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A Management and Selection System for R&D Projects

Volume II — Project Management System and Project Data System

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Volume II

A Management and Selection System for R&D Projects

Volume II — Project Management System and Project Data System

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ABSTRACT

This report in three volumes describes an R&D project management and selection system developed for the Utilization Technology Branch of the Division of Geothermal Energy, Department of Energy. The proposed project management system (PMS) consists of a project data system (PDS) and a project selection procedure (PSP). The project data system consists of a series of project data forms and project status logs, and descriptions of information pathways. The PDS emphasizes timely monitoring of the technical and financial progress of projects, maintenance of the history of the project and rapid access to project information to facilitate responsive reporting to DGE and DOE upper management. The project selection procedure emphasizes an R&D product-oriented approach to benefit/cost analysis of individual projects. The report includes: (a) a description of the system, and recommendations for its implementation, (b) the PDS forms and an explanation of their use, (c) a glossary of terms for use on the forms, (d) a description of the benefit/cost approach, (e) a data base for estimating R&D benefits, and (f) examples of test applications of the system to nine current DGE projects.

This volume discusses the proposed Project Data System in detail. It describes information needs and flow paths, and an information collection and storage system. Appendices contain the data forms for the system, and a glossary of terms and standard phrases for use on the forms.

TABLE OF CONTENTS

	<u>Page</u>
LIST OF ILLUSTRATIONS	vi
1.0 CURRENT DGE ORGANIZATION AND PROCEDURES	1
1.1 Organizational Structure of DGE	1
1.2 Current Procedures for Project Selection, Monitoring and Control	1
2.0 PROPOSED PROJECT MANAGEMENT AND INFORMATION SYSTEM	9
2.1 Major Consideration and Objectives	9
2.2 Information Needs and Flow Paths	12
2.3 Structure of the Program Management System (PMS)	16
2.4 The Project Data System	20
3.0 INFORMATION COLLECTION AND STORAGE	23
3.1 Information Collection	23
3.2 Data Organization and Consolidation	25
3.3 Standard Terminology	26
APPENDIX II-A - FLOW CHART FOR THE PROPOSED PROJECT MANAGEMENT SYSTEM	A-1
APPENDIX II-B - SAMPLES OF FORMS FOR PROJECT DATA SYSTEM	B-1
APPENDIX II-C - SAMPLES OF PROGRAM STATUS MONITORING LOGS	C-1
APPENDIX II-D - GLOSSARY OF TERMS AND STANDARD DEFINITIONS	D-1

LIST OF ILLUSTRATIONS

<u>FIGURE NUMBER</u>		<u>Page</u>
1	Organization Chart for the Division of Geothermal Energy U.S. Department of Energy	2
2	Relationship of Program Manager Task Assignments to the Major Program Thrusts for the RD&D Group of DGE Tasks	3
3	Suggested R&D Program Taxonomy for the Utilization Technology Branch	11
4	Structure of the Project Management System	13
5	Steps in the Subelement Management Sequence	14
6	Linkages in Program Management System	18
7	Progress of R&D Concepts through the Subelement Management Sequence	21
8	Flow of Information in the Program Management System	27
B-1	Flow Chart of Processing Concept Evaluation Form	B-11

1.0 CURRENT DGE ORGANIZATION AND PROCEDURES

1.1 Organizational Structure of DGE

The Division of Geothermal Energy is overseen by the Assistant Secretary for Energy Technology within the Department of Energy. Figure 1 shows the four subdivisions of the directorate; each subdivision has three or four branches. The five mission teams are supervised by the Assistant Director for Resource Utilization. The mission team leaders are individually charged with the development of specific geographical regions of the U.S.

Each branch is headed by a Branch Chief who supervises Program Managers responsible for segments of the RD&D program. Figure 2 shows the task assignments of the Program Managers of some of the branches of the DGE.

In the existing system for handling RD&D activities, an R&D concept is assigned to the Program Manager in whose technical area the concept belongs. The Program Manager then acquires full responsibility for monitoring the progress of the concept through various stages of evaluation, approval, contracting and execution of the project(s) pertaining to the concept. Officials in the Budget Program Coordination and Administrative Services branches become involved when the R&D concepts are approved for funding, or projected in the budgets for the future years.

1.2 Current Procedures for Project Selection, Monitoring and Control

In the existing system, most of the requests for funding of R&D activities originate from one or more of the following:

FIGURE 1
 ORGANIZATION CHART FOR THE DIVISION OF GEOTHERMAL ENERGY
 U.S. DEPARTMENT OF ENERGY

FIGURE 2
RELATIONSHIP OF PROGRAM MANAGER TASK ASSIGNMENTS TO THE MAJOR PROGRAM THRUSTS FOR THE RD&D GROUP OF DGE TASKS

- (i) Program Manager
- (ii) Mission Team Leader
- (iii) DOE Laboratories
- (iv) External Researchers

The formal request for funding an R&D effort is made through the submission of a proposal for conducting research on a concept, or developing and demonstrating technology. This proposal may be in response to a Request for Proposal (RFP) when the initiative for undertaking the activity was taken by the Program Manager or a Mission Team Leader. The proposal includes a statement of the objectives, technical description, work plans, resource requirements, outputs and the schedule for the proposed activity. If there is only one proposal for an effort (unsolicited proposal or sole source) the proposal evaluation leads to a decision either in favor of or against funding the proposed activity. If there are multiple proposals for the same activity, the decision process extends to the selection of one or more proposals for undertaking the activity.

The evaluation of proposals is based on criteria which are somewhat qualitative with external evaluators making a significant input to the determination of the overall quality of the proposal. No specified evaluation methods and criteria exist for unsolicited proposals. DGE recently issued some "Program Research and Development Announcements" (PRDA) last year, soliciting proposals for R&D in a number of areas. The methods and criteria for proposal evaluation

were clearly specified in these documents. The following extract from PRDA DGE 76-2 details these methods and criteria.

SECTION III - Proposal Evaluation

A. METHODS:

1. Proposals will undergo comprehensive evaluation by a panel consisting of Government personnel. Recommendations to select proposals for support will be submitted by this Government panel to the source selecting official, the Director of the Division of Geothermal Energy. The panel may utilize the services of technical consultants and advisors including ERDA staff members, ERDA laboratory personnel, personnel from other Government agencies, and non-Government consultants. Proposer-marked Proprietary Information will not be revealed to non-Government employees except when approved by the proposer.

B. CRITERIA: (In Relative Order of Importance)

1. The applicability of the proposed project to ERDA equipment goals as described in this solicitation, and the relative priority of the project as discussed in the referenced Sandia reports.
2. The technical feasibility of the proposed plan.
3. The capabilities, related experience, facilities, instrumentation, techniques and other resources which the proposer possesses and offers, and which are considered to be integral factors for achieving the project.
4. The qualification, capabilities, and experience of proposed key personnel.
5. The adequacy of the proposed project management structure and plan.
6. The estimated cost of the project and the projected time schedule.
7. The extent of cost sharing (if any) in relation to potential benefits to be derived by the proposing entities.
8. The ability of the proposer to provide responsible financial management of the proposed project.
9. The degree the proposed arrangements will encourage technology transfer to the user industry.

It is apparent that the evaluation criteria are mainly qualitative and subject to variation in interpretation.

The contract processing mechanism is quite well established and there seems to be regular compliance with the recommended procedures. The four major steps in this process are:

- (i) Preparation of the "contract justification memo",
- (ii) Processing of the "contract authorization",
- (iii) Preparation of the "procurement request", and
- (iv) Awarding of the contract.

Although the Program Manager generally monitors contracts in his area, the official responsibility for controlling a contract is usually assigned to a field operations office. DGE Headquarters retains control over selected contracts. In some cases, DOE laboratories control contracted projects.

Project control is exercised mainly through the requirement of periodic reviews and reports pertaining to the contract. The technical progress of the activity is monitored along with compliance with the schedule, and fiscal integrity of the contract.

At the DGE Headquarters, there is one file for each project, and all documents pertaining to the project are retained in this file. In some cases, a contractor may be associated with more than one project. Such contractors have just one file for all their projects. The comprehensiveness of this collection of documents varies from

contract to contract. It appears that there is no standard procedure for ensuring that these files are updated in a timely fashion.

2.0 PROPOSED PROJECT MANAGEMENT AND INFORMATION SYSTEM

2.1 Major Considerations and Objectives

The proposed Program Management System (PMS) is designed with the objective of providing a set of procedures that will ensure that all proposed and approved R&D projects/work units are evaluated, monitored and controlled in a consistent manner. Since the R&D program outputs need to be evaluated in terms of their impact on the DGE goals for the development of geothermal energy, each R&D project/work unit must be identified with some impact on the achievement of DGE goals. Expected project impacts such as "enhanced knowledge of a phenomenon" must be viewed in conjunction with R&D activities in which this enhanced knowledge is utilized for developing technology for reducing the cost and/or increasing the availability and utilization of geothermal energy. Consequently, the basic unit for planning an R&D program should be a subelement, which consists of one or more related projects whose successful completion can be expected to have an observable impact on achievement of DGE goals for the development of geothermal energy.

For example, a subelement titled "Develop a drill with increased lifetime for a given rate of penetration and power requirement" might involve projects/work units requiring research in metal properties, drill bit configuration, drilling speeds and other aspects of geothermal well drilling processes. Individually, some of these projects may not have any observable impact on the development of geothermal

energy, but other projects with explicit impact on DGE goals may be dependent on the successful execution of the first category of projects. This approach to subelement evaluation forces the R&D program planners to extend their planning to the stage of direct impact on DGE goals. Conversely, the R&D program is driven by the DGE goals, which themselves are susceptible to the success or failure of various R&D program subelements. Figure 3 shows an example of the R&D taxonomy for the Utilization Branch of DGE.

It is expected that the proposed system, if successfully implemented by DGE, will:

- (1) create a better coordination between DGE goals and the R&D strategy;
- (2) enhance the accountability of R&D efforts;
- (3) provide a rational basis for subelement selection, assignment, termination, modification, renewal, and extension;
- (4) promote more productive utilization of R&D resources;
- (5) provide a capability for timely input for resetting goals and R&D strategy;
- (6) generate better response to industry needs;
- (7) create an up-to-date and organized data base for subelement monitoring and control;
- (8) provide a capability for subelement status determination in real time; and
- (9) improve inter-program and intra-program coordination.

The development of the proposed Project Management System (PMS) is based on explicit consideration of the following dimensions of the system:

FIGURE 3

SUGGESTED R&D PROGRAM TAXONOMY FOR THE
UTILIZATION TECHNOLOGY BRANCH

- (i) DGE goals and R&D strategy
- (ii) Recognition of R&D needs
- (iii) Subelement formulation
- (iv) Subelement evaluation, selection, and assignment
- (v) Subelement monitoring and control, and
- (vi) Post-completion evaluation.

Figure 4 displays the structure of the proposed Project Management System. The two major elements of the system are the Project Data System (PDS) and the Subelement Management Sequence (SMS). The Project Selection Procedure (PSP) is a part of the Subelement Management Sequence. PDS and SMS provide a mechanism for R&D project monitoring and control through regular recording of the status of various projects in terms of schedules, milestones, funding and deliverable items. The steps in the Subelement Management Sequence are shown in Figure 5.

In order to implement this system, the data (information) needs, data sources, and the paths for the flow of information must be identified explicitly. In addition, procedures for generating, recording and updating information need to be established. These issues are addressed in the following subsection (the details of the Project Selection System are presented in Volume III).

2.2 Information Needs and Flow Paths

The system for subelement/project evaluation, selection, assignment, monitoring and control can be viewed as a mechanism for

FIGURE 4
STRUCTURE OF THE PROJECT MANAGEMENT SYSTEM

FIGURE 5

STEPS IN THE SUBELEMENT MANAGEMENT SEQUENCE

extracting information from appropriate sources, recording and organizing this information, transmitting the relevant information to potential users, and updating the recorded information whenever necessary.

Specific information needs will have to be identified for each of the following phases of the R&D program subelement planning and control cycle.

- (i) Subelement Identification
- (ii) Subelement Evaluation
- (iii) Subelement Selection
- (iv) Project/work unit assignment
- (v) Subelement monitoring and control
- (vi) Subelement modification, renewal, extension, termination
- (vii) Pre-Technology-Transfer Evaluation (where necessary)
- (viii) Post-Technology-Transfer Evaluation (where necessary).

The sources and users of various elements of information exist both inside and outside DGE. Most of the information will be generated and used by one or more of the officials and organizations listed below.

- (i) DGE Headquarters Officials (Program Managers, Branch Chiefs, Coordination Staff, Contracts and Procurement Staff)
- (ii) DOE Field Offices and DOE Laboratories
- (iii) Contractors
- (iv) Geothermal Industry Officials
- (v) Proposal Evaluators, Consultants, Congress, etc.

To alleviate the problems created by non-uniform practices for maintaining project/work unit records, a systematic, yet simple, procedure for recording, updating and transmitting information pertaining to R&D activities has been developed. Some of the logistic and procedural considerations underlying the record-keeping system are

- (1) maintenance of record files for subelements rather than for individual projects
- (2) development of special forms for recording and transmitting information in a timely manner
- (3) consolidation of extracted information at various levels of organization (e.g., technical status, fiscal status)
- (4) specified updating requirements for all important elements of the data base.

Perhaps the biggest obstacle in the path of a systematic record-keeping procedure is the lack of standard terminology. Prior to the implementation of the system, a set of commonly used technical, financial and miscellaneous terms will be identified. Each term in this set will be assigned a precise definition. The paths for the flow of information necessary for various decisions must be made explicit. This will ensure that the transmission of information will follow a regular pattern. The generation, transmission and utilization of information should be timely with respect to the budget cycles and other reporting requirements established by DOE.

2.3 Structure of the Program Management System (PMS)

Enhanced responsiveness of the R&D program to DGE goals and industry needs, along with the creation of a consistent procedure for

selecting, monitoring and controlling RD&D projects/work units are the prime considerations in the design of the proposed PMS. Figure 6 shows the links and interactions between various elements of a PMS which can be expected to meet these objectives.

In order to make the RD&D program responsive to DGE goals and industry needs, the recognition of RD&D needs and the formulation of RD&D strategy is guided by the following elements of the geothermal resource development scenario:

- (i) DGE goals
- (ii) Future geothermal energy utilization projections
- (iii) The current status of technology
- (iv) The overall RD&D needs of the geothermal industry
- (v) Site-specific RD&D needs.

The recognized RD&D needs and the RD&D strategy of DGE influence the formulation of DGE's budget for the current year, and the projected budget for future years. The preparation of RD&D program subelement plans for satisfying RD&D needs leads to a benefit/cost analysis of proposed RD&D activities prior to their approval for funding. As indicated in Figure 6, the process of subelement evaluation is dependent on the input of information concerning the five elements of the geothermal resource development scenarios listed above. Therefore, a data base containing these data needs to be maintained and updated in a timely manner.

The assignment of selected subelements to contractors or DOE laboratories is the next step in the implementation of the RD&D

FIGURE 6

LINKAGES IN PROGRAM MANAGEMENT SYSTEM

program. Since the current procedures for this part of the RD&D program management are not going to be modified significantly, it is expected that the existing mechanisms for generating and transmitting this information can be merged into the proposed PMS without major modifications. Although project monitoring and control is being carried out in the existing system, major changes will be needed on account of the emphasis on monitoring and controlling program subelements rather than projects. These revised procedures might necessitate more detailed and timely input (progress reports, etc.) from contractors than is currently required by DOE policies.

The next major activity supported by the proposed PMS is subelement modification, extension, renewal and termination. In the existing contracting procedures, there are check points for determining whether a project should be renewed, modified, extended or terminated. The implementation of the proposed program management system would involve one change in the current practices. Whenever a subelement is at a check point, it will have to be evaluated in competition with other ongoing subelements and new subelements. This will ensure that at various check points, all the funded activities represent the best utilization of DGE's RD&D resources.

The proposed PMS will generate documentation pertaining to all the important stages in the lifetime of a program subelement, extending from the recognition of the need for R&D to the post-technology

transfer (and/or commercialization) stage, which would mark the completion of a subelement. At various stages, the data base for all elements of the PMS will be updated in order to make timely decisions concerning R&D needs and strategy.

Figure 7 shows the sequence in which various events occur. The feedback/data base updating mechanism is also displayed. The PMS and its associated subelement evaluation model are described in the subsections which follow. The paths of various R&D concepts within the Subelement Management Sequence are shown in Figure 6.

2.4 The Project Data System

Effective decision-making requires complete and accurate information about activities associated with the decisions. The project data system (PDS) should attempt to ensure that adequate and timely information is available at all stages in the use of the system. In this description of the PDS, the emphasis is on identifying the decisions to be made, the associated decision-makers, the sources of information, and appropriate mechanisms for recording, organizing, consolidating and updating information. The flow paths and the elements of information which will flow along them are also identified.

Appendix II-A contains a flow chart showing the information needs, information sources and users, and information flow paths at various stages of the application of the PMS. In this flow chart, an RD&D concept is carried from the initial concept evaluation stage to the post-technology transfer/commercialization stage. All the

FIGURE 7

PROGRESS OF R&D CONCEPTS THROUGH THE
SUBELEMENT MANAGEMENT SEQUENCE

important segments of the PMS are explicitly addressed in this chart. To deal with certain abnormal situations (e.g., over-expenditure, lack of technical progress), special procedural branches are provided in the PMS.

At this time, the collection of information is expected to be accomplished through a set of carefully designed data collection forms. Certain subsets of this information will be organized and consolidated manually. Various categories of information will be aggregated (e.g., milestones, technical progress estimate, fiscal status data) for perusal by the Program Manager, Branch Chiefs and other officials, whenever they want to examine the status of one or more program subelements.

In order to minimize the possibility of misinterpretation of recorded information, a glossary of standard terms has been included as an important part of the PDS. It is expected that only standard terms, phrases, measures, etc., will be used to describe R&D activities.

Although the proposed system, as planned at this time, is designed for manual operation, it would be possible to computerize the proposed PDS. As the volume of R&D activity increases, it may become essential to computerize the PDS. Computerization will reduce the demands on the Program Managers and also provide the means for more efficient and timely consolidation and updating of the data base.

3.0 INFORMATION COLLECTION AND STORAGE

3.1 Information Collection

The successful implementation of the proposed PDS is dependent on the collection, storage and transmission of information which is timely and accurate. Equally important is the need for employing standard terminology.

The proposed PMS will rely heavily on the use of data collection forms. These forms are designed to make the task of filling them out easy. The possibility of computerizing the data base has influenced the forms' design considerations. To ensure that the data collection forms follow the desired paths, some forms will have a flow chart showing their disposition after any entry is made.

Since the concept evaluation and selection will be carried out at the program subelement level, the data forms for this purpose are mainly subelement-oriented. However, individual projects will have their own forms for contract processing and project monitoring. The forms listed below constitute a set of data collection sheets for one subelement.

- (1) R&D Concept Evaluation Form (one for each subelement)
This form will contain information and evaluation results used as the basis for either rejecting the proposed R&D concept at this stage or recommending that the R&D concept be considered for funding.
- (2) Detailed Evaluation Form (one for each subelement)
This form will be used for recording the assumptions, and input data used for estimating the benefits/cost ratio for

the concept. Detailed work plans, cost estimates, impacts of output, and the schedule of outputs would be presented in this form.

(3) Contract Processing and Project Monitoring Form (one for each project)

This form will essentially contain records of the events and steps which led to the awarding of the contract for a segment of the program subelement. Records of various stages of contract processing (e.g., Contract Justification Memo, Contract Authorization, Procurement Request, etc.) will be presented in this form. The monitoring section of this form will be used by the Program Manager to present an up-to-date status report of a project. Compliance with the planned schedule, technical progress, financial status, and the impact of project outputs on R&D strategy will be monitored through this form. This form will be a major source of information when making decisions regarding project reviews, modification, extension or termination.

(4) Program Sub-Element Status Form (one for each subelement)

This form will contain important elements of information extracted from the above-mentioned forms. The program subelement status form is designed to make it possible for the Branch Chief to get an idea of the status of any subelement without going through various detailed forms.

(5) Post-Technology Transfer Record Form (one for each subelement)

When the basic research, development and demonstration (if planned) has been accomplished successfully, the pre-technology transfer status of the R&D concept will be recorded in this form. Following the transfer of technology to the geothermal industry (through seminars, sale of designs, etc.) and commercialization (in some cases), the post-technology-transfer data will be recorded in this form. This data will indicate the extent of utilization of the outputs of the R&D program subelement.

A sample of each of the forms listed above is presented in

Appendix II-B.

3.2 Data Organization and Consolidation

At any given point in time, a very large number of subelements can be expected to be in various stages of advancement (i.e., preliminary evaluation, detailed evaluation, contract processing, execution, pre-technology transfer, post-technology transfer, etc.). Consequently, numerous forms will be current at any time. In order to facilitate transfer of information and the extraction of subsets of the total data base, the data contained in various forms will have to be organized and consolidated for use at various levels in the DGE organization.

Among the items of special interest to senior officials in the DGE are:

- (i) Milestones for various program subelements
- (ii) Financial status of activities
- (iii) Technical progress of program subelements
- (iv) Projected activities
- (v) Estimated benefit/cost ratios, etc.

The proposed PDS will provide means for consolidating information about all activities by type of information (e.g., fiscal, technical, etc.). The consolidated information will be presented in logs which can be reviewed very quickly to determine the overall status of a program or subprogram at any time. To ensure that these logs are updated regularly, instructions for transferring information from various forms to appropriate logs will be specified

very clearly. It can be expected that any official of DGE would be able to use these logs without assistance from Program Managers. As a matter of policy, DGE may decide to limit access to these logs.

Initially, the preparation of these logs will be manual, but it will be possible eventually to extract subsets of the data base (which correspond to the information in the log) from a computerized data base on a real-time basis.

Figure 8 shows the flow of information through the various data forms that are expected to be used in the proposed Program Management System.

Appendix II-C includes samples of "Program Manager's Log of R&D Concept Status", "Log of R&D Project Status", and "Log of Program Subelement Status."

3.3 Standard Terminology

In order to facilitate the use of standard terminology and the development of a common understanding of various technical and economic terms, a glossary of standard terms has been provided for use in conjunction with the proposed data forms.

This glossary contains terms relevant to DGE technical aggregation levels, subelement management sequence, subelement information system forms and files, benefit/cost evaluation, contract documentation and processing, technical performance parameters and geothermal technology. To facilitate the filling of forms and subsequent coding

FIGURE 8
FLOW OF INFORMATION IN THE PROGRAM MANAGEMENT SYSTEM

of the forms for computer storage of information, a set of standard phrases is being initiated. Whenever a new phrase is used, it should be recorded in the glossary.

The Glossary of Terms is presented in Appendix II-D of this volume.

APPENDIX II-A

FLOW CHART FOR THE PROPOSED
PROJECT MANAGEMENT SYSTEM

This Appendix shows the major steps in the implementation of the Project Management System. Results generated by different decisions and the subsequent activities are identified. The information/elements/decision criteria relevant to each step are specified. The identities of information sources and decision makers associated with different steps are recorded in the flow chart.

SOURCE/DECISION MAKER

- Contract Officer (ERDA)
- Representative of the Contractor

INFORMATION ELEMENTS/DECISION CRITERIA

- Complete details of the project
- Schedule, milestones
- Deliverables
- Check points (renewal/extension dates, etc.)
- Funding allocation
- Any special conditions

- Program Manager
- Principal Investigator (contractor)

- Program Manager (M.T.L.)
- Principal Investigator
- Branch Chief

- Program Manager (M.T.L.)
- Principal Investigator
- Branch Chief

- Program Manager (M.T.L.)
- Principal Investigator
- Branch Chief

- Program Manager (M.T.L.)
- Branch Chief

- Program Manager

SOURCE/DECISION MAKERS

- Program Manager (M.T.L.)
- Branch Chief
- D.G.E. Review Committee?
- Principal Investigator (contractor)

- Program Manager (M.T.L.)
- Branch Chief
- Representative(s) of Technology Users

- Program Manager (M.T.L.)
- Branch Chief
- D.G.E. Review Committee?

INFORMATION ELEMENTS/DECISION CRITERIA

- Planned schedule versus actual schedule
- Expected results versus actual results
- Planned expenditure versus actual expenditure
- Impact on D.G.E. goals and R&D strategy
- Plans for technology transfer
- Input from related activities

- Original plans for technology transfer
- Details of actual technology transfer process
- Prospects for commercialization
- Potential users/target market
- Manufacturers
- Impact on D.G.E. goals and R&D strategy

- Conclusions based on Post Technology Transfer Evaluation
- Current and future scenarios for Geothermal Energy

APPENDIX II-B
SAMPLES OF FORMS FOR PROJECT DATA SYSTEM

In this Appendix, samples of the project level data forms are presented. The following blank forms are included: R&D Concept Evaluation Form, Benefit/Cost Evaluation Form, Contract Processing and Project Monitoring Form, Program Subelement Status Monitoring Form, and Post-Technology-Transfer Record Form.

	<u>Page</u>
1. R&D Concept Evaluation Form	B- 5
2. Benefit/Cost Evaluation Form	B-13
3. Contract Processing and Project Monitoring Form	B-21
4. Program Subelement Status Monitoring Form	B-29
5. Post-Technology-Transfer Record Form	B-35

R&D CONCEPT EVALUATION FORM

R&D CONCEPT EVALUATION FORM

DATE:

CONCEPT I.D. NO.:

- (1) TITLE OF THE CONCEPT:

- (2) PROGRAM NAME:

- (3) PROGRAM MANAGER'S NAME:

- (4) NAME OF THE ORIGINATOR OF THE CONCEPT:

- (5) BRIEF TECHNICAL DESCRIPTION OF THE CONCEPT:

- (6) TECHNICAL OBJECTIVES OF THE CONCEPT:
 - (a)
 - (b)
 - (c)
 - (d)
 - (e)
 - (f)

- (7) DESCRIPTION OF WORK PLANS FOR ACHIEVING THE OBJECTIVES:

(8) TENTATIVE SCHEDULE, RESOURCE REQUIREMENTS, OUTPUTS AND THEIR EXPECTED IMPACT:

SCHEDULE

RESOURCES

- (a)
- (b)
- (c)
- (d)
- (e)

OUTPUTS AND IMPACTS

	<u>OUTPUT</u>	<u>EXPECTED IMPACT</u>
(A)		
(B)		
(C)		
(D)		
(E)		

(9) RELEVANCE OF THE R&D CONCEPT TO DGE GOALS:

- (a)
- (b)
- (c)
- (d)
- (e)

(10) DOES A FORMAL PROPOSAL EXIST FOR THIS R&D CONCEPT?

☐ YES ☐ NO (Go to 12)

(11) NAME OF THE ORGANIZATION WHICH SUBMITTED THE PROPOSAL:

- (12) DOES THIS CONCEPT DESERVE TO BE EVALUATED FOR POSSIBLE FUNDING OF RD&D?

PROGRAM MANAGER
(P.M.)

☐ Yes ☐ No

P.M.'s Initials

BRANCH CHIEF
(B.C.)

☐ Yes ☐ No

B.C.'s Initials

JOINT DECISION

☐ Yes (Go to 16)

☐ No

- (13) REASONS FOR NOT EVALUATING THE CONCEPT FOR FUNDING:

- (a)
- (b)
- (c)
- (d)

- (14) SHOULD THE CONCEPT BE CONSIDERED FOR EVALUATION AT A LATER DATE?

☐ Yes (Go to 15) ☐ No

PLACE THE DOCUMENTATION FOR THIS CONCEPT IN THE "REJECTED CONCEPTS" FILE. THE REST OF THE FORM NEED NOT BE COMPLETED.

DATE:

- (15) DATE FOR RECONSIDERATION OF THE CONCEPT:

PLACE THE CONCEPT PAPERS IN THE "PENDING CONCEPTS" FILE.
THE REMAINDER OF THIS FORM NEED NOT BE FILLED OUT.

- (16) ON THE BASIS OF A BENEFIT/COST ANALYSIS, WHAT IS THE "FIGURE OF MERIT" FOR THIS CONCEPT?

- (17) THE QUALITATIVE EVALUATION OF THIS CONCEPT IS TO BE CONDUCTED BY

INTERNAL EVALUATORS ONLY

☐

EXTERNAL EVALUATORS ONLY

☐

INTERNAL AND EXTERNAL EVALUATORS

☐

- (18) EXTERNAL EVALUATION DATA AND FIGURE OF MERIT (B/C RATIO)

	<u>Name & Address Of Evaluator</u>	<u>Date on Which Evaluation Was Requested</u>	<u>Date on Which Response Was Received</u>	<u>Evaluator's Grade For The Concept</u>	<u>Comments</u>
(i)					
(ii)					
(iii)					
(iv)					

(19) ON THE BASIS OF THE FIGURE OF MERIT, THE EVALUATOR'S GRADING, AND OTHER CONSIDERATIONS, SHOULD THE CONCEPT BE FUNDED?

☐ Yes (Go to 21)

P.M.'s Initials:

DATE:

☐ No

B.C.'s Initials

DATE:

(20) REASONS FOR NOT RECOMMENDING THE CONCEPT FOR FUNDING:

(a)

(b)

(c)

(d)

PLACE THE DOCUMENTATION FOR THIS CONCEPT IN THE FILE FOR "CONCEPTS NOT RECOMMENDED FOR FUNDING". DO NOT COMPLETE THE REST OF THE FORM. DATE:

(21) REASONS FOR RECOMMENDING THAT THE CONCEPT BE FUNDED:

(a)

(b)

(c)

PLACE ONE COPY OF THE CONCEPT EVALUATION FORM IN THE FILE FOR "CONCEPTS"

- INITIATE THE PROCESS OF SECURING FUNDS FOR THIS CONCEPT.

- START A "FUNDING AND CONTRACT PROCESSING" FILE FOR THIS CONCEPT. DATE:

- (1) Program Manager initiates the Concept Evaluation Form.
- (2) Program Manager and Branch Chief make this determination.
- (3) This file is maintained by the Program Manager.
- (4) This evaluation is made by a panel of evaluations and Program Manager.
- (5) This determination is made by the Program Manager and Branch Chief.
- (6) The Program Manager records this idea in the Pending Ideas File and sets a date for reconsideration.
- (7) The Program Manager starts a "Funding and Contract Processing" File and initiates action for securing funds and contracting the RD&D Projects pertaining to the concept.

FIGURE B-1
FLOW CHART OF PROCESSING CONCEPT EVALUATION FORM

BENEFIT/COST EVALUATION FORM

BENEFIT/COST EVALUATION FORM

SUBELEMENT I.D.# _____ TITLE: _____

EVALUATOR: _____ EVALUATION DATE: _____

1.0 TECHNICAL OBJECTIVE (FROM ITEM 6, R&D CONCEPT EVALUATION FORM):

--

2.0 R&D TIMING AND COSTS SUMMARY (FROM ITEM * 6, THIS FORM):

WORK REQUIRED, AS SPECIFIED BY SUBELEMENT DEVELOPMENT PLAN	COMPLETED? (YES/NO)	TIME, YEARS*	SUNK COSTS \$1000s	BUDGET \$1000s*
6.1 Preliminary Study				
6.2 Basic Research				
6.3 Exploratory Development				
6.4 Advanced Development				
6.5 Engineering Development				
6.6 Demonstration and Commercialization				
TOTALS: * For unfinished work, only.		(a)	(b)	(c)
(d) Anticipated Commercialization Date (Year):				

3.0 BENEFITS SUMMARY (FROM ITEM 7.4, THIS FORM):

(a) Non-discounted Total (\$ Millions)	
(b) Discounted @ 5% (\$ Millions)	
(c) Adjusted for Commercialization (\$ Millions)	

4.0 EXPECTED DEGREE OF SUCCESS AT START OF CURRENT PROJECT (FROM ITEM 8, THIS FORM):

(a) Degree of Success = DOS =	
-------------------------------	--

5.0 FIGURE OF MERIT (ENTER BENEFIT AND R&D COSTS AS \$ MILLIONS)

<p>(a) <u>Current (Without Sunk Costs)</u></p> <p>FOM = $\frac{\text{BENEFIT (3c)} \times \text{DOS (4a)}}{\text{BUDGET (2c)}} = \frac{() \times ()}{()} =$</p>	FOM=
<p>(b) <u>Historical (With Sunk Costs)</u></p> <p>HFOM = $\frac{\text{BENEFIT (3c)} \times \text{DOS (4a)}}{\text{SUNK COSTS (3b)} \times \text{BUDGET (2c)}} = \frac{() \times ()}{() + ()} =$</p>	HFOM=

6.0 SUBELEMENT DEVELOPMENT PLAN

DESCRIPTION OF RESEARCH, DEVELOPMENT, OR EVALUATION WORK	COMPLETED? (YES/NO)	YEARS	R&D COSTS (\$1000s)
--	------------------------	-------	------------------------

6.1 Preliminary Study			
WORK:			
EVALUATION:			
TOTAL:			

6.2 Basic Research			
WORK:			
EVALUATION:			
TOTAL:			

6.3 Exploratory Development			
WORK:			
EVALUATION:			
TOTAL:			

6.4 Advanced Development			
WORK:			
EVALUATION:			
TOTAL:			

6.5 Engineering Development			
WORK:			
EVALUATION:			
TOTAL:			

6.6 Demonstration and Commercialization			
WORK:			
EVALUATION:			
TOTAL:			

(Transfer Totals to Item 2, Page 1)

GRAND TOTAL:

--	--

7.0 ESTIMATE OF BENEFITS

7.1 Inputs to Benefits Model

(a) Type(s) of Prospects to be Affected:	
(b) Subsystem or Component(s) to be Affected:	
(c) Expected Quantitative Improvement in Performance of Component(s):	
(d) Cost of Affected Technological Component or Process:	
Cost of New Component:	\$
Cost of Current Component:	\$
Cost Ratio (New/Old):	

7.2 Model for Savings Per Prospect

Explain how savings are estimated for specific prospects. Attach extra pages if needed.

7.3 SAVINGS PER PLANT OR WELL AT EACH PROSPECT (WORKSHEET)

PROSPECT														SAVINGS PER PLANT OR WELL
Geysers, CA (Steam														
Brazoria, TX														
Salton Sea, CA														
Valles Caldera, NM														
Brady Hot Springs, NV														
Brawley, CA														
Roosevelt Hot Springs, UT														
Beowawe, NV														
Coso Hot Springs, CA														
Mono-Long Valley, CA														
Cove Fort-Sulfurdale, UT														
Heber, CA														
Geysers, CA (Hydrothermal)														
East Mesa, CA														
Steamboat Springs, NV														
Surprise Valley, CA														
Chandler, AZ														
Leach, NV														
Calcasieu Parish, LA														
Bruneau-Grandview, ID														
Lassen, CA														
Kenedy County, TX														
Alvord, OR														
Matagorda County, TX														
Cameron Parish, LA														
Acadia Parish, LA														
Corpus Christi, TX														
Safford, AZ														
Weiser-Crane Creek, ID														
Vale Hot Springs, OR														
Thermo, UT														
Raft River, ID														
Glass Mountain, CA														
Puna, HI														
Mt. Hood, OR														
Baker Hot Springs, WA														
West Yellowstone, MT														

EXPECTED SAVINGS (\$ MILLIONS)

PROSPECT	TIME PERIODS												TOTAL
	SAVINGS PER UNIT	I 1979 -80	II 1981 -82	III 1983 -84	IV 1985 -86	V 1987 -88	VI 1989 -90	VII 1991 -92	VIII 1993 -94	IX 1995 -96	X 1997 -98	XI 1999 -2000	
Geysers, CA (Steam)													
Brazoria, TX													
Salton Sea, CA													
Valles Caldera, NM													
Brady Hot Springs, NV													
Brawley, CA													
Roosevelt Hot Springs, UT													
Beowawe, NV													
Coso Hot Springs, CA													
Mono-Long Valley, CA													
Cove Fort-Sulfurdale, UT													
Heber, CA													
Geysers, CA (Hydrothermal)													
East Mesa, CA													
Steamboat Springs, NV													
Surprise Valley, CA													
Chandler, AZ													
Leach, NV													
Calcasieu Parish, LA													
Bruneau-Grandview, ID													
Lassen, CA													
Kenedy County, TX													
Alvord, OR													
Matagorda County, TX													
Cameron Parish, LA													
Acadia Parish, LA													
Corpus Christi, TX													
Safford, AZ													
Weiser-Crane Creek, ID													
Vale Hot Springs, OR													
Thermo, UT													
Raft River, ID													
Glass Mountain, CA													
Puna, HI													
Mt. Hood, OR													
Baker Hot Springs, WA													
West Yellowstone, MT													
(a) TOTAL:													
(b) DISCOUNTING FACTORS:													
(c) DISCOUNTED TOTAL:													
(d) COMMERCIALIZATION:													
(e) FINAL TOTAL:													

B-19

7.4 TOTAL SAVINGS ACROSS PROSPECTS AND TIME PERIODS

8.0 EXPECTED DEGREE OF SUCCESS

TYPE OF RD&D EFFORT		PROBABILITY OF ATTAIN- ING TEST CRITERIA	OVERALL DEGREE OF SUCCESS
6.2 Basic Research	→		
6.3 Exploratory Development	→		
6.4 Advanced Development	→		
6.5 Engineering Development	→		
6.6 Demonstration*	→		
Total Benefit Delivered	→	1.00	XXXXXXXXXX
Type of Current Project	→	XXXXXXXXXX	XXXXXXXXXX
(a) Currently Expected Degree of Success		→	

(* Partial commercialization is accounted for in Item 7.4)

9.0 REVIEW AT END OF CURRENT CONTRACT

(a) Current estimate of performance of device or process; in same terms as original estimate of performance.	
(b) Ratio of Current Performance Estimate to Previous:	→
(c) Actual RD&D Costs (\$1000s), this stage:	→
(d) Has expected benefit been altered by RD&D schedule change or changed performance of component? Explain:	
(e) Current estimate of benefit (\$1000s):	→
(f) Achieved Figure of Merit: = (9e) / Current Cost Estimate = () / () =	

CONTRACT PROCESSING AND PROJECT MONITORING FORM

CONTRACT PROCESSING AND PROJECT MONITORING FORM

DATE OF FIRST ENTRY: _____ DATE OF LAST ENTRY: _____

1. CONTRACT I.D. NUMBER _____; CONTRACT TYPE ☐ FIXED PRICE ☐ COST PLUS FIXED FEE ☐ COST SHARING ☐ COOPERATIVE AGREEMENT

2. PROJECT I.D. NUMBER: _____; CONTRACT AMOUNT: \$ _____

3. SUBELEMENT I.D. NUMBER: _____

4. PROJECT TITLE: _____

5. SUBELEMENT TITLE: _____

6. PROGRAM MANAGER: _____; PROJECT MANAGER: _____ 7. CONTRACTING OFFICE: _____

8. CONTRACTOR: _____; PRINCIPAL INVESTIGATOR: _____

9. SUBELEMENT START DATE: _____; SUBELEMENT COMPLETION DATE (TARGET): _____

10. CONTRACT START DATE: _____; CONTRACT (PROJECT) COMPLETION DATE: _____ SCHEDULED, _____ ACTUAL

11. TECHNICAL OBJECTIVES OF THIS PROJECT (PLEASE STATE THE OBJECTIVES QUANTITATIVELY TO THE EXTENT POSSIBLE):

- (a)
- (b)
- (c)
- (d)
- (e)

12. TECHNICAL DESCRIPTION OF THE PROJECT: _____

13. RELEVANCE OF THE PROJECT TO DGE PLANS AND GOALS: _____

14. THIS PROPOSAL WAS SELECTED

(i) ☐ COMPETITIVELY THROUGH ☐ RFP ☐ PON ☐ PRDA; (ii) ☐ NON-COMPETITIVELY ☐ LAB ☐ UNSOLICITED PROPOSAL

15. REASONS FOR SELECTING THIS PROPOSAL

- (a)
- (b)
- (c)
- (d)

16. CONTRACT PROCESSING DETAILS

CONTRACT/DOCUMENT	PREPARED ON (DATE)	APPROVED/SIGNED ON (DATE)	COMMENTS

17. LIST OF ALL PROJECTS/WORK UNITS IN SUBELEMENT

S. NO.	TITLE (ACTUAL OR TENTATIVE)	ACTUAL/SCHEDULED DATE FOR	
		START	FINISH

B-25

[illegible]

19. COST STATUS⁺ (DATA FOR THIS CHART CAN BE OBTAINED FROM FORM ERDA 536)*

[illegible]

+ There will be one cost plan and one cost status table/chart for each fiscal year. If a project covers more than one fiscal year, extra tables/charts should be prepared for each additional fiscal year.

* Instructions for filling ERDA forms 533P and 536 apply to these sections.

20. MILESTONE PLAN AND PROGRESS SUMMARY ⁺ (DATA FOR THIS CHART CAN BE OBTAINED FROM FORM ERDA 535)*

S.NO.	TASK/MILESTONE	9. Fiscal Years and Months												10. Percent Complete As of		
REMARKS:																

21. DELIVERABLE ITEMS: ENTRIES SHOULD BE MADE IN THIS TABLE WHENEVER AN ITEM IS DELIVERED. DUE DATES SHOULD BE RECORDED FOR ALL DELIVERABLE ITEMS.

ITEM/PRODUCT/OUTPUT (BRIEFING, PROGRESS REPORT, FINAL REPORT, DEMONSTRATION, ETC.)	DUE DATE	DATE OF ACTUAL DELIVERY	COMMENTS

⁺ There will be one milestone plan and progress summary sheet for each fiscal year.
* Instructions for filling form ERDA 535 apply to this section.

22. IF THE PROJECT WAS TERMINATED PRIOR TO SCHEDULED COMPLETION, REASONS FOR TERMINATION:
(a)

(b)

(c)

23. GENERAL COMMENTS (TO BE RECORDED DURING THE PROJECT AND/OR AT ITS COMPLETION, THE TECHNICAL ACHIEVEMENTS OF THE PROJECT SHOULD BE MENTIONED HERE)

B-27

24. HAS A TECHNOLOGY TRANSFER PLAN BEEN FORMULATED FOR THIS PROJECT?

☐

YES

☐

NO

25. SUGGESTIONS FOR FUTURE ACTION WITH REGARD TO THIS PROJECT:

PROGRAM SUBELEMENT STATUS MONITORING FORM

SUBELEMENT STATUS MONITORING FORM

DATE OF FIRST ENTRY: _____ DATE OF LAST ENTRY: _____

(1) SUBELEMENT I.D. NUMBER: _____ (2) SUBELEMENT TITLE: _____

(3) PROGRAM: _____ (4) PROGRAM MANAGER(S): _____

(5) STARTING DATE: _____ (6) COMPLETION DATE: SCHEDULED _____ ACTUAL _____

(7) TOTAL FUNDING (PLANNED) FOR THE SUBELEMENT: DATE _____; \$ _____; DATE _____; \$ _____

PROJECT MANAGER(S): _____

(8) TECHNICAL OBJECTIVES/RELEVANCE TO DGE GOALS: _____

(9) TECHNICAL DESCRIPTION OF THE SUBELEMENT: _____

(10) FIGURE OF MERIT (F.O.M.) AT THE TIME OF APPROVAL OF THE INITIAL PROJECT IN THE SUBELEMENT - F.O.M. REVISIONS (F.O.M. SHOULD BE RECOMPUTED AT EACH CHECK POINT IN THE SUBELEMENT)

DATE				
F.O.M.				
REASONS FOR CHANGE IN F.O.M.				

11. PROJECT DATA (ENTRIES IN THIS TABLE SHOULD BE BASED ON THE R&D CONCEPT EVALUATION FORM AND FORM ERDA 536 FOR THE RELEVANT PROJECTS)

DATE	PROJECT I.D. NO.	PROJECT TITLE (ABBREVIATED)	CONTRACTOR (IF KNOWN)	STARTING DATE		COMPLETION DATE		COMMENTS
				SCHEDULED	ACTUAL	SCHEDULED	ACTUAL	

(12) FOR TERMINATED PROGRAM SUBELEMENTS: DATE OF TERMINATION: _____

REASONS FOR TERMINATION

- (a)
- (b)
- (c)

SUGGESTIONS FOR FUTURE ACTION

- (a)
- (b)
- (c)

(13) RELATIONSHIP WITH OTHER SUBELEMENTS

(a) OTHER SUBELEMENTS WHICH DEPEND ON THE SUCCESS OF THIS SUBELEMENT (S.E.)

S.E. I.D. NO.	S.E. TITLE	PROGRAM MANAGER (P.M.)	DETAILS OF COMMUNICATIONS SENT TO THE P.M.		COMMENTS/NOTES
			DATE	CONTENT	

(b) OTHER SUBELEMENTS ON WHOSE SUCCESS THIS SUBELEMENT DEPENDS

S.E. I.D. NO.	S.E. TITLE	PROGRAM MANAGER (P.M.)	DETAILS OF COMMUNICATIONS SENT TO THE P.M.		ACTION TAKEN	COMMENTS
			DATE	CONTENT		

(14) SUGGESTIONS FOR FUTURE ACTION FOLLOWING SUCCESSFUL COMPLETION OF THE SUBELEMENT

POST-TECHNOLOGY-TRANSFER RECORD FORM

POST-TECHNOLOGY-TRANSFER FORM
(To be filled one year after the completion
of the subelement)

DATE:

1. Subelement I.D. No.:
2. Subelement Title:
3. Brief Description of Plans for Technology Transfer/
Commercialization:
4. Organization Responsible for Tech. Transfer/Commercialization:
5. Overview of Efforts in the Area of Tech. Transfer/Commercialization
During the Past 12 Months:
6. Significant Accomplishments:

POST-TECHNOLOGY TRANSFER FORM (Concluded)

7. Did the Actual Accomplishments Match or Exceed the Original Expectations:

_____ Yes _____ No
(Go to 11)

8. If the Actual Accomplishments Were Not Up to Expectations, What are the Reasons?
9. What Action can be Taken to Deal With the Reasons for Lack of Adequate Success in Tech. Transfer/Commercialization?
10. What Should be the Future Strategy/Policy Regarding the Tech. Transfer/Commercialization Activities Pertaining to This Sub-element?

APPENDIX II-C

SAMPLES OF PROGRAM STATUS MONITORING LOGS

This Appendix contains samples of the Program Level Data forms. The following blank forms are presented in this Appendix: Program Manager's Log of R&D Concept Status, Program Manager's Log of Project Status, and Program Manager's Log of Subelement Status.

	<u>Page</u>
1. Program Manager's Log of R&D Concept Status	C-5
2. Program Manager's Log of Project Status	C-9
3. Program Manager's Log of Subelement Status	C-13

PROGRAM MANAGER'S LOG OF R&D CONCEPT STATUS

PROGRAM MANAGER'S LOG OF RD&D CONCEPT STATUS

1	2	3	4	5			6			7			8	9	10
DATE	I.D. NO.	DATE ON WHICH THE CON- CEPT WAS SUBMITTED FOR CON- SIDERA- TION	ABBREVIATED TITLE	PRELIMINARY CONSIDERATION		DISPOSITION FOLLOWING PRELIMINARY CONSIDERATION		OUTCOME OF DETAILED EVALUATION			DATE OF PLACE- MENT IN THE FILE OF CON- CEPTS NOT REC- OMMENDED FOR FUNDING	DATE OF INITIATION OF FUNDING & CONTRACT PROCESSING FILE	INITIAL CONTRAC- TING ACTION (+ +)	COMMENTS	
				DATE	WAS THE IDEA RECOMMENDED FOR FORMAL EVALUATION?	DATE OF PLACEMENT IN REJECTED CONCEPTS FILE	DATE OF PLACEMENT IN PENDING CONCEPTS FILE	RE- CON- SID- ERA- TION (+)	FIGURE OF MERIT	WAS THE CON- CEPT RECOMM- ENDED FOR FUNDING?					
					NO - GO TO COL. 6	YES - GO TO COL. 7				NO - GO TO COL. 8					YES - GO TO COL. 9

C-7

* There should be entry for every R&D concept submitted to the Utilization Branch, regardless of the outcome of the concept evaluation.

(+) When a concept is reconsidered, it should be treated like a new concept and a regular entry should be made in the log at the appropriate time.

(+ +) Please use the following abbreviations in this column.

- Non-competitive procurement - N.C.P.
- Accept unsolicited proposal - A.U.P.
- Issue request for proposal - R.F.P.
- PRDA
- P.O.N.
- P.E.R.
- P.O.N.

PROGRAM MANAGER'S LOG OF PROJECT STATUS

FOR THE MONTHS PERIOD ENDING

- (1) The log should be updated once every two months. An entry must be made for every project which was active during the two month period preceding the updating of the log. If significant events (completion of a project, termination, change in scope, etc) occur in between regular updates, special entries should be made at the time of occurrence.
- (2) The scheduled date is the planned target/expected date at the time of making the entry. If an activity is completed during the updating period, record the actual date.
- (3) Entries should be made in this column only if a milestone completion target, scheduled or actual achievement date fell within the preceding two months period.
- (4) Entries should be made in this column only if the original due date, scheduled or actual delivery date for an item fell within the preceding two months period.
- (5) The date of next update will be two months from the date in the first column of the table.
- (6) MILESTONE CODES (7) DELIVERABLES CODES
Code	Milestones	Code	Deliverable
T	Technical Review	B	Briefing
L	Lab Test Completion	P	Progress Report
A	Analysis of Results	T	Technical Report
F	Field Test	F	Final Report
D	Demonstration		
C	Commercialization		

PROGRAM MANAGER'S LOG OF SUBELEMENT STATUS

SUBELEMENT (S.E.) TITLE _____ S.E. I.D. NO. _____ START DATE _____

SUBELEMENT (S.E.) TITLE

S.E. I.D. NO.

START DATE

[illegible]

* Entries need to be made in column 3 for only those projects which were completed during the preceding two months period.

** In column 4, entries should be made for projects which were in progress during the preceding two months period and were not completed at the time of updating this log.

APPENDIX II-D
GLOSSARY OF TERMS AND STANDARD DEFINITIONS

Appendix II-D contains a Glossary of Terms and Standard Definitions which are recommended for use in conjunction with the proposed Project Management System. Sections dealing with General Terms, DGE Technical Aggregation Levels, Subelement Management Sequences, Benefit/Cost Evaluation Terms, Contract Terms, Technical Terms, Standardized Explanations for Decisions and Evaluations, and Miscellaneous Terms are presented in this Appendix.

The terms and definitions in this Appendix will probably require regular updating and augmentation. As experience is gained, it may be possible to develop standard numeric codes for these terms. These codes can then be used for filling out the data sheets and also for developing a computerized data base for the Project Management System.

	<u>Page</u>
1.0 GENERAL TERMS	D-5
2.0 DGE TECHNICAL AGGREGATION LEVELS	D-7
3.0 SUBELEMENT MANAGEMENT SEQUENCE	D-9
4.0 BENEFIT/COST EVALUATION TERMS	D-11
5.0 CONTRACT TERMS	D-15
6.0 TECHNICAL TERMS	D-19
7.0 STANDARDIZED EXPLANATIONS FOR DECISIONS AND EVALUATIONS	D-25
8.0 MISCELLANEOUS TERMS	D-33

1.0 GENERAL TERMS

CURRENT DGE CONTRACT PROCESSING FORMS - Forms now used by DGE to process contracts. These are retained in the Program Management System and include: Contract Justification Memo, Procurement Request, Contract Authorization, and External Evaluation Form.

DGE TECHNICAL AGGREGATION LEVELS - The hierarchy of management activities and technical definitions through which DGE aggregates and organizes its R&D efforts. Levels include: Branch, Technical Program, Program Elements, Subelements, Projects, and Contracts.

PROGRAM MANAGEMENT SYSTEM (PMS) - A DGE system for the processing and storage of information required for the management of the technical substance of the DGE R&D Technical Programs. The PMS consists of a Subelement Management Sequence (SMS) and a Project Data System (PDS).

R&D CONCEPT - Any concept of how R&D activities might be used to further the scientific and technical goals and objectives of the Division of Geothermal Energy. If the concept is approved by a Program Manager and Branch Chief after a "Detailed Evaluation of Concept," it becomes a DGE R&D Subelement and funds are sought to pursue the idea.

PROJECT DATA SYSTEM (PDS) - A system of files, forms, and procedures for documenting the progress of each R&D Technical Program Subelement through all phases of R&D. The PDS documentation consists of:

- (i) R&D Concept Evaluation Form
- (ii) Detailed Evaluation Form
- (iii) Contract Processing and Project Monitoring Form
- (iv) Subelement Status Monitoring Form
- (v) Past Technology Transfer Record Form
- (vi) Program Manager's Log of R&D Concept Studies
- (vii) Program Manager's Log of Project Status
- (viii) Program Manager's Log of Subelement Status

SUBELEMENT MANAGEMENT SEQUENCE (SMS) - A nominal sequence of technical analyses, technical decisions, and management activities for organizing the research and development of one DGE Technical Program Subelement. The sequence consists of: Concept Origination, Initial Screening of Concept, Detailed Evaluation of Concept, Subelement Funding Recommendation, Subelement Funding

Approval, Stimulation and Selection of R&D Proposals, Contract Processing, Contract Approval, Project Monitoring and Control, Project Annual Evaluation, Project Termination and Technology Transfer Review.

OBJECTIVES - Statements of what DGE hopes to accomplish with respect to development and utilization of geothermal power in the U.S. (Example: "To provide the nation with an economically and environmentally acceptable energy resource option.")

GOALS - Quantitatively stated objectives with specific target dates for their achievement. (Example: "To develop a 6000 MWe power-on-line capacity using hydrothermal resources by 1985.")

TECHNICAL DESCRIPTION (of an R&D Project) - A statement of the research and development activities that will be undertaken to attain the stated technical objectives of the project. (Example: "A series of laboratory and field tests will be conducted to determine the rate at which silicates contribute to the formation of scales during the cooling of geothermal fluids.")

RELEVANCE OF THE PROJECT TO DGE GOALS - A statement of the extent to which the successful accomplishment of the technical objectives of a project will contribute to the attainment of the DGE objectives/goals. (Example: The successful development of the thermal pump binary system can be expected to increase the output of power from a geothermal well by a substantial amount (up to 70 percent increase is possible) and thereby reduce the cost and increase the availability of geothermal power.)

2.0 DGE TECHNICAL AGGREGATION LEVELS

DGE BRANCH - An aggregation of DGE Technical Programs managed by one Branch Chief. Focuses on system-level analysis, technical coordination, and guidance. Examples: Utilization Technology Branch, Resource Exploration and Assessment Branch.

TECHNICAL PROGRAM - An aggregation of R&D activities focused on one major subsystem for geothermal energy production or utilization. The sum of activities overseen by one DGE Program Manager. Examples: Well Drilling and Completion, Heat Exchangers and Energy Conversion Systems, Materials Development and Corrosion and Scale Reduction.

TECHNICAL PROGRAM ELEMENT - The combination of R&D activities through which DGE seeks to improve the performance and cost of specific small subsystems of geothermal energy production or utilization systems. The first level of subdivision of DGE Technical Program. Examples: Drill bits, well cements, scale control, heat exchangers.

TECHNICAL PROGRAM SUBELEMENT - Activities that are focused on the development of a specific product or process that can be incorporated into a geothermal energy production or utilization system. The defining characteristic is that the product of the subelement will stand or fall on its own merits, regardless of the success of the products of other subelements. Example: An improved unsealed bit for air drilling. A subelement consists of one or more projects conducted in series or parallel, as needed.

PROJECT - R&D activities conducted by one contractor to support a technical program subelement. A project will typically consist of a series of a few (two to four) contracts to research or develop a specific product or process. Example: The three-year Terra Tek improved geothermal drill bit project.

CONTRACT - The legal arrangement by which DGE executes projects. "Contract" means establishment of a binding legal relation basically obligating the seller to furnish personal property or nonpersonal services (including construction) and the buyer to pay therefor. It includes all types of commitments which obligate the Government to an expenditure of funds and which, except as otherwise authorized, are in writing. In addition to a two-signature document, it includes all transactions resulting

from acceptance of offers by awards or notices of awards;
agreements and job orders or task letters issued thereunder;
letter contracts, letters of intent; and orders, such as purchase
orders, under which the contract becomes effective by written
acceptance or performance. It also includes contract modifi-
cations. (See list of "Contract Terms.")

3.0 SUBELEMENT MANAGEMENT SEQUENCE

CONCEPT ORIGINATION - Start of a novel concept into the Subelement Management Sequence. Concepts are originated by the Program Manager, or by the receipt of an unsolicited proposal from a proposer outside DGE.

INITIAL SCREENING OF CONCEPT - Program Manager informally analyzes and develops the concept to enable Program Manager and Branch Chief to determine if the concept seems to have substantial merit. If so, the concept is subjected to a Detailed Evaluation.

DETAILED EVALUATION OF CONCEPT - Program Manager prepares a subelement development plan for the concept, and prepares a benefit/cost evaluation to determine a figure of merit for the concept. If the concept originated as an unsolicited proposal, the Program Manager initiates an external evaluation of the proposal.

SUBELEMENT FUNDING RECOMMENDATION - Program Manager and Branch Chief review the results of the Detailed Evaluation of Concept and decide whether or not to seek approval from higher DGE levels to fund the concept. If the decision is positive, the concept becomes an R&D subelement for subsequent management purposes.

SUBELEMENT FUNDING APPROVAL - All necessary approvals are obtained to initiate a project stimulation and selection process for the subelement.

STIMULATION AND SELECTION OF R&D PROPOSALS - Proposals for work to carry out the subelement are sought through such mechanisms as PRDAs (Program Research and Development Announcements), PONs (Program Opportunity Notices) and RFPs (Requests for Proposals). Preparation and revision of Forms-189 between DGE Headquarters and DOE laboratories occur here. Received proposals are reviewed as appropriate and selected by Program Manager and Branch Chief. This step is omitted when the R&D subelement originates as an unsolicited proposal.

CONTRACT PROCESSING - Contract is prepared to fund the selected project(s). This includes preparation of Contract Justification Memos, etc.

CONTRACT APPROVAL - All cognizant authorities of DGE approve the prepared contract. Project is initiated.

PROJECT MONITORING AND CONTROL - Program manager ascertains, throughout the term of the contract, the technical progress of the contracted R&D work.

PROJECT ANNUAL EVALUATION - Near the completion of each contract, the project is reviewed to determine if further funding should be committed to the project and the subelement as a whole. This is done usually, but not always, on an annual basis, and serves as the principal checkpoint for project control.

PROJECT TERMINATION - Completion of the last contract of a project. The termination of a subelement (which may consist of more than one project) is also included here. Project and contract monitoring are ended, and technology transfer efforts are started.

TECHNOLOGY TRANSFER REVIEW - The results of the completed subelement are reviewed to evaluate which R&D results or products should be or are being commercialized. Necessary technology transfer activities are initiated and monitored.

4.0 BENEFIT/COST EVALUATION TERMS

ANTICIPATED R&D COSTS - Amount of DGE funds which are expected to be required to bring an R&D subelement from its present status to commercial usage of the subelement's product. For example, this includes all current year and potential follow-on DGE funds mentioned in a proposal, plus whatever additional DGE funds the program manager estimates will be required to bring the product to commercialization.

BENEFITS TO R&D SUBELEMENT - Savings in the total cost of producing power from geothermal sources in the United States between 1979 and the year 2000. Benefits are estimated by calculating the savings which new technology would provide compared to the use of current technology, assuming that power is brought on line as projected by the DGE power-on-line scenario.

DEVELOPMENT TIME - Calendar years from the present until the product of the R&D subelement is expected to be used commercially for the first time. Development time is estimated for each required phase of R&D.

DISCOUNTING - Reduction of future costs and benefits to their present economic worth. Discounting factors are attached as Appendix G-7.

EXPECTED DEGREE OF SUCCESS - The program manager's estimate of what fraction of the maximum possible benefit from a subelement is most likely to be attained. Reductions in the maximum benefit might result from (i) low probability of technical success in early phases of R&D, (ii) less than ideal performance of a developed component, (iii) efficiency-reducing interactions with other geothermal subsystems, and (iv) fractional market penetration.

FIGURE OF MERIT - Ratio of the benefits of an R&D subelement to its anticipated R&D costs, multiplied by the expected degree of success for the subelement. The F.O.M. is a main basis for comparing the relative merits of R&D subelements.

GEOHERMAL POWER-ON-LINE SCENARIO - The DGE projection of the temporal sequence in which specific kinds of power plants will come into operation at each of 37 geothermal resource areas in the United States. This resulted from a DGE planning exercise in the spring of 1977 and is documented in Mitre report MTR-7586, Vol. III, "Site Specific Analysis of Geothermal Development - Data Files of Prospective Sites" (1977). The scenario covering the years 1979-2000 is shown in Vol. III, Appendix A, Table 1.

GEOHERMAL SYSTEM TOTAL COST PROJECTION - A projection, prepared by Metrek, of the total cost of the United States geothermal energy production system in the years 1979-2000. The projection is based on the Geothermal Power-On-Line Scenario and on an economic analysis of the cost of geothermal plants (Mitre report WP-12644, 1977). The cost in constant 1978 dollars is shown as Table 3 in Appendix III-A; the cost in constant 1978 dollars discounted at 5 percent to account for the opportunity cost of capital is given in Table 4 in Appendix III-A.

GEOHERMAL WELLS SCENARIO - A projection, prepared by Metrek, of the number of geothermal wells required to support the Geothermal Power-On-Line Scenario for the years 1979-2000. The scenario is based on the assumptions documented in Mitre report MTR-7613, "Prospects for Improvement in Geothermal Well Technology and Their Expected Benefits" (1977). The scenario includes exploratory, production, reinjection, and replacement wells required at each of 37 resource areas. It is attached as Table 5 in Appendix III-A.

GEOHERMAL WELLS TOTAL COST PROJECTION - A projection, prepared by METREK of the total cost to drill and complete the wells in the Geothermal Wells Scenario. The projection is based on the cost assumptions presented in Mitre report MTR-7586. The cost in constant 1978 dollars is shown as Table 7 in Appendix III-A; the cost in constant 1978 dollars discounted at 5% to account for the opportunity cost of capital is given in Table 8 in Appendix III-A.

GEOHERMAL TECHNOLOGY STANDARD SYSTEM (GTSS) - A standardized model geothermal energy production or utilization system used to prognosticate the types of technology that will be used to achieve the DGE Power-On-Line Scenario. GTSSs are conceptualized around design points that cover the technology needs associated with known geothermal resources.

PRIMARY BENEFITS (OF A SUBELEMENT) - Benefits due to achievement of the subelements performance goal. May or may not include estimates of secondary benefits. Example: Increased drill bit lifetime reduces the number of bits used to drill a well. The resultant savings are a function of both reduced number of bits and any change in cost per bit.

SECONDARY BENEFITS (OF SUBELEMENT) - Benefits due to the subelement's secondary impacts. Example: Savings due to lowering operation expenses, given that a longer-lived drill bit will reduce required tripping time. Secondary benefits may be calculated as an integral part of calculating primary benefits.

SECONDARY IMPACTS (OF SUBELEMENT) - Estimates of changes in geothermal components other than the subelement's target that will result from meeting the performance goal for the target. Example: reduced down-time for wells resulting from reduced time between maintenances for down-hole pumps. The relationships between performance goals and secondary impacts should be expressed mathematically (numerical data or model) if possible.

PERFORMANCE GOAL (OF SUBELEMENT)¹ - A numerical amplification of the technical objective of an R&D subelement. This is an estimate by the Program Manager of the impact which the R&D subelement will have on the technical performance and cost of the target of the subelement. If possible, the goal should be expressed in terms that facilitate estimating benefits of the technical objective. Example: Thirty percent increase in the lifetime of sealed geothermal bits at bit temperature of 200°C; twenty percent increase in the cost per bit.

SUBELEMENT DEVELOPMENT PLAN - A description of the RD&D work, and test and evaluation activities required to carry the device or process from its current status to commercial acceptance. A development plan should include: technical descriptions of RD&D and testing approaches, estimates of level of effort (man-years), estimates of time required for each RD&D phase (years), and estimates of the total RD&D costs for each phase (\$1000s). If the subelement consists of more than one project, contingency relationships between projects should be described.

TECHNOLOGICAL PRODUCT (OF SUBELEMENT) - The technical component or process of a geothermal energy system which is to be developed or improved by an R&D subelement. Examples: Acid corrosion, sealed drill bit, down-hole motor, total flow turbine.

TECHNICAL OBJECTIVE (OF SUBELEMENT)¹ - A technical statement describing what is anticipated to be achieved by an R&D subelement. It

¹NOTE: DISTINCTION BETWEEN GOALS AND OBJECTIVES - Many organizations define "goals" as non-quantitative final ends of strategies and activities, and define "objectives" as specific quantified and timed stepping-stones to goals. This relationship between goals and objectives is reversed in R&D project management because of the tradition of expressing the "technical objective" of a project in open-ended terms. When the objectives of a project express both degree and data of the desired or anticipated accomplishment, they are called project performance goals.

names the technological product of the subelement and describes what impact R&D will have on the performance or other technical characteristics of the target. Example: Increased retention of the secondary fluid in a binary-process heat exchange system.

5.0 CONTRACT TERMS

CONTRACT TERMS - Terms used to describe and define the legal and technical contents of DGE contracts.

ACTUAL COST FOR WORK PERFORMED (ACWP) - Direct and indirect costs identified specifically to the contractual effort being reported. These costs should reconcile with the contractor's incurred cost ledgers that are regularly audited by the Government.

CHANGE IN SCOPE - Change in objectives, work plan, or schedule that results in a material difference from the terms of an approval to proceed previously granted by higher authority under certain conditions (normally so stated in the approval instrument), change in resources application may constitute a change in scope.

COMPETITIVE PROCUREMENT - A negotiated procurement that (1) is initiated by a Request for Proposals, which sets out the Government's requirements and the criteria for evaluation of offers, (2) contemplates the submission of timely proposals by the maximum number of possible offerors, (3) usually provides discussion with those offerors found to be within the competitive range, and (4) concludes with the award of a contract to the one offeror whose offer, the price and other factors considered, is most advantageous to the Government.

CONTRACT MANAGEMENT SUMMARY REPORT - Summary status report contains a concise, visual presentation of the contractor's plan and status in three areas: cost, manpower, and major milestone schedule. Planned, actual, and variance amounts are plotted graphically on the three grid charts. This report can be required in lieu of the Cost Management Report, Manpower Management Report, Milestone Plan and Management Report for smaller projects. For larger projects it can be invoked together with the above reports and serve as a summary report for all three performance areas.

COST-ONLY CONTRACT - This cost-reimbursement type of contract provides for payment to the contractor of allowable costs incurred in the performance of the contract, to the extent prescribed in the contract. This type of contract establishes an estimate of total cost for the purpose of obligation of funds, and a ceiling which the contractor may not exceed (except at his own risk) without prior approval or subsequent ratification of the contracting officer.

COST PLAN - Displays the planned rate at which costs will be accrued for the life of the project. The planned accrued costs will be stated for each specified increment of time over the life of the project and for each specified reporting category. The reporting categories may be work breakdown structure elements, work statement tasks, contract line items, or categories of direct and indirect cost.

COST-SHARING CONTRACT

- (a) Description - A cost-sharing contract is a cost-reimbursement type contract under which the contractor receives no fee but is reimbursed only for an agreed portion of its allowable costs.
- (b) Application - A cost-sharing contract is suitable for those procurements which cover production or research projects which are jointly sponsored by the Government and the contractor with benefit to the contractor in lieu of full monetary reimbursement of costs. In consideration of this benefit, the contractor agrees to absorb a portion of the costs of performance. The following are illustrative situations in which this type of contract is generally desirable is jointly sponsored research and development work with nonprofit educational institutions or other nonprofit organizations.

COST TO DATE - Costs incurred by the contractor and reported to the DOE to date on the Contractor Cost Management Report, which are recorded by DOE as accrued costs. They represent all charges incurred for goods and services received and other assets acquired, regardless of whether payment for the charges has been made. This includes all completed work and work in process chargeable to the contract. Accrued costs include invoices for (i) completed work to which the prime contractor has acquired title, (ii) materials delivered (to which the prime contractor has acquired title), (iii) services rendered, (iv) costs billed under cost reimbursement or time and material subcontracts for work to which the prime contractor has acquired title, (v) progress payments to subcontractors that have been paid or approved for current payment in the ordinary course of business (as specified in the prime contract), and (vi) fee/profit allocable to the contract.

DELIVERABLE - A product of one or more tasks that satisfy one or more objectives. The report or other product that must be delivered to satisfy contractual requirements.

FINAL TECHNICAL REPORT - A comprehensive final technical report of the results achieved during the life of the contract or project. It summarizes all work activities and provides a comprehensive description of the results achieved. It is a technically oriented account of the investigation and is supported by necessary tabulations of data, figures, photographs and pertinent references.

JUSTIFICATION - Consists of all information and data by which it has been determined that the procurement is in the best interests of the Government.

MILESTONE: An important or critical event or activity that must occur in the project cycle in order to achieve the project objective(s).

MILESTONE PLAN - The contractor's milestone schedule for all work breakdown structure items, line items, or deliverables specified in the contract. Updated periodically (usually monthly) with status, progress toward completion, and percent completion of each line item and on the total contract.

MONITORING - Periodically gathering, validating, and analyzing various data on contract status to determine any existing or potential problems. Usually the GTR accomplishes this through use of the data provided in contractor reports to measure progress against the established baselines for each of these report areas. However, when deemed necessary, onsite inspection and validation and other methods will also be employed.

TASK - Any definable unit of work must have an identifiable start and ending and usually produces some recognizable result.

TECHNICAL STATUS REPORT - The Technical Status Report is a brief, concise, factual narrative description of overall progress during the report period. The report contains the contract objective, progress summary, changes, problem areas, open items, and supporting data. It is prepared and submitted to provide the contractor's comprehensive assessment of status toward achieving the objective(s) and requirements of the contract. Plans for the next report period, problems inhibiting normal progress, solutions recommended, variations from previously established plans, and other pertinent data shall be included. This report will be used by DOE Management to evaluate contract performance and will be the basis for management decisions within DOE. It will provide early recognition of potential problems that could prevent orderly progress on the overall objective.

TECHNICAL PROGRESS REPORT - A periodic report to communicate the results of research, development and demonstration activities carried out with DOE support. This information is submitted to DOE, who in turn applies the information to future efforts or disseminates it to interested parties including Federal, state and local governments, and, when appropriate, to the private sector. "Private Sector" includes industry, professional societies, the education community and the public.

6.0 TECHNICAL TERMS

ACTIVE FAULT - A fault along which measurable displacement has occurred in comparatively recent geologic time (usually late Quaternary or Holocene).

ACTIVE SEISMIC METHOD - Uses explosives to produce acoustic waves which are reflected and refracted through the earth and recorded by arrays of sensitive pickups (geophones); geologic structure is inferred from the recorded signals.

ANOMALY - In geology, a local feature distinguishable in a geophysical, geochemical, or geobotanical measurement over a larger area; a feature considered capable of being associated with commercially valuable deposits.

BASALTIC - Designates a volcanic rock low in silica, and rich in iron and magnesium; opposite of silicic.

BASIN AND RANGE PROVINCE - A large region characterized by tilted fault-block mountains separated by basins filled with young sediments.

BINARY CYCLE - In geothermal power-plant design, denotes the use of a heat exchanger to conduct heat from a geothermal brine to the working fluid (low-boiling-point fluid such as isobutane) which drives a turbine.

BLOWOUT - The sudden, often explosive escape of steam and perhaps hot water from a geothermal well; may be caused by improper drilling procedures or rupture of casing and wellhead equipment.

CASING - The steel pipe used to line a drill hole.

CONVECTION - A process of mass movement in a fluid medium (gas, liquid or plastic solid), in which cooler, denser material settles, and lighter, hotter material rises, causing vertical, near-circular flow. The process thus moves both the medium and the heat.

CORROSION - A process in which a solid (usually a metal) is eaten away by a fluid (usually an acid).

CRUST - The outmost layer of the earth, composed of relatively cool, brittle, low-density rocks (compared with the mantle), and ranging in thickness from 5 kilometers (beneath ocean floors) to 30 to 50 kilometers (under continents).

DIRECT-CURRENT RESISTIVITY SURVEY - Uses a direct-current generator to produce an electrical field in the earth, which is then measured with a voltmeter at many different points; many different electrode configurations (connections of generator and voltmeter to the ground) are employed; the resistivities of buried rock units can be inferred by calculation.

DRILLING RIG - Equipment used to drill through rock formations; shallow temperature-gradient holes are drilled with a truck-mounted rig; deep exploration holes are drilled with a large, stationary rig.

DRY STEAM - Steam without entrained liquid water, i.e., pure steam.

ENTHALPY - Heat content per unit mass, expressed in Btu/lb or cal/gm.

FLASHED STEAM - Steam produced by the boiling of superheated water upon release of confining pressure.

GEOCHEMICAL INDICATORS - In the geothermal context, geochemical anomalies indicating the presence of a potentially valuable geothermal prospect.

GEOCHEMISTRY - Chemistry of the earth; applied geochemistry uses chemical analyses to find economic resources, including minerals and geothermal fluids.

GEOPHYSICS - Physics of the earth; applied geophysics uses various methods of measuring physical characteristics of the earth's crust to locate economic resources.

GEOPRESSURE - Fluid pressure exceeding hydrostatic pressure.

GEOHERMAL - Of or relating to the earth's natural heat.

GEOHERMAL GRADIENT - The rate of temperature increase with depth below the earth's surface in degrees C/km or degrees F/100 feet.

GEOHERMAL IDENTIFIED AND PROVEN RESOURCES - Areas where geothermal resources may be identified from the distribution and abundance of such manifestations as hot springs, geysers, fumaroles, or indications of recent volcanic activity.

GEOHERMAL RESERVES - Those geothermal resources now recoverable at prices which are competitive with other forms of energy.

GEOTHERMAL RESERVOIRS - Confirmed geothermal prospects.

GEOTHERMOMETER - A geochemical method which uses groundwater chemistry to estimate the temperature of a geothermal reservoir.

HEAT FLOW - The amount of earth heat moving radially outward per unit surface area per unit time, expressed as microcalories/cm²/sec.

HOT DRY ROCK - Type of geothermal energy derived from deposits in which heat is contained in dry rock formations which are normally impermeable and of very poor porosity.

HYDROTHERMAL CONVECTIVE - Type of geothermal energy derived from hot water systems. When this energy is found in systems containing mainly steam they are called "vapor-dominated." When they contain steam and large amounts of liquid or liquid alone they are called "liquid-dominated."

IMPERMEABLE - Not permeable (see Permeable).

INJECTION - The returning of produced geothermal fluids back into the reservoir from which they came, through disposal wells.

INTRUSION - The process of injection of magma into the shallower portion of the earth's crust; an igneous (solidified magma) rock body formed by this process.

KGRA - (Known Geothermal Resource Area) - An area which the Mineral Land Classification Committee of the United States Geological Survey has designated as potentially valuable for production of geothermal energy.

LAND SUBSIDENCE - The sinking of land, usually due to withdrawal of natural underground fluids (oil or water) by man.

LITHOLOGY - The character of a rock formation.

MAGMA - Molten rock.

MAGNETIC SURVEY - Uses a magnetometer (either airborne or on the ground) to measure the intensity of the earth's natural magnetic field at many points in the survey area; the data are then used to interpret geologic structure.

MAGNETOTELLURIC SOUNDING - Relies on the earth's natural electrical (telluric) and magnetic fields which are induced in subsurface conductive rocks; the resistivity of buried conductive rock units can be inferred from measurements of these fields at the earth's surface.

MANTLE - The spherical shell of the earth's interior, lying beneath the crust and above the core; it is about 2,900 kilometers (1,800 miles) thick, hot, plastic.

MEGAWATT - One thousand kilowatts.

NORMAL GRADIENT - Type of geothermal energy derived from the change in temperature of the earth with depth.

PASSIVE SEISMIC METHOD - An exploration technique relying on naturally occurring seismic waves (e.g., from earthquakes).

PERMEABLE SOLID - A solid through which a fluid can move.

PROSPECT - An area in which the presence of an economic resource is indicated.

RADIOGENIC - Formed as a consequence of radioactive decay of materials in the earth's crust.

RECONNAISSANCE - The initial investigation of a large area in order to locate prospects or targets.

RECHARGE ZONE - Area where water is added to the zone of saturation in a formation.

RESERVOIR - A space in which a fluid is stored, as in the pores or fractures of a rock body.

RESOURCE - Stored heat, both identified and undiscovered, that is recoverable using current or near-current technology, regardless of cost.

RESISTIVITY - Electrical resistance of a unit cross-section per unit length of any material; this varies widely with rock type, porosity, temperature, mineral composition, fluid content, and salinity.

SALINITY - A measure of the total dissolved solids of water; for comparison, sea water has a salinity of about 30,000 ppm.

SCALING - Precipitation and deposition of dissolved solids in pipes or other containers (of geothermal or other fluids.)

SEDIMENT - In geology, rock and mineral debris which has been eroded, transported, and deposited by wind, water, or ice (glaciers).

SEDIMENTARY - Composed of sediments, usually deposited in water.

SEISMIC - Pertaining to, characteristic of, or produced by earthquakes or earth's vibration, or by artificial elastic wave generation.

SEISMICITY - Earthquake activity.

SEISMIC NOISE - Ambient or background seismic energy which can be measured anywhere on the earth's surface; its characteristics vary with local geologic structure.

SILICIC - Applied to igneous rock containing 66 percent or more of silica, such as rhyolite, dacite, granite and quartz monzonite.

SPACE HEATING - Heating of air inside a building.

SUBSIDENCE - A large-scale sinking or downward settling of part of the earth's crust.

TDS - Total dissolved solids.

TECTONIC - Refers to those processes by which rocks of the crust and upper mantle are deformed (faulted, fractured, folded).

TECTONIC PLATE - A large area of the crust and upper mantle (shallower than about 100 kilometers or 60 miles) that moves or is rafted across the underlying mantle as a unit over a long period of geologic time; the process of shifting leads to continental drift.

TELLURIC SOUNDING - (See Magnetotelluric Sounding).

TEMPERATURE-GRADIENT SURVEY - Uses a probe to sample temperature at successive points in a drill hole, in order to determine the rate of temperature increase with depth.

TOTAL FLOW - Conversion techniques capable of using both liquid and steam in a combined flow to turn a turbine.

VAPOR-DOMINATED RESERVOIR - A reservoir which produces dry steam without significant liquid water content.

VOLCANISM - Natural processes resulting in the formation, movement, eruption, and crystallization of magmas, forming volcanoes and volcanic rocks.

WELL-LOG - A record of certain geophysical properties of rocks penetrated by a well, from which lithology can be inferred.

7.0 STANDARDIZED EXPLANATIONS FOR DECISIONS AND EVALUATIONS

In addition to the codes presented in this section, it is anticipated that standard codes can be developed for the following statements:

- (i) Reasons for not conducting a preliminary evaluation (R&D Concept Evaluation Form)
- (ii) Reasons for terminating the project (Contract Processing and Project Monitoring Form)
- (iii) Reasons for terminating a subelement (Subelement Monitoring Form)
- (iv) Reasons for change in the Figure of Merit (Subelement Monitoring Form)
- (v) Suggestions for future action for terminated subelements (Subelement Monitoring Form)

TERMS FOR INDICATING THE IMPACT OF THE PROPOSED ACTIVITIES PERTAINING
TO AN R&D CONCEPT (R&D CONCEPT EVALUATION FORM)

<u>CODE</u>	<u>STATEMENT (IMPACT)</u>
1	Provide a basis for deciding to continue the effort.
2	The data generated upto this point will be used as a reference for evaluating future activities.
3	The government and industry officials will be made aware of the capability of this concept.
4	This output will result in the dissemination of relevant data to the interested parties.
5	This output will result in the identification of equipment manufacturers.

REASONS FOR RECOMMENDING THAT THE CONCEPT BE FUNDED
(R&D CONCEPT EVALUATION FORM)

<u>CODE</u>	<u>STATEMENT (REASON)</u>
1	The proposers possess a unique technical ability for undertaking the proposed effort.
2	The proposed technology is easily transferrable to other energy production/utilization areas.
3	The proposal evaluators consider the research proposal to be very good.
4	This research effort may result in a near-term impact on the cost and availability of geothermal energy.
5	The concept is relevant to DGE goals.

REASONS FOR REJECTING THE CONCEPT FOLLOWING PRELIMINARY EVALUATION
(R&D CONCEPT EVALUATION FORM)

<u>CODE</u>	<u>STATEMENT (REASON)</u>
1	The concept is not relevant to the current level of development of geothermal industry.
2	The funding requirements for pursuing the concept are excessive.
3	A similar concept is being pursued in an ongoing sub-element.
4	This concept does not have a sufficiently good chance for success.
5	Sufficient information/data not available for evaluation.
6	The technical/financial aspects of this concept are not clearly stated.

REASONS FOR RECOMMENDING DETAILED EVALUATION OF THE R&D CONCEPT
(R&D CONCEPT EVALUATION FORM)

<u>CODE</u>	<u>STATEMENT (REASON)</u>
1	This concept has the potential for eliminating a major impediment to the growth of the geothermal industry.
2	This concept can be expected to lower the cost of geothermal energy.
3	This concept will speed up the exploration and/or exploitation of geothermal energy resources.

REASONS FOR NOT RECOMMENDING THE CONCEPT FOR FUNDING
(R&D CONCEPT EVALUATION FORM)

<u>CODE</u>	<u>STATEMENT (REASON)</u>
1	The figure of merit for this concept is very low.
2	The evaluation of the concept and the associated work plans by the external evaluators is not favorable.
3	The schedule for outputs of the proposed effort does not coordinate well with the overall plans for the development of geothermal energy.
4	Funds for undertaking the proposed effort are not available.
5	Reliable data are not available for making a sufficiently accurate estimate of the figure of merit.

STATEMENTS PERTAINING TO THE RELEVANCE OF R&D CONCEPT TO DGE GOALS
(R&D CONCEPT EVALUATION FORM)

<u>CODE</u>	<u>STATEMENT</u>
1	Will reduce the cost of power.
2	Will speed up exploration.
3	Will speed up exploitation.
4	Will speed up exploration and exploitation.
5	Will minimize delays caused by the failure of equipment.
6	Will improve the chances of attaining the National goals for geothermal power on line.
7	Will reduce the reliance on imported fuel.

LIST OF STANDARD TECHNICAL OBJECTIVES
(CONTRACT PROCESSING AND PROJECT MONITORING FORM AND
SUBELEMENT STATUS MONITORING FORM)

<u>CODE</u>	<u>TECHNICAL OBJECTIVE</u>
1	Develop a detailed design.
2	Fabricate a prototype.
3	Design and fabricate.
4	Fabricate, test and evaluate.
5	Conduct laboratory test and evaluation.
6	Conduct a field demonstration.
7	Demonstrate the feasibility of using a new technique.
8	Determine the reliability of a new technique.
9	Determine the economic benefits of the proposed concept.
10	Determine the energy conservation benefits of the proposed concept.
11	Identify operating system criteria for plant design.

8.0 MISCELLANEOUS TERMS

COMMERCIALIZATION - Efforts, other than demonstration projects, undertaken by DGE to facilitate the rate at which developed products of DGE R&D become incorporated into commercial geothermal energy production and utilization systems.

DEMONSTRATION - Verification of economic and environmental viability for commercial application, through design, construction, test, and evaluation of large-scale energy systems in operational circumstances.

DEVELOPMENT - Development and test of systems and pilot plants judged to be technically and economically desirable as a means of achieving principal DOE goals. Engineering development may concern itself with processes, pre-production components, equipment, subsystems, or systems. Initiation of work in this category is dependent upon successful demonstration of technical feasibility and economic potential during the technology phase.

SUBSYSTEM - An aggregation of component items (hardware and software) performing some distinguishable portion of the function of the total system of which it is a part. Normally, a subsystem could be considered a system in itself if it were not an integral part of the larger systems.

SYSTEM - A collection of hardware (equipment and facilities) and related software (procedures, etc.) designed to perform a unique and useful function. A system contains everything necessary (except personnel and materials or supplies) to perform its defined function.

TECHNOLOGY DEVELOPMENT - Systematic use of the knowledge and understanding gained from research to achieve technical feasibility and to gauge economic and environmental potential of energy concepts, processes, materials, devices, methods, and subsystems.