United States Government Accountability Office

GAO

Report to Congressional Requesters

March 2010

OIL AND GAS MANAGEMENT

Interior's Oil and Gas Production Verification Efforts Do Not Provide Reasonable Assurance of Accurate Measurement of Production Volumes

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GAO-10-313

March 2010

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Interior's Oil and Gas Production Verification Efforts Do Not Provide Reasonable Assurance of Accurate Measurement of Production Volumes

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Highlights

Highlights of GAO-10-313, a report to congressional requesters

Why GAO Did This Study

Oil and natural gas produced from federal leases generated over $6.5 billion in royalties in 2009. To verify that royalties are paid on the correct volumes of oil and gas, the Department of the Interior (Interior) verifies the quantity and quality of oil and gas, both onshore, through the Bureau of Land Management, and offshore, through the Offshore Energy and Minerals Management Service. This report assesses (1) the extent to which Interior's production verification regulations and policies provide reasonable assurance that oil and gas are accurately measured; (2) the extent to which Interior's offshore and onshore production accountability inspection programs consistently set and meet program goals and address key factors affecting measurement accuracy; and (3) Interior's management of its production verification programs. To address these questions, GAO analyzed Interior data on oil and gas inspections and human capital, as well as interviewed officials from Interior, states, oil and gas companies, and other countries.

What GAO Recommends

GAO is recommending Interior improve the consistency and timely updating of measurement regulations and policies, clarify jurisdictional authority over gas plants and pipelines, and provide appropriate and timely training for key measurement staff. In commenting on a draft of this report, Interior generally agreed with our findings and recommendations.

View GAO-10-313 or key components.
For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

What GAO Found

Interior's measurement regulations and policies do not provide reasonable assurance that oil and gas are accurately measured. Interior's varied approaches for developing and revising its measurement regulations are both ineffective and inefficient—Interior's onshore measurement regulations have not been updated in 20 years and do not address current measurement technologies. Onshore and offshore staff have infrequently coordinated on measurement issues, although each addresses similar issues. Additionally, Interior's decentralized process for granting waivers from current regulations and approval of alternative measurement technologies allows officials to make key decisions affecting measurement with little oversight, increasing the risk of approvals of inaccurate measurement technologies. Further, Interior has failed to determine the extent of its jurisdictional authority over key elements of oil and gas infrastructure, including gas plants and pipelines, limiting its ability to inspect these elements to assess the accuracy of their measurement. Finally, Interior's onshore and offshore policies for tracking and approving where and how oil and gas are measured are inconsistent, with Interior tracking offshore measurement points offshore, but not for onshore, creating challenges for onshore inspection staff to verify measurement accuracy.

Interior's offshore and onshore production accountability inspection programs are not consistently setting or meeting program goals for inspecting oil and gas leases and do not sufficiently address key factors affecting measurement accuracy. Interior's offshore and onshore inspection program goals differ in key areas, with only the offshore program establishing goals for witnessing meter calibrations, a key control for accurate measurement. Additionally, while the onshore inspection program includes an activity to independently verify gas volume calculations, the offshore program does not. Moreover, Interior has not consistently met its inspection goals; offshore inspectors met program goals once between fiscal years 2004 and 2008, and onshore inspectors met program goals about one-third of the time over the past 12 years. Finally, neither program sufficiently addresses key areas affecting measurement accuracy, including how gas samples are collected.

Limited oversight, gaps in staff skills, and incomplete tools hinder Interior's ability to manage its production verification programs. In particular, we identified several instances where production measurement staff work with limited oversight. For example, onshore engineers generally make decisions autonomously in the absence of central guidance and oversight. Further, despite years of critical reviews by GAO and others, Interior recently lowered its own estimation of the risks of the oil and gas program from medium to low, exempting it from more rigorous internal oversight. In addition, some key production verification staff lack critical skills, in part, because Interior has not provided training. For example, Interior has provided training only once in the past 10 years for its onshore engineers, despite significant changes in technology used by industry. Interior's efforts to provide its inspection staff with tools to obtain real-time gas production data directly from producers and the ability to electronically document production inspection results in the field have shown few results.

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Abbreviations

AFMSS	Automated Fluid Minerals Support System
API	American Petroleum Institute
BLM	Bureau of Land Management
BTU	British Thermal Units
DWRRA	Deep Water Royalty Relief Act
EPAP	Enhanced Production Audit Program
ERCB	Energy Resources Conservation Board
FMFIA	Federal Managers' Financial Integrity Act
FOGRMA	Federal Oil and Gas Royalty Management Act
FPPS	Federal Personnel and Payroll System
IT	Information Technology
LACT	Lease Automatic Custody Transfer unit
mcf	one thousand cubic feet
MMS	Minerals Management Service
NPR-A	National Petroleum Reserve–Alaska
OMB	Office of Management and Budget
OEMM	Offshore Energy and Minerals Management
PCC	Production Coordination Committee
RDAWP	Remote Data Acquisition for Well Production
SCADA	Supervisory Control and Data Acquisition
TIMS	Technical Information Management System

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United States Government Accountability Office
Washington, DC 20548

March 15, 2010

Congressional Requesters

Oil and natural gas produced from federal lands and waters are critical to our nation's energy supply and reduce our reliance on foreign sources of energy. Specifically, in fiscal year 2008, federal lands and waters managed by the Department of the Interior (Interior) contributed about 26 and 24 percent, respectively, to the total of oil and gas produced in the United States. In fiscal year 2009, the Department of the Interior's Minerals Management Service (MMS) collected over $6.5 billion in royalties from companies that developed and produced federal oil and natural gas. These royalties represent one of the federal government's largest nontax sources of revenue.

Companies that develop and produce oil and gas from federal lands and waters do so under leases obtained from and administered by agencies of Interior—the Bureau of Land Management (BLM) for onshore leases, and MMS's Offshore Energy and Minerals Management (OEMM) for offshore leases. The oil and gas produced from these leases must be properly measured and reported to MMS on a monthly basis. These volumes are then used by MMS to verify that companies are accurately paying royalties. Measuring oil and gas can be challenging at times, with overall measurement accuracy affected by numerous factors, including the type of meter used, the specific qualities of the gas or oil being measured, the rate of production, and whether oil and gas of differing qualities are mixed together from multiple wells prior to measurement. Accordingly, both BLM and OEMM have independently established programs intended to provide reasonable assurance that the royalty-bearing volumes of oil and gas are being measured accurately. These programs both have an on-the-ground inspection component that consists of activities such as examining the pipelines delivering the oil and gas from the well to the meter for possible diversion of oil and gas; inspecting meter installations to ensure they meet agency standards; and witnessing the calibration of meters, as well as an in-office component consisting of comparisons of the monthly volumes included on the MMS-required production reports with source measurement documents obtained from the company. Given that proper measurement of oil and gas is critical to accurate royalty collections, Interior's measurement verification practices have been the subject of considerable scrutiny through the years, both by GAO (see the Related GAO Products section at the end of this report) and the Royalty Policy Committee, a group convened in 1995 by the Secretary of the Interior and charged with advising Interior on managing federal leases and revenues. In September 2008, we reported that neither BLM nor OEMM was meeting its statutory or internal goals for inspecting federal leases that produce oil and gas and that Interior lacks assurance that the royalty-bearing volumes are being accurately measured.[1] Furthermore, the Subcommittee on Royalty Management submitted a report to the Royalty Policy Committee in December 2007 that included more than 100 recommendations to strengthen Interior's royalty collections, including many directed at improving oil and gas measurement and reporting.[2]

This report responds to your request that we examine Interior's oversight of oil and gas measurement on federal leases. Accordingly, our audit objectives were to assess (1) the extent to which Interior's production verification regulations and policies provide reasonable assurance that oil and gas are accurately measured; (2) the extent to which Interior's offshore and onshore production accountability inspection programs consistently set and meet program goals and address key factors affecting measurement accuracy; and (3) Interior's management of its production verification programs.

To conduct this work, we reviewed relevant laws, regulations, and Interior, BLM, and OEMM guidance. We interviewed officials in BLM headquarters, as well as officials from seven BLM field offices (and their associated state offices), selected using a nonprobability sample that provided a range of oil and gas operations and state jurisdictions. Specifically, we visited and interviewed officials in three BLM state offices (Colorado, New Mexico, and Wyoming) and seven BLM field offices (Glenwood Springs[3] and White River in Colorado; Vernal in Utah; Buffalo and Pinedale in Wyoming; and Carlsbad[4] and Farmington in New Mexico)

[1]GAO, *Data Management Problems and Reliance on Self-Reported Data for Compliance Efforts Put MMS Royalty Collections at Risk*, GAO-08-893R (Washington, D.C.: Sept. 12, 2008).

[2]Subcommittee on Royalty Management, Royalty Policy Committee, *Report to the Royalty Policy Committee: Mineral Revenue Collection from Federal and Indian Lands and the Outer Continental Shelf* (Washington, D.C., 2007).

[3]The Glenwood Springs, Colorado, field office relocated to Silt, Colorado, on September 8, 2009.

[4]Representatives from the Roswell, New Mexico, BLM field office and the Hobbs, New Mexico, BLM field station were included in our discussion with Carlsbad, New Mexico, BLM field office staff.

and interviewed by telephone officials in two additional state offices (Montana and Utah). Additionally, we interviewed officials in four OEMM district offices (and their associated regional offices) that provided a range of geographic and regional jurisdictions. Specifically, we visited and interviewed officials in one OEMM regional office (Gulf of Mexico) and one OEMM district office (Lafayette, Louisiana) and interviewed officials in one additional OEMM regional office (Pacific) and four additional OEMM district offices (Lake Charles, Lake Jackson, New Orleans, and California) by telephone.

To assess the extent to which Interior's production verification regulations and policies provide reasonable assurance that oil and gas are accurately measured, we analyzed BLM's and OEMM's measurement regulations and policies and conducted semistructured interviews with engineers from seven BLM field offices, and inspection staff from nine BLM field offices and four OEMM district offices. To assess the extent to which Interior's onshore and offshore production accountability inspection programs consistently set and meet program goals and address key factors affecting measurement accuracy, we reviewed BLM's and OEMM's production inspection policies, interviewed representatives from oil and gas companies and flow measurement research labs about key areas of measurement uncertainty, and analyzed BLM and OEMM inspection data. To assess Interior's management of its production verification programs, we reviewed BLM's and OEMM's internal plans for conducting program oversight; reviewed a nonrandom and nongeneralizable sample of hard copy BLM and OEMM inspection files; analyzed BLM inspection activity data for fiscal years 2004 through 2008; analyzed human capital data for fiscal years 2004 through 2008 to calculate turnover rates; assessed BLM's and OEMM's training programs for key production verification positions; and interviewed BLM and OEMM officials responsible for developing two key IT tools intended for production inspection staff and analyzed associated project documentation. Appendix I presents a more detailed description of our scope and methodology.

We conducted this performance audit between October 2008 and March 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Created by Congress in 1849, Interior oversees the nation's publicly owned natural resources, including parks, wildlife habitat, and crude oil and natural gas resources on millions of acres onshore and offshore in the waters of the outer continental shelf. With regard to oil and gas in particular, Interior leases federal land, issues permits for oil and gas drilling, establishes guidelines for measuring oil and gas, and conducts production inspections.

Leasing

Onshore, the Mineral Leasing Act of 1920 gave Interior the responsibility for oil and gas leasing on both federal lands and private lands where the federal government has retained mineral rights.[5] Interior's BLM is responsible for managing approximately 700 million onshore acres, including the acreage leased for oil and gas development, through its 12 state offices; 38 district offices; and 127 field offices, 32 of which have oil and gas activities within their jurisdiction and are located mostly in the western United States. BLM is also responsible for managing the approximately 23 million acres of land in the National Petroleum Reserve-Alaska (NPR-A) in the North Slope of Alaska. The Naval Petroleum Reserve Production Act of 1976,[6] as amended, governs federal oil and gas leasing in the NPR-A. Offshore, the Outer Continental Shelf Lands Act,[7] as amended, and the Deep Water Royalty Relief Act (DWRRA),[8] as amended, gave Interior the responsibility for leasing and managing approximately 1.76 billion offshore acres through its three OEMM regional and seven district offices. These four statutes give Interior responsibility for collecting royalties associated with both onshore and offshore oil and gas production and serve as the basis for the current leasing framework for oil and gas leasing (see fig. 1).

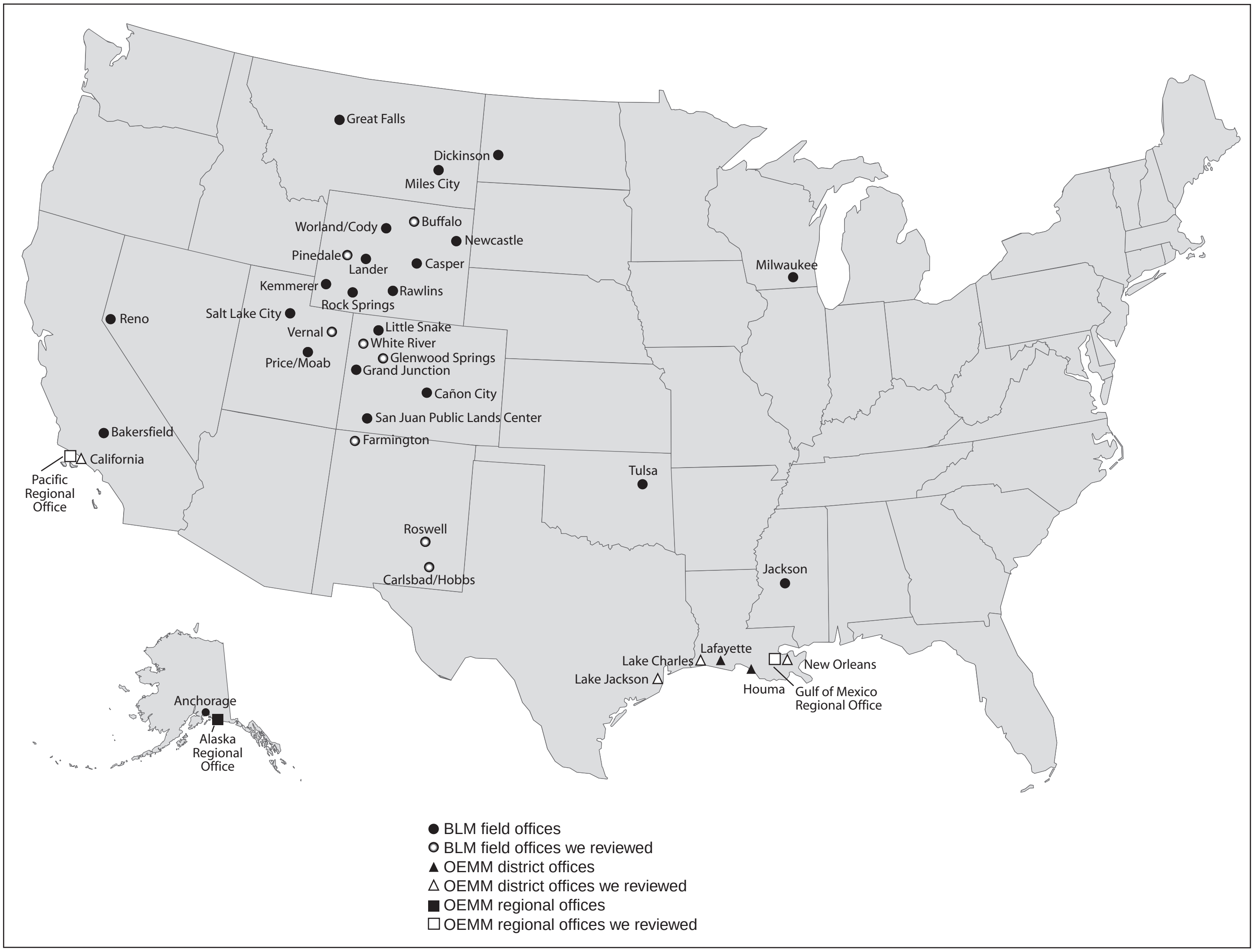
[5]Pub. L. No. 66-146, 41 Stat. 437 (1920).

[6]Pub. L. No. 94-258, 90 Stat. 303 (1976).

[7]67 Stat. 462 (1953) codified at 43 U.S.C. § 1331 *et seq*.

[8]Pub. L. No. 104-58, 109 Stat. 563 (1995).

Figure 1: BLM Field Offices and OEMM Regional and District Offices Responsible for Managing Onshore and Offshore Federal Oil and Gas Production



Sources: BLM and Map Resources (map).

Permitting

To drill on federal lands and waters, companies must first obtain a federal lease. Both MMS and BLM have auctions through which companies may secure the rights to federal leases that allow them to—upon meeting certain conditions—drill for oil and gas. Once it obtains a lease, a company may conduct further exploration and subsequently determine whether it would like to drill a well. Onshore, before a company may drill on leased lands, it must submit an Application for Permit to Drill to the appropriate BLM field office. BLM officials evaluate the company's proposal for drilling to ensure that it conforms with the relevant BLM land use plan for the area and applicable laws and regulations, including those focused on protecting the environment. In evaluating an Application for Permit to Drill, a BLM petroleum engineer reviews technical aspects of the proposed well design and drilling practices. In most cases, a BLM petroleum engineer will not need to specifically approve any oil or gas measurement equipment if a company plans to use metering technologies addressed by BLM's measurement regulations. However, if requested to do so by a company, BLM will also consider whether to approve a variance from current regulations governing the use of alternative metering technologies. After BLM approves a drilling permit, the company—or operator—may drill the well and commence production. Within 60 days of drilling, the operator must file a site facility diagram that accurately reflects the relative positions of the production equipment, piping, and metering systems.

A similar process is followed for obtaining a permit to drill a well offshore. In this case, the operator submits an application for a drilling permit to the appropriate OEMM district office, where the district engineer first reviews it for completeness. After reviewing the technical elements of the application and verifying that they conform with all applicable regulations, the district engineer approves the permit. Only after a permit is approved can drilling begin. Once drilling is completed—and if the operator discovers that oil and gas can be economically produced from the well—the operator submits an application to the appropriate OEMM regional office to begin production that describes, among other things, how oil and gas will be measured. If the application is approved, the regional office assigns a facility measurement point, which is an identifier for each location where oil and gas will be measured.

Royalty Payments to the Federal Government

Interior is also responsible for ensuring that the federal government receives payment from the private companies that extract oil and gas from federal land. When an operator begins producing oil or gas under a federal lease, the royalty interest owners—or payors—pay royalties on the oil or gas produced monthly according to the following equation:

Royalty payment = (sales volume x sales price - deductions) x the royalty rate

Royalty rates for leases issued in 2007 were 12.5 percent for onshore, 16.67 percent for offshore, and 12.5 percent or 16.67 percent for NPR-A. Importantly, MMS gas valuation regulations allow royalties to be paid on the sales value of gas after it has been processed at a gas plant. For processed gas, the volume measured at either BLM's or OEMM's official measurement point will not coincide with the final sales volume for royalty determination, as natural gas liquids may be removed prior to the gas plant. Furthermore, as the gas passes through the gas plant, various constituents are separated out of the gas streams and the end products—including gas types such as propane, ethane, and butane—are sold to various markets. Royalties are due on the sales value of each of these separate gas constituents. A productive lease remains in effect and the lessee can continue to produce oil and gas until the lease is no longer capable of producing in paying quantities, regardless of the length of the primary term.

Within Interior, MMS is also responsible for revenue collection.[9] MMS does this by, among other things, obtaining reports from payors on the amounts of oil and gas produced, the prices received for production, any deductions claimed, and the royalty rate applicable to the production.

Oil and Gas Measurement

Interior has established specific regulations and other mechanisms for how oil and gas may be measured. The degree of certainty that both the quantity and quality of oil and gas are being measured accurately can be affected by multiple factors. Because 100 percent measurement accuracy is not possible, measurement specialists commonly refer to uncertainty ranges—or ranges of expected values. Both regulators and industry acknowledge this uncertainty and, to varying extents, incorporate uncertainty ranges into their measurement requirements. What both regulators and industry attempt to avoid, however, is bias—or systematic error. Bias refers to when the volumes are consistently over- or under-measured. Therefore, the goal for measuring oil and gas is to minimize uncertainty and to eliminate bias. How—and the extent to which—this is achieved varies between oil and gas, but key controls include using the appropriate meter and other processing equipment for the situation; witnessing meter calibrations; witnessing sales; and verifying that volume

[9]MMS's Minerals Revenue Management, a separate directorate from OEMM, is responsible for collecting, accounting for, and distributing revenues associated with offshore and onshore oil, gas, and mineral production from leased federal and Indian lands. This directorate is located in Lakewood, Colorado.

calculations were completed accurately. Additional controls include following measurement standards intended to reduce uncertainty that have been generally agreed upon by industry and regulators and published by the American Petroleum Institute (API). Since the passage of the National Technology Transfer and Advancement Act in 1996, federal agencies have been required to adopt private-sector standards, such as API's, wherever practical, in lieu of creating their own proprietary, nonconsensus standards.[10]

Oil. According to an Interior official, most oil produced from federal lands and waters is measured through one of two very different methods. First, oil can be measured by periodically physically estimating the volume of accumulated oil—a process called tank gauging—which is used when oil is pumped directly from the well into a large cylindrical tank(s), typically located adjacent to the well. This is common onshore in locations where wells are not located adjacent to oil pipelines. The tank is used to store the oil until a tanker truck pumps the oil out and delivers it to a pipeline or other facility. These tanks can be 20 or more feet tall and hold hundreds of barrels or more of oil (see fig. 2).

[10]Pub. L. No. 104-113, 110 Stat. 775 (1996). Many regulations establish or incorporate technical standards. The National Technology Transfer and Advancement Act requires all federal agencies and departments to use technical standards developed or adopted by voluntary consensus standards bodies unless the agency determines that use of such standards is contrary to law or impractical, and provides an explanation to the U.S. Office of Management and Budget (OMB) of that determination. OMB must report to Congress annually on instances in which agencies submitted such explanations for not using voluntary consensus standards.

Figure 2: Oil Tanks in Carlsbad, New Mexico

Source: GAO.

Tank gauging is a manually intensive measurement process whereby the gauge, a device similar to a tape measure, is used to determine the depth of oil in the tank both before and after the oil has been pumped from the tank to the truck. Then, using a conversion table specific to that tank, the gauger—or person gauging the tank—converts the difference in the before and after depths into an overall volume. At the same time, the gauger obtains representative samples of the oil in the tank and tests them to determine the extent to which impurities, such as water and sediment, are present.[11] This entire process may be performed by the drivers of the tanker trucks, who drive routes through oil fields, picking up oil at many tanks along the way and delivering it to a central location where it is shipped, via pipeline, to refineries or other locations (see fig. 3). This entire process is called a tank sale, and a receipt recording the amount of

[11]The representative sample is spun for 5 minutes in a centrifuge to determine the water and sediment content of the oil.

oil removed is prepared and later provided to the operator. Because tank gauging is a manual process, the accuracy of the measurement depends on the extent to which the gauger adheres to requirements established by Interior, which reference API standards. There are several procedures that must be strictly followed to ensure measurement accuracy during a tank sale. For example:

- If the gauger does not follow standards endorsed by API, which include procedures for minimizing uncertainty and eliminating bias, errors in measurement can occur. For example, incorrectly measuring the depth of the oil in the tank due to the presence of unevenly distributed sediment on the tank bottom; a tank deformation, such as a dent; or using the wrong table to convert the tank depth to a volume would result in inaccurate measurement.

- If the impurities present in the oil are not measured according to API standards, the volume of oil will be inaccurately measured.

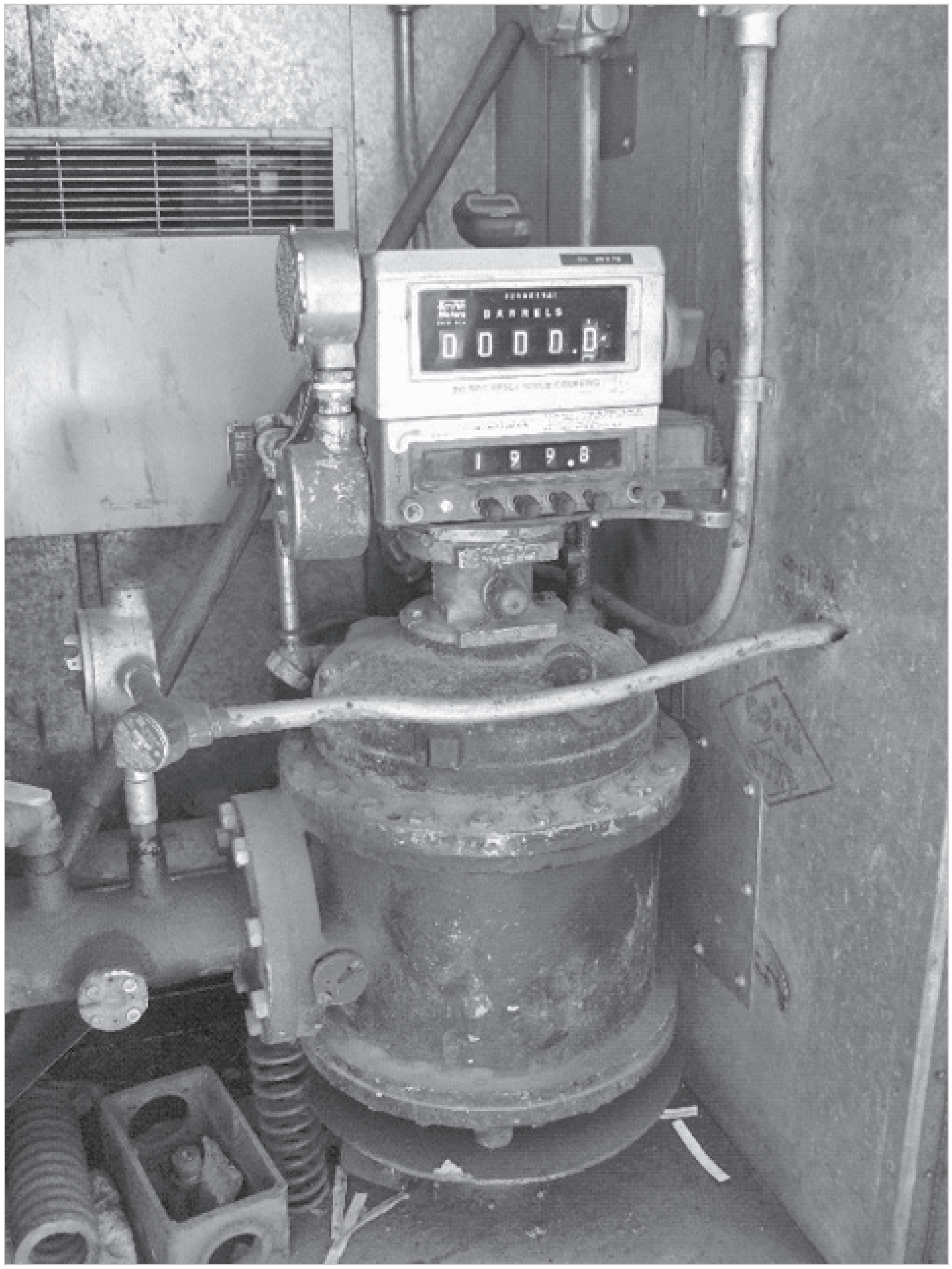
- Since oil tanks are often in remote locations and not supervised, there is risk that oil can be stolen. Because of this risk, Interior has policies for securing tank valves.

Figure 3: BLM Petroleum Engineer Technician Preparing to Gauge an Oil Tank

Source: GAO.

The second primary method for measuring oil involves the use of lease automatic custody transfer (LACT) units. These are automated systems for measuring, sampling, recording, and transferring oil from wells to a pipeline or a barge, and are common on the higher production rate platforms in the Gulf of Mexico. Historically, these units have been equipped with positive displacement meters—which operate similarly to a gasoline pump—though other types of meters may be used as well (see fig. 4). With this method, a critical factor for minimizing uncertainty is to ensure the meter is accurate. To ensure meters remain accurate through many years of use after manufacture, they must be calibrated—or proved—regularly. Meters are proved by comparing their measurement with the measurement of another device, such as a prover. The prover is itself tested for accuracy and must be clearly traceable to national measurement standards maintained by the U.S. National Institute of Standards and Technology. If the prover has fallen out of calibration, or the individual calibrating the meter is unfamiliar with the process, the measurement may be biased. API has standards specifying how often meters and provers must be tested.

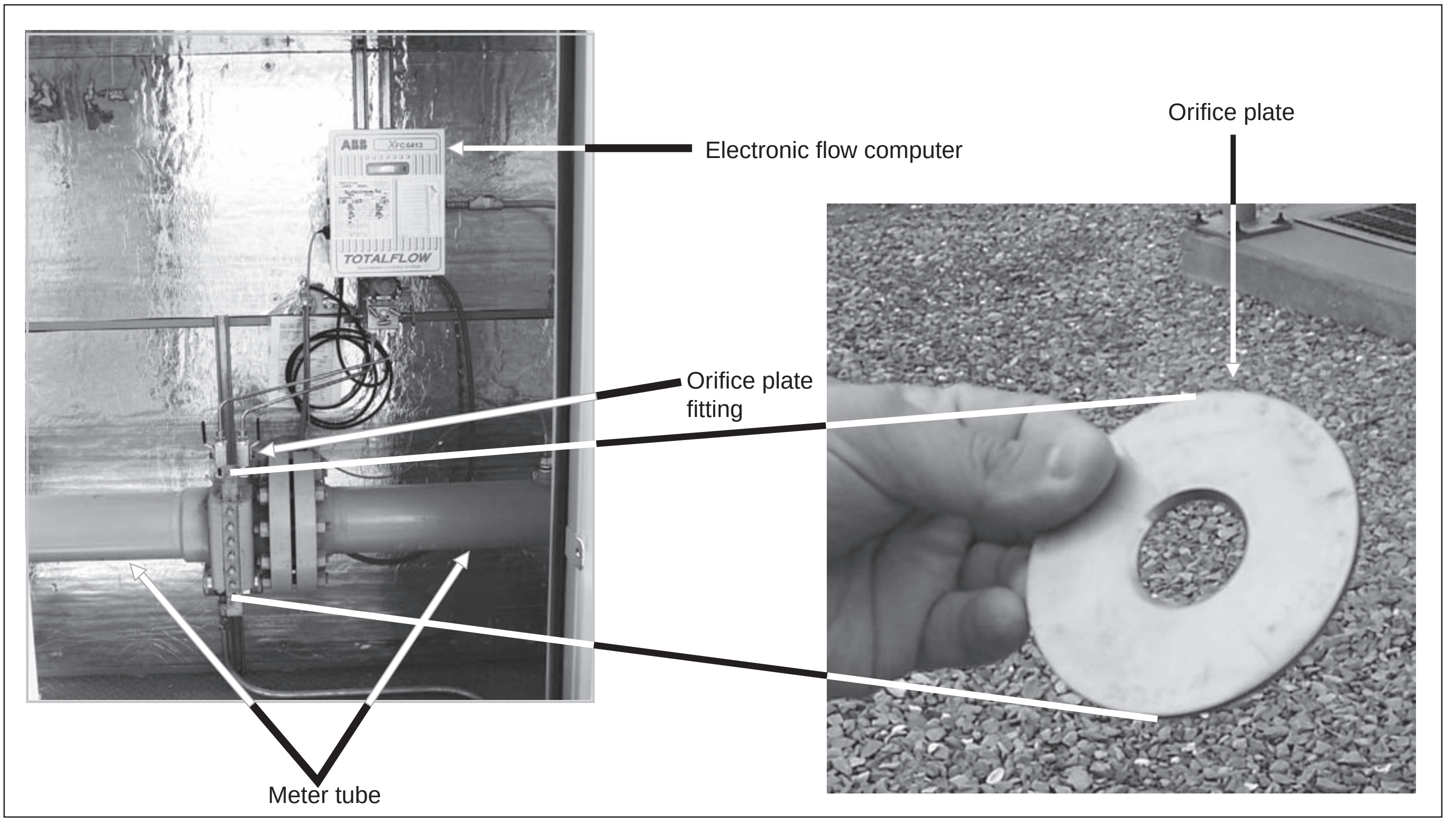
Figure 4: A Lease Automatic Custody Transfer Unit



Source: GAO.

Gas. Because gas produced at a well may flow at various pressures, thereby resulting in larger or smaller compressed volumes of marketable components, gas is generally measured using meter devices that are different from those used for measuring oil. Gas produced from federal lands and waters is typically measured using one of a variety of differential pressure devices, such as an orifice meter. Orifice meters have been in use for almost 100 years and are the most common device used to measure federal natural gas production. These meters force gas to flow through a circular piece of metal with a hole in it, called an orifice plate, to create a pressure difference (higher in front of the plate and lower behind it). Differential pressure and temperature data are measured by sensors allowing the volume of gas to be calculated based on equations developed by the American Gas Association. Historically, these data were physically recorded on a paper chart located near the meter and had to be interpreted manually. Since the early 1990s, industry has begun to use electronic flow computers to calculate the gas volumes, which are in widespread use today. Electronic flow computers are attached to the meter to track key parameters for calculating volumes and a variety of other information, such as when the meter was last calibrated and what size orifice plate is in the meter (see fig. 5).

Figure 5: An Orifice Meter with an Electronic Flow Computer



Source: GAO.

A number of factors affect the accuracy of gas measurement.

- *Orifice and meter tube condition.* Both the orifice plate and the meter tubes located upstream of the meter must be free of nicks or pits; not have a significant accumulation of debris, such as wax or other contaminants that commonly occur in gas production; and be installed correctly. Research shows that imperfections on the surface of the orifice plate, dirty meter tubes, or installing the plate backward can result in under measurement.

- *Orifice size.* The orifice plate must be appropriately sized for the volume of flowing gas. If too large a plate is used, the differential pressure will be lower, resulting in higher levels of uncertainty.

- *Measurement of all gas.* Gas production sites are often complex, with many pipes above and below ground. It is important that no pipes that can carry gas are allowed to bypass the meter so that all gas leaving the well is measured.

- *Presence of water or liquid hydrocarbons in the gas stream.* Most measurement standards require the gas being measured to be free of liquids—meaning that any water or liquid hydrocarbons mixed with the gas when it was produced have been removed. This is typically accomplished using separators and dehydrators located at the well site. According to an Interior official, gas measurement will be biased upward when liquids are present in the gas stream.

- *Meter installation.* The meter must be installed in a location where the gas is flowing freely and uniformly. For this to be the case, typically the meter must be placed a specified distance from bends in the pipes and other obstructions. In some cases, the flow of gas can be conditioned using devices to eliminate flow that could negatively affect measurement. API and other industry organizations have developed guidance specific to various meter types, for orifice meter size and placement, and the use of devices to condition the flow.

Industry is also developing and using newer and, in some cases, more complex gas metering technologies, including Wafer V-Cone, turbine, ultrasonic, Coriolis, and multiphase meters; however, these meters are less widely used for measuring federal gas than orifice meters.[12] API has established some standards for the use of some of these meters. Each of these meters is also associated with various factors that can potentially result in inaccurate measurement.

In addition to volume, determining the quality of the gas is also necessary. Gas typically has many different components—methane, ethane, and butane, among others—that may be separated during processing at a gas plant and subsequently sold. The composition of the gas gives it its overall heating value, which is reported in British thermal units (BTU).[13] The

[12]Wafer V-Cone meters work similarly to orifice meters in that they measure the differential pressure. While the manufacturer claims that wet gas measurement is possible with these meters, this has never been substantiated by BLM. Multiphase meters are designed to measure both oil and gas simultaneously and are still being studied and improved by industry. MMS has allowed the use of multiphase meters for offshore measurement in some instances.

[13]BTU is the amount of heat energy needed to raise the temperature of one pound of water by one degree Fahrenheit.

higher the BTU content, the higher the market value; thus, the sale price of the gas. The gas may be sampled through one of several different methods, including taking spot samples which involves taking a one-time gas sample from a point adjacent to the meter, or proportional-to-flow samples, which involves collecting a sample of gas over a specified period of time.[14] Most gas samples have associated water content that can be precisely determined through the gas analysis, resulting in the actual BTU. However, if the analysis does not specifically assess the water content, then one can report the BTU value on a dry basis if it is assumed that no water is present, or on a wet basis, if it is assumed the gas is saturated.

Commingling Oil and Gas. Interior has the authority to approve measurement agreements that allow oil or gas produced from a federal lease to be combined with oil or gas from another federal, state, or private lease; these agreements allow the combined volumes and varying qualities of oil or gas to be measured at some specified point downstream, rather than at each individual well head. Each upstream lease is then allocated a specific portion of the combined volume according to the commingling agreement. Operators may request approval for commingling for several reasons, including the need to reduce costs of installing and maintaining meters in marginally producing fields and to simplify their measurement operations. Additionally, BLM may encourage this practice to reduce the need for additional equipment at each well head, which reduces the environmental impacts on the land surrounding the well. However, the accuracy of the measurement of oil or gas produced may be affected by commingling.

Production Inspections

To ensure compliance with all stipulations in the lease and conditions of approval in the drilling permit, as well as applicable laws and regulations, both BLM and OEMM have inspection and enforcement programs that are designed to verify that the operator complies with all measurement requirements at a well site. The authority for inspecting wells for this purpose is derived from the Federal Oil and Gas Royalty Management Act of 1982 (FOGRMA), as amended.[15] This act requires the Secretary of the Interior to develop guidelines that specify the coverage and frequency of

[14] Both types of samples are drawn by attaching a sample bottle to a tap attached to a sample probe in the meter run and collecting a volume of gas into a bottle designed for this purpose.

[15] Pub. L. No. 97-451, 96 Stat. 2447 (1983).

inspections.[16] Interior has delegated responsibilities for implementing FOGRMA; BLM has responsibility for onshore wells, and OEMM has responsibility for offshore wells. Each agency has developed regulations, policies, and procedures to conduct inspections. Together, BLM and OEMM are currently responsible for ongoing oversight of oil and gas operations on more than 29,000 producing leases. Among other things, BLM and OEMM staff inspect leases to verify that oil and gas production is accounted for, as required by FOGRMA and agency regulations and policies. Finally, in many instances both onshore and offshore, the operators do not own or maintain the custody transfer meter—the meter where gas and oil are transferred from one party to another—which measures the oil and gas produced. Rather, that meter is owned and maintained by a pipeline company that is paid by the operator to transport the oil or gas to some point downstream.

Onshore. Production inspections are BLM's primary mechanism for ensuring that operators are complying with various measurement regulations and policies. BLM staff conduct production inspections to provide reasonable assurance that oil and gas produced from federal leases are being measured and handled appropriately. BLM's petroleum engineer technicians are responsible for conducting production inspections, in addition to other types of inspections, including drilling, well plugging, and abandonment inspections. Petroleum engineer technicians conduct and track production inspections by inspecting cases—a case is either a lease or a unit agreement[17] which can have between 1 to over 1,000 wells—to verify that oil and gas are being measured in accordance with regulations and policies. Production inspections typically consist of four key activities: (1) reviewing 6 months of production records to look for any anomalies, (2) assessing the physical conditions of the production area by looking for refuse or any leaking equipment, (3) verifying that the company-submitted site security diagram—which should include all the piping and equipment at the site—reflects what is actually at the site, and (4) examining a sample of both oil and gas measurement operations. For example, this examination may involve witnessing a gas meter calibration, independently recalculating the

[16] 30 U.S.C. §1718(c).

[17] Upon the request of companies, BLM and OEMM can administratively combine contiguous federal, state, or private leases into units to more efficiently explore and develop an oil or gas reservoir and to lessen the surface disruption caused by the building of roads and the installation of pipelines and production equipment.

gas production volumes using key values recorded by the electronic flow computer, or gauging an oil tank. BLM production accountability technicians also complete in-office detailed reviews of meter statements, calibration records, and oil and gas production volumes reported to MMS.

Offshore. OEMM's efforts to verify measurement consist primarily of physical inspections of oil and gas production platforms, and an automated comparison of operator-reported production data with volume data generated by pipeline companies. OEMM's inspectors are responsible for a variety of inspections, including safety and environmental, as well as those focusing on oil and gas production. OEMM's production inspections include verifying that piping connected to the meter is sealed to prevent theft and ensuring there are no bypasses around meters that could allow oil or gas to flow unmeasured. Additionally, OEMM inspectors witness oil and gas meter calibrations. OEMM also automatically compares operator-reported oil and gas production volumes with pipeline oil run tickets and gas volume statements through its Liquid Verification System and Gas Verification System. These programs require that operators submit gas volume statements and oil run tickets produced at OEMM's official metering points, called facility measurement points, that are used for royalty determination purposes. The volumes recorded on these statements, along with other technical information, are electronically and manually entered by OEMM staff. OEMM's database then compares these volumes with the monthly operator-reported production volumes, and forwards discrepancies to MMS. MMS staff then follow up with the oil or gas companies and work to reconcile the volume differences.[18]

[18] In OEMM's Pacific region, discrepancies are handled within the region, instead of by other MMS staff.

Interior's Measurement Regulations and Policies Do Not Provide Reasonable Assurance that Oil and Gas Are Accurately Measured

Interior's measurement regulations and policies do not provide reasonable assurance that oil and gas are accurately measured because (1) its varied approaches for developing and revising its offshore and onshore regulations are ineffective and inefficient, (2) it has a decentralized process for approving new measurement technologies not addressed by current regulations, (3) it has not determined the extent of its authority over key elements of oil and gas production infrastructure, and (4) its policies for tracking where and how oil and gas are measured are not consistent and effective.

Interior's Varied Approaches for Developing and Revising Its Offshore and Onshore Measurement Regulations Are Both Ineffective and Inefficient

Interior's approaches for developing and revising its offshore and onshore oil and gas measurement regulations differ, at times hindering Interior's ability to accurately measure oil and gas production. Since these regulations were first promulgated, they have been ineffectively revised and, in some cases, do not reflect current measurement technologies or industry standards. Finally, little coordination has occurred between OEMM and BLM, resulting not only in inefficient and duplicative efforts in reviewing and assessing new measurement technologies and practices, but a missed opportunity to take advantage of measurement expertise across agencies.

Interior's Offshore and Onshore Measurement Regulations Differ, Permitting Inconsistent Measurement of Oil and Gas

Interior's regulations for measuring oil and gas vary depending on whether the production is from an offshore or onshore federal lease, resulting in inconsistent oil and gas measurement practices and, in some instances, reducing Interior's assurances of accurate measurement. More specifically, in 1982, the Secretary of the Interior transferred authority for offshore and onshore oil and gas measurement to MMS and BLM, respectively. Accordingly, each agency developed its own set of measurement regulations which have varying requirements for how oil and gas should be measured. Some variations between Interior's offshore and onshore measurement regulations may be appropriate because of the differences between offshore and onshore oil and gas production volumes and operating environments. For example, OEMM regulations require that offshore meters be calibrated more frequently than BLM regulations require for its onshore meters. Given the relatively higher volumes of oil and gas typically flowing through offshore meters, more frequent calibrations help ensure that even small meter errors are corrected before large volumes are measured incorrectly, according to measurement specialists. Other variations between offshore and onshore measurement regulations are more problematic. For example, orifice plates that are free of nicks, pits, and grooves are critical for accurate gas measurement both onshore and offshore. BLM has regulations requiring operators to inspect the orifice plates every six months to ensure they are free of these defects.[19] In contrast, OEMM regulations reference API guidelines that highlight the importance of orifice plate inspections, but do not prescribe frequencies for operators to conduct these inspections.[20] This omission increases the risk of inaccurate offshore gas measurement because OEMM does not have sufficient assurance that the orifice plate is free of nicks and other imperfections. Similarly, Interior approves the use of electronic flow computers both onshore and offshore for calculating gas volumes. However, while OEMM has a regulation specifying the conditions under which electronic flow computers may be used; BLM relies on individual states' policies. While these state policies are generally the same, they were issued separately over 5 years, resulting in inconsistent application of requirements and standards when approving these devices during this period. This lack of a consistent departmentwide regulation on the use of electronic flow computers increases the risk that gas may not be measured accurately.

Interior Lacks an Integrated Approach for Ensuring Both its Offshore and Onshore Measurement Regulations Are Consistently Revised to Reflect Current Measurement Technologies

Interior lacks an integrated approach for ensuring that both its offshore and onshore measurement regulations are consistently updated to reflect current industry measurement technologies and practices, which would increase Interior's assurance that oil and gas are measured accurately. While OEMM has an established approach for annually reviewing its measurement regulations and has kept them reasonably updated, BLM does not have such an approach, and as a result, its measurement regulations have not been revised since 1989.

OEMM routinely updates its offshore oil and gas measurement regulations, most recently in 2009 when it established post-hurricane meter verification

[19] BLM's regulations are implemented and supplemented by onshore oil and gas orders which go through the rule making process and are binding on lessees and operators. The use of the term regulations throughout this report encompasses orders.

[20] American Petroleum Institute, *Manual of Petroleum Measurement Standards*, Chapter 14—Natural Gas Fluids Measurement, Section 3—Concentric, Square-Edged Orifice Meters, Part 2—Specification and Installation Requirements, Fourth Edition, Washington, D.C., Apr. 2000; reaffirmed Mar. 2006.

and calibration requirements. As a result of OEMM's annual reviews of its regulations, they generally reflect both current technologies and the oil and gas industry's voluntary consensus measurement standards. OEMM employs two methods to help maintain its regulations. First, it has an office of approximately nine full-time regulatory specialists and engineers who, among other things, annually review oil and gas industry standards, including API's measurement standards, upon which OEMM's measurement regulations are largely based. As part of this review, staff assess whether any revisions to industry standards referenced in current regulations represent a technological or process change significant enough to require an update to OEMM's regulations. OEMM's regulatory officials also coordinate with OEMM's regional production and development staff—staff responsible for approving how offshore oil and gas will be measured—to consider the likely impact of the revised industry standard. If both parties agree that updating the regulations is necessary, regulatory staff prepare a memorandum outlining the proposed change for MMS management to review. If MMS management approves the proposed regulatory change, the proposal continues through Interior's rule making process, which may or may not require public comment. Second, OEMM has also established a streamlined process to incorporate industry standards into its regulations when certain criteria are met—as set forth in the Administrative Procedure Act.[21] In 1996, MMS issued a regulation that allows OEMM to incorporate industry standards by reference without public comment when MMS determines that the revisions to an industry standards document will either improve safety or represent standards for newer technology used by industry, and will not impose undue costs on the affected parties.[22] For example, MMS first adopted API's 1993 standards for the use of electronic flow computers in 1998; when MMS updated its regulations to meet API's 2005 reaffirmed standards in 2007, it did so without soliciting public comment. According to OEMM officials, when notice and comment are not required, the rule making process is 6 to 12 months faster than when they are required. Overall, in part because of these two methods, OEMM's measurement regulations have been updated 10 times since 1988, 9 of which occurred after the 1996 change to include regulatory standards by reference.

In contrast, BLM has neither a dedicated staff to review changes to standards referenced by its regulations nor a regulation allowing it to

[21] 30 C.F.R. § 250.198.

[22] 61 Fed. Reg. 60019 (Nov. 26, 1996).

update its regulations by reference when certain criteria are met. In part, because it lacks such an effective approach, BLM last revised its oil and gas measurement regulations in 1989. As a result, BLM's regulations do not reflect current industry adopted measurement technologies and standards designed to improve oil and gas measurement. According to a senior BLM official, BLM generally relies on a single method for determining whether its measurement regulations need to be updated. While BLM does not have any specific personnel formally tasked with monitoring changes in either measurement technologies or industry measurement standards, BLM field office staff and BLM management may use an informal process to reach consensus that various sections of BLM's oil and gas regulations need updating. This process has resulted in two attempts since 1989 to update BLM's regulations, neither of which ended in revised measurement regulations. The first attempt began in the early 1990s, when BLM published proposed gas measurement regulations in the *Federal Register* in 1994 for public comment. These regulations would have addressed, among other things, electronic flow computers. Because these regulations were not finalized, BLM did not formally address electronic flow computers in some jurisdictions until 10 years later and, only then, through BLM policy changes on a state-by-state basis. BLM's second attempt occurred in the late 1990s, when it proposed revisions to all of its oil and gas regulations and planned to publish them in the *Code of Federal Regulations;* however, after BLM drafted 200 pages of regulations and published them in the *Federal Register* in 1998, they were never finalized.

BLM is now attempting for the third time to update its measurement regulations. In December 2007, Interior's Subcommittee on Royalty Management raised concerns about BLM's measurement regulations and recommended that BLM re-evaluate them.[23] Specifically, the subcommittee recommended that BLM establish a working group to evaluate its oil and gas measurement and site security regulations to ensure that they include adequate guidance for BLM to provide reasonable assurance that sufficient royalties are paid on oil and gas. For example, the subcommittee suggested that when BLM reviews its gas measurement regulations, it evaluate the use of electronic flow computers and gas sampling and analysis, among other areas. Although the subcommittee set a June 2008 deadline for BLM to complete this work, in April 2009, Interior's Inspector General issued a report that evaluated BLM's progress and found that BLM

[23]Subcommittee Report to the Royalty Policy Committee, Washington, D.C., December 2007.

had not yet established a work group to evaluate its regulations.[24] However, instead of empanelling a committee to work exclusively on this large task, BLM has asked staff to volunteer to do this work along with their other responsibilities, with the consent of their supervisors. An official told us that obtaining approval from local supervisors for staff to participate in these working groups was a challenge and may have contributed to the delay. In August 2009, a senior BLM official told us that even if the regulatory process was fast-tracked, the revised measurement regulations would be issued at the end of 2011, at the earliest. According to this official, the work groups had been established and would begin drafting proposed regulations soon.

Interior's Offshore and Onshore Staff Have Infrequently Coordinated on Measurement Regulations Resulting in Inefficient, Duplicative Efforts

Historically, according to both OEMM and BLM officials, there has been limited communication between the agencies regarding measurement regulations and other measurement issues. As a result, Interior does not have a coordinated approach for addressing measurement issues that draws on measurement expertise from both OEMM and BLM. Interior has, at various times, had staff from both OEMM and BLM independently reviewing and assessing the same industry standards that are referenced in both OEMM's and BLM's regulations, the results of which are not shared with one another, raising the likelihood that they may reach different conclusions. Furthermore, when industry develops new metering and measurement technologies and subsequently writes standards to address their use, staff from both agencies independently assess the new technology's effectiveness. For example, both OEMM and BLM have approved V-Cone meters for measuring royalty-bearing gas. However, the agencies did not coordinate to assess the technology or accuracy of the meter. Rather, staff from both OEMM and BLM each devoted time and resources to examining the meter. While BLM obtained the company-funded research evaluating the conditions under which the V-Cone meters could accurately measure gas, BLM did not share these findings with OEMM. As a result, there is a risk that the conditions for which meters are approved for onshore measurement and for offshore measurement may be different and that these different conditions may have varying effects on the accuracy of the oil or gas measurement. Interior is currently addressing some of these coordination issues through its Production

[24]Office of the Inspector General, U.S Department of the Interior, *Evaluation of Royalty Recommendations Made to the Department of the Interior Fiscal Year 2006 – February 2009*, (CR-EV-MOA-0003-2009, Washington, D.C., Apr. 2009).

Coordination Committee and its subteams which specifically address oil and gas measurement issues, which were established in response to a recommendation made by the Royalty Policy Subcommittee on Royalty Management. The Production Coordination Committee, established in 2008 and composed of BLM, OEMM, and MMS staff, is responsible for both implementing 22 of the over 100 recommendations that require intradepartmental coordination included in the subcommittee's December 2007 report, as well as facilitating ongoing internal coordination, communication, and information sharing between BLM, OEMM, and MMS. According to an MMS official, one outcome of this effort to facilitate coordination was a November 2009 joint BLM and MMS workshop that provided an opportunity for staff to share applicable best practices and discuss common oil and gas production concerns, including production verification, commingling and allocation, gas sampling, and auditing requirements. While other BLM and OEMM officials told us that the agencies are now communicating with one another more frequently, both BLM and OEMM continue to independently update and revise their measurement regulations.

Interior's Decentralized Process for Approving New Measurement Technologies Not Addressed by Current Regulations Increases the Risk of Inaccurate Oil and Gas Measurement

Interior lacks a centralized review process for approving technologies not addressed by current regulations, increasing the risk of inaccurate oil and gas measurement. When a company wants to use a technology that is not addressed by regulations, it requests specific approval to do so, referred to as a variance, from Interior.[25] Interior has delegated this decision making authority to both OEMM and BLM, which has resulted in the agencies developing approaches that are inconsistent with one another for assessing these requests. These inconsistent approaches may increase the risk of inaccurate measurement.

OEMM's process for granting approvals is centralized and the resulting decisions are generally consistent. OEMM chose to retain decision making about variances at the regional level, where OEMM possesses specialized production measurement expertise, as opposed to delegating this responsibility to its district offices, which do not have such expertise. Because decisions to approve variances are centrally made and reviewed by engineers solely responsible for measurement issues, these variances are generally consistent. Most OEMM variance requests are reviewed in

[25]The term variance is not used by OEMM in the Gulf of Mexico region, but OEMM officials told us that it refers to the same process.

OEMM's Gulf of Mexico Production and Development office, which oversees production of most federal offshore oil and gas activity. For example, OEMM recently approved a request from one company to use ultrasonic meters to measure royalty-bearing gas. In making this decision, OEMM staff evaluated both the performance data on the proposed meter's accuracy as well as the economic aspects of using the meter, which in this instance, suggested that measurement costs could be lowered by reducing the need for additional pipelines and space on a platform. Because OEMM's internal control environment is structured so that these decisions are centrally made by staff whose primary responsibility is measurement, there is less risk of a meter being approved that results in inaccurate measurement.

In contrast, BLM's approval process for variances from its measurement regulations are not centralized and approvals are not reviewed by specialized measurement staff; in some instances inconsistent decisions have been made, raising the risk that oil and gas measurements were inaccurate. For example, in some cases, where current measurement regulations do not apply and the BLM national or state offices have not provided formal guidance, the field office's authorized officer—who may or may not have a petroleum engineering degree or expertise in measurement issues—decides whether to approve a variance from current measurement regulations without further review or notifying BLM at the national level.

We found that in BLM's approvals of four measurement technologies: electronic flow computers, Wafer V-Cone meters, truck-mounted Coriolis meters,[26] and flow conditioners,[27] were either not consistently made, not centrally reviewed, or both. For example, BLM documents indicate that authorized officers at different field offices initially approved Wafer V-Cone meters—a type of differential pressure meter that was marketed as having the ability to accurately measure gas mixed with water—but that the operating conditions for which they were approved were inconsistent. After these initial approvals, BLM, at the national level, participated in a

[26]A Coriolis meter is a type of meter that can measure fluids by measuring the mass of a fluid traveling past a fixed point per unit time. In this particular application, a Coriolis meter was mounted on the back of a truck.

[27]Flow conditioners are devices placed within the upstream portion of the meter run to both stabilize the gas flow and allow for a shorter meter run, which is necessary for orifice meters to accurately measure the gas.

work group that assessed research paid for by the meter manufacturer to determine under what conditions the meters could accurately measure gas. The results of the research, which was completed in 2005, confirmed that BLM had previously approved the use of Wafer V-Cone meters for conditions outside of the meters' ability to accurately measure the gas. BLM issued a nationwide Instruction Memorandum in November 2006 specifying the conditions under which BLM's authorized officers could approve Wafer V-Cone meters, as well as requiring that all previously approved Wafer V-Cone meters be brought into compliance.[28] In response, one of the field offices we visited sent a letter to all companies in its jurisdiction in January 2009—over 2 years after BLM issued its Instruction Memorandum—requesting that all companies submit a plan to BLM outlining how they would bring any noncompliant Wafer V-Cone meters into compliance by May 2009. As a result, according to a BLM official, some royalty-bearing gas was inaccurately measured over a period of several years and resulted in costs to companies that were required to retrofit measurement installations that had been approved by BLM. Additionally, because BLM management does not centrally review approvals made by authorized officers at the field offices, they are unaware of what approvals are made at the field office level. For example, in November 2008, the BLM national office issued a nationwide Instruction Memorandum requesting information on the number of field offices that had approved truck-mounted Coriolis meters for oil measurement.[29] This incident suggests that BLM management was both unaware of how frequently this technology was being used and what measurement performance data were used by field office authorized officers in granting any variances (see appendix III for further details).

Furthermore, we found that within BLM field offices, the authority of the authorized officer is inconsistently delegated to one of several different BLM positions, which have different professional backgrounds. For example, in four of the seven field offices we visited, the petroleum engineers have approval authority, in two field offices the associate field office manager has approval authority, and in one field office a petroleum engineer technician has approval authority. In addition, according to BLM

[28]BLM, *Instruction Memorandum No. 2007-022: Policy for Approving Variances Allowing the Use of "Wafer V-Cone Meters" at Federal and Indian Points of Measurement* (Nov. 16, 2006).

[29]BLM, *Instruction Memorandum No. 2009-027: The Feasibility Use of Truck Mounted Meters for Oil Measurement Onshore* (Nov. 26, 2008).

staff who make decisions on whether to approve variances, they typically request supporting technical information from the operator; conduct Internet searches for related material to review; and, in some cases, consult with authorized officers in other field offices, though there is no requirement to do so prior to making a decision on an application for a variance.

Recently, BLM established a Gas Measurement team, as recommended by the Subcommittee on Royalty Management in December 2007, to assess new gas measurement technologies and consider other measurement issues; however, the team consists of staff who have volunteered for the task, subject to approval from their supervisors. Furthermore, the team members must split their time between their primary job responsibilities and their new role in assessing the technologies and considering measurement issues—potentially limiting the amount of time that they can devote to the gas measurement tasks. According to one member of the Gas Measurement team, this has created some challenges, as there are a large number of measurement issues that BLM needs to address, yet they have limited staff available to devote to the task. Finally, the team currently serves in an advisory role by assisting the authorized officers who have authority at the field office level. At the time of our site visits to seven BLM field offices, from March through May 2009, some staff stated that they would coordinate with the newly established Gas Measurement team, while others did not tell us whether they would coordinate with the team.

Interior Has Not Determined the Extent of Its Authority over Key Elements of Oil and Gas Production Infrastructure Necessary for Ensuring Accurate Measurement

Interior has not determined the extent of its authority over two key elements of oil and gas production infrastructure that are necessary for ensuring accurate measurement: (1) meters in (or after) gas plants which, in some cases, may include the meter where oil and gas are measured for royalties; and (2) meters owned by pipeline companies, which frequently own, operate, and maintain the meter used at the official measurement point on federal leases, as well as the production data the meter generates.

Interior's Failure to Determine the Extent of Its Authority over Certain Gas Plant Sales Meters Has Resulted in Limited Oversight of Measurement at Certain Gas Plants, Reducing Assurances that Royalty-Bearing Volumes Are Being Correctly Measured

Interior has exercised limited oversight over certain gas plants because it has failed to determine the extent of its authority for overseeing gas plants that process gas produced both onshore and offshore and what regulatory standards apply to the meters used in gas plants to measure royalty-bearing federal production. Gas plant meters are critical in determining accurate royalty payments as, often, operators measure the unprocessed gas at the well head and transfer the gas to a gas plant. Gas plants further refine unprocessed natural gas into various constituents upon which royalty payments are due. Beside methane, which is the most common constituent, these constituents include butane, propane, ethane, and other products that can be used in a variety of ways, including residential heating, transportation, and plastic manufacturing. Because many of these other sales products may have higher market values than natural gas used in homes, royalties paid on these components can be responsible for a significant share of royalties provided by a lease. As such, any inaccurate measurement at gas plants could significantly impact royalties that are due to the federal government. Accordingly, ensuring that sales products are accurately measured is essential for determining the correct royalty amount. Until recently, Interior had not physically inspected gas plant meters used to measure royalty-bearing gas production—except in the Pacific region, where OEMM approved official measurement royalty points in the gas plant. According to officials and documents obtained from Interior, for over 20 years, there has been a history of uncertainty as to which agency had both the legal authority and regulatory responsibility to inspect gas plant meters. For onshore gas plants, BLM and MMS have attempted to bring resolution to this uncertainty but, so far, they have been unsuccessful. For example:

- BLM and MMS established a Gas Plant task force in the mid-1980s to examine agency roles and responsibilities and industry requirements related to the gas stream, from the well head to the gas plant tail gate—meters measuring processed natural gas products. The central question the task force addressed was, "What are the roles of BLM and MMS in ensuring that the United States fully receives royalties due from the sale of all products produced from the gas stream?" The task force concluded that BLM would ensure that oil and gas were measured correctly before they leave the federal lease and that MMS would conduct a reasonableness check, through a formula, that gas plant products were correctly allocated back to the correct federal lease. The task force further concluded that MMS could make special requests to BLM to examine meters at a gas plant, if necessary; but that, in general, BLM's role regarding gas plants was very limited. One key finding of the task force was the existence of a "a void in regulatory connection between BLM's 'measurement point' and

MMS's 'sales point,'" though no specific actions were taken to address this. Finally, the task force concluded that, in general, while the government should generally be assured that the gas plant products are being accurately measured, verifying this is not among BLM's highest priorities.

- BLM and MMS revisited this issue in 1996 when they established an Oil and Gas Royalty Measurement Point/Gas Accountability work group to address, in part, potential oversight gaps between BLM's point of measurement and MMS's sales point at a gas plant. The work group raised the issue that the BLM point of measurement and the MMS sales point were two different points; with BLM's point of measurement typically located upstream of MMS's sales point. A document from one of the work group's meetings stated that "independent verification of actual volumes measured at the sales point (e.g., a meter in a gas plant), against what has been reported as sold, is not being conducted by either agency [BLM or MMS]." The memo further concluded that, "Additionally, all measurement for sales purposes which occurs after the BLM approved point of measurement does not require approval or need to meet any standards for accuracy," meaning that meters used to measure products upon which royalties are due are not required to meet any regulatory standards for accuracy.

As of September 2009, according to a BLM official, meters used in gas plants to measure onshore royalty-bearing federal production did not have to meet federal standards, and BLM did not independently verify volumes measured at gas plants. According to a senior BLM official, the reason BLM does not inspect meters in gas plants is that, until recently, BLM assumed that this was MMS's responsibility. When we discussed gas plants with BLM staff at field offices, some petroleum engineer technicians did express some concern about the accuracy of royalty payments based on how products were both handled and measured downstream of BLM's point of measurement. However, most BLM staff were not concerned because they considered anything past their point of measurement beyond their jurisdiction.

Similarly, OEMM has not determined the extent of its authority over gas plants processing gas produced offshore, which has resulted in OEMM's exercising minimal oversight over measurement issues in Gulf of Mexico gas plants. While OEMM did issue a regulation in 1998 allowing OEMM inspectors to inspect meters in gas plants, according to Interior officials, this provision has historically been used in cases where the lease operator owned the gas plant—which, because of industry consolidation and pipeline infrastructure, is common only in the Pacific region.[30] However, officials told us that, more commonly in the Gulf of Mexico, gas plants are not owned by the operator and OEMM has not determined its authority in these cases. Accordingly, OEMM does not have regulations specifically addressing the types of meters used in gas plants or standards for how often these meters are calibrated; and, until recently, has not conducted any inspections of gas plants, thereby increasing the uncertainty about whether royalty-bearing gas is being properly measured.

In December 2008, because of concerns raised by the Associate Director of OEMM about the lack of oversight at gas plants, OEMM initiated a comprehensive review of all gas plants in the Gulf of Mexico region processing royalty-bearing offshore federal gas. OEMM's efforts identified 37 gas plants, of which 27 were then processing federal gas; the remaining 10 gas plants were not operating because of the low volumes of gas being produced from the Gulf of Mexico. OEMM's inspections, which began in June 2009, included obtaining or creating a site-security diagram for the gas plant, identifying all meters associated with the plant, reviewing meter calibration reports, and identifying potential bypasses around royalty determination meters. OEMM plans to use some of these data to create a gas plant database that could be used for future audits. These gas plant inspections identified several potential areas of concern. First, OEMM identified one instance of possible misreporting of gas production. Each month, operators are required to submit to MMS their monthly production reports which, among other things, indicate which gas plant the operator's gas is being transferred to for processing. In this instance, an OEMM official found that the total monthly volume attributed to a particular gas plant for processing was significantly greater than the plant's total gas processing capacity for a month. Second, OEMM identified several instances in which meters had not been calibrated in accordance with OEMM's measurement regulations. Finally, OEMM identified piping configurations in gas plants that would potentially allow royalty-bearing gas streams to bypass the royalty sales point without being measured.

Interior's Office of the Solicitor is now reviewing what legal authority BLM and OEMM have for inspecting gas plants, and whether or not regulations need to be written or revised. According to Interior's attorneys, they began

[30] 30 C.F.R. § 250.1203(e)

the review of OEMM authority in May 2009, and BLM requested a review of its authority in September 2009.

Interior Has Not Determined the Extent of Its Authority over Meters and Pipelines, Limiting Production Verification Efforts

Interior has not determined the extent of its authority to obtain production data from meters designated as the official point of measurement or its authority over the meters themselves, when they are owned by pipeline companies; thus, limiting Interior's ability to access key production data and equipment necessary for verifying production.[31] While Interior has some statutory authority over pipelines and other shippers, such as tanker trucks that transport oil and gas produced from federal leases, neither BLM nor OEMM has issued regulations to enable Interior to implement this authority.[32] This creates two challenges for both BLM's and OEMM's production verification. First, because Interior currently does not obtain production and meter information directly from the pipeline companies, it relies on operators to provide the information. According to some Interior staff, obtaining the documents necessary for audits from the operators instead of the pipeline company is both inefficient and time-consuming. Several BLM staff at both the state and field office level with whom we spoke said that they have encountered situations where the operator did not have the required production records necessary for BLM to verify production—such as oil tank gauging records, meter calibration records, and gas analysis reports. In these instances, BLM worked through the operator to obtain the documents from the pipeline company. In one instance, a BLM official told us that during a meeting to discuss how BLM would obtain the necessary production documentation with both the operator and the pipeline company, a pipeline company official initially refused to provide BLM the documents, explaining that BLM did not have jurisdiction over pipelines. In these instances, BLM enters into a protracted interaction with the involved parties, which often results in BLM's requesting oil and gas production companies—either operators, lessees, or both—to obtain these records from the pipeline companies,

[31]Under current law, operators are required to have all data associated with the meter for six years, and are required to provide this information to Interior, regardless of who owns the meters. 30 U.S.C. §1713.

[32]Oil and gas pipelines may be subject to oversight by federal and state entities, depending on the nature of the pipeline. Interstate pipelines are regulated by the U.S. Department of Transportation for safety issues, and the U.S. Federal Energy Regulatory Commission for the transmission and sale of natural gas for resale in interstate commerce. Intrastate pipelines, such as gathering systems located on federal leases are, in some instances, overseen to some extent by state regulators.

which lengthens the time it takes for BLM inspection staff to verify production.

Second, Interior's uncertainty about its authority over the physical meter itself when it is owned by the pipeline company complicates Interior's efforts to schedule appointments to witness meter calibrations or other inspections—a critical control for ensuring accurate measurement. For example, some offshore inspectors told us that they had, in several instances, not been able to witness meter calibrations as planned because the pipeline company staff changed their schedule for calibrating a specific meter without notice. As a result, OEMM inspectors are less able to meet their goals for witnessing meter calibrations. Additionally, the unnecessary cost OEMM incurs for flying an inspector out to a platform to witness a meter calibration is significant—up to $5,000. According to OEMM officials, they currently have no direct recourse with the pipeline company when they cancel the calibration without providing notice.

Interior's Policies for Tracking Where and How Oil and Gas Are Measured are Not Consistent or Effective, Reducing Assurance that Oil and Gas Are Being Measured and Reported Accurately

Interior, which has delegated responsibility for oil and gas production verification to OEMM and BLM, tracks measurement points offshore but not onshore, thereby reducing Interior's assurance that oil and gas are being accurately measured and reported. [33] Additionally, while Interior has developed specific policies and instituted controls for reviewing and approving offshore commingling requests, [34] it has not done the same for onshore commingling requests, creating situations where, according to staff, verifying production is difficult.

Interior Does Not Consistently Track All Measurement Points, Resulting in Uncertainty about the Location of Meters Measuring Oil and Gas Produced from Federal Lands

Interior tracks offshore measurement points to assist in verifying oil and gas production, but not onshore measurement points, which creates uncertainty about the location of the official point of measurement and complicates production verification work. Offshore, OEMM tracks the number and location of its official points of measurement by assigning a facility measurement point number to each point of measurement. Each facility measurement point number, in turn, is associated with one or more meters that are numerically identified with meter ID numbers. In addition,

[33]Measurement points are meter locations which measure oil or gas that are reported on the operator-reported monthly production report.

[34]A commingling request is a request made by the lease operator to mix together oil or gas from separate leases prior to measurement.

MMS requires that operators report their monthly production volumes by their facility measurement point. OEMM subsequently matches these volumes with volumes generated by the pipeline companies and recorded on oil run tickets or gas volume statements. In this way, OEMM is able to identify the measurement point for all volumes of offshore oil and gas produced and to verify reported production compared with meter production records.

Onshore, BLM does not track either the number or location of its official measurement points for each lease—routinely called the point of measurement and described as the last meter before the oil or gas leaves the lease. This lack of tracking complicates BLM's production verification efforts. Moreover, MMS does not require onshore operators to report meter identification information, such as an ID number, on the monthly production reports, as it does for offshore operators. This makes it difficult to associate the oil or gas production reported on the monthly production report with any particular meter on the lease. Current measurement regulations require that all onshore oil and gas be measured on the lease or within the boundaries of the associated unit, unless BLM allows an operator to measure the production off-lease—at a location other than the lease where it was produced. However, BLM has no regulatory or policy requirement for the operator to clearly identify the point of measurement or provide BLM with specific identifying information. The absence of a clear identifier for the point of measurement has created challenges for BLM in verifying production and operators in reporting production. BLM petroleum engineer technicians and production accountability technicians verify production, in part, through ensuring the point of measurement meter is functioning properly and comparing operator-reported volumes on the monthly production report to production information recorded by the meter. Without clear identification of the point of measurement in the field and a meter ID number on the monthly production report, BLM staff may not be able to correctly identify the point of measurement. BLM staff with whom we spoke from nine field offices expressed a range of views on the difficulty they have with identifying the point of measurement while conducting production inspections. Generally, BLM petroleum engineer technicians said that when the point of measurement is at the well head, it is easy to identify; however, when off-lease measurement has been approved, locating the point of measurement can be challenging. Petroleum engineer technicians in most of the nine field offices stated that having clear documentation of the point of measurement would assist them in completing their inspections.

Additionally, some BLM staff stated that operators may be unaware of the location of the official BLM point of measurement, resulting in misreporting production. Specifically, field offices have experienced cases in which operators measured and reported gas from unapproved off-lease central delivery points—central locations at which gas from multiple leases or units is measured. These meters may be measuring commingled federal, private, and state production, which the operators allocate back to individual wells located upstream. According to BLM staff, it is unclear whether operators are doing this intentionally or unintentionally. To address some of this uncertainty, the Wyoming BLM state office issued an Instruction Memorandum addressing this issue in 2003, after it determined that operators were using off-lease central delivery point allocation systems, which led to significant discrepancies between the operator-allocated volumes and the point of measurement volumes.[35] The memorandum further stated that without a clear understanding of where BLM's point of measurement is, it is impossible to correctly account for production volumes, among other things. More recently, in March 2009, the Pinedale, Wyoming, field office issued a letter to all the operators in its jurisdiction stating that "due to the changing composition of production facilities and point of measurement for many wells, the Pinedale field office finds it necessary to require operators to provide additional measurement information for purposes of verifying production and measurement," which include posting at each lease site a list of all wells that flow through each of the measurement devices located on the lease.

Interior's Inconsistent Policies and Processes for Approving Commingling Agreements Compound Its Difficulties in Ensuring that Oil and Gas Are Accurately Measured

Interior's offshore and onshore policies for approving specific agreements for how oil and gas can be measured after being combined with oil or gas from another lease—commingling agreements—are inconsistent. OEMM has explicit policies and a centralized process for approving specific agreements for how oil and gas can be commingled. In contrast, BLM lacks a clear policy and uses a decentralized process, which makes its staffs' efforts to verify production difficult. As a general rule, because offshore commingling involves only federal production, offshore commingling agreements may be less complex than onshore commingling agreements, which may include federal, state, and private production.

Offshore, OEMM reviews requests for commingling agreements at a single office in each of its regional offices, rather than delegating this

[35]Wyoming BLM, *Instruction Memorandum No. WY-2003-036: Policy Clarification Regarding BLM's Point of Measurement* (May 30, 2003).

responsibility to petroleum engineers in its district offices. In addition, in the Gulf of Mexico, where the majority of commingling agreements are reviewed, each request is reviewed by two different supervisors to ensure consistency. Additionally, OEMM guidance provides criteria for evaluating commingling and allocation agreements in the Gulf of Mexico region. For example, to protect federal royalty interests, OEMM guidance instructs petroleum engineers not to allow production from leases with different royalty rates to be commingled without a separate measurement that meets API standards because, according to an agency official, production may be misallocated to a lease with a different royalty rate, resulting in inaccurate royalty payments. Moreover, OEMM requires operators with commingling agreements that involve nonfederal production to not only report production on their monthly production report, but to separately report their allocated production on a monthly production allocation schedule report. The purpose of this report is to provide additional information about how allocated volumes are divided among different leases in a commingling agreement. This report provides OEMM and MMS with an additional control for verifying commingled production, since the data are corroborated by the operators' monthly production report.

In contrast, BLM lacks sufficient policies and a consistent process for determining whether to allow federal production to be commingled with other federal, state, or private production prior to measurement. This results in complicated commingling agreements that, according to BLM staff, make verifying production difficult. BLM's policy for reviewing and approving requests to commingle and allocate production includes fewer criteria than OEMM's and creates significant challenges for BLM's petroleum engineer technicians and production accountability technicians in verifying production. Operators may submit a request to commingle production to their local BLM field office, where a petroleum engineer typically reviews the request and determines whether to approve it. According to petroleum engineers in six of the seven field offices we visited, however, there is a lack of sufficient BLM national guidance on how to review the requests. As a result, petroleum engineers we met with told us they rely, instead, on a variety of other guidance, including guidance produced at the field or state office level. For example, petroleum engineers from two field offices—one in Utah and one in Wyoming—told us that they consider criteria included in an Interior Geological Survey Conservation Division Manual, issued in 1974. A petroleum engineer from Wyoming provided us with Wyoming BLM general guidance dated May 2001 that was applicable to Wyoming field offices. Finally, a petroleum engineer from a field office in New Mexico told us he considers criteria from both local BLM guidance issued in 1995 and the findings of a 1994 joint BLM and Industry Off-lease Sales, Usage, and Measurement Subcommittee report. While there are similarities among these guidance documents, it appears as though BLM staff are not routinely referencing uniform national guidance and, therefore, are increasing the risk that when presented with similar commingling requests, they may make different decisions. Seemingly inconsistent decisions have caused at least one operator to raise the issue to a BLM State Director. In this instance, the operator's request to commingle production at one field office had been denied; whereas, according to the operator, the same types of commingling requests were routinely approved at another field office within the same state. Additionally, BLM currently has no guidance on what role either petroleum engineer technicians or production accountability technicians—staff who verify commingled production—have in reviewing and approving commingling requests. While the majority of petroleum engineers we spoke with in the seven field offices stated that when approving a commingling agreement, they would consider the effect on the petroleum engineer technicians' and production accountability technicians' capacity to ensure that production is measured and reported accurately; petroleum engineers from one field office said they would not.

Finally, petroleum engineer technicians and production accountability technicians—staff responsible for ensuring that production of oil and gas is accurately reported—told us that commingling and allocation agreements create significant challenges for verifying production, and the lack of guidance exacerbates the challenges. In all seven field offices we reviewed, production accountability technicians—those most responsible for conducting in-depth record reviews to ensure production is accurately reported—stated that when production is commingled prior to measurement, verifying production is significantly more difficult. Furthermore, several production accountability technicians acknowledged that, even after completing an in-depth records review, they were not confident that all production was being properly measured and accounted for, and that the complexities of these agreements may make it nearly impossible, in some cases, to ensure that production is accurately attributed to the appropriate lease. This inability to confidently verify production greatly increases the risk that misreported volumes and their associated royalty payments will go undetected.

Interior's Differing Offshore and Onshore Production Accountability Inspection Programs Do Not Consistently Meet Their Goals or Sufficiently Address Key Factors Affecting Measurement Accuracy

Interior's production accountability inspection programs for offshore and onshore differ in key areas. Additionally, Interior is not consistently completing either its offshore or onshore required production inspections. Finally, Interior's offshore and onshore production inspection programs do not sufficiently address key factors affecting measurement accuracy, thereby increasing the risk that oil and gas are not being accurately measured.

Although Interior's Offshore and Onshore Production Accountability Inspection Programs Have Recently Been Revised, They Differ in Key Areas

Interior's offshore and onshore oil and gas production accountability inspection programs have been revised multiple times in the past several years, with each program inconsistently emphasizing different key measurement inspection goals and activities intended to provide reasonable assurance that oil and gas are measured accurately.

OEMM Recently Revised its Production Accountability Inspection Program, Which Emphasizes Annual Goals for Witnessing Meter Calibrations and Site Security Inspections

OEMM's production accountability inspection program—which emphasizes annual goals for its offshore inspectors to witness meter calibrations and conduct site security inspections—has been revised twice in the past 2 years. From 1994 until 2007, OEMM's inspection program required annually witnessing the calibration of 5 percent of gas royalty meters, the proving of 10 percent of oil royalty meters, and conducting site security inspections on all offshore platforms and measurement locations (see fig. 6). In 2008, we found that OEMM had not defined key terms for its inspection program and recommended that the Secretary define "significant quantities of oil or gas" and "history of noncompliance."[36] In 2008, OEMM established an interim annual goal of conducting site security inspections on the highest producing 100 oil and gas platforms in the Gulf

[36] GAO-08-893R.

of Mexico, while leaving its goals for witnessing meter calibrations unchanged.[37] Finally, in 2009, OEMM implemented our recommendation by revising its inspection program to incorporate definitions for "significant quantities of oil and gas" and "history of noncompliance." OEMM's current annual inspection goals are to:

- witness the proving of 10 percent of oil meters and the calibration of 5 percent of gas meters;
- annually inspect the site security of all high-producing oil and gas facilities—defined as those facilities that produce more than 1,000 barrels of oil per day, or the equivalent heating value for gas[38] and all other locations on a 3-year cycle; and
- continue to reinspect all platforms that have been placed on the Monthly Operators Compliance list—a list OEMM district offices use to track violations that inspectors find during their work—until the violation has been corrected.

[37]OEMM offices responsible for the outer continental shelf in the Pacific and Alaska regions were able to inspect all measurement locations; they have a limited number of platforms.

[38]About 980 out of the approximately 2,900 active royalty meters in the Gulf of Mexico are found on measurement locations where more than 1,000 barrels per day of oil (or, for gas, the energy equivalent) are produced.

Figure 6: OEMM Inspectors Witnessing a Calibration of an Orifice Meter Associated With a Chart Recorder at a Land-Based Meter Location

Source: GAO.

OEMM inspection staff can perform two measurement-related activities while inspecting a measurement location: (1) witnessing meter calibrations, and (2) completing a site security inspection. According to Interior officials and oil and gas company measurement staff, witnessing calibrations is recognized as a strong control for ensuring accurate measurement. OEMM staff told us that their presence when company staff are calibrating the meters is a key mechanism for ensuring proper measurement of federal oil and gas production. Conducting site security inspections verifies that offshore platforms and other measurement facilities meet OEMM's regulations concerning the handling of oil and gas production. Such inspections typically include a visual examination of piping to verify that oil and gas do not flow around—or bypass—measurement meters.

However, OEMM does not conduct certain activities that BLM uses to verify gas production, such as independently verifying electronic flow computer gas calculations. According to an OEMM official, for a short period of time in 1988, OEMM independently verified gas meter volume calculations while conducting inspections; however, this practice was discontinued when measurement inspections were incorporated into OEMM's overall inspection program at the district office level. Further, unlike BLM, which has through state policies established a 3 percent overall uncertainty limit for gas measurement that incorporates uncertainties introduced by the temperature reading, the differential pressure reading, and the overall meter installation, among other inputs; OEMM has not. To assess compliance with the 3 percent uncertainty, BLM worked with a private independent lab with expertise in flow measurement to develop an "uncertainty calculator" that allows BLM staff to input data and determine the overall measurement uncertainty for any given gas measurement configuration. When we asked an OEMM official about why OEMM had not established an overall uncertainty level, the official told us OEMM had not considered including the concept in its production verification processes.

OEMM district offices track violations that inspectors find during their work in a monthly operators' compliance list, maintained at the district level. Once OEMM staff place a facility with a history of violations on their tracking list, OEMM inspects the facility at least once every four months until the district manager determines that the operator has remedied the violation; at which point, the operator is removed from the Monthly Operator Compliance list. Currently, these violations are not formally tracked on an OEMM-wide basis, limiting OEMM's oversight of operators that have violations.

Finally, in addition to OEMM's witnessing meter calibrations and site security inspections, MMS has additional checks on the accuracy of operator-reported production volumes called the Liquid Verification System and the Gas Verification System. Each month, OEMM staff use these systems to compare the operator-reported oil and gas volumes with volumes of oil and gas measured by pipeline company meters, which OEMM recalculates based on raw meter data. When volumes do not match, MMS staff work to reconcile the volumes through meeting with operators and requesting additional documentation.

BLM's Recently Revised Production Accountability Inspection Program Includes Several Key Activities beyond Witnessing Meter Calibrations and Inspecting Site Security, Although BLM Lacks Annual Goals for Witnessing and Other Measurement Activities

BLM's production inspection program—which was recently revised—differs from OEMM's inspection program in several ways. Prior to fiscal year 2009, BLM's production inspection program required staff to annually inspect all cases—BLM's unit of inspection, which may be one or several leases containing from 1 to over 200 wells—rated as high priority for production, or those producing at least 12,000 barrels of oil or 120,000 thousand cubic feet (mcf) per month. In addition, staff were required to inspect all high priority compliance cases—cases where the operator had six or more FOGRMA-related incidents of noncompliance, or two or more major incidents of noncompliance, within a 24-month period. The production inspection program further required inspections once every 3 years on all other cases. For fiscal year 2009, BLM lowered the criteria for "high production," thereby increasing the number of high priority production inspections—or cases that require annual production inspections. BLM's current production accountability inspection program requires the following:

- annual inspections of high priority production cases—producing, on average, 6,000 barrels of oil or 80,000 mcf of gas per month—and inspections once every 3 years for all remaining cases, and
- annual inspections of high priority compliance cases—cases where the lease operator has had two major, or a total of six or more FOGRMA-related incidents of noncompliance with BLM regulations in the preceding 24 months.

BLM's production inspection program also includes a wider range of activities than OEMM's inspection program; however, unlike OEMM, BLM has not established annual goals for witnessing oil and gas meter calibrations. Specifically, BLM inspectors complete one of two types of production inspections. The first type requires inspectors to complete four separate components for each producing case: (1) an assessment of the case's site security, including whether any bypasses around the meter are present; (2) a surface protection review, or visual examination of the surrounding surface area for trash or other items that should not be there; (3) a review of 6 months of operator-reported production reports; and (4) an oil or gas measurement activity. Several of the measurement activities are similar to OEMM's activities, including witnessing oil and gas meter calibrations and witnessing a tank gauging; however, BLM has no annual goals for specific measurement activities. Alternatively, BLM staff may conduct an in-depth records review, which are more detailed examinations of oil and gas production documents.

BLM conducts several key measurement activities that OEMM does not, including both in-depth record reviews and verifications of gas volumes calculated by electronic flow computers. BLM's production accountability technicians generally conduct the in-depth record reviews by routinely asking operators to provide volume data generated by the meters, which they compare with the monthly operator-reported production volumes.[39] During these record reviews, production accountability technicians may also review additional documentation on both meter calibrations and gas samples, both of which are used to verify production. Additionally, petroleum engineer technicians and production accountability technicians may elect to verify the calculated gas volume on the electronic flow computer. This verification typically requires staff to record such factors as temperature, differential pressure, and sometimes, the integral value—a key factor required to verify gas volumes—and to recalculate the volume in accordance with the American Gas Association gas volume equation. Recalculating gas volumes can provide assurance that the electronic flow computer's software is accurately calculating the volumes. As a result of this activity, BLM has found instances where the electronic flow computer is incorrectly calculating volumes. As one petroleum engineer technician explained, BLM staff identified at least one particular model of an electronic flow computer that was incorrectly calculating volumes, which caused the operator to hire a consultant to further study the problem. In contrast, as previously mentioned, OEMM does not check the calculations of the electronic flow computers. Also, as mentioned previously, BLM developed an overall 3 percent uncertainty limit for gas measurement, as well as software to calculate the uncertainty.

When petroleum engineer technicians identify violations of BLM's regulations in the field, BLM policy is to issue an "incident of noncompliance." These incidents of noncompliance, depending on the severity of the violation, may either be minor or major. For example, according to current BLM regulations, off-lease measurement of gas without prior approval is generally considered a minor violation, whereas not recording the temperature of oil to the nearest degree during a sale is typically considered a major violation. BLM personnel in each field office track these incidents of noncompliance data in BLM's database. However, BLM does not use an overall assessment of operators' compliance across field offices as criteria for high priority compliance cases. Consequently,

[39]Record reviews are a more in-depth and manual version of what MMS's Liquid Verification System and Gas Verification System do for offshore oil and gas production.

when a BLM field office places a case in its high priority inspection category, it does not consider an overall assessment of the operator's compliance on federal cases outside of a particular field office's jurisdiction. Accordingly, being placed on the high priority list by one field office has no impact on how the same operator is viewed by another field office. As a result, the same operator may have multiple major incidents of noncompliance; by not tracking across field office jurisdictions, BLM is also limited in its oversight of an operator's noncompliance (see table 1).

Table 1: Summary of Interior's Production Accountability Inspection Program Goals and Components

Goals and components	BLM	OEMM
Defined "high producing"	Yes	Yes
Defined "history of noncompliance"	Yes	Yes
Established annual goal for witnessing gas meter calibrations	No	Yes
Established annual goal for witnessing oil meter calibrations	No	Yes
Established annual goal for witnessing oil tank gaugings	No	Yes
Review site security diagrams and inspect for meter bypasses	Yes	Yes
Track incidents of noncompliance across jurisdiction boundaries	No	No
Verify electronic flow computer volume calculation	Optional	No
Use a gas volume uncertainty calculator	Optional	No
Perform volume reconciliation – comparisons between operator-reported volume data and pipeline-generated volume data	Optional	Yes
Receive meter calibration reports	Optional	Yes

Source: GAO analysis.

Interior Has Not Routinely Achieved Its Oil and Gas Production Accountability Inspection Annual Goals, Which Reduces Its Assurance that Oil and Gas Are Measured Accurately

Neither OEMM nor BLM has consistently completed statutory or agency required production inspections, a key control for verifying oil and gas production. Offshore, OEMM met its oil and gas site security and calibration witnessing inspection goals once between fiscal years 2004 and 2008 for the four district offices we reviewed. Onshore, BLM met its minimum goal of inspecting all producing cases once every 3 years, approximately one-third of the time over the past 12 years in the six field offices with reliable data we reviewed.[40]

OEMM Met its Annual Production Inspection Goals Once in 5 Fiscal Years

Offshore, for the four district offices we reviewed, OEMM met its oil and gas site security and calibration witnessing inspection goals only once—2008—during fiscal years 2004 through 2008. In 2008, OEMM's site security goal for the Gulf of Mexico, its major production area, was to conduct inspections on the 100 highest-volume measurement locations; its goal in the Pacific region was to inspect all meters. See tables 2 and 3 for more detailed data for the four district offices we reviewed.

From 2004 through 2007, OEMM's goals were to conduct site security inspections on 100 percent of all measurement locations. During those years, the agency performed about half of the site security inspections required to meet the annual goals. OEMM staff told us that, during these years, there was a shortage of inspectors and inspections were delayed because of the ongoing cleanup related to Hurricanes Katrina and Rita in 2005. We are unable to present data for these years because, according to OEMM officials, district offices often did not correctly record site security inspections on their inspection forms. This problem was identified in 2007; since then, OEMM has instituted a new policy to ensure that these inspections are being recorded correctly.

[40]We did not include data from the White River, Colorado, field office, because the Interior Office of the Inspector General is currently evaluating the reliability of the inspection data from that office.

Table 2: OEMM Site Security Inspections for Oil and Gas Measurement, Fiscal Year 2008

		Oil		Gas	
District office	Inspection activity	Meters in the top 100 highest volume measurement locations	All other active meters	Meters in the top 100 highest volume measurement locations	All other active meters
Lake Charles	Meters requiring inspection	[a]	124	16	520
	Meters inspected	[a]	118	16	484
	Percentage inspected	[a]	95	100	93
Lake Jackson	Meters requiring inspection	15	121	25	410
	Meters inspected	15	116	25	347
	Percentage inspected	100	96	100	85
New Orleans	Meters requiring inspection	61	170	48	342
	Meters inspected	61	164	48	313
	Percentage inspected	100	96	100	92
California[b]	Meters requiring inspection	19	[b]	15	[b]
	Meters inspected	19	[b]	15	[b]
	Percentage inspected	100	[b]	100	[b]
Total	**Meters requiring inspection**	**95**	**415**	**104**	**1,272**
	Meters inspected	**95**	**398**	**104**	**1,144**
	Percentage	**100**	**96**	**100**	**90**

Source: GAO analysis of OEMM data.

[a]The Lake Charles district office did not oversee any of the 100 top-producing measurement locations in the Gulf of Mexico in fiscal year 2008.

[b]Goals in the California district differed in 2008 because of the limited number of meters in the region; specifically, inspectors conduct site security inspections on 100 percent of royalty meters annually.

Additionally, in 2008, OEMM met or exceeded its goals for witnessing 10 percent of oil meter provings and 5 percent of gas meter calibrations. We are not reporting data for witnessing calibrations from 2004 through 2007 because OEMM expressed concern about the reliability of data for those years.[41]

[41]An OEMM official told us that for fiscal years prior to 2008, OEMM could not precisely identify the number of meters that inspectors were required to witness. In addition, for fiscal years prior to 2008, the official told us that inspectors may not have recorded every meter witnessing.

Table 3: OEMM Liquid Oil and Gas Meter Calibrations Witnessed, Fiscal Year 2008

	Oil			Gas		
District office	Oil meters	Meter provings witnessed	Percentage inspected	Gas meters	Meter calibrations witnessed	Percentage inspected
Lake Charles	124	37	30	536	30	6
Lake Jackson	136	14	10	435	23	5
New Orleans	231	54	23	390	39	10
California[a]	19	19	100	15	15	100
Total	**510**	**124**	**24**	**1376**	**107**	**8**

Source: GAO analysis of OEMM data.

[a]Goals in the California district differed in 2008 because of the limited number of meters in the region; specifically, inspectors witness calibrations on 100 percent of royalty meters annually.

For MMS' Liquid Verification System and Gas Verification System reconciliation activities, MMS established a goal of resolving 100 percent of the discrepancies it identified between the operator-reported monthly oil and gas reports and the volumes included on pipeline meter source documents by mid-2010. MMS staff follow up on missing documents that operators have not provided, such as the monthly production allocation schedule report, which are used to verify volumes reported by operators that are part of a commingling agreement that include production from nonfederal sources. As of November 2009, MMS had added additional staff and made progress toward this goal, but numerous discrepancies remain (see table 4).

Table 4: Progress Toward Resolving Liquid and Gas Volume Discrepancies and Obtaining Missing Production Allocation Reports, as of November 2009

Activity	Baseline (as of December 2008)	Discrepancies remaining	Percentage reduction
Liquid verification system discrepancies	2,427	733	70
Gas verification system discrepancies	5,134	3,561	31
Missing production allocation schedule reports	419	402	4

Source: GAO analysis of MMS data.

BLM Has Not Routinely Met its Production Inspection Goals, Decreasing Assurances that Oil and Gas are Being Accurately Measured

For onshore areas, BLM has been unable to consistently meet its statutory or agency goal for completing production inspections, which is a key control for ensuring that all production is properly measured. As we reported in September 2008, BLM's production inspection data were not entirely reliable, in part due to some ongoing issues related to the Cobell Indian Trust lawsuit[42] that resulted in the shutdown of BLM's information technology (IT) systems. As a result, BLM's ability to accurately identify high priority producing cases was limited, which impacted our ability to report BLM's production inspection data at the time. Consequently, we limited our current analysis of BLM data for the seven field offices we reviewed to determining whether or not cases—both high- and low-priority—had been inspected at least once every 3 years, in accordance with BLM's inspection frequency criteria for low-priority cases. While BLM's production inspection program tracks inspections on a case level, it is worth noting that a single case may include anywhere from one to several hundred wells. When a case contains multiple wells, BLM requires that each production inspection include inspections of one-fourth of the wells in the case. Our analysis of BLM data suggests that numerous producing cases have not been inspected for many years, raising significant uncertainty about whether the oil and gas are being accurately measured (see fig. 7).

[42] In the Cobell class-action lawsuit—concerning the government's management of Native American trust funds, a U.S. District Court Judge, on December 5, 2001, ordered Interior to disconnect from the internet all information technology systems that house or provide access to individual Indian trust data. Specifically, Interior's IT systems were impacted multiple times since 2001. According to BLM's database manager, the shutdown dates were: (1) December 2001 through May 2002, (2) June 2003 through September 2003, (3) March 2004, and (4) April 2005 through October 2005 for the federal data and August 2008 for Indian data.

Figure 7: Oil Storage Tanks that Had Not Been Inspected for Several Years

Source: GAO.

Approximately 2 percent, or 198, of active cases between fiscal years 1998 and 2009 requiring an inspection in the six BLM field offices we reviewed had not been inspected.[43] The percentage of uninspected cases varied by field office, with a low of zero cases in the Glenwood Springs, Colorado, field office to a high of about 101 cases, in the Carlsbad, New Mexico, field office. Additionally, we found that about 67 percent of cases had not met BLM's minimum 3-year inspection requirement. Finally, BLM met or exceeded its minimum 3-year inspection goals for approximately 31 percent of active cases in the field offices we visited, though the percentage varied significantly by field office. For example, the Glenwood Springs, Colorado, field office had met the minimum goal for about 58 percent of its cases, whereas both the Carlsbad, New Mexico, and Vernal,

[43]We did not include the results of our analysis for the White River, Colorado, field office as the Interior Office of the Inspector General is currently evaluating the reliability of the office's inspection data.

Utah, field offices met the minimum goal for about 27 percent of their cases as table 5 illustrates.

Table 5: Summary of BLM Production Inspections, Fiscal Years 1998–2009

Field office	Buffalo, Wyoming	Carlsbad, New Mexico	Farmington, New Mexico	Glenwood Springs, Colorado	Pinedale, Wyoming	Vernal, Utah	White River, Colorado[a]	Total
Cases requiring an inspection with no inspection	38	101	38	0	2	19	[a]	**198**
Percentage	2	5	1	0	1	2	[a]	**2**
Cases not meeting BLM's 3-year minimum inspection goal	1,233	1,261	2,569	79	152	601	[a]	**5,895**
Percentage	54	68	77	42	56	71	[a]	**67**
Cases meeting or exceeding BLM's 3-year minimum inspection goal	1,019	503	743	110	117	228	[a]	**2,720**
Percentage	44	27	22	58	43	27	[a]	**31**
Total	**2,290**	**1,865**	**3,350**	**189**	**271**	**848**	[a]	**8,813**

Source: GAO analysis of BLM data.

[a]The Interior Office of the Inspector General is currently evaluating the reliability of inspection data at the White River, Colorado, field office.

BLM petroleum engineer technicians and production accountability technicians provided multiple explanations for not completing their required inspections. First, onshore leases have recently experienced high levels of drilling; and under BLM's formal inspection strategy, conducting drilling inspections take priority over conducting production inspections. In one field office, a BLM official told us that, historically, the field office's de facto policy was to not complete production inspections. Second, when BLM revised the volume criteria downward for high priority cases, the number of cases that required annual inspections increased, which further reduced inspection staffs' ability to inspect low priority cases. Third, BLM officials in the majority of field offices we visited told us they had challenges with hiring and retaining staff at sufficient numbers to complete their required inspections. In particular, BLM officials told us that the low pay, when compared with industry, and the high housing costs in energy boom towns were major factors affecting hiring and staff turnover. Finally, the lack of a stable workforce resulted in multiple attempts to hire new staff. When BLM was successful in hiring staff, more senior and experienced staff told us that they had to spend additional time providing on-the-job training, which reduced the pace of the senior staff inspections. So, despite seeing an increase in staff at a field office, it is possible that staff will complete fewer inspections because of the time spent training new staff.

Furthermore, while BLM has not established goals for witnessing calibrations like OEMM, BLM staff may still conduct these activities. Our analysis of BLM data shows that BLM staff conducted gas meter calibrations and oil tank gaugings measurement activities with decreasing frequency between fiscal years 2004 through 2008 for seven of the eight BLM field offices we reviewed which had reliable data (see table 6). Specifically, the frequency with which BLM staff completed meter calibration activities as part of a production inspection decreased by 62 percent for the eight field offices we reviewed between fiscal years 2004 and 2008.

Table 6: Percentage Change in BLM Meter Calibration Activities Completed, Fiscal Years 2004–2008

Field office	Percentage change
Buffalo, Wyoming	- 9
Carlsbad, New Mexico	-91
Farmington, New Mexico	-57[a]
Glenwood Springs, Colorado	-71
Hobbs, New Mexico	-93
White River, Colorado	[b]
Pinedale, Wyoming	-57
Roswell, New Mexico	0
Vernal, Utah	-69[a]
Total	**-62**

Source: GAO analysis of BLM data.

[a]According to BLM officials, the reliability of data provided for these offices may have been affected for several years because of issues related to the impact the Cobell lawsuit had on BLM's IT systems. Specifically, some data at the inspection activity level may not have been entered into the system between 2004 and 2008 because of system shutdowns. Therefore, numbers presented here, while representative of what is in the system, may be undercounts.

[b]The Interior Office of the Inspector General is currently evaluating the reliability of inspection data at the White River, Colo., field office.

Petroleum engineer technicians from five of the nine field offices we spoke with did not believe that they were witnessing a sufficient number of gas meter calibrations. When asked why more calibrations were not witnessed, staff typically said there was either insufficient staff or time.

For petroleum engineer technicians in the four BLM field offices who felt a sufficient number of calibrations were witnessed, staff stated that they had infrequently identified meter calibration problems and, therefore, believed it was an area of lower concern.

Analysis of tank gauging inspection data also shows a general decline in the number of tank gaugings entered by BLM petroleum engineer technicians in BLM's database. From fiscal years 2004 through 2008, tank gauging activity codes were entered with decreasing frequency for seven of the eight BLM field offices we reviewed for which we had reliable data (see table 7). Overall, the frequency with which BLM staff completed meter calibration activities as part of a production inspection decreased by 33 percent for the eight field offices we reviewed between fiscal years 2004 and 2008.

Table 7: Percentage Change in BLM Tank Gauging Calibration Activities Completed, Fiscal Years 2004–2008

Field office	Percentage change
Buffalo, Wyoming	- 44
Carlsbad, New Mexico	- 55
Farmington, New Mexico	240[a]
Glenwood Springs, Colorado	- 57
Hobbs, New Mexico	- 67
White River, Colorado	[b]
Pinedale, Wyoming	- 74
Roswell, New Mexico	- 50
Vernal, Utah	- 50[a]
Total	**- 33**

Source: GAO analysis of BLM data.

[a]According to BLM officials, the reliability of data provided for these offices may have been affected for several years because of issues related to the impact the Cobell lawsuit had on BLM's IT systems. Specifically, some data at the inspection activity level may not have been entered into the system between 2004 and 2008 because of system shutdowns. Therefore, numbers presented here, while representative of what is in the system, may be undercounts.

[b]The Interior Office of the Inspector General is currently evaluating the reliability of inspection data at the White River, Colorado, field office.

According to BLM petroleum engineer technicians from the nine field offices we spoke with, representatives from five of the offices told us that they were not completing a sufficient number of tank gaugings and provided several reasons why more were not completed. Staff from two of the field offices stated that a limiting factor in completing additional tank gaugings was a lack of tank gauging equipment, whereas staff from another field office explained that they had insufficient staff and competing priorities. Staff from one field office who concluded that they were completing a sufficient number of tank gauging activities explained that they were consistently completing them on all cases with tanks, while staff from one other field office said that the office had never identified under-reported production from completing the tank gauging activity.

Interior's Production Accountability Inspection Programs Do Not Sufficiently Address Key Factors Affecting Gas Measurement Accuracy

Interior's production accountability inspection programs do not sufficiently address six key factors that may affect measurement accuracy: (1) witnessing gas sample collections, (2) verifying BTU values are correctly reported, (3) witnessing orifice plate inspections, (4) assessing impacts of liquids in gas streams, (5) addressing low differential pressure, and (6) inspecting meter tubes.

- *Witnessing gas sample collections.* Interior has not established goals for witnessing gas samples collected by industry. Because the heating value of gas—measured in BTU—is directly related to the royalties paid on the gas, any contamination or mishandling of the sample has the potential to lead to an incorrect BTU analysis. According to BLM calculations, a 10 percent error in reported heating value will result in a 10 percent error in royalties due. With onshore royalties valued at $2 billion per year, a 1 percent error in reported heating value would lead to a $20 million error in royalties paid. Current regulations require industry to take gas samples annually for onshore, and semiannually for offshore. However, one member of BLM's Gas Measurement team expressed concerns about how companies were collecting these gas samples in the field, and how those samples were subsequently handled and transported. Currently, neither BLM nor OEMM have regulations in place stating how or where a sample is to be taken, how a sample is to be analyzed, or how heating value should be reported. Additionally, neither BLM nor OEMM have established goals for witnessing gas sample collections, or tracking the number of samples the agencies may have witnessed during the course of an inspection. Furthermore, procedures for collecting gas samples were only recently incorporated into BLM's training courses, meaning that some BLM staff may not have the knowledge required to identify incorrect gas sampling techniques.

- *Verifying BTU values are correctly reported.* Interior only recently clarified how companies should report onshore gas BTU values, but does not sufficiently verify that operator-reported BTU values are correct. In December 2007, the Royalty Policy Committee's Subcommittee on Royalty Management recommended that Interior establish consistent guidelines for how companies report BTU values. Until 2009, BLM did not have a formal policy for how operators were to report BTU values. Instead, BLM informally carried forward a 1980 policy from the U.S. Geological Survey—which oversaw oil and gas activities and royalty collections before BLM and MMS assumed responsibility for overseeing oil and gas production. This policy allowed operators to report the BTU value with an assumed water content, as gas may contain water vapor. According to BLM documents, this assumption has resulted in an automatic reduction as high as 1.74 percent in the BTU value, which corresponds to approximately a 1.74 percent decrease in royalty payments. On July 30, 2009, BLM issued an instruction memorandum to its field office staff defining its policy for reporting BTU values.[44] The policy requires that all BTU values in the monthly production report be reported on a dry basis—without an assumed water content—unless the gas sample is analyzed for water content. In that case, the actual BTU value should be reported. BLM can verify this value when conducting a limited number of annual record reviews by comparing BTU values from gas analysis reports with the BTU value on the operator-reported production report. BLM estimates that this policy change may increase royalties up to $35 million per year. However, BLM had not formally communicated this policy change to companies producing onshore gas, as of September 2009. As a result, companies may continue to erroneously submit incorrect BTU values, thereby placing royalty collections at risk. Additionally, the same December 2007 Subcommittee on Royalty Management report included a recommendation that Interior develop a means to systematically compare reported BTU values on the operator-reported monthly production report with BTU values from lab analyses. According to MMS officials, in early 2010, they are planning to incorporate BTU comparisons into their Gas Verification System. However, a BLM official told us that comparisons will continue to be made on a limited basis during in-depth record reviews completed by production accountability technicians and that there is no plan to increase these reviews.

- *Witnessing orifice plate inspections.* Neither BLM nor OEMM has established specific goals for witnessing orifice plate inspections, a critical factor for ensuring accurate gas measurement (see fig. 8). While BLM has a regulatory requirement for the operator to inspect the orifice plate semiannually, it has no goal for BLM inspectors to witness this activity. According to BLM petroleum engineer technicians in multiple field offices, orifice plates are generally inspected during a meter calibration; however,

[44] BLM, *Instruction Memorandum No. 2009-186: Policy for Verifying Heating Value of Gas Produced From Federal and Indian Leases* (July 28, 2009).

BLM is unable to readily provide summary data from its database on the number of orifice plates inspected, the condition of the plates, or whether the plates were replaced. OEMM lacks a regulatory requirement for operators to inspect the condition of orifice plates with a specified frequency, and also lacks a goal for inspectors to physically witness the inspection of the plate, although OEMM officials and staff told us that inspectors routinely examine the orifice plate during the gas meter calibrations that they witness, and that conducting orifice plate inspections was included in a 2009 OEMM meter inspection training course. Similarly, OEMM does not track data in its database on the number of orifice plates inspected, the condition of orifice plates, or whether a plate was replaced.

Figure 8: BLM Petroleum Engineer Technician Inspecting an Orifice Plate

Source: GAO.

- *Assessing impacts of liquids in gas streams.* Neither BLM nor OEMM has a policy or an inspection activity for assessing the effects of liquids in gas on gas measurement. According to one BLM official, the impact of liquids in gas on measurement accuracy has largely been ignored by federal regulators, although the effect could be significant. Petroleum engineers at four of the seven BLM field offices we visited stated that they generally consider the impact of liquids on measurement; however, BLM does not have sufficient regulations or guidance on this issue and a BLM official told us that BLM does not currently have the authority to require the installation of additional equipment that would remove liquids from the gas stream. One petroleum engineer explained that contracts between the operator and the pipeline company include a maximum limit on liquids in the gas stream and that, if the limit is exceeded, the pipeline company will refuse to transport the gas. However, most of BLM's points of measurement are at the well head, where liquids in gas may be more prevalent. Similarly, an OEMM official told us that OEMM does not require petroleum engineers to determine the extent to which any liquids may affect gas measurement. However, the official noted that a measurement system without any equipment to remove liquids prior to measurement would not be approved, but that there were no requirements to assess whether this equipment would sufficiently remove liquids. Similarly, offshore inspectors are not required to examine whether liquids are present in gas meters—but some OEMM inspectors told us that they would likely notice the presence of liquids.

- *Addressing low differential pressure.* Interior has not fully addressed the impact of low differential pressures on gas measured by orifice meters. Typically, wells are calibrated for a continuous operating flow; however, there can be wide fluctuations in gas flow over time, resulting in extreme shifts in differential pressure—either raising it or lowering it. According to BLM officials, accurately measuring gas under low-pressure conditions can be difficult. Operators may size the orifice plates and calibrate the meters to accurately measure the gas during times of high pressure. This, in turn, limits the ability of the meters to accurately measure gas at low pressure. To date, BLM does not have regulations specifically addressing the complexities that arise with measuring gas under low pressure. While BLM has developed a tool—an uncertainty calculator—which allows staff to input various measurement parameters, including the differential pressure, and determine whether the measurement uncertainty exceeds BLM's 3 percent limit, we found that staff are not consistently using this important tool. Moreover, according to a BLM official, an industry group has recently completed a study on the impact of low differential pressure on gas measurement with results suggesting that at lower differential pressures, measurement uncertainty increases. However, according to a BLM official, BLM has not fully reviewed the study, though its results could inform a policy on gas measurement at low differential pressures.

- *Inspecting meter tubes.* Interior has not established goals for inspecting meter tubes, despite the potential impact on measurement that could result. According to BLM's 1994 draft gas measurement regulations, proper meter tube condition is essential for accurate measurement. These draft regulations established a requirement for operators to inspect the meter tubes once every 5 years; however, the regulations were not finalized, and BLM never implemented that requirement. Furthermore, BLM does not currently include meter tube inspections as a component of its inspection program. Similarly, OEMM has no regulatory requirement for inspecting meter tubes.

Limited Oversight, Gaps in Staffs' Critical Measurement Skills, and Incomplete Tools Hinder Interior's Ability to Manage its Production Verification Programs

Interior's management of its production verification programs are hindered by its (1) limited and inconsistent oversight of its oil and gas production accountability programs; (2) difficulties in hiring, training, and retaining staff; and (3) longstanding challenges with providing inspection staff with key information technology tools to allow them to more efficiently complete their production inspections.

Interior Has Exercised Limited and Inconsistent Oversight of its Oil and Gas Production Accountability Programs

Interior has not completed reviews of its production accountability programs' internal controls in recent years. Moreover, Interior's more decentralized organizational structure for its onshore inspection program, when compared to its offshore program, raises the risk of inconsistent program oversight. Finally, Interior's onshore oversight of production inspection data entry and key engineering decisions are less robust when compared with its offshore controls.

Interior Has Not Recently Conducted Internal Reviews of Its Production Verification Internal Controls

Interior has exercised limited programmatic oversight of key areas of its oil and gas production verification programs. Like all federal agencies, Interior is required to conduct ongoing internal reviews of its internal controls by both the Federal Managers' Financial Integrity Act (FMFIA)[45] and OMB Circular-123, *Management's Responsibility for Internal*

[45]Pub. L. No. 97-255, 96 Stat. 814 (1982). FMFIA was repealed as part of the general revisions to Title 31, U.S. Code. The key provisions of FMFIA were codified at 31 U.S.C. § 3512 (c), (d).

Control. However, Interior has made inconsistent and, in some cases, incomplete efforts to meet this requirement.

In accordance with this internal review requirement, senior management in both BLM and MMS are to annually determine which programs should be subject to formal review in order to supplement management's judgment as to the adequacy of internal controls and to ensure that adequate resources are allocated to evaluate those controls, among other responsibilities. Interior requires both BLM and MMS to annually create an Internal Control Review Plan that (1) summarizes their programs, (2) identifies the relative risk ranking of each of the programs, and (3) establishes the type of control evaluation to be conducted and the year the evaluation will be completed. However, BLM and MMS have undertaken inconsistent approaches to meeting these requirements.

BLM has not conducted a timely review of its production accountability program and has recently lowered the risk associated with its production verification program, despite mounting evidence that the program is placing at risk Interior's ability to ensure that the federal government is accurately collecting revenue. In our review of BLM's completed internal control reviews, we found that it had not conducted any reviews related to production verification in the western United States since 2000. Moreover, while BLM had planned to complete a review in 2009, it was cancelled in light of ongoing reviews being conducted by GAO and Interior's Inspector General. According to BLM's 2009 – 2011 Internal Control Review Plan, no subsequent production verification reviews are planned. Additionally, BLM has lowered its assessment of the risk of the program, despite reports issued by GAO, Interior's Inspector General, and the Royalty Policy Committee's Subcommittee on Royalty Management, that pointed out weaknesses in internal controls within Interior's oil and gas production and royalty collection programs. According to federal standards on internal controls, monitoring of internal reviews should include policies and procedures for ensuring that findings of audits and other internal reviews are promptly resolved.[46] Additionally, Interior guidance requires that such reports should be given appropriate consideration in determining risk. In fiscal year 2009, BLM lowered the risk rating of its oil and gas program from medium to low. According to a BLM official, risk ratings are assigned through a subjective evaluation based on program

[46]GAO, *Standards for Internal Control in the Federal Government*, GAO/AIMD-00-21.3.1 (Washington, D.C.: Nov. 1999).

management knowledge. In reviewing supporting risk assessment documentation, we found several questionable assumptions in the years leading up to the risk determination made in the most recent plan. In reviewing supporting BLM oil and gas program risk assessment documentation, we found that BLM documents ranked the production accountability program as a low risk area for three reasons. First, BLM officials determined there was a low risk of lost potential revenue collection due to incorrect production reporting, despite the fact that Interior was missing tens of thousands of monthly production reports from operators. Specifically, BLM assumed that potential losses from not submitting production reports may only be 0.1 percent of royalties, which, given that onshore production accounted for approximately $2 billion, the losses might amount to $2 million. Second, BLM officials determined that there was a low risk of not completing its production inspections due to its workforce levels and the capability of the workforce. Finally, BLM officials concluded that due to significant efforts over the past several years to improve internal controls, the production accountability program had a low level of risk due to a lack of internal controls.

Similarly, MMS has not completed any reviews of production verification related internal control activities in 5 years. While MMS completed one internal control review of OEMM's offshore inspection program in 2004, this review examined many aspects of the inspection program, not just those addressing production verification. The key findings of the review were that OEMM needed more clearly defined inspection strategies, and that about 70 percent of inspection staff had taken some training in measurement. According to MMS's 2009-2011 Internal Control Review Plan, OEMM's production verification program is scheduled to be reviewed in 2011, although the scope of this review has yet to be planned. Finally, in contrast to BLM's low risk status for its production verification programs, MMS has assigned a medium risk status for both its offshore inspection program and its production verification program, although MMS officials were unable to provide us with supporting documentation for how they determined the risk level.

Interior's Decentralized Approach to Onshore Oversight, When Compared to its More Centralized Approach to Offshore Oversight, May be Reducing Program Effectiveness

Interior has undertaken very different approaches to the oversight of the production inspection programs for onshore leases and offshore leases. BLM's production inspection program is decentralized, with field offices being granted a great deal of autonomy for making key decisions. In contrast, OEMM's Gulf of Mexico Regional Inspection Program is more centrally managed.[47] The difference in oversight approaches may lead Interior to miss opportunities to identify best practices; deploy such tools across Interior's operations; and, as a result, place program oversight at risk.

Agencies are generally provided the opportunity to determine how best to delegate responsibilities and conduct supervision. However, as a general matter, effective organizational structures should facilitate the flow of information needed for decision making to appropriate staff throughout the agency and provide for reasonable mechanisms to ensure that agency staff are appropriately supervised. An agency's structure may be centralized or decentralized given the nature of the organization's operations, but the management should be able to clearly articulate the considerations and factors taken into account in balancing the degree of centralization versus decentralization. According to Federal Standards for Internal Controls, key among the considerations for determining effective organizational structures are ensuring that clear internal reporting relationships have been established, which effectively provide managers information they need to perform their job.[48]

BLM's Inspection and Enforcement Program—which includes production inspections—for onshore leases is relatively decentralized (see fig. 9). While BLM has created a number of mechanisms for coordinating the operations of the production inspection program across field and state office jurisdictional boundaries, key supervisory functions remain largely under the control of field offices where, according to some BLM officials, supervisors have limited understanding of the jobs they are supervising. BLM's Inspection and Enforcement Program is currently coordinated at the national level by two national lead coordinators, one of whom coordinates program issues through quarterly teleconferences with state coordinators. According to one of the national coordinators, much of the

[47] OEMM's Gulf of Mexico region oversees approximately 99 percent of all offshore production, with the remaining offshore production occurring within the Pacific and Alaska regions.

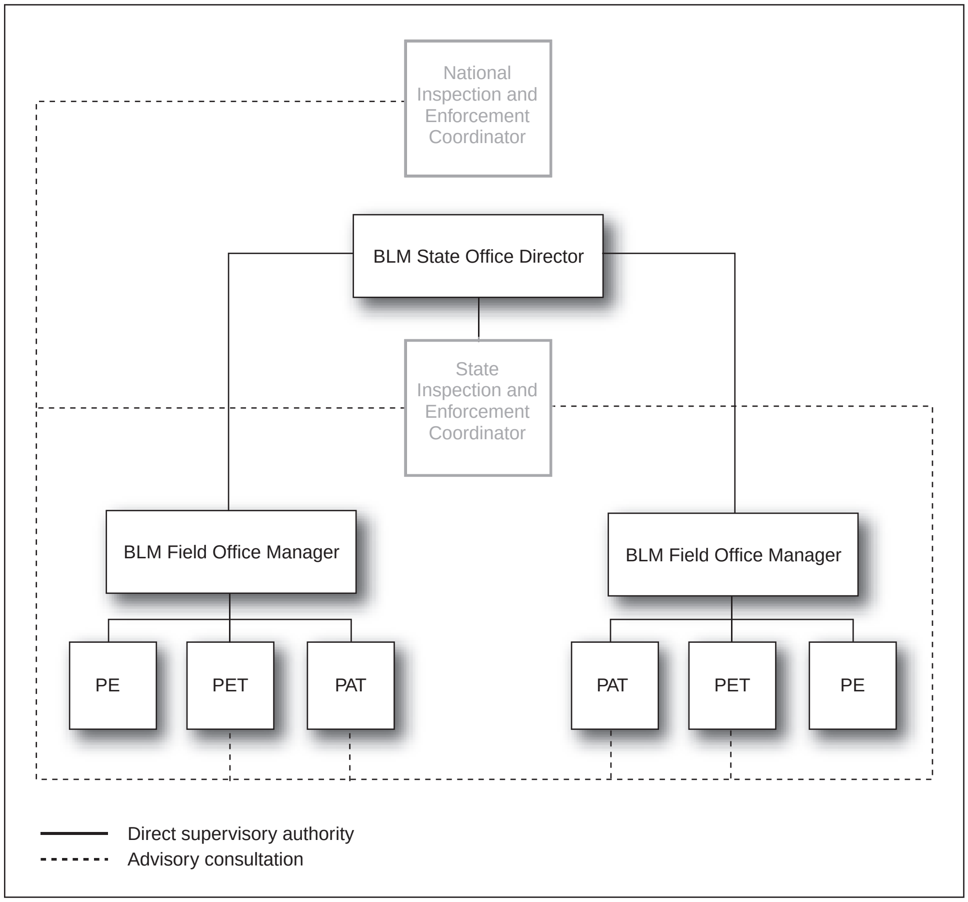
[48] GAO/AIMD-00-21.3.1.

inspection program oversight has been delegated to state coordinators who are responsible for conducting periodic reviews of inspections completed by field office inspection staff and coordinating among the state's field offices. This national coordinator further told us that reviews completed by the state coordinators are not systematically reviewed at the national level. Under the federal standards for internal control, federal agencies should employ internal control activities, such as top-level review, to help ensure that management's directives are carried out and to determine if the agencies are effectively and efficiently using resources.[49] According to several state coordinators, their reviews—which are not standardized—may include reviewing data in BLM's inspection database or participating with petroleum engineer technicians in conducting inspections in the field. Should a state coordinator identify areas of concern during these reviews, the state coordinator does not have authority to require that petroleum engineer technicians or production accountability technicians modify their work, as neither the national or state coordinators have supervisory authority over the BLM staff at the field office level. Rather, BLM's petroleum engineer technicians and production accountability technicians, in some field offices, report to and are evaluated at the field office level by BLM field office managers[50] who, according to BLM staff, do not in all instances have a strong background in oil and gas operations and production verification. Furthermore, while BLM offers an "Oil and Gas Training for Managers" course, managers are not required to take it. Therefore, state coordinators must relay any findings or concerns about an individual's performance to the field office manager, though there is no requirement that the field office manager act upon any findings. Several state coordinators told us that providing input on inspectors' performance to field office managers has been met with varying degrees of success. For example, one state coordinator stated that the field office managers were generally unreceptive to input on their staffs' job performance; whereas, another state coordinator explained that field office managers had been accommodating to their feedback on petroleum engineer technicians' or production accountability technicians' performance. The national and state coordinators' lack of supervisory authority may be putting the inspection and enforcement program at risk of diminished effectiveness.

[49] GAO/AIMD-00-21.3.1.

[50] Some field offices with larger numbers of petroleum engineer technicians include supervisory petroleum engineer technician positions, which help manage other petroleum engineer technicians and are, in turn, evaluated by the field office managers.

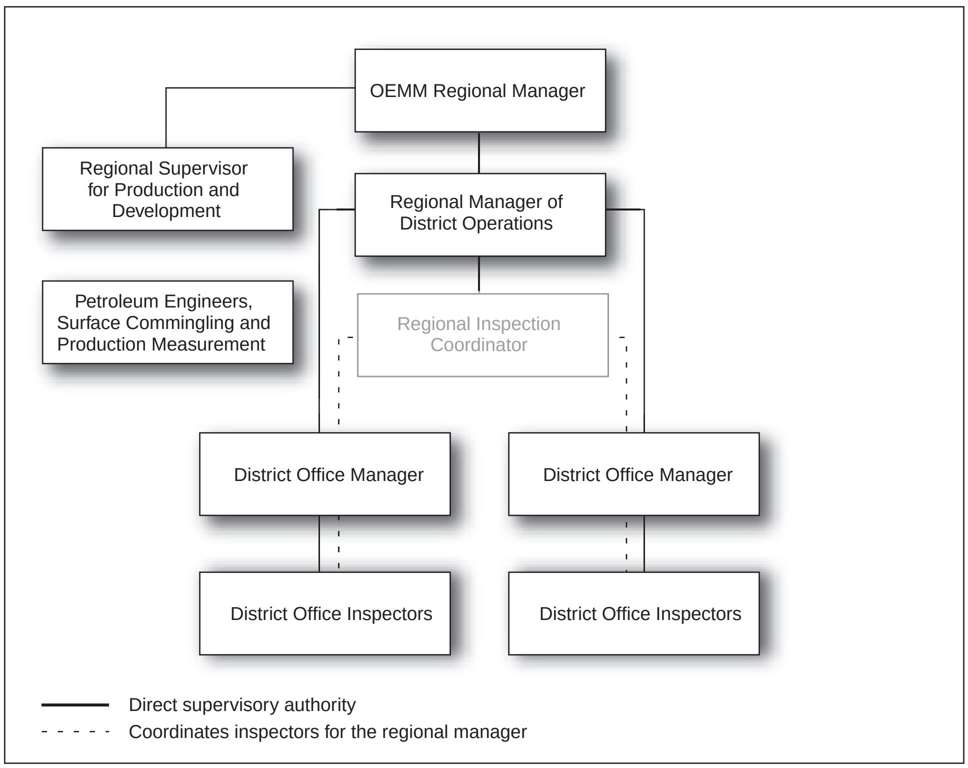
Figure 9: GAO Representation of BLM's Production Verification Inspection and Enforcement Organizational Structure



Source: GAO.

In contrast, OEMM's Gulf of Mexico region inspection program is more centralized and systematic in its oversight of its five district offices (see fig. 10). OEMM's inspection program is overseen directly by the supervisor of district operations, who has direct supervisory authority over each of the five district office managers. The district managers, who are typically petroleum engineers, supervise the district's chief inspector who, in turn, oversees the lead inspectors and other district inspectors. Furthermore, OEMM has a regional inspection coordinator whose role is to, in part, ensure that inspection activities are consistent across the OEMM district offices. In fulfilling these duties, the regional inspection coordinator has weekly discussions with lead inspectors in each of the five district offices and also holds a monthly teleconference among all supervisory inspection staff, for further coordination. In addition, the regional inspection coordinator conducts yearly consistency reviews of each district, which involve observing inspection personnel performing inspections, interviewing district inspection personnel, and reviewing inspection statistics. Findings and recommendations from the consistency reviews are documented in a standardized report. District offices are required to develop an action plan within 15 days to address any shortcomings identified during the review. If a district office fails to respond to the recommendations—which, according to the regional inspection coordinator, has not yet happened—then, regional management would be notified, according to the regional official who prepares these reports.

Figure 10: GAO Representation of OEMM's Production Verification and Inspection Organizational Structure



Source: GAO.

Interior Has Exercised Limited Oversight of its Onshore Inspection Data and Engineering Approvals When Compared with Its Offshore Oversight

Our review also found that Interior's oversight of inspection data varied significantly between BLM and OEMM, with BLM exercising limited oversight of its onshore inspection data and, thereby, increasing the risk of inaccurate inspection data. Typically, BLM petroleum engineer technicians document the results of their inspections on BLM official forms and, later, enter those results in BLM's inspection database. Except for situations where a petroleum engineer technician has not completed the required training, BLM does not require that inspection forms be reviewed to ensure that inspections were properly conducted or that the results of those inspections were properly documented in its database. Furthermore, when BLM petroleum engineer technicians find violations in the field, they may issue incidents of noncompliance without supervisory review, unless the petroleum engineer technician has not completed the required training.

We found BLM's controls over its production inspection data were insufficient to ensure accurate data. In examining BLM's controls over inspection data, we (1) reviewed a nongeneralizable sample of 43 hard copy production inspection files for inspections completed between fiscal years 2004 and 2008 for four of the seven field offices we visited[51] and (2) analyzed all BLM production inspection data for fiscal years 2004 through 2008 from the nine field offices we reviewed. We found several errors, including discrepancies between what was documented in the hard copy files and what was entered in BLM's database and inconsistencies in how BLM's chart verification production inspection activity was conducted to ensure accurate gas measurement. Additionally, we found errors in how specific production inspection activities were entered into BLM's database.

Specifically, our review of 43 hard copy files identified instances where inspection activities documented in BLM's database were not supported by documents in the hard copy files and that BLM staff were inconsistently completing the chart verification production inspection activity—an activity to independently verify the electronic flow computers' gas volume calculations. BLM's internal guidance for documenting inspections requires that, without exception, documentation gathered during the

[51]This nongeneralizable sample consisted of a review of 43 out of 3,556 available files to select from between fiscal years 2004 and 2008 for the four field offices we reviewed. Because we did not conduct a random sample, our analysis does not indicate the prevalence or extent of this problem. This applies to both the field offices whose files we reviewed, as well as the 26 field offices whose files we did not review.

inspection be incorporated into the hard copy files. Yet, we identified instances where BLM's database indicated that a particular activity had been completed, but no supporting documentation was included in the hard copy file. For example, we identified several instances where BLM's database indicated that a meter calibration activity had been completed, yet no calibration report was included in the hard copy file. We further found other instances where BLM staff were unable to locate hard copy files, and one instance where a hard copy file contained no information.

Our hard copy file review also found instances where BLM staff were inconsistently completing the chart verification production inspection activity—an activity to verify the reasonableness of the monthly operator-reported volumes and that the electronic flow computer is functioning properly. We found some instances where BLM staff compared the operator-submitted monthly gas volumes, divided by the number of days in the month to the daily gas volumes displayed on the well's electronic flow computer to determine whether they are were reasonably close. Alternatively, we found that other BLM staff used parameters displayed in the electronic flow computer to independently recalculate the volumes and compare those volumes to the volume displayed on the electronic flow computer. Additionally, one BLM petroleum engineer technician told us he used BLM's Gas Measurement Uncertainty Calculator, which is used to verify whether gas is measured within an overall 3 percent uncertainty range, when completing a chart verification inspection activity, although we found no evidence of this in the hard copy files we selected. Furthermore, though BLM's internal guidance for documenting inspections states that precise and clear documentation allows anyone reviewing the file to verify the inspection type and all completed activities associated with that inspection, we found that hard copy files in two of the four field offices were disorganized and not easily interpreted. For example, in several of the files, it was not possible to determine what inspection actions were completed without the assistance of BLM officials.

Finally, our analysis of all production inspection data recorded in BLM's database for fiscal years 2004 through 2008 for the nine field offices we reviewed, found that approximately 38 percent of the production inspections appeared to be coded incorrectly, suggesting that BLM does not have sufficient controls in place to ensure that production inspections are being conducted or entered into its database in accordance with agency policy. Specifically, BLM guidance on entering data for production inspections states that duplicate inspection activities should not be entered for the same inspection unless an oil or gas volume discrepancy was found; yet approximately 10 percent of inspections we analyzed included duplicate entries for inspection activities that are not associated with volume discrepancies. For example, a single production inspection from fiscal year 2004 had site security coded nine times and surface protection coded ten times which, according to BLM's database coordinator, is incorrect. Further, an additional 28 percent of production inspections recorded in BLM's database appeared to be erroneous because they did not include all four required inspection activities. For example, production inspections for producing cases should have four associated inspection activities—record review, surface protection, site security, and at least one measurement-related activity. However, we found numerous examples where the inspections were missing one or more of these activities (see table 8).

Table 8: BLM Production Inspection Activity Data, Fiscal Years 2004–2008

Total production inspections	Number	Percentage
Production inspections recorded in accordance with BLM criteria	6,443	62
Production inspections with erroneous duplicate inspection activities and/or potential missing inspection activities	994	10
Production inspections with missing inspection activities and no duplicate inspection items	2,893	28
Total	**10,330**	**100**

Source: GAO analysis of BLM data.

In contrast, OEMM has stronger supervisory controls for inspection data, providing greater assurance these data are accurate. Inspectors document the results of their inspections on official OEMM forms, specifying the kinds of inspections completed; which meters were observed; and what, if any, violations were documented. After the inspections are completed, one or more supervisory inspectors review the inspection form, and then give it to a clerical worker for recording in OEMM's database. If violations are found, they are issued during the inspection and are reviewed by supervisory inspectors.

In examining OEMM's controls over inspection data, we also reviewed a nongeneralizable sample of 20 hard copy production inspection files for inspections completed between fiscal years 2007 and 2008 for two of the four district offices we reviewed.[52] We found one instance where what was documented in the OEMM hard copy file did not match what was entered in OEMM's database regarding one of the two inspection activities—meter calibration witnessing. In the other 19 instances, we found that the hard copy inspection files matched what was in OEMM's database. We also found that the files were complete, in that they contained the required documentation for these inspections.

Regarding engineering approvals, there are also inconsistent supervisory controls between onshore and offshore programs, as well. We found that production measurement related engineering approvals completed by BLM petroleum engineers are typically not reviewed by other engineers. In many of the field offices we visited, petroleum engineers have approval authority for both variances of measurement regulations, as well as commingling and allocation agreements. These engineering approvals are significant and can greatly impact production verification and accountability for a number of years. Yet, BLM does not have controls in place to ensure a reasonable level of consistency in applying these policies. According to BLM petroleum engineers we spoke with, their engineering approvals have not been routinely reviewed, and according to one BLM official, the effect of poor decisions could have long-lasting impacts. For offshore production, OEMM engineers who approve systems for measuring oil and gas are centralized in one of OEMM's three regional offices: the Gulf of Mexico, Pacific, and Alaska.[53] The OEMM engineering approvals of proposed measurement systems and commingling arrangements are reviewed twice—first by a supervisory engineer, and then by the section chief, who signs and issues the final approval.

[52]Because OEMM only retains inspection file hard copies for the two most recent fiscal years, we were unable to review files from fiscal years 2004-2006. This nongeneralizable sample consisted of a review of 20 out of a total of 562 available hard copy inspection files for fiscal years 2007 and 2008 for the two OEMM district offices we reviewed. Because our sample was not random, our analysis does not indicate the prevalence or extent of the completeness of the files, or the subsequent database documentation, of the OEMM district office hard copy files we did not review. This applies to both the two district offices whose files we reviewed, as well as the five district offices whose files we did not review.

[53]In OEMM's Pacific region, geoscientists handle measurement approvals.

Interior Lacks Staff with Critical Production Verification Skills because of Difficulties in Hiring, Training, and Retaining Staff, Placing Production Verification Efforts at Risk

Interior's production verification program staff lack critical skills because of challenges in hiring experienced staff, not consistently providing the appropriate training for these staff, and high turnover in key production verification positions, according to agency officials. Onshore, agency officials told us that Interior has experienced challenges in hiring staff for its petroleum engineer, petroleum engineer technician, and production accountability technician positions; providing these staff with timely and ongoing training; and retaining these staff over the long term. Furthermore, while Interior's staffing challenges are less pronounced for its offshore program, there have been fewer difficulties in hiring and retaining staff, the agency has not consistently offered its engineers or inspectors a formal training program on oil and gas measurement (see table 9).

Table 9: Summary of Hiring, Training, and Retention Issues Identified for Interior Production Verification Staff

	Hiring	Training	Retaining
BLM			
Petroleum engineer	•	•	•
Petroleum engineer technician	•	•	•
Production accountability technician	•	•	•
OEMM			
Petroleum engineer	•	•	
Inspector	•	•	•
MMS			
Liquid and Gas verification system staff			

Source: GAO analysis.

Interior Has Key Weaknesses in Hiring, Training, and Retaining Staff in Critical Measurement Positions, Reducing Assurance that Oil and Gas Are Accurately Measured

Interior has weaknesses in key onshore and offshore positions critical for providing assurances that oil and gas are measured accurately due to challenges in hiring, training, and retaining these staff. Under federal standards for internal controls, federal agencies are to maintain effective management of their workforce in order to achieve results. Management should ensure that skill needs are continually assessed and that the organization is able to obtain a workforce that has the required skills that match those necessary to achieve organizational goals. Training should be aimed at developing and retaining employee skill levels to meet changing organizational needs.[54] Specific to oil and gas activities, FOGRMA requires

[54]GAO/AIMD-00-21.3.1.

that the Secretary of the Interior establish and maintain adequate programs for the training of all such authorized representatives in methods and techniques of inspections and accounting that will be used in the implementation of the law.[55]

According to both BLM and OEMM staff, hiring for the following key positions has been difficult in recent years because of low pay relative to comparable private sector jobs: BLM and OEMM petroleum engineers, BLM petroleum engineer technicians, BLM production accountability technicians and OEMM inspectors. For example, BLM's 2008 – 2013 Human Capital Plan identifies both the petroleum engineer and petroleum engineer technician positions as critical to its mission and identifies high salaries offered by industry and a lack of affordable housing in energy "boom towns" as factors that make recruiting employees for these positions difficult. Additionally, a 2007 study conducted by BLM on position classifications for its petroleum engineers and petroleum engineer technicians found, in many cases, a significant pay disparity between federal employees and the private sector, though the amount varied by location. For example, the report found that starting salaries for BLM petroleum engineers entering the workforce for the first time were between $10,000 and $35,000 less per year than in the private sector. Furthermore, while some BLM officials acknowledged benefits to government employment, including job stability, this benefit has not been sufficient to consistently attract qualified candidates. Additionally, BLM officials told us that several areas where BLM has field offices also have high costs of living, including in Pinedale, Wyoming, and Glenwood Springs, Colorado. In both of these locations, BLM officials told us that they had experienced difficulties in hiring staff at current salary levels because housing costs in these localities were such that finding affordable housing was extremely difficult. Offshore, OEMM officials told us that hiring petroleum engineers and inspectors had been difficult, but less so for engineers recently because of the economic downturn. OEMM officials told us that the private sector was able to offer significantly higher salaries for inspectors, compared with OEMM. However, one benefit OEMM offers is that, unlike many private sector offshore jobs, which require extended stays on offshore platforms, OEMM inspectors infrequently spend more than one day on a platform.

[55]30 U.S.C. § 1711(b)(2).

Neither BLM nor OEMM have consistently provided training necessary for performing official job duties of BLM and OEMM petroleum engineers, BLM petroleum engineer technicians, BLM production accountability technicians, and OEMM inspectors. For example, BLM and OEMM petroleum engineers are not required to take measurement training or other courses related to production verification. Specifically, BLM's petroleum engineers, who generally have responsibility for approving measurement methods not authorized under current regulations and reviewing and approving commingling agreements, do not have any required initial measurement training or subsequent annual maintenance training requirements. Similarly, OEMM petroleum engineers do not have specific measurement training requirements; instead, relying on an annual training plan that is developed according to individual topic preferences. Furthermore, BLM has not provided its petroleum engineer technicians and production accountability technicians with the necessary training. For example, BLM offers a core curriculum for its petroleum engineer technicians, requiring that they pass a six module training course, obtain official BLM certification, and then be recertified once every 5 years to demonstrate continued proficiency; however, BLM has not offered a recertification course since 2002. While BLM has, on occasion, offered training for its production accountability technicians, both a BLM training coordinator and staff we spoke with stated that it was not sufficient for fully understanding and performing the full range of job responsibilities. In contrast, OEMM does not offer its inspectors a core inspection training curriculum, though there is a requirement for completing 60 hours of training. In 2009, the Gulf of Mexico OEMM region also provided its inspectors with a newly implemented measurement class. However, while OEMM officials at four district offices we spoke with acknowledged that measurement issues were complex, OEMM does not systematically evaluate the extent to which inspectors have measurement knowledge, nor are there requirements for inspectors to take specific measurement training. As a result, OEMM does not have an effective system to evaluate whether its inspection staff lacks important measurement expertise.

Finally, Interior has struggled with high turnover rates in its onshore production verification positions. Specifically, we found that turnover rates for BLM's petroleum engineers, petroleum engineer technicians, and production accountability technicians were generally high and, according to BLM officials, were negatively impacting program implementation. Furthermore, we obtained and analyzed BLM human capital data and found that, for example, the overall turnover rate for petroleum engineers was between 33 and 100 percent between fiscal years 2004 through 2008 for the eight field offices we examined.[56] Similarly, the overall turnover rates for the same period for petroleum engineer technicians ranged between 30 and 83 percent for 7 of the 9 field offices we examined; with the remaining two offices having turnover rates of 22 percent or less. Finally, overall turnover rates for production accountability technicians were also generally high, with 8 of the 9 field offices having turnover rates of 50 percent or more between fiscal years 2004 and 2008.[57] According to BLM officials, staff turnover is impeding the production verification program in two areas. First, staff turnover results in the loss of institutional knowledge of the program. Second, BLM must direct its resources toward attracting and hiring staff, then have more senior staff provide on-the-job training for the new staff, which limits the senior staffs' capacity for completing their own work. Finally, BLM's 2008 – 2013 Human Capital report suggests that turnover will continue to be a challenge as it estimates that approximately 25 percent of its petroleum engineers and 47 percent of its petroleum engineer technicians will be eligible to retire by 2013. In contrast, OEMM petroleum engineers and inspectors generally had overall turnover rates less than BLM for fiscal years 2004 through 2008. For example, overall turnover rates for OEMM petroleum engineers in the OEMM Gulf of Mexico and Pacific regional offices—which are responsible for measurement approvals for the four district offices we reviewed—did not have overall turnover rates exceeding 30 percent between fiscal years 2004 and 2008. Additionally, we found that overall turnover rates for OEMM inspectors varied between 27 and 44 percent between fiscal years 2004 and 2008. For example, the California district office had an overall rate of 44 percent turnover, based on the four inspectors who left the position over those 5 years; the Lake Jackson, Texas, district office had an overall rate of 27 percent turnover. Finally, according to MMS officials, MMS has added a significant number of staff to its Liquid and Gas Verification system to help address current backlogs. Current provisions in federal employment regulations allow agencies to adjust pay rates to be more competitive with the private sector. For

[56]The Hobbs, New Mexico, field station does not employ any petroleum engineers.

[57]For the purposes of our analysis, we considered turnover to be any staff person who left BLM or OEMM, relocated to another BLM field office or OEMM district or regional office, or switched positions within BLM or OEMM. Additionally, some of the field offices we examined had low numbers of staff in the positions we analyzed which results in high turnover rates when limited numbers of staff move from their positions.

example, federal agencies may increase pay by increasing the General Schedule grade of the position, requesting special pay rates for difficult to fill positions, and providing bonuses for hiring and retention. However, while BLM has only recently begun to use some financial incentives for recruiting and retaining staff, BLM has not adjusted its overall pay structure for these positions and turnover rates remain high (see appendix IV for additional information on human capital challenges within key measurement positions).

Interior's Longstanding Efforts to Implement Two Key Technologies to Improve Production Verification Are Behind Schedule and Years From Widespread Implementation

Interior's efforts to develop (1) software to allow inspection staff to remotely monitor gas production, and (2) a mobile computing platform for inspection staff to enter inspection results while in the field, are behind schedule and, according to agency staff, years from widespread use.

Interior's 10-Year Effort to Obtain Continuously Updated Gas Production Data Have Shown Few Results

BLM's Remote Data Acquisition for Well Production (RDAWP) program—a program designed to allow BLM staff to monitor gas production in near real-time—has shown few results, despite 10 years of development at costs of over $1.5 million. BLM envisioned the RDAWP program as a means to provide industry and government with common tools to validate production and to view production data in near real-time in an automated and secure environment. BLM developed the concept of remotely monitoring oil and gas production data through meetings held with BLM field staff in 1999. Presently, many companies receive production data in real-time via Supervisory Control and Data Acquisition (SCADA) software. RDAWP works by BLM attaching specially designed electronic equipment to the company's computer server, which relays the SCADA production data to a BLM server. Currently, BLM has only been able to access these electronic data through individual voluntary agreements with companies—as BLM does not currently require that operators of federal leases provide BLM access to raw production data from the electronic flow computers. According to the BLM project manager, if BLM staff had access to these data, BLM could potentially complete production inspections more quickly and reduce the burden on industry in fulfilling BLM audit requests for multiple years of electronic flow computer production data and meter calibration reports. Specifically, according to BLM's project manager and project documents, RDAWP would provide BLM staff with a more automated means to complete several gas production inspection activities, such as:

- *Verifying Electronic Flow Computer Gas Calculations.* First, RDAWP would assist in verifying volumes reported by the operator on the monthly production reports by integrating the reports into the RDAWP software. Second, RDAWP would automatically independently recalculate the gas volumes and compare it to the volume generated by the electronic flow computer. Finally, RDAWP would reduce the need for BLM staff to visit the field to complete this work as the data would be available in the field office.

- *Meter Calibration.* Currently, meter calibration inspection activities may be completed by either reviewing meter calibration reports or actually witnessing a meter calibration. RDAWP would greatly assist in this task because when electronic flow computers were calibrated, it would generate an event log that would clearly record and store the "as found" and "as left" calibration values. With RDAWP, BLM staff would be able to determine from the office whether meters had been calibrated within the required time frame, and if any error was greater than 2 percent, which, according to BLM regulations, requires that the operator correct and resubmit previous monthly production reports.

- *Other Inspection Activities.* Finally, data obtained from the electronic flow computers would also provide several other key data. Currently, BLM requires gas sample analyses annually, unless otherwise approved. As the BTU value of gas is necessary for calculating the volume, according to a BLM official, the gas sample data must be entered into the electronic flow computer. RDAWP's ability to pull in data from the electronic flow computers would assist BLM staff in ensuring that gas samples were being taken. Additionally, BLM would more easily be able to track well status—or whether the well was producing or not producing. BLM has historically faced challenges in having accurate information on whether or not a well was producing. RDAWP would allow BLM staff to see, on a daily basis, whether the well was producing and how many days in a month it produced.

In 2003, BLM proposed a business case for obtaining real time production data—which eventually became known as RDAWP—that consisted of four phases:

Phase I. An initial pilot project encompassing 60 wells with one operator in the Farmington, New Mexico, resource area.

Phase II. If BLM opted to proceed after Phase I, a second phase would proceed with 300 to 600 wells, from three to four operators, and include the Farmington, New Mexico; Durango, Colorado; and Buffalo, Wyoming, field offices.

Phase III. The third phase would be full-scale use of RDAWP across all federal leases.

Phase IV. The last proposed phase would be to apply the technology and knowledge from RDAWP at the well head to other applications, such as using it to monitor major pipelines and other elements of the nation's infrastructure.

The 2003 BLM business case also states that there are no other available alternatives to RDAWP that can deliver the requirements of this proposal. Furthermore, while BLM acknowledged that oil and gas companies may employ technologies similar to RDAWP for monitoring oil and gas production, according to a BLM official, BLM lacks the authority to access companies' secured servers to obtain this production data. Finally, the contractor responsible for implementing the RDAWP program proposed a roll-out schedule that would begin with 200 wells connected to RDAWP in the first quarter of 2004 and ending in the third quarter of 2009 with a total of 108,500 wells connected.

As of the fourth quarter of 2009, BLM has completed trials in two field offices, has an ongoing pilot project in one field office where 50 wells are connected to RDAWP, and spent in excess of $1.5 million on the RDAWP program for fiscal years 2003 through 2009. Since 2003, according to the current project manager, RDAWP pilot projects have been conducted in two BLM field offices, Farmington, New Mexico, and one in Wyoming—although the manager could not identify which Wyoming field office. During these pilot projects, according to BLM officials, improvements were made to the RDAWP technology. However, funding and IT issues related to the Cobell lawsuit, according to a BLM official, considerably slowed the project. Finally, when we asked BLM project management staff to provide specific data on the $1.5 million RDAWP expenditures, it was unable to do so.

In March 2009, we visited the Glenwood Springs, Colorado, BLM field office to assess the effectiveness of the ongoing pilot project, which had begun in late 2008. According to BLM staff, they had not yet used the RDAWP system to assist in completing an actual production inspection because the RDAWP software was incorrectly calculating volumes.

Additionally, RDAWP was unable to fully access the event logs from the electronic flow computer or the operator-reported monthly production report from BLM's inspection database. Finally, BLM staff told us that they had not been given any criteria by which to evaluate the RDAWP pilot project. BLM staff did say, however, that RDAWP could be an effective tool if it worked as designed. We followed up with staff in the Glenwood Springs, Colorado, field office in late July 2009 to learn whether or not any changes had occurred. A BLM official told us that RDAWP now appeared to be calculating the volumes for the 50 wells correctly and that BLM management was working with the company to increase the number of wells included in the RDAWP program to those within the entire case. This would, according to the BLM official, allow staff to use the software to help complete a single production inspection.

Also, in early 2009, BLM updated its cost-benefit analysis plan for RDAWP, which included elements of the contractor's roll-out schedule. The roll-out schedule envisioned that by the end of the first quarter in 2009, 200 wells would be connected to RDAWP, and that by the end of the first quarter of 2010, approximately 9,000 wells would be connected. This outcome appears unlikely given the limited number of wells currently connected.

Despite the conclusion made by Interior in its 2003 business case analysis, it appears that there are commercial alternatives to Interior's efforts. During the development of RDAWP, another program within BLM responsible for monitoring and auditing gas volumes acquired commercially available off-the-shelf software to assist in production verification. Specifically, in 2008 BLM's Helium program, overseen by the Amarillo, Texas, field office, BLM worked with producers and purchasers of helium to procure a common suite of software. According to the BLM Helium program manager, the benefits of this approach are that purchasers, transporters, and the seller (BLM) have a common data platform through which they can verify volumes and audit one another. According to the program manager, this software cost approximately $500,000, which included training and 5 years of support. As part of our review, we spoke with representatives of the company that developed this software and found that it provides similar functionality to that offered through RDAWP. Additionally, according to a representative of the company participating with BLM in the RDAWP program, this software is widely used within the oil and gas industry, and has many of the functionalities outlined as goals for the RDAWP program. In 2006, as part of BLM's RDAWP development process, BLM completed an alternative analysis to examine its options for its production verification program. This analysis compared three options, including (1) maintaining the status quo and continuing to rely on-the-ground inspections, (2) procuring a customized off-the-shelf solution—RDAWP, or (3) developing software entirely in-house for obtaining well head production data. However, it does not appear as though BLM considered the software obtained by BLM's Helium program in its analysis of option 2 because only the RDAWP option is included in the section identifying customized off-the-shelf technology alternatives. See appendix V for production verification tools and policies used by other countries, states, and private companies, but not widely used by Interior.

Interior's Efforts to Provide Inspection Staff with Mobile Computing Capabilities For Use in the Field Are Moving Slowly and Are Years From Full Implementation

Interior's BLM and OEMM are independently developing the capacity for inspection staff to (1) electronically document inspection results, and (2) access reference documents, such as API standards and measurement regulations, via laptops while in the field. BLM initiated work on this tool in 2001, whereas OEMM is now in the preliminary planning stages of a similar tool. According to agency officials, widespread implementation of a mobile computing tool to assist with production verification is still several years away.

In 2000, according to the BLM official previously responsible for developing BLM's mobile computing capabilities, BLM identified a need for an alternative to its current approach of documenting inspection results on paper while in the field, and subsequently entering the results in BLM's database when back in the office. At the time, according to this official, BLM management identified two concerns with the current approach; first, staff had to contend with duplicate data entry—once in the field on paper, and once back in the field office into the database; and second, inspection data were not being entered into the database in a timely manner. In 2001, according to this same official, BLM received funds to fulfill a requirement in the Energy Policy and Conservation Act Amendments of 2000 for an inventory of onshore oil and gas reserves and concluded that an investment in mobile computing was warranted.[58] The development of mobile computing was initially directed toward work associated with drilling inspections. At the time, according to this official, the Buffalo, Wyoming, BLM field office was experiencing high drilling rates for coalbed methane, and the field office manager was looking for ways to minimize the amount of time petroleum engineer technicians spent in the office entering data; the field office manager, according to a BLM official, proposed that mobile computing could be part of the

[58]Pub. L. No. 106-469, 114 Stat. 2029, 2041 (2000), *codified at* 42 U.S.C. § 6217.

solution. After evaluating several options, BLM selected one option and started a pilot in 2001. According to feedback from petroleum engineer technicians, the BLM official told us that initial results were positive, with some technicians estimating a time savings of 50 percent through having the ability to document drilling inspection data on a laptop, and later uploading those data into BLM's database. The BLM project team then examined its applicability for other types of inspections, including production. However, in 2003, Interior's IT systems were seriously impacted by the Cobell Lawsuit.[59] The mobile computing project was initiated again in 2006 after BLM received additional funding for seven field offices. BLM used approximately $200,000 to purchase laptops designed to withstand use in the field, for inspection staff in the seven offices. However, despite this purchase of computers, BLM had not developed software for electronically documenting production inspections. In April 2008, BLM worked with a company specializing in field data collection software development—including for the oil and gas industry—to explore various mobile computing options for BLM. According to the BLM official, over the course of several days, BLM and the company were able to develop prototype electronic forms for the several types of BLM oil and gas inspections through a slight modification of the company's off-the-shelf software. More recently, in August 2009, a BLM national inspection and enforcement coordinator told us that a BLM IT advisory group decided to prioritize the electronic forms for production inspections over other inspection types. However, the official was unable to provide us with a time frame for when this technology would be widely adopted at the field office level.

In our discussions with petroleum engineer technicians from the seven field offices we visited, we learned that some staff in three of the field offices we reviewed generally used laptops while in the field. However, those staff using laptops stated that this use is not helping reduce duplicate data entry because there are no electronic forms for many of the inspections, and they currently lack the ability to automatically upload their inspection results into BLM's inspection database. Staff in all seven field offices told us that having the capability to document inspections in the field and upload them into the database at the end of the day would save time, allowing them to spend more time in the field doing actual inspection work. Additionally, the former project manager stated that the

[59]Specifically, the judge presiding over the case ordered the shutdown of all of Interior's IT systems several times over the course of 4 years, delaying many IT projects.

use of electronic forms could also improve the reliability of inspection data through the use of data edit checks. For example, an electronic form could be designed so that duplicate inspection activities could not be entered for the same inspection and that inspections could not be closed out unless all the relevant data fields were populated.

According to OEMM officials, OEMM is also considering the use of mobile computing in its inspection program. However, it is at the conceptual stage and no money has yet been allocated to development. The justification for moving toward mobile computing is the need for OEMM inspectors to have access to large amounts of technical reference material to complete inspections. For example, one official explained that right now, some inspectors are carrying 50 pounds of paper with them when they fly out to platforms to complete inspections, and that the ability to access this reference material electronically would benefit the inspectors. Moreover, with inspectors having the capability to electronically document inspections in the field, OEMM would be able to free up those data entry staff to work on other programs, rather than their current practice of recording inspections on paper and then handing the paper copies to other staff in the district offices to enter into OEMM's inspection database. OEMM officials also stated that electronic data entry would provide additional controls for ensuring that the reliability of inspection data remains high. For example, with the proper edit checks, OEMM would not have had the data issues with the site security data entries that prevented it from knowing the number of inspections it completed between 2004 and 2007. Finally, OEMM officials stated that this initiative would be funded under the program budget for updating OEMM's entire database, called OCS (Outer Continental Shelf) Connect. The officials told us that funding would not be available for at least 20 months, so full implementation of mobile computing is at least 2 to 4 years away.

Conclusions

The Department of the Interior is charged with the critical role of ensuring that the country's oil and gas assets are carefully developed and that the American people receive fair compensation when these assets are sold. A key part of this role consists of providing reasonable assurance that oil and gas are accurately measured and that measurement efforts undertaken by the private companies that are developing these national resources are held to high standards. Interior's current approach of delegating to BLM and OEMM the responsibility for developing and updating oil and gas measurement regulations, approving measurement technologies not addressed by current regulations, and developing policies for commingling oil and gas has resulted in inconsistent regulations and decisions regarding measurement. This has resulted in inefficiencies and increased risk of inaccurate oil and gas measurement. While Interior's Production Coordination Committee, on which representatives of BLM, OEMM, and MMS serve, has been tasked with providing advice on measurement issues, the Committee's lack of formal decision-making authority for these critical issues at the department level means that Interior cannot be assured that it is accurately measuring federally produced oil and gas.

Additionally, because Interior has not determined the extent of its authority over key elements of the oil and gas production infrastructure, the result has been limited oversight of key facilities, including pipelines and gas plants, which refine gas into royalty-bearing saleable commodities. Furthermore, according to Interior officials, in instances when pipeline companies own and maintain meters on federal leases, Interior has limited direct access to them or their associated production data. This absence of rigorous federal oversight increases the risk that oil and gas may not be accurately measured.

Interior also has not ensured that controls over where and how oil and gas are measured are being consistently applied to leases located offshore and onshore, and BLM does not provide sufficient criteria for approving commingling agreements to enable staff to verify that oil and gas are being measured and reported accurately under such agreements. Without the ability to consistently track where and how oil and gas are measured, Interior cannot be assured that production reported to Interior is accurate.

Furthermore, Interior's delegation of production accountability inspection programs to BLM and OEMM has resulted in inconsistent emphasis on key areas affecting oil and gas measurement accuracy across the two agencies. Also, while OEMM now appears to be able to meet its annual goals for inspecting oil and gas producing leases under its revised strategy, BLM has not consistently been able to do so. This lack of consistency, as well as BLM's inability to inspect all wells, does not provide Interior sufficient assurance that it is properly measuring and accounting for oil and gas removed from federal lands.

Moreover, BLM faces challenges overseeing production verification through its field office structure. While decentralized management approaches can be effective, BLM's structure and lack of top level review has led to inconsistencies within its production verification program across field offices. Without such review, BLM is not employing internal control activities specified in federal standards. Further, BLM's database and hard copy files have a wealth of information on oil and gas production inspections, but without adequate controls to ensure complete and accurate production inspections and lacking the transfer of this information into Interior's electronic data systems, BLM may lack adequate data to track annual progress toward meeting its goals and demonstrating compliance with its regulations.

In addition, according to agency staff, because Interior has not provided sufficient or timely training for many of its key staff responsible for oil and gas measurement, knowledge gaps exist departmentwide, but are particularly pressing in some disciplines and in some BLM field offices. Compounding this, according to agency staff, program operations at many BLM locations are being further impeded by high staff turnover rates. Furthermore, while the recent downturn in the oil and gas sector has reduced competition between Interior and the private sector for staff, as the economy improves and oil and gas companies begin hiring again, Interior may, once again, increasingly be challenged in attracting and retaining qualified staff. Until Interior can maintain a well-trained and stable production verification workforce, Interior risks not having staff with sufficient knowledge to identify inaccurate oil and gas measurement.

Finally, Interior has begun developing tools it anticipates will lead to greater staff productivity, but it has been unable to deploy these tools on a widespread basis. Specifically, while BLM has made progress in developing in-house software for obtaining and analyzing gas production data from electronic flow computers, it has fallen behind the private sector in collecting and analyzing these data and adopting common software that facilitates data exchanges for verifying oil and gas volumes. Additionally, while BLM has recognized the need for staff to have mobile computing technology for documenting production inspections in the field, it has not developed the necessary technology. OEMM has recently expressed an interest in developing a similar tool for its inspectors, yet no coordination has occurred between BLM and OEMM on the development of such a tool.

Recommendations for Executive Action

To increase Interior's assurance that it is accurately measuring oil and gas produced on federal lands and waters, we are making 19 recommendations to the Secretary of the Interior.

To improve the consistency and efficiency of Interior's oil and gas measurement regulations and policies, we recommend that the Secretary empower a centralized panel consisting of staff with measurement expertise from BLM and OEMM to take the following actions:

- increase consistency between offshore and onshore measurement regulations, as appropriate;
- annually review changes in the industry measurement technologies and standards that Interior's regulations reference to determine whether the related regulations should be updated;
- provide departmentwide guidance on measurement technologies not addressed in current regulations and approve variances for measurement technologies in instances when such technologies are not addressed in current regulations or departmentwide guidance; and
- develop guidance clarifying when federal oil and gas may be commingled and establish standardized measurement methods in such a way that production can be adequately measured and verified.

To provide greater assurance that key elements in the oil and gas production infrastructure are adequately overseen, the Secretary should determine the extent to which Interior has authority regarding:

- pipelines, including meters that pipeline companies own, as well as other methods transportation companies use to ship and measure oil and gas produced from federal leases; and
- gas plants that process gas from federal leases, including the requirements and responsibilities for approving gas plant meters, and conducting inspections of them.

If Interior determines that its authority over any of these components is lacking or unclear, the Secretary should seek the appropriate authority or clarification from Congress.

To help ensure that Interior is consistently tracking where and how oil and gas are measured, the Secretary should require that:

- BLM track all onshore meters, including information about meter location, identification number, and owner;
- MMS require onshore operators to report meter identification numbers in the required monthly production reports; and
- BLM petroleum engineers work with BLM staff conducting production verification to confirm that commingling agreements are (1) consistent

with Interior guidance on such agreements, and (2) are adequately structured to facilitate key production verification activities before such agreements are approved.

To help ensure that Interior's production accountability inspection program consistently addresses key areas affecting measurement accuracy and that BLM meets its inspection goals, the Secretary should:

- establish goals for (1) witnessing onshore oil and gas meter calibrations, (2) witnessing onshore and offshore gas sample collections, (3) comparing onshore reported BTU values with gas analyses, and (4) inspecting onshore and offshore orifice plates and meter tubes; and
- consider an alternative onshore production inspection strategy that enables BLM to inspect all wells within a reasonable time frame, given available resources.

To improve the consistency of Interior's management of its onshore production and inspection program, the Secretary should direct BLM to:

- review and revise, as appropriate, its oversight of field and state offices and train managers involved in BLM's inspection and enforcement program to ensure adequate and appropriate review of personnel, processes, and production, consistent with standards for internal controls; and
- conduct reviews of the quality and completeness of the hard copy production inspection program files across field offices periodically and ensure that the data in these files are accurately entered into its database.

To address gaps in critical oil and gas measurement abilities, the Secretary should:

- direct BLM and OEMM to ensure that key onshore and offshore production verification staff have received initial standardized training necessary to effectively carry out their job functions and receive ongoing measurement training as needed; and
- determine what additional policies or incentives are necessary, if any, to attract and retain qualified measurement staff at sufficient levels to ensure an effective production verification program.

To improve the tools available to Interior's production inspection staff, the Secretary should:

- direct BLM to evaluate its commitment to further develop its in-house software, in light of the functionality, cost, and ease of adoption by Interior and industry of commercially available software; and present the results of this evaluation to Congress;
- require all companies purchasing federal leases to immediately provide Interior access to oil and gas production data generated by electronic flow computers to leave open a range of future options for electronic data exchanges with operators;
- direct BLM to implement a mobile computing solution for its inspection and enforcement program to allow staff to spend more time in the field conducting inspections and to improve the reliability of the inspection data; and
- coordinate onshore and offshore inspection staffs' efforts to design and implement a mobile computing solution for inspectors in the field, while taking into account any unique or specific needs associated with onshore versus offshore inspections.

Agency Comments and Our Evaluation

We provided a draft of this report to Interior for review and comment. Interior generally agreed with our findings and fully concurred with 16 of our 19 recommendations and partially concurred with the remaining three recommendations.

With regard to the recommendation in our draft report which stated that the Secretary empower the Interior's Production Coordination Committee to: (1) increase consistency between offshore and onshore measurement regulations, as appropriate; (2) review changes in the industry measurement technologies and standards annually that Interior's regulations reference to determine whether the related regulations should be updated; (3) assess measurement technologies not addressed in current regulations and approve variances, as appropriate; and (4) develop guidance clarifying when federal oil and gas may be commingled and establish standardized measurement methods in such a way that production can be adequately measured and verified, Interior agreed with our findings and the need for more consistency in these decisions. However, Interior expressed uncertainty as to whether the Production Coordination Committee (PCC) is the appropriate entity to oversee the implementation of the recommendations because it was formed as an ad hoc body. While Interior acknowledged that the PCC might be the appropriate body, it believed that the Secretary should be allowed to make such a determination. We appreciate Interior's acknowledgement that the current system, where these authorities are dispersed, results in inconsistencies and that some centralization of authority is needed. In light of these concerns, we agree that some flexibility on determining whether the PCC, or some other body, should be empowered with this departmentwide authority is justified. Accordingly, we modified our recommendation to allow for the Secretary to empower a centralized body comprised of staff from OEMM and BLM to carry out the roles we described.

Interior partially concurred with our recommendation that a centralized panel should assess measurement technologies not addressed in current regulations and approve variances, as appropriate. Interior agreed that it should periodically assess measurement technologies not addressed by regulations, and provide staff with guidance when technologies are not addressed by its regulations. Interior noted they are considering a range of alternatives to provide additional controls for providing assurances that variance approvals are subject to additional review. We are concerned that continued reliance on dispersed authority for variances may not fully address the longstanding challenges with ensuring consistency across jurisdictional boundaries, and that without a strong framework to ensure greater centralization and coordination, such inconsistencies may persist. We strongly believe that a centralized panel that has shared expertise from both OEMM and BLM would be best suited to address new, and increasingly complicated, measurement technologies. It is our hope that by empanelling departmentwide expertise with the authority to regularly update regulations, fewer variances would be needed. We further believe that this same panel could issue departmentwide guidance on the uses of new technologies not already addressed by regulations, thereby limiting the need for any distributed decision making and the related inconsistencies we found during the course of our work. Because we are concerned that companies may request to use advanced technologies not well understood, and because of the limited background measurement knowledge of some Interior staff who approve variances, we believe it is important that the most knowledgeable people in the department make reasoned decisions on their approvals. In deference to Interior's concerns, we modified our recommendation to allow for the centralized panel to develop departmentwide guidance on the use of technologies that it determines to be technically sufficient but not covered by current regulations, and that the centralized panel approve variances only in cases where such technologies are not addressed by either current regulations or departmentwide guidance.

Finally, Interior partially concurred with two of our recommendations addressing IT issues. While Interior agreed with our recommendation that BLM conduct a study of its RDAWP program in light of commercially available software, it did not agree that the results of the study be presented to Congress. Rather, Interior preferred that the results be presented only to the Secretary. We believe that Interior could provide the results of a study to the Secretary as an interim measure, but given this technology's potential to significantly improve Interior's production verification efforts, Congress should have clear and thorough information available to it when determining how federal funds are spent. As such, we made no change. Interior also partially agreed with our recommendation that Interior should coordinate its onshore and offshore inspection staffs' efforts to implement a mobile computing solution for inspections in the field. Interior expressed concerns that the different operating environments may necessitate different technological solutions for BLM and OEMM staff. We fully recognize this issue, and understand that the work environments offshore and onshore may lead the agencies to develop different solutions. However, we believe that BLM's staff have accumulated a large body of knowledge on this issue after its 10-year effort at developing a system, and that this knowledge may help OEMM as it works toward developing its own mobile computing solution. Accordingly, we modified our recommendation to clearly state the BLM and OEMM should coordinate the development of a mobile computing solution for their staffs, taking into account any unique or specific needs associated with onshore versus offshore inspections. This allows each agency the flexibility to adopt an approach that best meets the agencies' needs, while ensuring that both agencies keep one another informed of their progress thereby reducing the possibility of duplicative or unnecessary work, and providing the opportunity to take advantage of any economies of scale that could exist. Interior also provided several technical clarifications, which we incorporated as appropriate. Appendix II contains the Department of the Interior's comment letter.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees, the Secretary of the Interior, the Director of the Bureau of Land Management, the Director of the Minerals

Management Service, and other interested parties. In addition, this report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or ruscof@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VII.

Frank Rusco
Director, Natural Resources and Environment

List of Requesters

The Honorable Jeff Bingaman
Chairman
Committee on Energy and Natural Resources
United States Senate

The Honorable Nick J. Rahall, II
Chairman
Committee on Natural Resources
House of Representatives

The Honorable Darrell Issa
Ranking Member
Committee on Oversight and Government Reform
House of Representatives

The Honorable Carolyn Maloney
House of Representatives

Appendix I: Scope and Methodology

This report assesses (1) the extent to which the Department of the Interior's (Interior) production verification regulations and policies provide reasonable assurance that oil and gas are accurately measured; (2) the extent to which Interior's offshore and onshore production accountability inspection programs consistently set and meet program goals and address key factors affecting measurement accuracy; and (3) Interior's management of its production verification programs.

For all three report objectives, we reviewed relevant laws, regulations, and Interior, Bureau of Land Management (BLM), and Offshore Energy and Minerals Management (OEMM) guidance. We interviewed officials in BLM headquarters and officials from ten BLM field offices (and their associated state offices), selected using nonprobability samples, that provided a range of oil and gas operations and jurisdictions.[1] Specifically, we visited and interviewed officials in three BLM state offices (Colorado, New Mexico, and Wyoming) and eight BLM field offices (Glenwood Springs and White River in Colorado; Vernal in Utah; Buffalo, Pinedale, and Rawlins[2] in Wyoming; and Carlsbad[3] and Farmington in New Mexico) and interviewed by telephone officials in two additional state offices (Montana and Utah).

Additionally, we interviewed officials in four OEMM district offices (and their associated regional offices) that provided a range of geographic areas and jurisdictions. Specifically, we visited and interviewed officials in one OEMM regional office (Gulf of Mexico) and one OEMM district office (Lafayette, Louisiana) and interviewed by telephone officials in one additional OEMM regional office (Pacific) and four additional OEMM district offices (Lake Charles, Lake Jackson, New Orleans, and California). In addition, we interviewed representatives from 10 state oil and gas agencies, 8 oil and gas companies, and 6 regulatory entities overseeing oil and gas measurement from other countries about key areas that affect oil and gas measurement accuracy and their production verification programs. In addition, we collected and analyzed data from both BLM's

[1]The results we obtained from these discussions are not generalizable to all BLM field offices.

[2]Our site visit to the Rawlins, Wyoming, BLM field office was a scoping visit. We did not administer our semistructured interview guide to staff in this office.

[3]Representatives from the Roswell, New Mexico, BLM field office and the Hobbs, New Mexico, BLM field station were included in our discussion with Carlsbad, New Mexico, BLM field office staff.

Automated Fluid Minerals Support System (AFMSS) and OEMM's Technical Information Management System (TIMS).

To assess the extent to which Interior's production verification regulations and policies provide reasonable assurance that oil and gas are accurately measured, we analyzed BLM's and OEMM's laws and regulations addressing oil and gas measurement and conducted semistructured interviews with key BLM and OEMM production verification staff, including BLM petroleum engineers; BLM petroleum engineer technicians; BLM production accountability technicians; OEMM petroleum engineers; and OEMM inspectors. We also compared several aspects of BLM's and OEMM's oil and gas measurement regulations to identify areas of variation. We further interviewed OEMM regulatory affairs staff and BLM headquarters staff about the processes employed by both OEMM and BLM for updating their measurement regulations. Additionally, we examined the laws and regulations for providing the Secretary of the Interior authority to oversee key areas of oil and gas infrastructure, including gas plants, meters, and pipelines; we also interviewed Interior officials within its Solicitor's Office to obtain their legal assessment of Interior's authority over these areas. Finally, we examined BLM and OEMM regulations for how oil and gas measurement points are tracked and what criteria the agencies use to approve requests to commingle oil or gas production prior to measurement. To learn more about tracking measurement points and how commingling affects measurement accuracy, our semistructured interview guide included questions addressing these topics. During these discussions, we used a standard interview protocol, in which respondents were asked a standard set of open-ended questions. We asked these BLM and OEMM staff to address whether they could identify official measurement points and what effect commingling agreements had on their ability to accurately verify production.

To assess the extent to which Interior's offshore and onshore production accountability inspection programs consistently set and meet program goals and address key factors affecting measurement accuracy, we reviewed and analyzed BLM's and OEMM's inspection program goals and inspection data and assessed to what extent these programs addressed key areas affecting measurement accuracy. To assess the extent to which Interior's production accountability inspection program consistently sets program goals, we obtained and reviewed OEMM's and BLM's inspection strategies and identified areas of variation. To assess the extent to which OEMM and BLM were meeting the program goals for completing inspections, we requested and analyzed production inspection data from both BLM and OEMM. Specifically, we collected and analyzed data from

BLM's AFMSS to determine the extent to which BLM was meeting its statutory and agency goals for completing production inspections. Prior GAO work concluded that, because of the Cobell litigation which resulted in IT systems shutting down for extended periods of time, several BLM field offices were unable to accurately identify high priority cases—cases requiring annual inspections—because they could not readily access the Minerals Management Service's (MMS) monthly production reports to examine volumes. Accordingly, we limited our analysis to determining whether BLM was meeting its inspection goal for low priority cases—cases requiring inspections once every 3 years. We collected and analyzed production inspection data for fiscal years 1998 through 2009 to determine the frequency with which BLM was inspecting active cases. We further collected and analyzed BLM's AFMSS data on measurement activities, including meter calibrations and tank gaugings, completed during production inspections for fiscal years 2004 and 2008. We assessed the reliability of BLM's AFMSS production inspection data by (1) performing electronic testing for obvious errors in accuracy and completeness; (2) reviewing existing documentation about the data and the system that produced them; (3) interviewing agency officials knowledgeable about the data; and (4) verifying with agency officials a limited sample of our results. We determined that BLM's data documenting completed production inspections were sufficiently reliable for the purposes of this report. However, based on our findings related to production inspection activities and our limited file review, we had less confidence in those data. However, we determined that the meter calibration and tank gauging measurement code data were sufficiently reliable to indicate trends over time, but not the actual number of activities completed.

Additionally, we collected and analyzed data from OEMM's TIMS database to determine the extent to which OEMM was meeting its statutory and agency goals for witnessing meter calibrations and conducting site security inspections for fiscal years 2004 through 2008. We assessed the reliability of OEMM's TIMS production inspection data by (1) performing electronic testing for obvious errors in accuracy and completeness; (2) reviewing existing documentation about the data and the system that produced them; and (3) interviewing agency officials knowledgeable about the data. We determined that, based on our discussions with OEMM officials, only the fiscal year 2008 data was sufficiently reliable for our reporting purposes.

Finally, to identify key areas that affect measurement accuracy not currently addressed by Interior's production accountability programs, we reviewed technical papers and interviewed representatives from industry, independent research organizations, the U.S. National Institute of Standards and Technology, the American Petroleum Institute, and BLM and OEMM officials responsible for oil and gas measurement. For these interviews, we used a standardized interview protocol, in which respondents were asked a standard set of open-ended questions. We asked these respondents to identify key factors that affect measurement accuracy. We then analyzed the extent to which BLM's and OEMM's production inspection program addressed the key areas affecting measurement uncertainty.

To evaluate Interior's management of its production verification programs, we examined its oversight activities, human capital policies, and the extent to which Interior was successful in developing key tools to assist its production inspection staff. To examine Interior's oversight of its oil and gas production verification program, we reviewed documentation on both BLM's and OEMM's internal reviews of their production verification programs, including the criteria for assigning a risk rating to the programs. We also interviewed agency officials about BLM's and OEMM's organizations as they relate to key oil and gas production verification staff, including the supervisory relationships. To examine internal controls related to production inspection documentation, we selected a nongeneralizable sample of hard copy BLM files from four of the seven field offices we visited. We nonrandomly selected files from fiscal years 2004 through 2008 to provide us with a range of measurement activities, including meter calibrations, tank gaugings, meter provings, and run ticket verifications. Specifically, we reviewed 7 files in the Vernal, Utah, field office; 9 files in the White River, Colorado, field office; 9 files in the Pinedale, Wyoming, field office; and 18 files in the Buffalo, Wyoming, field office. We reviewed the files for completeness and whether the files supported data recorded in BLM's database. In total, we reviewed 43 files out of a possible 3,566 available files to select from between fiscal years 2004 and 2008 for the four field offices we reviewed. Because we did not conduct a truly random sample, our analysis does not indicate the prevalence or extent of the problems we identified. This applies to both the field offices whose files we reviewed, as well as the 28 field offices whose files we did not review. We selected hard copy files based on OEMM data that indicated that the files included site security inspections and indications the files might contain additional information that would inform our understanding of OEMM's overall inspection process. Our nongeneralizable sample included a review of 20 out of a total of 562 available hard copy inspection files for fiscal years 2007-2008 in those two district offices. Because we did not conduct a truly random sample, our analysis does not indicate the prevalence or extent of the problems we identified. This applies to both the district offices whose files we reviewed, as well as the five district offices whose files we did not review. We also collected and analyzed BLM AFMSS production inspection data from the nine field offices we reviewed for fiscal years 2004 through 2008 and used BLM's documentation criteria to assess whether data was correctly coded. We also examined MMS and BLM staffing and training data. Specifically, we collected and analyzed staffing data for the nine BLM field offices, four OEMM district offices and two OEMM regional offices we reviewed, for fiscal years 2004 through 2009, to calculate turnover rates for BLM petroleum engineers, BLM petroleum engineer technicians, BLM production accountability technicians, OEMM petroleum engineers, and OEMM inspectors. We obtained human capital data from Interior's Federal Personnel and Payroll System (FPPS) for all nine BLM field offices and for four OEMM district offices. For regional OEMM staff performing the work of petroleum engineers, we obtained human capital data from regional office officials. We assessed the reliability of the FPPS data for BLM and OEMM staff by (1) interviewing agency officials knowledgeable about the data, (2) working closely with agency officials to identify any data problems, and (3) corroborating, on a limited basis, staff names included in the FPPS with names of staff on sign-in sheets obtained during our site visits and interviews.

Additionally, we reviewed training records and interviewed BLM and OEMM staff about training requirements and course offerings. In reviewing BLM's Remote Data Acquisition for Well Production program, we collected and analyzed project timelines, budget information, and planning documents. We also interviewed BLM project managers; representatives from the oil and gas company voluntarily participating in the pilot project; and BLM staff in the Glenwood Springs, Colorado, field office who had access to the software about the programs' effectiveness. To learn about oil and gas production monitoring and verification software used in the private sector, we interviewed oil and gas company representatives about their software, as well as held meetings with oil and gas software manufacturers. To assess BLM's and OEMM's efforts to develop a mobile computing option for field inspection staff, we analyzed project documentation, interviewed project managers, and discussed the potential applications of mobile computing with BLM staff from nine field offices and OEMM staff from four district offices.

Finally, in order to develop an informed view of how others involved in oil and gas production seek to perform similar functions, we examined how states, other countries, and private companies perform such functions. In particular, we reviewed state government regulations and policies and interviewed regulatory officials from a nongeneralizable sample of 10 states selected to represent states with the most production in barrels of oil equivalent. These states included Alaska, California, Colorado, Kansas, Louisiana, New Mexico, Oklahoma, Texas, Utah, and Wyoming. Further, we interviewed representatives from eight oil and gas producers, representing a range of scales of operations. We also reviewed the oil and gas regulations of Canada's Alberta, British Columbia, Newfoundland, and Labrador provinces; Mexico; Norway; and the United Kingdom; and interviewed their regulatory officials. We selected these countries on the basis of several criteria, including the volume of national production. We were unsuccessful in our attempts to also obtain information and interview officials with relevant expertise from Russia and Kuwait.

We conducted this performance audit between October 2008 and March 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Comments from the Department of the Interior

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

FEB 2 6 2010

Mr. Frank Rusco
Director, Natural Resources and Environment
Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548-001

Dear Mr. Rusco:

Thank you for the opportunity to review and comment on the Government Accountability Office's (GAO) draft report entitled, "*OIL AND GAS MANAGEMENT: Interior's Oil and Gas Production Verification Efforts Do Not Provide Reasonable Assurance of Accurate Measurement of Production Volumes*," (GAO-00-000). The Department of the Interior (Department) appreciates the recognition of its efforts currently underway to implement the GAO's recommendations. The Department generally agrees with the findings and fully concurs with sixteen of the recommendations.

As mentioned in technical comments submitted earlier, four recommendations that Interior's Production Coordination Committee take actions to address GAO findings should be directed to the Secretary to delegate for resolution as appropriate. The Production Coordination Committee is an ad-hoc committee established to oversee cross-bureau coordination and collaboration and may be the appropriate group to address these recommendations. However, the Secretary should make that determination.

The Department partially agrees with the recommendation to "assess measurement technologies not addressed in current regulations and approve variances, as appropriate." The Department agrees that measurement technologies should be periodically assessed and agency guidance provided; however, we do not agree that individual onshore variances in the use of measurement technology should be approved by the PCC or any other headquarters office. These offices are too removed from the variance request to make timely and informed decisions. The BLM is currently exploring ways to ensure that the approval of variances is properly reviewed and if effective, ultimately incorporated into national guidance. Establishing variance review teams who can quickly review variance requests, or requiring additional review by second-level professionals prior to management approval are two of several possible alternatives to resolve the issues identified by the GAO.

The Department would also prefer that GAO's recommendation for the Secretary "to direct BLM to evaluate its commitment to further developing its in-house software, in light of the functionality, cost and ease of adoption by Interior and industry of commercially available software, and present the results of this evaluation to Congress;" be revised to allow presentation of such an evaluation and agency recommendations to the Secretary for further consideration.

The Department partially concurs with the final recommendation, which is to coordinate onshore and offshore inspection staffs' efforts to design and implement a mobile computing solution for inspections in the field. The Bureau of Land Management (BLM) and the Minerals Management Service (MMS) will continue to assess technology and research the use of a mobile computing solution for their inspectors. There are technical constraints such as intrinsic safety, weight, and space, which must be considered for offshore implementation and may require different solutions.

As noted in the draft report, oil and gas leasing and development onshore, managed by the BLM, and offshore, managed by the MMS, operate in different regulatory and operational environments. The Department is focused on standardizing common agency practices, where appropriate, particularly those that make operations more efficient and effective. Both the BLM and the MMS are working to develop new regulatory requirements regarding commingling of produced oil and gas from different sources that would be appropriate in their respective environments.

The BLM and the MMS are collaborating on many important issues, such as the revision of Onshore Order #3, which will require onshore operators to include meter identification numbers on monthly production reports. Also, the BLM and the MMS are reviewing the Department's authority to regulate gas plants that process gas from Federal leases, including the requirements and responsibilities for approving gas plant meters and conducting inspections of them. This will lead to appropriate inspection and enforcement measures by both bureaus.

Technical comments on the draft report have been provided separately. If you have any questions about this response or the technical comments, please contact LaVanna Stevenson-Harris, BLM Audit Liaison Officer, at 202-912-7077, or Andrea Nygren, MMS Audit Liaison Officer, at 202-208-4343.

Sincerely,

Wilma A. Lewis

Wilma A. Lewis
Assistant Secretary
Land and Minerals Management

Appendix III: Four Examples of the Bureau of Land Management's (BLM) Inconsistent Meter Approvals

Variances to BLM's measurement regulations are made by the authorized officer at the field office level without additional review. As a result of this, there have been instances of inconsistent approvals at both the field office and state office level. Specifically, we found four instances of measurement technologies that had been approved in a possibly inconsistent manner: (1) electronic flow computers, (2) Wafer V-Cone meters, (3) truck-mounted Coriolis meters, and (4) flow conditioners.

Electronic Flow Computers. BLM's initial approvals of electronic flow computers were inconsistent across its field offices, and subsequent state policies authorizing their use were issued independently between 2004 and 2009. According to a BLM official, beginning in the early 1990s, oil and gas companies began using electronic flow computers—which are not addressed in BLM's 1989 gas measurement regulations—in lieu of chart recorders for measuring and recording gas volumes. BLM regulations require the authorized officer at the field office to ensure that any alternative method of measurement be approved only if it was equal to or better than what the regulations addressed. This official told us that electronic flow computers were approved with both inconsistent conditions of approvals, or had no approvals at all. Partly in response to this new technology, BLM wrote and published draft gas measurement regulations in the January 1994 *Federal Register* for public comment. These draft regulations, according to a BLM official, would have resolved internal inconsistencies with approving electronic flow computers by establishing criteria for granting approvals. BLM never finalized its revised gas measurement regulations. Rather, 10 years later, individual BLM state offices—beginning in 2004 with Wyoming and ending in July 2009 with Alaska—separately issued standardized Notices to Lessees establishing standards for the use of electronic flow computers. At least one standard included in these policies was initially included 14 years earlier in the draft 1994 gas measurement regulations.

Wafer V-Cone Meters. BLM has inconsistently approved Wafer V-Cone meters at the field office level. In the mid 1990s, a manufacturer developed a meter designed to provide accurate gas measurement with significantly shorter lengths of upstream and downstream meter tubes, as well as accurately measure gas associated with liquids. The meter—called a Wafer V-Cone meter—is similar to an orifice meter in that it measures the differential pressure, along with other parameters used in calculating the volumes. The Wafer V-Cone was marketed in areas with coal-bed methane production, as coal-bed methane is frequently produced with large quantities of water. According to BLM documents, prior to 2006, BLM field offices had received and approved requests for installing Wafer V-Cone meters on federal leases. However, BLM found that the conditions of approvals and the policies for approving them were inconsistent between field offices. Later, BLM found that Wafer V-Cone meters did not meet the manufacturer's stated specifications for accuracy. In 2005, under the direction of BLM, the manufacturer contracted with an independent flow measurement lab to study the conditions under which Wafer V-Cone meters could accurately measure gas. The research showed that the Wafer V-Cone manufacturer's stated ranges for operating the meter were not accurate and that, while Wafer V-Cones could accurately measure gas, it could only do so within a narrow operating range. According to a BLM official, Wafer V-Cone meters tend to undermeasure gas when high volumes are flowing through it and over-measure gas when low volumes are flowing through it. In November 2006, BLM issued a memo clarifying the flow conditions under which the authorized officer in the field offices could approve the Wafer V-Cone. The memo also stated that all previously approved or unapproved Wafer V-Cone meters would have to be brought into compliance within a "reasonable time frame." During the course of our work, we obtained one field office's plan for bringing Wafer V-Cones presently measuring federal gas into compliance, which was dated January 20, 2009—2 years after the initial BLM policy was put into place—which requested that operators bring their Wafer V-Cone meters into compliance by May 1, 2009. In this intervening time, according to a BLM official, federal gas was inaccurately measured. Some operators at the time of our visit in May 2009 had already begun retro-fitting the meter runs or replacing Wafer V-Cones with the more traditional orifice meters to bring the measurement into compliance. A BLM official estimated that the total number of meter reconfigurations will be in the thousands, with per-well costs ranging between $500 and $1,200. Finally, according to a BLM official, a second round of testing on Wafer V-Cones has recently been completed and BLM is assessing whether any revisions to its current approval conditions for the meters are warranted.

Truck-Mounted Coriolis Meters. Because BLM does not centrally approve, review, or track approved variances to measurement regulations, it was unaware if truck-mounted Coriolis meters had been inconsistently approved. In December 2008, BLM headquarters issued a memo stating that it knew of at least one field office that was allowing a truck-mounted Coriolis meter to measure federal oil for sales. Since Coriolis meters are not positive displacement meters, which are the only meters currently addressed by BLM's oil measurement regulations, they must receive a variance from the local authorized officer if used in that jurisdiction. The BLM memo requested that, in order to identify the extent of the use of truck-mounted meters for oil measurement, all field offices provide BLM headquarters data on the make of the meter, the number of facilities from which oil is loaded, the accuracy of specifications, the cost, and the field offices' staffs' impression of its performance versus that of manual tank gauging.

Flow Conditioners. BLM's absence of a formal policy addressing flow conditioners is leading to inconsistent field office decisions on the use of flow conditioners. Flow conditioners—devices placed within the upstream portion of the meter run to both stabilize the gas flow and allow for a shorter meter run—are not addressed by current gas measurement regulations. Accordingly, a variance from the authorized officer is necessary prior to installing flow conditioners in the field. However, according to BLM officials from all seven field offices we visited, operators have installed them without approved variances. According to one BLM petroleum engineer, operators may have begun using them believing that because BLM allowed a similar technology—straightening vanes—that BLM would also allow flow conditioners. However, BLM field offices are now taking an inconsistent approach for retroactively approving them. For example, an official in one field office told us that the office's engineers were planning to hold a meeting to discuss a strategy for addressing flow conditioners, whereas an official in another field office told us that management was not encouraging staff to examine the issue. Furthermore, while an official from one BLM field office told us that when petroleum engineer technicians identify unauthorized use of flow conditioners in the field, they will issue an incident of noncompliance, while an official in another field office told us that they do not—reasoning that the problem is because of BLM's out-of-date measurement policies, not the operators' use of flow conditioners. To date, BLM does not have a national policy on flow conditioners and has not completed any independent testing on flow conditioners' effects on measurement, though one BLM official has been reviewing data from studies.

Appendix IV: Analysis of the Department of the Interior's (Interior) Hiring, Training, and Retaining of Critical Measurement Staff

Interior has had challenges in hiring, training, and retaining staff for many of its critical measurement positions. The following section provides additional detail on the Bureau of Land Management's (BLM) petroleum engineers, BLM petroleum engineer technicians, BLM production accountability technicians, Offshore Energy and Minerals Management's (OEMM) petroleum engineers, and OEMM inspectors.

BLM Petroleum Engineers. BLM has struggled to hire qualified staff to fill the petroleum engineer positions in its field offices and to provide those it does hire with adequate training to improve their knowledge, skills, and abilities; moreover, BLM continues to experience high turnover in these positions. According to BLM data obtained from BLM's Human Capital office, for the seven field offices we reviewed, approximately 60 percent of the staff in the petroleum engineer position had a degree in petroleum engineering. Others currently serving as petroleum engineers held degrees in other areas, including chemical engineering, mechanical engineering, and civil engineering. Additionally, one petroleum engineer told us that oil and gas measurement is not typically covered in courses in engineering school and, thus, engineers did not necessarily have detailed backgrounds in oil and gas measurement or production verification activities. According to some BLM petroleum engineers, hiring qualified staff can be challenging, as both BLM and oil and gas companies are hiring from the same pool of applicants, but oil and gas companies are able to offer their engineers much higher compensation than BLM.

BLM has not provided consistent and formal training for recently hired petroleum engineers, nor is there a requirement for any continuing education. According to a BLM training coordinator, BLM has offered training to petroleum engineers once since 1999. In 2007, BLM held a 5-day course that focused on how to process drilling permits and review commingling agreements, among other topics. During that course, the training coordinator noted, it was clear that some petroleum engineers required remedial training in some areas and course instructors arranged for several tutorials to be held in the evening to review selected engineering concepts. The training coordinator further stated that there is a definite need for more petroleum engineer training, but no funding had been available for such training in recent years. According to the training coordinator, the lack of consistent formal training for petroleum engineers could have significant impacts on the decisions these petroleum engineers make, limit their ability to perform certain functions, and limit their understanding of how their decisions can affect overall production accountability within BLM. Regarding concerns over decision making, some current petroleum engineers noted that they had serious concerns about how prior petroleum engineers had made decisions. According to one petroleum engineer, because of some past decisions on commingling and allocation agreements, it was unlikely production verification staff could correctly verify the allocation of volumes, raising uncertainty as to whether federal oil and gas were being properly measured and reported. Furthermore, one petroleum engineer stated that she was not entirely aware of what activities the petroleum engineer technicians are conducting in the field, and that taking the petroleum engineer technician courses would provide BLM petroleum engineers with greater insight into measurement and other issues that are addressed on a daily basis. The lack of training for petroleum engineers can also limit what functions they may perform. A petroleum engineer told us that without the training that petroleum engineer technicians receive, petroleum engineers are unable to issue an Incident of Noncompliance themselves. Rather, they must work through other staff to have it issued. Several petroleum engineers also told us they would benefit from ongoing training, in part, to keep up with the rate at which technology and processes change in oil and gas fields.

In addition, BLM has experienced high rates of turnover in the petroleum engineer position. We analyzed Interior data from fiscal year 2004 through July 2009 for the eight field offices we reviewed and found that they had overall turnover rates between 33 percent and 100 percent. For example, the Buffalo, Wyoming, field office, which had an overall turnover rate of 80 percent between fiscal years 2004 and 2008, employed a total of five petroleum engineers, but during that time period, four individuals in that position either left BLM, relocated to another field office, or moved to another position within BLM. Overall, we found that seven of the eight field offices we reviewed had overall turnover rates of 50 percent or greater during this time period. According to several petroleum engineers, these high turnover rates have resulted in the loss of knowledge, skills, and abilities petroleum engineers accumulate through on-the-job training and force BLM to repeatedly hire new, often inexperienced petroleum engineers (see table 10).

Table 10: Total Turnover Rates for Petroleum Engineers, Fiscal Years 2004–2008

				Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					
Field office	Turnover percentage	Total number of employees in position, FY2004-08	Total employees leaving position, FY2004-08	2004	2005	2006	2007	2008	Average number of employees in position, FY2004-08
Buffalo	80	5	4	1 of 3	1 of 2	1 of 2	0 of 2	1 of 2	2
Carlsbad	75	4	3	1 of 1	0 of 0	1 of 1	0 of 3	1 of 3	2
Farmington	50	8	4	1 of 6	0 of 6	2 of 6	0 of 5	1 of 5	6
Glenwood Springs	50	2	1	0 of 0	0 of 0	0 of 1	0 of 1	1 of 1	1
White River	100	2	2	0 of 1	1 of 1	0 of 1	0 of 1	1 of 1	1
Pinedale	100	2	2	0 of 1	0 of 1	0 of 1	1 of 2	1 of 1	1
Roswell	80	5	4	0 of 5	0 of 5	2 of 5	0 of 3	2 of 3	4
Vernal	33	6	2	0 of 2	2 of 3	0 of 2	0 of 2	0 of 4	3

Source: GAO analysis of Interior data.

Note: We calculated the total turnover rate by (1) counting the number of individual petroleum engineers who separated from BLM, plus those who changed locations, plus those who changed from the petroleum engineer position to another position within that office; (2) dividing that by the number of individual petroleum engineers employed in each BLM office from fiscal years 2004 through 2008. For those individuals who changed jobs or locations, we did not determine whether they changed jobs or locations because of a management decision, as opposed to the employees' own decision.

Petroleum Engineer Technicians. BLM has also faced challenges in hiring, training, and retaining petroleum engineer technicians—staff critical for inspecting oil and gas sites and ensuring that oil and gas are measured and reported accurately—over the past 5 years. According to BLM staff we spoke with, all nine field offices we reviewed have had difficulty in recruiting staff for petroleum engineer technician positions. Officials in those offices provided several reasons, including higher salaries in the private sector compared with BLM salaries, and the high cost of living in several of the areas where BLM has offices, including Glenwood Springs, Colorado; and Pinedale, Wyoming.

Our review of BLM's petroleum engineer technician training program identified several areas where BLM is experiencing challenges. Once BLM hires a petroleum engineer technician, BLM has a five-step training process for ensuring that staff have the knowledge and skills to understand standard industry practices and BLM's regulatory requirements. These five steps include the following:

1. Successful completion of BLM's Oil and Gas Compliance Certification School, which includes six 2-week training modules over the course of 9 months on topics including oil and gas measurement, reviewing production records, and technical aspects of drilling and plugging oil and gas wells.

2. On-the-job training developed and conducted by the petroleum engineer technician's state office.

3. Passing a technical review exam, which successfully demonstrates the petroleum engineer technician's skills and knowledge in performing a field inspection.

4. Official Certification by the State Director, based on the recommendation by the National Lead for Certification and Training.

5. Maintain basic competency through successfully completing the Compliance Certification course once every 5 years.

However, until fiscal year 2010, BLM was limited in its ability to provide timely training, as it was unable to accommodate all petroleum engineer technicians who attempted to complete step 1, or enroll in the annual training course. This led to a training backlog for newly hired staff. A BLM official provided several reasons for not being able to accommodate the additional demand, including the need to limit the course to 25 people to ensure effective instruction in the field, and a lack of instructors for a second session for each of the modules. As a result of the backlog, however, petroleum engineer technicians who were unable to attend the training remained limited in their ability to independently complete production inspections. Rather, according to some senior petroleum engineer technicians, they had to devote additional time to providing on-the-job training and supervising new petroleum engineer technicians, which had the added effect of limiting the senior petroleum engineer technicians' ability to complete their own inspections. According to a BLM training coordinator, fiscal year 2010 is the first time that BLM does not have a backlog since this six-module training course has been offered. Moreover, because BLM has experienced difficulty in recruiting individuals with prior oil and gas training, many newly hired staff have been unable to complete the six pass / fail modules. According to BLM data, only 61 percent of petroleum engineer technicians initially enrolled in the course eventually pass (see table 11).

Table 11: Overview of Course Petroleum Engineer Technician Attendees by Fiscal Years 2003–2008

Fiscal year	Number of students selected for module 1	Number of students attending module 1	Number of students completing modules 1 - 6
2003/2004	25	25	16
2005	25	25	24
2006	20	17	13
2007	25	22	16
2008	25	25	19[+]
2009	25	19	TBD
Total	**145**	**133**	**88**
Percentage	**100**	**92**	**61**

Source: BLM.

[a]Two students did not pass Modules 2 and/or 3 and will attend modules in fiscal year 2009 to raise their scores to a passing grade.

Another area where BLM has been unable to meet its training policy standards is in ensuring that certified petroleum engineer technicians are provided maintenance training. According to BLM's petroleum engineer technician Certification Policy, staff must demonstrate their continued competence in completing inspections once every 5 years. According to a BLM official, this is necessary as industry practices and technologies change over time and additional training may be necessary. BLM created a course specifically for this purpose; however, it has not been offered since 2002, meaning that under BLM's own policy, some staff may be out of compliance.

Finally, turnover of petroleum engineer technician staff at the field office level continues to be high. In reviewing BLM data for petroleum engineer technicians who completed all six training modules, many of the petroleum engineer technicians have either moved on to other positions within BLM or left the agency altogether. Specifically, of the petroleum engineer technicians who completed the training modules, 7 percent have taken positions in other areas within BLM and another 13 percent have left BLM. The combined result of this are that BLM has foregone expenditures for recruiting, hiring, and training staff approximately 20 percent of the time (see table 12).

Table 12: Overview of Course Petroleum Engineer Technician Attendees by Fiscal Years 2003–2008

Fiscal year	Students completing modules 1 - 6	Petroleum Engineer Technicians who moved to other BLM jobs	Petroleum Engineer Technicians who left BLM after completing modules 1 - 6
2003/2004	16	0	3
2005	24	1	4
2006	13	4	2
2007	16	1	2
2008	19[a]	0	0
Total	**88**	**6**	**11**

Source: BLM.

[a]Two students did not pass Modules 2 and/or 3 and will attend modules in fiscal year 2009 to raise their scores to a passing grade.

Furthermore, our analysis of petroleum engineer technician turnover data at the field office level indicates that five of the nine field offices we reviewed had an overall turnover rate in excess of 50 percent between fiscal years 2004 and 2008. Moreover, some of this turnover occurred in field offices that have very high oil and gas production. For example, the Pinedale, Wyoming, field office which, in recent years, has had more production of federal gas than any other field office, had an overall turnover rate of 83 percent between fiscal years 2004 and 2008. Specifically, during this period, the Pinedale, Wyoming, field office employed 12 petroleum engineer technicians in that position, but during that time 10 individuals in that position either left BLM, relocated to another field office, or moved to another position within BLM. According to staff in the Pinedale, Wyoming, field office, turnover has added to already existing challenges in verifying production (see table 13).

Table 13: Total Turnover Rates for Petroleum Engineer Technicians, Fiscal Years 2004–2008

				Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					
Field office	**Turnover percentage**	**Total number of employees in position, FY2004-08**	**Total employees leaving position, FY2004-08**	**2004**	**2005**	**2006**	**2007**	**2008**	**Average number of employees in position, FY2004-08**
Buffalo	30	20	6	1 of 12	0 of 12	2 of 13	2 of 14	1 of 15	13
Carlsbad	47	19	9	1 of 10	1 of 9	4 of 9	1 of 10	2 of 12	10
Farmington	54	37	20	1 of 22	3 of 25	7 of 24	3 of 21	6 of 22	23
Glenwood Springs	67	3	2	0 of 0	0 of 0	0 of 0	0 of 2	2 of 3	3
Hobbs	22	9	2	2 of 8	0 of 6	0 of 6	0 of 6	0 of 6	6
White River	55	11	6	1 of 2	2 of 3	0 of 1	1 of 2	2 of 7	3
Pinedale	83	12	10	1 of 2	1 of 6	2 of 6	3 of 5	3 of 5	5
Roswell	57	7	4	0 of 4	0 of 4	1 of 4	1 of 4	2 of 5	4
Vernal	17	18	3	1 of 13	1 of 14	1 of 13	0 of 15	0 of 15	14

Source: GAO analysis of Interior data.

Note: We calculated the total turnover rate by (1) counting the number of individual petroleum engineer technicians who separated from BLM, plus those who changed locations, plus those who changed from the petroleum engineer technician position to another position within that office; (2) dividing that by the number of individual petroleum engineer technicians employed in each BLM office from fiscal years 2004 through 2008. For those individuals who changed jobs or locations, we did not determine whether they changed jobs or locations because of a management decision, as opposed to the employees' own decision.

BLM Production Accountability Technicians. BLM's production accountability technician position has experienced several of the same challenges that both petroleum engineer and petroleum engineer technician positions have. Production accountability technicians in five of the seven field offices we visited generally stated that there had been difficulties in hiring production accountability technicians. According to these staff, production accountability technicians are hired at a pay level below that of petroleum engineer technicians. Also, the low salary has made it difficult for BLM to attract people with the necessary skills to perform the responsibilities of the job.

Moreover, BLM has not provided production accountability technicians with sufficient training once they are hired. Production accountability technician work is technically complicated in that they review and corroborate oil and gas quality and volume data from a variety of sources. These sources include data generated by electronic flow computers, gas analysis reports, calibration reports, and monthly production records. Because their reviews are conducted on a case level, the total number of wells reviewed may be in the hundreds. According to a BLM training coordinator, BLM has offered three production accountability technician training sessions over the past 5 years; one in 2004, another in 2006 and, most recently, in 2009. This most recent session was 3 days which, according to the training coordinator, was not long enough to cover all the relevant material. Additionally, we found during our site visits that in some instances, little training or guidance is provided to production accountability technicians upon being hired. In one instance, a production accountability technician was hired by a field office that previously did not have other production accountability technicians. According to the production accountability technician, she learned most of her job responsibilities on the job with little oversight. In another field office, a production accountability technician who had been employed for over 3 years and had not yet received formal training reported having only recently completed her first gas audit.

Finally, our analysis of production accountability technicians shows that eight of the nine field offices we reviewed had an overall turnover rate of 50 percent or more between fiscal years 2004 thorough 2008. Also, similar to the petroleum engineer and petroleum engineer technician turnover rates for the Pinedale, Wyoming, field office, the production accountability technician turnover rate in that field office was high, as well, with an overall turnover rate of 100 percent between fiscal years 2004 and 2008 (see table 14). Specifically, the Pinedale, Wyoming, field office employed a total of three production accountability technicians in that position; but during that time, three individuals in that position either left BLM, relocated to another field office, or moved to another position within BLM.

Table 14: Total Turnover Rates for Production Accountability Technicians, Fiscal Years 2004–2008

Field office	Turnover percentage	Total number of employees in position, FY2004-08	Total employees leaving position, FY2004-08	Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					Average number of employees in position, FY2004-08
				2004	2005	2006	2007	2008	
Buffalo	75	8	6	0 of 2	0 of 2	0 of 2	3 of 4	3 of 5	3
Carlsbad	67	3	2	1 of 1	0 of 0	0 of 0	0 of 0	1 of 2	2
Farmington	63	8	5	0 of 3	1 of 4	0 of 3	2 of 5	2 of 5	4
Glenwood Springs	0	1	0	0 of 0	0 of 0	0 of 0	0 of 1	0 of 1	1
Hobbs	50	4	2	0 of 1	0 of 2	0 of 2	2 of 4	0 of 2	2
White River	50	2	1	0 of 0	0 of 0	0 of 0	1 of 2	0 of 1	2
Pinedale	100	3	3	0 of 0	0 of 1	0 of 1	1 of 1	2 of 2	1
Roswell	100	1	1	1 of 1	0 of 0	0 of 0	0 of 0	0 of 0	1
Vernal	50	2	1	1 of 1	0 of 1	0 of 1	0 of 2	0 of 2	1

Source: GAO analysis of Interior data.

Note: We calculated the total turnover rate by (1) counting the number of individual production accountability technicians who separated from BLM, plus those who changed locations, plus those who changed from the production accountability technician position to another position within that office; (2) dividing that by the number of individual production accountability technicians employed in each BLM office from fiscal years 2004 through 2008. For those individuals who changed jobs or locations, we did not determine whether they changed jobs or locations because of a management decision, as opposed to the employees' own decision.

OEMM Petroleum Engineers. Offshore, OEMM's ability to hire high-quality applicants for offshore engineers was described as very difficult in the past; however, according to one OEMM official, the recent economic downturn has increased the number and quality of the candidates applying for these positions. However, the official added that retaining individuals within the unit who approve measurement applications can be challenging, because of the difficult nature of the work and the lure of other opportunities within or outside MMS.

OEMM petroleum engineers who review measurement applications at the regional level, according to an OEMM official, are not required to receive specific training or to meet a minimum level of proficiency in measurement issues. Unlike BLM, OEMM does not have a specific training course for its petroleum engineer staff who review applications for oil and gas measurement. However, OEMM petroleum engineer staff receive individualized training for their work reviewing measurement, commingling, and allocation applications from oil and gas producers. This training includes classes provided both by OEMM and by external vendors, such as universities and private providers of measurement training. Training plans are assigned to OEMM engineers on a case-by-case basis, and generally fit the needs of the particular engineering staff member. In addition, a large portion of OEMM petroleum engineers in the Gulf of Mexico region hold degrees in petroleum engineering, according to OEMM officials. For the three district offices we reviewed that were in the Gulf of Mexico region, production measurement applications are reviewed at the regional level by a staff of seven petroleum engineers. Of those, five of the seven petroleum engineers hold petroleum engineering degrees, either at the Bachelor's or the Master's level. In OEMM's Pacific region, geoscientists handle measurement approvals.

According to OEMM officials and human capital data we reviewed, the petroleum engineering staff who review offshore measurement do not appear to have turnover rates that are impeding program operations. We found that the overall turnover rates for petroleum engineers for the OEMM Gulf of Mexico and Pacific regional offices—which handle measurement approvals at the regional level of the four district offices we reviewed—had overall turnover rates of 30 percent or less (see table 15).

Table 15: Total Turnover Rates for OEMM Petroleum Engineers[a] who Approve Measurement, Fiscal Years 2004–2008

				Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					
Regional office	Turnover percentage	Total number of employees in position, FY2004-08	Total employees leaving position, FY2004-08	2004	2005	2006	2007	2008	Average number of employees in position, FY2004-08
Gulf of Mexico region	30	10	3	0 of 8	1 of 7	2 of 6	0 of 7	0 of 7	7
Pacific region	0	1	0	0 of 1	0 of 1	0 of 1	0 of 1	0 of 1	1

Source: GAO analysis of Interior data.

Note: We calculated the total turnover rate by (1) counting the number of individual OEMM petroleum engineers who separated from OEMM, plus those who changed locations, plus those who changed from the petroleum engineer position to another position within that office; (2) dividing that by the number of individual petroleum engineers employed in each OEMM office from fiscal years 2004 through 2008. For those individuals who changed jobs or locations, we did not determine whether they changed jobs or locations because of a management decision, as opposed to the employees' own decision.

[a]In OEMM's Pacific region, geoscientists handle measurement approvals.

OEMM Inspectors. Inspectors in three of the four district offices we spoke with told us hiring new inspectors has been difficult. Not only does OEMM compete with the private sector, but there is also a long medical testing process for inspectors, which must be passed before inspectors can be hired on a permanent basis. This process can take from four to six months and involves rigorous training to prepare for possible helicopter accidents. This training is considered to be so critical that until inspectors successfully complete the medical testing—which involves being dropped into a tank of water to simulate an accident—they cannot conduct inspections. According to the inspectors we spoke with, a few individuals were unable to pass the medical testing and were, therefore, delayed prior to becoming inspectors. New inspectors who do not pass the test the first time can be delayed for several months until they can pass the test.

Offshore inspectors at OEMM district offices do not have a required, standardized measurement training curriculum. While OEMM inspectors are required to take a minimum of 60 hours of training every 2 years, including courses on safety and other basic issues, they are not required to take specialized training in measurement issues. OEMM officials in each of the four OEMM district offices we reviewed told us that measurement issues are complex, and that new inspectors can take from several months to 18 months, to become proficient at measurement inspections, depending on their level of prior experience and expertise. Some inspectors also told us that there is generally at least one inspector in the district office with more knowledge of measurement issues than the other inspectors and this inspector would be able to assist the others in addressing measurement issues in the field, which is done on an informal basis. In discussions with OEMM inspectors and officials, we were told that inspectors have the option of training in a variety of issues, such as platform operations, drilling, completion, and measurement issues. Furthermore, the inspectors told us that the training provided to new inspectors should depend on their experience. OEMM provides its inspectors with training through either on-the-job training, internal courses, or external courses, such as those offered by the University of Oklahoma's International School of Hydrocarbon Measurement or by private experts. Starting in 2009, one OEMM region, the Gulf of Mexico region, developed an internal measurement training presentation and gave it to inspectors at all district offices in the Gulf of Mexico region. At another OEMM regional office, an official told us that inspectors in their office do not have a standardized curriculum and that external measurement training is offered on an individual basis. Finally, OEMM inspectors told us that the time experienced inspectors spend training new inspectors reduces the amount of time that otherwise would be spent conducting inspections.

In addition, OEMM does not evaluate the extent of new inspectors' knowledge of measurement issues. During our discussions with offshore inspectors, we were told that new OEMM inspectors often have experience as offshore platform operators, which often involves some knowledge of measurement issues. OEMM officials also explained that, until the early 1990s, OEMM measurement inspections in the Gulf of Mexico region were performed by a measurement inspection team, based out of the regional office, of petroleum engineers who review and approve measurement systems. However, OEMM delegated the measurement inspection responsibilities to the district offices in order to cut costs, because the cost of flying to offshore platforms is cheaper and less time-intensive from the various district offices than flying from the regional office. While many of these measurement inspectors continue to be employed in OEMM district offices, OEMM does not formally identify the extent to which inspectors are proficient in measurement or identify what skills, experience, and training are necessary for this proficiency. Without a formal curriculum for measurement issues or a formal plan to ensure that inspectors are proficient in measurement, OEMM's seven district offices are at risk for not having the necessary measurement expertise to identify problems on offshore platforms.

Finally, we conducted an analysis of overall turnover rates for OEMM inspection staff for fiscal years 2004 through 2008 for the four district offices that we reviewed. This data shows that there was an overall turnover rate of between 27 and 44 percent for those 5 years (see table 16). For example, the California district office had an overall rate of 44 percent turnover, based on the four inspectors who left the position over those 5 years; the Lake Jackson, Texas, district office had an overall rate of 27 percent turnover. While turnover among OEMM inspectors generally occurred at lower rates than for BLM offices, offshore inspection staff and supervisors told us that turnover can still have a disruptive impact on their work. Inspectors in one district office told us that they had lost three experienced inspectors in fiscal years 2009 and 2010,[1] due to significant pay differences between private industry and OEMM.

[1]These inspectors were not counted in Table 16 because our method identified these staff as part of the "turnover" count for FY 2009 and FY 2010.

Table 16: Total Turnover Rates for OEMM Inspectors, Fiscal Years 2004–2008

District office	Turnover percentage	Total number of employees in position, FY2004-08	Total employees leaving position, FY2004-08	Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					Average number of employees in position, FY2004-08
				2004	2005	2006	2007	2008	
New Orleans	42	19	8	1 of 13	0 of 13	2 of 13	3 of 14	2 of 13	13
Lake Jackson	27	11	3	0 of 9	0 of 11	2 of 11	0 of 9	1 of 9	10
Lake Charles	41	17	7	2 of 15	0 of 13	0 of 13	1 of 13	4 of 14	14
California	44	9	4	0 of 7	2 of 9	0 of 7	1 of 7	1 of 6	7

Source: GAO analysis of Interior data.

Note: We calculated the total turnover rate by (1) counting the number of individual inspectors who separated from OEMM, plus those who changed locations, plus those who changed from the inspector position to another position within that office; (2) dividing that by the number of individual inspectors employed in each OEMM district office from fiscal years 2004 through 2008. For those individuals who changed jobs or locations, we did not determine whether they changed jobs or locations because of a management decision, as opposed to the employees' own decision.

MMS's Liquid Verification System and Gas Verification System Staff. MMS added about 10 additional staff to work on its Liquid Verification System and Gas Verification System programs in fiscal year 2009, after relocating the Gas Verification System discrepancy resolution function from the OEMM New Orleans office to its MMS Lakewood, Colorado, office. According to a MMS official in charge of the Liquid and Gas Verification systems, the training provided to technicians is specific to their work, which focuses on resolving detected volume discrepancies between reported volumes and the volumes shown on meter statements that MMS' computer system automatically detects. In recent years, the Liquid and Gas Verification systems have detected a number of discrepancies, some of which MMS staff have not yet been able to resolve, creating a backlog. Since MMS added additional staff to the Liquid and Gas Verification systems program, MMS is showing progress in eliminating its backlog of discrepancies and has a goal of eliminating this backlog by mid-2010.

Turnover of Liquid and Gas Verification system program staff for fiscal years 2004 through 2008 remained low, however, staffing levels were low during this period as well, with one person each assigned to the Liquid Verification system and Gas Verification system, respectively. The workload for resolving discrepancies identified by both systems was greater than the staffing levels were able to maintain, and a large backlog of exceptions developed (see table 17).

Table 17: Number of Liquid Verification System (LVS) and Gas Verification System (GVS) analysts, Fiscal Years 2004–2009

Fiscal year	LVS analysts	GVS analysts
2004	1	n/a
2005	1	1
2006	1	1
2007	1	1
2008	2	1
2009	5	9

Source: GAO analysis of Interior data.

Appendix V: Production Verification Tools and Practices Used by Selected States, Companies, and Other Countries

We identified four oil and gas production verification tools and practices used by other states, private companies, and other countries that are not widely employed by Interior, including (1) establishing uncertainty thresholds for oil and gas measurement, (2) using electronic tools to monitor oil and gas production, (3) requiring senior oil and gas company officials to annually attest to the controls for oil and gas measurement, and (4) balancing volumes of oil and gas systemwide.

Some Countries Rely on Established Thresholds for Oil and Gas Measurement Uncertainty at Critical Points to Ensure Measurement is Reasonably Accurate

While Interior has established measurement uncertainty limits for onshore gas, several countries have established standards for both oil and gas, providing greater assurance that oil and gas are accurately measured. Measurement uncertainty is determined through a calculation that incorporates the uncertainty for each component of the measurement system, thereby resulting in an overall uncertainty measurement. These components may include the meter, meter calibration, and sample gathering and analysis, among others. For example, to calculate the measurement uncertainty for gas at a single point, accuracies for the meter device, transducers, calibration, electronic flow computer calculations, and gas sampling are combined to determine the overall uncertainty. So, according to research conducted by Alberta, Canada's regulatory agency, a typical uncertainty calculation for natural gas at a delivery point might look like the following:

Primary measurement device – gas meter uncertainty	= 1.00 %
Secondary device–(transducer) uncertainty	= 0.5 %
Secondary device calibration	= 0.5%
Tertiary device (electronic flow computer) uncertainty	= 0.2 %
Gas Sampling and analysis uncertainty	= 1.5 %
Combined uncertainty [a]	= 1.95 %

[a]The combined uncertainty equals the square root of [(1.0)^2 + (0.5)^2 + (0.5)^2 + (0.2)^2 + (1.5)^2]

Similarly, uncertainty calculations may be applied to oil. To calculate the overall uncertainty for oil, uncertainty data for the oil meter, meter proving uncertainty, and the basic sediment and water determination are combined to determine the overall uncertainty. Our review of selected other regulatory agencies indicate that uncertainty standards have been incorporated into their measurement guidance. Specifically, four of the other entities we reviewed have measurement uncertainty standards (see table 18).

Table 18: Establishment of Uncertainty Standards in Selected Entities' Measurement Guidance

	OEMM	BLM	Alberta	Norway	Labrador/ Nova Scotia	United Kingdom
Gas	No	Yes	Yes	Yes	Yes	Yes
Oil	No	No	Yes	Yes	Yes	Yes

Source: GAO analysis.

As we mentioned, Interior has only established uncertainty standards for onshore gas measurement. This standard was established through Notices to Lessees issued by BLM state offices addressing electronic flow computers issued between 2004 and 2008, though the standard was referenced in both the 1994 and 1998 gas measurement draft regulations. The BLM state policies generally say that, for meters measuring more than 100 thousand cubic feet (mcf) per day on a monthly basis, the electronic flow computer should be installed, operated, and maintained to achieve an overall measurement uncertainty of +/- 3 percent or better. According to a BLM official, BLM arrived at the 3 percent threshold around 1990, when it reasoned that an appropriate threshold would approximate the worst-case conditions allowed for a chart recorder under its gas measurement regulations. Until 2006, however, BLM staff could not easily enforce this requirement because manually calculating uncertainties is technically difficult. It was not until BLM—in conjunction with an independent flow measurement lab—developed an uncertainty calculator that BLM staff were able to more easily calculate gas measurement uncertainties. OEMM has not established uncertainty thresholds for oil or gas and staff acknowledged that they were not entirely comfortable with the application of uncertainty standards at this time. Rather, they rely on operators following regulations that should provide reasonably accurate measurement—though the accuracy is not specifically quantified in any policy or regulation.

Our review of four other regulatory jurisdictions found that they all had established measurement uncertainty standards for both oil and gas. Specifically, Norway; the United Kingdom; and the provinces of Labrador/ Nova Scotia, and Newfoundland, Canada, have adopted a 1 percent measurement uncertainty for gas produced offshore, whereas Alberta, Canada, established a 2 percent measurement uncertainty limit for its onshore gas—1 percentage point lower than BLM's standard for onshore gas. Additionally, each of the other jurisdictions established measurement uncertainty standards for oil—ranging from a low of 0.25 percent for the

United Kingdom and certain Canadian provinces, to a high of 1.00 percent for low volume custody transfer points in Alberta (see table 19).

Table 19: Entities Where Percentage Uncertainty Standards Are Incorporated Into Measurement Guidance

	OEMM - offshore	BLM - onshore	Alberta - onshore	Norway - offshore	Labrador / Nova Scotia / Newfoundland- offshore	United Kingdom - offshore
Gas sales / custody transfer point	N/A	3.00	2.00	1.00	1.00	1.00
Oil sales / custody transfer point – low volume	N/A	N/A	1.00	0.30	0.25	0.25
Oil sales / custody transfer point – high volume	N/A	N/A	0.50	0.30	0.25	N/A

Source: GAO analysis.

According to documents and discussions with regulatory officials in other countries, they adopted measurement uncertainty standards in their countries for several reasons. For example, Norwegian regulators told us that, previously, they approved all measurement designs, which was both time-consuming and costly. In 1991, the regulations were revised so that regulatory officials would not approve, but provide consent to the company-proposed measurement system. To assist industry in determining what types of measurement methods would be sufficient, Norway incorporated uncertainty limits for oil and gas measurement. Alberta's Energy Resources Conservation Board first established uncertainty standards in 1972, when it concluded the need to establish production accuracy standards for pooled oil and gas. The standards have evolved since they were established, but still require that measurement at delivery or sales points meet the highest accuracy standards because volumes determined at those points have a direct impact on royalty determination.

Oil and Gas Companies and Some States Use Electronic Tools to Monitor Oil and Gas Production

Some oil and gas companies and state regulators use electronic tools not widely used by Interior for federal leases including: (1) using integrated software to monitor production in real time, (2) using electronic tools to document inspections in the field, and (3) using similar software packages to facilitate audits between purchasers and sellers.

Oil and Gas Companies Use Integrated Software Tools to Monitor Oil and Gas Production in Real Time

Each of the eight production operators and gas pipeline companies that we spoke with during the course of our review use sophisticated electronic Supervisory Control and Data Administration (SCADA) systems of electronic sensors and computer software to track production and transportation of oil and natural gas. According to these company officials, SCADA systems enable them to monitor the amount of oil and gas produced and transported on a daily, hourly, or an instantaneous basis. In addition, SCADA systems provide the ability to be automatically alerted if there are problems with production, such as an interruption of production or damaged metering equipment.

SCADA systems typically gather information about oil and gas production from electronic sensors in the field that measure oil or gas volumes, such as electronic flow computers on gas meters or special electronic sensors within oil tanks. They then collect and transmit that information through a variety of means, such as direct line of sight radio transmissions or transmissions via a cellular network. These production data are then compiled by computers at production operators' and transporters' offices and compiled by computers. The computers that receive this data can then use software packages to calculate, display, and report the oil and gas volumes that are flowing through various points of measurement.

SCADA systems allow production companies to carry out their production activities more efficiently. For example, onshore wells often produce liquid oil and gas that can be sold in association with underground wastewater, which must be disposed. While the gas is sent down a pipeline, the liquid oil and water are stored in tanks that must be drained periodically by trucks; the trucks then deliver the oil to refineries and the water to wastewater disposal facilities. Without a SCADA monitoring system installed in the oil and wastewater tanks, onshore production companies would not know when their tanks are full enough to be pumped out, otherwise they would need to send trucks to pump the tanks out whether or not they were full—resulting in wasted driving time and additional trips. However, if a SCADA system were installed in oil and wastewater tanks, companies could wait to send trucks until the tanks are full enough to be pumped out.

SCADA systems allow companies to report their oil and gas measurement data more easily. According to company officials we spoke with, software packages are available that can receive and interpret SCADA data, as well as automatically prepare standard reports on oil and gas production and transportation for a variety of time frames—such as daily, monthly, and annually. One software maker we spoke with told us that their systems are capable of producing reports in a variety of electronic formats for use by the entities that receive the reports.

Some States Use Electronic Tools for Inspections and to Collect and Report Production Data

Some of the state governments in our review used software tools to inspect oil and gas wells in their state.[1] For example, 5 of the 10 states that we reviewed told us that their inspectors used software tools on laptop computers to complete their inspections, either for production accountability or for other inspections, such as checking whether the well is producing, or to ensure that environmental damage was not occurring. For example, in New Mexico, inspectors enter data into notebook computers in the field when they perform inspections, using the state's Risk-Based Data Management System (RBDMS).[2] This system minimizes the amount of work required to capture environmental and groundwater inspection data in the field and then uploads that data to other computer systems. According to New Mexico state officials, two BLM field offices have purchased laptops from New Mexico equipped with the RBDMS system in order to evaluate them for use by BLM inspectors.

Finally, all of the states in our review publicly provided production information on the Web for oil and gas production data for wells in their state, including wells producing on state, private, and federal leases. For example, Louisiana's Strategic Online Natural Resources Information System provides geospatial information showing the production of wells by location. The Wyoming Oil and Gas Conservation Commission provides information about oil and production on its Web site,[3] which can be retrieved by searching for individual oil and gas wells, by geographic location, or by the name of the production operator. For more information on the production accountability practices of state governments, see appendix VI.

[1]We interviewed state regulatory officials and reviewed oil and gas measurement regulations for: Alaska, California, Colorado, Kansas, Louisiana, New Mexico, Oklahoma, Texas, Utah, and Wyoming.

[2]RMDMS is software created by the Ground Water Protection Research Foundation, with assistance from the Department of Energy. RBDMS is now used by 20 states and is intended to help state agencies to improve regulatory decision making, make oil and gas information more readily available to industry, increase environmental compliance, and reduce the regulatory barriers to oil and gas production.

[3]The address of the Wyoming Oil and Gas Conservation Commission Web site is http://wogcc.state.wy.us.

Companies Audit One Another More Easily by Using Similar Software Packages

Additionally, oil and gas companies routinely perform audits of measurement systems. This process can be completed more quickly and easily when they use similar software packages and data formats. According to industry officials at six of the eight companies we reviewed, audits of oil and gas companies are a common activity in the oil and gas industry; for example, many contracts between production operators and pipeline transporters include clauses that allow the transfer of data and audits. For example, according to an oil and gas auditor, oil and gas companies audit the transportation pipeline companies that purchase or deliver oil and gas they produce to ensure that the volumes they are producing are accurate. In addition, private companies can also conduct internal audits of their own systems, which provide company management with reasonable assurance that their own measurement and production verification systems are working adequately.

Similar software packages enable many private companies to complete their audits more quickly, according to several of the companies we spoke with. When companies use similar data and analytical tools, then the companies are able to use their software tools to more quickly interpret measurement data. For example, officials from one company told us that similar software tools allow the companies auditing its measurement to share or swap data from meters that measure the same flow—so that the auditing company can easily determine whether there are any problems.

In addition, similar software packages allow the audited company to provide both the edited data that they reported and the “raw,” unedited data. Editing raw meter data for reporting purposes is also a common part of reporting oil and gas measurement because many irregularities are possible in unedited data—such as a temporary electronic failure, interruptions in data due to meter servicing, intermittent production, or other problems. However, it is common for the private companies in our review to make available the raw, unedited data for audit and examination by other companies. Although there can be many different formats for raw data and because there are many different manufacturers of meters and SCADA systems, software packages exist that can interpret different data formats. In addition, one software company official we spoke with told us that meter manufacturers are moving toward a common data format.

Canada's Alberta Province Requires Senior Oil and Gas Company Management to Attest to Internal Controls over Measurement and Reporting, with a Goal of Providing Greater Assurance of Measurement and Reporting Accuracy

Canada's Alberta province Energy Resources Conservation Board (ERCB), the agency that regulates Alberta's oil and gas development, has recently established a requirement that oil and gas operators' senior executives must annually attest to the state of their compliance with ERCB measurement and reporting requirements. According to ERCB's Enhanced Production Audit Program (EPAP) officials, Alberta's Auditor General's 2004 to 2005 annual report raised concerns about ERCB's inability to provide an appropriate level of assurance over the accuracy of oil and gas measurement and the completeness of oil and gas production volumes submitted by operators. According to EPAP officials, up to this time, ERCB had relied on conducting substantive audits for a small number of facilities each year. According to these officials, substantive audits typically include activities such as conducting site visits to inspect the measurement infrastructure, verifying the meter volume calculations, and reviewing operator-reported oil and gas production volumes. According to ERCB staff, these substantive audits are labor intensive and can take up to 4 months to complete. Furthermore, EPAP officials told us that ERCB does not have sufficient staffing levels to audit a representative sample of facilities each year. To respond to the Auditor General's findings, ERCB staff studied various approaches that would: (1) not require significant additional operating funding; (2) lead to increased levels of assurance over ERCB measurement and reporting requirements; and (3) lead to increased levels of compliance through continuous improvement.

ERCB examined several alternatives, including requiring operators to conduct sufficient self-audits, before arriving at the adopted approach, which requires operators' senior executives to submit an annual declaration attesting to the state of their internal controls designed to ensure compliance with ERCB measurement and reporting requirements. During the development of this program, ERCB held at least 16 meetings with oil and gas operator representatives over 8 months to receive input on the EPAP design and on the wording of the new ERCB directive. EPAP officials explained that this approach would lead to both continuous improvement in measurement and reporting accuracy and would not require additional ERCB operating resources. One specific issue EPAP officials expect this approach to address is increasing senior executive involvement with addressing measurement and reporting issues with operators. EPAP officials told us that operator's own production accountants or measurement specialists would regularly identify production or measurement reporting problems, but operators' senior executives would not take corrective actions. EPAP officials said that requiring senior executives to sign a statement attesting to the level of assurance over compliance with ERCB measurement and reporting requirements, similar to the financial requirements included in the Sarbanes-Oxley law, may lead to increased interest from senior executives.

EPAP was to begin the implementation phase in January 2010. This phase is scheduled to end in December 2010, according to EPAP officials. The implementation phase provides time for operators to evaluate their internal controls and to strengthen its controls. Beginning in 2011, ERCB will require that all operators in Alberta submit their annual declaration. The penalty for not submitting a declaration is to be considered a significant noncompliance action. The initial effect of this noncompliance is that the operator will receive more scrutiny from the ERCB and will likely receive more action items as a result. Failure by the operator to respond to action items that arise from this scrutiny can result in the operator's name being published on the ERCB Web site and, eventually, all future applications being submitted by the operator will receive increased levels of review, significantly slowing the approval process. According to ERCB staff, this increased level of review and the publication of the operators' name on the ERCB Web site will have a larger impact on an operator's operations than a financial penalty because delays in approving applications, including drilling permits, directly affect an operator's revenue stream. According to ERCB officials, ERCB will track the performance of EPAP by:

(1) tracking the number of operators who submit their annual declarations;

(2) determining whether field inspectors find more or fewer noncompliances at facilities;

(3) determining whether or not operator data accuracy and completeness improve over time;

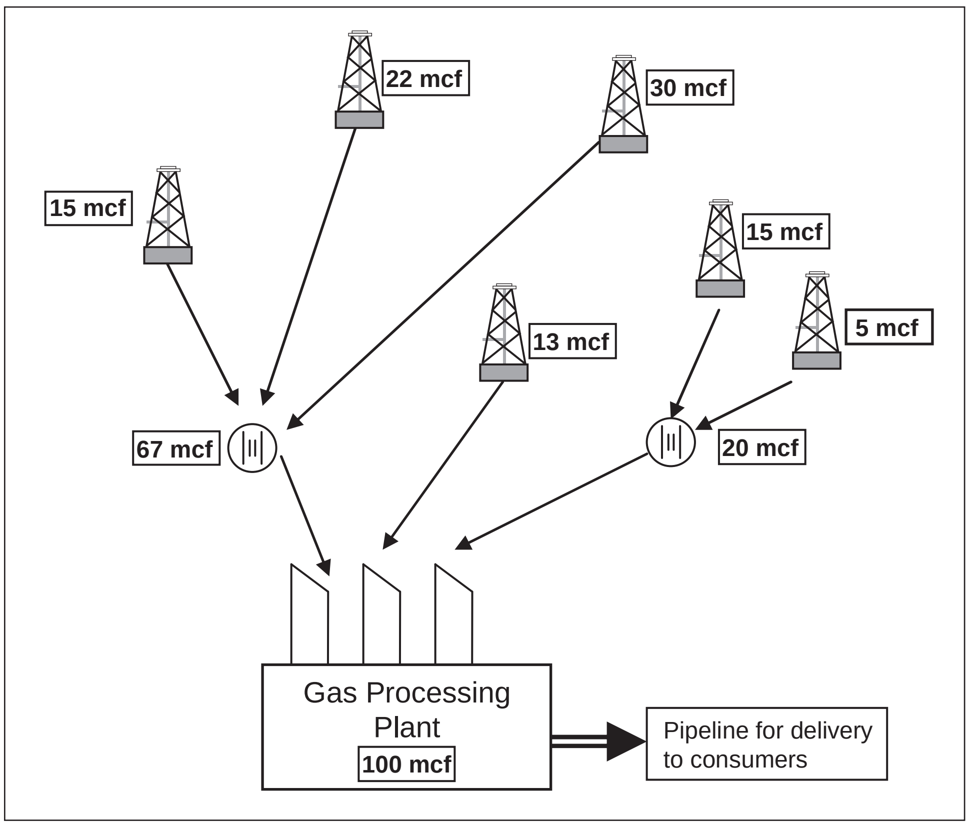
(4) determining whether the number of operator voluntary self-disclosures increase or decrease over time; and

(5) determining whether the number of action items increase or decrease over time.

Many Entities Rely on Volume Balancing to Verify Production

Verifying oil and gas volumes through volume balancing is a commonly used practice employed by many entities, including private oil and gas companies, foreign countries, and some state and federal entities. Volume balancing involves totaling the volumes of oil and gas produced from a variety of upstream meters and, then, comparing that total to the volume measured at a downstream meter. An illustration of system balancing is shown below (see fig. 11).

Figure 11: Volume Balancing Diagram Illustrating Gas Volumes Entering and Leaving a System



Source: GAO.

Private Companies Use Balancing to Manage Their Everyday Operations

Many private oil and gas companies use volume balancing to manage their everyday operations. For example, pipeline transportation companies use oil and gas balancing routinely to help manage their pipeline networks, enabling them to know how much gas they are transporting at any time and giving them the ability to detect leaks and other problems. According to officials at the pipeline companies we spoke with, balancing can be done on a daily, hourly, or other basis; and they are generally able to balance volumes within 1 to 2 percent. SCADA systems also assist private pipeline companies in balancing their volumes.

Balancing also enables companies to use larger gas meters with greater accuracy to balance the volumes of smaller gas meters with less accuracy. According to officials at Interior and at private companies, smaller gas meters closer to the well head are usually more likely to have greater uncertainty because well head flow may be intermittent, they may operate at lower pressures, or liquids may be present in the gas stream, among other reasons. However, larger meters further downstream of the well heads, which measure gas from several streams at one time, are generally more accurate because flow is less intermittent at higher pressures, and because liquids are more likely to be separated out by separation equipment, which is more economical to install further downstream. The greater accuracy of meters downstream was noted by a BLM official, who told us that gas meters closer to the well head generally measure 1 or 2 percent less gas volume than meters downstream.

Volume Balancing Is Used for Production Verification by Foreign Governments and Private Companies

Foreign countries and private companies also use volume balancing to track and verify production. Specifically, representatives we spoke with from the United Kingdom and Canada told us that they compare reports from local natural gas pipeline companies against reports from the larger pipeline companies that deliver the gas to consumers. According to officials from the Canadian province of Alberta, their ability to access information from several different gas producers and private pipeline transportation companies allow them to perform balancing. A United Kingdom official told us that their Department of Energy and Climate Change compares oil and gas balances monthly in order to find discrepancies. The official noted that it was typical to find that more liquid oil is measured on well head meters than in the larger meters that gather production from several oil wells; they noted that the opposite was true for natural gas, where offshore meters generally measure less gas than is measured by larger meters downstream, usually by a factor of 1 percent or less.

Interior Offshore and Some State Governments Conduct Volume Balancing on a Limited Basis

In the United States, Interior conducts one activity for commingled offshore oil and gas that amounts to a limited form of volume balancing. State government officials in three states told us that they incorporate some balancing activities into their audits. OEMM requires offshore producers who are commingling their production with state oil and gas production to report their production separately in a production allocation schedule report. This report enables OEMM to compare the volumes that are reported by individual leases against the total production of all leases reported by the operators. In addition, four U.S. state governments we reviewed also perform volume balancing during audits for commingled leases. Generally, state officials told us that they do not perform "field-wide" balancing of oil and gas systems on a regular basis.

Appendix VI: Production Verification and Accountability Practices of Selected States as Reported by State Officials

We reviewed the production verification practices of the 10 states where the most oil and gas is produced on state, federal, and private lands; we found that these states use some of the same production verification practices as the federal government does offshore and onshore. For example, 5 of the 10 states regularly inspected oil and gas meters for measurement issues, but of those that do, they generally employ fewer inspectors than the federal government. However, states do engage in practices that the federal government does not; for example, 5 of the states that we reviewed equipped inspectors with electronic devices in the field; 2 of these states also provided wireless access to these inspectors. Table 20 presents a summary of information reported by state officials and documents regarding their states' production verification practices.

Table 20: Summary of Production Verification Practices in 10 States as Reported by State Officials

	Alaska	California	Colorado	Kansas	Louisiana	New Mexico	Oklahoma	Texas	Utah	Wyoming
Number of state agencies that oversee oil and gas measurement	2	1	2	2	2	2	2	2	3	3
Point of measurement										
Policies require operators to report location of royalty meters	Yes	No	No	[a]	Yes	No	Yes	No	No	No
Inspections										
Inspectors regularly inspect meters and site security	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes
Inspectors regularly witness tank gauging	N/A	Yes	Yes	No	No	No	No	Yes	No	No
Inspectors regularly witness meter calibrations	Yes	Yes	Yes	No	No	No	No	Yes	No	No
Inspectors regularly inspect orifice plates in gas meters	Yes	Yes	Yes	No	No	No	No	Yes	No	No
Inspectors regularly inspect oil quality sampling (grind out)	Yes	Yes	Yes	No	No	No	No	Yes	No	No
Number of regular measurement inspectors (full-time equivalent)	5	1.2	1	0	0	0	0	8	0	4
Approximate number of wells or meters examined per year by State	2,000	250	30-40	[a]	1-2	0	0	3,000	200	420

	Alaska	California	Colorado	Kansas	Louisiana	New Mexico	Oklahoma	Texas	Utah	Wyoming
Inspectors use computer laptops or other handheld electronic devices in the field	Yes	No	No	Yes[b]	No	Yes[b]	No	Yes	No	Yes
Inspectors have wireless electronic data access in the field	No	No	No	Yes[b]	No	Yes[b]	No	Yes	N/A	No
Agencies collect real-time production data of oil and gas production or gathering	No	No	No	No	No	No	No	No	No	No
Comparison of production reports and royalty payment records	Yes	Yes	Yes	[a]	No	Yes	No	Yes	Yes	Yes
Volume measurement standards										
Electronic flow computers referenced by regulation	Yes	No	Yes	No	No	No	Yes	No	No	No
Most recent year of most recent API standards cited for oil meters	1998	1960	2005	N/A	2004	N/A	N/A	2007	N/A	2004
Most recent year of most recent API standards cited for gas meters	1998	c.1950	2007	N/A	1936	N/A	2006	N/A	None	N/A

Source: GAO and state regulatory officials.

[a]This information was not provided by the state officials we spoke with.

[b]Kansas and New Mexico inspection staff do not regularly conduct measurement inspections; however, their health and safety inspectors use computer laptops and remote data in the field.

Appendix VII: GAO Contacts and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, Jon Ludwigson, Assistant Director; Lee Carroll; Melinda Cordero; Nancy Crothers; Glenn C. Fischer; Cindy Gilbert; and Barbara Timmerman made key contributions to this report. Also contributing to this report were Maria Vargas and Muriel Forster.

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