2003 Project

Title: Development of Methods and Procedures for Field Deployment of DWS Well Designs

Objective: The decision whether (or not) use DWS is made from preliminary analysis. Typically, the analysis shows variety of structures and well configurations – very different to those presented in the theory. Thus, it is desirable that DWS should be selected by showing its specific performance in selected structure rather than a generalized model. Also, selection of DWS candidates should consider dynamics of production-depletion strategy rather than static approach. Moreover, most of geological settings are driven by side water rather than bottom water – and still could be potential candidates for DWS. Objective of this project is to develop methodology for selection and evaluation benefits of DWS technology applied to specific reservoir/well systems.

Tasks:
1. Guidelines for Design and Operation of DWS Completions in Gas Wells
   The task continues development of dual-completion method and procedures to control water in gas wells. The 2002 project identified low productivity gas reservoirs as the best candidates for DWS. The analysis, however, did not evaluate the operational conditions of DWS wells. The objective of this task is to quantify effects of the design and operational variables on DWS well performance using reservoir simulation experiments and make recommendations on how to operate these wells.

2. Nodal Analysis Toolbox for DWS Wells
   This task’s goal is to develop a production systems analysis method for DWS wells and build an Excel-based interface to a commercial reservoir simulator for designing a DWS well. The new tool should be capable of:
   - Employing a production systems analysis including tubing performance, water injection constraint, and pump pressure
   - Modeling distributed saturation around then well accurately
   - Providing a user-friendly application
   - Helping users with no reservoir simulation background to analyze and productivity of DWS wells using a reservoir simulator.

3. Candidate Selection and Valuation Method for DWS Projects
   The objective of Task 3 was to provide a methodology and technique to identify qualitatively and quantitatively higher economic priority candidate(s) for Downhole Water Sink (DWS) application with minimal amount of time, effort, expense and data.

4. Models and Procedure for DWS Deployment in Reservoir Structures with Side-water Drive
   This task’s goal is to identify oil displacement conditions where immature water production and poor oil recoveries occur due to water tongueing, salient forming and coning.

Deliverables:
1. A summary report describing simulation study results and analysis of the best combination of operational variables for effective well performance in terms of gas recovery and well life.

2. Deliverables from this task include a new engineering approach to maximize oil production from DWS wells using production systems analysis, and the new "Nodal Analysis Toolbox" software that enables such an analysis. Theoretical considerations during the software development stage are summarized in a written report that also includes the User's Manual explaining how to input, run, and retrieve data from the software.

3. A written literature review of expert or knowledge systems, game theory, decision trees, option valuation, Monte Carlo simulation and artificial intelligence for applicability to this task. The deliverables also include a format, rule and logic methodology for development of this task into an expert system through artificial intelligence and an example of this methodology.

4. Deliverables from this task include a report presenting analytical, numerical and statistical approaches used to analyze water under-running and coning in reservoir structures with side water drive. The use of experimental design framework combining analytical and numerical modeling is summarized in this report. The reservoir conditions resulted in poor performance and early water problems are identified and explained in this report.