DE-FC21-93MC30097--24
(6345)

Task 7.1 - Strategic Planning

Semi-Annual Report
July 1 - December 31, 1997

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Work Performed Under Contract No.: DE-FC21-93MC30097

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Disclaimer

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for the period July 1 through December 31, 1997
(including the quarterly reporting period of October 1 – December 31, 1997)

Prepared for:

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Cooperative Agreement No. DE-FC21-93MC30097--24
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January 1998

DISCLAIMER

ACKNOWLEDGMENT

This semiannual was prepared with the support of the U.S. Department of Energy (DOE) Federal Energy Technology Center, Cooperative Agreement No. DE-FC21-93MC30097. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the DOE.

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1.0 INTRODUCTION

Energy industry decisions on resources, utilization technologies, and environmental control measures are made in reference to changing patterns of fuel cost and availability, emerging technological choices, externality impacts, and governmental policies, statutes, and regulations. Energy and environmental research that makes a difference must be performed with an awareness of the forces that shape these future trends and should anticipate needs in advance to compensate for developmental lead time. Research relevance begins with the appropriate selection of research thrust and topical content and ends with integration, interpretation, and application of results in real-world commercial development. The Energy & Environmental Research Center (EERC) has endeavored to maintain a highly relevant research focus through activities dating back to the benchmark 1980 Low-Rank Coal Study, 1983 defederalization plans, and the 1991 comprehensive white paper on energy policy and technologies. Work was completed in FY94 on an energy and environmental profile for selected East Central European nations and more recently on a series of in-house white papers dealing with key environmental issues including global warming.

2.0 OBJECTIVES

Task 7.0 continues a limited effort devoted to strategic studies under the base Cooperative Agreement. The objective of this activity is to understand the potentialities, limitations, and status of competing energy technologies in terms of scientific basis, state of development, technical barriers, cost, efficiency, policy treatment, and environmental performance for the purpose of planning and evaluating research activities under the Cooperative Agreement. This work is performed under the direction of the EERC Director and Associate Directors to provide guidance in planning the broad outline for future research under the Cooperative Agreement in keeping with industry needs and national goals. This is being accomplished through the combination of directed studies, under Activity 1, Technical Assessment, and under Activity 2, Technical Oversight.

3.0 ACCOMPLISHMENTS

3.1 Technical Assessment

Information prepared on “Issues in Application of Advanced Power Systems to Low-Rank Coals” was presented at the U.S. Department of Energy (DOE)-sponsored Pittsburgh Coal Conference and Workshop held in Taiyuan, China (no travel was charged to this activity). The paper traced progress in combustion science and boiler design which has resulted in highly successful utilization of low-rank coals for power production in the United States, where nine of the ten steam electric plants having the lowest average operating cost over the past 5 years were

fueled on lignite or subbituminous coal. Problems have been largely resolved in pulverizing and burning high-moisture coals and remediating serious ash fouling and slagging. Serious ash deposition caused by high-temperature reactions of ionically bound sodium and calcium with silicates and sulfur has been remedied through changes in design and operating parameters, including added mill capacity, larger furnaces, lower furnace exit temperatures, wider tube spacings, on-line cleaning, and combustion additives. Current issues in conventional boilers burning low-rank coals are mainly concerned with improving the control of emissions, including acid gases (SO_2 and NO_x), fine respirable particulates, and toxic metals such as volatile mercury and selenium, while maintaining stable operation and high carbon burnout. In a future concerned over possible global warming, the challenge in utilizing low-rank coals will be to achieve substantially higher efficiencies and lower carbon emissions per unit of electricity generated at a cost that competes with inherently cleaner energy sources such as natural gas and nuclear. Emerging advances in power systems based on supercritical steam cycles, combined turbine cycles (PFBC and IGCC [pressurized fluidized-bed combustion and integrated gasification combined-cycle]) and fuel cells offer significantly improved efficiencies, but new issues are raised by the distinctive utilization properties of low-rank coals in these technologies. High moisture content in low-rank coals both reduces the energy density in the coal slurry feed to pressurized systems and increases stack losses unless water can be rejected hydrothermally. The high-sodium ash and low-viscosity slag from some low-rank coals pose special problems of high-temperature corrosion and deposition on heat exchange surfaces, hot-gas filters, and turbine blades made from new ceramic and alloy materials. Fouling and slagging occurring under reducing conditions in gasifiers and hot-gas-cleaning systems are as yet not adequately understood.

Recent EERC research on sorbents for controlling mercury emissions from coal-fired combustion was reviewed to establish the basis for patent applications.

3.2 Technical Oversight

Current research was reviewed in planning for the 1998–2002 renewal of the Cooperative Agreement and in preparation for the August 1997 Program Review held at the EERC. A topical reveiw of the significant findings and products for the current agreement was prepared and is included as Appendix A.

Research for 1998 will be proposed based on the following priorities:

- Air toxic metals, with emphasis on mercury: occurrence, measurement, transformations, and control.

- Fine respirable particulates: measurement of composition by size for primary and secondary particulates from combustion sources and avoidance/control methods.

- Assessment of past climate change and options for reducing greenhouse gas emissions: climate markers in the geological record, barriers to high-efficiency power systems, integration of fossil energy with renewable energy resources, and CO_2 sequestering.

- Waste management: mercury measurement and stabilization in solid wastes, economic treatment and remediation of liquid and solid wastes from oil and gas production and processing.

Information developed through the preparation of in-house white papers played a key role in the preparation of the proposed Cooperative Agreement. The preparation of "The Policy Assessment on Climate Change" demonstrated the need for placing a higher priority on research activities directed toward understanding and mitigating greenhouse gas emissions and climate change, including 1) climate markers in the geological record; 2) barriers to higher-efficiency power systems; 3) integration of fossil fuels and renewable resources, applying extensive existing background on high-alkali ash chemistry applicable to biofuels; and 4) new concepts for separating and sequestering carbon dioxide, including engineered biosystems that can be integrated with power systems. Development of the emissions research activities was supported by the white paper on nongreenhouse emissions. The development of the solid waste priorities was supported by the white paper on wastes and waste management.

4.0 FUTURE WORK

The task has been extended to June 30, 1998. In the coming reporting period, efforts will continue to be focused in the areas of Strategic Investigations and Technical Oversight as directed by EERC senior management. In the near term, efforts will be directed toward analysis of distributed power systems and supplementing the in-house environmental white papers, including the report on climate change.