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September 10, 1979

Date: _____

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INTERNAL TECHNICAL REPORT

Title: PROGRAM PLAN FOR CONVERSION OF BIOMASS TO
LIQUID FUEL USING GEOTHERMAL ENERGY

Organization: Geothermal Technical Development Program

Author: B. E. Chaney, J. K. Jacoby, D. M. LaRue

Checked By: C. A. Allen

Approved By: _____

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Simmons, Patty

From: Dale J Claflin [Dale.Claflin@inl.gov]
Sent: Thursday, December 07, 2006 8:43 AM
To: Simmons, Patty
Cc: Claflin, Dale; Flynn, Vesta; Ponce, Linda
Subject: Re: EG&G Idaho Geothermal Reports
Attachments: EG&G Patent Docs.doc

Patty,

The 13 reports listed are all OK for unrestricted release. Please remove (cover up) the patent caution wording, as well as any other statements concerning restricted distribution. We don't have a concern with the "Internal Technical Report" words, but if you feel it would eliminate confusion by removing that term, please do so. Let me know if you need anything else.

Dale Claflin
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"Simmons, Patty" <SimmonsP@osti.gov>

To dfc@inl.gov

12/06/2006 12:34 PM

cc "Ponce, Linda" <poncel@osti.gov>, "Flynn, Vesta" <flynnv@osti.gov>

Subject EG&G Idaho Geothermal Reports

Dale,

OSTI has been working on a project for the last year or so to collect geothermal documents. At the STIP meeting in April, I sent out a plea to the DOE labs to identify and send to OSTI any geothermal documents that we did not already have in our database. I have a problem with a group of reports from EG&G Idaho. I am not sure you are the person correct person to ask for help on this issue. If not, maybe you can direct me to the responsible individual.

Attached is a list of documents that were sent to OSTI as part of that special geothermal project. All of the documents in this list have a patent caution as well as 'Internal Technical Report' stamped on the front of the report. The date on each of the documents is well past the sunset date for patentable material. If there is no other reason for control, I would like permission to cover up the patent caution and release each as unlimited. Would we also need to cover 'Internal Technical Report'?

If you need me to, I will be happy to fax you a copy of the covers of the reports.

Please let me know if you can help me out with this problem, or advise if I should communicate with someone

12/7/2006

else - and who

Thanks ahead for your help,
Patty

Patty Simmons

U.S. DOE Office of Scientific and Technical Information

simmonsp@osti.gov

865-576-1290

12/7/2006

GP-AP-008

September 10, 1979

PROGRAM PLAN FOR CONVERSION OF BIOMASS TO
LIQUID FUEL USING GEOTHERMAL ENERGY

Geothermal Technical Development Program

R. E. Chaney, J. K. Jacoby, D. M. LaRue

C. A. Allen

SUMMARY

Due to the decreased supply of petroleum and the large quantity of import oil, there exists sufficient economic justification to develop a biomass-liquid fuel industry. Geothermal energy uniquely fits the biomass production and conversion requirements. To accelerate industrial development of biomass-to-liquid fuel conversion using geothermal energy, a national program is required. Because of the INEL's unique experience in moderate-temperature geothermal applications, they should take the lead in this program.

Based on an extensive survey of the biomass conversion field, areas of needed work were identified and a program plan was developed. This plan separates the INEL role into two parts.

- Commercial Support - Existing technology can be commercially applied to provide a portion of the liquid fuel needs. To accelerate development, INEL needs to provide technical and management support to existing programs such as direct assistance, loan guarantees, PONs, and PRDAs.
- Technical Development - Application of new geothermal technology in the production and conversion of biomass can increase the quantity of domestically produced liquid fuel. The program plan identifies needed work down to the task level.

Three cost account levels are identified: (1) Biomass-to-Liquid Fuel Technology, (2) Biomass-to-Liquid Fuel Advanced Technology Demonstration, and (3) Biomass-to-Liquid Fuel Commercial Support. The end item is an advanced technology demonstration plant with an FY-86 target date. This plant should be built by the private sector through cost sharing, loan guarantees, or the PON program. However, it could be built by a government contractor.

Development work will be centered at INEL, but much of the work will be contracted to take advantage of outside expertise and for technology transfer

reasons. Other programs, agencies, institutions, and companies are performing and will perform related work. Continued interface is necessary to build national expertise and avoid duplication of effort.

The enclosed program plan is an integrated approach to industrial development of biomass-to-liquid fuel using geothermal energy. It incorporates existing INEL projects and needed work into an integrated program. Costs are projected for technical development and commercial support for FY-80 and FY-81. Demonstration plant costs are not included since further definition is required and the start date is three years away. Cost for FY-80 is projected to be \$2,507K and \$4,252K for FY-81.

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INTRODUCTION

In the last few years the use of fuels, particularly oil and gas, has grown to the point where demand cannot be met by traditional sources at traditional prices. As easily accessible domestic sources have been depleted, importation of oil has steadily increased and now accounts for half of the liquid fuels consumed in the United States. Additionally, the worldwide production of fuels from nonrenewable resources cannot meet increasing demand. Therefore, now fuel sources must be developed which rely on renewable resources which are essentially inexhaustible.

Over half of the liquid fuels used in the United States are for transportation. Since liquid fuels are required for the large-scale transportation needs of the country, sources for these liquids must be developed. In the near term, alcohol, either in mixtures (Gasohol) or as straight fuel, is a viable alternative to imported oil as a transportation fuel. It has been demonstrated in a number of road tests, in Brazil's national program, and in the growing public involvement in small-scale farm production and use of alcohol fuels in internal combustion engines.

One source for alcohol is renewable biomass which can be in the form of sugar or starch agricultural crops, cellulose, or lignocellulose products or wastes. Some of these biomass sources are currently being used; others require development to reach their potential. Many programs are currently underway to perfect these conversion processes.

The potential for biomass utilization is dependent upon the available land which can be used to produce "energy crops" and the yield of biomass/acre. Each acre in the United States receives average incident solar radiation equivalent to 10 or more barrels of oil per day. The conversion of this radiation to biomass and the production of usable fuel from the biomass is the problem which this program will address.

Geothermal energy is an energy source which is currently being developed but has not reached its maximum utilization potential. By its nature, it is

site-specific and nontransportable. "Conversion" of this resource into transportable and/or transportation fuel will help accelerate its development and utilization. In most cases, geothermal fields are located in fairly remote areas away from population and industrial areas. However, proximity to biomass resources makes it a natural choice as a process heat source for many moderate-temperature processes in biomass-to-liquid fuel conversion schemes. The marriage of these two energy technologies seems a logical step in the solution of the current energy problem.

To keep perspective, it is the general consensus that no single approach to the solution of the energy problem will be sufficient. Rather a series of technologies, developed in parallel, will offer the solution. Alcohol fuel is just one phase of the required effort and the geothermal/biomass approach is part of that thrust.

OBJECTIVE AND CONSTRAINTS

EG&G Idaho began an internal TDP to evaluate the field of biomass conversion and the unique position of INEL in geothermal technology to determine if a program should be initiated to combine the two and if so, the approach which should be taken in developing the technology.

The objective of the Program Plan/Work Package Group of the Geothermal/Biomass Conversion TDP is to evaluate the technology and recommend what DOE-ID/INEL's role should be in the application of geothermal energy to the production of petroleum substitutes from biomass materials.

The conclusions and recommendations reported here resulted from literature searches, conference attendance, and extensive discussions with workers in the field. These recommendations were made within the boundaries of five basic constraints

1. Major emphasis placed on geothermal application.
2. Duplication and/or competition with academic or commercial organizations in development work will be avoided.
3. Long-range goals and advanced process technology will be stressed so that needed research will be begun in a timely manner.
4. Develop a program plan which will establish DOE-ID/INEL's leadership in the field so that our expertise will be effectively applied to the solution of the energy problem.
5. Identify those areas where DOE-ID/INEL can assist other organizations in the development of facilities or processes.

It was determined that a geothermal/biomass conversion program was needed and that a program plan should be developed to incorporate geothermal process technology and biomass conversion.

APPROACH TO THE PROGRAM PLAN

As stated in the objective, our role is to promote geothermal usage, not to develop a totally independent program for biomass conversion. Many of the necessary background investigations have been undertaken and completed by other organizations. Distillation is an established industrial process. Many agricultural groups have already begun work in this field. Industrial concerns are actively planning production plants. However, conclusions concerning our involvement are clear and, therefore, guided the development of the program plan.

- Geothermal wetlands may provide an attractive source of biomass input material.
- Development of front-end processing of the biomass is required, particularly for geothermal application.
- Mixed-feed systems should be developed.
- Work is needed to lower the temperature requirements of some processes to allow utilization of a broader range of geothermal resources.
- Cascading processes should be emphasized for maximum energy utilization efficiency, i.e., use of the discharge of electrical power plants as a heat source for liquid-fuel production plants.
- Both large- and small-scale facilities will be built. We should be prepared to assist both.
- An integrated approach to the total process system is necessary for energy and water conservation.
- Small-scale plants in the near term will use agricultural products. Thus, we should assist in the education of private individuals in the application of geothermal resources and process technology.
- Long-term biomass sources require the use of cellulose and cellulose/starch/sugar conversion processes.
- Byproduct utilization should be stressed to effect cost reduction.
- The end product of the program should be a commercial-scale plant demonstrating the application of geothermal/advanced conversion technology.

MILESTONE SEQUENCE CHART

The milestone chart specifies the critical path towards the operation test of the advanced technology demonstration plant beginning in FY-86.

The initial milestone is the establishment of an experimental plan to lead to process selection. The experimental plan is the product of the results of several work packages intended to define the boundaries within which the overall process must be designed. These packages include most of the basic and developmental research which must be conducted.

The process selection milestone includes the selection of feedstocks, various process stream and side stream control/usage techniques. This will in turn be tested on a pilot-plant scale. The results of the pilot tests will be summarized in a report. This report will be followed by the selection of site for large-scale plant construction.

Site selection will encompass geothermal resource definition coordinated with biomass availability and environmental evaluations. The geologic studies, field development plans, and agricultural/biomass resource assessment will be segments of this selection process.

After the site and processes have been defined, conceptual design and sizing of the plant will be undertaken followed by construction and a one-year operation test. The actual construction/operation of the plant may be done through a loan guarantee, PON, or as a DOE-ID project. This is to be defined as the program progresses.

MILESTONE SEQUENCE CHART

GEOTHERMAL/BIOMASS CONVERSION PROGRAM

WORK BREAKDOWN STRUCTURE

The objective of the Geothermal Biomass Program is to promote the use of geothermal resources in the commercial production of petroleum substitutes from biomass materials. The role of INEL is seen as twofold: provide support for the commercialization of state-of-the art facilities and develop advanced technology to increase the number of geothermal and biomass resources which can be used to increase the liquid fuel supply. This program will culminate in the construction of a production plant using advanced technology by FY-86.

The program plan outlined here includes three major cost account level segments: Technology, Advanced Technology Demonstration, and Commercialization. These include 11 work packages directed towards the construction of a plant employing the most advanced technology available. The turn-key target date is 1986. Below is a brief synopsis of each work package. The complete work packages are included in the Appendix.

(6AB1511) Geothermal Application and Advanced Process Development

Geothermal Applications are those topics which require development for effective utilization of geothermal energy to provide process heat. These include linking subsequent processes for maximum energy utilization, heat exchanger applications, and the use of geothermal water in the process flow. The emphasis of Advanced Process Development is low-temperature process improvement to extend the number of useful geothermal resources. Also included are emerging technologies such as cellulose and lignocellulose conversion which will enlarge the useful biomass resource available for fuel production.

(6AB1512) PRDA Support

This work package includes the administration of the Bechtel and other potential contracts. Involvement in commercial projects is critical to maintenance of up-to-date information as well as assisting in the development of state-of-the-art technology.

(6AB1513) Biomass Production

Biomass Production is intended to develop the production of energy crops uniquely suited to geothermal applications. Included are investigations of geothermal wetlands, soil warming to increase the production period of agricultural crops, silviculture, native plants, integrated systems, land use and economic analysis.

(6AB1514) Specialty Products

This work package will emphasize the development of processes which will isolate valuable chemical byproducts which have a sufficient market to provide revenue to increase the profitability of the overall operation.

(6AB1515) Byproduct Utilization

This will analyze the usefulness of the byproducts for animal feed, protein supplements, solid fuels, and CO₂ for greenhouse atmosphere control. Included will be analyses of livestock feeding programs and nutritional evaluations.

(6AB1516) Test Facilities

These will be constructed to evaluate the advanced processes as they are developed. Included are the small-scale test unit at Raft River, a mobile demonstration unit to be designed and built in conjunction with lignocellulose conversion work of CSU, and an advanced technology pilot plant for scale-up to the demonstration plant.

(6AB1521) Site Selection

This includes biomass availability evaluation, geothermal resource definition, and field development plans for a large-scale commercial production plant to be constructed and operational by 1986. The start-up date for this package will be FY-82.

(6AB1522) Commercial Plant Process Selection and Design

This work will begin in FY-82 and will include all aspects required to generate a conceptual design of a large-scale production plant.

(6AB1523) Plant Contract and Construction

This package includes contractor selection, field development, design, construction, and start-up of an advanced technology production plant. This will begin subsequent to the conceptual design. The operational details will be defined as the program develops. This may be done through a loan guarantee, PON, or as a DOE-ID project.

(6AB1531) Technology Transfer

The functions of this work package include dissemination of information to interested outside organizations and individuals, economic analyses for site studies, and market surveys.

(6AB1532) PON/Loan Guarantee Support

This package will provide technical and management support to DOE for PON and Loan Guarantee Programs which are related to geothermal/biomass commercialization projects.

The estimated cost of this program for FY-80 is \$2,507,000. This increases to \$4,251,800 in FY-81. Much of the development work is intended to be contracted to outside organizations for maximum benefits to be derived from the investment. The total INEL effort in biomass conversion will be coordinated within this program.

An integrated schedule for the program will be formulated within the next few weeks.

GEOTHERMAL/BIOMASS CONVERSION
(6AB1500)

BIOMASS-TO-LIQUID FUEL
TECHNOLOGY
(6AB1510)

GEOTHERMAL APPLICATION
& ADVANCED PROCESS
DEVELOPMENT

PRDA SUPPORT

BIOMASS PRODUCTION

SPECIALTY PRODUCTS

BYPRODUCT UTILIZATION

TEST FACILITIES

BIOMASS-TO-LIQUID FUEL
ADVANCED TECHNOLOGY
DEMONSTRATION
(6AB1520)

CONTRACTOR SELECTION

DEMONSTRATION PLANT
PROCESS SELECTION &
DESIGN

DEMONSTRATION PLANT
CONTRACT & CONSTRUCTION

BIOMASS-TO-LIQUID FUEL
COMMERCIALIZATION
(6AB1530)

TECHNOLOGY TRANSFER

MANAGEMENT SUPPORT
FOR DOE COST SHARE
PROGRAMS

BIOMASS-TO-LIQUID FUEL
TECHNOLOGY
(6AB1510)

BIOMASS-TO-LIQUID FUEL
ADVANCED TECHNOLOGY
DEMONSTRATION
(6AB1520)

CONTRACTOR SELECTION
(6AB1521)

- ISSUE RFP
- REVIEW PROPOSALS
- ISSUE CONTRACT

DEMONSTRATION PLANT
PROCESS SELECTION &
DESIGN
(6AB1522)

- ANALYSIS
- SELECTION
- SPECIFICATION
- CONCEPTUAL DESIGN

DEMONSTRATION PLANT
CONTRACT & CONSTRUCTION
(6AB1523)

- CONTRACT
- TITLE I
- TITLE II
- CONSTRUCTION
- ACCEPTANCE
- OPERATION

BIOMASS-TO-LIQUID FUEL
COMMERCIALIZATION
(6AB1530)

TECHNOLOGY
TRANSFER
(6AB1531)

TECHNICAL
ASSISTANCE

ECONOMIC
ANALYSIS

MARKET
SURVEYS

MANAGEMENT SUPPORT
FOR DOE COST SHARE
PROGRAMS
(6AB1532)

ISSUE RFP

PON

LOAN GUARANTEE

OTHER

COST SUMMARY

Included are the estimated cost summaries for FY-80 and FY-81. All values include a 30% contingency. Where possible, the performing organization and man hours have been indicated. Further details will be considered subsequent to program approval. The total project costs are \$2,507,000 for FY-80 and \$4,251,800 for FY-81. Those work packages which are scheduled to begin after FY-81 have not been cost estimated.

FY-80 COST ESTIMATES

<u>Work Package</u>	<u>Organization/Hrs</u>	<u>Cost</u>	<u>Current Funding Level</u>
6AB1511 Geothermal Application & Advanced Process Development	7120/9600	\$520 K	\$261 K
6AB1512 PRDA Support	7510/500	148.4K	135 K
6AB1513 Biomass Production		350.2K	
6AB1514 Specialty Products	7130/1600 7120/320	71.5K	
6AB1515 Byproduct Utilization	7130/2160 7120/800	188.2K	
6AB1516 Test Facilities		721.5K	
6AB1521 Contractor Selection		-0-	
6AB1522 Demonstration Plant Process Selection & Design		-0-	
6AB1523 Demonstration Plant Contract & Construction		-0-	
6AB1531 Technology Transfer		319.6K	
6AB1532 Management Support for DOE Cost Share Programs	7510/1000	2,040 K	
		<u>\$4,359.4K</u>	<u>\$396 K</u>
	Total	\$4,755.4K	

FY-81 COST ESTIMATES

<u>Work Package</u>	<u>Organization/Hrs</u>	<u>Cost</u>
6AB1511 Geothermal Application & Advanced Process Development	7120/13,440	\$780 K
6AB1512 PRDA Support	7510/1000	2120 K
6AB1513 Biomass Production		305 K
6AB1514 Specialty Products	7130/640	30.2K
6AB1515 Byproduct Utilization	7130/720 7120/2080	423.5K
6AB1516 Test Facilities		2262 K
6AB1521 Contractor Selection		-0-
6AB1522 Demonstration Plant Process Selection & Design		-0-
6AB1523 Demonstration Plant Contract & Construction		-0-
6AB1531 Technology Transfer		344.5K
6AB1532 Management Support for DOE Cost Share Programs	7510/1500	3315 K
	Total	\$9580.2K

BENEFITS

There are several benefits to be derived from undertaking this program. In addition to maintaining DOE-ID/INEL's leadership in the commercial application of geothermal resources, it will expand the scope of our energy development work into the field of transportable and transportation fuels. The contribution of INEL, consistent with its role as a national laboratory, is to develop technology and accelerate commercialization using geothermal heat. The emphasis on advanced technology insures that processes and techniques required for efficient utilization of biomass resources are developed. This plan also provides for the dissemination of information and transfer of technology from the laboratory to the appropriate commercial organizations.

ACKNOWLEDGMENTS

A steering committee reviewed the progress of this plan, decided the INEL role and individuals contributed work packages with cost and schedule. This committee consisted of C. A. Allen, J. F. Whitbeck, H. R. Hilker, S. W. Metzger, K. W. Jones, S. A. Hodgson, N. E. Stanley, J. I. Mills, and W. D. Gertsch.

APPENDIX

WORK PACKAGE NO. 6AB1511

TITLE: ADVANCED PROCESS DEVELOPMENT FOR GEOTHERMAL APPLICATIONS

APPROVALS:

PERFORMING ORGANIZATION: _____

WORK PACKAGE MANAGER: _____

COST ACCOUNT MANAGER: _____

REVISIONS:

NO. 1

NO. 2

NO. 3

PERFORMING ORGANIZATION:

WORK PACKAGE MANAGER:

COST ACCOUNT MANAGER:

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED, MUST BE SPECIFIC.)

Perform an engineering analysis, laboratory-scale, and pilot-scale experimental program to optimize the utilization of geothermal resources for liquid fuels production from renewable biomass resources. Analysis and testing will be done in the following areas:

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

None

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE, SIGNIFIES
PARTIAL OR TOTAL COMPLETION,)

1. Interim progress reports on each phase of analysis and testing.
2. Final reports on each area of overall development program.

ADVANCED PROCESS DEVELOPMENT FOR GEOTHERMAL APPLICATIONS

ADVANCED PROCESS DEVELOPMENT FOR GEOTHERMAL APPLICATIONS (Con't)

W O R K P A C K A G E N O . 6AB1512

TITLE: PRDA SUPPORT

APPROVALS:

PERFORMING ORGANIZATION: 7510

WORK PACKAGE MANAGER: _____

COST ACCOUNT MANAGER: _____

REVISIONS:

NO. 1

NO. 2

NO. 3

PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

WORK PACKAGE NO. 6AB1512

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

1. To provide technical and management support to DOE for Program Research and Development Announcements (PRDA) projects.
2. To provide analytical and project management direction for biomass/geothermal energy commercialization engineering and economic studies.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

1. One PRDA is currently funded with Bechtel.
2. Other PRDA-type proposals may develop.

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

This work package covers a level-of-effort task to provide technical and management support to DOE. The deliverables are:

1. Monthly input of PRDA status for the Project Status Report.
2. Technical evaluation letters for PRDA proposals.
3. Technical evaluation letters for quarterly, phase, and final reports.
4. Trip reports for each review meeting conducted with the PRDA contractors.
5. Review of contractor's monthly reports and invoices to verify that work is technically acceptable.
6. Technical assistance for the PRDA contractor on an as-required basis in the area of environment, hydrology, geology, material science, and system design.
7. Maintain DOE apprised of the PRDA contractor's progress through periodic informal communications.

PRDA SUPPORT - LEVEL OF EFFORT

FY-80		FY-81	
7510 Travel	500 man hours \$3K	7510 Travel	1000 man hours \$5K
Total	\$18K plus 30% contingency = \$23.4K	Total	\$32K plus 30% contingency = \$41.6K

WORK PACKAGE NO. 6AB1513

TITLE: BIOMASS PRODUCTION

APPROVALS:

PERFORMING ORGANIZATION: 7130
WORK PACKAGE MANAGER: _____
COST ACCOUNT MANAGER: _____

REVISIONS:

NO. 1

NO. 2

NO. 3

PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

1. Identify the most promising plant species for production and conversion to liquid fuels. (Plant surveys to include: aquatic macrophytes, algae, agricultural crops and residues, silvicultural, and non-cultured native plants.)
2. Develop and evaluate cultural techniques for optimizing short rotation-sustained yield biomass production.
3. Develop conceptual design for integrated biomass production system which will utilize spent geothermal fluids and ethanol plant byproducts as nutrients.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

1. A suitable site and water for test plantings.
2. Initial field tests will assume a plant vicinity climate equal to or milder than southeast Idaho.
3. Site selection, conversion processes, alcohol yields, etc. will be performed under other work packages.

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

1. Reports
 - A. Species screening studies - March 31, 1981.
 - B. Cultural treatments to optimize production of selected species - March 31, 1982.
 - C. Species ranking and cultural feasibility determinations.
 - D. Conceptual design of integrated biomass production - geothermal conversion facility.
 - E. Site vicinity land use and biomass production potential - June 30, 1983.
2. Test plots for observation and evaluation.
3. Sources of biomass for feedstock testing.
4. Installation of biomass production demonstration farm.

*Includes 30% contingency.

WORK PACKAGE NO. 6AB1514

TITLE: SPECIALTY PRODUCTS

APPROVALS:

PERFORMING ORGANIZATION: 7130
WORK PACKAGE MANAGER: _____
COST ACCOUNT MANAGER: _____

REVISIONS:

NO. 1

NO. 2

NO. 3

PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

WORK PACKAGE NO. 6AB1514

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

Define and develop process schemes for production of various alcohols or chemicals which can be produced from ethanol or byproducts using geothermal process heat which yield high revenues on relatively small volumes.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

Report:

- A. Product identification and market analysis.
- B. Synthesis schemes for chemical production.
- C. Recommendations for systems.

SPECIALTY PRODUCTS

WORK PACKAGE NO. 6AB1515

TITLE: BYPRODUCT UTILIZATION

APPROVALS:

PERFORMING ORGANIZATION: 7130
WORK PACKAGE MANAGER: _____
COST ACCOUNT MANAGER: _____

REVISIONS:

NO. 1

NO. 2

NO. 3

PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

Design and implement a program to investigate the utilization of byproducts from the geothermal production of ethanol. This includes solid byproduct usage as animal feed, solid fuel, and protein sources as well as gaseous CO₂ for sale or atmosphere control in greenhouse facilities.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

1. Liquid byproducts from the still will be considered in the work package on Specialty Chemicals.
2. Sufficient quantities of byproducts will be available for feeding trials and analysis.
3. Solid fuel project timing coordinated with lignocellulose work.
4. Cost of equipment construction materials not included.

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

1. Test Plans: Animal feed, protein sources, and solid fuels.
2. Economic Analyses: Solid fuel and CO₂ usage.
3. Product-by-product summaries including analyses reports.
4. Design and manage the implementation of contracts covering livestock feeding trials and nutritional program.
5. Reports summarizing all aspects of program in fourth quarter of FY-82 with recommendation and design of systems.

WORK PACKAGE NO. 6AB1516

TITLE: GEOTHERMAL/BIOMASS ENGINEERING TEST FACILITIES

APPROVALS:

PERFORMING ORGANIZATION: 7130
WORK PACKAGE MANAGER: _____
COST ACCOUNT MANAGER: _____

REVISIONS:

	NO. 1	NO. 2	NO. 3
PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

Design/construct test facilities to support biomass-to-liquid fuel technology development utilizing geothermal energy resources. Pilot-scale facilities will produce ethanol for use in INEL vehicles.

Projected test facilities include:

- A. Advanced process and geothermal application research lab.
- B. Advanced technology pilot plant.
- C. CSU mobile unit.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

- 1. Geothermal water available at 300 gpm, 280°F.
- 2. Power plant geothermal discharge available at 1000 gpm, 120-140°F (intermittent).

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

- 1. Advanced technology pilot plant.
- 2. Advanced technology pilot plant operation and test final report.
- 3. Geothermal/biomass test laboratory.
- 4. CSU mobile test unit.
- 5. CSU test unit operation and test final report.
- 6. Ethanol for INEL vehicle usage.

TEST FACILITIES

	FY-80	FY-81	FY-82	FY-83
Laboratory	Design Construct 225K	Operate 50K	50K	50K
Advanced Technology Pilot Plant		Design Construct 900K	Operate 300K	300K
			Report 25K	Report 25K
			Report 25K	Report 25K
CSU Mobile Unit (Lignocellulose)	Lab Research Design 330K	Construct 790K	Operate 270K	290K
	\$555K plus 30% contingency = 721.5K	\$1740K plus 30% contingency = \$2262K	\$620K plus 30% contingency = \$806K	\$690K plus 30% contingency = \$897K

W O R K P A C K A G E N O . 6AB1521

TITLE: DEMONSTRATION PLANT SITE SELECTION

APPROVALS:

PERFORMING ORGANIZATION: _____

WORK PACKAGE MANAGER: _____

COST ACCOUNT MANAGER: _____

REVISIONS:

NO. 1

NO. 2

NO. 3

PERFORMING ORGANIZATION:

WORK PACKAGE MANAGER:

COST ACCOUNT MANAGER:

WORK PACKAGE NO. 6AB1521

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)
Identify potential site(s) for siting an advanced technology demonstration facility, perform resource evaluation and development activities as needed to qualify site, and make final site selection.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)
Work dependent on technology development - FY-82 start - scheduling for FY-86 plant start-up.

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

1. RFP and contractor selection for resource evaluation.
2. Target resource identification/biomass availability crossmatch and preliminary site selection (includes integrating expression of interests by private commercial entities for subsequent participation).
3. Resource development plan.
4. Resource test report (includes geoscience study, test hole drilling results, other actions to define resource).
5. Final site selection recommendation (includes PON action or other procurement results for commercial entity participation).

WORK PACKAGE NO. 6AB1522

TITLE: COMMERCIAL PLANT-PROCESS SELECTION AND DESIGN

APPROVALS:

PERFORMING ORGANIZATION: _____
WORK PACKAGE MANAGER: _____
COST ACCOUNT MANAGER: _____

REVISIONS:

NO. 1

NO. 2

NO. 3

PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

Select individual processes to be employed for a commercial alcohol plant to be constructed.
Design plant components and process specifications using advanced technology.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES
PARTIAL OR TOTAL COMPLETION.)

Report:

1. Process selection document including but not limited to process descriptions, economic analyses, marketing surveys.
2. Specification document detailing design parameters.
3. Process and plant conceptual design document including but not limited to hardware design and costing.

W O R K P A C K A G E N O . 6AB1523

TITLE: COMMERCIAL PLANT - CONTRACT AND CONSTRUCT

APPROVALS:

PERFORMING ORGANIZATION: _____
WORK PACKAGE MANAGER: _____
COST ACCOUNT MANAGER: _____

REVISIONS:

	NO. 1	NO. 2	NO. 3
PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

WORK PACKAGE NO. 6AB1523

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

Contract/construct commercial alcohol production plant using advanced process technology and geothermal water (plant may be built with federal support in the forms of technical assistance, cost sharing, loan guarantee, or completely funded).

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

Contracts
Title I
Title II
Constructed Plant
Acceptance
Operational report including one-year financial accounting.

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED, MUST BE SPECIFIC.)

1. Identify possible interested parties: investors, agricultural associations, industrial ethanol producers, state teams, etc.
2. Establish contacts with all interested parties. Distribute information sheet monthly. Inform parties of programs forming and ongoing progress of the programs. Serve as information clearing house.
3. Solicit input and participation in program from private sector. Search for qualified firms to participate in loan guarantee program for commercial scale geothermal/fuel alcohol plant.
4. Set up workshop series to advise and up-date all parties of geothermal/biomass programs and technology development.
5. Prepare economic analysis for various feedstocks and locations. Up-date quarterly to keep current with technology development; distribute to all interested parties (above).
6. Prepare market surveys, up-date annually and distribute information (through Item 2 above).
7. Maintain contacts with state teams and federal agencies, identify all sources of funding, information and other forms of support. Solicit input and program participation from these agencies.
8. Provide technical assistance to requesting parties.
9. General public information through press releases, public television programs, and other media productions.

ASSUMPTIONS: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

1. That information required for economic analysis can be generated by end of FY-80 (particularly cost estimate for given size plant - completion of Bechtel PRDA).
2. That larger-scale (commercial-scale) plant will prove economically feasible.

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE, SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

1. Education package and information containing process explanations, hardware and process requirements, licensing requirements, etc.
2. Set of brochures and presentations tailored for industry and general audiences.

3. Produce suitable candidates for loan guarantee programs, PONs and PRDAs (through an organized cultivation program, literature distribution, technical assistance, promoting, etc.).
4. Site-specific econometric analysis.
5. Contribute to data base, particularly economics, to assist econometric analysis, policy formulation, and decision making.
6. General marketing information and surveys.

MARKETING TECHNOLOGY TRANSFER

WORK PACKAGE NO. 6AB1532

TITLE: PON/LOAN GUARANTEE SUPPORT

APPROVALS:

PERFORMING ORGANIZATION: 7510
WORK PACKAGE MANAGER: _____
COST ACCOUNT MANAGER: _____

REVISIONS:

	NO. 1	NO. 2	NO. 3
PERFORMING ORGANIZATION:	_____	_____	_____
WORK PACKAGE MANAGER:	_____	_____	_____
COST ACCOUNT MANAGER:	_____	_____	_____

WORK PACKAGE NO. 6AB1532

SCOPE OF WORK: (CONCISE DESCRIPTION OF WORK TO BE PERFORMED. MUST BE SPECIFIC.)

1. To provide technical and management support to DOE for Program Opportunity Notice (PON) and Loan Guarantee Programs.
2. To provide engineering and project management direction for biomass/geothermal energy commercialization demonstration projects.

ASSUMPTION: (THOSE THINGS THAT MUST BE PRESENT TO PERFORM SCOPE.)

It is assumed that the Bechtel PRDA, Agri-Energy Corporation, and other proposals may be awarded demonstration contracts.

DELIVERABLES: (WHAT IS DELIVERED AS RESULTS OF WORK PACKAGE. SIGNIFIES PARTIAL OR TOTAL COMPLETION.)

This work package covers a level-of-effort task to provide technical and management support to DOE. The deliverables are:

1. Monthly input of PON and Loan Guarantee Program status for the project status report.
2. Technical evaluation letters for PON and Loan Guarantee Proposals.
3. Technical evaluation letters for quarterly, phase, design, evaluation, and final reports.
4. Trip reports for each review meeting conducted with the contractors.
5. Review of contractors' monthly reports and invoices to verify that the work is complete and technically acceptable.
6. Technical assistance for the contractors on an as-required basis in the area of environment, hydrology, geology, material science, system design, and facility operation.
7. Maintain DOE apprised of the contractor's progress through periodic informal communications.

PON AND LOAN GUARANTEE

FY-80		FY-81	
7510 Travel	1000 man hours \$5K	7510 Travel	1500 man .hours \$10K
Total	\$32K plus 30% contingency = \$41.6K	Total	\$50K plus 30% contingency = \$65K