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United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on
Environment, Energy, and Natural
Resources, Committee on Government
Operations
House of Representatives

April 1986

OIL RESERVE

Status of Strategic Petroleum Reserve Activities as of March 31, 1986



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**Resources, Community, and
Economic Development Division****B-208196**

April 18, 1986

The Honorable Mike Synar
Chairman, Subcommittee on Environment,
Energy, and Natural Resources
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

On December 9, 1985, the Subcommittee on Environment, Energy, and Natural Resources, House Committee on Government Operations, requested that we continue to report on a quarterly basis, at least through fiscal year 1986, on the Department of Energy's (DOE's) progress in developing, filling, and operating the Strategic Petroleum Reserve (SPR) and in complying with the requirements of applicable law. A list of prior SPR quarterly reports is contained in appendix III.

This report discusses events and activities related to the administration's progress in developing, filling, and operating the SPR during the second quarter of fiscal year 1986. Specifically, it notes the following:

- The administration's fiscal year 1987 budget included nearly \$150 million for SPR development and management but deferred about \$776 million in storage capacity development and oil purchase funds under a proposed SPR moratorium.
- The administration's proposed SPR moratorium and related funding deferrals have generally been resisted by the Congress. GAO concluded that the redeferral of \$156.8 million of facility construction funds is not permissible under the Impoundment Control Act of 1974.¹
- The proposed moratorium and funding deferrals have extended the planned SPR completion date beyond 1990, but DOE does not believe the delay will adversely impact the reliability of storage site equipment.
- DOE added 4.1 million barrels of oil to the SPR, bringing the total to 496.9 million barrels. The oil fill rate averaged about 45,500 barrels per day.
- DOE made payments of \$92 million for oil acquisition and transportation, had unpaid obligations of about \$72 million, and had about \$644 million in unobligated funds.

¹On April 11, 1986, OMB notified GAO that it was releasing the \$156.8 million. DOE is currently formulating plans to resume construction at the Big Hill site.

- The storage capacity development program remained stopped and sites are being prepared for standby operations. Ongoing construction projects at the Big Hill, Texas, site were not completed as scheduled.
- DOE completed its SPR drawdown test sale and distribution exercise. Approximately 1 million barrels of oil were competitively sold to oil company bidders and subsequently withdrawn from DOE storage sites for delivery. The exercise generally achieved DOE's test goals, but it appears that DOE missed some opportunities to demonstrate drawdown system capabilities.
- Distribution enhancement plans were changed by cancelling all improvements to the Texoma complex and substituting changes to the Capline complex.

Additional details related to the above events and activities are provided in appendixes I and II.

Objectives, Scope, and Methodology

We limited our review, because of the time allowed, to providing primarily statistical information and highlights of major activities that occurred during the period. To obtain this information, we reviewed DOE program documents, publications, and studies, and interviewed DOE managers and operations personnel responsible for planning and managing activities associated with developing and operating the SPR facilities. We also interviewed employees of DOE contractors.

Our review was performed in accordance with generally accepted government auditing standards, except that we did not verify the volumes or quality of oil that DOE received or the available capacity of SPR storage facilities. The effort required to do this was beyond the scope of this report.

In accordance with your request, we did not obtain official agency comments. However, we provided DOE program officials with a draft of this report and discussed its factual accuracy with them. We made appropriate revisions as necessary.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 7 days after the date of this letter. At that time, we will provide copies to the Secretary of Energy and other interested parties and make copies available to the public upon request.

Sincerely yours,

A handwritten signature in black ink that reads "J. Dexter Peach". The signature is written in a cursive style with a large, stylized initial "J".

J. Dexter Peach
Director

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Abbreviations

API	American Petroleum Institute
ARCO	Atlantic Richfield Company
ASO	Apparently Successful Offerors
DOE	Department of Energy
FEDWIRE	Federal Reserve Wire Transfer Service
GAO	General Accounting Office
I&C	instrumentation and control work
IFB	invitation for bid
MOM	management, operations, and maintenance
OMB	Office of Management and Budget
PEMEX	Petroleos Mexicanos
SPR	Strategic Petroleum Reserve
TELEX	teletypewriter/automatic exchange
WHA	Walk, Haydel, & Associates, Inc.

Status of Strategic Petroleum Reserve Activities as of March 31, 1986

The Energy Policy and Conservation Act (Public Law 94-163, Dec. 22, 1975), as amended, authorized the creation of a Strategic Petroleum Reserve (SPR) to store up to 1 billion barrels of oil for use in the event of an oil supply disruption. To meet the act's goals, the Department of Energy (DOE) established a three-phase plan to store 750 million barrels of oil.

Phase I of the SPR plan involved the storage of about 260 million barrels of oil and is now complete. It consisted of acquiring and modifying for oil storage existing caverns in salt deposits at Bryan Mound, Texas; Bayou Choctaw, Sulphur Mines, and West Hackberry, Louisiana; and a salt mine at Weeks Island, Louisiana, as well as constructing a marine terminal at St. James, Louisiana.

Phase II involves creating new caverns through a leaching program at three of the Phase I sites to increase SPR capacity to about 550 million barrels. The leaching program entails pumping fresh water into salt deposits and removing the resultant brine. DOE injects oil into the top of the cavern as the leaching process creates the storage capacity. However, as we previously reported, Phase II leaching was stopped on December 31, 1985, in anticipation of a proposed moratorium on further SPR development to be included in the administration's fiscal year 1987 budget.¹ The budget was also expected to provide for terminating oil fill when a 500-million-barrel inventory level was reached. Accordingly, a final completion date for storage capacity development and ultimate oil fill is now uncertain.

Phase III, which was originally scheduled for completion in 1990, was designed to create additional capacity to reach the 750-million-barrel goal by expanding three existing storage sites and developing a new site at Big Hill, Texas. Because of the time needed to develop capacity, activities associated with Phases II and III have overlapping schedules. Again, the administration's proposed moratorium on SPR development makes current completion schedules uncertain.

The SPR storage sites are connected by pipeline to three marine terminals for crude oil deliveries during site development and for oil drawdown and distribution during an oil supply disruption:

¹Status of Strategic Petroleum Reserve Activities as of December 31, 1985 (GAO/RCED-86-84, Jan. 29, 1986).

- Seaway complex: The Bryan Mound storage site is connected to Phillips Petroleum Company's terminal (formerly the Seaway terminal) in Freeport, Texas.
- Texoma complex: The West Hackberry and Sulphur Mines storage sites are connected to Sun Oil Company's terminal in Nederland, Texas. The Big Hill storage site, when completed, also will be connected to the Sun terminal.
- Capline complex: The Weeks Island and Bayou Choctaw storage sites are connected to DOE's St. James marine terminal.

The SPR Program Office in Washington, D.C., has overall programmatic management and planning responsibility for achieving the goals and objectives of the SPR program. Responsibility for SPR project management and implementation activities is assigned to the Oak Ridge Operations Office (Operations Office) in Oak Ridge, Tennessee. These activities, as delegated by the Operations Office, are carried out through the Project Management Office (Project Office) in New Orleans, Louisiana. On March 28, 1985, DOE signed a 5-year management, operations, and maintenance (MOM) contract with Boeing Petroleum Services, Inc., to provide the necessary qualified personnel and services to run the government-owned SPR facilities. DOE will retain responsibility for the overall project management and project technical direction, while the contractor will be responsible for the SPR's day-to-day management.

This report discusses activities affecting the SPR that occurred during the quarter ending March 31, 1986, including (1) submittal of a fiscal year 1987 budget proposal, which included about \$150 million for SPR operations and management, proposed a moratorium on further SPR development retroactive to January 1, 1986, limited oil fill to 500 million barrels, and deferred funding of about \$776 million, (2) congressional reaction to the budget submittal, (3) the potential impact of deferred funding, (4) activities associated with adding 4.1 million barrels of oil during the quarter, (5) the status of the oil acquisition and transportation account, (6) storage site activities under the moratorium, (7) observations on DOE's test drawdown and sale of SPR oil, and (8) the status of DOE's distribution enhancement program.

SPR Budget for Fiscal Year 1987

The administration's fiscal year 1987 SPR budget identified a total requirement of \$149.9 million of nonphase-specific development and management funds. No funds were requested for storage capacity development and oil fill because the budget proposes an indefinite moratorium on further capacity development effective January 1, 1986, and

stopping oil fill at the 500-million-barrel level. In line with the proposed moratorium, the administration submitted with the budget, deferrals of approximately \$198 million in the SPR appropriation for capacity development and about \$578 million of SPR Petroleum Account funds, including prior-year oil money, SPR oil sales receipts, and other unneeded funds.

The budget is based on the expectation that during the last half of fiscal year 1986, activity at SPR development sites will focus on (1) completing ongoing construction and (2) performing tasks necessary to transform the sites to a standby mode ready for drawdown or restart of development. According to DOE officials, the focus in fiscal year 1987 would be on increasing the drawdown readiness of the sites. Work will also continue on distribution enhancements that are necessary to sustain a 3.1-million-barrel-per-day drawdown and distribution capability. This work is expected to be completed in fiscal year 1987.

According to the budget, balances of unobligated funds appropriated in prior years would be sufficient to sustain activities essential for maintaining SPR facilities in a standby-readiness state and continue the distribution enhancement program. Therefore, the administration is not requesting any new budget authority in fiscal year 1987.

According to DOE officials, the fiscal year 1987 budget for the SPR was developed in May 1985 on the basis of expected funding requirements to maintain the SPR in a standby mode, as envisioned under the administration's proposed moratorium on development and fill included in its fiscal year 1986 budget. DOE projected a need for about \$161.5 million in fiscal year 1987 for that purpose. Before this budget was submitted to the Office of Management and Budget (OMB), the Congress rejected the fiscal year 1986 proposed moratorium in the Fiscal Year 1985 Supplemental Appropriations Act and restored the \$271 million deferred for site construction and \$290 million of the \$827 million deferred for oil fill.

Although DOE recognized that fiscal year 1987 costs would likely increase because of the additional expenditures for facilities in fiscal year 1986 from the released funds, there was no policy determination on SPR restart by either DOE or OMB that provided a basis for adjusting the May 1985 budget estimates. Consequently, the budget submitted to OMB in mid-September was a moratorium-based estimate of fiscal year 1987 funding requirements. In subsequent budget negotiations between DOE and OMB, the \$161.5 million estimate was reduced to \$149.9 million on the basis of a \$24.4-million reduction in distribution enhancements, a \$11.7-million increase in the operations and maintenance account, a

\$1.1-million increase for management, a proposed moratorium on SPR development, and a reduced level of oil fill in fiscal year 1987.

In testimony before the Subcommittee on Interior and Related Agencies, Senate Committee on Appropriations, on February 25, 1986, DOE's Acting Assistant Secretary for Fossil Energy stated that the SPR moratorium and funding deferrals are warranted by the combination of favorable oil market conditions and federal budget constraints. He noted that as a result, the administration believes that further development of SPR storage capacity is not warranted at this time and it would be inadvisable to add further storage capacity now when there are no apparent near-term needs to add additional oil to the SPR. However, according to the budget justification, the moratorium would be periodically reevaluated in light of changes in world oil markets and the federal government's fiscal situation.

Congressional Reaction to Budget Proposal

The administration's deferral of funds and proposed moratorium has generally been resisted. On February 25, 1986, the Comptroller General notified cognizant members of the Congress and the Secretary of Energy that the deferral of \$156.8 million of the facilities construction funds (an amount previously deferred in the fiscal year 1986 budget and subsequently disapproved by the Congress on August 15, 1985) is not permissible and the funds must be made available for obligation. On March 4, 1986, the Comptroller General further notified cognizant members of the Congress that in accordance with Section 1016 of the Impoundment Control Act, he contemplates bringing a civil action against DOE to compel release of the redeferred budget authority.²

On March 25, 1986, the House Committee on Appropriations, reported out the Urgent Supplemental Appropriations Bill, 1986 (H.R. 4515), which proposes to disapprove the full \$198-million SPR construction deferral and \$315 million of the deferred \$578 million in oil purchase funds. Further, H.R. 4515 would direct DOE to fill the SPR at a minimum daily rate of 100,000 barrels.

On March 20, 1986, the Congress gave final approval to the Consolidated Omnibus Budget Reconciliation Act of 1985 and sent it to the President for signature on April 1.³ The act proposed the continued

²On April 11, 1986, OMB notified GAO that it was releasing the \$156.8 million. DOE is currently formulating plans to resume construction at the Big Hill site.

³The President signed the act on April 7, 1986 (Public Law 99-272).

filling of the SPR at a minimum fill rate of 35,000 barrels per day during fiscal years 1986, 1987, and 1988 until the SPR contains at least 527 million barrels of oil. The act also amended Section 160 (d) (1) of the Energy Policy and Conservation Act to prohibit future oil sales from the Elk Hills Naval Petroleum Reserve unless the fill rate or inventory level is achieved.

Final action on the fiscal year 1987 DOE budget is not expected until sometime during the next quarter.

Funding Deferral Impacts

The deferral of SPR funds in the fiscal year 1987 budget follows a similar effort by the administration in its fiscal year 1986 budget submission. DOE initially estimated that contract cancellations associated with the fiscal year 1986 deferrals would delay the completion of a 750-million-barrel reserve by about 17 months—primarily because of extending the completion date for the Big Hill, Texas, site. Subsequently, DOE amended its estimate and stated that changes proposed for the leaching process at Big Hill would improve operations efficiency to the point of reducing the delay to only about 6 months.

On the basis of DOE information, it appears that future delays in completing the four SPR sites because of the fiscal year 1987 budget deferral would be on a 1-to-1 basis (for each month that restart is delayed beyond January 1, 1986, the completion date would be extended by 1 month), plus the time required at Big Hill and Bayou Choctaw to reissue new invitations for bid (IFBS) for the construction contracts (about 2 to 3 additional months). DOE also informed us, however, that if restart is delayed at Big Hill beyond July 31, 1986, when the current architect/engineer contract expires, construction start-up could be delayed by an additional 9 months or more while DOE goes through the process of awarding a new architect/engineer contract.

Another impact of the deferral is on the final completion date for oil fill. If the SPR were filled at the fiscal year 1985 rate of about 159,000 barrels per day, a 750-million-barrel reserve would be completed in fiscal year 1991, assuming that all leaching was completed. Filling at less than this rate would extend the completion date. For example, a fill rate of 50,000 barrels per day would extend fill completion to fiscal year 2000.

The proposed moratoriums on continued SPR development have raised questions about the effects of delays on equipment reliability. DOE officials believe, however, that there will be no adverse effects on equipment reliability. They stated that with proposed maintenance and periodic testing of the equipment, the sites can be held ready for restart or drawdown for the design life of the equipment. This is particularly true for the two completed sites and the three sites that had an active leaching and/or oil fill program going on at the time the moratorium was imposed. At the Big Hill site, however, DOE officials noted that with no water, brine, or oil pipeline systems in place, routinely exercising the equipment that is currently installed will be more difficult. For that reason, DOE officials said that they will consider removing installed critical equipment at the Big Hill site if the moratorium extends beyond fiscal year 1987.

SPR Oil Fill Activities

DOE reported that 4.1 million barrels of oil were added to the SPR during the quarter ending March 31, 1986, bringing the total SPR inventory to 496.9 million barrels. All oil delivered during this quarter was purchased under DOE's 1981 contract with Petroleos Mexicanos (PEMEX), the Mexican national oil company. The average SPR oil fill rate for the quarter was about 45,500 barrels per day.⁴ (See fig. II.1 and table II.1 for further information on SPR oil acquisition and fill activities.) DOE issued instructions to the Project Office on December 30, 1985, to stop actions associated with oil deliveries beyond January 31, 1986, until further notice. This instruction was followed up on January 27, 1986, by instructing the Project Office to continue purchasing PEMEX crude at an approximate delivery rate of 50,000 barrels per day until the SPR has achieved a total inventory of 499 million barrels. On February 25, 1986, DOE increased the inventory level to be achieved to 500 million barrels.

Of the 496.9 million barrels of oil in storage, 39 percent was sweet (low sulfur) crude, 49 percent was sour (high sulfur) crude, and about 12 percent was a combination of lower quality crude oils. (See table II.1 for SPR oil quality specifications.) This sweet/sour crude oil mix will change slightly as DOE continues to meet its oil purchase objective as planned through its PEMEX contract, which expires on August 31, 1986. The addition of another 3.1 million barrels of Mexican sour crude to achieve the 500-million-barrel inventory level would result in oil-type ratios of

⁴The 1985 Supplemental Appropriations Act amended the Energy Policy and Conservation Act to eliminate the requirement for a specific daily rate of fill as long as the SPR will reach 500 million barrels by the end of fiscal year 1986 without restricting future sales of oil from the Elk Hills Naval Petroleum Reserve. (This provision has been subsequently amended—see p. 10.)

about 39-percent sweet crude, 50-percent sour crude, and an 11-percent combination of lower quality crude oils.

Status of SPR Oil Acquisition and Transportation Account

According to DOE, its oil acquisition and transportation account provides funds for (1) SPR oil procurements, (2) associated transportation costs, such as pipeline, tanker, and marine terminal activities, (3) operation and maintenance of the SPR terminal at St. James, (4) U.S. Customs duties, and (5) miscellaneous costs, such as administrative costs, associated with acquiring and transporting the oil. A DOE official told us that in the event of an SPR oil drawdown, this account would also fund the federal cost of withdrawing the oil from the storage caverns and transporting it to the point where private purchasers would take title.

During the quarter, DOE made payments of \$92 million for oil acquisition and transportation. Program Office personnel stated that as of March 31, 1986, DOE had unpaid obligations of about \$72 million and unobligated funds of about \$644 million. On February 5, 1986, the administration deferred SPR oil account funds of approximately \$578 million for fiscal year 1986. About \$537 million of these funds had been previously deferred in fiscal year 1985. (See table II.2.)

Storage Site Activities

As a result of DOE's proposed moratorium on further SPR development, DOE suspended all activities relating to storage cavern development (leaching) at two sites and cancelled the additional construction efforts planned for the Big Hill, Texas, and Bayou Choctaw, Louisiana, sites.⁵ DOE plans to place all sites in standby mode ready for restart or drawdown as soon as ongoing construction at the Big Hill and Bayou Choctaw sites is completed. Although oil fill continued during this quarter, DOE plans to stop oil deliveries in July 1986, when the SPR inventory will be 502 million barrels. At West Hackberry, DOE is still considering the correction of the previously reported brine line problem. However, a crude oil pipeline problem was resolved and further evaluation of the entire pipeline is ongoing. At Bryan Mound, crude oil deliveries were switched to West Hackberry so that a cavern configuration problem in the Bryan Mound Phase I cavern 5 could be evaluated. Finally, because construction work at Big Hill has not been completed according to the contract schedule, DOE began assessing penalties on the contractor at the rate of \$10,000 per day starting on February 11, 1986,

⁵With OMB's release of construction funds, DOE is formulating plans to resume construction at the Big Hill site.

and increased this by an additional \$10,500 per day on February 18, 1986.

West Hackberry

The West Hackberry site received 1.5 million barrels of crude oil this quarter, all in March 1986. The oil was injected into storage capacity developed prior to the leaching moratorium directed by the Program Office. The status of the caverns remains about the same as reported in our December 31, 1985, quarterly report: of the 16 Phase II caverns, 6 are full (containing a total of 59.9 million barrels of oil), 5 are in the final-fill stage (containing a total of 41.9 million barrels with an additional capacity of about 8.1 million barrels of oil), 4 are in the standby stage (containing about 8.2 million barrels), and 1 is in the leaching-only stage.

The cavern brine displaced by the oil injected in March 1986 was disposed of into on-site brine disposal wells. These wells can absorb about 75,000 barrels of brine daily, which is more than enough to accommodate the crude oil injection rate of about 50,000 barrels daily. These wells were drilled and used in the initial stage of the site's oil fill operations while the brine disposal line was being constructed from the site to the Gulf of Mexico. These wells are now being used again because, as noted in our December 31, 1985, report, the brine disposal line to the Gulf is currently inoperable.

A Boeing maintenance official told us that three Boeing teams are developing a brine disposal line study to analyze and evaluate the present disposal lines (including the Bryan Mound and Bayou Choctaw lines) and to formulate options that may range from replacing only the West Hackberry line section that is leaking with a smaller diameter line, to replacing major sections of the line. According to DOE officials, a contract will be issued in early April to inspect the entire brine line with an electronic measuring tool (known as an instrumented pig). A decision on the repair method is expected by mid-April.

In our December 1985 report we discussed the Phase II cavern that is in the leaching-only stage. This cavern has been the subject of testing and evaluation because of a leaching problem and a concern over cavern well leaks. In January 1986 Boeing successfully completed a cavern low-pressure test. According to a Boeing engineer, the test results prove that the cavern pressure can be maintained at the required low level while the cavern is being prepared for leaching. Following this test, nitrogen was injected into the cavern for a roof leak test that began on February

25, 1986. The nitrogen injection test will continue into May 1986, which is 1 month longer than originally planned, but which is now possible since there are no ongoing leaching activities. A Boeing engineer told us that no leaks had been detected yet.

A DOE engineer told us that if the roof leak test is successfully completed as expected and funds for leaching are available, the cavern will be prepared for leaching. Otherwise the cavern may remain inactive. However, a Boeing engineer told us that another option for this cavern, should the leaching program not be resumed, would be to use the already leached capacity for temporary crude oil storage. Decisions regarding this cavern's use will not be made until the next quarter.

Our December 1985 report also discussed DOE's plans to investigate a potential problem in the crude oil pipeline between West Hackberry and the Sun Oil Company marine terminal in Nederland, Texas. A Boeing contract management official said that Boeing gave the contractor notice to proceed with the work on February 21, 1986. The Boeing official said that a firm-fixed-price contract for about \$78,000 was awarded to Triangle Engineering and Constructors, Inc. to excavate the pipeline at the problem point (across the river from the Sun Oil Company terminal) and analyze the magnitude of any problems. This official said that the contractor's work disclosed a serious pipeline corrosion problem. The corrosion included 13 pits in a localized 4-foot section of the pipeline where an estimated 80 percent of the pipe wall had corroded away.

The DOE West Hackberry site manager said that the corrosion occurred in the vicinity of a pipe joint weld, which is an area of pipe that does not receive a factory-applied protective coating but receives a coating that is applied in the field after the joint welding is completed. According to this official, the field-applied protective coating at this joint may have been faulty.

The Boeing official said that, with DOE's approval, the contractor exercised a contract option for repair of the pipeline. The repair, which was completed on March 12, 1986, involved welding a 6-foot-long tubular split sleeve onto the 42-inch pipeline to cover the corroded area. The DOE site manager said that Boeing was planning to reexamine the West Hackberry crude oil pipeline by running an instrumented pig through the line.

The instrumentation and control (I&C) work, started in July 1985 to convert the West Hackberry raw water intake structure from a manned

(manual) operation to an unmanned (automatic mode) operation, continued during this quarter. According to a DOE contract specialist, the contractor will complete the I&C work as scheduled in April 1986.

Bryan Mound

The Bryan Mound site received 2.6 million barrels of crude oil this quarter, most of it January and February 1986. The oil was injected into storage capacity leached before the moratorium.

A DOE engineer said that the crude oil deliveries were switched from Bryan Mound to West Hackberry in early March 1986 to permit Boeing to change the configuration of Bryan Mound Phase I cavern 5 to improve the site's drawdown performance.

Bryan Mound cavern 5 currently contains nearly 34 million barrels of oil and consists of two vertical cavities (or sections) connected by a narrow opening (similar to an hour-glass) that engineers estimate is about 2 to 3 feet wide. This narrow connection restricts oil flow during drawdown and has previously caused damage to well piping (the piping was pinched off), which was extended through the narrow opening to the lower cavity. These factors combine to reduce the overall cavern drawdown efficiency.

A Boeing engineer stated that two projects are being planned for cavern 5 to improve cavern drawdown performance efficiency and overall drawdown capability of the site. The first project is short-term and involves leaching out the narrow connection between the upper and lower cavities large enough to permit the well piping to be extended through to the lower section without the risk of being pinched off by large falling chunks of undissolved salt and mineral impurities (anhydrites) from the cavern walls. Additionally, leaching out this bottleneck between the upper and lower cavities will allow any upper-cavity anhydrites to fall through to the lower section without clogging the opening between the cavities.

The leaching will use about 3 million barrels of water which, when injected, will drop through the crude oil to the narrow connection and leach the opening larger as it passes through to the lower section. The crude oil displaced by the water will surge into Phase I cavern number 4 for temporary storage. This project is in final approval stage and is estimated to cost about \$50,000 to complete. Project engineers estimate that the project will require about 35 days to complete and could begin in April 1986.

The second project, aimed at improving cavern 5 drawdown efficiency, is a long-term, large-scale effort, which has not yet been approved by the Program Office. The project proposes extensive leaching to join the two sections of the cavern into a single cavity. In order to accomplish this, about 23.7 million barrels of the sweet crude oil now in the cavern would have to be transferred to some Phase III caverns that now contain sour crude, which in turn would have to be transferred to other crude oil caverns.

The objective is to achieve a drawdown capability of 1.1 million barrels daily with sweet crude, which is not possible now because of the cavern configuration. This project is estimated to require a year or more and about \$1.4 million to complete.

Bayou Choctaw

The Bayou Choctaw cavern exchange between Allied Chemical Corporation and DOE, which we discussed in our December 1985 quarterly report, was completed on December 5, 1985. DOE awarded a firm-fixed-price contract on December 18, 1985, to Dilco, Inc. for about \$4.3 million to drill a second well and complete the surface piping construction for the newly acquired Phase II cavern. A DOE official told us that DOE plans to give the contractor notice to proceed in April 1986, at which time the contractor will have about 425 days to drill the cavern's second well and complete the surface piping so the cavern can be connected to the water, brine, and oil systems.

DOE also planned to award a contract during April 1986 to install the necessary surface piping for leaching Phase III cavern 101. This plan was also affected by the proposed moratorium, and DOE now plans no further action on developing the cavern storage space.

Boeing's evaluation of brine disposal pipeline corrosion problems indicated significant corrosion in the brine line at the site. As a result, the first 10 feet of the line to the brine disposal wells will be replaced.

Boeing also told us that DOE is considering plans for a drawdown exercise of the Bayou Choctaw site sometime in May 1986.

Weeks Island

A Boeing official told us that a drawdown test of the Weeks Island site is tentatively scheduled for April 22 and 23, 1986. The official said that the goal of this drawdown test from Weeks Island to the St. James terminal tanks will be to achieve a sustained drawdown for 40 hours and to

demonstrate that a maximum crude oil flow of about 690,000 barrels per day can be sustained. This rate would surpass the site drawdown rate of 590,000 barrels per day and the instantaneous rate achieved at the time of the test sale (592,000 barrels per day), and would require putting into service the spare oil flow metering equipment (which is used to measure the quantity of oil being pumped and designed to be used as backup equipment during actual operations).

Big Hill

Construction work at Big Hill under the I-A contract (on-site construction of the central facilities, leaching system, piping, and instrumentation for the first 5 of 14 planned caverns) and I-B contract (raw water-intake structure) is continuing, although the work was to have been completed by February 17 and 10, 1986, respectively. During a field visit to the Big Hill site, we noted that the basic construction work is nearly complete, but DOE officials said that sufficient questions remain about contractor compliance with design requirements that DOE is precluded from accepting the project as substantially complete. For example, as of March 22, 1986, DOE records showed 48 punch-list items (incomplete work noted by DOE in its walk-through inspection of the project segments) for the I-B contract plus 95 discrepancies that require correction to work that the contractor considered complete. The I-A contract report showed 833 discrepancies that require correction. DOE had not made its walk-through inspections of the on-site construction so no punch-list was prepared for the I-A contract. DOE takes into account both the number and the significance of open punch-list items and the uncorrected discrepancies in deciding when it will accept the contractor's work as substantially complete.

On February 11, 1986, DOE began assessing the contractor a \$10,000-per-day penalty on the incomplete I-B contract. This was increased by an additional \$10,500 per day on February 18, 1986, when the contractor failed to complete the work on the I-A contract as scheduled.

The DOE site manager at Big Hill estimates that the I-B contract should be completed in April 1986, but expects the I-A contract to continue into early May. The contractor's project manager, however, believes the work can be substantially complete at the site by mid-April. Both DOE and contractor officials acknowledge that the major item remaining to be completed is the electrical work, including making final system tests after the substation is energized and permanent power is available to the site.

DOE site officials expect the resolution of final I-A and I-B contract costs to require extensive negotiations with the contractor and will likely involve a number of claims against the government. Although the contracts were for firm, fixed prices, numerous modifications were added that changed the initial cost agreements. DOE estimated the cost of each modification prior to adding it to the corresponding contract. The actual costs the contractor submitted at completion, however, were frequently much higher than the estimates. For example, the cost of modification A053 in the I-A contract was estimated at \$62,695. The contractors claimed the costs were \$142,703. A DOE site contract specialist said that final costs are difficult to resolve because the contractor is slow to provide supporting cost documentation. The contractor's project manager stated that part of the problem results from inconsistencies in the architect/engineer designs and the use of DOE government-furnished equipment, which add time and labor costs that are difficult to quantify.

The contract awards for the Big Hill raw water, brine, and oil pipelines and for the remaining on-site construction that were suspended by DOE on December 30, 1985, were subsequently cancelled on January 27, 1986. This decision leaves the Big Hill site vulnerable to deterioration and vandalism unless it is carefully maintained. To the extent possible, DOE plans to maintain all equipment installed under the I-A and I-B contracts in place under standby conditions until more definitive guidance on the expected length of the moratorium is provided. Boeing Petroleum Services, Inc. will assume full responsibility for the site when the I-A and I-B contracts are completed. Boeing's current plan is to assign about 40 employees to the Big Hill site to maintain it in a standby/restart condition.

DOE plans to close out the Walk, Haydel, & Associates, Inc. (WHA), contract for architect/engineer services at Big Hill. Employee terminations are already in process and some of the tasks initially assigned to WHA, such as completing site drawings to reflect "as built" conditions and preparing operating manuals and procedures, will be done by Boeing employees when the site work is complete. The WHA field service manager expressed some concern that the phase-down of his staff and the delays in completing the construction work will make it difficult for WHA to carry out its contractor oversight responsibilities on the final phases of the site construction. The DOE site manager, however, said he believes that the construction work will be completed in time to have WHA inspectors work with DOE's Readiness Review Board in assessing compliance with contract requirements.

DOE also has equipment ordered or on hand that will not be installed and needs to be stored. Some of the field instrumentation units, the major electronics component of the control room facility, and the remote electronic control units will all be stored in air-conditioned/heated vans, with some of the vans being kept in the warehouse under cover. DOE also will take delivery of 10 large, horizontal pumps intended for installation under the Stage II contract for on-site construction that was cancelled in January. These pumps will also require the protected storage that is available on site.

SPR Test Sale Exercise

As we reported in our December 1985 quarterly report, the Energy Policy and Conservation Amendments Act of 1985 (Public Law 99-58, July 2, 1985) required that DOE conduct a sale to demonstrate that SPR oil can successfully be withdrawn, sold, and distributed. In November and December 1985, DOE competitively sold 1 million barrels of oil to five commercial oil companies and started withdrawing and distributing it to the successful bidders. On January 8, 1986, DOE delivered the last of the 966,800 million barrels actually shipped during the test sale.

Receipts from the five successful purchasers amounted to nearly \$28 million, with the purchase price of sweet crude averaging \$30.36 per barrel and sour crude averaging \$27.89 per barrel. The SPR Project Office estimates that the test sale cost about \$168,000 for terminal throughput charges, electric power, and related miscellaneous charges. The replacement cost for the oil sold will depend on the market price at the time of repurchase. Currently, this is less than one-half the sale price.

DOE conducted the test so that, although 1 million barrels of oil were sold, 2.05 million barrels were actually drawn from the underground storage caverns in five separate drawdown exercises. The additional 1.05 million barrels were used to displace oil already in the SPR's pipeline network, thus ensuring that the oil delivered to purchasers was actually from underground storage.

As we reported in our May 8, 1985, report, a test involving the sale of only 1 million barrels of crude oil over a 30-day period does not stress the sales and delivery systems, and therefore is not necessarily indicative of how procedures would work in an emergency.⁶ According to DOE

⁶Analysis of Oil Withdrawal and Distribution Tests for the Strategic Petroleum Reserve (GAO/RCED-85-115, May 8, 1985).

officials, they recognized the testing limitation and accordingly established test goals with a view of what could realistically be learned. According to DOE officials, the following goals were set:

- Demonstrate the capability to sell SPR oil by means of sealed bid price competitive sales and deliver the oil to purchasers through existing distribution systems.
- Provide industry with an opportunity to participate in the SPR drawdown test and to become more familiar with the SPR sales process.
- Provide additional training for SPR and contractor personnel.
- Identify any measures that would further enhance the SPR drawdown and sales processes.

The authorizing legislation afforded DOE considerable flexibility in designing and conducting the test. DOE used this flexibility to design a sale that would test as many facets of SPR sales and distribution procedures as possible. Specifically, the following design decisions were made:

- To test emergency sale procedures, conduct a test sale rather than an exchange.
- To the extent practicable, use existing emergency procedures.
- Withdraw oil from four SPR storage sites and distribute it through all three terminals, using both commercial marine and pipeline transportation systems.
- Move oil from storage sites to terminals at design drawdown rates.

GAO Observations on the Sale Results

Our review of pertinent test sale documents and discussions with DOE and contractor personnel revealed that the test was generally successful in achieving the test goals. For example, 23 companies representing major and independent oil companies, refiners, traders, and non-oil industry associations attended a pretest-sale conference at which the test sale process and procedures were presented. Following the issuance of the sale notice on November 18, 1985, DOE received offers for over 7 million barrels of SPR oil from 17 companies through 35 separate bids. Once the successful bidders for the 1 million barrels of oil were identified, delivery schedules were arranged, oil was transferred from the storage sites to terminals, and the purchasers took title to the oil. DOE also involved a relatively large number of agency and contractor personnel across a wide range of test sale activities. Up to 30 people were involved in the initial planning, with site representatives added later. About 30 people—mostly contractor personnel—were involved in data input operations training. Personnel from site operations, finance, and

procurement were also involved in conducting the test. To provide for an independent evaluation of the test, DOE's Office of Energy Emergencies was tasked with developing a test sale report, which was published on March 21, 1986.⁷

From our review of drawdown and distribution documents and agency personnel evaluations, it appears that DOE missed some opportunities to demonstrate drawdown system capabilities that would have been possible even within the constraint of the small test size. Some specific examples of this follow.

Bayou Choctaw

At this site the test design plans were developed so that a newly devised pumping arrangement could be tested. The new pumping arrangement theoretically increases the achievable drawdown rate from 380,000 barrels per day to about 474,000 barrels per day. The expected increase resulted from improvements to on-site piping and an operational change in how the raw water injection pumps are linked together when withdrawing oil from the storage caverns. The pumping change involved using three pumps together rather than two, as initially designed for the site. According to a DOE official, using the new arrangement would provide a good test of the new system and the results would provide valuable data for calibrating the Site Operations Model (a computer model used to simulate and predict site performance). During the actual oil movements, however, the old pump configuration and one extra raw water pump were used. Although at one point in the withdrawal, output reached the maximum rate predicted, the way the drawdown was conducted precluded DOE from obtaining the data desired from the test.

Bryan Mound

At this site a technique known as "splitstreaming" (sending oil in two or more directions simultaneously) was to be tested. This capability is required in DOE's Level I Criteria for the site, but it has never been previously demonstrated. The test design plans called for 300,000 barrels of oil to be drawn down from site caverns and sent directly to a ship at the Phillips dock while simultaneously withdrawing an additional 600,000 barrels and pumping it to on-site storage tanks.

Just prior to the test, DOE's contractor at the site expressed doubts about the reliability of the on-site meters needed in the custody transfer/accountability function of the oil going to the dock. As a result, the oil

⁷Strategic Petroleum Reserve Test Sale Report (DOE, Office of Energy Emergencies, Mar. 21, 1986).

movement plan was changed and site officials decided to send the 300,000 barrels directly into the on-site storage tanks where it could be measured and transferred to the Phillips dock for loading onto the ship. Since only one-third of the planned oil quantities was to be moved, the contractor used the built-in pressure normally present in the caverns to force the oil out and into the storage tank.

Since no pumps were used in the withdrawal process, no conclusions can be drawn as to either site capability for splitstreaming oil movement or pump performance under maximum drawdown conditions.

Weeks Island

The initial test plan at this site called for achieving the Site Operations Model's indicated maximum drawdown rate of 690,000 barrels per day. However, achieving that rate would require use of spare metering equipment so the site only achieved a peak rate of 592,000 barrels per day during the test. As a result, a DOE Project Office official has requested further study and recommendations regarding equipment requirements at this site.

The test also disclosed a design flaw with respect to the location of a protective pressure switch on the mainline pumps that are used to send the oil through the pipeline to the St. James terminal. This flaw created difficulties in running two of the three pumps simultaneously, a condition required to meet expected pumping rates. After the test the pressure switch was relocated to a place where it protects the meter banks but does not interfere with pump performance.

DOE Test Evaluation

To improve future operations, DOE provided opportunity for test sale participants—agency and contractor personnel, bidders, and non-bidders—to submit evaluations of the sale process and procedures. The comments were solicited in the form of questionnaires, which were then submitted to the DOE Energy Emergency Office through the Oak Ridge National Laboratory (a DOE contractor) and the Drawdown Readiness Assurance Board, which is comprised of representatives from the Program Office, Oak Ridge Operations Office, Project Office, and the Project Office for Procurement/Sales. DOE also received comments that included questionnaire responses and individual staff assessments from personnel of Boeing Petroleum Services (the MOM contractor), SPR site personnel, Wells Fargo Guard Services personnel, and Defense Contract Administration Service personnel.

In its March 21, 1986, Test Sale Report, DOE's Office of Energy Emergencies noted that the test size was too small to draw conclusions regarding a larger emergency drawdown. The report also noted that in an emergency drawdown at or near design rates, the scheduling and delivery systems could well prove to be the "choke points" of the drawdown. The report concluded, however, that the test sale was successful in complying with the authorizing legislation and meeting the goals established by DOE, and that the test demonstrated that the SPR sales and delivery processes worked as intended. In addition, the report noted that the test helped to identify areas where modifying SPR procedures may further enhance their effectiveness in an energy emergency.

Although the report states that the review team found no evidence of any major deficiencies in SPR sales and distribution procedures during the test sale, it specified that the following areas should be examined.

Minimum bid price. DOE should undertake a comprehensive analysis of how best to establish a minimum bid price.

Distribution of the Notice of Sale. DOE should consider alternative methods for distributing the Notice of Sale (such as overnight mail, TELEX, or electronic mail) because of the brief interval (7 days) between its distribution and the deadline for receipt of bids.

Communication with bidders. DOE may be able to streamline the bid review process by using TELEX or electronic mail for bidders to transmit offers to the Project Office and for the Project Office to communicate with bidders.

Notification of Apparently Successful Offerors (ASO). Under present procedures, each ASO contacts the Project Office to schedule delivery. An alternative would be for the Project Office to notify all ASOs concurrently, possibly by TELEX, as to the appropriate point of contact.

Bid document format. In a few cases, there were minor discrepancies in the bid document forms or between the forms and the covering letter. The bid document forms should be examined to determine whether discrepancies can be eliminated.

Use of FEDWIRE. In light of an apparent misunderstanding between SPR Project Office personnel and the Atlanta Federal Reserve Bank and its New Orleans branch regarding the use of the Federal Reserve Wire Transfer Service (FEDWIRE) system in DOE's collection process, DOE should

explore a long-term agreement with the Federal Reserve for the use of this system.

Transfer of funds. To confirm that funds have been transferred from purchasers' accounts to a Treasury account, the Project Office Accounting Branch electronically queries the Treasury account daily. DOE should examine whether the existing system can be modified to provide additional purchaser payment data during the query.

Metering. Problems need to be resolved with respect to the use of custody transfer meters. The meters at Bryan Mound were not functioning properly, and there was a problem with the prover loop (the loop of pipe that is used to calibrate the meter) at the St. James site. Moreover, the meters at the Phillips terminal can be used only for oil being discharged, not for oil being loaded onto vessels.

Delivery of contractual volumes. The Standard Sales Provisions permit the volume of oil delivered to a purchaser to vary (for operational reasons) by plus or minus 5 percent from the quantity specified in the contract. The Contracting Officer can authorize changes beyond the 5-percent limit by modifying the contract. DOE should consider modifying the provisions to provide more specific guidelines on the conditions under which variations within the 5-percent limits are allowable, and the conditions under which contracts may be modified.

Delivery window. DOE should explore the prospective benefits and costs of narrowing the 3-day vessel delivery window as a means of reducing the government's exposure to possible demurrage costs.

Simulation test of scheduling. The recent exercise, because of its limited scope, did not provide a full test of how the scheduling process would work in an emergency. It might be useful for DOE to conduct a comprehensive, multi-cycle simulation exercise to provide a more rigorous test of scheduling procedures.

Industry Comments

The comments submitted by companies that purchased SPR oil and by those unsuccessful bidders who did not purchase oil were generally favorable. All five purchaser firms said that the experience gained during the test had improved their ability to purchase SPR oil in an energy emergency. Further, three of the five firms that purchased oil said that prior to the test sale, they had no plans for purchasing SPR oil in the event of an oil shortage; but as a result of their participation in

the test, they are planning to purchase SPR oil during any future oil shortage.

SPR Oil Distribution Enhancements

In our December 1985 quarterly report, we discussed DOE's proposed enhancements to correct problems in the SPR oil distribution system caused when Texoma Pipeline Company and Seaway Pipeline, Inc., sold their interstate crude oil pipelines. DOE estimated that the required enhancements would cost \$97 million.

Proposed distribution enhancements for the Seaway complex consist of constructing a 40-inch, 42-mile pipeline from Bryan Mound to Texas City, Texas, and modifying the Phillips Petroleum Company's marine terminal at Freeport, Texas, and the ARCO tank farm and marine terminal at Texas City. This project will increase Bryan Mound's current distribution capability of 390,000 barrels per day by 1 million barrels per day. Land acquisition for the new pipeline is in progress, and the Army Corps of Engineers is performing real estate appraisals and negotiating with land owners.

During this quarter DOE revised the date to begin constructing the Bryan Mound pipeline. The construction IFB was originally scheduled to be issued on April 1, 1986, and construction was to begin in June 1986. However, according to a DOE contract specialist, the IFB will be delayed until July 1986, with pipeline construction now planned to begin in September 1986. A DOE general counsel official told us the original schedule has slipped because the Army Corps of Engineers, which has responsibility for obtaining required rights-of-way, has encountered difficulties in securing them. As of March 31, 1986, 30 of the required 98 rights-of-way had been agreed to.

On March 26, 1986, DOE and ARCO signed a 5-year terminal enhancement and service contract for about \$12.6 million. This contract provides for the necessary connections between the Bryan Mound-Texas City pipeline and ARCO's marine terminal as well as terminalling services for oil shipments. SPR officials had expected to complete contract negotiations earlier in the quarter, but DOE requested the Project Office to propose a different financing arrangement with ARCO than the one under discussion. The initial offer was to amortize the contract cost over a 43-month period. DOE subsequently proposed paying a lesser amount in full after construction was completed (about 17 months). ARCO accepted the offer and DOE estimates that it saved about \$1.5 million.

The contract negotiations between DOE and Phillips for the Seaway terminal enhancements have not begun as anticipated because of the change in negotiations strategy with ARCO. The negotiation plan for the Phillips terminal is being redesigned to incorporate similar financing provisions to those in the current ARCO contract.

Distribution enhancements for the SPR Texoma complex, which includes the Sun Oil Company terminal in Nederland, Texas, and a pipeline from the West Hackberry site to Lake Charles, Louisiana, was discussed in our September 1984 quarterly.⁸ Subsequent SPR analyses in 1985 of the Sun terminal's operations and distribution capabilities concluded that previously proposed modifications would not substantially increase the terminal's throughput. DOE also concluded that the pipeline to Lake Charles is not needed because of the delays in completing the Big Hill site. Accordingly, DOE cancelled the implementation plans for the Sun terminal enhancements and the additional pipeline from West Hackberry to the Lake Charles, Louisiana, refinery and terminal complex. This decision limits oil distribution from the West Hackberry and Sulphur Mines sites to 1.2 million barrels per day—200,000 barrels per day short of their design drawdown capability.

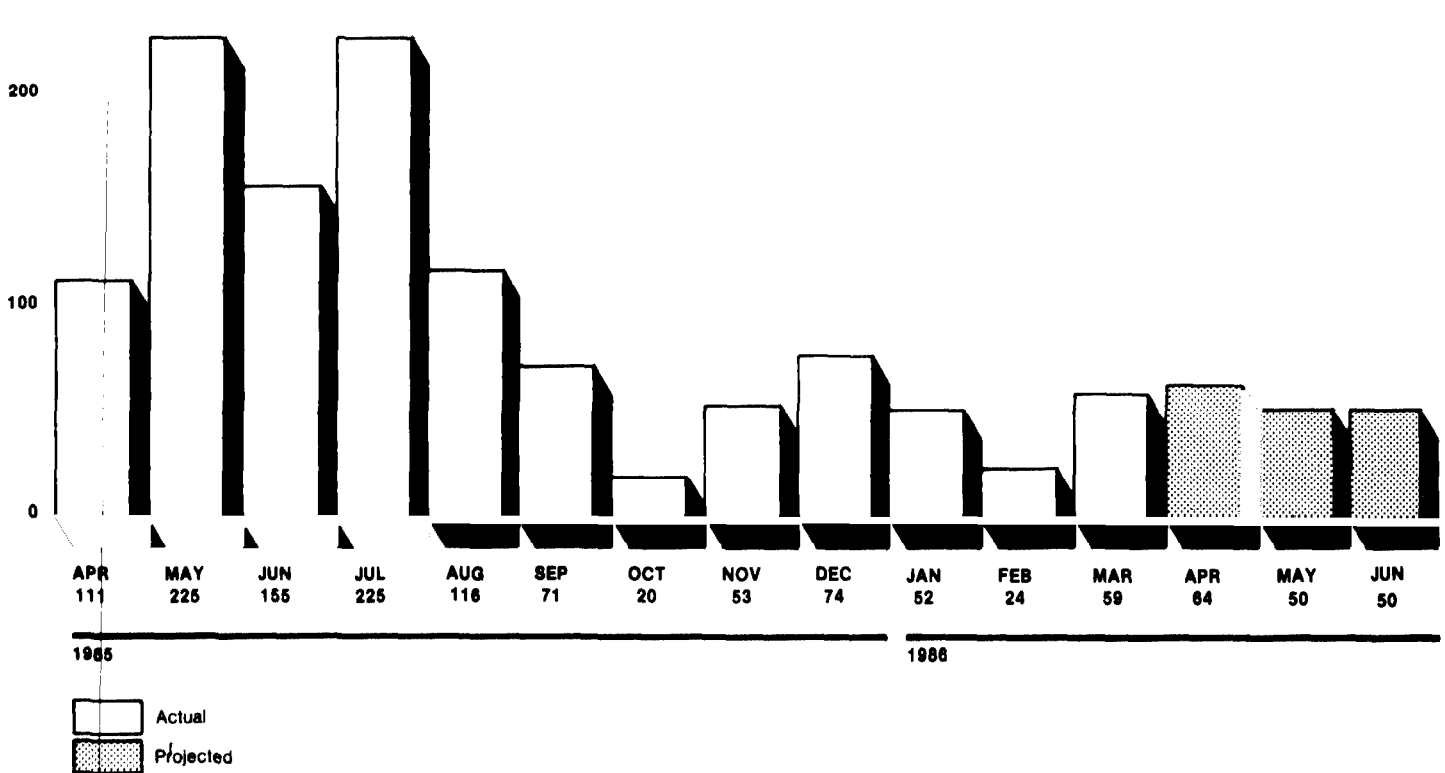
DOE also studied the Capline distribution system in 1985. As a result of the study, DOE officials proposed metering and piping modifications for the St. James terminal and a direct pipeline connection between the Capline and St. James terminals. DOE estimated that these enhancements would increase the Capline complex's distribution capability from 730,000 barrels per day to 830,000 barrels per day. As of March 31, 1986, the proposed enhancements were in the project conception stage. The concept is being discussed between the Project and Program Offices, but a schedule for the design work has not been established.

⁸Status of Strategic Petroleum Reserve Activities as of September 30, 1984 (GAO/RCED-85-40, Oct. 15, 1984).

Figures and Table on the Status of the Strategic Petroleum Reserve

Figure II.1: Average Daily SPR Oil Receiving Rate

300 Volume (barrels per day) in thousands



^aDaily receiving rate for April, May, and June 1986 based on DOE projection of future deliveries and is subject to change.

Appendix II
Figures and Table on the Status of the
Strategic Petroleum Reserve

Table II.1: SPR Oil Deliveries by Crude Type as of March 31, 1986

	Type I ^a	Types II-V ^b	Type VI ^c	Type VIa ^d	Maya ^e	Total
Volume delivered (millions of barrels)	245.1	192.2	31.4	16.6	11.6	496.9
Percentage of total oil delivered	49	39	6	3	2	99^f

^aHigh-sulfur crude (from 0.5 to 1.99 percent sulfur content) with an American Petroleum Institute (API) gravity range of 30 to 36 degrees. Type I oil includes Arabian Light and Isthmus crudes. The oil industry uses degrees of API gravity to measure an oil's specific gravity. API gravity measures the mass of a fluid relative to water and ranges from 10 degrees for very heavy crude to 45 degrees for very light crudes.

^bHigh-quality crudes with a low sulfur content (maximum 0.5 percent sulfur content) and an API gravity range of 30 to 45 degrees. These types include some North Sea and West African crudes.

^cType VI was established for Alaskan North Slope crude, an intermediate-sulfur crude (maximum 1.25 percent sulfur content) with an API gravity range of 26 to 30 degrees.

^dType VIa was established for the Maya/Isthmus blend under the PEMEX contract. The blend is a high-sulfur mixture with an API gravity of at least 28 degrees.

^eMaya crude is a lower quality oil having a maximum sulfur content of 3.5 percent and an API gravity of at least 22 degrees. As of April 1984, Maya crude was no longer being acquired as part of the PEMEX contract.

^fPercentages do not add to 100 because of rounding.

Source: DOE.

Appendix II
Figures and Table on the Status of the
Strategic Petroleum Reserve

Table II.2: Status of the SPR Oil
Acquisition and Transportation Funds
as of March 31, 1986^a

Dollars in Millions	
	Amount
Funds made available	
Carryover from fiscal year 1981	\$ 1,806
Fiscal year 1982 appropriations	3,684
Fiscal year 1983 appropriations	2,074
Fiscal year 1984 appropriations	650
Fiscal year 1985 appropriations	2,050
Total made available	10,264
Funds used or committed	
Fiscal year 1982 payments	3,687
Fiscal year 1983 payments	1,641
Fiscal year 1984 payments	2,329
Fiscal year 1985 payments	1,621
Estimated fiscal year 1986 payments ^b	270
Estimated DOE unpaid obligations as of March 31, 1986 ^c	72
Total used or committed	9,620
Estimated unobligated funds at DOE ^d	\$ 644

^aThe Omnibus Budget Reconciliation Act of 1981 (Public Law 97-35, Aug. 13, 1981) established the SPR Petroleum Account, effective October 1981, to pay for petroleum acquisition and transportation. This is an off-budget account.

^bAmount consists of DOE's actual reported payments through February 1986 and DOE's estimated payments for March 1986. Amount through February 1986 is net of \$27.9 million of receipts from SPR test sale of about 1 million barrels of crude oil delivered in December 1985 and January 1986.

^cUnpaid obligations represent funds that have been committed to pay for fiscal year 1986 oil deliveries under the first PEMEX contract, or are obligated to Defense Fuels Supply Center for PEMEX oil transportation costs. The Supply Center estimates that of the funds obligated to it, about \$5.9 million is available as of March 31, 1986, for future costs.

^dOn February 5, 1986, the administration reported a deferral of \$578 million for fiscal year 1986, of which \$537 million had been previously deferred.

Source: DOE and DFSC.

Appendix II
Figures and Table on the Status of the
Strategic Petroleum Reserve

Table II.3: Status of SPR Underground Capacity for Crude Oil Storage as of March 31, 1986

Millions of Barrels					
Storage facilities	Gross volume planned	Gross volume completed	Permanent capacity planned ^a	Capacity available	Capacity filled
Phase I sites:					
Bayou Choctaw	48.3	48.2	46.0	46.0	45.7
Bryan Mound	74.5	72.8	66.0	66.0	64.3
Sulphur Mines	27.4	27.3	26.0	26.0	26.1
Weeks Island	73.1	73.1	73.0	73.0	72.5
West Hackberry	51.1	50.6	49.0	49.0	47.8
Total	274.4	272.0^b	260.0	260.0	256.4
Phase II sites:					
Bayou Choctaw	12.2	12.2	10.0	0	0 ^c
Bryan Mound	134.4	139.2	120.0	121.2	116.0
West Hackberry	179.2	159.6	160.0	117.0	110.0
Total	325.8	311.0	290.0	238.2	226.0
Phase III sites:					
Bayou Choctaw	11.2	0	10.0	•	•
Bryan Mound	44.8	33.4	40.0	12.0	12.0
West Hackberry	11.2	1.5	10.0	•	•
Big Hill	156.8	0	140.0	•	•
Total	224.0	34.9	200.0	12.0	12.0
Tanks and pipelines	•	•	•	•	2.5
Total for SPR	824.2	617.9	750.0	510.2	496.9

^aCapacity for oil storage is less than gross cavern capacity completed because a certain volume of unoccupied capacity must be provided for water, sediment, and anhydrites that settle out of the oil and brine.

^bDOE acquired and modified existing caverns and a mine containing this gross volume. No leaching was required.

^cA newly leached cavern with 4.5 million barrels of usable capacity has been exchanged for an existing 10-million-barrel cavern owned by Allied Chemical Corp. at the Bayou Choctaw site.

Source: DOE.

Listing of Prior GAO SPR Quarterly Reports

1. Progress in Filling the Strategic Petroleum Reserve Continues, but Capacity Concerns Remain (GAO/EMD-82-112, July 15, 1982).
2. Status of Strategic Petroleum Reserve Activities as of September 30, 1982 (GAO/RCED-83-29, Oct. 15, 1982).
3. Status of Strategic Petroleum Reserve Activities as of December 31, 1982 (GAO/RCED-83-93, Jan. 14, 1983).
4. Status of Strategic Petroleum Reserve Activities as of March 31, 1983 (GAO/RCED-83-136, Apr. 15, 1983).
5. Status of Strategic Petroleum Reserve Activities as of June 30, 1983 (GAO/RCED-83-203, July 13, 1983).
6. Status of Strategic Petroleum Reserve Activities as of September 30, 1983 (GAO/RCED-84-11, Oct. 14, 1983).
7. Status of Strategic Petroleum Reserve Activities as of December 31, 1983 (GAO/RCED-84-92, Jan. 13, 1984).
8. Status of Strategic Petroleum Reserve Activities as of March 31, 1984 (GAO/RCED-84-148, Apr. 13, 1984).
9. Status of Strategic Petroleum Reserve Activities as of June 30, 1984 (GAO/RCED-84-182, July 13, 1984).
10. Status of Strategic Petroleum Reserve Activities as of September 30, 1984 (GAO/RCED-85-40, Oct. 15, 1984).
11. Status of Strategic Petroleum Reserve Activities as of December 31, 1984 (GAO/RCED-85-58, Jan. 22, 1985).
12. Status of Strategic Petroleum Reserve Activities as of March 31, 1985 (GAO/RCED-85-111, Apr. 15, 1985).
13. Status of Strategic Petroleum Reserve Activities as of June 30, 1985 (GAO/RCED-85-149, July 15, 1985).

14. Status of Strategic Petroleum Reserve Activities as of September 30, 1985 (GAO/RCED-86-37, Oct. 15, 1985).

15. Status of Strategic Petroleum Reserve Activities as of December 31, 1985 (GAO/RCED-86-84, Jan. 29, 1986)

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