CLASS 3 TRACKING AND MONITORING SYSTEM REPORT

August 1995

By
S. Phillip Salamy
L. Eugene Safley

November 1999

Performed Under Contract No. DE-AC22-94PC91008
(Original Report Number NIPER/BDM-0161)

BDM-Oklahoma, Inc.
Bartlesville, Oklahoma

National Petroleum Technology Office
U. S. DEPARTMENT OF ENERGY
Tulsa, Oklahoma

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DOE/PC/91008-0161
Distribution Category UC-122

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Prepared for
U.S. Department of Energy
Assistant Secretary for Fossil Energy

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ACKNOWLEDGEMENTS

The authors wish to acknowledge Project Manager Edith Allison for her direction and insight; Tom Burchfield, Mike Madden, Lance Cole, Mike Fowler, Susan Jackson, Mark Young, Bob Welch, and Viola Schatzinger for their technical review and constructive comments; Irene Chang for editing assistance; Teresa Wilson for word processing; and MaryLou Birmingham for production.

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EXECUTIVE SUMMARY

This report is one of several Department of Energy (DOE) deliverables for Task 1, Work Package 95-A02, Class 3 Negotiation and Monitoring Support. This Work Package, which is a continuation of Work Package AC/15024/BC/42 Task 1, directs BDM-Oklahoma to assist DOE with negotiations, fact-finding, and monitoring of Class 3 projects.

Under Subtask 1.1 of the negotiations and fact-finding activities task, BDM-Oklahoma is responsible for developing systems for tracking the performance and progress of nine Class 3 projects.

The objectives of Class 3 tracking system are to assist DOE in tracking the performance and progress of these projects and to capture the technical and financial information collected during the projects' monitoring phase. The captured information will be used by DOE project managers and BDM-Oklahoma staff for project monitoring and evaluation, and technology transfer activities.

The proposed tracking system will use the CLass EValuation Executive Report (CLEVER), a relational database for storing and disseminating class project data; GeoGraphix, a geological and technical analysis and mapping software system; the Tertiary Oil Recovery Information System (TORIS) database; and MS-Project, a project management software system.

The captured information will be stored as appropriate in the CLEVER database for project monitoring and technology transfer activities; in the TORIS database for use in predictive modeling studies; in the GeoGraphix database, if needed, for detailed data analysis and display; and in MS-Project for in-house monitoring of schedule and budget data. Information stored in CLEVER and certain information in GeoGraphix, such as project updates, geologic maps, and production decline curves, will be publicly accessible on Internet.

Data sources, data elements, and data storage systems for Class 3 project monitoring were identified based on Class 3 Program Opportunity Notice (PON), discussions with the DOE Project Manager, and Class 1 and 2 project monitoring activities.

A project tracking process was identified to insure that proper and appropriate Quality Assurance/Quality Control (QA/QC) procedures are followed to maintain the validity and quality of the stored data. In addition, users of the tracking system were identified to include DOE-BPO (DOE-Bartlesville Project Office), BDM-Oklahoma staff, and other users.

CHAPTER 1 INTRODUCTION AND BACKGROUND

This report is one of several Department of Energy (DOE) deliverables for Task 1, Work Package 95-A02, Class 3 Negotiation and Monitoring Support. This Work Package, which is a continuation of Work Package AC/15024/BC/42 Task 1, directs BDM-Oklahoma to assist DOE with negotiations, fact-finding, and monitoring of nine Class 3 projects. The nine Class 3 projects, identified as Slope Basin and Basin Clastic reservoirs selected by DOE for cost-shared projects in September 1994, are located in California, New Mexico, and Texas, as exhibited in Figure 1-1.

Under Subtask 1.1 of the negotiations and fact-finding activities task, BDM-Oklahoma is responsible for developing systems for tracking the performance and progress of Class 3 projects. The objectives of this report are to identify the various components of the tracking system such as data elements, data sources, data storage, and project monitoring systems. In addition, the report will identify the different users of the tracking system and discuss the proposed tracking process to ensure the quality and validity of stored and disseminated data.

The objectives of Class 3 tracking system are to assist DOE in tracking the performance and progress of the nine Class 3 projects, and to capture the technical and financial information collected during the projects' monitoring phase. The information will be used by DOE project managers and BDM-Oklahoma staff for project monitoring and evaluation, and for technology transfer activities.

In the Class 3 Program Opportunity Notice (PON), DOE identified the following objectives to be accomplished through the requested Class 3 data. As stated in the PON, the requested data should be sufficient in order to:

- Permit in-depth comparative assessments of each project to others in the same and different classes using alternative recovery technologies
- Permit future researchers to fully evaluate and reproduce any results
- Permit future researchers to perform reservoir simulation and other analytical studies on reservoirs included in the project
- Allow easy transfer of information to interested parties for studies using their own PCs or workstations
- Update TORIS data on existing TORIS reservoirs, or provide complete TORIS level data for a new entry
- Update TORIS models to predict the performance of respective technologies in Class 3 reservoirs

**CLASS III
OIL RECOVERY PROJECTS**

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Figure 1-1 Class 3 Oil Recovery Projects

Information gathering and storage for Class 1 and 2 projects were reviewed to assist in the development of the Class 3 tracking system. This review determined that tracking and monitoring of Class 1 and 2 projects are limited to technical reviews of Quarterly and Annual progress reports, tracking milestones and deliverables, site visits and project review meetings, and updating budget information.

Currently, the storage system for monitoring Class 1 and 2 projects consists mainly of the CLEVER database, which stores and displays general project and class information collected from Quarterly and Annual progress reports, Project Fact Sheets, project review meetings, workshops and seminars, and site visits. In addition, budget information, milestones, and statements of work for the various projects are updated and stored in the CLEVER database.

Additional technical data have been requested from the Class 1 operators by BDM-Oklahoma (Planning and Analysis) which could be used in performing TORIS predictive model studies to determine the effect of applying technologies from these projects on incremental recovery. TORIS level data include general reservoir information such as permeabilities, porosities, water saturations, and production and injection data.

The need to collect sufficient technical data to conduct future project analysis, as prescribed in the Class 3 PON, is the criterion for developing a tracking system beyond the capabilities of CLEVER.

The proposed tracking system will use the CClass EValuation Executive Report (CLEVER), a relational database for storing and disseminating class project data; GeoGraphix, a geological and technical analysis and mapping software system; the Tertiary Oil Recovery Information System (TORIS) database; and MS-Project, a project management software system. In addition, the tracking system will capture budget and cost data, and milestone activities to track the performance of these projects. This data will assist DOE in evaluating the major project cost elements such as reservoir characterization costs, drilling and completion costs, well testing costs, and others.

Data for monitoring the technical performance and progress of Class 3 projects will be obtained through the review and analysis of Quarterly and Annual progress reports and other requested information submitted by the project participants, site visits to Class 3 projects, Class 3 project review meetings, Statements of Work (SOWs), workshops and seminars, and published technical articles. In the process of assisting DOE in fact-finding and negotiating Class 3 projects, members of the BDM-Oklahoma Petroleum Demonstration Projects staff were assigned one or two Class 3 projects each to assist DOE in monitoring and reviewing the progress of these projects. The staff will be responsible for capturing the information from the various sources and forwarding it to the appropriate personnel to be entered in the tracking system.

CHAPTER 2 PROPOSED CLASS 3 TRACKING SYSTEM

2.1 Introduction

This report will identify and discuss the major components of the tracking system as illustrated in Table 2-1. These components are:

- **Data Elements:** The types of data that will be collected and entered in the tracking system will be identified.
- **Data Sources:** The data sources for the tracking system are Quarterly and Annual progress reports, site visits, published articles, submitted project data, requested project information, Project Fact Sheets, SOWs, workshops and seminars, and budget reports and cost information.
- **Storage Systems:** The major elements of the data storage system are CLEVER, TORIS, GeoGraphix, and MS-Project.

The captured information will be stored as appropriate in the CLEVER database for project monitoring and technology transfer activities; in TORIS form for use in predictive modeling studies; in the GeoGraphix database, if needed, for detailed data analysis and display; and in MS-Project for in-house monitoring of schedule and budget data. Information stored in CLEVER and certain information in GeoGraphix, such as project updates, geologic maps, and production decline curves, will be publicly accessible on Internet.

- **Monitoring System:** The technical and financial progress of the Class 3 projects will be monitored by CLEVER and MS-Project. CLEVER will be accessible to the public on Internet, whereas MS-Project is primarily for in-house monitoring and tracking of Class 3 projects.
- **Tracking system/Data users:** The users of the developed tracking system will be identified.

2.2 Data Elements

The effectiveness and accuracy of a tracking system highly depend on the quality and quantity of collected data. The types of data required depend on the selected storage and monitoring systems and on the types of data elements supplied by the project participants. For example, the types of data elements used by GeoGraphix are more technical and detailed than those for CLEVER. The objective of this discussion is to identify the data elements required for the storage and monitoring systems that will meet DOE data requirements and objectives.

TABLE 2-1 ELEMENTS OF CLASS 3 TRACKING SYSTEM

Data Elements and Corresponding Storage Systems	General Information	CLEVER GeoGraphix
	Reservoir Description	GeoGraphix TORIS
	Field Development History	GeoGraphix
	Production Constraints	CLEVER GeoGraphix
	Simulation & Economic Data	CLEVER GeoGraphix MS Project
	TORIS Level Data	TORIS
	Supporting Data	GeoGraphix
	Budget, Schedule, & Cost Data	CLEVER MS Project
On-Line Monitoring Systems	CLEVER, MS Project	
Analysis & Evaluation Systems	GeoGraphix, TORIS	

* Data Elements are discussed in Section 2-2 and listed in Tables A-1- A-8 in Appendix A.

Review of the various data elements to be collected contractually under Class 3 projects determined that the data specified by the Class 3 PON satisfy the input data needed for the tracking system. The majority of the required data will be submitted to DOE by Class 3 participants in electronic database form as specified in the Class 3 PON. The database will include three types of data, as required by contract:

- Numerical data to be managed through a computer database. The majority of this data will contain GeoGraphix and TORIS level data and will be accessed through these systems. In addition, general project data will be stored in CLEVER to be accessed on Internet.
- Descriptive text which further identifies the source and character of the numerical data. This type of information will be stored in CLEVER and GeoGraphix.
- Supporting hardcopy data related to each reservoir that are not easily convertible to electronic form such as logs, cross sections, seismic lines, etc. This type of data, if not supplied in electronic form, will be identified in the tracking system on CLEVER and made available to interested parties when requested.

The requested data from Class 3 participants will fall into eight major categories, whose subcategories are summarized in Tables A-1 through A-8 in Appendix A.

Types of data elements, types of data storage systems, and analysis software packages proposed by Class 3 project participants were extracted from Class 3 proposals and SOWs and appear in Appendix B in Tables B-1 through B-9. These tables will provide the basis for the types of data elements and data storage systems for each of the projects.

2.3 Data Sources

Data sources for the Class 3 tracking system were identified based on information in the Class 3 PON, current tracking information on Class 1 and 2 projects, and discussions with DOE-BPO.

Information collected for the tracking system will originate from the following Data Source:

- Reports
- Articles
- Site Visits
- Project Fact Sheets
- Contact Log Reports
- Requested Data
- Statement of Work
- Workshops and Seminars
- Data Provided on Internet by Class 3 participants

This information collection process will be the responsibility of the BDM-Oklahoma Class 3 technical representatives, who are tasked to collect and review Class 3 project data. In addition, budget data and milestone activities will be gathered from budget and cost reports submitted by Class 3 participants. This information will be used in tracking the various cost elements of the project. From a technical standpoint, these cost elements, submitted at the task level, will help assess the various major project cost components such as reservoir characterization costs, drilling and completion costs, well stimulation costs, well testing and analysis costs, and others.

2.4 Data Storage Systems

Data storage systems for the proposed tracking system include CLEVER, GeoGraphix, TORIS, and MS-Project. The following is a discussion of the different data storage systems with emphasis on the components of each system.

2.4.1 CLEVER

The CLEVER database is currently being used for storing and monitoring Class 1 and 2 projects. Key database components within CLEVER include:

- Fact Sheet Narrative
- General Information
- Milestone Information
- Funding Information
- Contractor Information
- Co-Participant Information
- Statement of Work
- References

Currently, CLEVER can capture technical information which include the types of technologies being applied, the technologies' objectives, and the expected versus actual benefit of applying the technology. In addition, CLEVER can list the publications, journal articles, and general database information generated by the project and available for technology transfer.

Proposed enhancements to CLEVER will capture more of the technical information and methodologies of the applied improved oil recovery processes. Methodologies detailing how the technology was applied will be displayed in a sequence of steps, by flow chart, or in a decision tree. Graphics will help to illustrate key elements of the technology. A listing of the products, types of data generated by the project, and a schedule of technology transfer activities will also be included in CLEVER and accessible on the Internet.

2.4.2 GeoGraphix

The GeoGraphix software package will capture technical and descriptive data from the projects, where applicable. The GeoGraphix software package is comprised of three integrated systems:

- The GeoGraphix Exploration System (GES): mapping and data management system
- QLA 2: well log analysis system
- Jaguar: production and reservoir assessment system

The systems run under the Microsoft Windows operating environment. Each system can be operated separately or in conjunction with the other system. Typical hardware setups include a 486 or Pentium based personal computer with four to eight megabytes (MB) of Random Access Memory (RAM), a 500 MB hard disk, a VGA color monitor, and a color printer or plotter.

ASCII data from commercial or proprietary sources can be easily imported and converted using a variety of predefined conversion methods. Included within the GeoGraphix Exploration System is a digitizing tool with which hard copy sources of logs and maps can be easily digitized and converted into a usable format. Interfaces to a variety of seismic modeling packages are available. Reports and export files may be designed using a flexible report generator and exported to an ASCII file or to a Windows printing device. The network version of the system uses a relational database manager to permit simultaneous access to a project database.

The GeoGraphix Exploration System (GES) is a technical mapping and data management application which uses geological, geophysical, geographical, and engineering data. Within GES, a customizable, relational data model consisting of more than 100 discrete fields organizes critical data into logical tables. A series of layers is used to store and display logically related data. Each project may have a number of layers, and each layer may contain a large number of entities.

By clicking on a map display layer, the user retrieves all stored well data. With user-defined filters, the GES system can search for data that meet specific criteria. Specialized features include interactive gridding and contouring, faulting, 3D visualization, cross sections, 2D and 3D velocity modeling, deviated and horizontal wellbore profiles, and reservoir and economic predictions.

The QLA 2 system is a log analysis tool that stores and interactively analyzes digitized log data. It offers interactive log presentations, three-dimensional crossplots integrated with the log curve display, log digitizing, LIS/TIF import and export, and custom reports. QLA 2 interfaces with GES to provide multi-well, annotated, log curve cross sections.

The Jaguar system is a production and reservoir assessment system that stores and analyzes production, pressure, and economic data. Unique features include direct access to CD-ROM production data; plus integration and summary of volumetric, pressure, production, and economic data by lease and/or by well. Data stored and processed in Jaguar can be posted on maps and analyzed using the mapping and surface modeling facilities within GES.

The various data elements that can be captured by the GeoGraphix systems can be grouped into geological, geophysical, and engineering data. Geological data include well and reservoir information derived from well logging, core analysis, production tests, and completion operations. Geophysical data include seismic line header data, event attribute data, and processing notes. Engineering data include pressure tests, monthly and cumulative production volumes, gas-oil and oil-water ratios, and economic data.

Results from Class 3 projects will generate GeoGraphix level data that can be stored in a digital database. Access to this digital data will be important to monitor the progress of the project and identify the types of technologies being developed by the Class 3 projects. The tracking system will not duplicate the effort involved by the project participants to store the supporting data or make it available to the general public. Supporting data generated by those projects that do not

establish a digital database, and are expected to be successful and applicable to a large segment of the industry, will be especially important to capture in CLEVER and GeoGraphix so that it is available for monitoring the project and for future analysis and technology transfer.

2.4.3 TORIS

The TORIS database will be used to capture the average reservoir parameters of the Class 3 projects. The project data will be used to update data on existing TORIS reservoirs, or provide complete TORIS level data for a new entry. The TORIS system screens the reservoir parameters contained within the database to determine the recovery processes that are applicable to the reservoir.

The predictive models included within TORIS analyze the recovery potential for various improved oil recovery processes on a reservoir basis using the average reservoir parameters and historical recovery data in the database. The TORIS database is maintained and updated by DOE-BPO. TORIS level data will be subject to the normal review and approval process set by DOE prior to storage in the database.

2.4.4 MS-Project

MS-Project, a project management software system which is a PC- and/or Mac-based system, is the software that will be used to store, view, and monitor budget, cost data, and schedule for tracking the progress of Class 3 projects. Task information, such as cost by task, allocated resources, schedule, and milestones will be stored in MS-Project and be used to compare the planned and actual tasks.

2.5 Project Monitoring

Project monitoring will use the CLEVER database and MS-Project. In the CLEVER database, general project and class information, milestone information, funding information, products generated by the project, and the status of technologies applied will be input for monitoring the progress of the project. CLEVER will identify the types of additional data available for the project and in what storage system(s) that data resides (i.e., GeoGraphix or TORIS). A schedule of workshops, presentations, and other technology transfer activities will also be listed in CLEVER.

MS-Project is computer-based project management software capable of tracking the actual progress of a project and comparing it to the original schedule to determine deviations from planned tasks. Class 3 project monitors will use MS-Project to track and control the project schedule, resources, and costs. The project schedule is generated after providing MS-Project with a list of all tasks required to complete the project, and the sequence in which the tasks must occur. The computer generated schedule will become the baseline information/plan to compare

the project progress against. Furthermore, the project monitors can use the various MS-Project viewing charts such as CPM (Critical Path Method), and/or Gantt charts to view the progress of Class 3 projects. Also, MS-Project can be used to generate a list of resources to perform the tasks and costs of using each.

Project information and deliverables will be updated quarterly in CLEVER and MS-Project. The monitoring of the project status and evaluation of the project results will be integrated with the responsibilities of the Technology Transfer and Planning and Analysis groups.

2.6 Project Tracking Process and Data Quality Control

As illustrated in Figure 2-1, the project tracking process will involve the various BDM-Oklahoma staff that are directly involved with the class program. This process will be continuous and will ensure that proper and appropriate Quality Assurance/Quality Control (QA/QC) procedures are followed in order to maintain the validity and quality of the stored data in the proposed tracking system.

The continuous tracking process will involve BDM-Oklahoma Class 3 technical representatives (i.e., staff members from the Petroleum Demonstration Projects group who were assigned and are responsible for specific Class 3 projects) who will update the input data on a quarterly basis. Class 3 technical representatives will collect and review project data from the various sources identified earlier in this report and exhibited in Figure 2-1. The collected information by project will be reviewed for data quality, validity, and integrity by Class 3 participants. The Class 3 task leader and the manager of the Petroleum Demonstration Projects group will be responsible for reviewing the collected data prior to data entry by the Planning and Analysis group.

The Planning and Analysis group will be responsible for data storage into the various tracking system elements such as CLEVER, GeoGraphix, MS-Project, and TORIS. TORIS level data will be subject to the normal review and approval process set by DOE prior to storage in the database. Data retrieval and dissemination will be a shared task among the various groups within BDM-Oklahoma and DOE-BPO. The Planning and Analysis group will maintain and control the tracking system. In the event that Class 3 participants provide project information on the Internet, the tracking system will only point to its location and identify the type of data provided.

Data evaluation guidelines as specified in a deliverable to DOE titled "Status Report on Data Performance Evaluation" for Work Request Number 95A-10, may be used prior to data entry into the tracking system. In this report specific guidelines are identified at the project and data levels to ensure the quality and validity of the stored data. In addition, a coordinated effort with the Class Coordination Committee to continuously update and modify the tracking system, shall enhance the quality of the stored information.

Figure 2-1 CLASS 3 PROJECT TRACKING PROCESS QUARTERLY ACTIVITY

2.7 Tracking System/Data Users

The principal users of the DOE Class 3 tracking system will be DOE-BPO and BDM-Oklahoma. The DOE-BPO project managers may use the system to track the technical and financial progress of the ongoing projects by accessing the CLEVER database. MS-Project will provide additional detail to the DOE-BPO project managers to track the project performance schedule and financial activities. Under the direction of DOE-BPO, TORIS level data will be used by BDM-Oklahoma to conduct predictive model studies.

BDM-Oklahoma staff will be heavily involved in using and updating the information on the developed tracking system. Through periodic updates of the information, several groups within BDM-Oklahoma such as Petroleum Demonstration Projects, Planning and Analysis, and Technology Transfer can use the developed system to serve their needs in terms of technology assessment, technology transfer and packaging, and project evaluations.

Access to CLEVER type information on the Internet will provide a potential source for outside users such as major and independent oil companies, consultants, state geological surveys, educational institutions, state oil and gas commissions, financial institutions, database developers, and other government agencies.

CHAPTER 3 SUMMARY

A Class 3 tracking system and process were developed to monitor and track the progress of the nine Class 3 projects. The developed tracking system will use several database systems such as CLEVER and TORIS, and software packages such as GeoGraphix and MS-Project. Project information collected from identified sources such as quarterly and annual progress reports, site visits, budget and cost reports, and published technical articles defined the input data for the tracking system.

The collected input data will be effectively displayed and periodically updated so that the progress of the project can be monitored. The tracking system will capture and store the technical information on new or improved technologies being developed and applied in Class 3 projects for use in technology transfer activities. The technical data will be accessible for predictive modeling studies and for determining the economics of applied technologies. In addition, the stored information will be made available through the Internet to users as defined in this report. In the event that Class 3 participants provide project information on the Internet or through another organization such as a state oil and gas commission, the tracking system will only point to its location and identify the type of data provided.

The various functions of the tracking system will also be enhanced with time to improve their capabilities and accessibility, and at the same time to meet the needs and requirements of DOE; Planning and Analysis, Technology Transfer, and Field Demonstration groups; and the general public. The proposed tracking system for Class 3 projects is a result of continuous coordination and efforts between DOE-BPO and various groups within BDM-Oklahoma.

APPENDIX A
Tables Identifying the Data Elements
As Outlined in Class 3 PON

TABLE A-1 GENERAL INFORMATION

Field name	Estimated primary recovery factor (%)
Reservoir name	Estimated incremental secondary recovery factor (%)
State	Estimated total of primary and secondary recovery factors (%)
County(s)	Date of first production
Formation(s)	Number of wells drilled in field (all time)
Project locations	Well patterns (5-spot, 9-spot, line drive, etc.)
RRC district (if Texas)	Number of wells penetrating reservoir
Field discovery data	Total completions to date in field
Current operator and address	Total current completions, each reservoir
Current working interest ownership (names and percentages for all those > 10%)	Total current producers, each reservoir
Project description (approximately 500-1000 words from public abstract)	Total current injection well, each reservoir
Project team members	Number of flowing wells
Technical contracts (name, affiliation, phone, address)	Summary field history (about 500 words)
Primary drive mechanism	

TABLE A-2 3D DESCRIPTION OF RESERVOIR

Areal and Vertical Description	
Areal extent	Average net pay thickness, distribution, and map
Porosity mean, distribution, and map	Average gross pay thickness, distribution, and map
Original saturation mean, distribution, and map	Number of reservoir layers
-Oil	Vertical permeability profile(s)
-Water	Vertical porosity profile(s)
-Gas	If gas cap is present
Saturation distribution map at the inception of cost-share project	-Gas/oil contact
Permeability mean, distribution, and map	-Gas cap area
Directional permeability (k_y/k_x)	-Gas cap bulk volume
Pay continuity as a function of well spacing	-Gas-in-place
Reservoir dip (angle and direction)	If aquifer is present
Location and extent of faults or other flow barriers (if applicable)	-Initial oil-water contact
Location and extent of salt domes (if applicable)	-Current oil-water contact
Measure of crossflow among reservoir layers	-Aquifer size
	-Water influx rate
Geological Characteristics	
Lithology	Initial reservoir pressure
Geologic age	Log of reservoir pressure vs. production (or time)
Facies analysis for each reservoir	Reservoir temperature
-Description of depositional facies	Oil gravity
-Distribution of facies across the project area	Oil viscosity at standard condition
-Distribution of porosity, permeability, oil saturation, and net pay by facies	Oil viscosity at in-situ reservoir condition
-Cross-plot of permeability vs. porosity by facies	Init. oil formation volume factor (B_o)
-Wireline log response to depositional facies	Bubble point pressure
-Horizontal continuity and vertical communication of facies	Initial gas in solution (R_s)
Description of geologic elements	Fluid composition test (CO_2 , N_2 , H_2 , hydrocarbons)
-Depositional environmental	Gas gravity
-Reservoir diagenesis	Gas viscosity
-Structural style	Init. gas formation. volume factor (B_g)
Evaluation of reservoir heterogeneity	Log of B_o , R_s , B_g as a function of reservoir pressure
-Microscopic heterogeneity; pore throat size distribution	Water density
-Macroscopic heterogeneity; features at interwell scale	Water viscosity
-Megascopic heterogeneity; features at field/reservoir level	Water salinity

TABLE A-3 FIELD DEVELOPMENT HISTORY

Recovery Techniques Used	For Each Recovery Technique
Primary	Start date
Secondary	Project life
Tertiary	Estimated incremental recovery
Advanced secondary (including horizontal drilling)	Monthly production by well
	Type of injectant
	Injection schedule (B/D/well)
	Number and timing of new wells drilled (producer, injection, disposal)
For Each Well in Project Area	
Well name	Perforated intervals (MD)
Existing well or Project well?	Cored intervals
API reference number	Completion type (openhole, gravel pack, cased and perforated, etc.)
Completion data	Stimulation type (acid, fracture treatment)
Formation top (MD & TVD)	Stimulation size
Formation base (MD & TVD)	If wells are offshore:
Total depth (MD & TVD)	-OCS area
Vertical or horizontal well?	-Lease number
Horizontal: radius, lateral, TVD, MD	-Platform size (well slots)
Status (producing, flowing or artificial lift)	-Water depth (ft.)
-Type of artificial lift	
MD = measured depth	
TVD = true vertical depth	

TABLE A-4 FIELD PRODUCTION CONSTRAINTS AND DESIGN LOGIC

Qualitative review of reservoir description and development history

Problem statement - constraints on further producibility

- Technological
- Economical
- Environmental
- Other

Method of problem detection

- Application of new tools or techniques
- Inconsistency between the design and actual performance

Proposed solution for reduction of constraints

- Development plan for project impact and projected incremental production
- Actual implementation of project; noting any departures from plan

Evaluation

- Actual impact on the project's reserves and production; interpretation of any differences from projection
- Assessment of potential value of the proposed work to fields/ reservoirs of similar type

TABLE A-5 EVALUATION OF COST-SHARE PROJECT RESULTS

Type of project
Secondary
Tertiary
Advanced secondary (including horizontal drilling)
Injection program
Type of injectant
Injection schedule (volume/day/well)
Injection pattern (before the inception of cost-shared project and proposal)
Number and schedule of new producers drilled
Number and schedule of new injectors drilled
Number and schedule of conversion wells
Simulation study
Type of simulator used
Complete set of rock and fluid data used in the simulator
1) Historical production data by well
2) Historical injection data by well
3) PVT data
4) Relative permeability (kro, krw, krg)
5) Three dimensional grid of porosity, permeability and fluid saturation
6) Rock compressibility factor
Simulation of performance for oil, gas, water, and reservoir pressures
1) History match of reservoir performance prior to cost-shared project
2) Projection of performance of cost-shared project
3) Comparison of actual with projected performance and any diagnostic simulators done to account for the differences
Project economics
Incremental non-drilling capital costs (compressors, etc.)
Fixed operating cost (lifting cost, etc.)
Process dependent operating costs (\$/well/ month)
1) Injectant purchase cost
2) Injection and recycling cost
3) Treatment and disposal costs
Drilling and completion costs (\$/well)
Reservoir description costs
1) Data gathering and processing (logs, cores, seismic)
2) Reservoir simulation study
3) Other

TABLE A-6 SUPPORTING DATA

Logs (all open-hole and cased-hole)	Well completion reports
Available maps (oil isopach, gas isopach, structure, net pay, HC volume, etc.)	Well workover histories
Cross sections	Simulation output
Seismic sections	Special laboratory studies
3D seismic interpretations	- Rock/chemical compatibility tests
PVT analysis reports	- Fracture descriptions
Core analysis reports	- Mechanical preparation
Core descriptions and thin sections	- Minimum miscibility pressure measurements
Directional surveys	- Special core flood tests
Well schematics	Results of pilot flood tests
Injectivity tests	DST reports
	Pressure buildup or drawdown tests
	Tracer studies

TABLE A-7 ENVIRONMENTAL INFORMATION

Surface elevation
Surface conditions (plains, wetlands, etc.)
Distance from navigable surface water (if < 5 mi.)
Distance from air quality non-attainment area (if < 20 mi.)
Location (depth) of groundwater < 10,000 TDS
Depth of surface casing
Volume of produced water
Produced water quality (if state requires tests)
Produced water treatment/disposal methods used
Volume of drilling wastes from new wells
Drilling mud content for new wells
Drilling mud handling practice (closed system, lined pit, unlined pit)
Location, size, purpose of any surface impoundments at site
Results of recent mechanical integrity tests
Results of area of review studies for injection wells

TABLE A-8 TORIS RESERVOIR DATA

Field code	*Formation salinity (ppm, total dissolved solids)
*State postal code	*Original oil in place (OOIP)
*Lithology code (-1 or 0=unknown 1=sandstone, 2=carbonate, 3=dolomite)	Primary recovery factor, (fraction of OOIP)
Geologic age code, (AAPG)	Secondary recovery factor, (fraction of OOIP)
*Field name	*Reservoir name
Reference number	*Cumulative oil production (bbl)
*Formation name	*Year for cumulative oil production (Ex. 1986)
Field acres (acres)	Technical availability date (Ex. 1990)
*Proven acres (acres)	Primary recovery (bbl/acre-ft.)
*Well spacing (acres)	Primary recovery (bbl)
Total wells (number)	Year for primary recovery (Ex. 1984)
*Net pay (feet)	*Current producing GOR (scf/bbl)
*Gross pay (feet)	Initial producing GOR (scf/bbl)
*Porosity (% , bulk volume)	*Reservoir acreage (acres)
*Initial oil saturation (% , pore volume)	Initial formation pressure (psi)
Current oil saturation (% , pore volume)	Reservoir dip (degrees)
*Initial water saturation (% , pore volume)	*Production wells (number)
Current water saturation (% , pore volume)	*Injection wells (number)
*Initial gas saturation (% , pore volume)	Swept zone oil saturation (% , pore volume)
Current gas saturation (% , pore volume)	(residual to water)
*Initial oil FVF (Res. bbl/STB)	Injection water salinity (ppm TDS)
Current oil FVF (Res. bbl/STB)	Clay content (%)
*True vertical depth (feet)—mid-perforation	Dykstra-Parsons coefficient
*Formation temperature (°F)	Current injection rate (b/d/well)
Current formation pressure (psig)	Fractured faulted (Y, N; N=0, Y=1)
*Permeability (mD)	Field multiplier (number)
*API gravity (° API)	*District (California and Texas Railroad Com- mission only)
*Oil viscosity (cp) at reservoir conditions	Production rate (Mbbbl/day)
	Ultimate recovery factor
	(fraction of OOIP, primary + secondary - tertiary, if applicable)

*Required critical TORIS data elements

APPENDIX B

Survey of Class 3 Data Elements and Storage Systems to be provided by Class 3 Participants

TABLE B-1 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR BEG'S CLASS 3 PROJECT

Project Title: Application of Reservoir Characterization, Simulation, and Production Optimization Strategies to Maximize Recovery in Slope and Basin Clastic Reservoirs, West Texas (near term)

Contractor: Bureau of Economic Geology-The University of Texas at Austin

1. Types of data to be collected:

Reservoir Characterization

3D Seismic

Well logs

Core description and analysis

Outcrop characterization

Reservoir Eng. and/or Modeling

Waterflood history

CO₂ flood history

Production Testing

Production and pressure tests (past)

Production and injection tests (project)

2. Will this data be stored electronically in a database form? If yes, what type of storage software system will be implemented?

None is specified in the proposal or the SOW. However, there is a mention of collecting the information in a database.

3. What type of software will be used for geological, reservoir engineering, and production analysis/modeling?

Geological Modeling

Not identified

Production Analysis

Not identified

Reservoir Eng. Modeling

Not identified

TABLE B-2 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR CHEVRON'S CLASS 3 PROJECT

Project Title: Advanced Reservoir Characterization in the Antelope Shale to Establish the Viability of CO₂ Enhanced Oil Recovery in California Monterey Siliceous Shales (mid term)
Contractor: Chevron

1. Types of data to be collected:

Reservoir Characterization

Downhole video camera log

Spinner flowmeter data

Carbon-Oxygen logging

Coring and core data analysis

Modern openhole logging

VSP data

Structural mapping data

Tracer test data

Reservoir Eng. and/or Modeling

Fluid properties

Simulator input data

Phase behavior data

CO₂ coreflood data @ res. conditions

Water injection and imbibition data

Production Testing

Production, pressure, and temp. surveys

Production data analysis (pre-1994)

Pressure falloff surveys

New technology production log data

2. Will this data be stored electronically in a database form? If yes, what type of storage software system will be implemented?

StrataModel #D cellular modeling package. Database will be used to store reservoir characterization data. Stratigraphic, structural, petrophysical, fracture, and geophysical data will be loaded on StrataModel.

3. What type of software will be used for geological, reservoir engineering, and production analysis/modeling?

Geological Modeling

StrataModel, VoxelGeo

Production Analysis

Not Specified

Reservoir Eng. Modeling

In-house Simulator

TABLE B-3 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR PARKER AND PARSLEY'S CLASS 3 PROJECT

Project Title: Advanced Reservoir Characterization and Evaluation of CO₂ Gravity Drainage in the Naturally Fractured Spraberry Trend (mid term)

Contractor: Parker and Parsley Development Company

1. Types of Data to be Collected

Reservoir Characterization

Routine and special core analysis data (porosity & permeability at reservoir conditions, mini-permeameter, thin section data)

Porosity, permeability, saturation crossplot data

Wireline log data (new & old wells)

Porosity isopach and net pay cutoff data

Fracture data (cores, logs, outcrops, lab porosity & permeability, geostatistical analysis)

In situ stress data (open hole and core based)

Volumetric determination data

Reservoir Eng. and/or Modeling

Pulse, interference, tracer, mod. dynamic, remote formation test data

PVT analysis & CO₂/Spraberry crude phase behavior, minimum miscibility pressure interfacial tension data

Spraberry oil and brine imbibition, capillary pressure, & wettability data

CO₂ coreflood gravity drainage data (reservoir conditions)

CO₂ core-scale simulation data

Modeling input data

Modeling output data

Production Testing

Wellbore database/well histories Production history by well (new & old)

Water injection history by well

Inj./prod. profile logging data

CO₂ injection profile data

Fluid movement monitoring

2. Will this data be stored electronically in a database form? If yes, what type of storage software system will be implemented? Production Analyst.

3. What type of software will be used for geological, reservoir engineering, and production analysis/modeling?

Geological Modeling

Not specified

Production Analysis

Production Analyst

Reservoir Eng. Modeling

Not specified

TABLE B-4 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR STRATA'S CLASS 3 PROJECT

Project Title: Advanced Oil Recovery Technologies for Improved Recovery from Slope Basin Clastic Reservoirs, Nash Draw Brushy Canyon Pool, Eddy County, New Mexico (mid term)

Contractor: Strata Production Company

1. Types of Data to be Collected

Reservoir Characterization

Routine and special core analysis data (thin section,

SEM, wettability, and capillary pressure data)

Digital wireline log data (new & old wells)

Geologic facies and flow unit data

Sequence stratigraphic data

Water analysis and sensitivity data

3-D surface seismic data

VSP survey data

Volumetric determination data

Reservoir Eng. and/or Modeling

PVT data

DST, well completion, well stimulation data

Pressure interference and continuity test data

BHP survey data

Interwell tracer survey data

Modeling input data

Modeling output data

Production Testing

Production, injection, & pressure data

Well history data (per well data)

Decline curve analysis data

Injection survey & injectivity test data

Pressure maintenance & production

test data

Produced water analysis data

FDP evaluation data

2. Will this data be stored electronically in a database form? If yes, what type of storage software system will be implemented? Stratamodel SGM

3. What type of software will be used for geological, reservoir engineering, and production analysis/modeling?

Geological Modeling

Stratamodel SGM

ProMAX (VSP geophysical)

Production Analysis

Not specified

Reservoir Eng. Modeling

Western Atlas VIP/Geolink

Eclipse/Grid

TABLE B-5 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR CITY OF LONG BEACH CLASS 3 PROJECT

Project Title: Increasing Heavy Oil Reserves in the Wilmington Field Through Advanced Reservoir Characterization and Thermal Production Technologies (mid term)		
Contractor: City of Long Beach		
1. Types of data to be collected:		
<u>Reservoir Characterization</u>	<u>Reservoir Eng and/or modeling</u>	<u>Production Testing</u>
Digitized logs and directional surveys on all wells (database)	Water chemistry data	Historical production data
Logs on new wells	Oil composition	Injection profiles
Cores and core analyses	PVT data	Tracer surveys
Thin section/XRD/SEM/EDS	Thermal simulation input data	Project prod/inj. data
Log/Core correlations	Stochastic 3D model data	Temperature surveys
Stochastic geologic model data		Pressure/fluid level data
2. Will this data be stored electronically in a database form? If yes, what type of storage software system will be implemented?		Mechanical well histories
NEWILMA: Database (in-house) for logs-all digitized in Log ASCII Standard format (LAS)		
GEOLOG & EarthVision: geologic data (logs, cross sections, maps, etc.)		
Production Analyst: production data		
3. What type of software will be used for geological, reservoir engineering, and production analysis/modeling?		
<u>Geological Modeling</u>	<u>Production Analysis</u>	<u>Reservoir Eng. Modeling</u>
GEOLOG	Production Analyst	SSI: THERM (modified @ USC)
EarthVision		
Geostatistical software (USC)		

TABLE B-6 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR CITY OF LONG BEACH CLASS 3 PROJECT

Project Title: Increasing Waterflood Reserves in the Wilmington Field Through Improved Reservoir Characterization and Reservoir Management (near term)

Contractor: City of Long Beach

1. Types of data to be collected:

Reservoir Characterization

Digitized logs and directional

surveys on all wells (database)

Pulsed acoustic logs

Historical core data

Reservoir Eng. and/or modeling

Production/injection pattern

balance data

Production Testing

Historical production data

Mechanical well histories

Injection surveys

Pressure/fluid level data

Production data on recompletions

2. Will this data be stored electronically in a Database form? If yes, what type of storage software system will be implemented?

NEWILMA: Database (in-house) for logs- all digitized in Log ASCII Standard Format (LAS).

EarthVision: geologic data (logs, cross sections, maps, etc.) and modeling

3. What type of software will be used for geological, reservoir engineering and production analysis/modeling?

Geological Modeling

EarthVision

Production Analysis

Production Analyst

Reservoir Eng. Modeling

Roaming Tank Model (in-house)

TABLE B-7 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR POOI'S CLASS 3 PROJECT

Project Title: Feasibility of Optimizing Recovery Reserves from a Mature and Geologically Complex Multiple Turbidite Offshore California Reservoirs Through the Drilling and Completion of a Trilateral Horizontal Well (near term)

Contractor: Pacific Operators Offshore, Inc.

1. Types of data to be collected:

Reservoir Characterization

Reservoir Eng. and/or modeling

Production Testing

Digitized well log data on PA

PVT data on PA

Rate and pressure data

Directional well Database on PA

Well test data on PA

Completion data records

Water production analysis

2. Will this data be stored electronically in a database form? If yes, what type of storage software system will be implemented?

All the collected data will be stored on the Production Analyst (PA) Database system as well as StrataModel Database.

The PA system will be the main storage media for the collected data where reservoir, log, and production data will be stored.

3. What type of software will be used for geological, reservoir engineering and production analysis/modeling?

Geological Modeling

Production Analysis

Reservoir Eng. Modeling

StrataModel

PA

None specified

TABLE B-8 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR ARCO'S CLASS 3 PROJECT

Project Title: Economic Recovery of Oil Trapped at Fan Margins Using High Angle Wells and Multiple Hydraulic Fracturing (mid term)

Contractor: ARCO Western Energy

1. Types of data to be collected:

<u>Reservoir Characterization</u>	<u>Reservoir Eng. and/or modeling</u>	<u>Production Testing</u>
Oriented core	Micro-seismic logging and data frac	RFT measurements
Microseismic logging	Fluid saturations and pressures	Flowmeter surveys
Well Logs (temp, gamma ray, FMS	Grid data	Pressure buildup/falloff tests
AIT, RFT		Production rate tests
Data fracs		Tracer surveys
Core analyses		Temperature surveys
Perm-Por relationships and capillary pressures		
3-D seismic data		

2. Will this data be stored electronically in a Database form? If yes, what type of storage software system will be implemented?

CD ROM, digital database. Specific software not indicated in the proposal.

3. What type of software will be used for geological, reservoir engineering, and production analysis/modeling?

<u>Geological Modeling</u>	<u>Production Analysis</u>	<u>Reservoir Eng. Modeling</u>
None specified	MATBAL (in-house)	In-house simulators

TABLE B-9 DATA ELEMENTS AND PROPOSED DATA STORAGE SYSTEMS FOR UNIVERSITY OF UTAH'S CLASS 3 PROJECT

Project Title: Reactivation of an Idle Lease to Increase Heavy Oil Recovery through Application of Conventional Steam Drive Technology in a Low Dip Slope and Basin Reservoir in the Midway-Sunset Field, San Joaquin Basin, CA.

Contractor: University of Utah

1. Types of data to be collected:

Reservoir Characterization

Reservoir Eng. and/or modeling

Production Testing

Core data

Fluid data

Rate and pressure data

Logs from newly drilled wells

Pressure and temperature data

Cross sections and maps

Steam injection data

2. Will this data be stored electronically in a database form? If yes, what type of storage software system will be implemented?

INTEGRAL database managed by Utah Geological Survey.

3. What type of software will be used for geological, reservoir engineering, and production analysis/modeling?

Geological Modeling

Production Analysis

Reservoir Eng. Modeling

Landmark StratWorks

None specified

STARS, Thermal and Chemical additive

PV-Wave

simulator-Computer modeling group (CMG)

Sigma View