

# PROJECT FACT SHEET

**CONTRACT TITLE:** Increased Oil Production and Reserves Utilizing Secondary/Tertiary Recovery Techniques on Small Reservoirs in the Paradox Basin, Utah -- Class II

<p><b>ID NUMBER:</b> DE-FC22-95BC14988</p> <p><b>B&amp;R CODE:</b> AC1010000</p>	<p><b>CONTRACTOR:</b> Utah Geological Survey</p> <p><b>ADDR:</b> 1594 West North Temple, Ste 3110 P.O. Box 146100 Salt Lake City, UT 84114</p>
<p><b>DOE PROJECT MANAGER:</b></p> <p><b>NAME:</b> Gary D. Walker <b>LOCATION:</b> NPTO <b>PHONE:</b> 918/ 699-2083 <b>E-MAIL:</b> gary.walker@npto.doe.gov</p>	<p><b>CONTRACT PROJECT MANAGER:</b></p> <p><b>NAME:</b> Thomas C. Chidsey, Jr. <b>PHONE:</b> 801/ 537-3364 <b>FAX:</b> 801/ 537-3400 <b>E-MAIL:</b> nrugs.tchidsey@state.ut.us</p>
<p><b>PROJECT SITE</b></p> <p><b>CITY:</b> Salt Lake City                      <b>STATE:</b> UT <b>CITY:</b> Paradox Basin, San Juan      <b>STATE:</b> UT Co.    <b>STATE:</b> <b>CITY:</b></p>	<p><b>CONTRACT PERFORMANCE PERIOD:</b> 2/9/1995 to 8/31/2005</p> <p><b>PROGRAM:</b> Reservoir Life Extension <b>RESEARCH AREA:</b> Class 2 <b>PRODUCT LINE:</b> RLE</p>

**CO-PARTICIPANTS:**

<b>PERFORMER:</b> Harken Energy	<b>CITY:</b> Irving	<b>STATE:</b> TX	<b>CD:</b> 26
<b>PERFORMER:</b>	<b>CITY:</b>	<b>STATE:</b>	<b>CD:</b>
<b>PERFORMER:</b>	<b>CITY:</b>	<b>STATE:</b>	<b>CD:</b>
<b>PERFORMER:</b>	<b>CITY:</b>	<b>STATE:</b>	<b>CD:</b>

FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	2381	2734	5115
FY 2002 CURRENT OBLIGATIONS	0	0	0
FUTURE FUNDS	0	0	0
<b>TOTAL EST'D FUNDS</b>	<b>2381</b>	<b>2734</b>	<b>5115</b>

**OBJECTIVE:** Increase production and reserves from the shallow shelf carbonate reservoir in the Paradox Basin of Utah and Colorado through geological and engineering investigations, leading to the application of advanced secondary recovery technology. Technical studies will be conducted on five diverse small fields located within the Navajo Nation to select the best candidate field to be targeted for a pilot demonstration project.

*March 2002*

**PROJECT DESCRIPTION:**

**Background:** More than 400 million barrels of oil have been produced from shallow-shelf carbonate deposits consisting of algal mounds and oolitic-bank deposits in the Ismay and Desert Creek zones of the Pennsylvanian Paradox Formation. The value of secondary or tertiary recovery has not been demonstrated on any of the smaller shallow-shelf carbonate reservoirs in the basin. These fields typically contain 2 to 10 million barrels of original oil-in-place. Only 15 to 20 percent of that oil is recoverable during primary production. Either Anasazi or Runway fields have been selected and approved for Phase II CO<sub>2</sub> flood. Modeling of Anasazi field predicts economic return of 62% with payout in 35 months. Modeling of Runway field predicts economic return of 30% with payout in 32 months. The 1st horizontal well in a small algal mound reservoir in the Paradox basin was completed at Mule field in 1997 initially flowing producing at 149 BOPD. Potential oil recovery from CO<sub>2</sub> flooding of the Anasazi field is estimated at 2.2 million bbls of oil over primary recovery of 2.0 million bbls.

Potential oil recovery from CO<sub>2</sub> flooding of the Runway field is estimated at 1.6 million bbls of oil over primary recovery of 0.8 million bbls. Many similar oil fields are at risk of premature abandonment unless secondary recovery techniques can be effectively demonstrated. In the absence of applying an effective secondary or tertiary recovery technology, an estimated 200 million barrels of oil would be left in the 100 or more known reservoirs of the Paradox Formation in Utah, Colorado, Colorado, and Arizona. Through proper geological and engineering evaluation of the reserves, production may be increased by 175 percent, or an additional 0.5 to 3.5 million barrels per field. Water flooding has proven to be uneconomic and not technically feasible. Success of the CO<sub>2</sub> flood project will reveal to operators in the Paradox Basin that production may be increased by the application of selected enhanced recovery projects, and benefit not only the producers but also the royalty owners in a manner similar to that of the Navajo Nation in this project.

**Work to be Performed:** Phase I Reservoir Characterization - (1) analysis of regional setting; stratigraphic framework; reservoir heterogeneity, quality, and lateral continuity or compartmentalization, (2) drilling development well(s), (3) mapping reservoir, (4) determining field reserves and recovery, (5) laboratory testing and analogies to large scale waterflood/CO<sub>2</sub> flood, (6) integrating geological data, and (7) simulating reservoir models. Phase II Demonstration - (1) implement pilot CO<sub>2</sub> flood on selected field which includes conducting CO<sub>2</sub> injectivity test(s), obtaining CO<sub>2</sub> source and fuel gas, determining economic feasibility, drilling development well, purchasing and installing injection facilities (CO<sub>2</sub>); (2) monitor testing and production, evaluate demonstration techniques; (3) determine suitability for use in other similar fields in the Paradox basin and throughout the U.S.; and (4) technology transfer.

**PROJECT STATUS:**

**Current Work:** Project began Budget Period II in June 1999.

**Scheduled Milestones:**

Completion of Project Evaluation Report	02/98
Completion of CO <sub>2</sub> availability study, and pipeline and facilities cost	02/98
Completion of CO <sub>2</sub> availability study, and pipeline and facilities cost	
Project remains on hold until CO <sub>2</sub> source can be obtained from nearby pipeline which has been sold to a new owner since project began.	09/00

**Accomplishments:** A carbonate facies belt was mapped which identifies the three major facies. Geological characterization on a local scale focused on reservoir heterogeneity, quality, and lateral continuity as well as possible compartmentalization within each of the five project fields. Core and geophysical logs were used to characterize and grade each of the five fields for suitability for enhanced recovery projects. This included the identification of carbonate fabrics, pore types, cements, and determination of diagenetic history in each reservoir. The typical vertical sequence or cycle of lithofacies from each field, as determined from core, was tied to its corresponding log response. The resultant graphs are used to identify reservoir and non-reservoir rock, determine potential units suitable for water and/or CO<sub>2</sub> flood projects, and comparison of field to non-field areas. The core from the Anasazi and Runway wells have been described and major flow units and barriers identified. The reservoir analysis for the Anasazi and Runway fields utilized a field-scale reservoir simulator. Enhanced recovery through water-flooding and CO<sub>2</sub> flooding were evaluated using a compositional simulation. Variations in carbonate lithotypes, porosity, and permeability were incorporated into the simulation in order to accurately predict reservoir response. Completed the 1st study of waterflood and CO<sub>2</sub> potential for Paradox Basin small carbonate fields. Continuous CO<sub>2</sub> injection without gas processing recommended for algal mounds. Reservoir modeling used 20 geostatistical models to predict CO<sub>2</sub> flood performance history, matches were made by tying to previous production and reservoir pressure history so that future reservoir performance could be confidently predicted. Engineering analysis and reservoir simulation of Anasazi and Runway fields was completed 06/98. Either Anasazi or Runway fields have been selected and approved for Phase II CO<sub>2</sub> flood based the 1998 reservoir evaluation and geostatistical modeling which predicts economic return of 62% with payout in 35 months for Anasazi field and economic return of 30% with payout in 32 months for Runway field. Completion of the Project Evaluation Report and the CO<sub>2</sub> availability study,

with the associated pipeline and facilities cost, were completed in June 1998. The Utah Geological Survey continues to display project materials at the annual meeting of the American Association of Petroleum Geologists (Denver, Colorado, June 2001). The Utah Geological Survey also released an issue of Petroleum News to over 300 interested parties and continues to maintain a project page on the Survey's Internet web site.

Harken Southwest Corp. was purchased by The Rim Energy Companies of Englewood, Colorado, in December 2000. The Utah Geological Survey plans to update their staff on the project and determine the level of interest in pursuing the field demonstration.

**TECHNOLOGY TRANSFER:**

**Technology/Information Transfer:**

**Public Relations:**

**Updated By:** Gary Walker

**Date:** 7/16/2001

NOTE