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Preferred Waterflood Management Practices for the Spraberry Trend Area

DE-FC26-01BC15274

Program

The project was selected under the Preferred Upstream Management Practices (PUMP) solicitation DE-PS26-01BC15304 issued in the fall of 2000. PUMP is aimed at pairing "best practices" and solutions coming from new technologies to an active campaign of dissemination information to domestic producers. PUMP goals are to slow the decline of domestic oil fields and to maintain the infrastructure to continue to produce oil as a vital part of National security.

Project Goal

The objective of this project is to design and test different waterflood techniques that have never been utilized in the Spraberry Trend Area. The new waterflood aligned injection wells along the fracture trend with production wells. One new injection well was drilled that was not artificially fractured to test whether specific zonal isolation is the primary key. Existing producers with massive hydraulic fracture treatments will be converted to injectors to test whether the hydraulic fractures hinder or aid sweep efficiency. An injection pattern, which is adjacent to, and on-trend with a section containing a majority of plugged wells will be dedicated to investigating whether there is still mobile oil in the vicinity of old, abandoned wells and whether this oil can be swept and captured in current producing wells. A comprehensive analysis was provided to identify the preferred management practices and to transfer the information to all Spraberry operators so that other operators can initiate water injection based on the results of the Spraberry Germania Unit field demonstration.

Performer

Texas Engineering Experiment Station
Texas A&M University
College Station

Project Results

The major achievements of the project are 1) providing an integrated solution to technological, regulatory, and data constraints in the Spraberry Trend area; 2) completing a field demonstration via technological innovations; 3) determining that converted production wells are not suitable for injection due to previous fracture treatments; and 4) stimulating investment in further waterflood projects in the Spraberry Trend area.

Benefits

Spraberry was once deemed the "largest uneconomic field in the world." As the major oil companies migrate to larger international projects with higher potential returns, mid-size and small oil companies have resumed operating old fields in the U.S. These companies usually increase production in marginal fields but lack access to developments in technology that could perhaps be the difference between a plugged and abandoned (P&A) and a producing well. Spraberry wells are known for their longevity; however, many have been P&A, with many

more scheduled in the future. The average well in the Spraberry Trend area produces 7 barrels of oil per day, thus it is obvious there exists a tremendous number of wellbores that will be P&A in the near future. This loss of wellbores in a field containing such a large amount of remaining oil without thoroughly investigating water injection is not in the best interest of maintaining healthy domestic production and hence is contrary to the Nation's energy security interests. If only a fraction of the Spraberry wells could increase production, the tremendous scale of the reservoir would result in a highly successful endeavor for DOE and the PUMP program.

Background

The naturally fractured Spraberry Trend Area is one of the largest reservoirs in the United States and is the largest reservoir in areal extent in the world. Production from Spraberry sands is found over a 2,500 square mile area, and Spraberry reservoirs can be found in an eight-county area in west Texas. Over 150 operators produce 65,000 barrels of oil per day from the Spraberry Trend area from more than 9,000 production wells. Recovery is poor, on the order of 7-10% due to the profoundly complicated nature of the reservoir, yet billions of barrels of hydrocarbons remain. NETL estimates over 15% of remaining reserves in domestic Class III reservoirs are in Spraberry Trend Area reservoirs. This tremendous domestic asset is a prime example of an endangered hydrocarbon resource in need of immediate technological advancements before thousands of wells are permanently abandoned.

Project Summary

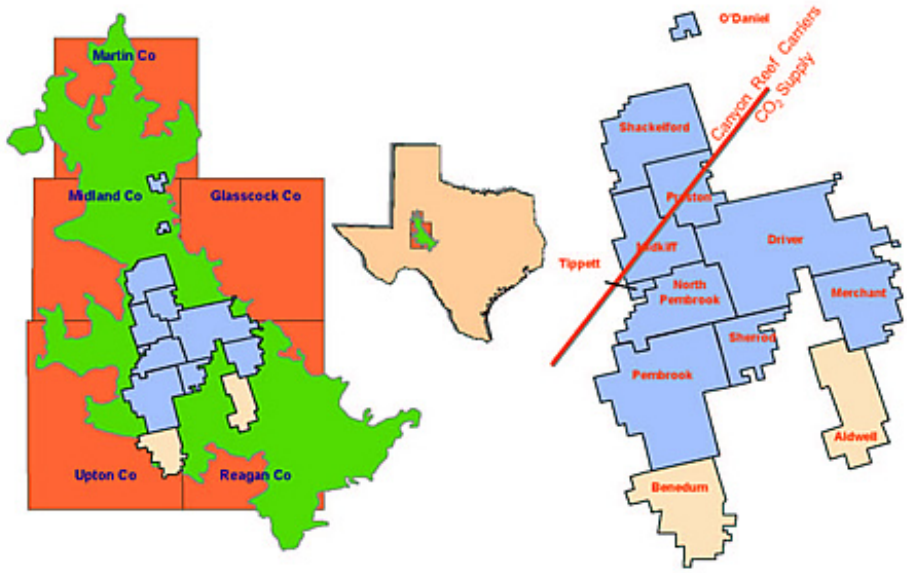
The project calls for researchers to:

- Integrate solutions to technological, regulatory, and data constraints by:
  - Reconstructing Shackelford and Germania injection/production data.
  - Providing a new reservoir surveillance software, Integrated Field Data Management software (IFDM).
  - Acquiring and managing 40 years of production and injection data using Oil Field Manager (OFM) and IFDM.
- Conduct a field demonstration of technological innovations by:
  - Identifying casing leaks in San Andres disposal wells that eventually water out Spraberry producers or damage casing, resulting in premature abandonment.
  - Evaluating the performance of past waterflood pilots in order to reach the stage of development of management practices that eventually could unlock the key to successful water injection in Spraberry formations.
  - Refining Germania subsurface maps for 1U and 5U oil-saturated intervals using an analog field and old cased-hole neutron data.
  - Improving an understanding of fluid movement, waterflood recovery mechanisms, and sweep efficiency.
  - Proposing a new waterflood technique by aligning injection wells along the fracture trend with production wells.
  - Providing complete production surveillance information.
  - Evaluating pilot flood performance and proposing pilot modification.
  - Proposing several field tests in order to acquire more important information of the flood performance.
  - Proposing a new strategy based on response and development of expansion plans.
  - Improving confidence in the merits of water injection.

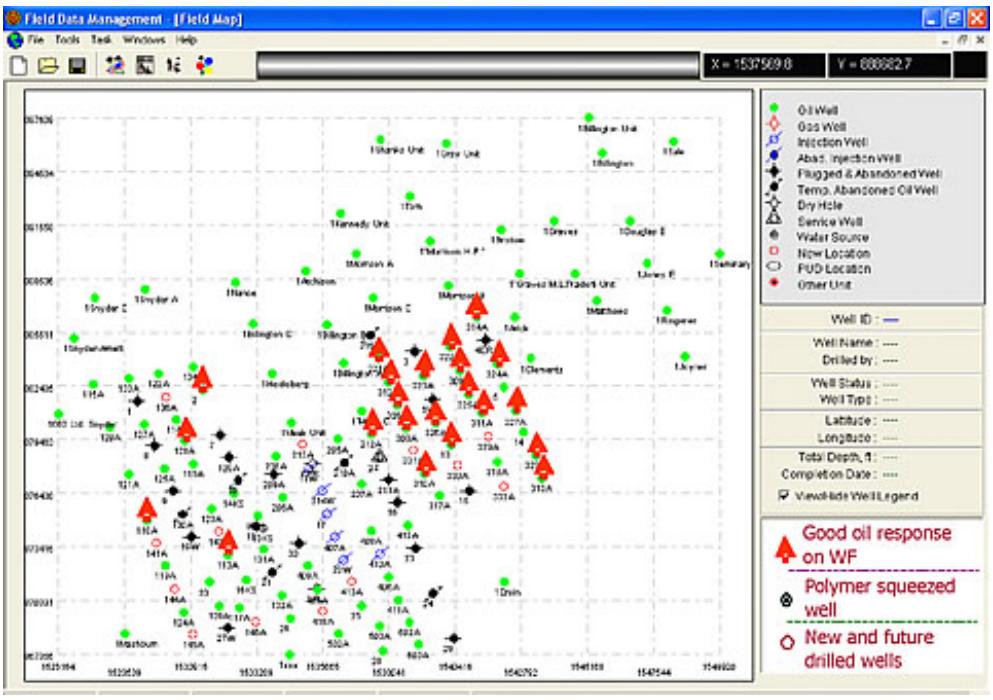
Current Status (October 2005)

The project was concluded in September 2004. However, the waterflood continues. Furthermore, plans have been formulated to extend the injection into other areas of the field using horizontal injection wells. The lack of injection well density in the PUMP project resulted in poor sweep efficiency. Injection out of zone as determined by profile logs was observed in converted producers. Incremental oil was recovered; however, the results were

not as impressive as the Class III Field Demonstration that has been previously reported. Results of the PUMP project stimulated investment in improvement of sweep efficiency. The first test ever of injection in horizontal wells in the Spraberry Trend Area was to commence in third quarter 2005.



Spraberry Trend area, was fomerly the "largest uneconomic field in the world".



Integrated Field Data Management Software (IFDM), newly developed software to manage and evaluate waterflooding performance in the Germania Unit.

Publications

A description of the project research group can be found at the following Petroleum Engineering Texas A&M Website:

http://pumpjack.tamu.edu/faculty/schechter/baervan/homepage.html. The site lists the publications of the group and allows downloads of several papers, reports, and presentations.

Project Start: September 1, 2001
Project End: August 31, 2004

Anticipated DOE Contribution: $505,232
Performer Contribution: $1,568,000 (76% of Total)

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