
Reservoir Storage Field Expansion Studies

Project Summary

This client-confidential facility is a natural gas storage field located in Wyoming. The underground storage operation was developed from a depleted gas reservoir to provide natural gas during peak demand. Parsons Brinckerhoff Energy Storage Services (PBESS) was the lead contractor for the evaluation, design and development to expand the current operations.

(LONG-FORM PROJECT DESCRIPTION FOLLOWS)

Reservoir Storage Field Expansion Studies

Wyoming

Owner

Confidential

Background

This client-confidential facility is a natural gas storage field located in Wyoming. The underground storage operation was developed in 1951 in a depleted gas reservoir to provide natural gas during peak demand. The field is operated with nearly 10 times the base gas vs. working gas and cycles only 1 to 1.5Bcf of gas annually.

Parsons Brinckerhoff Role

Parsons Brinckerhoff Energy Storage Services (PBESS), a subsidiary of Parsons Brinckerhoff (PB), was the lead contractor for the evaluation, design and development of the capacity expansion and gas deliverability.

Project Elements

- Project management
- Reservoir engineering
- Drilling engineering
- Geology
- Seismic survey
- Environmental engineering
- Assistance with federal and state permitting

Project Description

PB ESS was lead contractor for the evaluation, design, and development of an expansion of the storage capacity and gas deliverability. This included a review of the field geology, an evaluation of the initial engineering design and an interpretation of the seismic survey conducted by the client across the underground gas storage (UGS) area.

The objective of the evaluation included:

1. Bcf capacity
2. Deliverability per well
3. Number of wells required to meet projected market demand
4. Total deliverability
5. Number of cycles per year for working gas
6. Development cost

The scope of work included:

- Evaluating the existing facilities for improved field performance
- Designing the overall program for storage field expansion

- Processing and interpreting the seismic survey over a six-square-mile field (1,554 hectare)
- Designing the drilling program and well completions.
- E P C for drilling horizontal wells (storage)
- Re-completing two gas production wells.

The project's objective was for the client to use the full storage capacity of the field and increase the working gas cycle to 50 to 60% of the field capacity.

Reservoir Capacity

In an effort to determine the current capacity of the reservoir, PB compared the original pressure to the pressure that would be needed to contain the full field capacity. PB also conducted a review of the field volumetric capacity calculations based the isopach map of the reservoir. These calculations were compared with the original reserve estimate and the storage historical operational data. Data and interpretation from the PB-conducted seismic survey was also completed to determine the pore volume and reservoir capacity.

PB also reviewed the potential storage capacity by calculating the reservoir capacity, at various pressures, using the original production data and the current storage operations data.

Storage Field Deliverability

PB reviewed the reservoir characteristics to evaluate the capability to meet the client's projected operational schedule. PB determined the pressure differential (reservoir vs. wellhead pressure) necessary to make the required deliverability at the end of the period for the deliverability level (last day deliverability at the lowest reservoir pressure). This resulted in the development of a deliverability schedule to maintain a continuous storage deliverability service.

To achieve the client's deliverability schedule it was determined that, in addition to using the existing wells, several new wells would need to be drilled. The number of new wells required will depend on location of the well and the completion technique (conventional or horizontal).

Deliverability of Existing Wells

One option put forward by the client was to have the existing wells provide the deliverability to meet the existing customer demand and the new wells

provide the deliverability for the projected new storage business. PB reviewed the conditions required for the four existing wells to meet current demand and the new wells to provide the remaining deliverability to meet projected demand and worked with the client to design a schedule of gas delivery.

Teaming

PB served as prime consultant. Principal subconsultants included:

- RESPEC Inc.: seismic survey
- Boyd/PetroSearch: seismic survey

Staffing

Chuck Fontenot served as project manager; Noah J Matthews served as reservoir engineer; and Tim Reichwein served as principal-in-charge.

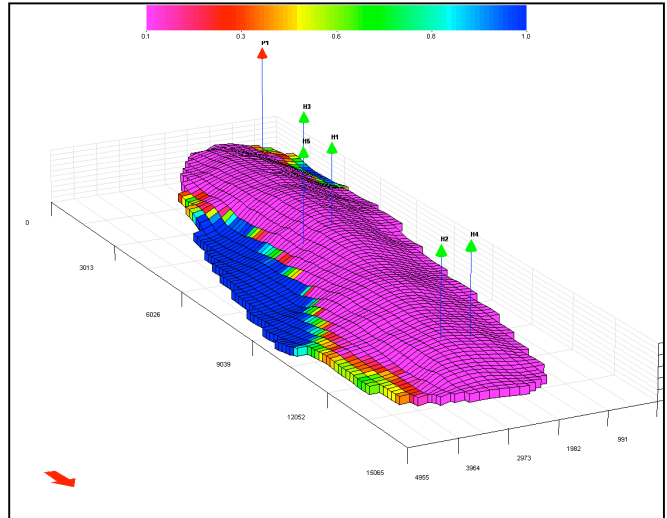
Schedule

Our services began in August 2007 and were completed in July 2008.

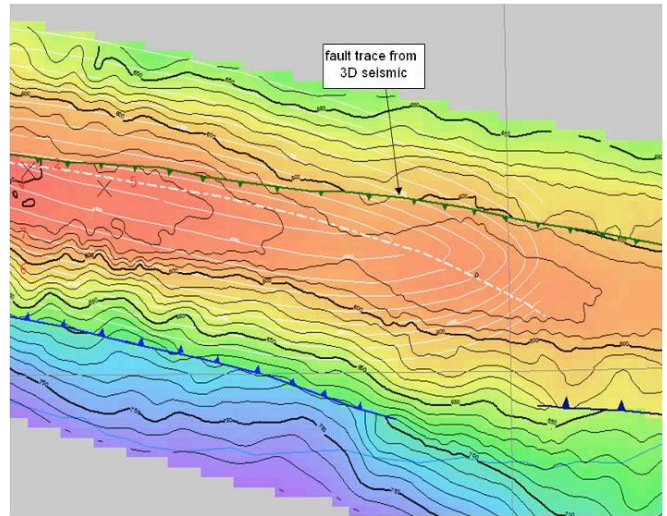
Project Number: 50709

Creation Date: 11/10

Approved By: Noah J Matthews/Tim Reichwein



Reservoir structure showing existing and proposed storage wells.



Enlarged image of the Reservoir structure east of the well control