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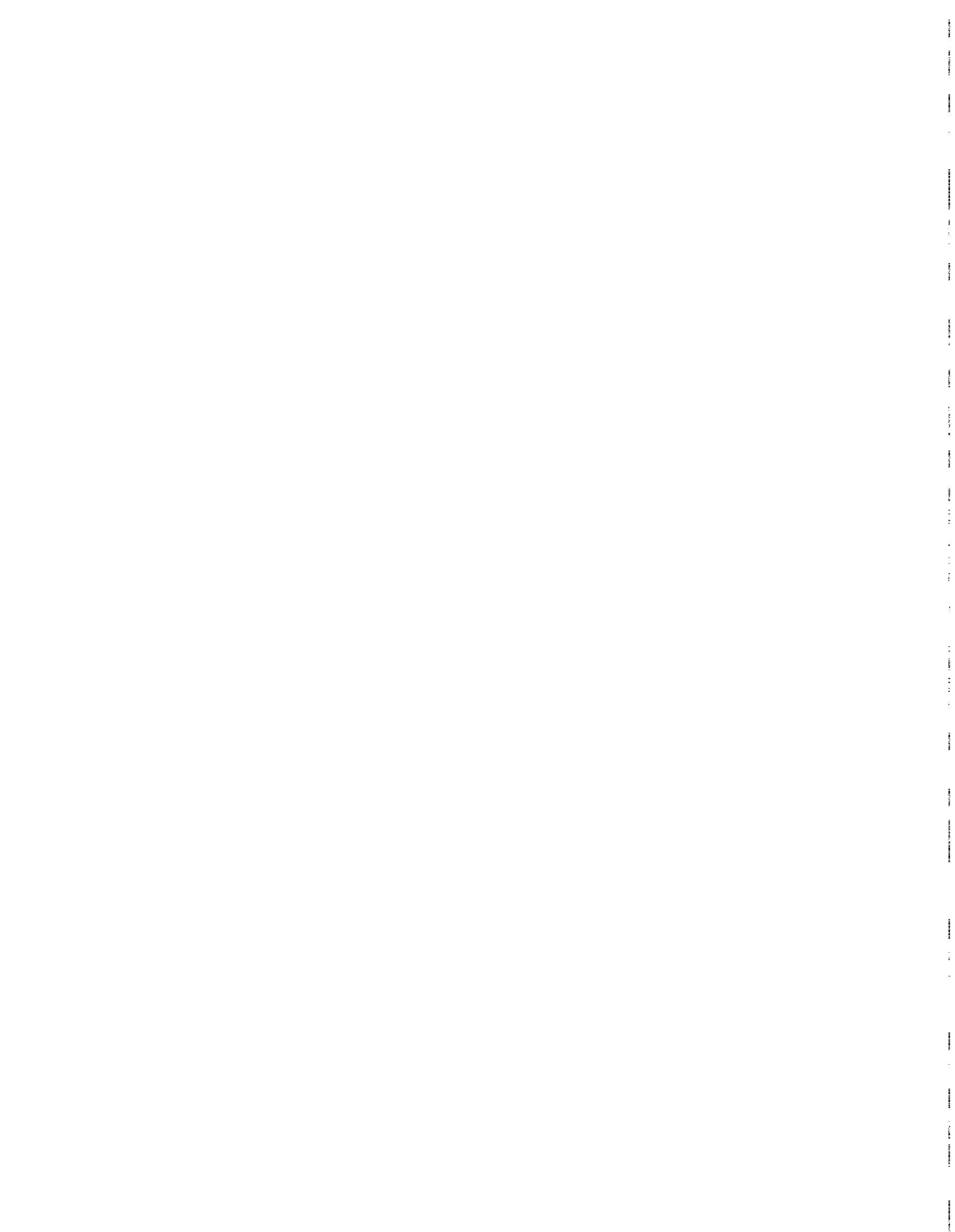
Report to the Chairman, Subcommittee
on Energy and Power, Committee on
Energy and Commerce, House of
Representatives

May 1994

NAVAL PETROLEUM RESERVE

Limited Opportunities Exist to Increase Revenues From Oil Sales in California







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

Resources, Community, and
Economic Development Division

B-256427

May 24, 1994

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

Dear Mr. Chairman:

The government-owned and operated Naval Petroleum Reserve (NPR) in Elk Hills, California—currently the seventh largest oil field in the lower 48 states—generated oil sales revenues of \$327 million in 1992. The Department of Energy (DOE) sells most of this oil to California refiners through competitive bids.

The prices received by the government for this oil have been lower than prices for crude oil in other regions of the country. Observing this disparity, you asked us to determine whether the government could increase its revenues from the sale of NPR oil.¹ At the current production rate of 41,000 barrels per day, even a modest increase in the price DOE receives for NPR oil would result in substantial added revenues. More specifically, this report responds to your request that we examine whether

- selling NPR oil to Gulf Coast and mid-continent refiners could enhance revenues and result in higher prices for the remaining NPR oil sold in California,
- significant barriers impede shipping NPR oil to those refiners,
- DOE omits any significant factors in determining whether the prices bid for NPR oil are high enough and determines this often enough, and
- revenues could be enhanced by other means.

Results in Brief

It will be difficult for the government to increase revenues by selling NPR oil to Gulf Coast and mid-continent refiners even though crude oil prices in these regions are higher. Refiners in these regions have little incentive to bid on NPR oil after considering differences between the quality of NPR oil and other available crude oils and the cost of transporting NPR oil to their refineries. Selling NPR oil outside of California would also reduce the supply of oil in that state and could result in slightly higher prices for the

¹In this report, the term "NPR oil" refers to crude oil from the Stevens zone of the NPR-1 at Elk Hills, California.

oil sold there. However, DOE would be unlikely to increase its overall revenues because the lower bids it would have to accept on the oil it sells outside of California to account for transportation and quality differences would offset any price gains for the oil sold in California.

There are no significant barriers to shipping a sizeable portion of NPR oil to Gulf Coast or mid-continent refiners. The smallest of the California pipelines connecting the NPR to interstate pipelines can accommodate slightly less than one-half of the current production rate of NPR oil. This capacity could be increased if the investment were warranted by potential sales.

In determining whether the prices bid for NPR oil are high enough, DOE has not included the additional shipping costs of using U.S. flag vessels for oil the government imports from foreign sources. DOE chose to omit these costs from its calculations because including them could divert benefits intended for the U.S. maritime industry. DOE makes these price determinations with adequate frequency and includes adjustment factors so that the sales reflect market prices.

DOE could enhance revenues from NPR oil in several ways. When DOE makes monthly price adjustments in its contracts, it bases these changes on a California oil price index derived from a relatively small number of transactions and price quotes. Replacing this index with a price indicator based on a larger number of transactions and price quotes could result in slightly higher bids to the extent that bidders could more easily predict future movements of the price index. In addition, bids on NPR oil are likely reduced by a preference DOE grants to small refiners, as allowed under the NPR Production Act.² DOE may be invoking this preference unnecessarily in some cases because it does not first analyze, as required by statute, whether these refiners have adequate alternative supplies of oil before it makes the second part of the determination—that selling the NPR oil to small refiners under the preference provision is in the public's best interest.

DOE has additional opportunities to enhance revenues by changing its NPR oil sales program. DOE bills its customers more frequently than private oil producers do, which likely results in buyers making lower bids to compensate for their additional administrative costs. In addition, DOE does not market its oil as aggressively as private producers do, possibly resulting in fewer and less informed bidders and lower winning bids.

²Small refiners are defined as those with a total crude oil input of 75,000 barrels or less per day.

Background

The Naval Petroleum and Oil Shale Reserves were established in the early 1900s to ensure fuel supplies for the military. The reserves were largely inactive until the Congress passed the Naval Petroleum Reserves Production Act of 1976 (P.L. 94-258) in response to the 1973 Arab oil embargo. This statute changed the NPR from a strategic reserve for the military to a source of oil for the U.S. economy. The act authorizes the Secretary of Energy to sell oil from the NPR in Elk Hills, California, through public sales to the highest bidders. DOE sells the oil through 6-month contracts, adjusting prices monthly to reflect changing market conditions.

The rapid fall in oil prices in 1986 precipitated two changes in the NPR sales process. First, DOE changed the index it uses to price NPR oil to the average of the spot or daily prices of two crude oils traded in the Los Angeles area—Alaskan North Slope (ANS) crude oil and the crude oil blend sold from ARCO's Line 63 pipeline.³ In 1986, the Congress also created a two-part price test, or determination, (P.L. 99-413) to ensure that NPR oil was sold at market prices. This act prohibits the sale of NPR oil for less than whichever is higher of two prices: 90 percent of the current California market price or the price of oil purchased for the Strategic Petroleum Reserve (SPR), less the cost of moving oil from the NPR to the SPR, after adjustments are made for differences in the oil's quality.⁴ Between June 1992 and September 1993, when DOE received bids for NPR oil that were lower than the price it would have paid for oil to fill the SPR, it shipped oil to the SPR.

Selling NPR Oil to Gulf Coast and Mid-Continent Refiners Is Unlikely to Enhance Revenues

It will be difficult for the government to enhance revenues by selling NPR oil to Gulf Coast and mid-continent refiners because these refiners have little incentive to bid on NPR oil. Although prices for NPR oil at Elk Hills are generally lower than prices for comparable crude oils outside of California, three factors explain this price difference and discourage these refiners from bidding on NPR oil. First, NPR oil yields a less valuable mix of petroleum products than West Texas Intermediate (WTI), the comparable oil in these other regions. Second, NPR oil contains more nitrogen and heavy metals than WTI, resulting in higher refining costs. Gulf Coast and mid-continent refiners would discount their bids for NPR oil to reflect these higher costs. Third, transporting NPR oil to these refineries would be costly, further eroding any benefit of purchasing NPR oil. As a result, we estimate

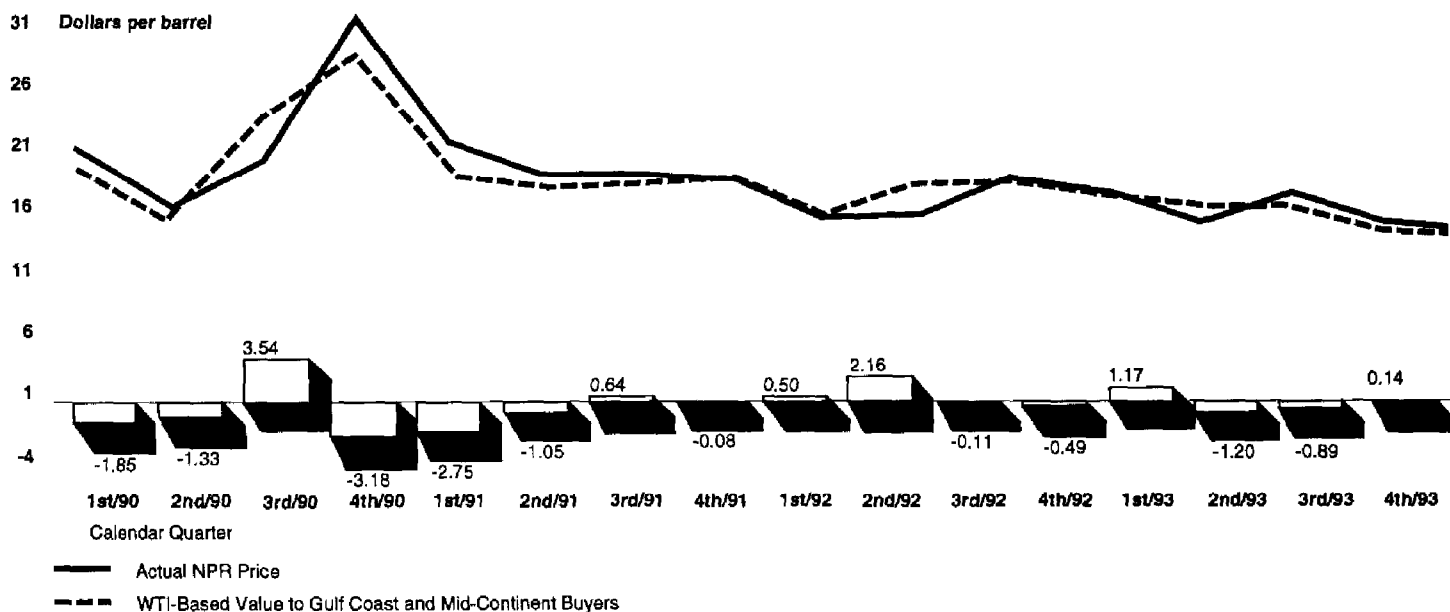
³ARCO's line 63 connects the San Joaquin Valley (where Elk Hills is located) and the Los Angeles area.

⁴The SPR was created by the Energy Policy and Conservation Act of 1975 to provide the United States with a strategic supply of crude oil to protect against future disruptions in oil supplies. SPR oil is stored in large underground salt caverns in Louisiana and Texas.

that these refiners would bid about \$3 per barrel less for NPR oil than for WTI.⁵

As illustrated in figure 1, Gulf Coast and mid-continent refiners would have lost more often than they gained by buying NPR oil at the price paid in California. This is the expected result in a well-functioning market.

Figure 1: Comparison of NPR Prices and WTI Spot Prices, Adjusted for Transportation and Quality



Note: The bar values represent the potential gain or loss to Gulf Coast and mid-continent buyers.

We had a consulting firm analyze the volume and value of petroleum products refined from NPR oil.⁶ This yield analysis suggested that NPR oil would be worth \$0.84 to \$1.06 per barrel less to Gulf Coast and mid-continent refiners than WTI, before accounting for the oil's higher

⁵This lower bid, or discount, is somewhat sensitive to the price of WTI, as discussed below.

⁶Bonner & Moore Associates, Inc., Houston, Texas.

nitrogen and heavy metals content and the cost of transportation.⁷ Details of this analysis are presented in appendix I.

The consulting firm also examined the effect of the nitrogen and heavy metals content on the value of NPR oil to Gulf Coast and mid-continent oil refiners. It found that \$0.25 per barrel would cover the added refining costs resulting from these factors.⁸

The cost of transporting NPR oil to these refineries—a difference of approximately \$2 per barrel from Elk Hills to Midland, Texas, for example—is the most important reason for expecting lower bids. In addition, according to DOE, it takes 60 to 90 days to move oil from Elk Hills to the Gulf Coast. As a result, a Gulf Coast or mid-continent refiner would also lower its bid to cover the time value of funds that are unavailable while the oil is in transit.⁹ Finally, NPR oil can degrade during transit as a result of mixing with other crude oils along the route, and refiners could discount for this degradation. In August 1993, the SPR estimated the value of the degradation of NPR oil during transit from Elk Hills to the Gulf Coast at \$0.17 per barrel.

Selling NPR oil outside of California would reduce the supply of light crude oil in that state and could result in somewhat higher prices for the NPR oil sold there. However, because Gulf Coast and mid-continent refiners do not have strong incentives to bid on NPR oil, this strategy would come at a cost. To sell NPR oil outside of California, DOE may have to accept lower bids from outside buyers. Aside from the dubious economics, it is unclear how such sales could be accomplished and be consistent with competitive bidding.

Pipelines Can Carry a Sizeable Portion of NPR Oil to Other Regions

The Santa Fe Pipeline in California can currently accommodate about 20,000 barrels of NPR oil per day, or slightly less than one-half of the government's share of NPR production in fiscal year 1993, for shipment to Gulf Coast and mid-continent refineries. The Santa Fe and Celeron Gathering pipelines connect Elk Hills to the All American Pipeline—the primary interstate pipeline linking California and Texas. DOE, the operator

⁷This price differential is based on a price for WTI of \$18.60 per barrel. The value of NPR oil is generally about 94.6 percent of the value of WTI or, in this case, \$17.59.

⁸These added costs are due to lower product yields resulting from interference with the operation of the refinery catalyst and the cost of replenishing the catalyst. The level of acidity of the NPR oil would not be a significant factor.

⁹While oil is in transit, oil prices can be expected to fluctuate. As a result, buyers' price expectations and aversion to risk also influence the amount bid.

of the All American Pipeline, or prospective buyers could arrange with Santa Fe Pipeline officials to increase throughput above the current level. Santa Fe Pipeline officials told us that they can increase their pipeline throughput to 40,000 barrels per day with an investment of \$700,000 to \$1 million. However, the doubtful economics of shipping oil to other regions make such an investment unlikely.

DOE, under 10 U.S.C. 7422, has the authority to condemn—take for public use—any proprietary pipeline that refuses to ship NPR oil without discrimination and at reasonable cost.¹⁰ However, we found that the Santa Fe and Celeron Gathering pipelines, the two proprietary pipelines that shipped NPR oil to the SPR, appear to have cooperated with DOE to accommodate its transportation needs.

DOE's Price Test Omits U.S.-Flag Shipping Costs but Is Adjusted to Reflect the Market

DOE has not included higher costs of shipping on U.S.-flag vessels in determining whether prices bid for NPR oil are high enough—that is, whether the prices bid exceed the cost of acquiring oil for storage in the SPR after adjusting for transportation costs and differences in quality.¹¹ When the SPR buys oil from the NPR rather than importing it, it avoids the additional shipping costs of using U.S.-flag vessels. DOE chose to omit these costs because including them could divert benefits intended for the U.S. maritime industry. DOE makes its price determinations every 6 months, in conjunction with its oil sales. However, in its contracts for NPR oil, DOE includes monthly price adjustments that are designed to more fully capture market price fluctuations.

NPR Price Determination Excludes a Cost Associated With Importing Oil for the SPR

In calculating the price of acquiring oil for the SPR to compare with the bids for NPR oil, DOE has not included a cost it avoids by buying NPR oil. Oil purchased for the SPR from foreign sources is usually shipped by tanker and includes a cost, averaging about \$0.75 per barrel, resulting from a legal requirement that DOE use higher-cost U.S.-flag vessels to ship half of the oil

¹⁰A proprietary pipeline is a privately owned pipeline that, with few exceptions, is not obligated to ship oil for anyone other than the pipeline's owner.

¹¹DOE's price test is based on the requirements of Public Law 99-413, which prohibits the sale of NPR oil for less than whichever is higher of two prices: 90 percent of the current California market price or the price of oil purchased for the SPR, less the cost of moving oil from the NPR to the SPR, after adjustments are made for differences in the oil's quality.

it imports for the SPR.¹² By purchasing oil from the NPR, the SPR avoids this cost.

If this cost had not been excluded from DOE's price determination, the SPR would have spent less on shipping costs and purchased more NPR oil. Including this cost in the price would have resulted in "recycling" SPR funds within the government. In place of outlays for shipping on U.S.-flag vessels, the SPR would have increased outlays for NPR oil.

Including these avoided shipping costs in the calculation, while making the NPR a preferred supplier of crude oil for the SPR, could effectively transfer benefits intended for the maritime industry to California oil producers. These producers would benefit to the extent that the SPR's increased purchases of NPR oil resulted in higher oil prices in California. Both government actions have economic costs resulting from the associated misallocation of resources: Capital that would otherwise be used instead flows to either the maritime industry or to California oil producers.¹³

Frequency of Price Test Reflects Practical and Market Considerations

Although oil prices change frequently, DOE makes its required price test determination semiannually, at the time the NPR oil is sold. Doing so more often would increase administrative and pipeline company costs and reduce the security of contracts in the eyes of prospective buyers. DOE's contract does not lock in a fixed price to be paid over 6 months. The price is adjusted monthly during the contract to reflect changes in market prices.

Given this arrangement, if prices received in the middle of a contract fell below the price that the SPR was paying for oil, DOE could do little except terminate or modify the contract. Introducing such uncertainty into DOE's contracts could result in buyers' making lower bids to account for the added expense of replacing NPR oil on short notice. Furthermore, without the certainty of a 6-month contract, pipeline companies would likely charge the government higher rates to ship oil to the SPR. Alternatively, if market conditions changed during contract periods in which DOE was shipping oil to the SPR, DOE would have to reoffer the oil for sale in California. This process would be costly and time-consuming.

¹²Section 901 of the Merchant Marine Act of 1936, as amended, requires federal agencies to ensure that at least 50 percent of their cargo transported on ocean vessels in a calendar year is transported by privately owned U.S.-flag vessels.

¹³If policymakers are interested in minimizing the costs of acquiring oil for the SPR, one way would be to accept oil shipped on U.S.-flag tankers only when the price of the oil delivered is competitive.

A related issue is whether DOE's revenues could be enhanced by using shorter- or longer-term contracts. We found no consensus among oil companies on whether they would bid more for NPR oil sold through contracts that were longer or shorter than 6 months.

DOE Has Several Opportunities to Enhance Revenues

The price the government receives for NPR oil is affected by the method DOE uses for pricing NPR oil, a current ban on exporting Alaskan oil, the preference that DOE grants to small refiners in the purchase of NPR oil, and DOE's billing practice and marketing strategies. In addition, DOE is considering several changes to the operation of the NPR that could significantly affect revenues.

Current Basis for Pricing NPR Oil May Result in Lower Revenues

The current basis for pricing NPR oil—the average of the spot prices for ANS oil and ARCO's Line 63 oil at Los Angeles—may result in lower revenues. Transactions in the ANS and Line 63 spot markets are dwindling and may be causing some buyers of NPR oil to lower their bids. Buyers discount their bids to compensate for the risk that DOE's "base" and "monthly" reference prices—the prices used as the basis for bidding and determining the actual price to be paid each month during the 6-month contract term—may not reflect market conditions.¹⁴

According to the Chief of DOE's Contract Operations Branch, which oversees NPR oil sales, the basis for pricing NPR oil should meet several criteria. First, it must reflect the California market because that is where NPR oil is sold and where most of its buyers are located. Second, it must reflect enough transactions to yield a reliable price. Finally, it must not be subject to manipulation.

The current pricing basis meets the first criterion but not the other two. It is based on fewer and fewer transactions and, in the absence of transactions, on a notional price quote—a best guess of the price at which transactions would have occurred. Often this estimated price is the result of discussions between the price-quoting service and the oil companies participating in the spot markets. A market in which there are many transactions is termed a "liquid" market. Such a market provides the most reliable data on the market price of a commodity and is less subject to manipulation than a "thin" market—one with few transactions. This lack of liquidity is currently most pronounced for the Line 63 component of the basis used for pricing NPR oil.

¹⁴Faced with price uncertainty, risk-averse buyers will discount their bids.

Because the method for calculating the monthly reference price is specified in DOE's sales contracts, DOE cannot use alternative means of calculating this price when there are insufficient transactions. Furthermore, as ANS production declines, the spot market for ANS will become thinner. As a result, the reliability of the base and monthly reference prices is decreasing.

California oil industry officials told us that the thinness of spot markets for ANS and Line 63 oil causes them to discount their bids to compensate for the risk that the base and monthly reference prices do not reflect market conditions. As spot transactions of ANS and Line 63 oil decrease, the size of this discount could increase.

WTI is traded on the New York Mercantile Exchange (NYMEX), one of the most liquid crude oil markets in the world. Some oil company officials believe that DOE should base its price for NPR on the price of WTI, arguing that doing so would facilitate the hedging of purchases on the NYMEX, thereby reducing a purchaser's financial risk.¹⁵ On the other hand, some California refiners told us that changing the pricing basis for NPR oil to WTI would result in large bid discounts because they do not know the Gulf Coast market and believe it could move independently of the California market, thereby increasing their price risk. However, we found a high correlation between spot price movements for WTI and DOE's current pricing basis for NPR oil.

Another alternative would be to eliminate Line 63 from the pricing basis, thereby reducing reliance on notional price quotes. However, the spot market for ANS is getting thinner as production declines. Furthermore, some California oil industry officials expressed concern that one company, as a major supplier of ANS to Los Angeles and the Gulf Coast, is in a position to directly influence its spot price.

Lifting the Ban on Alaskan Oil Exports Could Enhance Revenues

Prices for crude oil in California are generally lower than prices for similar crude oils in other parts of the United States and the world because crude oil is relatively abundant in the state. One source of this supply is Alaska's North Slope. A principal reason ANS is shipped to California is that, by law, it can not be exported, and California is the nearest domestic market.

¹⁵Crude oil futures are used largely by those who are holding oil in inventory or who have contracted for delivery of oil at a set price to protect against losses resulting from price changes. Futures contracts are essentially a financial instrument; fewer than 1 percent of contracts result in actual delivery.

In 1990, GAO examined the implications of lifting the export ban.¹⁶ For the two periods studied (1988 and 1995), we found that ANS exports, primarily to Japan and other Asian markets, would be substantial in the absence of the ban. We also estimated higher prices for Alaskan crude oil and crude oils produced on the West Coast, including NPR oil. The magnitude of this price increase depended on the volume of Alaskan crude exported. We also found that as production of Alaskan crude oil declines, the effect on West Coast crude oil prices of lifting the export ban diminishes.

The results we reported were due largely to the types of products that ANS yields and the different demands of the West Coast and the Far East markets. The California market was characterized by a high demand for gasoline, while the Far East market was characterized by a high demand for petroleum distillate and residual fuel oils. Alaskan crude oil produces a small fraction of gasoline products and a larger fraction of fuel oils.

Adopting Industry Practices Could Enhance Revenues but Hurt Other Policy Objectives

Sales and contract terms for NPR oil differ from industry practices. Some of these differences arise from legislative constraints on NPR oil sales imposed to meet other policy objectives. DOE also bills purchasers of NPR oil more frequently than oil companies bill their customers, tying up funds that its customers could have put to other uses and resulting in greater administrative costs for itself and its customers. According to oil company officials, these costs are reflected in lower bids. Several companies and DOE officials also told us that NPR oil should be marketed more aggressively.

To promote the economic viability of small refineries and ensure access to NPR oil, the Congress included two provisions in the NPR Production Act. First, DOE can give preference to small refiners in the purchase of up to 25 percent of the NPR oil being sold when it and the Secretary of the Interior determine that (1) these refiners do not have adequate alternative supplies and (2) selling crude oil to these refiners under the preference serves the public interest.

According to officials from the NPR and DOE's Office of General Counsel, this determination has not been supported by an analysis of the small refiners' supplies of crude oil—the first part of the statutory test for invoking the preference. NPR invitations for bids state that this preference will be invoked when small refiners do not win 25 percent of the oil being

¹⁶Energy Security: Impacts of Lifting Alaskan North Slope Oil Exports Ban (GAO/RCED-91-21, Nov. 8, 1990) and Alaskan Crude Oil Exports (GAO/T-RCED-90-59, Apr. 5, 1990).

sold. Since 1983, DOE has invoked the preference nine times, and small refiners have paid the price bid by the company displaced as a result of the preference granted. However, DOE and California oil company officials told us that the preference provision causes both small and large oil firms to discount their bids. According to these officials, large refiners react to the possibility of losing oil they would otherwise have won by discounting their bids.¹⁷ At the same time, small refiners bid lower amounts in an effort not to win the oil outright so that they can then obtain it at what might be a lower price if the preference is invoked.

Second, the act prohibits DOE from selling to one buyer more than 20 percent of the NPR oil offered. As NPR production declines, this requirement increasingly constrains some potential buyers and may result in lower revenues because those that value the oil highly are limited in the amounts they can buy.

DOE bills purchasers of NPR oil weekly. However, standard industry practice calls for payment by the 20th day of the month following delivery. DOE's more frequent billing increases administrative costs, requiring four payments instead of one. It also imposes time-value-of-money costs that purchasers do not face when purchasing oil on the open market. According to oil company officials we spoke with, purchasers of NPR oil discount their bids to reflect these two factors.

Nevertheless, if DOE changed its billing to conform with industry practice, the risk to the government would increase because it would be carrying larger accounts receivable. According to DOE officials, DOE might be required to raise the performance guarantee it requires bidders to provide; this guarantee is currently equal to the estimated value of 35 days' worth of oil deliveries. If the guarantee were raised, some potential buyers could lower their bids. Alternatively, DOE could choose to waive some or all of the performance guarantee for creditworthy companies or allow only such companies to pay for NPR purchases on a monthly basis. Private sellers of crude oil typically do not require performance guarantees from creditworthy buyers.

NPR officials concede that there has been little emphasis on marketing NPR oil. DOE employs one headquarters staff part-time on marketing activities. While the Director of the NPR in California thought there would be some benefit to having a full-time marketing position at Elk Hills, he did not

¹⁷From the large refiners' perspective, the preference is an encumbrance because it adds an uncertainty not present in private oil sales.

expect higher bids as a result because NPR oil is sold by competitive bid. DOE recently announced that it was moving the NPR sales program to Elk Hills. However, it is not clear what role the Elk Hills staff will have in marketing NPR oil as a result of this change. In our view, aggressive marketing of NPR oil could induce additional bidding and higher bids. In fact, the refinery yield analysis described in appendix I provides information that could be used to market NPR oil. For instance, it illustrates the refinery configurations that can derive the highest value from NPR crude oil; refineries with such configurations might thus be induced to offer the best price for this oil.

DOE Is Considering Major Changes to NPR Operations

DOE is currently considering several more fundamental changes in the NPR's current operating arrangement. The administration's fiscal year 1995 budget request calls for the restructuring of the NPR at Elk Hills "by leasing, sale, farmout, or other means." In addition, DOE is currently studying the notion of converting the NPR from a DOE program to a government-chartered corporation.¹⁸

Conclusions

In a well-functioning market for crude oil, the gap between the prices for NPR and comparable oil in the Gulf Coast and mid-continent regions can be explained by differences in product yields and transportation costs. Consequently, the government will find it difficult to increase revenues by selling NPR oil to refiners from these regions.

DOE could potentially increase the bids and therefore the revenues it receives by addressing several constraints and practices it engages in as an oil producer and seller. For example, DOE could replace the oil price index it uses to make price adjustments with a price indicator based on a larger number of transactions and price quotes. One alternative would be an index based on transactions for West Texas Intermediate crude oil. To the extent that bidders found it easier to predict future movements of the new price index, this change could result in somewhat higher bids.

DOE could also ensure that it did not unnecessarily invoke the preference for small refiners to purchase 25 percent of its oil if it first determined that these refiners lack adequate supplies of crude oil, as set forth in the NPR Production Act. In addition, by billing purchasers of NPR oil on the

¹⁸The Senate report accompanying the National Defense Authorization Act for fiscal year 1994 (S. Rep. No. 112, 103d Cong., 1st Sess. at 241 (1993)) directed DOE to study this alternative and report back to the House and Senate Committees on Armed Services by May 1, 1994. As suggested in the Senate report, DOE enlisted the National Academy of Public Administration to conduct this study.

common industry schedule, monthly rather than weekly, DOE could encourage bidders not to discount their bids to account for additional costs resulting from more frequent billing. Furthermore, DOE could minimize the risk to the taxpayer of the government's carrying larger accounts receivable by only offering this payment option to creditworthy buyers. Alternatively, it could offer this option to all buyers and require a larger performance guarantee from companies that pose a credit risk.

Finally, DOE could market its crude oil more aggressively, possibly resulting in more and better-informed bidders and somewhat higher winning bids. More aggressive marketing would require devoting greater resources to the marketing function, particularly in California. In addition, it would entail contacting potential buyers regularly to provide them with complete assays of the oil, learn their needs and requirements for crude oil supplies, discuss the logistics of obtaining NPR oil, and educate them on DOE's sales process. It is not clear whether DOE's recently announced decision to move the NPR sales program to Elk Hills includes the transfer of the marketing function.

While changing some of its sales procedures to more closely mirror oil industry practices should enhance government revenues, DOE may have to change the operation of the NPR more fundamentally to achieve and maintain the efficiencies and profitability of a private oil producer. While we have not evaluated DOE's proposal for converting the NPR from a DOE program to a government-chartered corporation, our work suggests that net government revenues should rise to the extent that such a corporation is free to maximize profits.

Recommendations

In order to maximize opportunities to enhance revenues to the government from the sale of NPR oil, the Secretary of Energy should direct DOE to

- seek an alternative to the index it currently uses to establish and adjust prices for NPR oil that reflects enough transactions to yield a reliable price and is not subject to manipulation;
- conduct the required analysis to ascertain whether small refiners have adequate alternative sources of crude oil before granting them preference in the purchase of NPR oil;
- consider changing its billing practice to conform to standard industry practice, which requires payment on the 20th day of the month following

delivery and performance guarantees from buyers that pose a credit risk, and

- take steps to market NPR oil more aggressively, such as establishing a marketing presence in California and contacting prospective buyers regularly to educate them on the NPR sales process and the logistics of transporting NPR oil.

Agency Comments and Our Evaluation

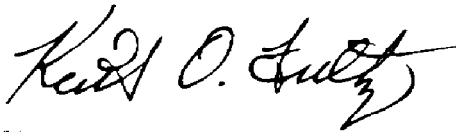
In commenting on a draft of this report, DOE expressed general agreement with our findings. The agency added that it is continuing to explore options for enhancing revenues from NPR operations beyond those analyzed in this report. DOE agreed with our recommendation that it consider alternatives to the index currently used to price NPR oil. DOE did not comment on our recommendations that it (1) conduct the required analysis before invoking the purchasing preference for small refiners and (2) take steps to market NPR oil more aggressively. DOE disagrees with our recommendation that buyers be allowed to pay monthly, rather than weekly, for oil purchases and that performance guarantees be required only from companies that pose a credit risk. In the agency's view, the risk of default from the larger accounts receivable that would result from monthly billing is too great. We believe that this risk is acceptable for creditworthy buyers. DOE could choose not to allow monthly billing for companies that pose a credit risk and/or could require such companies to post a guarantee to ensure payment. DOE's comments are reproduced in appendix II.

To determine the potential for DOE to enhance government revenues by selling NPR oil to Gulf Coast and mid-continent refiners, we contacted oil industry officials, analyzed oil prices and transportation costs, and contracted with a consultant to analyze the value of NPR oil. We did not verify our consultant's calculations, but we did review the quality control procedures used. To identify significant barriers to shipping NPR oil to Gulf Coast and mid-continent refiners, we interviewed pipeline company and SPR officials. To ascertain whether DOE omitted any significant factors in determining whether NPR oil prices were high enough, we analyzed agency records. To identify other options for enhancing revenues from the NPR, we reviewed the current NPR sales process and interviewed officials from DOE's NPR, General Counsel, and Procurement offices and from oil companies. Details of our scope and methodology appear in appendix III. We conducted our review from May 1993 to March 1994 in accordance with generally accepted government auditing standards.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Secretary of Energy. We will make copies available to others on request.

This work was performed under the direction of Victor S. Rezendes, Director, Energy and Science Issues, who may be reached at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix IV.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Keith O. Fultz". The signature is written in a cursive, somewhat stylized script.

Keith O. Fultz
Assistant Comptroller General

Contents

| | | |
|---|---|-----------|
| Letter | | 1 |
| Appendix I | | 18 |
| Modeling Analysis of the Refinery Yield of NPR Crude Oil | | |
| | Analysis of Crude Oil Assay Data | 18 |
| | Historical and Projected Prices Used in the Model | 20 |
| | Structure of the Linear Program Model | 21 |
| | Calculation of Refining Values | 31 |
| | Estimation of the Effects of Crude Oil Contaminants on the Refining Value of NPR Crude Oil | 32 |
| | Shipping Costs Are a Significant Determinant of the Overall Value of NPR Crude Oil in Each Region | 34 |
| | California Yielded the Highest Net Values for NPR Crude Relative to the Marker Crudes | 35 |
| Appendix II | | 37 |
| Comments From the Department of Energy | GAO Comments | 41 |
| Appendix III | | 44 |
| Objectives, Scope, and Methodology | | |
| Appendix IV | | 46 |
| Major Contributors to This Report | | |
| Tables | | |
| | Table I.1: Distillation Yields and Qualities of Crude Oils | 19 |
| | Table I.2: Incremental Crude Yields, Gulf Coast, Coker Configuration | 23 |
| | Table I.3: Incremental Crude Yields, Gulf Coast, FCC Configuration | 24 |
| | Table I.4: Incremental Crude Yields, Gulf Coast, Hydroskimmer Configuration | 25 |
| | Table I.5: Incremental Crude Yields, Mid-Continent, Coker Configuration | 26 |
| | Table I.6: Incremental Crude Yields, Mid-Continent, FCC Configuration | 27 |

| | |
|---|----|
| Table I.7: Incremental Crude Yield, Mid-Continent, Hydroskimmer Configuration | 28 |
| Table I.8: Incremental Crude Yields, West Coast, Coker Configuration | 29 |
| Table I.9: Incremental Crude Yields, West Coast, FCC Configuration | 30 |
| Table I.10: Incremental Crude Yields, West Coast, Hydroskimmer Configuration | 31 |
| Table I.11: Estimated 1994 NPR Crude Oil Values—FOB Elk Hills—in Dollars per Barrel | 35 |

Figure

| | |
|---|---|
| Figure 1: Comparison of NPR Prices and WTI Spot Prices, Adjusted for Transportation and Quality | 4 |
|---|---|

Abbreviations

| | |
|-------|---|
| ANS | Alaskan North Slope |
| API | American Petroleum Institute |
| DOE | Department of Energy |
| FAR | Federal Acquisition Regulations |
| FCC | fluid catalytic cracking |
| FOB | free on board |
| GAO | General Accounting Office |
| LP | linear programming |
| LPG | liquified petroleum gases |
| mmbtu | million British thermal units |
| MTBE | methyl tertiary butyl ether |
| NPR | Naval Petroleum Reserve |
| NYMEX | New York Mercantile Exchange |
| OPEC | Organization of Petroleum Exporting Countries |
| ppm | parts per million |
| PADD | Petroleum Administration for Defense District |
| RPMS | Refining and Petrochemical Modeling System |
| SPR | Strategic Petroleum Reserve |
| VGO | vacuum gas oil |
| WTI | West Texas Intermediate |

Modeling Analysis of the Refinery Yield of NPR Crude Oil

This appendix presents the methodology and results of the modeling analysis of the refinery yield of the government-owned crude oil from the Naval Petroleum Reserve No. 1 (NPR-1)¹ at Elk Hills, California.² Specifically, the purpose of the model was to estimate the refinery yield value of NPR crude oil relative to a marker or benchmark crude in three different generic refinery configurations of varying complexity in three U.S. refining regions. The three refinery configurations modeled were, in order of increasing complexity: (1) topping/hydroskimming, (2) fluid catalytic cracking (FCC), and (3) coking. The three refinery markets modeled were the (1) Gulf Coast (PADD III³), (2) mid-continent (PADD II), and (3) Los Angeles basin (PADD V). West Texas Intermediate (WTI) crude was used as the marker crude for comparison in the Gulf Coast and mid-continent markets, while WTI and Alaskan North Slope (ANS) crudes were used as the marker crudes for comparison in the Los Angeles market.

The analytical framework used to determine the refining value of NPR crude oil relative to the marker crudes involved

- analysis of assay data on the crude oils to determine the distillation (straight-run) yields and qualities of NPR crude oil and the marker crudes;
- the development of historical and projected (1994) data on the prices for petroleum and refined products in the three refining regions;
- the development of linear programming models to determine yield patterns for finished products of the crudes;
- calculation of refinery values for NPR crude oil and the marker crudes;
- calculation of the effects of crude oil contaminants—metals, nitrogen, and acidity—on the refining value of NPR crude oil;
- estimation of transportation costs; and
- estimation of the overall value of NPR crude oil relative to the marker crudes.

Analysis of Crude Oil Assay Data

A crude oil assay is a laboratory analysis of crude oil to determine its potential yield and quality characteristics. GAO obtained the assay data for NPR crude from the Department of Energy (DOE).⁴ The assay data for NPR

¹More specifically, we examined the yield of crude oil from the Stevens zone of this oil field.

²To perform the modeling, GAO contracted with Bonner & Moore Associates, Inc., a refinery modeling and crude oil market consulting firm based in Houston, Texas.

³PADD stands for Petroleum Administration for Defense Districts. California is part of PADD V.

⁴The assay laboratory analysis was performed by the National Institute of Petroleum and Energy Research.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

crude oil, WTI, and ANS were run through Bonner & Moore's ASSAY 2000 model to generate the properties of the distillation cuts, or fractions, and the yields of each crude. This process provided the volumetric yields and the associated qualities of each crude's initial product components or fractions, as shown in table I.1.

Table I.1: Distillation Yields and Qualities of Crude Oils

| | Crude oil | | |
|---|------------|------------|------------|
| | NPR | WTI | ANS |
| Gravity (degree API) | 36.4 | 40.5 | 27.2 |
| Percent of sulfur | 0.56 | 0.35 | 1.00 |
| Volumetric yields, in percents | | | |
| NGL-naphtha (400°F EP) | 40.0 | 42.4 | 21.0 |
| Jet (400-550°F) | 14.1 | 14.8 | 14.4 |
| Diesel (550-650°F) | 9.2 | 9.4 | 11.8 |
| VGO (650-1050°F) | 25.7 | 25.2 | 32.6 |
| Resid (1050+°F) | 11.0 | 8.3 | 20.1 |
| Total | 100 | 100 | 100 |
| Quality of crude fraction | | | |
| Mid naphtha (200-330), N+2A | 71.4 | 59.2 | 75.0 |
| Jet | | | |
| Percent of sulfur | 0.16 | 0.26 | 0.17 |
| Smoke point (mm) | 21.1 | 18.30 | 17.0 |
| Diesel | | | |
| Percent of sulfur | 0.38 | 0.16 | 0.58 |
| Cetane number | 50.3 | 53.5 | 47.5 |
| Cloud point (°F) | 22.2 | 25.4 | 6.4 |
| VGO UOP K factor | | | |
| 800-900°F | 11.77 | 11.92 | 11.87 |
| 900-1050°F | 11.59 | 12.17 | 11.94 |
| VGO aniline point | | | |
| 800-900°F | 175 | 208 | 173 |
| 900-1050°F | 176 | 213 | 182 |
| Neutralization no. (mg KOH/g), 650-1050°F | 0.4 | 0 | 0.14 |
| Nitrogen, total weight in ppm, 650-1050°F | 4,900 | 1,350 | 1,400 |
| Vacuum resid | | | |
| Percent of sulfur | 1.43 | 1.16 | 2.30 |
| Degrees API | 5.3 | 12.7 | 7.1 |
| Nickel | 183 | 31 | 57 |
| Vanadium | 183 | 37 | 117 |

As the table shows, although the basic gravity and sulfur properties of NPR and WTI crudes are fairly similar, the overall distillation yields and qualities of NPR crude are lower than those of WTI. On the other hand, the distillation yields of NPR crude are quantitatively and qualitatively superior to those of ANS. In summary, the major distillation differences between NPR crude oil and WTI are as follows:⁵

- Overall, WTI yields a higher proportion of high-valued products than NPR crude.
- WTI yields a lower proportion of low-valued, vacuum residual fuel oil (resid) than NPR crude (8 percent vs. 11 percent).
- The quality of the naphtha fraction for NPR crude is superior to the naphtha fraction for WTI.
- The sulfur content of WTI's distillate and heavy fuel oil fractions is lower than that of NPR crude.
- WTI's diesel combustion property (cetane) is superior to that of NPR crude.
- WTI has a better quality—that is, a higher k-factor and aniline point in the VGO cut (for FCC or lube processing)—than NPR crude.
- NPR crude has a significantly higher level of crude oil contaminants (metals, nitrogen, acidity) than WTI.

These yield and quality patterns determined the ultimate refining yield values calculated by the linear programming (LP) model for each crude “at the refinery gate”—that is, exclusive of transportation costs.

Historical and Projected Prices Used in the Model

Historical and projected quarterly price data on crude oil and refined products were used to run the LP models that estimated the values of NPR crude in each refinery configuration and region.⁶ The historical data were collected from published sources including Platt's Oilgram and Oil Price Information Service. The 1994 data were forecast by Bonner & Moore. Crude oil forecasts were based on Bonner & Moore's assessment of world oil supply and demand in general, and for the United States in particular, including the Organization of Petroleum Exporting Countries' (OPEC) likely actions during the period. Price projections for refined products for 1994 were estimated to reflect the impact of Clean Air Act requirements for oxygenated gasolines and low-sulfur distillates.

⁵We provide a summary only of NPR-1 and WTI distillation differences because WTI is the crude that NPR-1 is likely to displace in the Gulf Coast and mid-continent markets and because NPR-1 crude and WTI are more similar than are NPR-1 crude and ANS.

⁶Projected price data were used for the 4th quarter of 1993, as well as for all of 1994.

In keeping with industry practice, this analysis assumes that the source of incremental refinery fuel supply is natural gas. The historical and projected spot prices for natural gas used in the analysis reflect the delivered price to large industrial consumers in each of the three regions. Similarly, all prices for crude oil and refined products are the relevant spot quotes in the regional markets under consideration. Spot prices were used because spot transactions most closely reflect incremental refining economics. All prices have been adjusted as necessary to approximate values at the refinery gate.⁷

Although the price projections reflect the general supply and demand outlook for both crude oil and petroleum products in 1994, price forecasts can be expected to deviate from actual prices. However, this should not significantly alter the ultimate results because relationships among petroleum prices are more significant to this analysis than absolute price levels. The forecast assumes that the relationships between WTI and ANS, and between these crudes and other internationally traded crudes, should not change significantly in 1994 relative to 1993.

Furthermore, no significant changes in the relationships of product prices to crude oil prices are expected in 1994, except for the typical seasonal variations. According to Bonner & Moore, while a very modest increase in average refining margins is expected from 1993 to 1994, as a result of a gradually strengthening domestic market balance, this should not have significant implications for the results of this analysis. In addition, the spreads among the prices projected for individual products (e.g., light products vs. fuel oils) are not expected to deviate greatly from historical trends.

Structure of the Linear Program Model

Using its Refining and Petrochemical Modeling System (RPMS 2000), Bonner & Moore developed and ran LP refining models to estimate the yield value of NPR crude and the marker crudes in each of the aggregate refinery configurations described above. The LP analysis was performed for each of the three U.S. refining regions.

To determine the regional yield value of NPR crude relative to the marker crudes in the three refinery configurations, each crude was modeled as an incremental crude above a base crude slate that approximates the region's

⁷Prices at the refinery gate represent the delivered costs of crude oil and other refinery inputs to the refiner and the spot prices of refined products, less transportation costs from the refinery to the market.

Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil

actual aggregate crude slate in API gravity and sulfur.⁸ For example, the modeled API gravities and sulfur contents (in percents) for crude slates for the Gulf Coast, the mid-continent, and California were 33.50/1.23, 34.24/1.07, and 27.54/1.20, compared with 1992 actual values of 32.37/1.23, 33.94/1.09, and 24.95/1.19, respectively.

Tables I.2 through I.10 present the incremental refinery yield patterns of NPR, WTI, and ANS crudes for each refinery configuration in each of the three regions, as calculated by the LP model. To obtain the product yield percentages presented in the tables, the model was designed to maximize the refinery yields of the higher-valued products while minimizing the yields for the lower-valued products for each crude, consistent with the prices of the respective products and refining costs. The tables show the quantity of each refined product, the cost of each type of raw material used, and the costs of utilities (e.g., electricity), all expressed as a percentage of a barrel of crude oil. To account for seasonal variations in product demand and price patterns, the LP models were calibrated to estimate the incremental refined product yield of each crude for summer and winter, corresponding to "maximum gasoline production" and "maximum distillate production" scenarios, respectively.

⁸DOE's Energy Information Administration publishes annually the aggregate crude slate API gravity and sulfur for each PADD.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

**Table I.2: Incremental Crude Yields,
Gulf Coast, Coker Configuration**

| | Summer | | Winter | |
|---|--------|-------|-------------------|-------|
| | NPR | WTI | NPR | WTI |
| Product^a (percentage per barrel of crude) | | | | |
| Unleaded regular | 15.80 | 13.20 | 0.07 | 0.72 |
| Unleaded premium | 40.87 | 55.90 | 47.02 | 49.01 |
| Diesel | 40.63 | 29.31 | 47.41 | 53.99 |
| Medium-sulfur fuel oil (1%) | -9.15 | -9.17 | -0.42 | -8.63 |
| High-sulfur fuel oil (3%) | 3.61 | 3.54 | 0.66 | 2.47 |
| Normal butane | 1.73 | 0.92 | N.A. ^b | N.A. |
| LPG | 4.64 | 5.80 | 4.10 | 4.57 |
| Plant fuel gas | 4.50 | 5.28 | 4.37 | 4.46 |
| Coke | 0.73 | 0.25 | 0.73 | 0.25 |
| Sulfur (tons) | 0.05 | 0.04 | 0.05 | 0.04 |
| Raw materials used (percentage per barrel of crude) | | | | |
| Iso butane | 2.91 | 2.48 | 1.15 | 1.03 |
| Normal butane | N.A. | N.A. | 1.30 | 1.98 |
| MTBE | N.A. | N.A. | 1.51 | 1.59 |
| Utilities used (per barrel of crude) | | | | |
| Catalyst/chemicals (\$) | 0.22 | 0.23 | 0.16 | 0.16 |
| Plant fuel (MMBTU) | 0.23 | 0.23 | 0.16 | 0.17 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

**Table I.3: Incremental Crude Yields,
Gulf Coast, FCC Configuration**

| | Summer | | Winter | |
|--|--------|-------|-------------------|--------|
| | NPR | WTI | NPR | WTI |
| Products^a (percentage per barrel of crude) | | | | |
| Unleaded regular | 6.07 | 10.54 | 4.09 | 6.19 |
| Unleaded premium | 44.28 | 43.13 | 52.48 | 57.49 |
| Aviation jet fuel | 20.14 | 32.52 | 41.69 | 64.96 |
| Diesel | 6.90 | -3.57 | -14.98 | -39.10 |
| High sulfur fuel oil (3%) | 17.22 | 11.71 | 17.48 | 11.79 |
| Normal butane | 1.62 | 1.00 | N.A. ^b | N.A. |
| LPG | 3.83 | 4.44 | 4.02 | 4.90 |
| Plant fuel gas | 4.83 | 5.08 | 4.37 | 4.83 |
| Sulfur (tons) | 0.02 | 0.01 | 0.04 | 0.03 |
| Raw materials used (percentage per barrel of crude) | | | | |
| Iso butane | 2.03 | 1.97 | 2.66 | 3.38 |
| Normal butane | N.A. | N.A. | 1.92 | 2.75 |
| MTBE | N.A. | N.A. | 1.79 | 2.01 |
| Utilities used (per barrel of crude) | | | | |
| Catalyst/chemicals (\$) | 0.18 | 0.19 | 0.20 | 0.22 |
| Plant fuel (MMBTU) | 0.13 | 0.13 | 0.17 | 0.18 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil

**Table I.4: Incremental Crude Yields,
 Gulf Coast, Hydroskimmer
 Configuration**

| | Summer | | Winter | |
|---|--------|-------|-------------------|-------|
| | NPR | WTI | NPR | WTI |
| Product^a (percentage per barrel of crude) | | | | |
| Unleaded premium | 28.21 | 27.69 | 28.14 | 30.23 |
| Aviation jet fuel | 20.68 | 36.12 | 24.69 | 36.70 |
| Diesel | 4.97 | -7.29 | 4.37 | -6.89 |
| Medium-sulfur fuel oil (1%) | 7.08 | 16.42 | 7.08 | 16.42 |
| High-sulfur fuel oil (3%) | 31.49 | 18.90 | 31.49 | 18.90 |
| Normal butane | 1.47 | 1.22 | N.A. ^b | N.A. |
| LPG | 3.71 | 4.29 | 3.62 | 4.26 |
| Plant fuel gas | 2.84 | 3.07 | 2.49 | 2.91 |
| Sulfur (tons) | 0.01 | 0.01 | 0.01 | 0.01 |
| Raw materials used (percentage per barrel of crude) | | | | |
| Iso butane | N.A. | N.A. | N.A. | N.A. |
| Normal butane | N.A. | N.A. | 0.49 | 1.03 |
| MTBE | N.A. | N.A. | 0.93 | 0.99 |
| Utilities used (per barrel of crude) | | | | |
| Catalyst/chemicals (\$) | 0.07 | 0.07 | 0.06 | 0.07 |
| Plant fuel (MMBTU) | 0.13 | 0.14 | 0.14 | 0.14 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

**Table I.5: Incremental Crude Yields,
Mid-Continent, Coker Configuration**

| | Summer | | Winter | |
|---|--------|-------|-------------------|-------|
| | NPR | WTI | NPR | WTI |
| Product^a (percentage per barrel of crude) | | | | |
| Unleaded regular | 11.99 | 9.55 | -3.23 | -8.96 |
| Unleaded premium | 56.46 | 70.30 | 49.03 | 45.48 |
| Diesel | 20.29 | 9.90 | 49.28 | 59.76 |
| Medium-sulfur fuel oil (1%) | 0.03 | 0.03 | 0 | 0.01 |
| High-sulfur fuel oil (3%) | 1.56 | 1.50 | 0.43 | -0.45 |
| Normal butane | 0.97 | 0.15 | N.A. ^b | N.A. |
| LPG | 5.35 | 6.48 | 3.99 | 3.94 |
| Plant fuel gas | 6.00 | 7.20 | 4.21 | 3.91 |
| Coke | 0.73 | 0.25 | 0.73 | 0.25 |
| Sulfur (tons) | 0.05 | 0.04 | 0.05 | 0.04 |
| Raw materials used (percentage per barrel of crude) | | | | |
| Iso butane | 2.58 | 2.13 | 0.79 | -1.01 |
| Normal butane | N.A. | N.A. | 1.86 | 1.95 |
| MTBE | N.A. | N.A. | 2.00 | 1.63 |
| Utilities used (per barrel of crude) | | | | |
| Catalyst/chemicals (\$) | 0.23 | 0.25 | 0.15 | 0.10 |
| Plant fuel (MMBTU) | 0.18 | 0.15 | 0.17 | 0.14 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

**Table I.6: Incremental Crude Yields,
Mid-Continent, FCC Configuration**

| | Summer | | Winter | |
|---|--------|-------|-------------------|-------|
| | NPR | WTI | NPR | WTI |
| Product^a (percentage per barrel of crude) | | | | |
| Unleaded regular | 7.86 | 12.16 | -1.64 | -1.63 |
| Unleaded premium | 44.00 | 43.61 | 50.45 | 54.21 |
| Aviation jet fuel | 17.54 | 28.23 | -0.16 | 11.29 |
| Diesel | 8.15 | -1.25 | 35.56 | 26.34 |
| High sulfur fuel oil (3%) | 17.42 | 11.91 | 16.18 | 10.15 |
| Normal butane | 1.23 | 0.56 | N.A. ^b | N.A. |
| LPG | 3.88 | 4.52 | 3.51 | 4.21 |
| Plant fuel gas | 4.65 | 4.96 | 4.41 | 4.82 |
| Sulfur (tons) | 0.03 | 0.02 | 0.01 | 0.01 |
| Raw materials used (percentage per barrel of crude) | | | | |
| Iso butane | 2.01 | 1.94 | 1.41 | 1.64 |
| Normal butane | N.A. | N.A. | 2.15 | 2.83 |
| MTBE | N.A. | N.A. | 2.12 | 2.28 |
| Utilities used (per barrel of crude) | | | | |
| Catalyst/chemicals (\$) | 0.19 | 0.19 | 0.16 | 0.17 |
| Plant fuel (MMBTU) | 0.15 | 0.15 | 0.12 | 0.11 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due refinery inputs other than crude oil.

^bN.A. = not applicable.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

**Table I.7: Incremental Crude Yield,
Mid-Continent, Hydroskimmer
Configuration**

| | Summer | | Winter | |
|---|--------|-------|-------------------|-------|
| | NPR | WTI | NPR | WTI |
| Product^a (percentage per barrel of crude) | | | | |
| Unleaded premium | 28.09 | 28.11 | 28.92 | 31.04 |
| Aviation jet fuel | 19.11 | 32.75 | 22.07 | 32.14 |
| Diesel | 6.82 | -4.23 | 6.98 | -3.35 |
| Medium-sulfur fuel oil (1%) | 7.27 | 16.99 | 7.27 | 16.99 |
| High-sulfur fuel oil (3%) | 31.30 | 18.33 | 31.30 | 18.33 |
| Normal butane | 1.33 | 1.05 | N.A. ^b | N.A. |
| LPG | 3.72 | 4.32 | 3.56 | 4.19 |
| Plant fuel gas | 2.82 | 3.10 | 2.52 | 2.96 |
| Sulfur (tons) | 0.01 | 0.01 | 0.01 | 0 |
| Raw material used (percentage per barrel of crude) | | | | |
| Iso butane | N.A. | N.A. | N.A. | N.A. |
| Normal butane | N.A. | N.A. | 0.89 | 1.46 |
| MTBE | N.A. | N.A. | 1.30 | 1.39 |
| Utilities used (per barrel of crude) | | | | |
| Catalyst/chemicals (\$) | 0.07 | 0.07 | 0.06 | 0.06 |
| Plant fuel (MMBTU) | 0.13 | 0.14 | 0.12 | 0.12 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

Table I.8: Incremental Crude Yields, West Coast, Coker Configuration

| | Summer | | | Winter | | |
|---|-------------------|-------|-------|--------|--------|-------|
| | NPR | WTI | ANS | NPR | WTI | ANS |
| Product^a (percentage per barrel of crude) | | | | | | |
| Unleaded regular | 11.95 | 12.08 | 27.63 | 0 | 0 | 0 |
| Unleaded premium | 49.19 | 50.61 | 31.78 | 69.50 | 70.73 | 61.65 |
| Diesel | 28.96 | 35.32 | 31.61 | 39.58 | 48.43 | 41.86 |
| Medium-sulfur fuel oil (1%) | 0.26 | -8.07 | 2.94 | -2.63 | -10.75 | 2.95 |
| High-sulfur fuel oil (3%) | 1.02 | 2.94 | 0.69 | 0 | 0.01 | 0 |
| Normal butane | 1.12 | 0.71 | 0.33 | 0 | 0 | 0 |
| LPG | 4.82 | 5.36 | 4.65 | 4.59 | 5.02 | 4.54 |
| Plant fuel gas | 5.62 | 5.78 | 4.94 | 3.20 | 3.25 | 2.94 |
| Coke | 0.66 | 0.29 | 1.07 | 0.66 | 0.29 | 1.07 |
| Sulfur (tons) | 0.05 | 0.03 | 0.09 | 0.06 | 0.04 | 0.10 |
| Raw materials used (percentage per barrel of crude) | | | | | | |
| Iso butane | 2.39 | 2.19 | 4.42 | 2.01 | 1.71 | 3.82 |
| Normal butane | N.A. ^b | N.A. | N.A. | 2.52 | 3.12 | 1.94 |
| MTBE | N.A. | N.A. | N.A. | 9.37 | 9.54 | 8.13 |
| Utilities used (per barrel of crude) | | | | | | |
| Catalyst/chemicals (\$) | 0.22 | 0.22 | 0.26 | 0.20 | 0.19 | 0.25 |
| Plant fuel (MMBTU) | 0.18 | 0.17 | 0.27 | 0.32 | 0.31 | 0.47 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

Table I.9: Incremental Crude Yields, West Coast, FCC Configuration

| | Summer | | | Winter | | |
|---|-------------------|-------|-------|--------|-------|-------|
| | NPR | WTI | ANS | NPR | WTI | ANS |
| Product^a (percentage per barrel of crude) | | | | | | |
| Unleaded regular | 9.90 | 10.44 | 20.08 | 0 | 0 | 0 |
| Unleaded premium | 47.71 | 49.55 | 29.52 | 50.59 | 51.59 | 44.03 |
| Diesel | 19.44 | 22.42 | 21.85 | 37.10 | 42.05 | 34.90 |
| High-sulfur fuel oil (3%) | 17.68 | 11.56 | 27.98 | 17.90 | 10.72 | 30.36 |
| Normal butane | 0.81 | 0.44 | -0.07 | 0 | 0 | 0 |
| LPG | 4.09 | 4.82 | 3.25 | 3.39 | 3.73 | 3.33 |
| Plant fuel gas | 4.98 | 5.28 | 3.74 | 3.79 | 3.99 | 3.14 |
| Sulfur (tons) | 0.04 | 0.03 | 0.05 | 0 | 0 | 0.01 |
| Raw materials used (percentage per barrel of crude) | | | | | | |
| Iso butane | 1.89 | 1.84 | 3.25 | 1.41 | 0.84 | 3.39 |
| Normal butane | N.A. ^b | N.A. | N.A. | 1.41 | 1.91 | 1.74 |
| MTBE | N.A. | N.A. | N.A. | 6.77 | 6.92 | 5.78 |
| Utilities used (per barrel of crude) | | | | | | |
| Catalyst/chemicals (\$) | 0.19 | 0.20 | 0.20 | 0.11 | 0.12 | 0.12 |
| Plant fuel (MMBTU) | 0.14 | 0.14 | 0.20 | 0.12 | 0.10 | 0.20 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

Table I.10: Incremental Crude Yields, West Coast, Hydroskimmer Configuration

| | Summer | | | Winter | | |
|---|--------|-------|-------|------------------|-------|-------|
| | NPR | WTI | ANS | NPR | WTI | ANS |
| Product^a (percentage per barrel of crude) | | | | | | |
| Unleaded premium | 32.35 | 33.81 | 16.86 | 32.90 | 20.70 | 12.20 |
| Diesel | 21.93 | 23.02 | 24.21 | 29.52 | 43.50 | 32.69 |
| Medium-sulfur fuel oil (1%) | 3.65 | 10.02 | 8.25 | 3.45 | 10.57 | 7.75 |
| High-sulfur fuel oil (3%) | 34.38 | 24.37 | 46.34 | 34.22 | 22.90 | 46.41 |
| Normal butane | 1.05 | 0.79 | 0.38 | N/A ^b | N/A | N/A |
| LPG | 4.03 | 4.87 | 2.65 | 3.22 | 3.33 | 2.02 |
| Plant fuel gas | 3.19 | 3.70 | 1.67 | 2.25 | 1.87 | 0.84 |
| Sulfur (tons) | 0.01 | 0 | 0.01 | 0.01 | 0 | 0.01 |
| Raw materials used (percentage per barrel of crude) | | | | | | |
| Iso butane | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| Normal butane | N.A. | N.A. | N.A. | 0.49 | -0.40 | -0.04 |
| MTBE | 0 | 0 | 0 | 4.51 | 2.84 | 1.67 |
| Utilities used (per barrel of crude) | | | | | | |
| Catalyst/chemicals (\$) | 0.07 | 0.07 | 0.04 | 0.05 | 0.05 | 0.03 |
| Plant fuel (MMBTU) | 0.11 | 0.09 | 0.14 | 0.13 | 0.15 | 0.17 |

^aSome products with zero values have been excluded from the table. Totals may exceed 100 percent due to refinery inputs other than crude oil.

^bN.A. = not applicable.

Calculation of Refining Values

The refinery values of NPR crude oil and each of the marker crudes were estimated for the years 1991 through 1994 by quarters, calculated as the sum of the incremental yields times the price of the respective product, less the sum of feedstocks (excluding crude) times feedstock prices and less the sum of the variable processing costs. The basic formula for calculating the refining value for each crude, by region and configuration was determined generically as follows:

Refining value = sum of (product yield x product prices) - sum of (feedstocks x feedstock prices) - sum of variable processing costs

Overall, the average incremental refining value of NPR crude oil is lower than that of WTI across the three refinery configurations and regions, but higher than that of ANS crude in California. Specifically, the average incremental refining value of NPR crude for 1994 is expected to be about

\$0.85 per barrel lower than that of WTI in all three configurations and regions and approximately \$1.30 per barrel higher than that of ANS crude in the three configurations in California. These yield differentials are based on a projected price of \$18.60 per barrel for WTI and a price of \$15.85 per barrel for ANS, respectively, and do not include the effects of crude contaminants.⁹

Estimation of the Effects of Crude Oil Contaminants on the Refining Value of NPR Crude Oil

NPR crude oil, like other crudes produced in California, contains high levels of contaminants, such as heavy metals, nitrogen, and acidity. These contaminants can reduce the refining value of the crude relative to the marker crudes used in this analysis. Generally, the presence of high levels of these elements in crude oil reduces the overall yield and quality of the product stream. Measures to ameliorate the effect of the contaminants raise the processing costs of the crude in the refinery and should be factored into the valuation of the crude oil in question. To determine the discount that buyers would apply as a result of each contaminant for NPR crude oil relative to the marker crudes, Bonner & Moore developed quantitative estimates of the impact on refining costs of the contaminants in NPR and the marker crudes. The final results are expressed as a cost differential between NPR crude and the marker crudes.

Metals

The presence of high levels of heavy metals in crude oil typically damages the catalytic elements used in the refining process, resulting in the degradation of the yield of refined products. The metals in NPR crude oil include iron, nickel, and vanadium; the latter two are of most concern. In a refinery equipped with FCC and coking units, the metals concentrate in the heaviest crude fractions: Approximately 98 percent of the metals are found in the residual oil fraction, and the remaining 2 percent are found in the vacuum gas oil (VGO) cut. These cuts typically require further catalytic processing to maximize the yield of lighter, higher-priced refined products.¹⁰ However, the metals contained in them can reduce the potency of the applicable catalysts, resulting in the production of more of the lower-valued product streams like light cycle oil, decant oil, coke, and hydrogen rather than the higher-valued olefin components like butylene, propylene, and catalytic gasoline.

⁹These yield differentials are sensitive to large swings in the absolute price of crude oil and can be adjusted using the following formula:

$$\text{WTI-NPR}(1) = \$1.00/\text{barrel} + (0.054) \times (\text{WTI} - 18.60)$$

¹⁰The residual oil fraction is processed in the coking unit, while the VGO cut is processed in the FCC unit.

To ameliorate the effect of the metals, the catalysts can be treated with a "metals passivation" agent, such as antimony for nickel and tin for vanadium. The effect can also be offset by increasing the amount of catalyst to maintain the desired yield structure. Bonner & Moore used the higher costs associated with both of these methods to estimate the maximum discount that buyers would apply because of the presence of metals in NPR crude and the marker crudes.

Nitrogen

High levels of nitrogen compounds in crude oil produce an effect similar to that of metals in that they damage or weaken the catalysts in the refining units, resulting in the production of more low-quality products. Nitrogen in liquid fuels also contributes to nitrogen oxide emissions. However, unlike the metals, nitrogen compounds begin to concentrate in the diesel cut and are distributed throughout the VGO cuts, which are fed into the FCC unit for further processing into lighter, more valuable products.

Several measures can be used to reduce the adverse impact of nitrogen on FCC yields. These measures include hydrotreating the feed to the catalytic unit, the use of solid absorbents or immiscible solvents, neutralization, and varying the type of catalyst used in the refinery. These measures add to the refiner's processing costs. To determine the general cost impact of nitrogen compounds in the feed to the FCC unit for the different crudes, Bonner & Moore estimated the change in FCC yields as a function of the nitrogen content of the oil.

Acidity

The presence of high levels of acidity in crude oil typically causes corrosion during processing. Specifically, the corrosion is caused by the presence of naphthenic acids. These acids have high boiling temperatures and, therefore, tend to concentrate in the VGO portion of the crude. Crude oil acidity is typically measured by a neutralization number. The higher the neutralization number, the more acidic the crude and the greater the potential for corrosion in the refinery. In general, California crudes have high acidity levels; as a result, most California refineries have the appropriate metallurgy and/or procedures in place to minimize corrosion due to acidity.

The acidity level of NPR crude oil is low enough so that no treatment is warranted. Bonner & Moore estimated the acidity level in the VGO cut of NPR crude at a neutralization number of about 0.4. This level of acidity is

lower than the 0.5 threshold above which attention is warranted. Moreover, if NPR crude were marketed east of the Rocky Mountains, it would probably be blended with other nonacidic crudes, resulting in even lower acidity levels. Therefore, Bonner & Moore believes that no discount for acidity is warranted for the refinery yield valuation of NPR crude oil.

Crude Contaminants Slightly Reduce the Value of NPR Crude Relative to the Marker Crudes

The total effect of the high levels of crude oil contaminants in NPR crude is estimated at a maximum discount of \$0.25 per barrel for NPR crude relative to the price of WTI, and about \$0.24 per barrel relative to ANS crude. Metals account for \$0.09 per barrel of the discount for NPR crude relative to WTI, while nitrogen accounts for the remaining \$0.16 per barrel discount.¹¹ Similarly, metals account for \$0.09 per barrel of the total contaminants discount for NPR crude relative to ANS crude, while nitrogen contributes the remaining \$0.15 per barrel discount, on average. These amounts represent the high end of the discount for contaminants and could be substantially lower, depending on each refinery's tolerance level for contaminants. For example, the discount of \$0.09 per barrel for metals represents the cost of maintaining the catalyst at a very low metals-on-catalyst equilibrium level of 3,000 parts per million (ppm). This cost, and therefore the discount, can be reduced by half for a refinery that operates at a metals-on-catalyst equilibrium level of 6,000 ppm.

Shipping Costs Are a Significant Determinant of the Overall Value of NPR Crude Oil in Each Region

The refining value of NPR crude relative to WTI and ANS, based on free on board (FOB) Elk Hills prices, is significantly determined by the cost of transporting it to the respective regional markets. The cost of shipping NPR oil from Elk Hills Station in California to Midland, Texas, was estimated at \$1.98 per barrel. This cost was derived from the various costs of transporting the oil via the Santa Fe, Celeron, and All American pipeline routes. Midland, Texas, was chosen as a common delivery point because transportation from there to the Gulf Coast or mid-continent would cost the same for NPR and WTI crude. On the other hand, the cost of shipping NPR crude from Elk Hills to the Los Angeles refining area was estimated at \$0.60 per barrel. This estimate was based on the cost of transporting NPR crude via the Four Corners pipeline from Elk Hills Station to the Hynes Station in the Los Angeles basin. The Los Angeles basin is the pricing point for spot transactions for ANS crude oil.

¹¹The nitrogen discounts represent an average for summer and winter. In the winter, the estimated maximum nitrogen discount is about \$0.13 per barrel, but the discount rises to about \$0.19 per barrel in the summer because the yield degradation due to nitrogen increases during the summer months.

Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil

California Yielded the Highest Net Values for NPR Crude Relative to the Marker Crudes

Refiners in California would place the highest value on NPR crude oil relative to both WTI and ANS under all three refinery configurations, after accounting for yield differentials, discounts for contaminants, and transportation costs. Table I.11 presents the estimated (1994) net values of NPR crude oil relative to WTI and ANS for the three refinery configurations and regions.

Table I.11: Estimated 1994 NPR Crude Oil Values—FOB Elk Hills—in Dollars Per Barrel

| | Region | | | |
|--|----------------|----------------|----------------|-------------------|
| | Gulf Coast | Mid-Continent | West Coast | West Coast |
| Price marker | WTI | WTI | WTI | ANS |
| 1994 price for WTI at Midland, Texas | \$18.60 | \$18.60 | \$18.60 | N.A. ^a |
| 1994 price for ANS at Los Angeles | N.A. | N.A. | N.A. | \$15.85 |
| Coking refinery | | | | |
| Yield differential (WTI minus NPR) | 0.84 | 0.74 | 1.30 | N.A. |
| Yield differential (ANS minus NPR) | N.A. | N.A. | N.A. | -0.77 |
| Discount for contaminants ^b | 0.25 | 0.25 | 0.25 | 0.24 |
| Transportation | 1.98 | 1.98 | 1.98 | 0.60 |
| Net NPR value (FOB Elk Hills) | \$15.53 | \$15.63 | \$15.07 | \$15.78 |
| Catalytic cracking refinery | | | | |
| Yield differential (WTI minus NPR) | 0.74 | 0.88 | 0.71 | N.A. |
| Yield differential (ANS minus NPR) | N.A. | N.A. | N.A. | -1.14 |
| Discount for contaminants ^b | 0.25 | 0.25 | 0.25 | 0.24 |
| Transportation | 1.98 | 1.98 | 1.98 | 0.60 |
| Net NPR value (FOB Elk Hills) | \$15.63 | \$15.49 | \$15.66 | \$16.15 |
| Hydroskimming refinery | | | | |
| Yield differential (WTI minus NPR) | 0.78 | 1.06 | 0.43 | N.A. |
| Yield differential (ANS minus NPR) | N.A. | N.A. | N.A. | -1.95 |
| Discount for contaminants ^b | 0 | 0 | 0 | 0 |
| Transportation | 1.98 | 1.98 | 1.98 | 0.60 |
| Net NPR value (FOB Elk Hills) | \$15.84 | \$15.56 | \$16.19 | \$17.20 |

^aN.A. = not applicable.

^bThe cost of contaminants on the West Coast will probably be significantly less than that shown because of the presence of contaminants in regional crudes and the corresponding adaptation required for processing in the California refining industry.

The hydroskimming refinery configuration in California yielded the highest net value for NPR crude oil relative to WTI and ANS, making this group of California refiners the best target for selling NPR crude. In fact,

**Appendix I
Modeling Analysis of the Refinery Yield of
NPR Crude Oil**

the California market yielded the highest net value for NPR crude relative to ANS for all three configurations—higher than the Gulf Coast and mid-continent markets.

The relatively high net value of NPR crude oil under the hydroskimming configuration in California is, for the most part, due to the light and sweet attributes of the NPR crude compared with most California crudes, as well as the low transportation costs from Elk Hills to the Los Angeles refining market. Because NPR crude is light and sweet, its yield differential relative to WTI in a typical California hydroskimming mode with no downstream capabilities is relatively small—\$0.43 per barrel. In a typical California hydroskimming refinery, NPR crude enjoys a large positive yield differential—\$1.95 per barrel—over the heavier and more sour ANS crude. In addition, a hydroskimming operation does not warrant a contaminant discount since no catalyst that would be destroyed by the contaminants is involved in the process.

Comments From the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



Department of Energy
Washington, DC 20585

April 15, 1994

Mr. Victor S. Rezendes
Director, Energy and Science Issues
Resources, Community, and
Economic Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Rezendes:

The Department of Energy appreciates the opportunity to review and comment on the General Accounting Office draft report entitled "Oil Reserves: Changes to Sales Program Could Enhance Revenues From Oil Sales in California." The report discusses the California crude oil market and the sales and marketing program of Naval Petroleum Reserve No. 1, known as Elk Hills. The Department generally agrees with the findings in the report, but we believe it could go further in exploring opportunities for enhancing the value of Elk Hills oil.

See comment 1.

Marketing Elk Hills Oil Outside California

An option under consideration by Naval Petroleum and Oil Shale Reserves program staff is to offer some Elk Hills oil for sale on the spot market at Midland, Texas. Midland is a central distribution hub and purchasers can deliver the oil into the Mid-Continent or the Gulf Coast refining regions without the same degree of risk encountered by buying Elk Hills oil under six month contracts in California and transporting it themselves.

See comment 2.

If bids at Midland do not equal or surpass the California sales price plus transportation costs to Midland, then the Naval Petroleum and Oil Shale Reserves could temporarily place the unsold Elk Hills oil in leased storage, or perhaps in the Strategic Petroleum Reserve. When the Elk Hills oil is sold later, the sales price must pay for the additional cost of storage. Storing the Elk Hills oil in the Strategic Petroleum Reserve has the added benefit of providing energy security as well as a convenient access to the local market. By having the flexibility to sell or store Elk Hills oil in the Gulf region, the Department of Energy will be able to place the oil where it has the most value for the Government.

See comment 3.

The Department agrees with the General Accounting Office that the time-value-of-money is a significant cost for refiners and that Gulf Coast refiners will not tie up limited capital by purchasing Elk Hills oil in California--only to wait approximately two months for the first shipment to arrive--as they would have to under Department's current sales procedures. Because the mission of the Naval Petroleum and Oil Shale Reserves is somewhat different than that of commercial refiners, it may be profitable for the Department of Energy to carry this oil in inventory for the two months it takes to move the oil from

Appendix II
Comments From the Department of Energy

2

See comment 4.

California. The Elk Hills oil remaining in California should command higher prices since there will be less of it, partially offsetting the risks incurred by moving some oil to Midland.

Indexing to West Texas Intermediate

See comment 5.

The Department of Energy agrees with the General Accounting Office suggestion of indexing Elk Hills crude oil to the price for West Texas Intermediate oil as traded on the New York Mercantile Exchange. Nevertheless, Naval Petroleum and Oil Shale Reserves's discussions with several refiners, and confirmed by the General Accounting Office review, suggest that some California companies might lower their bid prices if Elk Hills oil is indexed to the New York Mercantile Exchange.

To phase in the West Texas Intermediate index, the Department of Energy could offer 20,000 barrels per day in California indexed to the price of the New York Mercantile Exchange oil, and retain the current index for the remaining crude oil. If bids for the West Texas Intermediate-indexed crude oil are lower than offers for oil using the current index, then Naval Petroleum and Oil Shale Reserves could transfer that oil to Midland, Texas, for sale there. Currently, 20,000 barrels per day is the maximum quantity that the Department can transport to the Gulf Coast without significant quality degradation. Further, California purchasers will have the option of selecting their preferred index. As California purchasers become familiar with the West Texas Intermediate index, the existing index can be phased out over time.

The Department of Energy should have time to arrange for selling the oil at Midland since approximately two months pass before the oil is available at that location. One note of caution, since Elk Hills oil is new to the Mid-Continent and Gulf Coast markets, the Department of Energy can expect lower bid prices until the oil becomes better known. Nevertheless, there are statutory minimum prices that must be met before the Elk Hills oil can be sold, and, if those prices are not met, the oil can be stored or diverted to the Strategic Petroleum Reserve as mentioned above.

Weekly versus Monthly Billings

See comment 6.

At this time, the Department plans to retain the weekly billing cycle. The General Accounting Office report suggests the Department of Energy might receive higher bids by employing a monthly billing cycle. While the Department agrees with the larger view that adopting industry practices will increase bid prices, we believe there are significant factors contributing to low bid prices besides the billing cycle. Until bidders are relieved of the 20 percent purchase limitation, the small refiners preference, and the 15-day Department of Justice review period, each required by 10 U.S.C. §7430, the Department of Energy believes bidders will continue to submit low bids, even if a monthly billing cycle is adopted, and especially if the Department of Energy increases the size of the required performance guarantee. An independent industry panel's "Evaluation of Operations at Naval Petroleum Reserve No. 1, Report to Congress" specifically recommends removal of the 20

See comment 7.

percent purchase limitation. They also reported that Elk Hills operates under significant non-value added burdens imposed by the Government. Some of the sources of extra burdens identified by the panel include:

- o Congressional mandates - These are intended to achieve political and social goals.
- o Department of Energy Headquarters Orders that are generally applied across the board to all Department of Energy facilities without considering their applicability on a case-by-case basis.
- o Institutionalized procedures that have accumulated over the years as the Elk Hills mission and structure have evolved.

The report states, "These Federal burdens are often contrary to industry practice and are inconsistent with maximization of the value of Elk Hills as an asset. The panel realizes, however, that many government requirements can add value and can be justified by national policy goals."

Weekly billings will not be required if the Department of Energy sells a portion of Elk Hills oil into the Midland, Texas, spot market. One option is to sell Elk Hills oil for a flat price for the entire batch of oil, presumably 100,000 barrels. The sales price will reflect the price of oil at the time of the transaction.

Standard Industry Practice

Competitive sale of Elk Hills crude oil, as well as for all Naval Petroleum and Oil Shale Reserves hydrocarbons, is required by the 1976 Naval Petroleum Reserves Production Act. The definition of "competitive," combined with the constraints of the 1976 Naval Petroleum Reserve Production Act, led to establishing a sales process that differs from normal commercial practice.

The oil industry employs a portfolio of contract mechanisms. Some oil is bought and sold on the spot market, while other oil is sold under long-term, fixed- or index-priced contracts. Industry practice is for a refinery company to issue a "posting" sheet offering a price it will pay for various crude oils. Postings are offers to buy oil and do not necessarily reflect the price a refiner is actually paying for its crude oil.

Commercial producers seek their best prices through negotiation, supplemented by spot and term price quotes for refined products and other crude oil transactions reported in daily trade sources, including New York Mercantile Exchange price quotes. Postings often serve as the starting point for price negotiations for both buyers and sellers of oil.

The Department of Energy issues an Invitation for Bids that defines the terms under which the Department of Energy will sell its oil. It is strictly a take-it-or-leave-it proposition that does not allow negotiation nor consideration of the bidder's credit rating.

See comment 8.

See comment 9.

Appendix II
Comments From the Department of Energy

4

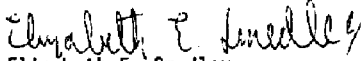
Subsequently, bids for Elk Hills oil reflect the burdens and risks imposed by the Invitation for Bids. The Department created its sales program using the Federal Acquisition Regulation as a guide. Consistent with the Federal Acquisition Regulation, the Department of Energy maintains that the Government should assume little risk in its sales transactions, all-the-while recognizing that such security may result in lower bid prices that a more aggressive marketer of crude oil may get by assuming more risk.

The Department is considering whether it should recommend that Congress adopt an operating structure for the Naval Petroleum and Oil Shale Reserves that more closely resembles an oil industry corporation.

Conclusion

The Department will continue striving for increasing revenues under current sales and marketing practices. While largely concurring with the General Accounting Office's findings, the Department of Energy is examining options other than the single scenario discussed in the General Accounting Office report, with an eye toward enhanced profitability.

Sincerely,


Elizabeth E. Smedley
Acting Chief Financial Officer

See comment 10.

The following are GAO's comments on DOE's April 15, 1994, letter.

GAO Comments

1. GAO agrees that there may be other changes to the management of the NPR and the operation of the NPR sales program beyond those analyzed in this report, such as turning the NPR into a government-chartered corporation, that could enhance net revenues from sales of NPR oil. GAO limited its analysis to the sales program as currently configured and the options for enhancing revenues that a review of that program revealed. An in-depth exploration of possible alternative management arrangements was beyond the scope of the congressional request. However, GAO supports DOE's efforts to explore such options.
2. GAO believes that there are substantial risks associated with the government's taking the initiative to move oil halfway across the country to a market that has not historically expressed any interest in buying the oil. Of course, Gulf Coast refiners will gladly buy and refine NPR oil at the right price. As our refinery yield analysis of NPR crude suggests, the price such refiners will offer will be significantly lower than the market price of WTI—the benchmark crude used for estimating the value of NPR crude to Gulf Coast refiners—because NPR crude yields a less valuable mix of petroleum products. The question then is whether the price Gulf Coast refiners might offer will be sufficiently higher than the price the government would have received in California to cover the additional costs and risks DOE would face in shipping the NPR oil. The federal government will face all of the risks and costs that have kept the private sector from undertaking such a venture. For instance, oil markets are volatile—prices could fall during the 60-90 day period that the oil is in transit. In addition, while the government's borrowing costs are lower than those of private oil refiners, they are not negligible. Thus, the government would be incurring costs related to the time-value of the funds tied up in the inventory in transit. If oil shipped to Texas has to be stored while DOE waits for prices to rise sufficiently to cover transportation and storage costs, the time-value-of-money costs increase. Furthermore, there is no guarantee that prices will rise sufficiently to cover the costs of transporting and storing NPR oil as well as the opportunity costs resulting from the government's carrying oil in inventory that it would otherwise have already sold in California, depositing the proceeds in the Treasury. DOE will need to demonstrate that all of these costs, plus a healthy premium to cover the added price risk, can be recouped before such a venture can be justified on the grounds that it will increase net revenues.

3. As DOE noted, storage of the NPR oil in SPR facilities may have some energy security benefit. However, we question whether NPR oil, after accounting for transportation and other costs, is the cheapest oil for providing this security, particularly under the scenario discussed in DOE's comments.

4. While California prices could be expected to rise as a result of shipping some NPR oil out of the state, the increase in the price DOE receives for oil sold in California will be marginal because of the relatively small volume of oil removed from that market.

5. We are pleased that DOE agrees with the need to change the current index for NPR oil sales. However, we believe that such a change is justified for sales in California and should not be linked to the notion of transferring NPR oil for sale in Texas. As noted above, we do not believe that the costs and risks associated with such a transfer are justified by the price DOE would likely receive for NPR oil on the Gulf Coast. As DOE has noted, some California refiners claim that they would discount their bids for NPR oil if it were indexed to WTI crude. We do not believe this a likely outcome for several reasons. First, WTI is widely recognized as the U.S. benchmark crude, and it is doubtful that anyone in the business of buying crude oil is unfamiliar with it. Second, as noted in the report, we found a high correlation between the spot price for WTI crude and DOE's current index, indicating that, to the extent these buyers understand the current index, they should be able to understand a WTI-based index. Finally, not all of the companies we spoke with had this concern. Therefore, because NPR oil is sold by competitive bid and bidders seek more oil than is available for sale, a bidder that discounts its bid because of the index will lose oil to bidders that do not. This should result in a very short learning curve during the transition to the new index.

6. GAO is not implying that billing frequency is the primary cause of low bid prices. We mention the 20-percent limitation and the preference to small refiners as factors that also cause buyers to discount their bids. However, the frequency of billing for purchases of NPR oil is something that DOE controls; that is, changing this aspect of DOE's sales program would not require legislation and should result in slightly higher bids. We further believe that basing the requirement for a performance guarantee on a buyer's creditworthiness should keep the risk of default within acceptable limits, as demonstrated by industry experience. Later in its comments, DOE expresses concern that it could not incorporate consideration of a potential buyer's creditworthiness in its invitation for bids. We believe this

could be done. For instance, DOE may be able to add language to its sales offer specifying monthly billing unless its review of the winning bidder's credit rating information indicates that more frequent billing and/or a performance guarantee are necessary.

7. GAO agrees that the opportunity exists to increase profitability by reducing costly burdens, as recommended by the independent industry panel. While our review was limited to the NPR oil sales program, our observations lead us to support the panel's views that the NPR operates under significant constraints that do little to increase the value of this asset to the taxpayer.

8. We must reiterate that we believe that the cost and risks associated with shipping NPR oil for sale in the Texas spot market are substantial.

9. We agree that DOE's invitation for bids is a "take it or leave it proposition." However, as noted above, we also believe that it may be possible to sell the oil in a way that specifies monthly billing without a performance guarantee for a winning bidder unless a subsequent review of the company's credit rating shows it to be an unacceptable credit risk. In that case, the sales offer could specify that DOE require more frequent payment and/or a performance guarantee. While DOE used the Federal Acquisition Regulations (FAR) as a guide in setting up the NPR sales program, we note that the program is not subject to the FAR. Obviously, DOE is faced with striking a balance between the risk it is willing to take in selling NPR oil and the price it receives for it. In this case, we believe that the risk resulting from adopting monthly billing and varying the requirement for performance guarantees on the basis of a buyer's creditworthiness is acceptable.

10. We support DOE's efforts to develop a proposal for an operating structure that will eliminate unnecessary constraints on oil sales and increase the value of this asset to the taxpayer.

Objectives, Scope, and Methodology

The Chairman of the Subcommittee on Energy and Power, House Committee on Energy and Commerce, asked us to examine whether (1) selling NPR oil to Gulf Coast and mid-continent refiners could enhance government revenues and result in higher prices for the remaining NPR oil sold in California, (2) significant barriers impeded shipping NPR oil to those refiners, (3) DOE omits any significant factors in determining whether prices bid for NPR oil are high enough and determines this often enough, and (4) revenues could be enhanced by other means.

To determine the potential for enhancing government revenues through possible sales to the Gulf Coast and mid-continent markets, we interviewed officials at the Department of Energy (DOE) in Washington and Elk Hills, California; representatives of oil producing, refining, and trading companies in California and Texas; and oil industry publication officials. We also analyzed data on the billing prices of NPR oil, crude oil prices in California and the Gulf Coast and mid-continent regions, and transportation costs. In addition, we contracted with an industry consultant, Bonner & Moore Associates, Inc., to perform a refinery yield modeling analysis of NPR oil to determine its relative refinery value in these regions. We did not verify the consultant's calculations. However, we did discuss quality control procedures with the team that conducted the analysis.

To determine the likely impact of selling a portion of NPR oil to Gulf Coast and mid-continent refiners on the price of the portion sold in California, we interviewed oil company, oil industry association, and trade press officials. We also analyzed data on the crude oil supply in California.

To identify possible barriers to shipping a portion of NPR oil to the Gulf Coast and mid-continent regions, we interviewed officials from the relevant pipeline companies in California and the Gulf Coast, namely, the operators of the Santa Fe, Celeron Gathering, and All American pipelines. In addition, we interviewed officials of the offices of the Strategic Petroleum Reserve (SPR) and the Naval Petroleum Reserves at DOE. We also obtained and reviewed relevant data on pipeline companies' rates and cost estimates for potential modifications to increase pipeline capacity. Furthermore, we reviewed DOE's legislative authority to condemn pipelines that refuse to ship NPR oil without discrimination and at reasonable cost and identified the conditions for exercising that authority.

To determine the factors DOE considers in conducting the SPR portion of the oil sales price test and the adequacy of the frequency of these price

tests, we interviewed NPR and SPR program officials and analyzed their records of these calculations. We also talked with oil industry officials to obtain their views on the relevance of factors considered in and excluded from the price-test calculation.

To identify other options for enhancing revenues from the sale of NPR oil, we reviewed the legislative history and examined the potential impact of current statutory and regulatory conditions governing the sale of this oil on its prices. We also reviewed previous GAO studies on the impact of lifting the ban on exporting Alaskan oil and other studies related to California oil market conditions. We discussed these issues with oil industry officials and market experts and with officials from DOE's NPR, General Counsel, and Procurement offices. We also examined the current pricing mechanism for NPR oil. This entailed interviewing officials from the two reporting services used by DOE as well as DOE, oil company, and trade press officials. Furthermore, we conducted a correlation analysis of the spot prices of the two crudes that make up the pricing mechanism—Alaskan North Slope (ANS) and the crude oil blend from ARCO's Line 63 pipeline—and West Texas Intermediate (WTI) crude oil.

Major Contributors to This Report

Resources,
Community, and
Economic
Development
Division, Washington,
D.C.

Charles W. Bausell, Jr., Assistant Director
Jonathan N. Kusmik, Assignment Manager
Godwin M. Agbara, Evaluator-in-Charge
Phyllis Turner, Reports Analyst

Office of the General
Counsel

Michael G. Burros, Attorney-Adviser

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