amount of SO2 in a circulating PFBC. Although the bubbling-bed PFBC is a more mature process, current research is focused on circulating-bed PFBC because of its potential advantages.

However, little data are available to design and evaluate pressurized circulating-bed combustion processes. There are no data concerning the effect of pressure on high fluidization velocities. These data are needed for design, evaluation, and scale-up of circulating PFBC process. METC proposes to conduct the Fundamental Fluidization Research Project (FFRP) to obtain this information.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 THE PROPOSED ACTION

2.1.1 Project Description

The proposed project would involve design, construction, and operation of a 2-foot diameter, 50-foot high pressurized fluidized bed warm unit to study fluidization characteristics at elevated temperature and pressure conditions ranging from ambient temperature to 700 degrees F and from 20 psig pressure to 75 psig pressure.

The 2-foot diameter, 50-foot high pressurized fluidized-bed unit (Figure 1) would be an open-loop system designed to suspend inert

particles using warm air. Atmospheric air would be compressed to 75 pounds per square inch, gauge (psig), and heated to 750ùF. The maximum air flowrate would be 16,000 actual cubic feet per minute. The air would be fed to the bottom of the fluidization vessel, where it would contact and suspend inert particles fed from the top of the bed. Limestone, sand, or plastic would be used as the inert particles. At the top of the vessel, four cyclone separators would collect and return particles to the bottom of the vessel through the solid collection vessel. When the unit is operated at an elevated temperature, the warm air exiting the vessel would flow through a spray water cooler before entering a baghouse to remove fine particles. The air heaters would be fired with natural gas, and the exhaust flue gas would be discharged to the atmosphere. The unit would operate approximately 36 hours per week for about one year.

The 2-foot diameter, 50-foot high pressurized fluidized-bed unit would be constructed in an existing building, Building-22, at METC. The dimensions of the building are 30-foot X 30-foot X 65-foot high. The pressurized fluidized-bed vessel and its components (e.g., cyclones, solid feed hopper, and solid collection vessel) would occupy the entire building. The air compressor is installed in a separate building, Building-22A, located adjacent to Building-22. Except for the baghouse, the fluidization vessel and all the major components are already installed. However, remaining equipment, such as piping and instrumentation, would need to be installed for the project. The 2-foot diameter, 50-foot high pressurized fluidized-bed unit would be built and operated in compliance with all applicable local, State, and Federal regulations.

The primary objective of the proposed research would be to study the dynamics of fluidization under elevated temperature and pressure conditions. Fluidized-bed reactors for fossil energy applications would operate in many different flow regimes (e.g., minimal fluidization, bubbling, slugging, turbulent, and fast fluidization). Determining the flow regime of operation would be essential for proper design and scale-up of fluidized-bed reactors and prediction of reactor performance. The tests planned for the Fundamental Fluidization Research Project would

characterize the fluidization flow regimes and their transitions at elevated temperature and pressure. The test program would investigate the effects of bed temperature (i.e., ambient to 750ùF), bed pressure (i.e., 20 to 75 psig), static bed height (i.e., 1 to 12 feet), and various physical properties of the solid materials such as particle shape, density, and size distribution. The test program would also investigate gas/solid mixing, circulation patterns, and heat transfer in fluidized-beds. The anticipated result of the proposed project would be a better understanding of the pressurized fluidization process at high velocities. This better understanding would provide a sound basis for design and scale-up of circulating PFBC for fossil energy applications.

Figure 1

2.1.2 Description of Project Location

2.1.2.1 General Description of the Area

METC (Figure 2) occupies 145 acres and is located in Morgantown, West Virginia. The City of Morgantown, located in Monongalia County in northern West Virginia approximately 70 miles southwest of Pittsburgh has a population approximately 60,000 residents. METC is surrounded by low-density residential areas on its southern, eastern, and western borders and by the Monongahela River on its northern border. West Fork Run and its tributary, Burroughs Run, form the eastern and southern boundaries at METC.

2.1.2.2 Description of Project Site

METC is one of two Energy Technology Centers of the U.S. Department of Energy's Office of Fossil Energy. Its mission is to develop technologies that use coal, oil, and gas and transfer these technologies to the private sector for commercialization. There are 40 buildings on the METC site. The 2-foot diameter, 50-foot high pressurized fluidized-bed unit, as shown in Figure 3, would be installed in an existing, steel frame, metal clad building (Building-22) located at METC.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, DOE would not proceed with the proposed project at METC, and the proposal is not otherwise expected to be implemented. Therefore, the impacts described in this EA as a sequence of the proposed action would not occur.

Figure 2

Figure 3

2.3 ALTERNATIVE SITES

Considerable additional expense would be required if the proposed research were conducted at an alternative site. The unique expertise of the METC researchers was a key factor in determining that the proposed work should be performed at METC. METC is equipped to perform the proposed work, and the project would be integrated with existing support systems (e.g., utilities and analytical facilities) already at METC. As a result, environmental impacts of alternative sites was not analyzed in this EA.

2.4 ALTERNATIVE TECHNOLOGIES

Alternative technologies to circulating PFBC reactors include fixed-bed, bubbling-bed, and entrained-bed reactors. Each of the alternative technologies is already undergoing development at METC and/or its contractors. Data collected from the circulating PFBC process being developed under the proposed action would be made available for comparison with data from alternate technologies relative to economic and environmental performance. The environmental impacts of alternative technologies will not be analyzed in the EA.

3.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND THE NO-ACTION ALTERNATIVE

3.1 THE PROPOSED ACTION

3.1.1 Air Quality

During operation, the 2-foot diameter, 50-foot high pressurized fluidized bed system would generate new sources of air emissions. During operation, process air would be heated to approximately 750ùF using two indirect, natural gas-fired heaters. Each natural gas-fired heater would have an input heating value of 4.02 million Btu per hour. Each natural gas-fired heater would emit approximately 36,000 scfh of nitrogen, 12 scfh of oxygen, 8,500 scfh of water vapor, and 8,400 scfh of carbon dioxide. A total of 15.6 million standard cubic feet of carbon dioxide per year would contribute to the global carbon dioxide emissions during one year (36 hrs/week x 52 week/year = 1872 hrs/year) of operation. No release of sulfur dioxide or sulfuric acid mist would be expected.

The particle loading in the gas exiting the cyclones would range from a minimum of 0.4 grains per cubic foot (or 0.057x10-3 pounds per cubic foot) to a maximum of 4.0 grains per cubic foot (or 0.57x10-3 pound per cubic foot of air). With a baghouse efficiency of 99.9 percent, the total maximum particle emission to the atmosphere would be 1,030 pounds per year (or 0.55 pph).

3.1.2 Water Quantity/Quality Impacts

The proposed action would be located within the existing METC facility. Operation of the 2-foot diameter, 50-foot high pressurized fluidized-bed unit would require a total of 4.4 million gallons of water from the municipal water supply system. A water spray cooler would consume 20 gallons per minute which would be turned into steam and discharged to the atmosphere. The closed-loop spray cooling tower would evaporate approximately 18 gallons per minute of water for discharge to the atmosphere as steam. About 0.7 gallons per minute of water would be removed from the circuit to limit the concentration of scale in the recirculated water. This water would be discharged to the city sewer system. Water removed from the action of compressing the air would flow to a floor drain, be captured, be collected in waste containers, and be disposed by approved waste water disposal methods. No change in water quantity or quality would be anticipated.

3.1.3 Solid Waste Disposal

During each test, the 2-foot diameter, 50-foot high pressurized fluidized-bed unit would use a maximum of 940 pounds of material (for example, sand, limestone, or nylon sphere). Most of the particles would be collected by cyclones and recirculated back to the fluidized bed in order to maintain the bed inventory. A small amount of particles would escape collection in the cyclones and enter the baghouse. The particles collected in the baghouse would be non-hazardous, and would be stored on the METC site in 55-gallon drums for possible use in future test programs. The inert particles used in the test program would be limestone, sand, or plastic.

3.1.4 Noise

Operations of the 2-foot diameter, 50-foot high pressurized fluidized-bed unit would be within an enclosed structure, therefore, no increase in noise at the structure boundaries would be anticipated from the project. The noise level of the air compressor would be no more than 85 decibels at a distance of one meter from the equipment. Personnel entering the Building-22 during operation would be required to wear ear protection.

3.1.5 Floodplains or Wetlands

The proposed project would be located at an elevation of approximately 962 feet above sea level (ASL). The normal pool elevation of the Monongahela River is 797 feet ASL. The highest rise in the river, since construction of the Tygart Dam, occurred in November 1985, and caused the river to rise to an elevation of 814 feet ASL. The Corps of Engineers, Pittsburgh District, calculates the elevation of a 500-year flood to be 816 feet. West Run Creek runs around the METC property starting at an elevation of 920 feet and drops to the river elevation. No wetland areas are located near the project site. The U.S Army Corps of Engineers, Pittsburgh District, has verified that no impact to wetlands or floodplains would result from this project.

3.1.6 Historic Areas

The proposed action would be conducted within an existing building at an existing research facility, and no earthmoving would be necessary. Therefore, no impact to historic landmarks,

archeological sites, or cultural sites is expected.

3.1.7 Ecological Impacts

The proposed action would not affect federally-listed threatened or endangered species. No impact to terrestrial or aquatic ecology would be expected, since the operation would be within an existing facility.

3.1.8 Socioeconomic Impacts

The proposed action would not require additional labor, nor would it require public services in Morgantown, West Virginia.

3.1.9 Summary of Impacts

The environmental effects associated with the design, construction, and operation of a 2-foot diameter, 50-foot high pressurized fluidized bed unit at METC have been reviewed. This project would have little or no impact on air quality, water quality/quantity, solid waste management, noise levels, floodplains, wetlands, historic areas, ecological resources, or socioeconomic factors.

3.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, DOE would not fund the proposed project at METC, and the proposal is not expected to be implemented in the absence of Federal funds. Therefore, the impacts described in this EA as a consequence of the proposed action would not occur.

4.0 LIST OF AGENCIES AND PERSONS CONSULTED

Carl Hackett
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Finding of No Significant Impact

MORGANTOWN ENERGY TECHNOLOGY CENTER

FUNDAMENTAL FLUIDIZATION RESEARCH PROJECT

AGENCY: U.S. Department of Energy (DOE)
ACTION: Finding of No Significant Impact (FONSI)
SUMMARY: The DOE has prepared an Environmental Assessment (DOE/EA-0575) that analyzes the potential environmental impacts for the design, construction, and operation of a 2-foot diameter, 50-foot high, pressurized fluidized-bed unit in an existing research building at the U.S. DOE's Morgantown Energy Technology Center (METC) in Morgantown, West Virginia. Based on the analysis in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act (NEPA) of 1969. Therefore, the preparation of an Environmental Impact Statement is not required and the Department is issuing this FONSI.

COPIES OF THE EA ARE AVAILABLE FROM:

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BACKGROUND: METC proposes to conduct fundamental research on fluidization technology by designing, constructing, and operating

a 2-foot diameter, 50-foot high, pressurized fluidized-bed unit. The anticipated result of the proposed project would be a better understanding of fluidization phenomena under pressurized and high velocity conditions. This improved understanding would provide a sound basis for design and scale-up of pressurized circulating fluidized-bed combustion (PCFBC) processes for fossil energy applications.

DESCRIPTION OF PROPOSED ACTION: The 2-foot diameter, 50-foot high, pressurized fluidized-bed unit would be an open-loop system, designed to suspend inert particles using warm air. The unit would operate under ambient or elevated temperature and pressure. Atmospheric air would be compressed to 75 pounds-per-square inch gauge (psig) and heated to 750 degrees Fahrenheit. The maximum air flow rate would be 16,000 actual cubic feet-per-minute. The air would be fed to the bottom of the fluidization vessel, where it would contact and suspend inert particles injected pneumatically by a separate air stream into the vessel. Limestone, sand, or plastic chips would be used as the inert particles. At the top of the vessel, four cyclone separators would collect and return carry-over particles to the bottom of the vessel. The warm air exiting the vessel would flow through a spray water cooler before entering a baghouse where fine particles would be removed. The air heaters would be fired with natural gas, and the exhaust flue gas would be discharged to the atmosphere. The 2-foot diameter, 50-foot high, pressurized fluidized-bed unit would be constructed in an existing research building at METC. The test program would investigate the effects of bed temperature (i.e., ambient to 750 degrees Fahrenheit), bed pressure (i.e., 20 to 75 psig), static bed height (i.e., 1 to 12 feet), and various physical properties of the solid materials, such as particle shape, size, density, and size distribution. The unit would operate approximately 36 hours-per-week (1,872 hours-per-year) for about one year.

ENVIRONMENTAL IMPACTS: The environmental effects associated with the design, construction, and operation of a 2-foot diameter, 50-foot high, pressurized fluidized bed unit at METC, have been reviewed and found to be clearly insignificant. This project would have little or no impact on air quality, water

quality/quantity, solid waste management, noise levels, floodplains, wetlands, historic areas, ecological resources, or socioeconomic factors. About 2 million pounds-per-year of carbon dioxide would be emitted from natural gas-fired heaters with no release of sulfur dioxide or sulfuric acid mist expected from the project. The total particle emission would be about 1,030 pounds-per-year. All required permits would be obtained prior to operation of the project. No solid waste would be generated by the project, as the solid bed materials (i.e., limestone, plastic, or sand) would be recirculated back to the unit in order to maintain the constant bed inventory. About 4.4 million gallons-per-year of water would be used for indirect cooling, and would be discharged to the atmosphere as steam. No increase in noise at the METC site boundaries would be anticipated from the project. Sound level measurements would be performed during operations, and proper signs and personal protection equipment (PPE) would be used in accordance with approved procedures. Because the project would be conducted within an existing research building, there would be no significant impact to floodplains, wetlands, historic areas, and ecological resources.

ALTERNATIVES CONSIDERED: Alternatives to the proposed action were considered in the EA. Under the No Action Alternative, DOE would not fund the proposed project at METC, and the proposal is not expected to be implemented in the absence of Federal funds. Therefore, the impacts described in the EA as a consequence of the proposed action would not occur. However, a no-action alternative would fail to provide necessary data for design and scaleup of PCFBC processes. A no-action alternative would delay or abort any technology transfer to industry, and any subsequent industrial plans to demonstrate PCFBC technology. Alternative sites were considered and dismissed for conducting the proposed research, but implementation would be cost prohibited. The unique expertise of the METC researchers and the availability of METC facilities were key factors in determining that the proposed Fundamental Fluidization Research Project should be sited at METC. Alternative technologies to PCFBC include fixed-bed, bubbling-bed, and entrained-bed processes. Each of the alternative technologies is already undergoing development at METC and/or its contractors.

PUBLIC AVAILABILITY: Copies of the EA and the FONSI will be distributed to all persons and agencies known to be interested in or affected by the proposed action or alternatives, including appropriate agencies within the State of West Virginia. Additional copies of the EA and FONSI are available on request from the DOE directly and from the Morgantown Energy Technology Center at the address given above.

DETERMINATION: The proposed action, Fundamental Fluidization Research Project, does not constitute a major Federal action normally requiring an Environmental Impact Statement. Based on the analysis provided in the EA, DOE determines that this action would not significantly affect the quality of the human environment within the meaning of the National Environmental Policy Act, 42 U.S.C. 4321 et seq. Therefore, an Environmental Impact Statement is not required.

ISSUED IN WASHINGTON, D.C. ON February 10, 1993

Tara O'Toole, M.D., M.P.H.
Assistant Secretary
Environment, Safety and Health

DISTRIBUTION LIST FOR FINAL ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT

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