



U.S. Department of Energy  
Office of Inspector General  
Office of Audit Services

# Special Report

---

## Expansion of the Strategic Petroleum Reserve

DOE/IG-0767

June 2007



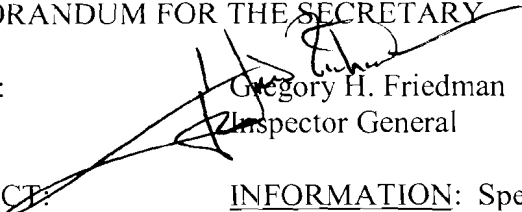
## Department of Energy

Washington, DC 20585

June 19, 2007

### MEMORANDUM FOR THE SECRETARY

FROM:

  
Gregory H. Friedman  
Inspector General

SUBJECT:

INFORMATION: Special Report on "Expansion of the Strategic Petroleum Reserve"

### INTRODUCTION

The Energy Policy Act of 2005 required the Department of Energy to expand the Strategic Petroleum Reserve's (Reserve) maximum storage capacity to 1 billion barrels of crude oil. The Department stores the oil in large underground caverns, which have been created in salt domes. After evaluating various alternatives, the Department decided to develop a new 160 million barrel storage facility at Richton, Mississippi, and to expand the storage capacity at two existing Reserve facilities. As part of the evaluation, the Department eliminated a salt dome in Bruinsburg, Mississippi, from consideration as a potential expansion site. According to Department officials, the Bruinsburg site was not selected because (1) the salt dome was too small to meet storage needs, and (2) the site presented significant technical risks since the Department would have to use deep injection wells to dispose of nearly 1.2 million barrels per day of brine used to excavate the caverns.

Subsequent to the announcement of the Richton site as the preferred expansion alternative, public and congressional entities raised serious concerns about the procedures used by the Department in eliminating Bruinsburg as an expansion location. For example, a member of Congress raised concerns to the Department on several occasions that in determining the size of the Bruinsburg salt dome, the Department had not (1) considered existing well data, (2) resolved questions about data reliability concerning the location of wells, and (3) used existing seismic data. Additionally, four private-sector geologists concluded that the Bruinsburg salt dome was large enough to meet the Department's storage requirements for 160 million barrels of oil. Finally, the Congressman was concerned that the Department's planned approach at the Richton site to use a 100-mile long pipeline to the Gulf of Mexico to dispose of brine produced during the creation of the storage caverns could cause environmental damage due to pipeline leaks. We initiated this review to evaluate the above concerns.

### OBSERVATIONS

Our review found that the Department and its contractor analyzed all available well data and seismic data related to the Bruinsburg site and augmented this information with additional seismic tests. We found, as well, that there are inherent uncertainties involved in the process of estimating the size of the salt domes. As a consequence, the exact size and shape of the Bruinsburg salt dome is not fully known. Professional geologists have interpreted the available data differently, and we were not able to resolve these differences of opinion.



With reference to the concern about brine leaks, we found that the Department has improved its pipeline protection measures at its existing facilities and plans to employ such improved measures in support of the Richton storage operations.

## EVALUATION OF BRUINSBURG DOME

### Consideration of Well Data

In evaluating the size of the Bruinsburg salt dome, Sandia National Laboratories (Sandia), which conducted the evaluation for the Department, considered previously collected well data. Specifically, Sandia gathered well data from multiple sources and evaluated the data in developing the geological model used to estimate the size of the Bruinsburg salt dome.

Sandia used well data indicating the presence of salt, or lack thereof, to estimate the extent of the salt dome to establish the boundaries of the dome. Where well data conflicted with seismic data, Sandia relied on the seismic data to establish the boundaries of the salt dome.

Overall, Sandia obtained data from 28 wells in the immediate vicinity of the Bruinsburg salt dome. In evaluating the size of the Bruinsburg salt dome, Sandia:

- Used data from 23 of the 28 wells to define the boundaries of the salt dome: 9 of the wells showed the presence of salt, and 14 did not;
- Determined that it could not use data from two wells either because the well was too shallow or geologic information about the well was insufficient to be of use in the evaluation; and,
- Did not rely on the data from three remaining wells because of uncertainties associated with the location of the wells. In each of these instances, Sandia decided to use seismic data, which it considered more definitive in analyzing the size and shape of the salt formation, rather than rely on well data that only indicated one point on the top of the salt dome.

### Reconciliation of Well Locations

We determined that Sandia, in conducting its analysis, was not able to fully reconcile the uncertainties related to well locations at the Bruinsburg site. The well location discrepancies resulted from Sandia obtaining relevant data from multiple sources. For example, Sandia obtained well data from a commercial vendor, a web site maintained by the State of Mississippi Oil and Gas Commission, and a compendium of salt dome information published by the Mississippi Department of Environmental Quality. These sources often reported conflicting locations for the same wells. These differences were compounded by the use of multiple maps with different coordinates. Sandia attempted to reduce the uncertainty related to the well locations by overlaying maps and adjusting map scales. However, significant discrepancies regarding well locations still existed for multiple wells. For example, at the project's completion, the spatial uncertainty for nine of the wells was 500 feet or more. Sandia's inability to fully

reconcile the uncertainties with well locations at the Bruinsburg site was consistent with the Mississippi Office of Geology's *Atlas of Shallow Mississippi Salt Domes*, which identified issues with well locations in the Bruinsburg area.

Sandia notified the Department of the issues regarding the well locations and recommended locating the wells in February 2006. Sandia restated its recommendation to locate the wells in June 2006. The Department, citing the difficulties and limited usefulness of locating buried well casings, decided to obtain existing and new additional seismic data to delineate the edge of the salt dome in lieu of attempting to locate the wells at Bruinsburg.

#### Use of Seismic Data

To supplement its use of well data, Sandia used seismic data in the evaluation of the Bruinsburg salt dome. In May 2006, Sandia obtained and analyzed seismic data from two previous seismic surveys performed for oil exploration in the 1970s. Only one of the seismic surveys showed evidence of salt at depths needed to meet the Department's design criteria for storage caverns, which Sandia used in establishing the southwestern boundary of the dome.

In addition to using existing seismic data, the Department directed and funded Sandia to conduct two additional seismic surveys to further define the boundaries of the Bruinsburg salt dome. We determined Sandia used the existing and additional seismic survey data. Although there were two other seismic tests that had been conducted in the Bruinsburg dome area, data from the tests were either not available for sale, or the broker/owner could not find the data.

#### Interpretation of Data

Although Sandia used all publicly available data and obtained additional seismic data, large areas of the salt dome are not characterized by data. As a result, there are differing professional interpretations of the data and conclusions about the size and shape of the dome.

The impact of additional data and professional interpretation of the data is illustrated by the revisions to Sandia's size estimates throughout the project. Sandia initially projected the size of the dome to be about 700 acres after a preliminary review of publicly available well data. Sandia later reduced that estimate to 277 acres after incorporating data from two seismic surveys, which were shot in the 1970s for oil exploration. After adding additional data from two new seismic surveys, conducted specifically for the Reserve expansion project, Sandia reduced its estimate of the area of useable salt from 277 acres to 121 acres. Based upon the available well and seismic data, Sandia concluded that the Bruinsburg salt dome could hold a maximum of 70 million barrels of oil, was not sufficient to meet the Reserve's storage capacity requirement.

Several private-sector geologists expressed disagreement with Sandia's estimate of the size of the dome and the decision to give preference to seismic data over conflicting well data. The dissenting geologists provided summary estimates of the dome size, which ranged from 286 acres to 365 acres. These geologists also stated that all well data should have been incorporated into Sandia's analysis and relied upon. We were not able to resolve these professional differences of opinion.

Departmental and Sandia personnel indicated that additional tests, such as 3-dimensional seismic tests, could be performed that might reduce the uncertainty as to the size and shape of the Bruinsburg dome. However, these individuals stated that the test results would not eliminate all questions related to the suitability of the Bruinsburg salt dome for Reserve expansion.

One of the private-sector geologists provided a nonpublic salt proximity survey from a well located southeast of the Bruinsburg salt dome, to support that the dome was larger than Sandia estimated. After analyzing the data and contacting the generator of the data, Sandia concluded that the assumptions (on which this 1989 vintage salt proximity survey was based) did not reflect what is currently known about the dome and had a probable error rate of about 25 percent. Overall, Sandia concluded that this data did not show that the Bruinsburg salt dome was larger.

### PIPELINE LEAKS

Finally, we found with reference to the concern about brine leaks, that the Department planned to implement pipeline protection measures that it has used at other Reserve sites to minimize such leaks. About 20 years ago, the Reserve had problems with leaks in brine disposal pipelines. Specifically, the Reserve had two major brine disposal pipeline leaks in the 1980s, including 575,000 barrels of brine leaked at the West Hackberry site in 1985 and 825,000 barrels of brine inadvertently released at the Bryan Mound site in 1989. To protect against additional brine pipeline leaks, the Reserve instituted a corrosion prevention program and internally lined replacement brine pipelines. We found that the number of brine spills at the Reserve had greatly declined, and only 232 barrels were released by the Reserve between 1997 and 2005.

-----

This report is being provided for information purposes, and no formal recommendations are being made. The Office of Inspector General appreciates the cooperation of all parties that were contacted during the conduct of this review.

Attachment

cc: Acting Under Secretary of Energy  
Assistant Secretary, Office of Fossil Energy  
Assistant Secretary, Office of Congressional and Intergovernmental Affairs  
Chief of Staff  
Team Leader, Audit Liaison Team, CF-1.2  
Audit Liaison, Office of Fossil Energy, FE-3

## SCOPE AND METHODOLOGY

We conducted this review from February 2007 through May 2007 at the Office of Fossil Energy in Washington, D.C. and Sandia National Laboratories in Albuquerque, New Mexico. The scope of the review included site selection and evaluation activities related to the Reserve expansion project. To accomplish the review objective, we:

- Met with Department officials responsible for developing recommendations for the Reserve expansion project;
- Reviewed Sandia's February, June, and December 2006 reports on the geological assessment of the Bruinsburg salt dome;
- Interviewed personnel from Sandia regarding the methodology used for the Bruinsburg geological assessment;
- Interviewed two private-sector geologists who disagreed with Sandia's methodology and conclusions;
- Obtained a listing of wells in the vicinity of the Bruinsburg salt dome, reviewed supporting documentation, and determined the disposition of the data for each well;
- Gathered documentation related to the acquisition of seismic data at Bruinsburg;
- Obtained additional non-public geotechnical information from one well and provided the information to Sandia for review; and,
- Reviewed environmental reports for documentation of historical brine leaks at Reserve sites.

## CUSTOMER RESPONSE FORM

The Office of Inspector General has a continuing interest in improving the usefulness of its products. We wish to make our reports as responsive as possible to our customers' requirements, and, therefore, ask that you consider sharing your thoughts with us. On the back of this form, you may suggest improvements to enhance the effectiveness of future reports. Please include answers to the following questions if they are applicable to you:

1. What additional background information about the selection, scheduling, scope, or procedures of the inspection would have been helpful to the reader in understanding this report?
2. What additional information related to findings and recommendations could have been included in the report to assist management in implementing corrective actions?
3. What format, stylistic, or organizational changes might have made this report's overall message more clear to the reader?
4. What additional actions could the Office of Inspector General have taken on the issues discussed in this report which would have been helpful?
5. Please include your name and telephone number so that we may contact you should we have any questions about your comments.

Name \_\_\_\_\_ Date \_\_\_\_\_

Telephone \_\_\_\_\_ Organization \_\_\_\_\_

When you have completed this form, you may telefax it to the Office of Inspector General at (202) 586-0948, or you may mail it to:

Office of Inspector General (IG-1)  
Department of Energy  
Washington, DC 20585

ATTN: Customer Relations

If you wish to discuss this report or your comments with a staff member of the Office of Inspector General, please contact Judy Garland-Smith (202) 586-7828.

The Office of Inspector General wants to make the distribution of its reports as customer friendly and cost effective as possible. Therefore, this report will be available electronically through the Internet at the following address:

U.S. Department of Energy Office of Inspector General Home Page  
<http://www.ig.energy.gov>

Your comments would be appreciated and can be provided on the Customer Response Form attached to the report.