1. OBJECTIVE

To support the BPO TORIS Program Coordinator in the maintenance, operations, enhancement, and applications of the data bases, models, and hardware of Tertiary Oil Recovery Information System (TORIS) on the Bartlesville Project Office (BPO) computers.

2. WORK STATEMENT

ICFR provided services required under three highly integrated and closely coordinated activities: (a) maintenance and operations of the TORIS system and the Concurrent (formerly Perking-Elmer) computer and the Sun workstation operated in the Unix environment; (b) enhancements to the TORIS data base and modeling capabilities and (c) applications of TORIS in analytical studies.

Activity A. Maintenance and Operations

ICFR provided two on-site representatives for operations and systems support of the TORIS computer systems. The systems include the Sun workstation and the Concurrent computer (Model 3230). These representatives provided computer hardware and software support to system users to provide overall systems hardware system utilization and operations.

Work in this area included assisting the BPO TORIS manager in updating, implementing, and executing standard operating procedures (SOPs) for accessing, using, backing up, and maintaining the hardware and software of TORIS. These SOPs included all aspects of hardware maintenance (both routine and specific problems), supplying inventories, computer security, accessing logs and accounts, routine backups of all current programs and data bases, and assisting users in accessing equipment, software, and data and in performing analyses.

During the contract performance period, a major effort was expended on the conversion of all TORIS models and data bases to the new computer system in Bartlesville.

Migration of the TORIS System from the Concurrent 3230 to the SUN

The DOE/BPO acquisition of a SUN SPARCserver 690 networked to four SPARC 2 workstations provided a powerful platform for the TORIS system. However, before the new hardware could be significantly put to use, it was necessary to migrate the TORIS software and associated data from the Concurrent system. In addition, since the future of the Concurrent system at the BPO was somewhat uncertain, it was deemed necessary to convert past TORIS runs which had been archived using propriety Concurrent utilities and hence were incompatible with the SUN system.
The porting of the TORIS system was achieved via the execution of five major tasks:

1. The initial conversion of the EOR models and data performed by Argonne National Laboratory personnel;

2. The addition of a TORIS user interface by Argonne;

3. The conversion of the ASR models, EOR and ASR screening programs, and TORIS utility programs performed by ICFR personnel;

4. The updating of the EOR and ASR models to reflect changes in oil and gas tax statutes performed by ICFR, and

5. The migration of historical TORIS archives performed by ICFR.

The work performed during the execution of tasks (1) and (2) is summarized in documentation already provided by Argonne.

The work performed by ICFR in completing tasks (3) and (4) included adapting software to accommodate direct access binary 2-D and 3-D files, generation of UNIX shell scripts, and modification of taxation algorithms.

The accomplishment of task (5) involved the design and implementation of two software systems: one for the migration of single-account studies residing on multiple disk volumes, and a second to accommodate multi-volume, multi-account full system archives written by either the Concurrent FASTBACK or BACKUP utilities. The general approach utilized in both procedures consisted of restoring archived data to the Concurrent system, creating CSS commands and UNIX shell scripts to achieve a magnetic real transfer tape compatible with both systems, exporting the data from the Concurrent system to the transfer tape, importing the data from the tape to the SUN system, and archiving the data from the SUN system to 8mm cassette via the DUMP utility.

Activity B. Enhancements

Work in this area consisted of evaluating, recommending, and where approved, implementing improvements to the data bases and models that constitute TORIS. The following enhancements have been completed to date as part of this task:

1. Developed and implemented a new infill drilling methodology in TORIS;

2. Upgraded the infill drilling predictive model (IDPM) to process infill drilling in combination with polymer flooding. The final report was submitted to BPO on January 13, 1994;

3. Upgraded the infill drilling predictive model (IDPM) to process infill drilling in combination with profile modification;

4. Developed and implemented advanced technology criteria for ASR;

5. Developed a methodology to incorporate risk into the economic models for EOR and ASR processes;

6. Updated all production data for all TORIS reservoirs from 1988 through 1991 using EIA PDS/TOTL database;
7. Reviewed and updated the well spacing data for the entire TORIS database. This resulted in finding and correcting anomalies for about 700 reservoirs;

8. Integrated all TORIS databases; reservoir databases, production database, operator profile, and geologic classification system;

9. Developed and tested a methodology for the combined application of EOR and ASR in a given reservoir. After careful evaluation of results, it was concluded that given the inconsistency in the physics and mechanics of the predictive model between the two systems, it will take a considerable number of changes to the EOR model in order to process the combined application;

10. Reviewed and developed a feasibility study for a new timing model in TORIS. A final report was submitted to BPO on January 13, 1994;

11. Reviewed and evaluated the NIPER Heavy Oil database for possible incorporation into TORIS. A report of all findings was submitted to BPO September on 29, 1993, and,

12. Updated the SSI documentation of IDPM to include all changes made to the model by ICF Resources (January 13, 1993).

Activity C. Applications

Work in this area consisted of assisting BPO managers in the application of the TORIS data bases and models to address policy and programmatic issues. The following areas of TORIS applications were focused on:

1. Completed all EOR and ASR TORIS runs and analyses for the IOGCC multistate project. These included two levels of technology, a base and a tax incentive scenario, for seven oil prices (June - July, 1993);

2. In support of DOE’s oil strategy development, a major effort was expended on updating all TORIS analysis results (remaining resource, EOR/ASR reserves, operator profile, abandonment status, etc.) and provided all updated data for COPM (April - May, 1993);

3. As requested by BPO and funded by OPE, major analysis was completed to evaluate the impact of an environmental regulation on U.S. future production and reserves. The regulation addressed extending the surface casing to the base of the deepest fresh water zone for new producers and injection wells. All TORIS models were modified to include additional costs associated with such well modifications (August 1993);

4. At the request of the TPO, an analysis was conducted to validate the results reported in the NIPER Heavy Oil Study (September 1993);

5. Generated customized technical data for Class III technical report and briefing materials. These included:
   (1) generating cross walk of all EOR projects with TORIS Class III reservoirs using publicly available information from OGJ, DOE, and state agencies,
   (2) updating all operator profile data for light and heavy oil Class III reservoirs, and
   (3) determining original oil-in-place (OOIP), remaining resources, EOR and ASR potential for both near-term and mid-term cases (September, October, and November, 1993);
6. At the request of Senator Pete Domenici, U.S. Senate, an analysis of the impact of the 1990 tax credit on domestic enhanced oil recovery (EOR) activity was conducted. Due to the unavoidable lag between the planning and implementation stages of a project and the realization of its economic feasibility, it was too soon to evaluate the impact of the EOR tax credit. The next comprehensive survey of EOR activity, due to be published in September 1994, will contain more decisive evidence of its impact on oil production. Constraints that may lessen the potential benefits of the EOR tax credit and ways to overcome each of them were also studied (January 10, 1993);

7. At the request of Senator Pete Domenici, U.S. Senate, a study was conducted to estimate the relative values of domestically produced versus imported crude oil. Conclusions on the effects of imported oil on the U.S. economy were also provided. In the light of both a decline in domestic oil exploration and development and a continuous outflow of investment capital, we estimated a debilitating effect on the Gross Domestic Product (GDP) of the U.S. (January 11, 1993), and

8. At BPO's request, a compilation of technical economic data was provided to EIA in support of the development of EOR submodule by the EIA. These included:
   (1) TORIS cash flow assumptions including the EOR tax credit calculation,
   (2) incremental investment, operating cost, injection cost by process for each of EIA's regions,
   (3) production schedule and cash flow for selected EOR projects,
   (4) assumptions regarding implemented and advanced technology scenarios, and
   (5) Cogen situation and results for ongoing steam projects in California (April and May, 1993).

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
Task Order 2

1. **OBJECTIVE**

   Support BPO management in following, analyzing, interpreting, and reporting on trends in the oil and gas industry as well as technical assistance in the areas of environmental health and safety and quality control and quality assurance procedures. In addition, ICFR provided support in program implementation planning as requested by the TPO.

2. **WORK STATEMENT**

   Under the explicit direction of the COTR or his designee, ICFR performed activities under this task, which included:

**Activity A. Tracking of Trends**

   ICFR followed technical, economic, and environmental trends as reported in the open literature that may affect the priorities, structure, or direction of the AOR or AEPT programs. Trends in environmental regulations and research findings will be monitored more closely and with greater sophistication and detail, recognizing their increased impact on the domestic oil industry and the increased programmatic commitment to oil and gas environmental research.

**Activity B. Technical Data Support**

   ICFR has compiled a report to provide background information to augment the DOE’s understanding of the reservoir and geologic characteristics of the slope-basin & basin clastic reservoirs and the principal impediments to increased production from these reservoirs. From a study conducted with the aid of the TORIS data base, ICFR has:

   - identified the location of slope-basin & basin clastic reservoirs;
   - reviewed the literature to determine the major technological problems facing operators producing from these reservoirs;
   - studied the viability of enhanced oil recovery (EOR) and advanced secondary recovery (ASR) projects in these reservoirs over a range of oil prices under both existing and advanced technology scenarios;
   - studied the environmental impacts of production from these reservoirs;
   - reviewed and provided comments on NIPER’s geologic chapter for Class III;
   - prepared draft and final presentation materials for the Class III manager; and
   - prepared a comprehensive technical report for Class III.

**Activity C. Confirmation of Planning Tools**

1. Reviewed and recommended Critical Path Method (CPM) planning software: ICFR has used both the CA Superproject and Symantix Timeline 5.0 CPM programs. At this point, the Timeline 5.0 is in use due to its upward compatibility with Open Plan which is used by DOE headquarters.

2. Reviewed and recommended priority trade-off software: ICFR has selected and used Expert Choice 8.0 to prioritize program elements. It is based upon the Analytical
Hierarchical Process and has been used in many Federal programs to aid in decision making.

3. Reviewed and recommended of spreadsheet software for use in budgetary planning: ICFR has used in the past and will continue to use Lotus 123 for most spreadsheet operations. It handles the work adequately and is compatible with most locations. The data can be exported to many other programs for presentations, graphics, and word processing purposes.

**Activity D. Technical Support -- Environment, Health and Safety**

At the request of the Western States Petroleum Association (WSPA), the Independent Oil Producer’s Agency (IOPA), and the California Independent Producers Association (CIPA), BPO sponsored a workshop to bring together numerous study efforts and examine the status of the petroleum industry in California, the extent of environmental compliance requirements impacting this industry, and the effect of these requirements on developing, producing, and refining oil in California. At BPO’s request, ICFR personnel attended this workshop in November, both to participate in the articulation of environmental constraints affecting the industry and to document the findings and recommendations resulting from the workshop. ICFR prepared a draft and final report on the workshop in addition to attendance at the workshop.

ICFR also provided support to the Environmental Research Program. This support included the compilation of operator profile data from DB-TORIS by state and related data on production, reserves, and injection wells to be used by the Metairie Site Office in prioritizing some of its research efforts. ICFR also prepared two white papers covering drilling wastes and "other associated" wastes. These papers discussed the environmental concerns associated with these wastes, current research efforts, and potential R&D opportunities related to these waste streams. These white papers will be used for background purposes in identifying and prioritizing research needs for the Environmental Research Program.

**Activity E. Technical Support -- Quality Control & Quality Assurance Program**

None was requested.

**Activity F. Program Implementation Planning Support**

ICFR has positioned itself to be ready at any time to provide BPO management support for program implementation. Discussions have been held as to the timing and effort required to properly prioritize the DOE/BPO strategies. We helped to draft the strategies and therefore have an intimate knowledge of the program implementation strategies. We also sent representatives to the DOE contractors’ meeting in August to gain an overview of the ongoing projects. We have the training, software and personnel ready to help with the planning when the TPO requests help.
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