

ENERGY STUDIES



Drs. Sally Cook Lopreato, Martin Baughman, and Michael Kennedy, part of the CES technical study team, discuss procedure for the California Nuclear Initiative Analysis.

CES CHOSEN FOR NUCLEAR INITIATIVE STUDY

The Federal Energy Administration has commissioned perhaps one of the most important energy policy studies of 1976 under contract to the Center for Energy Studies. CES will assess the economic, social and environmental effects of both constrained and unconstrained nuclear power development on California and several neighboring Western states under two basic but very complicated futures.

The reference future is a business-as-usual scenario where nuclear power *growth* is not constrained by legislation. Another, a more complicated scenario, examines the impacts of the passage of the California Nuclear Safeguards Initiative scheduled for a June 8th ballot.

Currently, over 20 states are considering legislation which prohibits, restricts or otherwise regulates the operation of nuclear power plants. National attention is focused on California where the issue will come to the voting booth for the first time. While the phrase "as California goes, so goes the nation" may or may not prove prophetic, it is clear that legislation that either restricts or stops the growth of nuclear power plants is the central nuclear issue of 1976.

The study is being conducted under the direction of Dr. Martin Baughman and Dr. Herbert Woodson. Baughman says the special research team will not be addressing the questions of whether nuclear plants represent acceptable safety risks, but rather will conduct a systematic and dispassionate assessment of the impacts of alternative methods for meeting energy requirements.

Specific areas to be examined include cost of electricity, personal income, tax base, employment levels, Gross State and National Products, balance of payments, capital requirements, water, air and land-use environmental considerations, dependence on other states and other countries for substitute fuels, in addition to other areas. The results of the competitively-awarded contract are slated for release in late April, and will be available to the public.

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EDITOR

BARBARA K. GRAHAM

THE EFFICIENT UTILIZATION OF TEXAS LIGNITE

Mike E. Leesley, *Coordinator of Lignite Studies*

There are an estimated 10 billion tons of easily-recoverable lignite in the State of Texas, and considerably more in deeper seams. Whatever balanced plan is implemented to exploit indigenous energy sources, it is both appropriate and essential that lignite should play a role. However, we must consider its most efficient utilization. Though it could be burned in steam-raising equipment, modern process technologists should regard this as much of a sin as that committed by the early Texans who burned unprocessed crude oil. Both raw fuels are a rich source of feedstocks for a very wide spectrum of the chemical industry.

The problem, then, is to develop some method of stripping these valuable chemicals from the lignite prior to its combustion. Because the method must be feasible both from an engineering and an economic standpoint, CES has proposed the "UT Process" as a possible answer. Briefly, the Process can be described as follows:

1. Air dried lignite is pulverized to less than 300 microns in a mill which is swept by hot gases recycled from #6 or #7 below.

2. Carbonization of the lignite occurs and a major portion of the volatile matter is evolved leaving a carbonaceous char. The temperature is controlled at about 900°F by introducing air, if necessary, to burn some of the lignite.

3. The char is separated from the carrier gases and vapors in a hot cyclone.

4. The gases and vapors are subjected to a conventional separation chain to give a low BTU gas, aliphatics, aromatics, sulfur compounds and an ammoniacal liquor.

5. The char is further pulverized, if necessary, to less than 150 microns in an air-swept mill.

EITHER 6. The char is burned in a conventional pulverized fuel boiler to raise steam. Attempts will be made to develop a high-intensity combustor to slag the ash. The hot combustion gases will be recycled to #1 above.

OR 7. The char is gasified in an air-stream mixture and the resulting gas recycled to #1 above or burned in a combined gas-steam turbine.

Research Outline

The research program has been organized into (*Phase 1*) estimation of the engineering and economic feasibility; (*Phase 2*) design, construction and proving of experimental rigs to gather necessary data on the mechanisms of carbonization and combustion of lignite; (*Phase 3*) process design of a separation train; (*Phase 4*) detailed engineering simulation of the total process using the collected data; and (*Phase 5*) construction of a pilot plant, in conjunction with suitable sponsors.

Phase 1 is nearing completion, and indications¹ are so encouraging that preliminary work for Phase 2 has already commenced. Phase 2 is attracting wide-spread industrial interest because in addition to compiling the necessary data, the experimental equipment will have other important uses, described later in this article.

The research program is to build a one-dimensional plug-flow reactor or furnace. Essentially, the furnace will be a 24 foot refractory cylinder, 18 inches in diameter, and vertically mounted with provision for admission of the fuel-air mixture at the upper end. Careful, accurate design and construction will insure that there is no recirculation from the end of the flame to the ignition and early reaction zones. This feature is especially important since it entirely divorces the reaction mechanism from the masking effects of aerodynamic factors and thus makes relatively simpler the calculation of specific reaction rates from measured data.

Further, the one-dimensional characteristic insures that flame properties vary along the flame length only. Thus the reaction profile will be flat and only negligible radial transport will occur. The design for the equipment is an enhancement of a similar facility proven by the author at the University of

Sheffield, England², using the earlier ideas of Beer and Thring³. The furnace will be provided with ports spaced 12 inches apart for the purposes of taking temperatures, gas and solid samples for analysis.

Experimentation will be broken down into three series of runs, the data from which will be used to carry out the process and design of the "UT Process." In the first, 50 lb/hr of pulverized lignite will be burned with 10% excess air. The data will be used to compute the specific reaction rate of lignite as a function of temperature and partial oxygen pressure using the theory² developed by Leesley. A second series of runs will simulate the carbonization process using a propane burner to generate hot gases. An empirical carbonization rate equation will be developed. The lignite char produced in the second series will be collected and stored to be burned at 50 lb/hr with 10% excess air to determine its specific reaction rate as before.

Equipment

The equipment could also have other important uses. Later experimentation will be devised to discover the relationship between the reaction rate of lignite and such parameters as (1) percent excess air, (2) initial particle size distribution, (3) recirculation, (4) swirl, and (5) different lignite compositions and types. The design of the equipment has taken into account these future requirements.

Finally, there is one further, equally important use for the equipment. Industrialists who own and sell lignite need to specify the burning characteristics of their product for the design engineers of their potential customers. A thorough combustion or carbonization investigation using an industrial-sized plant may need thousands of tons of fuel, necessitating a large-scale mining venture to produce the lignite for the trials. Using the one-dimensional furnace, complete and accurate burning data can be compiled with a fuel supply of around 10 tons.

Conclusions

The entire research program has been structured to insure industrial input early-on to smooth the transition from university research to an industrially-oriented pilot demonstration plant, and hence to speed the eventual development of this important resource. A *Lignite Research Advisory Committee* has been formed by invitation to companies with relevant experience and expertise, and financial interest in the research. While the Committee will be kept small in order to be responsive, vacancies still exist and an early attempt will be made during 1976 to bring it to full working strength. Frequent and regular seminar sessions will involve UT researchers, ERDA officials, and the industrial members.

We must insure that the vast lignite resources of Texas and other states be used to their fullest advantage. The described research program is primarily aimed at gathering the necessary hard data to determine feasibility. While the "UT Process" may be modified by experience, the basic concept of stripping off the useful chemicals before combustion will be adhered to throughout. Further, strong industrial input will be encouraged at all phases. Earliest commercialization backed by unique but commonsensical methodology characterizes the program.

References

- ¹Leesley, M. E., Aul, E. F. Jr. and Massey, N., current research, Department of Chemical Engineering, University of Texas at Austin.
- ²Leesley, M. E., "Prediction of the burning rate of pulverized anthracite from particle size distribution parameters only," 68th Annual Meeting of A.I.Ch.E., Los Angeles, Nov. 1975.
- ³Beer, J. M., and Thring, M. W., Proceedings of the Anthracite Conference, Bulletin 75, Penn State Univ., Sept. 1961.

AN OVERVIEW OF SELECTED MAJOR PROGRAM AREAS

COMMERCIALIZATION

"The Energy Forum," the weekly energy information newspaper column prepared by the CES commercialization group, has now been accepted for publication by 30 Texas daily newspapers having a combined readership of nearly 1 million. The papers cover the state geographically from El Paso to Amarillo to Corpus Christi and Brownsville, and readership response has been most encouraging. Any newspaper may request use of the column free of charge by writing "The Energy Forum" in care of CES.

CONSERVATION

The CES conservation studies group is currently involved in a relatively new area of research to determine the impact of conservation on future energy demands. Though previous studies have included conservation only as a price response, CES researchers are also taking into account nonpricing items such as building standards, and mandatory efficiency standards for appliances, industrial equipment, and transportation . . . Dr. Jerold W. Jones, coordinator of CES conservation studies, gave an extensive briefing to the buildings and industry section of the Energy Research and Development Administration in Washington in early January on current projects and future plans of the CES conservation section.

ELECTRIC POWER

The CES electric power program is designed to provide a research, educational, and public service capability that is responsive to the needs of the Texas utility industry, the various state agencies, and the public. Current research in this area, under the direction of Mr. D. G. Hannan, is focused on four program areas: Load factor improvement and load management, impact analysis, and short course development. The electric power program complements and is inter-related with most of the Center's indicated areas of research.

ENVIRONMENTAL

The University of Texas hosted a conference on air quality management in the electric power industry January 28-30. The conference was a review of the state-of-the-art of air pollution control and was attended by those directly involved in environmental quality control for the electric power industry. Dr. Richard Balzhizer, Director of the Fossil Fuels and Advanced Systems Division of the Electric Power Research Institute, gave the keynote address. A full day of the conference was devoted to throw-away and regenerative sulfur dioxide flue gas desulfurization processes. Another session emphasized coal liquefaction and gasification processes for providing clean boiler fuels.

GEOHERMAL

Dr. Myron Dorfman, Director for CES Geothermal Studies, presented the paper, "Potential natural gas reserves in the US Gulf Coast geopressured geothermal zones," by special invitation to the National Research Council in Washington last month. The Council is the principal operating arm of the National Academy of Sciences and the National Academy of Engineering . . . Dr. Roy M. Knapp, Assistant Professor of Petroleum Engineering, has received a \$175,000 grant from the Energy Research and Development Administration for a twelve-month study commencing February 1, 1976 to develop a suite of computer programs that can be used to model the behavior of the Gulf Coast geopressured geothermal aquifers. The simulation studies will increase the understanding of geopressured geothermal systems so that extraction techniques can be improved, long-term forecasts can be made of performance using various extraction strategies, amount of surface subsidence due to production can be predicted, and the relative desirability of continued production of a given field can be assessed.

NUCLEAR

Dr. E. Linn Draper, coordinator of CES nuclear studies, is continuing promotion of a public information program on nuclear energy. Dr. Draper was one of three nuclear proponents who spoke at a day-long meeting of approximately 150 ministers in Tulsa, Oklahoma during January. The ministers are researching a resolution being considered by the National Council of Churches which would oppose nuclear power on the basis that dissemination of large amounts of plutonium is immoral. One of Dr. Draper's contentions is that it might be equally as immoral or unethical to burn up all the fossil fuels in the world. The Oklahoma ministers are especially interested in the controversy because the state is considering promoting a referendum to slow down construction of nuclear plants.

SOCIAL SYSTEMS

The social systems research group is cooperating with the Bureau of Economic Geology in providing an evaluation of the need for an environmental impact statement regarding a test well for the US Gulf Coast geopressured geothermal resource. Among other things, the study will evaluate the potential impact on the sociocultural environment brought by drilling and continued operation of the geothermal test facility. Important variables on the individual level will include cost of living, per capita income, unemployment, and environmental health. The social organization dimension will include data on employment levels, occupational distribution, and tax base and capital formation.

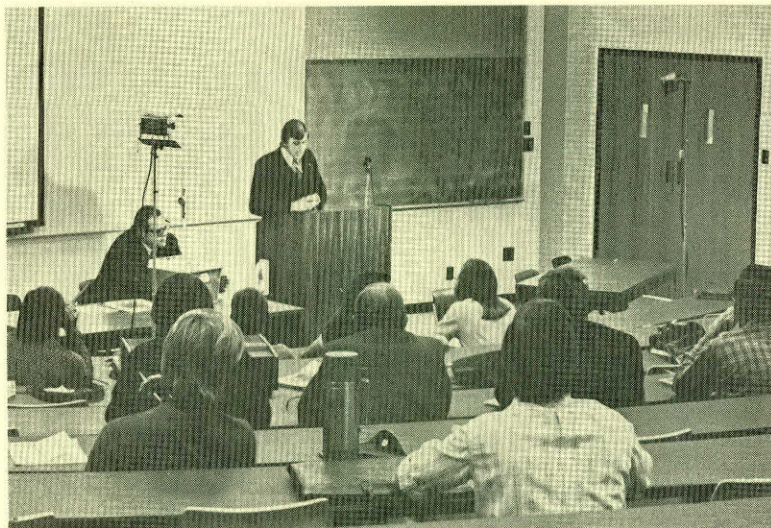
SOLAR

Continuing research efforts in the CES solar studies division have resulted in several exploratory proposals to the Energy Research and Development Administration. These include a proposal to assess and recommend design features in new housing and mechanical equipment so that a changeover to solar energy at a later date can be facilitated at minimum expense. Also, the solar researchers propose to investigate the potential for storing solar energy within an absorption system and ultimately using it in the heat pump as well as the cooling model for the system . . . Dr. Gary C. Vliet, coordinator of CES solar studies, and Dr. Jerold W. Jones, coordinator of CES conservation studies, are currently making plans for a four-day short course on "Solar Energy and Energy Conservation in Residential/Commercial Buildings" to be held May 12-15 on the University of Texas at Austin campus.

BRIEFINGS AIRED ON TV

In an effort to extend its educational and public service functions, CES is videotaping its Spring, 1976 series of energy briefings for replay over the University of Texas closed circuit network (See *ENERGY STUDIES, VOL. 1, NO. 3*).

The activity is an original project of the Center and the staff of the University's Closed Circuit Communications Division. The edited television version is regularly shown at 4 p.m. on the Wednesday following the briefing over the University's closed circuit Channel 2. The program is further available for individual scheduling by University of Texas instructors as well as by those at St. Edward's University, Austin; Southwest Texas State University, San Marcos; and St. Mary's University, San Antonio.



Clif Drummond, CES Liaison Officer, introduces Professor Ben Caudle of UT's Petroleum Engineering Department at the first of the Spring, 1976 Briefings.

GEOHERMAL CONFERENCE REPORT NOW AVAILABLE

The Proceedings of the First US Geopressed Geothermal Energy Conference, edited by Dr. Myron Dorfman, Director for CES Geothermal Studies, and Dr. Richard Deller, Assistant Director, is now available for distribution. The 369-page, illustrated document contains the complete record of the conference activities, including both the invited papers, and the discussions between the authors and participants.

The purpose of the Energy Conference was to describe the geological system, the reservoir engineering aspects, the surface technology, and the institutional, legal, and environmental problems that must be studied with reference to the US Gulf Coast geopressed geothermal project. This project, conducted solely by University of Texas researchers, is the first major analysis of a geopressed area in the world. The Conference, held at UT Austin June 2-4, 1975, is considered to be a major bench mark in geothermal energy development.

To obtain a copy of the *Proceedings*, send \$12.50 (Texas residents add \$0.63 for sales tax) to: Publications, Center for Energy Studies, The University of Texas at Austin, Austin, TX 78712.

SECOND ERDA ANALYSIS BEGUN FOR CONGRESS

CES has received a continuation grant from the US Congress Office of Technology Assessment (OTA) for further assessment of the nation's energy research and development plans (See *ENERGY STUDIES, VOL. 1, NO. 3*). The Center's staff will analyze the 1976 revised Energy Research and Development Administration (ERDA) Plan and Program for the OTA, which is the research arm of the Congress.

According to Dr. Charles Fergusson, Project Coordinator, the Center's primary responsibility will be to compare the revised Plan with the original Plan, and to assess the extent to which the OTA analysis has been incorporated into the revised Plan. The result, says Dr. Fergusson, will be "a model for an interdisciplinary assessment by a university research group."

Center for Energy Studies
Engineering Science Building 305
The University of Texas at Austin
Austin, Texas 78712