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AN EVALUATION OF COMPUTER DATA BASE ALTERNATIVES FOR THE U. S. DEPARTMENT OF ENERGY WESTERN GAS SANDS PROJECT

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TRW
SYSTEMS AND ENERGY

FOREWORD

This study was conducted by TRW Systems and Energy, as a task under TRW's subcontract to CER Corporation to provide technical and administrative support to the Department of Energy's Western Gas Sands Project. A long-range objective of the Western Gas Sands Project is the establishment of a computerized data base system. The objective of this report was to define and evaluate feasible implementation alternatives for that data base system.

The study was conducted under the direction of William Bailey, Manager of the Las Vegas Field Office of TRW Energy Systems Group, and the work was accomplished under an inter-group work agreement by personnel from the TRW Defense and Space Systems Group. The evaluation project manager was Elaine G. Pate, of the Architectural, Civil, and Geotechnical Department. Lila M. Bhuta of the same Department was a major participant in the study and co-authored the final report. Peter Wong, Minicomputer Technology Department, provided data and recommendations regarding minicomputer applications.

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1.0 INTRODUCTION AND SUMMARY

1.1 DATA BASE REQUIREMENTS

A long-range objective of the Department of Energy's Western Gas Sands Project (WGSP) is the establishment of a computerized data base. This data base (or data bases) will contain geologic description information of the western tight gas reservoirs, industrial activity in the basins of interest, and the state-of-the-art of diagnostic and stimulation technology. The data base will be maintained and updated throughout the life of the Project, and work on its development is being initiated during FY 1980.

At least two types of information retrieval capability are envisioned. The first is a document index which would contain keywords for all reports, books, periodicals, and other documents with information relevant to the Western Gas Sands Project (WGSP). By using any of the key words, a user would have the computer conduct a search and print a listing of all relevant documents and where they may be obtained (e.g., WGS Las Vegas Library, BETC Library, etc.). For the purposes of this study, this capability is referred to as "Level I".

Specific types of data would be stored in the data base itself (which could be a separate system, data base, or file from the index look-up). These data would be retrievable according to certain formats. For example, various data, such as gas production versus time, could be stored for all gas wells included in the data base. This capability is referred to in this study as "Level II".

Determination will be required on a well case-by-case basis as to whether all types of data, such as well logs, should be included in the actual data base or only identified for further manual search, in the document index.

1.2 POTENTIAL USERS

It is anticipated that, initially, WGSP participants will be primary users of the data base. Various government offices, which require information supporting regulatory and policy decision-making are expected to become, indirectly or directly, significant users. Ultimately, the information included in the data base will become available to government agencies, major and independent oil and gas companies, consulting firms, gas transmission firms, research organizations, educational institutions, financial institutions, and the media. Specific applications these users might have are listed below.

1. For the Department of Energy (DOE) headquarters and other high level government agencies -- needs include resource estimations in the various basins and reserves

possible via the general purpose query language.

Many DBM systems (DBMS) are available today. These systems are available for use in the user's hardware. The "system" (or software), therefore will often have a different name from the hardware (or machine). Software systems can be bought and input into hardware with compatible protocol.

A DBMS can be used regardless of the location of the actual hardware providing it has telephone access capabilities. The only limitations to this would be the availability and extent of the user's remote equipment.

Therefore, the data base selected for the WGSP could be located in-house or within another company and be accessible by telephone hook-up. Total in-house or remote contracted systems are not necessarily the only available options. Any combination of in-house and remote contracted systems can be used.

To provide consistency in communication and costing algorithms, and to estimate possible data volume, the following "levels" of data content have been established:

Level I. A simple document abstracting system. This system would contain no actual data. Data base query and manipulation would be executed through the use of keywords.

An average of 450 characters per record (alphabetical and numeric) is assumed. Because it is currently uncertain what size data base might be required, the number of records (or abstracts) has been tested at 1,500, 7,000, and 12,000. These numbers approximate 675,000, 3,150,000, and 5,400,000 bytes (storage units), respectively.

Level II. A more sophisticated system than Level I would be used for storing and retrieving geological and technological data.

An average of 2,200 characters per record is assumed. The number of records (or information pertaining to individual wells, fields, pools, etc.) has been tested at 1,500, 7,000, and 12,000. These numbers approximate 3,300,000, 15,400,000, 26,400,000 bytes, respectively.

Level IIA. A combination of both Level I and Level II. This system would store and retrieve both document abstracting information and geological and technological data.

An average of 2,650 characters per record is assumed. The number of records has been tested at 1,500, 7,000, and 12,000. These numbers approximate 3,975,000, 18,550,000, and 31,800,000 bytes, respectively.

estimates as a function of gas price and technology level, or data from which analysts in these agencies can make their own estimates. Such data are needed to support domestic and international policy making.

2. For engineering staffs in consulting firms, government laboratories, government energy technology centers, universities, and research departments of oil and gas companies -- needs consist of detailed geologic and geographical data for the various basins in support of, for example, test site location determinations, basin geological studies, and preparation of site specific or general environmental impact statements. Researchers investigating diagnostic and other technology improvements can use the data base to locate related published results, access relevant field test data, if available, and determine the availability of core samples to use in laboratory testing, or other tests.

3. For exploration and production departments of oil and gas companies and sponsors of oil and gas investment programs -- needs include data which directly support exploration and development of the tight gas sands resource by the private sector.

4. For economic analysts, and industry accountants -- needs include data to assess the economic viability of applying various stimulation technologies in specific geologic settings as a function of drilling and stimulation costs and gas prices.

It is anticipated that users in locations remote from the actual facility location will be able to access information directly using remote terminals, or by requesting hardcopy from the data base manager.

1.3 IMPLEMENTATION CONSIDERATIONS

A basic objective is to select and set up a readily usable and centralized rapid retrieval system such that any person with access privileges can query the data base. One method of meeting this objective is to use a computer to store and retrieve the data. The computer technology that performs this type of function is known as Data Base Management (DBM). DBM is a method of storing data for quick and easy retrieval. The data base can be accessed by either a query language or an application program.

A query language is a command language which provides the user with direct data manipulation ability. It allows the user to examine or change the data base by giving commands such as "find", "change", etc. An application program is used to manipulate, tabulate, and filter the data base in ways not

Three general alternatives were considered for implementing the WGSP computer data base system.

With Alternative A, the WGSP would add data to a data base established and in use by one of the data service companies investigated and reported herein. For WGSP application none of the service companies offer sufficiently convenient, flexible, or cost-effective service at this time.

Alternative B would involve creating a program to fit the needs of the WGSP using the software of a DBMS. The capacities of GE's Data Management System (DMS), Data Retrieval System (DRS), and TRW's Generalized Information Management System II (GIM II) offer the flexibility and sophistication required for the project.

Alternative C would involve the purchase of minicomputer hardware and software and the use of remote public access telephone lines (i.e., TELENET). Based on a comparison of five hardware and five software systems, the HP 3000 minicomputer using the IMAGE/3000 DBMS, appears the most applicable and cost effective minicomputer for WGSP use.

1.4 EXISTING DATA BASES

Prior to development of this computer data base system, it is apparent that the applicability of existing data bases should be assessed. Consequently, data services provided by the following organizations were examined:

1. University of Tulsa Information Services Department (Petroleum Abstracts [PA]).
2. American Geological Institute (GeoRef).
3. Petroleum Information (PI) Corporation.
4. University of Oklahoma Information Systems Programs (Petroleum Data System [PDS]).
5. Dwight's Oil and Gas Production Reports, Inc. (Dwight's Energydata).

Detailed descriptions of each of these systems are presented in Section 2.0. It should be noted that existing data bases which may contain information directly relevant to WGSP needs, may still not be applicable. The WGSP data base must be sufficiently flexible to accept relevant, new information as designated by the WGSP data base manager and the information must be accessible at a minimal cost to Project participants and other designated users. It is nonetheless important to know precisely what information is available through commercial data bases, and also, examination of existing systems provides

insights into the design of a future WGSP system.

1.5 SCOPE OF STUDY

Section 2.0 describes and assesses data service organizations for informational content as well as data base applicability for the addition of WGSP information.

Section 3.0 describes the applicability of various networking services which provide generalized data bases as well as access to informational data bases.

Section 4.0 presents three feasible alternatives for data base implementation. These alternatives are: adding data to an informational service organization's system; purchasing the use of a data base management system (containing no information) for the insertion of WGSP information; and procuring an in-house minicomputer accessible by telephone hook-up for insertion of WGSP information.

Section 5.0 provides estimated costs for comparison of various options discussed in Section 4.0 as a function of data volume and time.

Appendix A provides samples of the type of data one could expect to receive from the various informational data service organizations.

Appendices B through F provide detailed lists of all informational elements possible through data service organizations.

Appendices G, H, and I provide data base verb and command definitions for DMS, DRS, and GIPSY respectively.

Appendix J is a brief glossary intended to familiarize the reader with some of the frequently used data base nomenclature.

1.6 INFORMATIONAL DATA SERVICES SUMMARY

The information service organizations discussed in Section 2.0 offer geotechnical data applicable to the WGSP. These data, which include detailed well information graphics and literature abstracts, are available as standard reports, customer-formatted projects, by online access to the information. In addition, System Development Corporation (SDC) offers a suitable capacity to create a publicly accessible private data bank. Such a system allows input of purchased data as well as private data generated by the WGSP. A summary of informational data is provided below.

1.6.1 Petroleum Abstracts

Bibliographic references and abstracts of petroleum-related articles (data for a Level I system); available online through SDC as hardcopy subscription or on magnetic tape. Covers 700 journals, symposia, theses, and patents from 1964 through the present. Pricing is set up individually for each customer. Service is provided by the University of Tulsa. See Section 2.1 for pricing information.

1.6.2 GeoRef

Bibliographic references to and abstracts of geoscientific literature (data for Level I system); available online through SDC; abstracts prepared by the American Geological Institute from 3,000 journals, symposia, and monographs dating from 1967 to the present; available online through SDC; pricing involves $75/hour computer connect time, $0.20/citation printed offline (by high-speed printer).

1.6.3 Petroleum Information Corporation

Well-location, drilling, well completion, production, and limited secondary recovery data (for a Level II system); logs, base and ownership maps, custom-formatted graphs, charts, and subsurface maps; exploration and marketing statistics; frequent updates; pricing varies with service used.

1.6.4 Dwight's Energydata

Standard and customer-designed production reports; available by hardcopy subscription and on magnetic tape; production statistics accessible online via General Electric/Network Software Services pricing depends on the size and number of geological districts specified.

1.6.5 Petroleum Data System

Geologic and lithologic data, well volume yield, and limited secondary oil recovery and production data; some plot diagrams; data extracted from industry publications, thus files are usually one calendar year behind; online access through NSS or custom-formatted reports via PDS. See Sections 2.4 and 3.1 for pricing information.

1.7 CONCLUSIONS AND RECOMMENDATIONS

A careful assessment of the expected life-span and volume use of the WGSP data base should be conducted by WGSP management. A decision will probably have to be made between alternatives B and C. The principal factors will be the time-span and volume of data. Tables 5-1 through 5-3 show that a minicomputer could

be more cost effective anytime after approximately one to four years depending on data volume.

Although a minicomputer would involve higher initial start-up and capital costs, it would recover these initial costs after a certain period of several years. This period of time would be comparable to the expected project data base life span.

A cost factor not assessed in this report is the need to bill outside data base users if a minicomputer were implemented. A subroutine to determine outside usage could be implemented at nominal cost. Billing costs, however, would involve additional operator, clerical, and postage costs. With Alternative B, billing would be done by the commercial data base organization.

Based on the various services assessed in this report, basic recommendations can be made:

1. Establish data base requirements: begin and complete data base design (i.e., dictionaries, utilities, report-writers) on the most expandable, flexible and cost-effective system.

2. Establish data acquisition procedures.

3. After the data base design has been completed and sample data have been entered, tested, and accepted, establish the data base, with its programming, on the most flexible and cost effective commercial data networking system for public accessing and billing.

2.0 EXISTING DATA SERVICES

The organizations discussed in this section offer geotechnical data of use to the WGSP. These data include detailed well information, maps, graphs, and bibliographic references to and synopses of relevant scientific and economic articles. Some service companies issue subscriptions to hardcopy standard well reports and graphics, whereas others also create customer-designed assemblages of data. Files of Level I-type abstracts of articles are updated frequently. Online computer interaction with these files is offered through information retrieval service companies such as System Development Corporation (SDC) and Network Software Systems (NSS) and are described in Section 3.0.

Production data (for use by a Level II system) are available through Dwight's Energydata, Petroleum Data System (PDS), and less extensively through Petroleum Information (PI) Corporation. In addition, PDS and SDC offer the capacity to create a publicly accessible private data bank. Costs and access to data are discussed for each data service company.

2.1 PETROLEUM ABSTRACTS, UNIVERSITY OF TULSA INFORMATION SERVICES

Operated by the University of Tulsa, the Petroleum Abstracts Information System offers bibliographic references to and summaries of scientific articles, patents, symposia, and government reports. Technical professionals select articles covering petroleum exploration, drilling, recovery methods, etc., from over 700 foreign and domestic journals. Since 1965, approximately 1,200 abstracts per month have been added to the files, creating a total of over 225,000 abstracts (records). These abstracts are useful only for a Level I system.

The abstracts are accessible by two methods:

1. Online computer interaction.

2. Hardcopy subscription.

By dialing a local telephone number using WATS lines, the user may connect with a computer at Systems Development Corporation (SDC) in Santa Monica, California. This literary reference retrieval service offers access to the entire Petroleum Abstracts computer file and is discussed in greater detail in Section 3.2.

Each item in the file displays the following information:

- TITLE
- AUTHOR

- BIBLIOGRAPHIC SOURCE
- DESCRIPTOR LIST

The descriptors form an assemblage of terms which merely suggest the content of the article rather than provide a summary. Information from the computer is therefore useful in choosing references for further study. The use of suitably defined descriptors eliminates ambiguities due to synonyms or multi-meaning words. Although controlled, this vocabulary is open-ended, permitting the addition of descriptors as needed to identify new concepts or expanding areas of technology.

The Geographic as well as the Exploration and Production Thesauri employed by indexers may be purchased in hardcopy form. These thesauri provide clear definitions of semantically questionable terms and provide substituted terms in the case of synonyms. A thesaurus will inform the searcher when a particular term was first used (before which date no citations are stored in the system), and also will suggest alternate terms for use in searching earlier files before the date that particular descriptor came into use. Thus, alternate search questions can be structured to cover the entire file. This information on past and present indexing policies and usage of descriptors helps in refining search strategies to obtain the maximum number of pertinent references.

The cost to use this system depends on telephone charges and on rates for computer time (adjusted for individual cases by the University of Tulsa), and on high-speed printing when desired. Online printing is also available but since the terminal connect costs are relatively high, this option is not always economical for the user.

Hardcopy bulletins contain 250-300 abstracts per weekly issue. Synopses of articles, which appear in sentence form, average about 200 words per abstract (a sample is shown in Appendix A, page A-1).

To retrieve information effectively, the Alphabetical Subject Index is useful. This manual search index brings together titles of articles and patents under single subject headings and includes a year-end cumulative index in addition to bimonthly publications.

Computer search tapes may be purchased and organized sequentially by abstract number, and contain title, author, bibliography, and descriptor lists (issued every four months). Reformatting of tapes may be necessary for more efficient search systems. A program for integration with other tapes would be necessary if the information were to be loaded onto another data base management system such as a minicomputer.

Although it is possible to add proprietary data to the Petroleum Abstracts file, and such a precedent is being set by one other company, a problem arises. In general, Petroleum Abstracts chooses to service mainly private companies and their specific corporate goals.

Since Petroleum Abstracts is a cooperative effort, subscribers agree not to furnish any of the information or material received to any other person, firm, or organization except corporations related by more than 50% stock ownership through parent or subsidiary corporations. An agreement has also been made that no more than 10% of the file can be used by the Department of Energy. Thus, any purchased information made public through the WGSP would violate both agreements. Under these conditions, Petroleum Abstracts is not amenable to selling any information whatsoever for use by the WGSP.

2.2 GEOREF, AMERICAN GEOLOGICAL INSTITUTE

GeoRef is a geological reference file, covering geosciences literature from 3,000 journals, books, theses, conferences, major symposia, and government documents. Subject coverage includes some 29 geoscience areas such as structural, economic, areal and environmental geology, mineralogy, geochemistry, petrology, paleontology, stratigraphy and geophysics.

The American Geological Institute provides approximately 50,000 records per year which date from 1961 and adds about 4,000 updated citations to the file monthly. Searches of the data base are carried out by means of any compatible remote terminal. One begins by dialing a telephone number in a near-by city, and after identifying oneself to the SDC computer with a provided user identification number, one may begin to query and search the files using a simple English-like language.

Fourteen different categories of information are recorded for most citations, as shown and defined in Appendix A, pages A-3 and A-5. It is necessary to plan an initial search strategy before going on-line. The descriptors, which are selected by scientific professionals to represent document contents (examples appear in Appendix A, page A-4) may be selected from GeoRef publications such as the Bibliography and Index of Geology, Glossary of Geology, or a listing of geographical descriptors. These indexing guides do contain controlled vocabulary lists, but the lists are not used continuously across the data base. In comparison, the controlled vocabulary used by Petroleum Abstracts provides for searches which can cover the entire file.

After a set of descriptors is entered, the computer will relate the number of pertinent citations stored. Users may then modify the descriptor list to narrow down the number of records to a manageable size. To review the search results, one may choose

to print parts (e.g., titles only) or all of certain citations online, then revise the search with different combinations of descriptors as needed, and print the final results. In the case of long bibliographies, it may be less expensive to print the results offline on SDC's high-speed printer and have the listings air mailed. When searching is complete, one orders the system to "STOP". Users may obtain advice or assistance by telephone 12 hours a day.

Three price elements are involved:

- Computer terminal connect time: $75.00/hour.
- Telephone use.
- Offline high-speed printing, if desired: $0.20/citation.

Appendix A, Page A-3 is a sample of output retrieved from the GeoRef data base. Each citation is represented by a unit record containing up to 14 different categories of descriptive information. In Appendix A, Page A-5 these 14 categories are listed and each is followed by its two-letter computer abbreviation and an "X", if it is a searchable and printable category.

Terms from searchable categories -- e.g., SANDERS, JENSEN (from the Descriptor Category) -- can be entered in a search statement alone or in combination with other terms. The computer will inform the user how many citations relate to the statement so that the statement may be refined or broadened as desired.

2.3 PETROLEUM INFORMATION (PI) CORPORATION

Petroleum Information (PI) Corporation is a comprehensive oil and gas information resource offering exploration and production data. Well-by-well information is provided for nearly the entire United States as well as for parts of Canada. All of the geographic areas under study by the WGSP are covered in PI's data library.

Products and services range from printed reports to computer files, graphic services, and engineering consultation. So that information may be kept current, updates are added to the files on appropriate daily to annual bases. These updates are available through a subscription service.

Initially, PI's data had been collected over a period of 50 years by a number of firms from operating oil companies and governmental and industry agencies. These independent firms recently merged with other petroleum-related organizations to form PI.

The following types of products offered by the separate

divisions often overlap and differ in pricing methods. Actual lists of data elements, extent of geographic coverage, and samples of graphic output appear in Appendices A, B, C, and D.

2.3.1 Well Data

The Well History Control System (WHCS) file contains data on more than 1,160,000 wells drilled in the United States including location, extensive drill-log information and a limited amount of production data. Every well drilled since 1972 and selected recompletions of older wells are covered.

Latitude and longitude information is normally available but is considered proprietary in the Gulf Coast region. Public release of data can be negotiated with PI. Their historic data contain:

- Initial potential test data.
- Production test data (including perforation and fracture data).
- Formation tops and bases (tops are more prevalent than bases in the files).
- Core data.
- Formation test data.

Paleontological and structural information are rarely reported. Gas analyses and data on bit cuttings are incomplete. Another file, DAAS (discussed below), lists drilling costs. In addition, clients may add their own proprietary file to the system.

Five options exist for obtaining access to the WHCS file:

1. A hardcopy dump can be created to include client-specified data items. Hard copy updates are also available. The client enters and integrates the data into his own computer system.
2. Information is retrieved from the WHCS data base and a magnetic tape with a specified format created. PI assesses a central processing unit (CPU) charge and a charge for labor expended on a pay-as-used basis.
3. The entire WHCS file may be purchased and is available to place in the customer's file or through online access to GE/NSS. Data may be integrated by the client, through the technical services division of PI, or through the services of a PI programmer. The cost for the entire file purchase is estimated to be several million dollars.

4. The Technical Services division of PI can prepare a customer-specified report or tape for each project. Many of the services offered by PI may be used in the performance of a task. Accordingly, costs must be determined separately for each project.

5. The customer may request that a custom project be carried out against a proprietary retrieval file of his own. In this case, the cost is determined in part by the amount of computer time used.

The WHCS file contains an average of 30 "lines" of information for each well, and PI charges $.30 per line purchased.

2.3.2 Completion Cards

Data on manually-searched completion cards routinely include: operator, contractor, well name and number, location, named township, elevation, spud and completion dates, casing records, log or sample tops, drillstem tests, core descriptions, perforated intervals, drilling or log total depth, plugged back total depth, completion data, and final classification. More than two million historic well cards are available in both hard copy and microform.

PI also offers current completion cards issued weekly in hardcopy form.

2.3.3 Log Services

The Log Services division of PI is essentially a clearinghouse for information on over 1.4 million wells and includes electric logs, spontaneous potential curves, micro logs, formation density logs, temperature logs, sonic logs and other logs. PI acquires this information from logging companies through permits from operators, or from state oil and gas commissions. This data is sold in hardcopy form according to their printed length; the average log costs about $7.00.

Since the company has recently begun the process of digitizing logs, only a meager amount of data is available via computer. Most geographic areas within the United States are covered.

2.3.4 Exploration and Marketing Statistics

2.3.4.1 First Reports and Well Starts

First reports and well starts provide data for every new well. Each program is designed for specialized user application.

The report may be generated as frequently as desired in hard copy form, with a periodic delivery of magnetic tape data. The client may add items sold and/or dollar volume derived from sales on each well and/or estimated competitor volumes, type of

product or equipment usage, etc. Proprietary data goes to the client computer center or to PI processing for input to client data tapes.

This report facilitates determination of market share, competitor activity, sales/product volume, decision data for placement of sales staff, development of sales areas, and statistical reports of operator/contractor activity, drilling depths, and industry and economic trends.

2.3.4.2 Completion Statistics

Completion statistics include custom-formatted reports which permit operator analyses, area and field activity analyses, and depth-of-drilling analyses. Possible formats include: Detail of Drilling by Operator of Record, Detail of Drilling Within Oil and Gas Fields, and Analyses of Drilling by Depth Ranges.

Analyses pertinent to budget, economic planning, exploration, and other presentations are available for specific parameters. Clients may add their own interpretive and proprietary data to achieve an optimum data base for analysis.

2.3.4.3 Drilling Activity Analysis System (DAAS)

DAAS is a computer data retrieval system which provides display of gas well drilling information.

Updated monthly, DAAS contains all permits and well starts and completions nationwide, as reported by PI. Workovers which result in a discovery, such as a new productive formation of a significant field extension, are included. Data for 1970 through the present are available.

In addition to online services, PI offers in-house report retrieval to client specifications. The DAAS is also available online through GE/NSS

2.3.5 Energy Map Services

Specializing in stock map acquisition, this group of seven different divisions of PI can provide base and custom designed topographic maps, as well as maps which illustrate lease/ownership details, production display, and contoured structure. Photogeologic-geomorphic maps with remote sensing analyses are also available. As is true of other data offered by PI, most of the Continental United States is well covered.

2.3.5.1 Base Maps

Regional base maps may be purchased either with or without oil and gas fields and pipelines plotted. The scales on which these maps are printed range from 1:4,000 to 1:250,000. Sepia, blue/blackline, film, and mylar copies are priced at $27.00 to

$245.00. Topographic maps are custom designed and priced.

2.3.5.2 Lease/Ownership Maps

Lease/ownership maps display such data as names of land and mineral rights owners, oil and gas lease owners, lease expiration dates, well locations and operators, total depth, and elevation. Federal and state maps are updated bi-weekly; county maps are updated every three weeks. Bi-annually updated subscriptions for specific areas in Oklahoma are available. Scales range from 1:2,000 to 1:8,000; prices vary with the printing medium (film, cloth, paper) from $11.00 to $300.00. An average map has dimensions 19" x 18".

2.3.5.3 Display Maps

Three, four, and five-color display maps give production information as well as other features which are plotted for particular geographical areas, i.e., township and range, highways and county roads, sedimentary basins, and tectonic uplifts. Pricing and scales are as follows: $15.00 to $60.00 per map; 1:500,000 to 1:5,000,000, respectively. Plastic coated paper is available.

2.3.5.4 Contoured Structure Maps

Contoured structure maps, which conform to geological basins rather than political subdivisions, post information such as dry holes, key field wells, operator, total depth, elevation, and top of contoured formation. Film, linen, and paper copies cost from $24.00 to $143.00. In addition, seven-color maps designating producing unit and current wells are $232.00 to $465.00. Map scales vary from 1:125,000 to 1:500,000.

2.3.6 Well Record Service

The Well Record Service (WRS) direct field information is provided on a daily to weekly basis for currently serviced wells and continues during workovers and redrills. Data are published weekly in a narrative well ticket format (on a 5" x 8" sheet) which is computer edited for standardization.

This contract service includes daily wildcat reports, weekly first reports, drilling progress reports and completion tickets on all wells. All of the geographic regions under consideration by the WGSP are covered.

To purchase the nationwide subscription records for wells currently serviced, the charge is $27,000; historical records for completed wells cost $4.00 per well. If the customer is not subscribing to the WRS, individual well records cost $8.00 each. It is also possible to purchase regional files, such as for the Rocky Mountains.

2.3.7 Production Data

PI covers over 85% of U.S. oil and gas production. Data are supplied in hard copy reports, computer tapes, and microform.

Information is gathered primarily from state agencies. Production records available in PI data banks may be retrieved by: field, operator, lease, well, or specific data items such as pressure, volume test, or gravity. Reports are published for thirteen separate regions and are updated by several schedules, including monthly, quarterly, semi-annually, annually, and five-year historical.

Customized reports and/or tapes are available for engineering, geological, financial, and government studies. Primary applications encompass production by depth slice, backup for regulatory body hearings, and competitive analysis by field and/or operator.

PI presently has secondary gas recovery data for limited regions. The only report currently published is for wells in Oklahoma. Sample reports show volume of monthly and cumulative production; however, telephone contacts have reported that well location, duration of secondary procedures, total volume of agent used, and total volume of return are also recorded. Secondary recovery information is stored for Texas and Louisiana but is not readily available.

PI's production division will undertake a special project to secure information for additional regions.

2.3.8 Graphic Capabilities

The following graphics can be generated (see samples in Appendix A):

- Structure and show map.
- Non-producing shows map.
- Initial potential map.
- Penetration map.
- Time versus rate production curve.
- Estimated reserves decline curve.
- Pressure/depth decline plots.
- Custom designed projects.

2.3.9 Consulting Services

Various consulting services in natural gas engineering, geology, geophysics, reservoir stimulation studies, and economic appraisal are available. The cost of this service depends on the extent of the project.

2.4 PETROLEUM DATA SYSTEM, UNIVERSITY OF OKLAHOMA

Petroleum Data System (PDS) is one of the data bases in the University of Oklahoma Information Systems Program. Sources of data primarily are acquired from annual state and regulatory agency reports, including those from the Texas Railroad Commission. Secondary supplementary data are reported by state geologists, International Oil Scouts Association, The Canadian Provinces Conservation Boards, and Journals of AAPG and SPE. Contributing federal agencies have included: USGS, DOE, FPC, FEA, ERDA (pre DOE), and the Bureau of Mines.

Because data in the system are extracted primarily from annual publications, the oil and gas files are usually one calendar year behind. Information more recent than that, however, can be obtained from the state (or possibly from PI Corporation) before it is published. This more recent data would be received in hard-copy form; therefore it would be necessary for data management for the user to enter such information into the WGSP's selected system.

Information on 80,000 individual oil and gas reservoirs in the U.S. and Canada is currently available. PDS contains data and parameters on fields and pools in the average or aggregate sense, and is not structured around individual wells with the exception of discovery well data. Secondary recovery information for some states is included. The data base also contains limited gas analysis, reserves analysis, and historical production data.

Items in the data base include: the name and age of the producing formation, discovery method, trap type, drive, reservoir lithology, depth, proved acreage, well spacing, average thickness of the producing formation, porosity, permeability, gravity, reservoir pressure, reservoir temperature, and present status (whether wells are producing or not). Fluid data include: production of oil and gas, annual and cumulative, secondary and tertiary recovery projects, and analysis of oil, gas, and brines. Secondary recovery and production data are neither as complete nor as detailed as data provided by other services assessed in this report.

Field or reservoir records are classified as oil, condensate, gas-associated, gas storage, or helium.

Limited illustrative graphics and display services are available through the Applications Management System (AMS). This system can directly interface with PDS to generate:

- Scatterplots
- Histograms
- Triangle Plots

Federal agencies make major contributions to the PDS data base. The USGS, the sponsoring agency, plays a lead role in expansion advice and supplies additional information, principally from the Conservation Division.

PDS is currently updating detailed reservoir engineering data not readily available in federal reports. Some of the extracts are from the following sources:

1. AAPG bulletins dating back to 1930.
2. American Institute of Mining, Metallurgical and Petroleum Engineers (AIME) bound volumes.
3. Individual SPE papers.
4. Journal of Petroleum Technology.
5. Bureau of Mines special reports.
6. API bound volumes from 1930 - 1974.
7. Maximum Efficient Rate hearings.
8. IOCC annual special reports.

The USGS is digitizing the field outlines and providing coordinates of a centerpoint location for each field in the file.

Because it is available through GE/NSS, PDS prices are per GE Mark III Service Price Schedule (GE's costs have been modeled in Section 5.0). No front-end charge or subscription fee is required for using PDS.

Because it is available through GE/NSS PDS can be used on a one-time basis. This would consist of the requestor supplying PDS with various sort or report criteria. With this information, a run is completed and the results are mailed to the requestor. Costs for this service are dependent on the amount of personnel and computer time required for run completion.

PDS information is stored per Generalized Information Processing System (GIPSY) software (see Section 4.2.5). Although PDS is amenable to the addition of WGSP information, this course is not recommended because of the limits of GIPSY. In addition, to

enter information and be provided with more than the standard user capabilities usually executed through GE, PDS requires a $1,000/month fee for this privilege.

Major data items in PDS are listed in Appendix E.

2.5 DWIGHT'S ENERGYDATA

Dwight's Energydata furnishes production data and related information on individual gas wells available through its retrieval systems. The geographic coverage includes most of the states under study by the WGSP with the exception of Montana, South Dakota, Nebraska, and Idaho. Thus, information for portions of the Northern Great Plains Province ; the Snake River Downwarp, and part of the Denver Basin is not available.

Several data formats are available to choose from which include: (a) Monthly Gas Well Histories, (b) P/Z Decline Plots, (c) P/Z and Rate/Cum Decline Plots, and (d) Monthly Detail since January 1966. Other special reports including: Reservoir-wide Gas Plots, Calculated Gas-In-Place Reports, Calculated Pressure Gradient Reports, and New Gas Well Connection Reports.

Standard API state and county codes are used throughout the files. Original wellbore API numbers are also available.

As of March 1980, Texas, Oklahoma and Kansas gas data have been updated through December 3, 1979. All other report codes are updated through September 30, 1979.

Subscriptions to hard copy data are priced according to the number and size of the basins or districts requested and to the report output frequency selected by the user; e.g., annually, semi-annually, or quarterly.

All or any portion of Dwight's Production Data System is available on magnetic tape so that the customer may search, retrieve, sort, and print information from Energydata's files and convert it to his specifications.

The Production Statistics are accessible via the GE Mark III Service (NSS, see Section 3.1). The set of retrieval codes necessary to use the system are contained on microfiche. Dwight's collects an annual online access fee which is also based on the number and size of the districts and states specified by the customer. Prices range from less than $100 per district to $14,409 for the complete Texas file, to $34,172 for access to the entire file (including oil as well as gas information).

For customized projects, Dwight's will sort, rearrange, total, retrieve, and tabulate data to any desired format.

3.0 NETWORKING AND COMBINATIONAL DATA BASES

To provide maximum diversity to a great number of customers, some computer-oriented companies offer a number of computing services. These can range from providing information (such as GeoRef) to scientific computing to personal biorhythm plotting. These organizations also market a number of data bases (such as DMS) in which the customer is free to insert, manipulate, or delete his own information.

These services are operational on a networking basis. This means that a customer can access the desired computing service by remote terminal, telephone hook-up, and (usually) a local telephone number regardless of the actual location of the service organization or its computers.

Three of these organizations have been assessed. Of the three, General Electric Information Services Company Network Software Services (NSS) and System Development Corporation (SDC) were found to provide applicable information or data base capability. The third service, Control Data Corporation CYBERNET Services, was found to only be applicable to the WGSP in a data base sense. None of its informational services were applicable. CYBERNET, therefore, has been assessed with the other data bases (Section 4.2.7).

3.1 GENERAL ELECTRIC INFORMATION SERVICES COMPANY NETWORK SOFTWARE SERVICES (NSS)

Network Software Services (NSS) allows businesses to utilize available software systems applicable to their areas of interest. The software programs are written by business or professional people or other software companies for their own use, and then offered by these "authors" for royalty premiums to other businesses. Each author is commonly referred to by GE as a "catalogue". If the author is an NSS author, the catalogue number will contain a "Q". These programs are accessible online through the world-wide MARK III Information Services Network.

To use MARK III, a General Electric Information Services Standard Computer Service Agreement must be executed. This agreement is first activated by paying an initiation fee of $100.00.

For each NSS "author" the user wishes to access, a fee of $20.00/month is required. To maintain access to GE/NSS, the user must use the system(s) frequently enough to maintain at least a $500.00/month charge. Use, therefore, of GE services must exceed approximately 22 hours per month (and some GE/NSS authors may require an additional agreement between the author and the user). Once these agreements have been reached, the software can be used at any time.

General Electric offers general training in the use of MARK III. GE/NSS authors provide literature and training in various locations in their particular application.

The MARK III service itself is referred to as the "foreground" or the "foreground driver". It possesses interactive capabilities with the "background" software, the author's machine. Many times, however, the author does not wish users to have access to the author's entire data base. To prevent this, they will send GE an updated magnetic tape periodically for loading onto another available GE computer.

Among many other data bases, the following are available through this service:

- Dwight's Energydata.
- Petroleum Information Corporation's Drilling Activity Analysis System (DAAS).
- Petroleum Data System (PDS).

The information from Dwight's Energydata through GE represents most, but not all, of the data or services available through Dwight's. This company will send GE an updated tape periodically, which is then loaded onto Data Management System (DMS) -- available through GE (see Section 4.2.1).

Data available from Dwight's Energydata through GE include:

PRODUCTION HISTORY

- All well completions in Texas, Oklahoma, New Mexico, Louisiana, Kansas, Colorado, North Dakota, Utah, Wyoming, and Arkansas.
- Full description of each of 400,000 gas wells and oil leases including:
  - Operator name
  - Gatherer
  - Reservoir name
  - Field name
  - Well or lease name
  - County
  - Location
- Gas test information

A more detailed description of the above and other data and services is discussed in Section 2.5.

Petroleum Information Corporation's DAAS is only one of many data bases available through that company. All data bases available through PI are discussed in Section 2.3. DAAS information available through GE is complete.

Petroleum Data System (PDS) is completely accessible through GE. One-time non-interactive runs, however can be performed by personnel at the University of Oklahoma for a fee. (These fees are quoted at the time the run is performed.) See Section 2.4 for more detailed information.

The rates for using GE Mark III and other GE service rates are integrated into the costs shown in Section 5.0.

3.2 SYSTEM DEVELOPMENT CORPORATION (SDC)

System Development Corporation (SDC), in Santa Monica, California, offers the capacity to create a privately accessible file as well as offering online access to a variety of previously constructed public files such as Petroleum Abstracts and GeoRef. Access to both public and proprietary files is by remote terminal.

The following cost parameters are involved in the creation and use of a private file:

1. If the information to be stored is not yet in machine-readable form, and if the customer hires SDC to complete this task, the conversion cost will range from several man-weeks to a man-year according to the complexity of the assignment.

2. A loading cost is charged as follows:

   $2,000.00 for the first 25,000 citations entered plus $50.00 for each additional group of 1000 citations.

3. The cost for data storage is $12.00 per million characters per month. If the customer stores greater than 200 million characters, the charge drops to $6.00 per million characters per month.

4. Costs for computer interaction are generally less than those for public data banks:

   - Computer terminal connect time: $35/hour.
   - Telephone use.

- Off-line printing: $0.10/citation.

This proprietary file is appropriate for a Level I system only.

4.0 FEASIBLE ALTERNATIVES FOR IMPLEMENTATION OF A WGSP COMPUTER DATA BASE

After data abstracting/acquisition methods and requirements have been established, the procurement of an appropriate data base management system is necessary.

Three alternatives for implementation of the various established types and extent of input data have been identified:

1. Add WGSP data to an existing data base in which information already exists.

2. Purchase the use of an existing data base management system and computer hardware.

3. Procure a minicomputer and either acquire or develop data base management software.

An expansion of these alternatives follows in Sections 4.1 through 4.3.

4.1 ALTERNATIVE A: ADD WGSP DATA TO A SERVICE ORGANIZATION DATA BASE

With this option, the WGSP would add data to a data base already established and currently in use by one of the data service organizations discussed in Sections 2.0 and 3.0.

SDC and PDS are able to create publicly-accessible, proprietary data files. Although PA can provide such an option, it is unwilling to allow public access to its files; hence this arrangement does not suit WGSP requirements. PI and Dwight's Energydata offer this alternative, but not with the user freedom required by the WGSP.

General costing considerations for SDC and PDS are included in Sections 3.2 and 2.4, respectively.

4.2 ALTERNATIVE B: PURCHASE THE USE OF A SOFTWARE SYSTEM TO STORE WGSP DATA

The following software systems are capable of manipulating WGSP information on various levels:

- Data Management System (DMS).
- Data Retrieval System (DRS).
- Reserves and Production System (RAPS).

- Generalized Information Management System II (GIM II).
- Generalized Information Processing System (GIPSY).
- Computer Sciences Corporation, Department of Energy CDCS.
- Control Data Corporation CYBERNET.

Although there are many other software packages available today, the listed systems represent the basic varieties available. Costs for implementation of alternative B are discussed in Section 5.0.

4.2.1 Data Management System, General Electric Information Network Software Services

Data Management System (DMS) is a highly flexible system capable of sorting, retrieving, plotting, and reporting complex alpha-numeric information. Input, update, and deletion are performed and executed in the system immediately following user command.

The user can communicate with DMS online command-by-command with no limitations. The user also has the option to perform a series of update commands within the system over-night at a lesser cost. This is done by using system routines designed especially for the purpose. Commands are given online and the execution is performed later that day. Results are delivered by courier to the user from GE/NSS or the results can be printed on the user's printer.

Adding, deleting, changing, and manipulating data will not require personnel with computer programming/data base background. Data base maintenance and design, however, will require an experienced data base administrator.

Output is received either online or on a designated high-speed printer. A high-speed service is available through GE or reports can be received through an in-house printer with GE-compatible hardware at TRW DSSG, Redondo Beach, California.

Sorts can be performed either by online commands or through a series of report commands. Extensive logic can be incorporated when report programming is utilized.

A sort can be executed on any item contained in the data base. Multiple item sorting is another capability of this system.

As a function of the SORT command or as a separate command, DMS can produce automatic subtotals. For example, the following items could be retrieved, sorted, and printed online:

- PRINT FORMATION NAME, AGE, THICKNESS BY REGION
- PRINT WELLNO, WELLNAME BY BASIN
- PRINT CUMPROD BY POOL

Counts on both records and items can be performed.

Simple plots can be produced on a high-speed output. Plotting capabilities are limited to X-Y value graphing. For instance, production versus time or map points programmed by latitude and longitude coordinates could be plotted, but variable base maps or seismic lines could not.

DMS also has the capability to perform on-the-spot and if-then testing of information.

Multi-level sorting is performed by creating (through an initial sort) a "parent" file, then sorting that file to create "dependent" sublevel files.

DMS can accept and manipulate on an item, record, and keyword synonyms. This is an important tool when many different users having access to the system use the nomenclature inconsistently.

The above items can also be renamed -- the opposite of synonym usage.

Input can be added online. The computer is capable of checking for character limits, alpha-numeric requirements, and will, if necessary, sort incoming data.

Record storage is limited to 5,000 characters. DMS is contained in a Honeywell Inc. computer hardware environment.

DMS commands and their functions are listed in Appendix G.

4.2.2 Data Retrieval System (DRS), A.R.A.P., Inc.

Data Retrieval System (DRS) is a generalized retrieval system available on a number of computer systems and operating systems. Currently, DRS is available and operational on the TRW/TSS.

The user is given the following abilities when retrieving from a pre-stored data base:

- SELECT from the data base a subset of data based on a logical analysis of informational requirements which the user has provided and which the subset must satisfy.
- ARRANGE the selected subset to order the values present in one or more categories of the subset.

- LIST all, or parts of, the selected and arranged subset, either on the remote terminal or a high-speed line printer.

Four commands (SELECT, ARRANGE, LIST, EXECUTE) perform this task.

For the sophisticated user, many more commands are possible. New data fields can be defined in terms of an arithmetic or logical expression involving currently stored fields. A count of the number of records which have the same value in a specified field can be obtained. Headings can be added and changed interactively, as well as pre-stored. Output formats can be easily switched. The system permits the input, modification, and deletion of data either interactively or in batch mode. Data may be error-checked on input, and a security feature is available for limiting both the retrieval of sensitive data and the use of data modification commands to "privileged" users.

DRS possesses a "noiseword" and thesaurus capability for compression of data. This feature provides the capability of screening out a user-supplied list of noisewords such as "the, a, and, to", from a list of words generated by the present word-arrange capability of the ARRANGE command by including in such a word list only those words contained in a user-supplied "thesaurus" list. These capabilities are particularly useful in library-oriented operations when one is generating an index from a Title or Comments data field.

The exclusion of noisewords or the inclusion of thesaurus words is not confined to single words. Either can be whole phrases or even the contents of an entire data field, in which case a PHRASE ARRANGE and straight ARRANGE, respectively, would be requested to generate the desired listing. This feature would be particularly useful for the WGSP when users wish to "screen" data received from other sources.

Of particular interest to the WGSP is DRS's LINK command. This capability, along with its accompanying commands permits the data base administrator to re-format data obtained from other sources to the DRS format. Hours of WGSP personnel programming time could be saved by using the LINK command to transfer and translate data from information service companies to DRS.

Generalized report-writing capabilities are available in DRS. Simple to sophisticated logic can be incorporated either in query or report writing.

When a user-generated "index" has been built, retrieval on synonyms is possible. This is useful when users of different backgrounds query the system. Although DRS is available in many programming languages, the particular package at TRW is functional in modified FORTRAN on Control Data Corporation (CDC)

Cyber 70 series computers. If data from service companies or interim data bases are transferred to or from a CDC computer, interfacing and translating is not as complicated. DRS commands and functions are listed in Appendix H.

4.2.3 Reserves and Production System, PSI Energy Software Inc.

Reserves and Production System (RAPS) is a petroleum-oriented data base system which stores, computes, updates, and reports production, reserves, and other time series information and data relevant to production and injection operations. RAPS does not contain data for sale but is a petroleum-oriented data retrieval and reporting system in which the user supplies the data.

Updates can be easily made online. Reports can be generated with either a standard RAPS format or with custom formatting. One available RAPS format is the U.S. Department of Energy Form EIA-23.

The system is capable of performing multi-level sorts as well as calculating gross production, working interest, and net interest. RAPS does not generate plots, but reports are designed for generation of graphic display by users.

Because RAPS is available through GE, costs conform to those of GE/NSS (integrated into Section 5.0).

System security includes checking of valid entries and deletions for certain authorized users. This makes accidental purging less likely, and insures data integrity.

In short, RAPS is capable only of storing and arranging most petroleum production data. For this reason, this system was not further investigated.

4.2.4 Generalized Information Management System (GIM) II, TRW, Inc.

TRW's Generalized Information Management (GIM) System II is a data base management system designed and developed to enable a user to obtain relevant facts for making decisions. The GIM system maximizes intelligent man machine interaction by accepting queries in English and returning the answers precisely as desired. Although GIM is primarily designed as an online system, it has the capability to produce reports in the batch mode. It also has the capability to accept and render data compatible from diverse, existing data bases within the system.

GIM II is a user-oriented system; it can accommodate simple, single-purpose files or can structure complex data files to reflect real-world data relationships. The GIM file organizing techniques increase responsiveness to general or specific

information requests: data can be acted on arithmetically; can be indentured; can be edited for size, pattern, or update restriction; and are selectively accessible. The user controls GIM's flexibility to organize and retrieve information from data files and fields. GIM correlatives permit field-to-field, record-to-record, and file-to-file data associations; and synonyms can be created within file dictionaries to effectively allow GIM to respond to foreign-language or special-terminology requirements.

Logically, a GIM data base consists of fields, logical records, and files.

A field is the lowest level in the data base structure; each field has a name and may have up to 999 values. Fields are grouped into logical records. A collection of related logical records forms a file.

A user data base consists entirely of files. Logically, these files fall into five categories:

- Dictionaries that contain definitions of the characteristics of records and fields in other files.
- Files that contain records of the user's data.
- System files that are required for GIM software operation.
- User procedure lists that contain GIM statements the user may wish to execute "as a group" (similar to utilities).
- User report definitions.

GIM software is currently operative at TRW - Washington Operations on a PDP 11/70 minicomputer. The GIM data base managers would be willing to send GIM II software on magnetic tape to TRW - Redondo Beach or to Las Vegas for loading onto a compatible system. At Redondo Beach there are two available hardware systems with enough available core to accept additional software. If this option were selected, the WGSP would move the data base to a commercial system for public access purposes after all data have been tested and approved for production usage.

4.2.5 Generalized Information Processing System University of Oklahoma Information

The Generalized Information Processing System (GIPSY) is capable of sorting and retrieving varied information. It possesses utility provisions for building, moving, protecting, updating, and deleting information.

Communication between the user and the data base is in an

English-like command language.

Although knowledge of data bases is helpful, the user does not need to know computer or data base programming to successfully query the system. GIPSY is capable of searching a large set of information and iterating that set into a highly refined subset. It can then report this subset to the user via remote terminal or high-speed printer. If the subset is unsatisfactory, the user can either repeat the loop or return to a sub-step, or abandon the search altogether.

Reporting and updating would require the assistance of personnel with data base knowledge for reasons below.

GIPSY command language is QUESTRAN (QUESTion TRANslator) -- modified from an IBM-OS Assembler language. In a standard query, command errors by the user are most common. GIPSY is programmed to assist the user in identifying any command errors. This is done by insertion of a message to the user identifying the general nature of the error.

Data are input according to a "form". The form specifies two items:

1. The data base in which the information is stored.

2. The format for data input/output.

A "dictionary" defines valid entries for input.

A set of valid entries following the specified form comprise a "record". Maximum record length is 32,000 characters. A dictionary and any new inputs must be entered batch (on keypunched cards). Any inputs, therefore would have to be written out on a "source format" (green sheets) and then keypunched for input.

For WGSP purposes, this does not seem to be a convenient way to use the system if new data are to be added frequently. New data, however could be read into the system by magnetic tape with the aid of translator interface programs.

Updating is facilitated by the use of a system software subprogram (a utility). It is recommended that assistance be provided by an individual with programming/data base administration knowledge for updating.

A brief explanation of the update utility follows: The user identifies to the computer the record to be changed. The system then copies this record. Changes are made to the copied record by the user. The old record is then flagged for deletion, and a new record is then relocated as the last record in the data base. Later, the system operators run a deletion routine, and all of the flagged records are deleted.

This delayed form of updating may inhibit a quick turn-around of data for report writing. It would probably take two days to ensure that all data is as the user wants it and then to have it reported (printed out for presentation).

GIPSY formatting is very simple and easy to understand and use. No fixed field requirements exist. A fixed field can be requested in the "COPY" command, otherwise all information is input free-form. The disadvantage to this is that no automatic error checking can be performed by the system. For example, if the user wishes the date of a record to be entered, and wishes it to be entered the same way every time, in a fixed field formatting system, he could tell the computer to check and assure that all the dates are entered with the date first (two numeric characters), the month second (up to eight alpha characters), and the year last (four numeric characters). This error checking is absolutely necessary when many users are entering and updating information.

When a run is performed, the user must estimate and specify the time required to complete the run. If not enough time was specified, then the computer stops in the middle of the run. After that, the run is lost and has to be resubmitted. If many users not familiar with computer time requirements are expected to use the system, a system with timesharing and queueing is necessary.

GIPSY command verbs are defined in Appendix I.

4.2.6 CDCS, Computer Sciences Corporation

Computer Sciences Corporation (CSC) has many information services on the market. One such service, based in Las Vegas, Nevada, is servicing the Department of Energy's Nevada Operations Office.

A relatively small data base (serving non-WGSP applications) functions on a Control Data Corporation (CDC) 6400 computer using a CDC-developed DBMS software package called CDCS.

Because of an unfamiliarity with CDCS software, and the present lack of literature pertaining to it, it is difficult to assess applicability to the WGSP.

From telephone contacts with CSC personnel, however, it appears that this system would be functional for a low volume Level I system. A study should be made of the feasibility of establishing the WGSP data base and subsequent transfer of data and application programming to a more publicly accessible and expandable remote system (such as DMS).

Presently CDCS is servicing local authorized Las Vegas users. No remote long-distance public access exists, nor are there

plans for such access.

The following discount (GSA) costs are available for government users:

- Central processing unit (CPU) time: $0.005/second.
- Permanent file storage (disk): $0.0015/day per 640-6 bit character (PRU).
- Tape mount: $1.00 per mount.
- Terminal connect time: $0.0005 per minute.

These costs are the lowest of all the systems investigated but are subject to change at CSC's discretion.

CSC plans on expanding this data base in Fall, 1980 to include:

- CDC Cyber 70 hardware.
- Additional disk storage (exact amount has not been established).

Costs will probably increase when the new equipment arrives.

4.2.7 Control Data Corporation CYBERNET Services

CYBERNET Services provides a world-wide data processing network for many different applications. Of interest to the WGSP would be the petroleum and data base management services. The available petroleum services are ones designed to manipulate user-provided data (similar to RAPS), and because of this, consideration has only been given to the data base services.

Data base management applications from CYBERNET Services provide the ability to update, query, and report with little computer or programming experience.

The following are a summarization of the available data bases.

4.2.7.1 Information Processing Family (IPF)

IPF is a family of interactive data handling programs designed to interface with standard sequential or indexed sequential data files. These files can be part of existing applications or can be newly created within the IPF system. The Update module allows users to create and maintain data bases. The Query module allows users to extract information from data files. Formal reports are created with user commands (no logic). No report-writing programming can be used. This system would be used strictly for a Level I system.

4.2.7.2 LEXITEC

LEXITEC is a rapid retrieval system designed for user search with keywords. It locates and displays information units that match keywords entered by the user. Display begins with those units having the most keywords and proceeds to those having the fewest. Before initiating display, the user may request the number of units located, determine which to include in the display, and modify the list of keywords accordingly. Display may include complete text, a short summary, keywords, or a combination of these.

The user can scan large files and narrow the search to information units most responsive to the requirements. Large volume output can be directed to a high-speed printer or saved in a file for subsequent handling.

The user may enter information units at the terminal and also add information to the data base batch. LEXITEC would be used for a Level I system.

4.2.7.3 IS/ATHENA

IS/ATHENA is an information retrieval and update system which allows users to develop, maintain and derive information from a data base. The system does not have provisions for data definition compilation and data base creation runs. The user can create data files online in an interactive or batch mode. The system edits data for accuracy and changes, deletes, or arithmetically manipulates data records.

IS/ATHENA would be used for a Level I system, however, it does not appear to have much flexibility.

4.2.7.4 BASIS

BASIS is an information storage, retrieval and analysis system. BASIS document retrieval capabilities include: online sorting and report generation; user designated standard thesaurus; user-predefined search procedures; comprehensive data description language; inverted file or sequential file searching; user program insertion; user-defined retrieval aids; extraction of formatted data for input to other applications; search on word stems; override of default messages to allow for user's own messages; field mapping; hierarchical searching; change of data universe to subset of the data base; numerous display and print-out options; specification of word placement in text searches; four levels of security; and indexing.

Because of the absence of logic in query or report-writing, this system, too would be best used for Level I applications.

Any services that CYBERNET data bases offer appear to only be applicable to a Level I system.

4.3 ALTERNATIVE C: PROCURE MINICOMPUTER HARDWARE AND SOFTWARE FOR IN HOUSE DATA STORAGE AND PUBLIC ACCESS

Alternative C options were studied by the Minicomputer Systems Department at TRW as a subtask to the data base evaluation. The following is a summary of their findings and recommendations.

WGSP data types, extent, and limits were given as guidelines to the minicomputer group. Also, a description of the various applications (frequency of use, number of reports output per month, etc.) of the theoretical database was supplied. Subsequently, the minicomputer group concluded that the systems capable of data base management are also capable of storing and retrieving the full range of WGSP information and geotechnical data provided that the WGSP acquire a 40 megabyte (MB) or larger disk and diskdrive.

The WGSP would have to acquire the hardware and the software before a minicomputer system could be functional.

Costs (see Section 5.0) have been based on the following assumptions:

- 256,000 megabyte main (core) memory.
- 40 megabyte disk for storage would compute at any level.
- Disk drive.
- 8 to 10 ports for remote dial-up terminals.
- 2 hardcopy terminals.
- Line printer (high-speed).

In addition to the acquisition of minicomputer hardware and software, the use of public access WATS lines will be necessary. See Section 4.4 for such details.

Table 4-1 shows the characteristics of five different computer hardware systems.

The protocols supported information on the following charts are presented to assist WGSP management in understanding any interfacing incompatibilities/compatibilities. For instance, if the WGSP begins a data base on a computer with similar protocol to a desired minicomputer, then the transference of programming and storage is made simple and less expensive. Also, protocol information is necessary when purchasing software packages.

TABLE 4-1 REPRESENTATIVE MINICOMPUTERS AND DATA BASE MANAGEMENT HARDWARE FEATURES

FEATURES:

Hardware	PDP 11/44	PDP 11/60	HARRIS 100	HP 3000	PE3220
Word Length	16 bits	16 bits	24 bits	16 bits	32 bits
No. Work Stations	--	--	32	32	16
Max Memory Capacity (K Bytes)	256	256	288	1024	2000
Storage Types	MOS/CACHE	CORE,MOS CACHE	MOS	MOS	MOS
Max I/O Rate	1 MBPS	--	19 MBPS	1 MBPS	2 MBPS
Protocols Supported	DDCMP, DNA	DDCMP, DNA	ASYNC, BISYNC	BISYNC	--

Table 4-2 shows representative computer software features.

TABLE 4-2 REPRESENTATIVE MINICOMPUTER DATA BASE MANAGEMENT SOFTWARE FEATURES

FEATURES:

Software	PDP11/44	PDP 11/60	HARRIS 100	HP3000	PE 3220
Assembler	MACRO ASSEMBLER	MACRO ASSEMBLER	MACRO ASSEMBLER	NO	MACRO ASSEMBLER
Compilers	BASIC,FOR-TRAN,COBOL, APL,COBOL	BASIC,FOR-TRAN,COBOL	FORTRAN,APL, COBOL,RPG-II	COBOL,RPG-II,APL, BASIC,FOR-TRAN	BASIC,COBOL RPG-II, FORTRAN
Operating System	BATCH,REAL TIME TIME-SHARING	BATCH,REAL TIME TIME-SHARING	BATCH,REAL TIME TIME-SHARING	BATCH,TIME-SHARING, TRANS-ACTION	BATCH,REAL TIME MULTI-TASKING
Price	$74K	$98K	$79K	$63K	$100K
Availability	120-150 days	120-150 days	60-90 days	60 days	120 days

There are many data base management systems on the market today. Some of the most commonly used are DRS, DBMS II, TOTAL, and IMAGE 3000. Table 4-3 shows their main features.

TABLE 4-3 DATA BASE MANAGEMENT SYSTEM SOFTWARE PACKAGES

SOFTWARE	DRS	DBMSII	TOTAL	IMAGE/3000
PRICE,$	9,900	16,500	21,000	INCLUDED IN SYSTEM PURCHASE
MEMORY REQUIREMENTS (KW)	16/32	32	64	64
QUERY LANGUAGE	NO	NO	NO	YES, WITH IN-HOUSE SOFTWARE
APPLICATION LANGUAGE	FORTRAN, COBOL	FORTRAN, COBOL, BASIC, RPGII, ASSEMBLER	FORTRAN, COBOL ASSEMBLER, RPGII	FORTRAN, COBOL, SPL, RPG-II BASIC
COMPUTERS W/COMPATIBLE PROTOCOL	IBM1130 DEC PDP-11 DSC META4 GA 18/30 CHI 2130	DEC PDP-11/70 HARRIS	DEC PDP-11 HARRIS IBM HONEYWELL INTERDATA UNIVAC MODCOMP	HP3000

From the consideration of cost and query language availability, the IMAGE/3000 data base management system appears to be the most desirable of the five listed in Table 4-3. This is compared to many of the software packages for minicomputers that are only equipped with application programming capability. (See Section 1.3 for further explanation.) A HP 3000 system is currently being utilized at TRW performing data base management. It is probable that in-house software would be transferable without cost to the new project.

The HP3000 using the IMAGE/3000 data base management system appears optimum for project applications for the following reasons:

a) Least expensive.

b) Can be delivered at the earliest date.

c) As reliable as the other vendors (companies that sell hardware and software packages).

d) Has a query language for the data base management system which the other packages do not have (see Section 1.3).

e) Software already exists that could be used on this project.

It is difficult to estimate the cost to provide a usable software system until more details of the data base are known, the computer system is selected, and software requirements established. In the costing section, computer operator personnel time and minicomputer maintenance have been taken into consideration.

4.4 REMOTE PUBLIC ACCESS OPTIONS -- TELENET

Many information retrieval services (i.e., SDC and NSS) provide remote public access options as a service to their customers. A dial-up intermediary such as Telenet allows direct communication with other desired computers from a remote terminal anywhere in the country. This would eliminate long-distance telephone bills. Thus, data bases set up with GIM II or on a minicomputer can be made accessible by dialing a local Telenet telephone number and identifying oneself with computer identification and user numbers.

Both GIM II and the minicomputers discussed possess the hardware needed for remote timeshare hook-up. Telenet assesses an accounting fee of $100.00 per month, and computer connect time is priced at $3.75/hour. (During periods of heavy Telenet usage, the charge may increase to $3.85/hour.)

5.0 COST EFFECTIVENESS TRADE-OFFS

To aid in the WGSP data base decision-making process, cost estimations for the various alternatives and levels (see Section 1.3 for a review of level definitions and test cases) have been made.

To ensure that co-measurable comparisons of different services are costed, the following assumptions have been established:

- regardless of the data base capacity (storage) required, four (4) hours of interactive online communication, five (5) days per week.
- one (1) 1500-record informational report of data per month extracted from the data base and printed by high-speed printer.
- an average of one (1) magnetic tape is mounted each month in order to add acquired information directly into the data base.
- purchase (rather than lease) a minicomputer.
- TELENET costs for GIM II and minicomputers at $4980/year.
- regardless of the system (minicomputer or otherwise) chosen, the WGSP would pay an Operator/Administrator for operative user maintenance of the data base. (Includes input/output, information reports, tape mount, etc.) This cost, therefore, is similar and is excluded in the comparisons.
- the average approximate costs to repair and maintain a minicomputer are included.
- costs for acquiring and loading data would be similar in each case and are excluded in the comparisons.

GIM II is not included in the cost comparisons because currently, it can be used but is not intended for high-volume, high-production use. For this type of high usage, commercial computing service bureaus are preferable. The reason for this is that commercial systems have back-up computers in case the main bank fails. Therefore there is virtually no machine down-time.

Under present arrangements GIM II does not charge for data storage, and inhouse TRW terminal connect costs are comparable to those for DRS. If GIM II at TRW could be implemented for high production on current hardware, costs would approximate $19,500/year regardless of storage required. If GIM II software were moved to another hardware system (see Section 4.2.4),

storage would be per DRS.

Both GIM II and DRS at TRW can be made available to the public for query. Both can accept utility programming for determination of user costs. There are, however, no public billing procedures for use of these systems. This should be considered when comparing to GE/NSS or CYBERNET which have such billing procedures. If GIM II or DRS costs, however, were reported to a billing service, the same net result would occur.

At the request of Control Data Corporation and General Electric, CYBERNET and GE/NSS costs have been based on those quoted to civilian public users. Costs would decrease approximately 30% from the prices with GSA qualification.

If public users were billed for query on any of the systems discussed in this section, they would pay for computer interactive online time. The public users, therefore could possibly pay for approximately 50-70% of the computer query costs.

Tables 5-1, 5-2, and 5-3 show approximate yearly (based on current prices) costs using variable (1500, 7000, and 12000) record storage following the aforementioned assumptions. They are compared to the cost of the minicomputer alternative.

Those cost trade-off values listed in the following tables are not defined by one set of algorithms or simple formulas. For each of the systems, the important cost features were determined from the authors' experience. Features considered important to this cost evaluation are: CPU time, tape and disk seizure time, line printing process and time, and terminal connect time. Since current costs using a combination of these features could not be readily obtained, they were compared to existing but similar processes where cost ratios could be estimated and applied to this study. Thus, the estimated costs of Tables 5-1, 5-2, and 5-3 represent approximate factors for comparison purposes only. In addition, much of the costing information received from service company representatives has been kept private at their request. Individual needs may require different emphasis or weighting factors on the costing features for specific purposes beyond the scope of this project.

TABLE 5-1 LEVEL I COST TRADE-OFFS

	COST/YEAR (N*),Dollars		
	1500	7000	12000
GE/NSS/PDS	39700 (1.7)	42900 (1.5)	45000 (1.5)
CYBERNET	32400 (2.0)	36200 (1.8)	38600 (1.7)
GE/NSS/DMS	27700 (2.4)	30900 (2.1)	33000 (2.0)
DRS	17200 (3.8)	19000 (3.4)	20500 (3.2)

TABLE 5-2 LEVEL II COST TRADE-OFFS

	COST/YEAR (N*),Dollars		
	1500	7000	12000
GE/NSS/PDS	43200 (1.5)	55500 (1.2)	66800 (1.0)
GE/NSS/DMS	31200 (2.1)	43500 (1.5)	54800 (1.2)
DRS	19130 (3.4)	27800 (2.4)	36650 (1.8)

* N represents the number of years of operation for which total costs equal the total costs of the minicomputer alternative.

TABLE 5-3 LEVEL IIA COST TRADE-OFFS

	COST/YEAR (N*),Dollars		
	1500	7000	12000
GE/NSS/PDS	43700 (1.5)	58800 (1.1)	72400 (0.9)
GE/NSS/DMS	31700 (2.1)	46800 (1.4)	60400 (1.1)
DRS	19650 (3.3)	28300 (2.3)	40730 (1.6)

* N represents the number of years of operation for which total costs equal the total costs of the minicomputer alternative.

APPENDICES

```
ELAPSED TIME ON ORBIT: 0.01 HRS.
YOU ARE NOW CONNECTED TO THE TULSA DATABASE.
COVERS 1965 THRU DEC 1979 (7912)

SS 1 /C?
USER:
PROPPANT

PROG:

-1-
AN  - 269280
TI  - DYNAMIC EXPERIMENTS ON PROPPANT SETTLING IN CROSSLINKED FRACTURING FLUIDS
AU  - HANNAH R R; HARRINGTON L J; WILLIAMS D
SO  - 54TH ANNU SPE OF AIME TECH CONF (LAS VEGAS, 9/23-26/79) PREPRINT NO
      SPE-8342, 8 PP, 1979
EY  - 1979
IT  - *ADDITIVE; *CARRYING CAPACITY; CROSSLINKING; ENGLISH; FISSURE (GEOLOGY);
      *FLUID; *FLUID PROPERTY; FORCE; FRACTURE WIDTH; FRACTURE (ROCK);
      FRACTURED RESERVOIR; FRACTURING; *FRACTURING FLUID; *FRACTURING FLUID
      ADDITIVE; GEL; GELLING AGENT; GEOLOGIC STRUCTURE; *GRAVITATIONAL
      SEPARATION; *HYDRAULIC FRACTURING; INDUCED FRACTURE; MIXTURE;
      *NONNEWTONIAN FLUID; *PHYSICAL PROPERTY; *PHYSICAL SEPARATION; POLYMER;
      *PROPPING MATERIAL; RESERVOIR; RHEOLOGY; *SAND OUT; *SETTLING; SETTLING
      VELOCITY; SHEAR; STRESS; VELOCITY; WATER THICKENING; WATER TREATING; WELL
      COMPLETION; WELL STIMULATION; WIDTH


-3-
AN  - 268441
TI  - EXPERIMENTAL DETERMINATION OF PARTICLE-SIZE DISTRIBUTIONS FROM PROPPANT
      INTERACTIONS WITH TIGHT RESERVOIR ROCKS
AU  - BAKER B A; CARROLL H B JR
SO  - 5TH ANNU U S DEP ENERGY ET AL ENHANCED OIL & GAS PROC V 3, PP L-6/1 -
      L-6/15, 1979 (CONF-790805-P3)
EY  - 1979
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Petroleum Abstracts

Sample Format of On-Line Printout from SDC

Petroleum Abstracts

Typical Hardcopy Abstract

WELL COMPLETION & SERVICING

5 *ACIDIZING* 174, 809 4

2 ACIDIZATION. PT. 1. THE DISSOLUTION OF DOLOMITE IN HYDROCHLORIC ACID-- K. Lund and H. S. Fogler 6 (Michigan Univ) and C. C. McCune (Chevron Research Co);

7 CHEM. ENG. SCI. v. 28, No. 3, pp 691-700, March 1973

The dissolution of dolomite in hydrochloric acid was studied with the aid of a rotating disk system. At 25°C, the dissolution process is surface reaction rate limited even at low disk rotation speeds. As the temperature is increased to 100°C, the dissolution process approached diffusion limitation even at relatively high (500 rpm) rotation speeds. The rate of reaction was found to be proportional to a temperature dependent fractional power of the hydrochloric acid concentration. Analysis of the experiments suggests that adsorption of hydrogen ion (described by a Freundlich isotherm) on the solid dolomite surface and subsequent reaction of the adsorbed hydrogen ion with the solid dolomite matrix is the reaction mechanism. (24 refs.)

ID- E7Ø-29742
TI- GREAT CIRCLE RAYLEIGH AND LOVE WAVE DISPERSION FROM 1ØØ TO 9ØØ SECONDS
AU- DZIEWONSKI, A.; LANDISMAN, M.
SO- R. ASTRON. SOC., GEOPHYS. J., VOL. 19, NO. 1, P. 37-91, ILLUS. (INCL. SKETCH MAP), 1969
TA- PHASE VELOCITIES, MEASUREMENT TECHNIQUES, SIGNIFICANCE AND APPLICATIONS IN MANTLE STRUCTURE STUDIES
DE- EARTHQUAKES, AUSTRALIA, JAPAN, USSR, SEISMIC SURVEYS, CHILE, SEISMIC METHODS, STATISTICAL METHODS, 1963, KURIL ISLANDS, 196Ø, EAST, MATSUSHIRO OBSERVATORY, RAYLEIGH WAVES, LOVE WAVES, DISPERSION, GREAT CIRCLE PATHS, AUTO-CORRELATION ANALYSIS
LA- EL
JC- GEOJA

ID- E72-7849Ø
TI- NEW DATA ON THE FLORA IN THE QUARTERNARY SEDIMENTS OF GORNY ALTAI
OT- NOVYYE DANNYYE O FLORE CHETVERTICHYKH OTLOZHENIY GORNOGO ALTAYA
AU- CHERNYSHOVA, M. B.; POPOV, P. A.; RYBAKOVA, N. O.
SO- MOSCOW, UNIV., VESTN., SER. GEOL., VOL. 27, NO. 2, P. 1Ø6-1Ø8, ILLUS., 1972
TA- DISTRIBUTION OF SPORES AND POLLEN IN QUATERNARY SEDIMENTS, USSR
DE- USSR, PALYNOMORPHS, QUATERNARY, PALEOBOTANY, DISTRIBUTION, GORNY ALTAI
LA- RU
JC- VMUGA

ID-E73-12396
TI- HYDROGEOLOGY OF A SANITARY LANDFILL IN GLACIAL DRIFT IN EASTERN CONNECTICUT :ABSTR.:
AU- CHESTNUT, LAWRENCE, JR.; HOLZER, THOMAS L.
SY- IN NORTHEASTERN SECTION, 8TH ANNUAL MEETING
SO- GEOL. SOC. AM., ABSTR., VOL. 5, NO. 2, P. 146-147, 1973
TA- CHEMICAL ANALYSIS, CONTAMINATION, HORIZONTAL MIGRATION
DE- CONNECTICUT, GROUND WATER, ENVIRONMENTAL GEOLOGY, HYDROGEOLOGY, CONTAMINATION, POLLUTION, EAST, UNITED STATES, LANDFILL, GEOCHEMISTRY
LA- EL
JC- GAAPB

Sample Unit Records from the GeoRef Data Base

Single Terms:	METEORITES
	PROPERTIES
	COMPOSITION
	PEBBLES
Multiterm Words:	LANDFORM EVOLUTION
	DRAINAGE PATTERNS
	MARINE GEOLOGY
	KYANITE-SILLIMANITE TRANSFORMATION
Phrases:	NIOBIUM-TANTALUM IN ZIRCON
	ABUNDANCE OF ELEMENTS

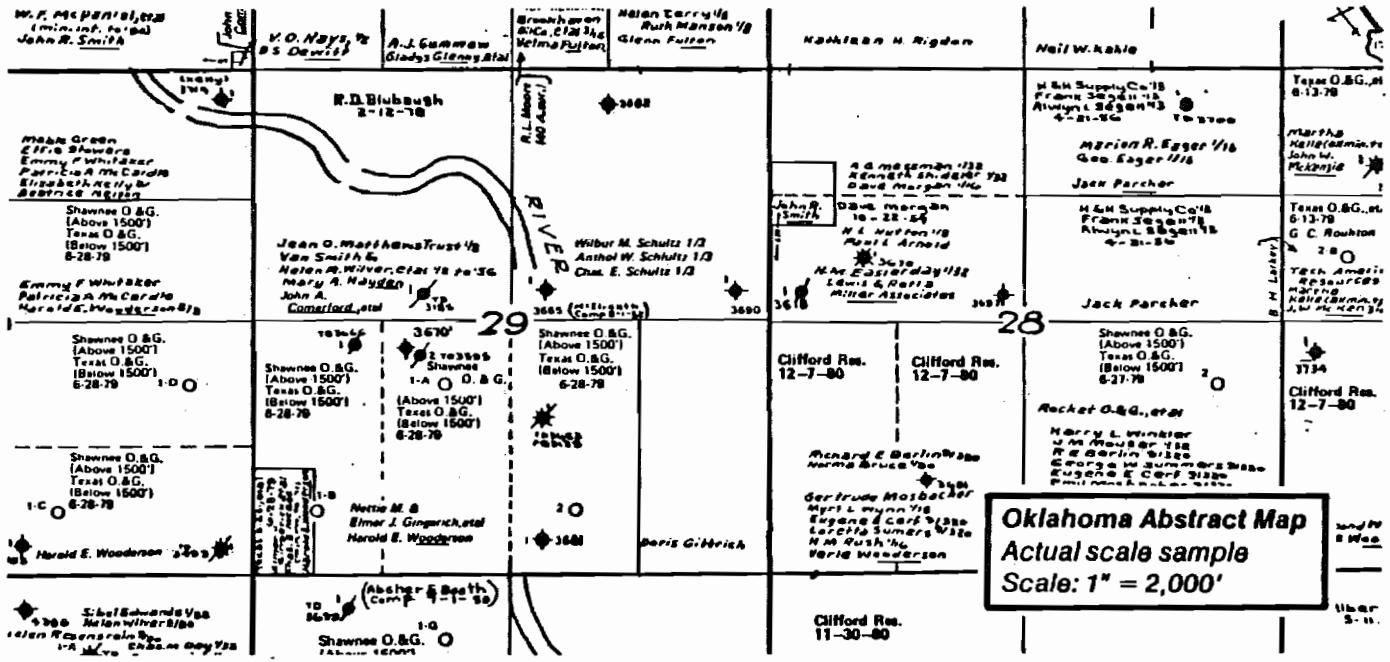
GeoRef Descriptors

CATEGORY NAMES	ABBREVIA-TIONS	SEARCHABLE CATEGORIES	PRINTABLE CATEGORIES
ID Number	ID	X	X
Title	TI		X
Original Title	OT		X
Author(s)	AU	X	X
Symposium	SY		X
Source Reference	SO		X
Secondary Publication	SP		X
Title Annotation	TA		X
Descriptors	DE	X	X
Language	LA	X	X
Category Code	CC	X	
Publication Year	PY	X*	
Update Code	UP	X	

*The Publication Year is searched by a range of years.

GeoRef Unit Record

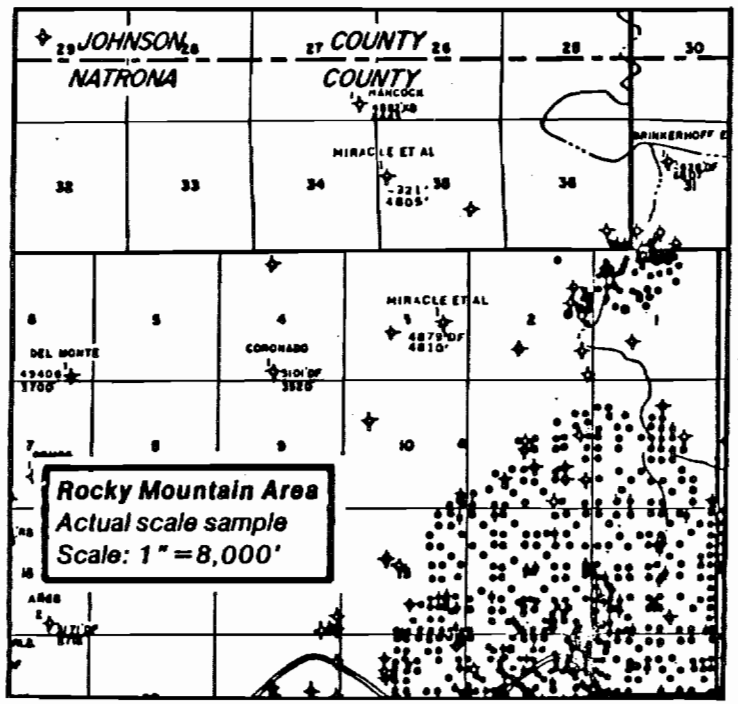
Petroleum Information.
Corporation

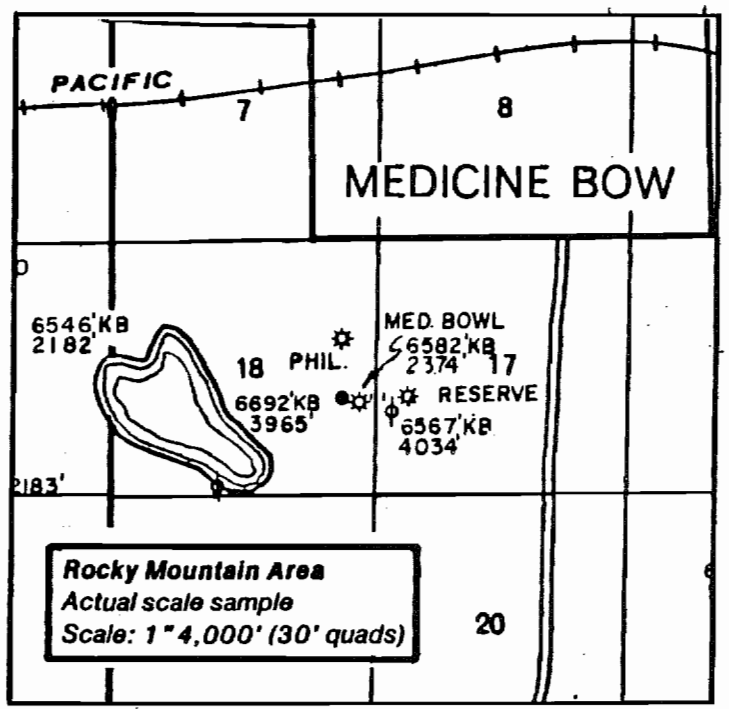


Content: Names of land owners
Names of principal mineral owners
Names of oil and gas lease owners with lease expiration dates
Locations of oil wells, gas wells, dry holes and drilling wells
U.S. General Land Office Survey lot numbers and acreages
Bureau of Land Management leases with BLM lease numbers
Restricted Indian land designations
Secondary recovery unit outlines .

Land Ownership Map by PI

Petroleum Information.
Corporation

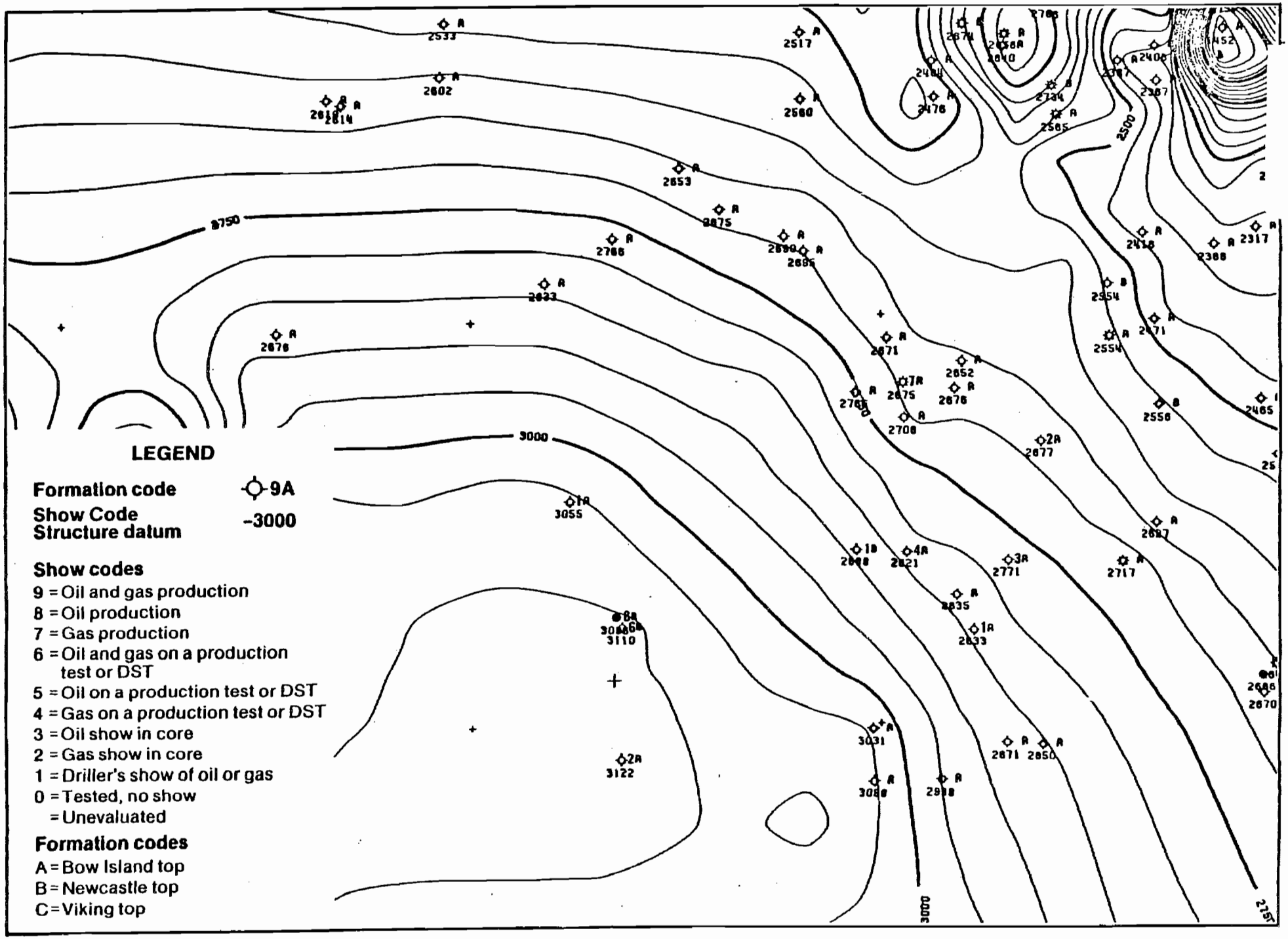




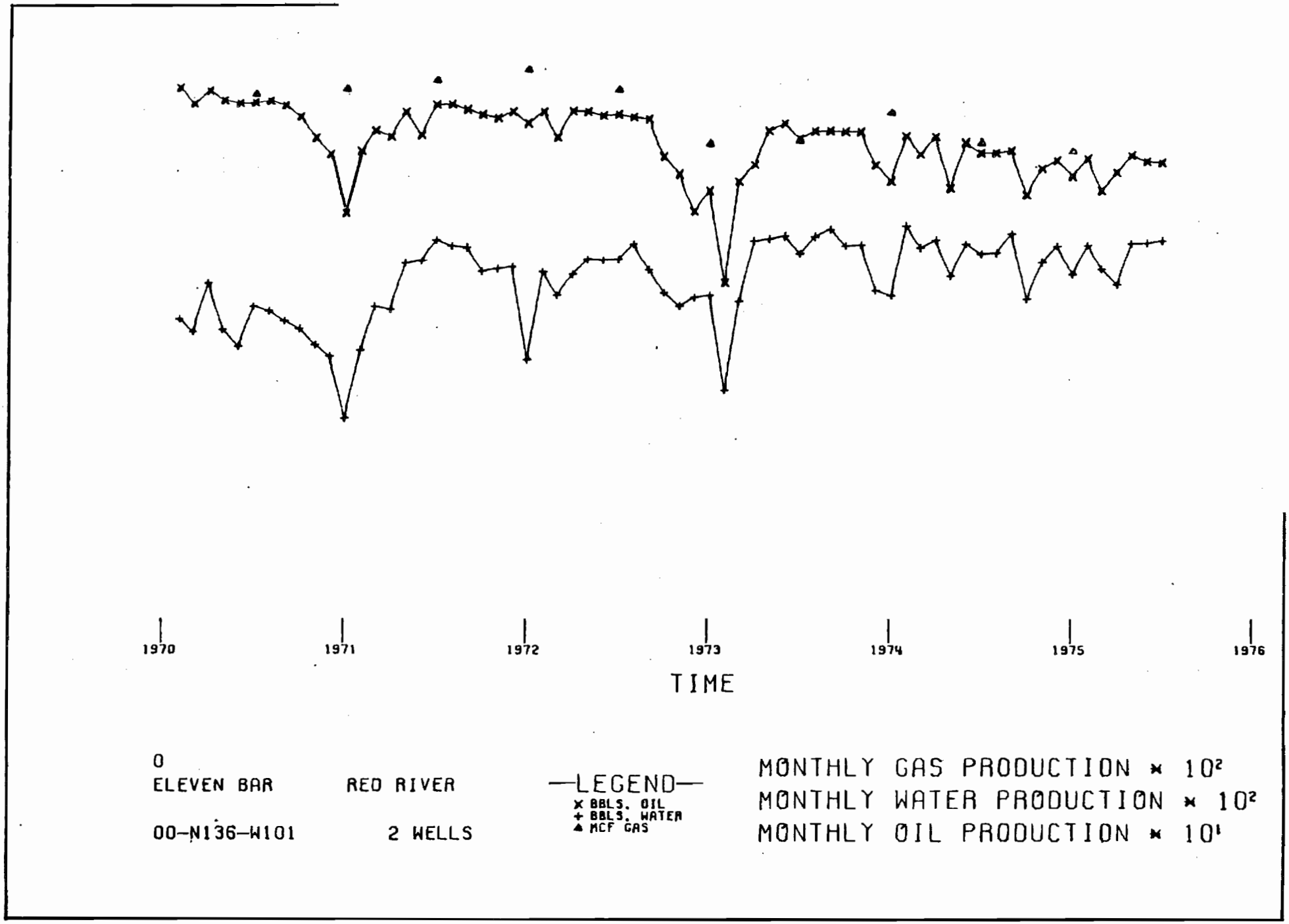
Controlled Regional Base Maps by PI with Current Well Data

40 DA	YR	STA	-COUNTY-	---OPERATOR NAME----	—WELL #—	-----WELL NAME-----	PRODUCING FORMATION	-TD-	TREATMENT INFORMATION TYPE	INTERVAL	VOLUME	PROPPING AGENT
01/15	79	OHIO	TRUMBULL	BOIS DARC CORP	1	H S SREDNIWA	251CLNNS	4126	SWFR	3928- 3990	60000GALS	50000LBS SAND
01/09	79	OHIO	TRUMBULL	DARC BOIS CORP	1	E KABAT	251CLNNS	4155	SWFR	3940- 4000	61500GALS	50000LBS SAND
01/28	79	OHIO	MORROW	IRVIN PRODUCING	5	VERNIE CAMPBELL	202GLRVL	3346	ACID	3291- 3328	1500GALS	
01/17	79	OHIO	TRUMBULL	OHIO O&G	2	B & R ALDERMAN	251CLNNS	4965	SWFR	4730- 4794	76000GALS	60000LBS SAND
01/08	79	OHIO	TRUMBULL	PYRAMID O&G	1	TOTH-ANDERSON	251CLNNS	4112	SWFR	3966- 4019	1350BBLS	49000LBS SAND
01/24	79	OHIO	WASHNGTN	TREND EXPLORATION	1	J & H JUSTICE	306GRDNS	5551	SWFR	3980- 3984	45200GALS	43000LBS SAND
									ACID	3980- 3984	300GALS	
01/29	79	PENN	ARMSTRNG	ADOBE O&G	1	GLENN W JEWART	306DVNNU	3583	SWFR	1987- 1996	12000GALS	16000LBS SAND
									SWFR	2732- 2755	14000GALS	19000LBS SAND
									SWFR	2964- 3102	12500GALS	16000LBS SAND
									SWFR	3280- 3417	15000GALS	20000LBS SAND
01/02	79	PENN	INDIANA	ADOBE O&G	1	JOHN G AULD	306BLTNS	3774	SWFR	3091- 3096	16250GALS	22000LBS SAND
									SWFR	3156- 3269	12750GALS	16000LBS SAND
									SWFR	3412- 3421	12750GALS	16000LBS SAND
									SWFR	3515- 3613	16500GALS	22000LBS SAND
01/05	79	PENN	INDIANA	ADOBE O&G	1	JOHN P BAKER	306DVNNU	3379	SWFR	2590- 2596	16500GALS	22000LBS SAND
									SWFR	2724- 2729	17000GALS	25000LBS SAND
									SWFR	2977- 2978	12250GALS	15000LBS SAND
									SWFR	3159- 3165	16750GALS	22000LBS SAND
01/18	79	PENN	JEFFERSN	ADOBE O&G	1	ROBERT MARSHALL	306DVNNU	3216	SWFR	1928- 1932	12000GALS	15000LBS SAND
									SWFR	2230- 2280	16000GALS	22000LBS SAND
									SWFR	2456- 2484	18000GALS	24000LBS SAND
									SWFR	2770- 2780	19000GALS	24000LBS SAND
	79	PENN	JEFFERSN	ADOBE O&G	2	CHESTER KNAPP	306DVNNU	3131	SWFR	2251- 2305	16500GALS	23000LBS SAND
									SWFR	2490- 2508	12000GALS	16000LBS SAND
									SWFR	2568- 2576	13500GALS	18000LBS SAND
									SWFR	2815- 2823	13500GALS	18000LBS SAND
01/31	79	PENN	JEFFERSN	ADOBE O&G	1	DALE BURKETT	306DVNNU	3225	SWFR	2474- 2486	14000GALS	17000LBS SAND
									SWFR	2593- 2615	12000GALS	12000LBS SAND
									SWFR	2753- 2757	12500GALS	16000LBS SAND
									SWFR	2793- 2814	15500GALS	20000LBS SAND
									SWFR	3078- 3191	12500GALS	14000LBS SAND
01/04	79	PENN	WESTMRLD	ADOBE O&G	1	JAMES C POOLE	306DVNNU	4080	SWFR	2504- 2519	14200GALS	18000LBS SAND
									SWFR	3011- 3017	18250GALS	25000LBS SAND
									SWFR	3121- 3126	12000GALS	15000LBS SAND
									SWFR	3373- 3404	16250GALS	22000LBS SAND
									SWFR	3739- 3758	13000GALS	16000LBS SAND
01/10	79	PENN	INDIANA	C & N CO	3	RUSSELL A SPANARD	306DVNNU	4128	SWFR	1842- 1872	604BBLS	30000LBS SAND
									SWFR	2018- 2022	420BBLS	16000LBS SAND
									SWFR	3254- 3258	457BBLS	15000LBS SAND
									SWFR	3410- 3416	558BBLS	22000LBS SAND
									SWFR	3858- 3862	459BBLS	20000LBS SAND
01/08	79	PENN	INDIANA	C & N CO	2	RUSSELL A SPANARD	306DVNNU	3823	SWFR	1950- 2127	374BBLS	12000LBS SAND
									SWFR	3363- 3447	657BBLS	24000LBS SAND
									SWFR	3519- 3525	623BBLS	20000LBS SAND
									SWFR	3597- 3603	570BBLS	18000LBS SAND

Sample of Customized Computer Output by PI



Map Illustrating Contoured Structure and Shows Within a Formation by PI



Time vs. Rate Production Curve by PI

OIL AND CASINGHEAD GAS
PRODUCTION STATISTICS

FROM DWIGHT'S—ENERGYDATA
1201 EXCHANGE DR.
RICHARDSON, TEXAS 75081

020102533 391515129120685610 0 3R18 DATE:

DATE YR MO	NO. OF WELLS FLOW	NO. OF WELLS DELT	NO. OF WELLS TOTAL	ALLOWABLE BBLS	OIL PRODUCTION BBLS	OIL RATE BBLS/DAY OIL	CUM OIL PROD. BBLS SINCE 1-1-66	CSGHD. GAS PROD MCF GAS SINCE	CUM GAS PROD. MCF 1-1-66	GAS OIL RATIO SCF/BBL	OIL RUNS
							33588 59		306,		
71	36	8	44	863699	865867	2372	42247 26	894059	3955	1033	864
72	36	9	45	1195569	1174667	3218	53993 93	2438482	6393	2076	1175
73	36	10	46	1264106	1246506	3415	66458 99	2561486	8955	2055	1246
74	37	9	46	1326601	1326489	3634	79723 88	3080826	12036	2323	1326
75	34	11	45	1376653	1360975	3729	93333 63	2687188	14723	1974	1361
76	35	10	45	1428592	1380186	3781	107135 49	2976802	17700	2157	1380
77 01	34	11	45	1201110	1137741	3669	108272 90	3170402	18017	2787	113709
77 02	36	9	45	1085079	1025577	3663	109298 47	2703622	18287	2636	102459
77 03	36	9	45	1224179	1156466	3731	110454 93	2581352	18545	2232	115722
77 04	36	9	45	1184970	1206433	4021	111661 36	3461022	18891	2869	119441
77 05	36	9	45	1224199	1207600	3895	112868 96	3771992	19268	3124	121864
77 06	36	9	45	1174677	1180398	3935	114049 35	3717882	19640	3150	118104
77 07	36	9	44	1211488	1207788	3896	115257 13	3491388	19989	2891	120443
77 08	36	9	45	1234139	1089788	3515	116346 91	3432971	20333	3150	108411
77 09	36	9	46	1198622	1195066	3984	117541 97	4086332	20741	3419	119130
77 10	36	9	46	1269266	1226770	3957	118768 67	4149988	21156	3383	123065
77 11	36	9	46	1234788	1183211	3944	119951 88	4375992	21564	3698	118716
77 12	36	12	46	1279999	1217713	3928	121169 61	3997477	21994	3283	121681
TOTALS				1452312	1403412			42940 20		3060	1402745
78 01	31	14	45	1239400	1223300	3946	122392 91	4665732	22460	3814	122428
78 02	31	14	45	1211688	1211800	4006	123514 71	4328542	22893	3859	112201
78 03	31	14	45	1241866	1207200	3894	124721 91	5171662	23410	4284	120547
78 04	31	14	45	1201880	1178133	3927	125900 04	5423912	23953	4604	117965
78 05	31	14	45	1241886	1191488	3843	127091 52	5401482	24493	4533	118974
78 06	31	14	45	1201800	1088700	3629	128180 22	4750262	24968	4363	109239
78 07	31	14	46	1283000	1227360	3959	129407 58	5081182	25476	4140	122671
78 08	31	14	46	1296420	1266110	4084	130673 69	4376202	25913	3456	126676
78 09	31	14	46	1254900	1200020	4001	131873 89	4345022	26348	3620	118396
78 10	31	14	46	1270600	1252050	4039	133125 94	4855092	26833	3878	126937
78 11	31	14	45	1227700	1181110	3937	134307 05	3901992	27224	3304	118133
78 12	31	14	45	1267500	1206460	3892	135513 51	4465262	27670	3701	120624
TOTALS				1484840	1434390			56766252		3958	1434791
79 01	27	18	45	1267120	1198330	3866	136711 84	4739142	28144	3955	119617
79 02	26	18	45	1145966	1049120	3747	137760 96	3952562	28439	3768	104825
79 03	26	18	46	1276889	1178410	3801	138939 37	4625452	29002	3925	118101
79 04	26	18	46	1255440	1143300	3811	140082 67	4047202	29407	3540	114146
79 05	26	18	46	1295490	1133440	3656	141216 11	4369642	29844	3855	113355
79 06	26	18	46	1253700	1125210	3751	142341 32	4527622	30296	4024	112412
TOTALS				1449440	1382781			26261612		3846	682456

API NO.	DATE 1ST PROD	FIG GRAV	STATUS	GATHERER GAS	GATHERER LIQUID
00276	080159		ACTIVE	QUINTEXXGN	

IDENTIFYING NUMBER	OPERATOR	WELL NAME	RESERVOIR
020102533	QUINTANA PET. CORP.	WILLIAMS, MAUDE, ETAL #A-	

STATE	DIST	FIELD NAME	FIELD NUMBER	COUNTY	LOCATION
TEXAS	2	LAKE PASTURE (H-640 SAND)	51512912	REFUGIO	

TOTAL

IDENTIFYING NUMBER	LOCATION	OPERATOR	WELL NAME	WELL
080220637	27 101 TC	PHILLIPS PET CO	FISHER-BONSACK	1

STATE OR PROVINCE	FIELD NUMBER	FIELD NAME	RESERVOIR	STATUS	GATHERER GAS	GATHERER	API
TEXAS	73355498	PUCKETT (ELLENBURGER)		ACT	NONAT	PHIPK	37

DIST NO	COUNTY OR PARISH	DATE COMP	DATE 1ST PROD	GAS GRAVITY	INIT TEST DATE	INIT POTENTIAL	INIT WHSIP	LATEST N FAC	INIT BHP/Z	M C	TOTAL DEPTH	PERFORATIONS	GAS GRAVITY	WELLHEAD FLOWING PRESSURE AT END OF TEST
8	PECOS	051154	05-54	.86	052254	102000	4536		6406	C	14430	13399-	50.1	

PERIOD ENDING	MCF LAST SIX MONTHS	MCF YEARLY PRODUCTION	MMCF CUMULATIVE PRODUCTION	MMCF CUMULATIVE AT TEST	TEST DATE	POTENTIAL	WHSIP	BHP	M C	BHP/Z	WATER BBLS/DAY	MCF/-DROP INIT WHSIP	SIX MONTHS WATER PROD	SIX MONTH COND PROD	SIX MONTHS BBLS MMCF	
7-72	2643789		77397											662	3	
1-73	2375575	5019304	79772	77639	07-19-72	12657	1938	3102	C	3702	22	29884		549	2	1086
7-73	2483942		82256											719	3	
1-74	2294269	4778231	84551	82609	07-11-73	13032	1793	2798	M	3339	22	30044		608	3	831
7-74	2309386		86860											603	3	
1-75	2160413	4669799	89020	87112	07-20-74	12410	1654	2637	C	3139	21	30226		564	3	772
7-75	2060274		91081											482	2	
1-76	1896774	3957068	92977	91248	07-15-75	10973	1530	2425	C	2873	22	30355		408	2	709
7-76	1956064		94933											437	2	
1-77	1704004	3660068	96637	95341	08-13-76	10166	1413	2225	C	2618	18	30329		251	1	671
7-77	1727361		98365											262	2	
1-78	1487698	3215059	99852	98657	08-02-77	9603	1308	2048	C	2393	19	30363		276	2	573
7-78	1384972		101237	101092	06-05-78	7882	1193	1855	C	2147	15	30241		229	2	623
1-79	1322296	2707208	102560											194	2	
7-79	1285382		103845											202	2	

IDENTIFYING NUMBER	LOCATION	OPERATOR	WELL NAME	WELL
080220638	TC	PHILLIPS PET CO	GLENNA	1

STATE OR PROVINCE	FIELD NUMBER	FIELD NAME	RESERVOIR	STATUS	GATHERER GAS	GATHERER	API NO.
TEXAS	73355498	PUCKETT (ELLENBURGER)		ACT	NONAT	PHIPK	3628

DIST NO	COUNTY OR PARISH	DATE COMP	DATE 1ST PROD	GAS GRAVITY	INIT TEST DATE	INIT POTENTIAL	INIT WHSIP	LATEST N FAC	INIT BHP/Z	M C	TOTAL DEPTH	PERFORATIONS	GAS GRAVITY	WELLHEAD FLOWING PRESSURE AT END OF TEST
8	PECOS	041552	08-52	.86	080152	50000	4538	7.000	6423	C		13700-14532	50.0	

PERIOD ENDING	MCF LAST SIX MONTHS	MCF YEARLY PRODUCTION	MMCF CUMULATIVE PRODUCTION	MMCF CUMULATIVE AT TEST	TEST DATE	POTENTIAL	WHSIP	BHP	M C	BHP/Z	WATER BBLS/DAY	MCF/-DROP INIT WHSIP	SIX MONTHS WATER PROD	SIX MONTH COND PROD	SIX MONTHS BBLS MMCF	
7-72	1631781		49217											681	4	
1-73	2204498	3836279	51422	49340	07-12-72	14872	1963	3171	C	3766	30	19161		665	3	1131
7-73	2546553		53969											412	2	
1-74	2382619	4929172	56351	54060	07-07-73	11638	1813	2827	M	3361	24	19839		454	2	1190
7-74	1941200		58292											358	2	
1-75	2076770	4017970	60369	58384	07-08-74	11676	1663	2676	C	3178	22	20308		292	1	1147
7-75	1855184		62224											303	2	
1-76	1715925	3571109	63940	62292	07-08-75	9309	1535	2455	C	2902	20	20743		229	1	1215
7-76	1972423		65913											318	2	
1-77	1688095	3660518	67601	65944	07-03-76	9298	1423	2262	C	2658	22	21170		249	1	1003
7-77	1426021		69027											173	1	613
1-78	1303620	2729641	70330	68652	06-20-77	12500	1241	1952	C	2265	27	20914		163	1	
7-78	1231145		71562											94	1	
1-79	1159020	2390165	72721	71608	07-07-78	10500	1223	1922	C	2227	28	21601		114	1	653
7-79	1210819		73931											119	1	

APPENDIX B

PETROLEUM INFORMATION CORPORATION
LIST OF AVAILABLE DATA ELEMENTS

WELL HISTORY CONTROL SYSTEM (WHCS) FILE CONTENTS

LOCATION INFORMATION

Master Well Control (For All WHCS Files)

- COUNTY CODE
- UNIQUE WELL NUMBER
- SIDETRACK
- HOLE CHANGE
- OPERATOR
- ZEROES
- LATITUDE AND LONGITUDE

Location Option for Rocky Mountain Region

- TOWNSHIP AND RANGE
- SECTION
- SPOT
- DATE: MONTH AND YEAR
- HOLE CHANGE
- LATITUDE AND LONGITUDE

Location Option for Mid-Continent Region (Excluding Texas)

- COUNTY CODE
- TOWNSHIP AND RANGE
- SECTION
- UNIQUE WELL NUMBER
- HOLE CHANGE
- LATITUDE AND LONGITUDE

LAMBERT COORDINATES (Surface Location and Reported Bottom Hole Location)

NARRATIVE DESCRIPTION OF WELL LOCATION

DRILLING DATA

Formation Tops and Bases

- FORMATION ZONE CODE
- MEASURED DEPTH
- TRUE VERTICAL DEPTH (rarely reported)

Fault Data (rarely reported)

FAULT TYPE
MEASURED INTERVAL
(TRUE VERTICAL DEPTH INTERVAL)
FORMATIONS INVOLVED
REMARKS

Initial Potential and Production Test Data

General

METHOD
VOLUMES OF GAS AND WATER
UNIT AND/OR RATE
BS & W OR WATER CUT %
CHOKE SIZE
DURATION OF TEST (HOURS)

Completion Interval

FORMATION AND ZONE CODE OF PRODUCING INFORMATION
TYPE OF PERFORATIONS
NUMBER OF PERFORATIONS PER FOOT/INTERVAL TESTED
INTERVAL TESTED
OPERATION SEQUENCE
DETAIL DATA ON PERFORATIONS BY INTERVAL

Treatment

TYPE OF TREATMENT
INTERVAL TREATED
VOLUME OR WEIGHT
AMOUNT OF PROPPING AGENT
TYPE OF PROPPING AGENT
FORMATION PRESSURE BREAKDOWN
AVERAGE INJECTION RATE (BARRELS/MIN)
TYPE OF ADDITIVE
NUMBER OF STAGES
REMARKS

Casing, Lining, and Tubing History

CASING STRING:	SIZE
	DEPTH
	CEMENT
	DATA NARRATIVE
LINING:	SIZE
	DEPTH
	TYPE
	CEMENT

OPERATION SEQUENCE
TUBING STRING: SIZE
DEPTH
FLOWING CASING PRESSURE
FLOWING TUBING PRESSURE
SHUT-IN CASING PRESSURE
SHUT-IN TUBING PRESSURE
CALCULATED ABSOLUTE OPEN FLOW

} rarely reported

Details on the following attributes are rarely available:

PRESSURES
CALCULATED OPEN FLOW
BOTTOM HOLE TEMPERATURE AND PRESSURE
FOUR POINT TESTS
WATER ANALYSIS
CONDENSATE PER MMCF
GAS ANALYSIS: CONTENT
BTU
GAS GRAVITY
SHUT-OFF INTERVALS
NARRATIVE DESCRIPTION

Core Data
Data is abundant but is difficult to retrieve and process.

CORE INTERVAL
CORE RECOVERY
FORMATION CODE
TYPE OF CORE (CONVENTIONAL OR SIDEWALL)
TYPE OF SHOW

} Typically the only data retrieved

NARRATIVE DESCRIPTION OF CORE
FORMATION OVERLAPPED BY CORE (rarely reported)
GENERAL LITHOLOGY
POROSITY
SHOWS

} Used only in Permian file

Drillstem and Wireline Test Information
Records are abundant and fairly complete.

TYPE OF TEST
FORMATION AND INTERVAL TESTED
AMOUNT OF CUSHION
TYPE OF CUSHION MISRUN
FORMATIONS OVERLAPPED BY TEST
WIRELINE INTERVAL AND FORMATION TESTED
MATERIAL TO SURFACE: TYPE
TIME
RATE
PIPE RECOVERIES: AMOUNT
DESCRIPTION

INITIAL OPEN TIME AND INITIAL AND FINAL FLOWING PRESSURES
FINAL OPEN TIME AND INITIAL AND FINAL FLOWING PRESSURES
BOTTOM HOLE TEMPERATURE (rarely found for pre-1972 wells: common for current wells)
SHUT-IN PRESSURE AND TIME: INITIAL
FINAL
HYDROSTATIC PRESSURE: INITIAL
FINAL
CHOKES: SIZE: TOP
BOTTOM
RECORDER DEPTH
TOOL DIAMETER
TEST FLOW PRESSURE - AT SURFACE
GAS CONTENT — Used in Permian file only
CONDENSATE RATIO
WATER SALINITY RESISTIVITY — rarely reported on pre-1972 wells; available for many current wells.

MUD DATA: WEIGHT
TYPE
VISCOSITY — Common in Gulf Coast file
SALINITY

Details on the following attributes are rarely available:

MUD AND MUD FILTRATE RESISTIVITY
FORMATION TEST GAS ANALYSIS DATA: GRAVITY
BTU
CHEMICAL ANALYSIS
DATA FROM TESTING COMPANIES: PERMEABILITY
MAXIMUM RESERVOIR PRESSURE
SHUT-OFF INTERVALS
NARRATIVE DESCRIPTION OF FORMATION TEST

MISCELLANEOUS DATA

Of the following data elements, only drilling shows are commonly reported. Logs are reported for 25% to 60% of the wells, depending on the area. A sample listing of WHCS microfiche of the area should be checked before attempting to retrieve from these records.

DRILLING SHOWS: INTERVAL OR DEPTH
FORMATION ZONE CODE
TYPE OF SHOW
LOGS: INTERVAL
TYPE
COMPANY
LITHOLOGY LOGS: COMPANY AND TYPE; MUD
PALEONTOLOGY
RESIDUE
SAMPLE

POROSITY ZONES: INTERVAL
FORMATION
POROSITY

DRILLING MEDIA: MUD TYPE
DEPTH
DETAILS BY INTERVAL
MEDIA WEIGHT

BIT RECORD: BIT
COMPANY
TYPE OF BIT
SIZE OF BIT
FOOTAGE BIT DRILLED
BIT WEIGHTS CARRIED: LOWER WEIGHT
HIGHER WEIGHT
REVOLUTIONS PER MINUTE

AIR DRILLING DETAIL:
NAME OF AIR CONTRACTOR OR GAS SOURCE
NUMBER OF COMPRESSIONS
AIR/GAS CAPACITY AVAILABLE
INTERVAL
AIR GAS VOLUME
MAXIMUM GAUGE PRESSURE
WATER INFLUX
NARRATIVE DESCRIPTION

LAST CIRCULATION ZONES:
DEPTH
FORMATION CODE
INTERVAL
AMOUNT OF FLUID LOST
AMOUNT AND TYPE OF LOST CIRCULATION MATERIAL

BLOWOUT ZONES: DEPTH
FORMATION ZONE CODE (Permian file only)

MISC. DRILLING PROBLEMS

HOLE DEVIATION: DEPTH
DIRECTION OF DEVIATION
ANGLE OF DEVIATION

DIRECTION SURVEY: MEASURED DEPTH OF HOLE
DISTANCE N OR S OF SURFACE LOCATION
DISTANCE E OR W OF SURFACE LOCATION

PROPOSED BOTTOM HOLE LOCATION

WELL SPACING
GEOLOGIST
PARTICIPATING INTERESTS -- NARRATIVE DESCRIPTION

PRODUCTION DATA

The WHCS file includes the following limited information (see Appendix C for other production information).

ABANDONMENT OF PRODUCING WELL
- DATE: MONTH, DAY, YEAR
- CUMULATIVE GAS PRODUCTION
- REMARKS
- PRODUCING FORMATION (Permian file only)

PLUGGING RECORD
- INTERVAL PLUGGED
- SACKS OF CEMENT
- NARRATIVE DESCRIPTION

PRODUCING FORMATION ZONES

APPENDIX C

LIST OF AVAILABLE DATA ELEMENTS

GROUPED BY SERVICE OFFERED BY PETROLEUM INFORMATION CORPORATION

PRELIMINARY DATA

Well Record Service - features the following information often in a narrative format:

- Daily Wildcat Reports
- Weekly First Reports
- Drilling Progress Reports
- Completion Tickets

Completion Cards - include these data elements:

- Operator
- Contractor
- Well name and number
- Location
- Named township
- Elevation
- Spud and completion dates
- Casing records
- Log and/or sample tops
- Drillstem tests
- Core descriptions
- Perforated intervals
- Drilling and/or log total depth
- Plugged back total depth
- Completion data
- Final classification

STATISTICAL DATA

First Reports and Well Starts - provide the following data entries for every new well:

- First Reports
- Control number
- State
- County
- First report date
- Province report date
- Province code (AAPG)
- Well History Control System and Well Record Service project codes
- Miscellaneous codes defined by State/County
- Location data
- Operator name and code
- Well name and number
- Field name and code

Initial classification
Projected formation and/or depth
Contractor name, code and location
Offshore: name of platform, rig site, water depth, number of drill slots, water bottom zone

Well starts
Same as first report, plus well start and/or spud date

Completion Statistics - provide these data elements:

API number
State
County
First report, spud, and completion dates
Operator name
Final class and status
Province code (AAPG)
Location data (congressional, offshore, block and tract, Carter and Texas)
Well name and number
Field name and code
Projected formation and/or depth
Code
Total depth -- equals drillers or log or deepest of the two
Formation at TD
If producer: type and volume, formation

Drilling Activity Analysis System (DAAS) - includes these data items in alphabetical sequence:

API number

Average depth

Average gas IP
Average gas potential (MCFPD) for all gas-producing wells in a specific category.

Class

1 = NFW = New-found wildcat,
2 = DEV = Development, or
3 = OE = Other exploratory well.

Completion date

Cost (Drilling cost per foot)
: Computed using cost per foot as determined by P. I. research and/or the values published by the "Joint Association Survey of the U. S. Oil and Gas Producing Industry" (JAS).

County name
County number
Depth range
Entry date
Field name and number
Footage drilled for gas wells
Formation at total depth
Formation at producing zone
Initial potential of gas and oil
Location data
Operator name
Name of geologic province
Province numeric code
Sidetrack
: Old well workover; old well drilled deeper.

Spud day and month
State name
State number
Status
: 2 = Gas, 3 = Dry, or 4 = Suspended

Success ratio
Barrels per day of all gas coming from a specific category
Total footage
Value gas
: A dollar amount equal to an amount of gas times an average dollar value per unit of measurement as determined by P. I. research.

Well counts
Well depth
Well name

Statistical Custom Services - Customized reports are available from a file whose items may be combined in any fashion:

Control number
API number
State
County
First report, spud, and completion dates
Province code (AAPG)
Well History Control System and Well Record Service project codes
Miscellaneous codes defined by State/County
Final class and status
Operator name and code
Well name and number
Field name and code
Initial class
Projected formation and/or depth
Contractor name, code and location
Offshore: name of platform, number of drill slots
Location data
Total depth -- equals drillers or log or deepest
Formation at TD
Plugback at TD, if applicable
If producer: type and volume, formation, depth interval

File Maintenance - Is a service which permits the creation of a personal data base which may include any of the following data:

Control number
API number
State
County
First report, spud, and completion dates
Province code (AAPG)
Well History Control System and Well Record Service project codes
Miscellaneous codes defined by State/County
Operator name and code
Well name and number
Field name and code
Final class and status
Initial class
Projected formation and/or depth
Contractor name, code and location
Offshore: name of platform, rig site, water depth, number of drill slots, water bottom zone
Location data
Well start and/or spud date
Total depth -- equals drillers or log or deepest

Formation at TD
Plugback at TD, if applicable
If producer: type and volume, formation, depth interval

PRODUCTION FILE DATA ELEMENTS

STATE
FIELD
NAME OF PRODUCING RESERVOIR
LEASE OR UNIT
COMMINGLED FACILITY
WELL SERIAL NUMBER
SUBCOMPLETION NUMBER
YEAR
TYPE OF PRODUCT (I.E., NATURAL GAS, SWEET GAS, CASINGHEAD, ETC.)
MODE OF PRODUCTION
PRODUCTION ZONE
STATE FIELD CODE
COUNTY OR PARISH
OPERATOR
API NUMBER
DATE PRODUCTION BEGAN
DATE PRODUCTION CEASED
TOTAL DEPTH
UPPER PERFORATION
LOWER PERFORATION
CUMULATIVE GAS
CUMULATIVE WATER
SECTION
TOWNSHIP AND RANGE
WELL NUMBER
COMPLETION DATE
SPOT
BASE MERIDIAN
SAND THICKNESS
CUMULATIVE GAS START YEAR
CUMULATIVE WATER START YEAR
FIELD DISCOVERY DATE
GAS PRODUCTION
NUMBER OF GAS WELLS
GAS TRANSPORTATION LINE
MONTHLY WATER PRODUCTION
ALLOWABLE
DAYS WITHIN MONTH DURING WHICH WELL PRODUCED
UNIT ACREAGE
BOTTOM HOLE PRESSURE
BOTTOM HOLE TEMPERATURE

CALCULATED BOTTOM HOLE VALUES
DATE WHEN BOTTOM HOLE MEASUREMENTS WERE TAKEN
FIELD GRAVITY
CHOKE SIZE USED
BASIC SEDIMENTATION AND WATER
FLOW TO BRING PRESSURE
CASING OR LINE PRESSURE
GAS GRAVITY
TEST DATE

APPENDIX D

PETROLEUM INFORMATION CORPORATION
CURRENT GAS WELL COUNT
AND GEOGRAPHIC COVERAGE OF WELL DATA

The following chart lists the number of gas wells currently on record with PIC:

STATE	NO. OF GAS WELLS
Arkansas	84
Colorado	416
Idaho	0
Kansas	735
Louisiana	1,458
Montana	250
North Dakota	18
South Dakota	8
New Mexico	851
Oklahoma	1,474
Texas	4,039
Utah	111
Wyoming	239
Total	9,683

Petroleum Information has divided the United States into a number of regional files. The areas have common data formats and applications but each has some unique data characteristics.

ROCKY MOUNTAIN REGION

This file contains information for the four primary study areas as well as these additional areas:

- Snake River Downwarp
  Big Horn Basin
  Wind River Basin
  Wasatch Plateau
  Douglas Creek Arch
  Denver Basin
  San Juan Basin
  Raton Basin

File Content: All wells, historic and current, exploratory, development, service, workover, and deepenings.

General Data Characteristics:

1) Excellent coverage of completion data, including historic wells.

2) User must be aware of stratigraphic synonymies.

3) 90% of test and core data identified by formation.

4) 93% of wells report a formation at total depth.

5) 86% of wells have operator log tops.

Location Parameters: Township, range, section, spot, and location/ footage from reference point.

MID-CONTINENT REGION

This file includes these areas under study by the Western Gas Sands Project.

Anadarko Basin
Parts of Arkoma Basin
Ouachita Mountains Province
Fort Worth Basin

File Content: Pre-1965 development wells in selected areas (Anadarko and Arkoma Basins); all exploratory, development, service, workover, and deepening wells from 1965 to present.

General Data Characteristics:

1) Many wells in Eastern Oklahoma and Arkansas do not have elevations.

2) Excellent data in Anadarko Basin.

3) Many Arkoma Basin records are incomplete.

4) Most tests and cores identified with formation.

5) 80% of wells have a formation at total depth.

6) 98% of wells report operator log tops. Some of tops in Oklahoma have a lithology code.

Location Parameters: All states except Texas township, spot, and location/ footage from reference point; Texas offers survey or district name, field/ pool/area/wildcat, location/footage from reference point, and a narrative description.

PERMIAN BASIN

This file includes the Val Verde Basin.

File Content: Industry file contains all wells through 1966 as well as all post-1966 wells owned by P.I.

General Data Characteristics:

1) Pre-1966 wells have mainly commercial elevations; newer wells have mostly operator elevations.

2) User must purchase 1966 and older well data from Permain Basin well data service.

3) Few wells report formation at total depth.

4) Many wells have log tops.

5) Test data are good but have poor formation identity.

6) All reservoirs are identified by name.

Location Parameters: Texas offers informations listed under Mid-Continent Region. New Mexico offers township, range, section, spot, and location/ footage from reference point.

GULF COAST - EAST TEXAS REGION

This file includes these areas:

Western Gulf Basin
Cotton Valley Trend

File Content: All pre-1963 exploratory wells per Committee of Statistics on Drilling Classification Selected pre-1963 development wells. All exploratory, development, service, workover, and deepening wells from 1963 to present.

General Data Characteristics:

1) Tertiary Gulf Area has abundant test data, but tests are rarely identified with formation.

2) East Texas area has good formation identity for tests and cores.

3) 20% of wells report a formation at total depth.

4) 25% of wells have log tops. Most are in East Texas area and are verified by correlation.

5) 80% of wells have elevations.

NORTH LOUISIANA - SOUTH ARKANSAS REGION

This file includes parts of these areas:

Arkoma Basin
Ouachita Mountains Province

File Content: All pre-1967 exploratory, development, service, and workover wells, all current wells.

General Data Characteristics:

1) 53% of wells report a formation at total depth.

2) 50% of tests are identified by formation.

3) 60% of wells report log tops.

Location Parameters: Township, range, and section.

APPENDIX E

DATA ITEMS AVAILABLE WITHIN PETROLEUM DATA SYSTEM (PDS)

IDENTIFICATION
- CONTINENT
- COUNTRY
- STATE
- STATE CODE (STATE POSTAL CODE)
- COUNTY, PARISH OR OFFSHORE AREA
- COUNTY CODE (FIPS OR API CODE)
- FIELD
- FIELD CODE NO. (FPC CODE)
- UNIQUE ID NUMBER
- POOL
- STATE OR FEDERAL IDENTIFICATION NO.
- SOURCE DOCUMENT (OTHER THAN STATE REPORTS OR OIL SCOUTS REVIEW)
- STATE REPORTS
- OIL SCOUTS REVIEW
- FPC EXHIBIT H DATA

FIELD/POOL DATA
- REGULATORY DISTRICT OR AREA
- PRODUCING FORMATION NAME
- PRODUCING FORMATION CODE
- GEOLOGIC AGE OF PRODUCING FORMATION (AAPG STRATIGRAPHIC CODE)
- ERA NAME (AAPG STRATIGRAPHIC NAME)
- SYSTEM NAME (AAPG STRATIGRAPHIC NAME)
- SERIES NAME (AAPG STRATIGRAPHIC NAME)
- DESIGNATION OF FIELD & POOL BY STATE REGULATORY AGENCY)
- OIL
- CONDENSATE
- GAS
- GAS CAP GAS
- GAS STORAGE
- HELIUM
- OFFSHORE
- LOCATION
  - SECTION
  - TOWNSHIP
  - RANGE
  - MERIDIAN

FIELD CENTERPOINT
- LATITUDE (DECIMAL)
- LONGITUDE (DECIMAL)

FIELD ELEVATION (AVERAGE-FT.)

TYPE OF RECORD
- FIELD RECORD
- POOL RECORD

NO. OF POOLS IN FIELD

YEAR DISCOVERED

YEAR ABANDONED

YEAR REVISED

FIELD DISCOVERY METHOD
- SEISMIC
- SUBSURFACE
- SEISMIC PLUS SUBSURFACE
- SURFACE
- GROUND MAGNETICS
- AIRBORNE MAGNETOMETER
- PHOTOGEOLOGY
- RANDOM DRILLING
- OLD WELL REENTERED
- GEOCHEMICAL
- GRAVITY
- TREND
- OTHER

TRAP TYPE (GENERAL)
- STRUCTURAL
- STRATIGRAPHIC
- STRUCTURAL PLUS STRATIGRAPHIC
- HYDRODYNAMIC
- OTHER

TRAP TYPE (SPECIFIC)
- ANTICILINE
- SALT DOME
- FAULT
- NOSE
- SYNCLINE
- TERRACE
- FRACTURE
- HOMOCLINE
- DOME
- DIAPIR FOLD
- BURIED HILL
- REGIONAL FACIES CHANGE
- UNCONFORMITY
- LATERAL CHANGE IN POROSITY AND PERMEABILITY
- IGNEOUS INTRUSIVE
- ASPHALT SEAL
- BIOHERM (REEF)
- BIOSTROME
- SECONDARY CHEMICAL ALTERATION
- MONOCLINE
- LENSE
- OTHER

PRESENT STATUS OF POOL
- ABANDONED
  - OIL
  - GAS
  - CONSOLIDATED OR DIVIDED POOLS
- TEMPORARILY ABANDONED
  - OIL
  - GAS
- PRODUCING
  - OIL
  - GAS
- SHUT-IN
  - OIL
  - GAS
- GAS STORAGE (DEVELOPED OR UNDEVELOPED)
- ENHANCED RECOVERY
- UNITIZED POOL
  - YES
  - NO

DEEPEST WELL IN (FIELD) OR (POOL)
- DEPTH (FT.)
- FORMATION NAME
- GEOLOGIC AGE
- OPERATOR-LEASE-WELL NUMBER

GEOLOGIC BASIN NAME (AAPG PROVINCE NAME)

GEOLOGIC BASIN CODE NUMBER (AAPG PROVINCE CODE)

DISCOVERY WELL (FIELD) OR (POOL)
- OPERATOR NAME
- OPERATOR CODE
- WELL NO.
- LEASE NAME
- COMPLETION DATE OF DISCOVERY WELL
- API WELL NUMBER
- LEASE TYPE
  - FEDERAL
  - STATE
  - FEE
  - UNIT
  - INDIAN LAND
  - OTHER

WELL CLASSIFICATION
- NEW FIELD
- NEW PAY

ELEVATION (KB, DF, GRD, OTHER) FEET

TYPE OF COMPLETION
- WILDCAT
- OLD WELL WORKED OVER
- OLD WELL DRILLED DEEPER
- OLD WELL PLUGGED BACK
- MULTIPLE COMPLETION

DEEPEST FORMATION PENETRATED

FORMATION NAME

GEOLOGIC AGE

DEPTH

PAY DATA
- PLUG BACK DEPTH (FT.)
- DEPTH TO TOP OF PAY (FT.)
- DEPTH TO BOTTOM OF PAY (FT.)
- NET PAY (FT.)
- TOPS

PERFORATION INTERVALS (FT.)
- TOP PERFORATION (FT.)
- BOTTOM PERFORATION (FT.)

DISCOVERY WELL LOCATION
- DISCOVERY WELL SECTION
- DISCOVERY WELL TOWNSHIP
- DISCOVERY WELL RANGE

INITIAL CRUDE OIL PRODUCTION (BBL/DAY)
- FLOWING
- PUMPING

INITIAL CONDENSATE PRODUCTION (BBL/DAY)

INITIAL GAS PRODUCTION (MCF/DAY)

API GRAVITY

WATER (%)
- WATER (BBL/DAY)

CHOKE SIZE (/64)

TUBING PRESSURE (PSI)
- SHUTIN
- FLOWING

NUMBER AND TYPES OF WELLS

PRODUCING OIL OR GAS
- FLOWING
- GAS LIFT OR AIR LIFT
- PUMPING OR ARTIFICIAL LIFT
- OTHER
- TOTAL PRODUCING
- CAPABLE OF PRODUCING
- DUAL PRODUCING OIL AND GAS

ABANDONED (PLUGGED)
- SHUT-IN OR TEMPORARILY ABANDONED

SERVICE
- INJECTION
- DISPOSAL

PROVED ACREAGE (DEVELOPED ACREAGE)
- FIELD AREA (TOTAL APPROVED BY STATE)

SPACING (REGULATORY ACRES PER WELL)

WELL DENSITY (ACRES PER WELL)

PRODUCING INTERVAL (POOL)

AVERAGE THICKNESS (FT.)
- AVERAGE FEET PERFORATED

DEPTH TO TOP (FT.)

DEPTH RANGE
- SHALLOWEST (FT.)
- DEEPEST (FT.)

CONTACTS (OIL, WATER & GAS) (SUBSEA FT.)
- ORIGINAL WATER CONTACT (SUBSEA FT.)
- ORIGINAL GAS/OIL CONTACT (SUBSEA FT.)
- CURRENT WATER CONTACT (SUBSEA FT.)
  - YEAR
- CURRENT GAS/OIL CONTACT (SUBSEA FT.)
  - YEAR

RESERVOIR DATA - GENERAL

LITHOLOGY
- SILTSTONE
- SHALE
- CHERT
- ANHYDRITE
- INTRUSIVE IGNEOUS (SERPENTINE) OR EXTRUSIVE IGNEOUS

METAMORPHICS, DETRITAL, SANDSTONE, CONGLOMERATE, ARKOSE, GRANITE WASH, BEACH SANDSTONE, BAR STANDSTONE, NEARSHORE MARINE SANDSTONE, OR CHANNEL SANDSTONE
LIMESTONE (CHAT), OOLITIC LIMESTONE, MICRITIC LIMESTONE, LIMESTONE REEF, OR MARLSTONE
DOLOMITE OR DOLOMITE REEF
CARBONATE
OTHER

PRIMARY DRIVE TYPE
DISSOLVED (SOLUTION) GAS OR DEPLETION
GAS CAP GAS
GAS EXPANSION OR VOLUMETRIC (DRY GAS POOLS ONLY)
WATER DRIVE
GRAVITY
PRIMARY DRIVE REMARKS

POROSITY
LOW (PERCENT)
HIGH (PERCENT)
AVERAGE (PERCENT)

TYPE POROSITY
INTERGRANULAR (PINPOINT)
INTERCRYSTALLINE
VUGGY
FRACTURE

PERMEABILITY (MILLIDARCIES)
LOW (MD)
HIGH (MD)
AVERAGE (MD)

ORIGINAL FORMATION VOLUME FACTOR

CURRENT FORMATION VOLUME FACTOR
YEAR

RECOVERY FACTOR (PERCENT)
PRIMARY (PERCENT)
SECONDARY (PERCENT)

WATER SATURATION (PERCENT)
LOW (PERCENT)
HIGH (PERCENT)
AVERAGE (PERCENT)

WATER CUT (PERCENT)

OIL SATURATION (PERCENT)
LOW (PERCENT)
HIGH (PERCENT)
AVERAGE (PERCENT)

GAS SATURATION (PERCENT)
    LOW (PERCENT)
    HIGH (PERCENT)
    AVERAGE (PERCENT)

BULK VOLUME
    ACRE-FEET

TEMPERATURE DEGREES (FAHRENHEIT)
    RESERVOIR OR BOTTOM HOLE

SATURATION PRESSURE
    PSIA
    AT (^{o}F)

SALINITY (PPM)

VISCOSITY (AT RESERVOIR TEMPERATURE)

PSIA

AT (^{o}F)

GAS MEASUREMENT BASE
    PRESSURE BASE (PSIA)
    TEMPERATURE BASE (^{o}F)
    ASSOCIATED GAS GRAVITY
    NON-ASSOCIATED GAS GRAVITY

SHUT-IN BOTTOM HOLE PRESSURE (PSIA)
    INITIAL OR ORIGINAL RESERVOIR PRESSURE (PSIA)

LAST RESERVOIR PRESSURE PRIOR TO 1968
    YEAR

SUBSEQUENT PRESSURE (PSIA), (1968 THROUGH CURRENT YEAR)

DATUM (SUBSEA FT.)

PRESSURE AT ABANDONED CONDITIONS (PSIA)

AVERAGE RATE OF PRESSURE DECLINE (PSI/BBL PRODUCED)

GAS-CONDENSATE RATIO (BBL/MMCF)

INSTANTANEOUS PRODUCING GAS-OIL RATIO (SCF/BBL)
    INITIAL (SCF/BBL)
    CURRENT (SCF/BBL)
    YEAR

Z FACTOR
    INITIAL
    ABANDONED CONDITIONS
    CURRENT
    YEAR

PRODUCTION (ANNUAL AND CUMULATIVE PRODUCTION FROM 1968 THROUGH CURRENT YEAR)

PRODUCTION (ANNUAL AND CUMULATIVE PRODUCTION
FROM 1968 THROUGH CURRENT YEAR)

ANNUAL

NON-ASSOCIATED GAS (MCF)
CONDENSATE (BBLS)
WATER (BBLS)
ASSOCIATED WITH GAS OR GAS CAP (MCF)
HELIUM (MCF)
CARBON DIOXIDE (MCF)
HYDROGEN SULFIDE (MCF)
DISSOLVED SOLUTION OR CASINGHEAD GAS (MCF)
TOTAL GAS (MCF)

CUMULATIVE

NON ASSOCIATED GAS (MCF)
YEAR (LATEST)
CONDENSATE (BBLS)
YEAR
WATER
YEAR
ASSOCIATED GAS OR GAS CAP (MCF)
YEAR
HELIUM (MCF)
YEAR
CARBON DIOXIDE (MCF)
YEAR
HYDROGEN SULFIDE (MCF)
YEAR
DISSOLVED SOLUTION OR CASINGHEAD GAS (MCF)
YEAR
TOTAL GAS (MCF)
YEAR

AMOUNTS OF HYDROCARBONS REPORTED

ORIGINAL RECOVERABLE (PRIMARY)

ADDITIONAL RECOVERABLE (SECONDARY)

SECONDARY RECOVERY DATA
(includes all cycles of injection, year initiated, year abandoned, and type)

WATER ANALYSIS
(includes pH, gravity, specific gravity at 68°F, resistivity, and _____ chemical constituents)

NATURAL GAS ANALYSIS

- ANALYST (agency)
- WELLHEAD PRESSURE
- HEATING VALUE (BTU/CU. FT.)
- SPECIFIC GRAVITY
- CONSTITUENTS
  - METHANE
  - ETHANE
  - PROPANE
  - n-BUTANE
  - ISOBUTANE
  - n-PENTANE
  - ISOPENTANE
  - CYCLOPENTANE
  - HEXANES PLUS
  - NITROGEN
  - OXYGEN
  - ARGON
  - HELIUM
  - HYDROGEN
  - HYDROGEN SULFIDE
  - CARBON DIOXIDE

APPENDIX F

DWIGHT'S ENERGYDATA
LIST OF AVAILABLE DATA ELEMENTS

GAS REPORTS

LOCATION CODE
OPERATOR
WELL NAME
WELL NUMBER
STATE OR PROVINCE
FIELD NUMBER
FIELD NAME
RESERVOIR
STATUS
GATHERER
API NUMBER
DISTRICT NUMBER
COUNTY OR PARISH
DATE COMPLETED
DATE FIRST PRODUCTION
GAS GRAVITY
INITIAL TEST DATE
INITIAL POTENTIAL
INITIAL WHIPSTOCK
INITIAL BHP/Z
TOTAL DEPTH
PERFORATIONS
MCF LAST SIX MONTHS
MCF YEARLY PRODUCTION
MMCF CUMULATIVE PRODUCTION
MMCF CUMULATIVE AT TEST
TEST DATE
POTENTIAL
BORE HOLE PRESSURE
BORE HOLE PRESSURE vs. DEPTH
WATER (BBLS/DAY)
WATER PRODUCTION FOR PREVIOUS SIX MONTHS
WELLHEAD FLOWING PRESSURE AT END OF TEST

ADDITIONAL GAS PRODUCTION STATISTICS

DATE (YEAR, MONTH)
MCF GAS PRODUCTION
GAS RATE (MCF/DAY)
TEST DATE

PRESSURES
- SURFACE
- BOTTOM HOLE

TEST RATE
TEMPERATURE GRADIENT
FIELD DISCOVERY
FIELD TYPE

GAS MONTHLY HISTORY FORMAT

OPERATOR
WELL NAME
WELL IDENTIFICATION NUMBER
WELL NUMBER
COUNTY
FIELD NUMBER
PERFORATIONS
DATE OF FIRST PRODUCTION (YEAR, MONTH)
INITIAL
- POTENTIAL
- WHIPSTOCK

LAST
- POTENTIAL
- WHIPSTOCK

DATE OF LAST TEST (YEAR, MONTH)
GAS WITHDRAWALS
- DURING SPECIFIED NUMBER OF MONTHS
- CUMULATIVE

GATHERER

APPENDIX G

DATA MANAGEMENT SYSTEM (DMS) VERB DEFINITIONS

ACCUM		Accumulates column total.
AVG		Calculates average of items being tabulated.
BEGIN END		Marks the start and end of the range of a CASE.
CALL		Executes a routine.
CASE		Conditionally executes statement(s).
COMMENT		Programming comments to allow user to understand data base programming.
COUNT		Counts specified records and items.
DEPENDENT		Assigns multi-level sorts.
ENDCASE		Marks the end of the range of a CASE.
FOOTING		Specifies page footings.
FOR		Specifies a certain record within a file.
GO		Indicates end of user command sequence; triggers computer to begin job execution.
>	Inquiry words and symbols	Greater than.
<		Less than.
AND		
OR		
= (EQ)		Equals.
<>(NE)		Not Equal to.
<= (LE)		Less than or equal to.
>= (GE)		Greater than or equal to
NOT		
LOOK UP IN USING		Implements table lookup.
MAX		Shows maximum value for item.
MIN		Shows minimum value for item.
PAGE		Groups record items together as one, i.e., "PAGE ON REGION"

PAGINATE	Allows user to specify output headings without report programming.
PARENT	Assigns a first-level sort.
PAUSE	Creates pause before report program begins -- allows printer operator to line up paper.
PCT	Calculates column percent.
PLOT	Begins plotting.
PRINT	Outputs specified information.
RATIO [OF] (VALUE 1) TO (VALUE 2)	Creates ratios and percents.
RENAME	Assigns old for new.
REPORT	Starts definition of report section.
ROUTINE END (ROUTINE)	Marks the start and end of a routine definition.
ROWACCUM	Accumulates row total.
ROWPCT	Calculates row percent.
SUM	Sums items being tabulated.
TAB	Tabs print format to specified column in reporting.
TABULATE	Tabulates items as a function of another item, i.e., "TABULATE FORMATIONS BY AGE"
IF THEN ELSE	Testing condition verbs (true-false) -- like a "DO LOOP".
ENDIF	Turns of IF-THEN-ELSE logic.
FOR WHERE ALWAYS	Testing condition for "true" values.
LET UNLESS THEN	Allows an item to equal a value or expression unless the item is one specified, then assigns that item another specified value or expression.

USE	Specifies file to be used within data base.
WORKFILE	Declares an item to be of the "workfile" class.
WORKING	Starts a working storage section.

HISAM F77 Subroutines are available for limiting record length for online retrievals, automatic updates, and automatic deletions.

Also available are DMS interface programs for FORTRAN 77.

These routines can be explained upon request at a later date.

APPENDIX H

DRS COMMANDS AND THEIR FUNCTIONS

BASIC COMMANDS

OP - OPEN	open the data base.
S - SELECT	select records from the data base.
SS - SUBSELECT	select a subset of records from the active record set.
A - ARRANGE	arrange the active record set.
L - LIST	designate and order the fields to be listed.
E - EXECUTE	perform functions as specified.

FUNCTIONAL COMMANDS

AR - ARRANGE RESTORE	restore the most recent ARRANGE command.
B - BREAK	control line spacing between groups of data.
C - CONTINUE	continue listing records beyond the number initially requested.
DS - DEFINE SELECT	save the active record set in a disk file.
F - FORMAT	change the active input or output formats.
H - HEADING	alter report headings.
HF - HISTOGRAM FORWARD	arrange the data base in ascending order of frequency of the value of a specified field.
HR - HISTOGRAM REVERSE	arrange the data base in descending order of frequency of the value of a specified field.
KS - KEY SELECT	select records using the DRS-assigned user key.
LINK (no mnemonic abbr.)	execute a user-written program module.

N - NUMBER	count the number of records containing identical data in a specified field(s).
PUNCH (no mnemonic abbr.)	output to cards, disk or tape in free format the specified fields of the selected records.
QS - QUICK SELECT	select records using an index search.
SF - SUPRESS FIELD	inhibit printing of specified fields when their content is identical to that of the previous record.
T - TOTAL	provide numerical total, mean standard deviation, minimum value, maximum value, and number of values that exist for any numerical field(s).

UTILITY COMMANDS

BC - BATCH CONTINUE	extract commands from the disk command file.
CB - CHECK BATCH	check the syntax of the commands on the disk command file.
ED - EDIT	cause DRS to create or access a disk file of commands or data.
EJ - EJECT	restore automatic page ejection.
K - KILL	reduce to a minimum the DRS conversation in the interactive mode.
KB - KEYBOARD	transfer the listing of data from the line printer back to the console.
LP - LINEPRINTER	transfer the listing of data from the console to the line printer.
NJ - NONEJECT	kill the automatic page ejection for those devices that normally utilize paging, i.e., line printer, scope terminals.
R - RESTORE	restore interactive typing by DRS.
X - EXIT	log out of DRS after providing a summary of DRS usage.

Y - EXPEDITED EXIT	log out of DRS without the summary of DRS usage.

SYSTEM COMMANDS

AD - ADD	add new records.
CA - CHECK ADD	check new records for errors without adding the records to the data base.
CK - CHECK DATA FILE	check existing records for errors.
CM - CHECK MODIFY	check for errors in modifying data without modifying the data base.
CREATE (no mnemonic abbr.)	initialize a data base.
DELETE (no mnemonic abbr.)	delete records.
EON - EXECUTE ON	cause DRS to continue executing bath commands even if errors are detected.
EOF - EXECUTE OFF	cause DRS to switch to console mode whenever an error is detected.
GI - GENERATE INDEX	generate an index file for use in high speed selection of records.
IO - INPUT/OUTPUT	alter the nominally assigned input or output devices.
LE - LIST ERRORS	list the specific errors when they are detected during the execution of a command.
MO - MODIFY	modify existing records.
TA - TRANSFER ADD	transfer active record set to another data base.

SYSTEM MANAGER COMMANDS

CP - CHECK PROCESS	cause the current data bank to be checked as a specification.
DU - DELETE USER	delete all passwords belonging to a specific user.

PR - PROCESS	convert the current data bank to a specification.

SECURITY COMMANDS

PW - PASSWORD	allow various portions or all of the system to be opened (when using a secure system) and allow passwords to be combined or changed.

APPENDIX I
GIPSY COMMANDS AND THEIR DEFINITIONS

SELECT	Searches the entire data base for a specified word or attribute.
ITERATE	Searches within a searched subset for a specified word or attribute.
SORT	Arranges a subset into a user-defined sequence. The maximum sort criteria is 25 items, 100 characters total.
SUM	Used for the study of numerical data. Can perform a frequency count, a total summation, a range, or average values.
PRINT	Outputs an entire record according to a user-defined format. The computer defaults to an 80 character across page size unless otherwise specified. The maximum specified size allowed is 120 characters.
LIST	Selectively identifies entry or entries within a user-defined format.
COPY	Produces a fixed-field, fixed record length output.
BACK	Returns the system to any previously selected subset for subsequent processing.
COUNT	Counts occurrence of various data strings in a set or subset of records.
HELP	Lists the entire GIPSY command repertoir with definitions/uses
???	Describes/defines in detail the usage command currently being used.
DEFINE	Lists specified dictionary synonyms.
TOTAL	Sums and totals all of several fields.
MESSAGE	Allows the user to communicate a message to the computer console operator.

APPENDIX J -- GLOSSARY

Abstract	A synopsis of a document or article; often a collection of keywords.
Batch mode	A computer mode of operation which uses punched cards as opposed to terminal transmitted commands.
Bit	A unit of computer information equivalent to the result of binary choices.
Byte	A measure of computer storage equivalent to 8 to 16 bits.
Citation	Individual abstracts or summary of information stored for computer access.
Core	The computer main memory which stores basic software.
Descriptor	An index term used in a data retrieval system used to identify contents of a file.
Data elements	Keywords for variables of stored information.
DBMS	Data Base Management System.
Disk	A computer storage bank peripheral to the core; stores information, rather than software.
Dictionary	A reference which defines to the user as well as to the computer valid entries for input.
Hardcopy	A listing either printed by a line printer or available only on paper.
Keyword	A significant word from a title or document that is used as an index to content.
Magnetic tape	Often used for physical transport of information from one source to another; also can store information. not used frequently.
Module	See Utility.
Online	In direct link-up with a computer through a remote terminal.
Port	Accessory computer hardware which accepts telephone signals and converts them into computer-readable signals.

Protocol	Internal software mechanism used to interpret information.
Queueing	An internal mechanism within a computer's software that allows many users to use the system on a rotating basis.
Record	See Citation.
Sort	A request to the computer to order and list a set of information elements grouped by common desired characteristics.
Subroutine	See Utility.
Tape	See Magnetic Tape.
Timesharing	Simultaneous access to computer by many users whose programs are executed interchangeably.
Utility	Procedural program stored in a computer which can operate on a file to produce, for example, update runs, or correction of spelling errors by a spelling dictionary comparison.
WATS lines	Long-distance telephone lines arranged for unlimited use at a standard flat rate.