

GAO

Report to the Chairman, Subcommittee on
Energy and Power, Committee on Energy
and Commerce, House of Representatives

June 1988

NAVAL PETROLEUM RESERVES-1

Data Corrections Made but More Accurate Reserve Data Needed



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United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

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June 28, 1988

The Honorable Philip R. Sharp
Chairman, Subcommittee on Energy and Power
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

This report responds to your April 1, 1987, request that we review the actions taken by the Department of Energy (DOE) to correct problems stated in our March 1987 report on data inaccuracies at the Naval Petroleum Reserve No. 1 (NPR-1) in California.¹ The report stated that production data inaccuracies at NPR-1 probably result in incorrect computations of the maximum efficient production rates and also could result in the government getting less than its share of remaining recoverable reserves should NPR-1 be sold. We reported that the underlying cause of these problems was an absence of effective internal controls, and we made three recommendations to the Secretary of Energy to correct the problems stated in our report.

NPR-1 is owned jointly by Chevron, U.S.A., Inc., and the federal government. While the actual percentage of ownership between Chevron and the federal government varies among the four producing geologic zones and separate producing pools within those zones, overall the federal government owns about 78 percent of NPR-1. The relationship between the government and Chevron for developing and producing NPR-1 is contained in the Unit Plan Contract. The government has, subject to the terms of the contract, exclusive control over NPR-1 operations. Since 1985, Bechtel Petroleum Operations, Inc., has provided the day-to-day maintenance, operation, and management of NPR-1 under a contract with DOE.

Results in Brief

We found that DOE's actions in response to our recommendations have improved the accuracy of production data and that other actions still underway, when completed, could largely correct the production inaccuracies that we identified. However, it will take almost a year to complete all corrective actions.

¹Naval Petroleum Reserve No. 1: Data Inaccuracies Complicate Production and Ownership Issues (GAO/RCED-87-105BR, Mar. 1987).

Reserves. However, in accordance with your request, we did not obtain official agency comments.

We are sending copies to the Secretary, DOE, and interested congressional committees. We will also make copies available to others upon request. As agreed with your office, this report completes our follow-up work on corrective actions that DOE is taking at NPR-1 in response to our March 1987 report. This report was prepared under the direction of Keith O. Fultz, Senior Associate Director. Other major contributors are listed in appendix II.

Sincerely yours,

A handwritten signature in cursive script that reads "J. Dexter Peach". The signature is written in black ink and is positioned above the typed name and title.

J. Dexter Peach
Assistant Comptroller General

In March 1987, we reported that production data inaccuracies at NPR-1 probably result in incorrect computation of the MER and also could result in the government getting less than its share of remaining recoverable reserves should NPR-1 be sold. We reported that the underlying cause of these problems was an absence of effective internal controls, and we made three recommendations to the Secretary of Energy to correct the problems stated in our report. The following sections discuss each of the three recommendations made in our report and DOE's actions.

Actions Taken to Correct Data Inaccuracies

Because of the inaccuracies found in the NPR-1 production data and the flawed production allocation process, we recommended that the Secretary of Energy give priority attention to correcting the production data inaccuracies and establishing an allocation system that more accurately reflects the source and ownership of petroleum production in commingled wells.

DOE's Response to Our Recommendation

DOE promptly initiated actions to correct the problems stated in our report. The NPR-1 Director established a committee in April 1987, comprised of DOE, Chevron, and Bechtel officials, to assure that production data problems addressed in our March 1987 report were corrected in a timely manner. DOE directed Bechtel to (1) correct the computer programming errors, (2) develop corrected historical three-phase pool allocation factors for wells in the Stevens Zone, and (3) correct and validate existing computerized production data. Bechtel was also instructed to update related policies and procedures. As of January 29, 1988, three related actions were nearly complete. Bechtel had

- rewritten computer programs to correctly apply historical three-phase pool allocation factors to generate individual well and pool production histories;
- conducted tests of the corrected data from the production accounting system to validate the system's accuracy;
- prepared and entered into the production accounting system new three-phase pool allocation factors for all wells in the Stevens Zone but had not completed a final review of new allocation factors for producing commingled wells;
- established standards for developing new allocation factors whenever allocations change and for entering the changes into the production accounting system on a timely basis, generally within 30 days; and
- validated all historical monthly production data in the computer data base.

undertake a comprehensive review of the existing computer programs to define, validate, and document the production accounting system. According to a Bechtel official, unneeded or duplicative computer programs will be eliminated.

New Allocation Factors Have Improved Production Accounting but Still Contained Some Errors

As stated previously, Bechtel prepared new historical three-phase allocation factors for all of the Stevens Zone wells in response to our report. While Bechtel began developing the new allocation factors just prior to the release of our report in March 1987, the allocation factors were generally prepared in accordance with Bechtel procedures developed in May 1987 and subsequently revised in August and October 1987. These procedures require that a standardized form be completed for each well, detailing how the allocation factor was determined, with supporting documentation attached.

Although the new allocation factors have improved production accounting, we found that not all errors were corrected and that procedures for determining allocation factors were not being consistently applied. We reviewed new allocation factor packages developed by Bechtel for 40 Stevens Zone wells, 19 of which were commingled between pools. Thirty-six of these packages were sent to us by NPR-1 officials as examples of completed allocations. Further, these 40 allocation packages were from four different time periods: 28 prior to the first guidance in May 1987, 6 prior to the amended guidance in August 1987, 2 prior to the final guidance in October 1987, and 4 after the final guidance was issued in October 1987.

However, none of the allocation packages contained sufficient information for our complete analysis. We therefore picked five of these packages and four other new commingled well allocation packages to review during an onsite visit to the field. The data filed at NPR-1 contained sufficient information for a complete review. Our judgmental sample of nine wells included the major pools and three wells that had been independently analyzed in a pool model. Of these nine cases reviewed, we found instances where

- allocation factors did not take into account that mechanical devices, designed to either isolate or control the flow of fluids from specific producing pools, had been installed in the well or had been changed at some point during the well's life;

wells have now been reclassified underscores the need for accurate production accounting.

Actions to Improve Internal Controls

In March 1987, we reported that DOE did not have effective internal controls over entering well data into the computerized production accounting system or over developing accurate well allocation factors. We recommended that the Secretary of Energy establish an effective internal control program to (1) prevent problems similar to those identified in our March 1987 report from recurring, (2) provide the necessary assurances that corrective actions are and will be fully implemented, and (3) provide continuous oversight of NPR-1 operations.

DOE's Response to Our Recommendation

DOE responded promptly by initiating actions to improve its internal controls in the areas covered by our report. The committee (noted previously) established by the Director of NPR-1 also was to assure that internal control problems addressed in our report were corrected in a timely manner. The corrective actions stated previously for the pool allocation factors also correct internal control problems. In addition DOE has created other internal controls. For example, DOE has

- established procedures to minimize computer data input errors;
- assigned a support contractor to monitor monthly well activity to assure new allocation factors are developed and entered into the automated data processing (ADP) production accounting system when necessary;
- restricted access to the allocation factor data base to a single Bechtel employee who must use an access code; and
- initiated a complete review of all software associated with the ADP system for production accounting in order to formally define, validate, and document the system.

However, certain internal controls that DOE intended to establish were not yet in place when we did our follow-up work. DOE had not formalized as standard written procedures the responsibilities for review and evaluation, such as validating data entry and tracking well activity to assure allocation factors are updated when necessary. During our close-out conference at the reserve, we identified this issue as a recommendation that we would be making in this report. On the basis of our proposed recommendation, DOE formalized the process by issuing a DOE order on April 18, 1988. This order defines the responsibilities for the review and evaluation of three-phase pool allocation factors.

be done. A worst case scenario would be the government ignoring the imbalance issue, in which case it may not obtain its fair share of past production and may not have paid its fair share of expenses. Consequently, we recommended that the Secretary of Energy ensure that the government's interests concerning the allocation of past production and remaining recoverable reserves are protected in any proposed sale of NPR-1.

DOE's Response to Our Recommendation

It is DOE's current position that any imbalance between the volumes of oil and gas produced from each owner's share of NPR-1 and the volumes delivered to each owner can be resolved at no loss to the government through the sale process. DOE states that any imbalance will reverse itself as the field is depleted and that the purchaser's bid, which will be based on the government's percentage share of recoverable reserves, will reflect the value of any production imbalance due to the government. We generally agree that any imbalance will be corrected by the time the field is depleted. We do not agree, however, that a purchaser's bid will necessarily reflect the true value of the imbalance, that is, the value of the imbalance that would be expected to accrue to the government if it retained NPR-1 ownership through depletion. The purchaser's value of the government's share of remaining recoverable reserves, including any imbalance that may be due from Chevron, will be based on a discounted cash flow computed using an industry rate of return that would likely be higher than the government's rate of return. Under this circumstance, the buyer's discounted cash flow value of the oil would be lower than what the government would expect to receive if it held onto NPR-1. Consequently, should the expected difference between the industry and government rates of return differ significantly at the time of a sale decision, it would be in the government's best interest to settle any imbalance with Chevron in pre-sale negotiations.

On the basis of audit work that we have done at NPR-1, it is clear that there are insufficient up-to-date, accurate data on past production, estimated recoverable reserves, appropriate production rates, and ownership percentages on which to base a sale of the NPR-1. DOE has recognized that it needs better NPR-1 reserve and ownership data in order to (1) provide potential bidders more current data and negotiate a fair and equitable settlement with Chevron if a sale occurs and (2) better manage the reserve even if NPR-1 is retained by the government. Consequently, DOE has contracted for a new study of NPR-1 reserves. The 6-month contract, which was awarded on January 22, 1988, calls for four

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phases of studies. The first three phases will require work to determine NPR-1 reserve estimates and are scheduled for completion in July 1988.

DOE must exercise a contract option to undertake phase IV of the study. Phase IV has two parts. Part a is a contingency provision that allows DOE to develop more detailed data on individual reservoirs if the data developed in phases I through III are not adequate. Part b authorizes a reevaluation of the government's ownership share in NPR-1. As part of this reevaluation, phase IV b will require more detailed geological and engineering analysis of individual wells at NPR-1 and would develop specific geologic data about the nature and extent of individual producing sand and shale formations at the field. Without this data, DOE would have difficulty in renegotiating its current equity position with Chevron in a revised or new unit contract. The additional data are also expected to help improve NPR-1 management. DOE expects that it would take at least 12 months to complete this work with an estimated cost of about \$1.8 million. This represents about 1 percent of the expected operating costs for fiscal year 1989 and less than 0.3 percent of estimated net revenues. However, DOE currently has no plans to exercise or fund this contract option.

Recommendation

We recommend that the Secretary of Energy authorize the Director, Office of Naval Petroleum Reserves and Oil Shales, to exercise the government's option for phase VI b under the current NPR-1 contract to obtain more detailed geologic and engineering data needed to accurately determine the ownership of oil produced to date.

Further, DOE officials told us that they do not intend to establish a separate, new system of internal controls over the ADP portion of the production accounting system because they intend to enforce existing policies and procedures. Nevertheless, they are adding some new controls in this area. DOE officials have initiated a complete review of the ADP software, as mentioned earlier, which will take almost one year to complete. Also, the new order establishing responsibilities for review and evaluation of the three-phase pool allocation process creates some new internal controls over ADP input.

While progress has been made in establishing a system of internal controls, we have some concerns. DOE's procedure for routinely reviewing new pool allocation factors prepared by Bechtel appears to provide an appropriate framework for establishing internal controls over this single element of the production data system. However, errors we found in allocation factors that had cleared DOE's review process raise some doubt about the effectiveness of the established internal controls. In addition, the ADP system has yet to be defined. Therefore, we cannot determine whether internal controls over the ADP portion of the production accounting system are adequate.

Progress Toward Protecting the Government's Interests Should NPR- 1 Be Sold

The administration's proposed sale of NPR-1 has added an extra dimension to the need for accurately defining the amount of oil that has been produced from the various pools within a single zone, the remaining recoverable reserves, and each owner's equity share. In our March 1987 report, we stated that the historical distribution of the oil produced from individual Stevens Zone pools was out of balance with the actual ownership of oil in those pools because the oil is distributed based on the overall zone ownership percentages established in the unit agreement.³ Consequently, we estimated that the government had received 11.9 million barrels of oil less than it actually owned.

This imbalance will correct itself naturally over the entire producing life of the field allowing for a fair and equitable settlement of the owners' accounts when the field is depleted. However, if the government sells its share of NPR-1 in the immediate future, we believe a fair and equitable settlement of any imbalance should be reached at that time. The unit agreement between the owners does not outline clearly how this should

³Oil produced from any pool usually is not in the same proportion as the total ownership of the zone. If you take production from each pool to date, determine how much actually belongs to each owner based on the pool ownership percentages, and add the production for each owner for all the pools, the totals will probably not equal the total ownership percentage of the zone until the field is depleted.

- several different methods were used to determine allocation factors for a particular well at different points in time, when one method was more precise and could have been used consistently;
- inconsistent methods used to allocate production from adjacent wells with similar physical and operating characteristics resulted in one well being considered to be commingled and the other non-commingled, which can make a difference in how ownership is determined; and
- production and pressure data from other nearby wells was inaccurately interpreted and/or applied when Bechtel tried to use it to compensate for the lack of similar data for the well being reviewed.

Generally, the errors and inconsistencies we identified in Bechtel's development of the new allocation factors did not result in major errors in the allocation factors themselves. In two cases, however, significant errors did occur. For example, the allocation ratio for one well changed by 22 percent when the error was corrected. A DOE official told us that some of the inconsistencies occurred early in the allocation factor redetermination process, while procedural guidelines were being developed. He agreed, however, that other errors and inconsistencies occurred throughout the redetermination process.

After we informed DOE of our observations, DOE had Bechtel assign two of its production engineers to review the new allocation factors for all of the commingled wells with production in the Stevens Zone. This new review by Bechtel's engineers has resulted in changes to allocation factors for 32 of the 94 wells reviewed as of March 24, 1988, but the overall effect of the changes on pool production was not significant, according to a DOE official. The official said that 30 of the resubmitted allocations originally had been done prior to Bechtel's issuing new procedures in May 1987.

We also found that Bechtel's redetermination of allocation factors for all Stevens Zone wells caused a significant shift in the specific wells that are considered to be commingled in the production accounting system. We found that 45 of the wells identified as commingled at the time of our March 1987 report are not now considered to be commingled. Most of these changed because of a new geologic interpretation of the producing strata (i.e., redefined pool boundaries, etc.) or because two producing pools have been redefined as a single pool since our last report. In addition, we found that 50 other wells are now classified as commingled that had not been identified as commingled in the production accounting system previously. The fact that 95 commingled and non-commingled

The procedures for developing new three-phase allocation factors included DOE's NPR-1 engineers reviewing all pool allocation factor packages prepared by Bechtel for ambiguities, irregularities, and completeness. The engineers were to return the packages to Bechtel for rework and resubmittal if errors or omissions were identified.

We did not examine all pool allocation factor packages and, therefore, cannot say whether these procedures were followed in every case. However, we found that DOE's NPR-1 engineering staff did routinely review a sample of the allocation factor packages. We also know that DOE engineers found errors in some packages, which they returned to Bechtel for correction and additional review.

To supplement its review process, DOE assigned a support contractor to routinely review the completed allocation factor packages to assure that they were completed in accordance with prescribed procedures. In the future, the contractor will also be required to validate data entry accuracy for all new allocation factors entered into the data base.

Data Management
Requires Close Monitoring
to Ensure Continued
Accuracy

During the time that DOE and Bechtel were working to correct the computer programming problem and to develop new allocation factors, we periodically reviewed the results of their actions. During our review, we discovered a second computer problem and some continuing errors in completed allocation factor work packages. These findings emphasize the need for DOE to maintain good internal controls to minimize the occurrence of these errors and to prevent them from being entered into the production accounting system.

Computer Program Error Leads
to Additional Review

While verifying that DOE had corrected the error in the computer program stated in our previous report, we found that another computer program used to generate production data had the same programming error. This error was in a computer program, which according to a DOE official, was used only for internal purposes at the field and was not used to generate official production accounting data that could affect MER determinations.

However, when asked to define the computer programs that make up the official production accounting system, DOE advised us that the system had not been formally defined. DOE also said that about 60 separate computer programs had evolved over time to serve various information needs related to field production. DOE has now instructed Bechtel to

Corrections Made but More Accurate Reserve Data Needed

Background

The Naval Petroleum Reserve No. 1 (NPR-1) is owned jointly by Chevron, U.S.A., Inc., and the federal government. While the actual percentage of ownership between Chevron and the federal government varies among the four producing geologic zones and separate producing pools within those zones, overall the federal government owns about 78 percent of NPR-1. The relationship between the government and Chevron for developing and producing NPR-1 is contained in the Unit Plan Contract. The government has, subject to the terms of the contract, exclusive control over NPR-1 operations. Since 1985, Bechtel Petroleum Operations, Inc., has provided the day-to-day maintenance, operation, and management of NPR-1 under a contract with DOE.

Of the four commercially productive geologic zones at NPR-1, the Stevens Zone is the largest. It currently produces the most oil and has the largest amount of remaining recoverable reserves. This zone also has 11 of the 15 individual oil pools contained in the 4 geologic zones. In 1987, the Stevens Zone had 653 producing wells. Production from these wells is usually a mixture of oil, gas, and water. About 138 of these wells were considered to be commingled.¹

The Naval Petroleum Reserves Production Act of 1976 (Public Law 94-258) requires that NPR-1 be produced at its maximum efficient rate (MER),² and the production from each pool needs to be determined as a basis for computing the MER. Because a number of wells in the Stevens Zone are commingled, it is necessary to allocate a portion of each commingled well's production back to the pool from which it was produced. Production tests are run routinely to physically measure the oil, gas, and water produced from a particular well. However, the flow rate into the well for these fluids varies naturally because of their individual physical properties such as fluid viscosity. Each flow rate also depends upon the type of material the fluid is passing through, which also varies between pools. Therefore, allocation factors have to consider all of these differences to accurately determine the amount of production from each pool. Allocation factors that individually consider the source and movement of each of the three fluids produced (oil, gas, and water) are termed three-phase allocation factors.

¹A commingled well produces from more than one pool. The well casing is drilled through and perforated in each pool, allowing fluids (oil, and/or gas, and/or water) to flow into a common wellbore for production.

²MER is defined as "the maximum sustainable daily oil or gas rate from a reservoir which will permit economic development and depletion of that reservoir without detriment to the ultimate recovery." A reservoir and a pool are generally used synonymously.

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Abbreviations

DOE	Department of Energy
GAO	General Accounting Office
RCED	Resources, Community, and Economic Development Division
NPR-1	Naval Petroleum Reserve-1
MER	maximum efficient rate
ADP	automated data processing

While DOE established improved internal controls over review and evaluation of production allocation factors, it is too soon to tell if these measures will effectively prevent a recurrence of the production data inaccuracies that we identified. The effectiveness of internal controls can be judged only after all corrections are made and they have been in place for some period of time. While the controls appear to be an improvement, we found that DOE did not detect certain errors in allocation factors that had cleared its review process, raising some doubt about the effectiveness of newly established internal controls.

We also found that more up-to-date and accurate reserve data are still needed by DOE in order to (1) provide bidders more current data and negotiate a fair and equitable settlement with Chevron if a sale occurs and (2) better manage NPR-1 if it is retained and operated by the government. DOE has a current reserve study underway that will provide part of the needed data. However, the specific geologic data about the nature and extent of individual producing sand and shale formations, which is required to fully meet DOE's needs for reevaluating each partners' ownership share and managing NPR-1, are not included in the current study. Option IV b in the contract, currently estimated to cost about \$1.8 million, would provide the detailed data needed by DOE as described above. Because of the importance and the relatively small cost (about 1 percent of operating costs), we believe the study should be undertaken. Therefore, we recommend that the Secretary of Energy exercise the government's option to proceed with phase IV b of the current contract to study NPR-1 reserves.

DOE's response to the findings and recommendations included in our March 1987 report, and our observations on the adequacy of DOE's response are discussed in greater detail in appendix I.

Scope and Methodology

In conducting our follow-up work, we interviewed DOE officials in Washington, D.C., and DOE and Bechtel officials at NPR-1 in California. We reviewed actions that DOE and Bechtel identified as responses to our previous recommendations. This included a review of new policies and procedures that have been developed and implemented at NPR-1 to improve internal controls over production accounting. We conducted our study from March 1987 to January 1988 in accordance with generally accepted government auditing standards.

We discussed the information in this report with appropriate DOE staff at NPR-1 and with DOE's Director of Naval Petroleum and Oil Shale

