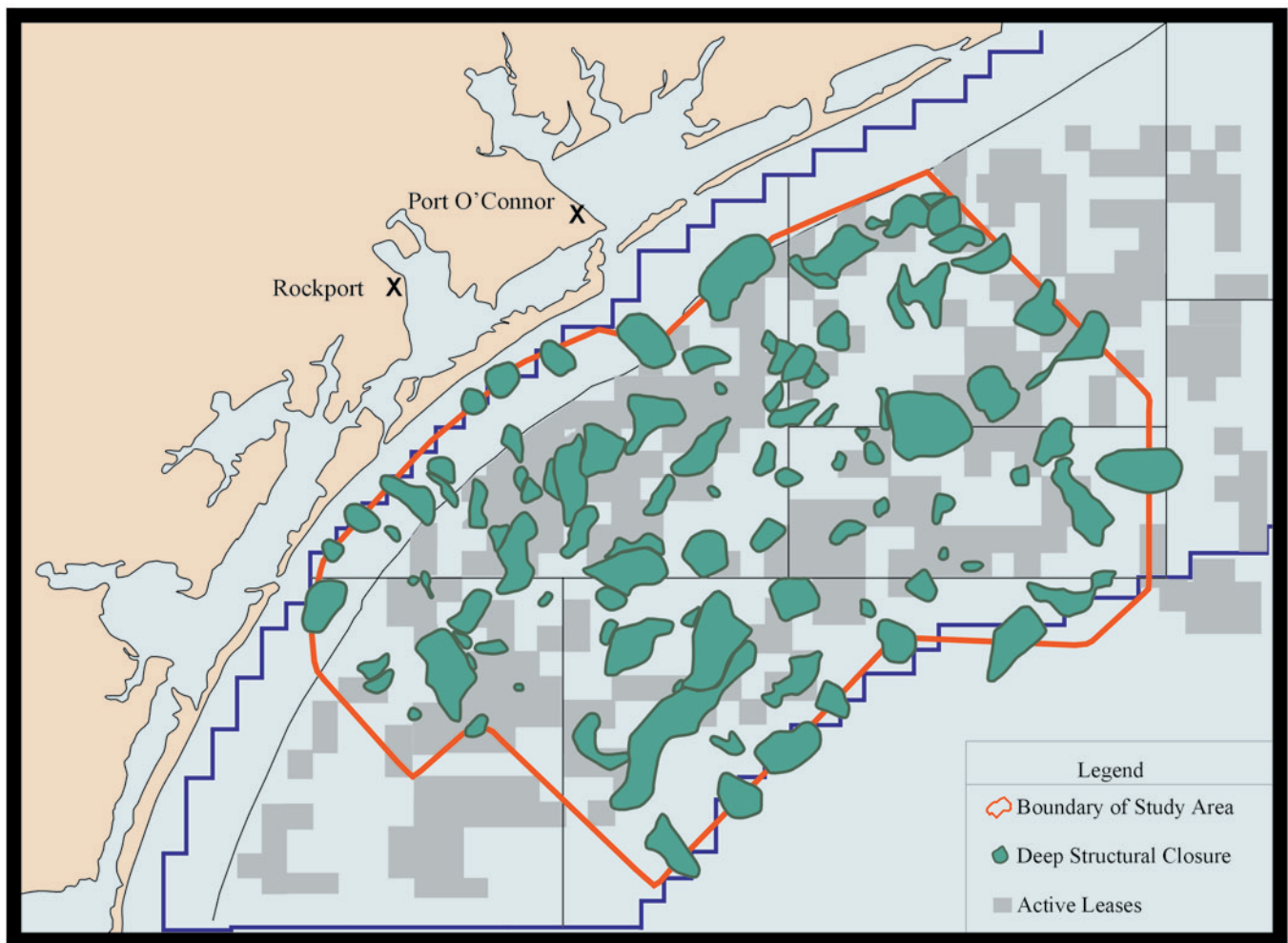


The Promise of Deep Gas in the Gulf of Mexico



The Promise

As the Nation continues to face increased demand for environmentally safe, clean energy resources, there are increasing calls to look for resources in places that have not been as economic or as attractive in the past. One of these areas is the potential for deep gas on the Gulf of Mexico continental shelf.

This offshore province has been rigorously explored, especially the shallow-water area. However, sediments located at depths greater than 15,000 feet below sea level (subsea) and in less than 200 meters (656 feet) water depth on the Gulf of Mexico Outer Continental Shelf (OCS) are relatively unexplored. Only 5 percent of all wells drilled on the OCS have penetrated sediments below 15,000 feet subsea. Yet, the Minerals Management Service (MMS) estimates there could be 5 to 20 Tcf, with the most likely value at 10.5 Tcf of deep gas recoverable resources below this depth. To get at these resources successfully will require some special resources. In order to achieve economic success, deep wells require larger structures (which means higher resources) and there must be the potential for higher flow rates to compensate for higher drilling costs.

The MMS is committed to working with offshore operators to explore and develop the undiscovered, recoverable deep gas resources on the OCS. MMS has already offered incentives in the form of royalty relief on deep gas production from new OCS leases issued in Sale 178 (March 2001), and is considering various options for offering incentives to explore and produce deep gas from OCS blocks that have been leased in previous sales.

New discoveries of deep gas on the OCS offer the best short-term opportunity for achieving the large reserve additions and necessary high flow rates to offset declining gas production, which has been falling since 1997. Recent deep gas discoveries on the OCS have shown these new completions can produce as much 20 to 80 million cubic feet per day (MMcfd). The abundance of platforms, producing facilities, and pipelines on the shelf will allow new deep gas production to flow quickly to the market to help meet increasing U.S. demand for gas.

Background on U. S. Gas Demand

America's demand for natural gas has shown no sign of slowing. According to forecasts by various organizations, consumption of natural gas in the U.S. is expected to rise from about 22 Tcf in 1999 to more than 30 Tcf in 2015. The Energy Information Administration (EIA) of the Department of Energy, the Gas Research Institute (GRI), the National Petroleum Council (NPC), and the American Gas Association (AGA) have each forecasted increases in U.S. gas demand in the range of 1.5 to 2.5 percent annually from 1999 through 2015.

Natural gas is essentially a North American commodity. This means that, because of the nature of gas, demand must be met by U.S. production and increased imports from nearby areas such as Canada. Smaller volumes can be imported as liquefied natural gas (LNG). Production from the Federal waters of the Gulf of Mexico supplies about 23 per cent of domestic gas production. According to forecasts for increased gas demand, the Federal waters of the Gulf of Mexico will have to contribute from 6.5 to 7.5 Tcf of gas production per year by 2015, compared with the estimated 5.0 Tcf currently produced each year.

Natural gas supplies about 24 per cent of total U.S. energy consumption. The various forecasts for increased natural gas consumption are caused primarily by the strong growth in the U.S. economy and a public preference for the cleanest of fuels (natural gas) to produce electric power. Demand will grow in all sectors, including for electric power generation and for industrial, residential, and commercial uses. Almost half the demand growth will come from electric power generation, as electric utilities add gas-fired power generation capability as quickly as possible to meet the growing demand and to replace aging coal and nuclear plants.

Deep Gas Resource Assessment

The MMS estimates that the potential of undiscovered resources for deep

gas (more than 15,000 feet below sea level) in the Gulf of Mexico OCS is approximately 5 to 20 trillion cubic feet (Tcf), with the most likely value estimated at 10.5 Tcf. Of this estimated undiscovered resource of 10.5 Tcf, the deep gas potential under existing leases in the OCS is estimated at about 6.3 Tcf, with another 4.2 Tcf to be found under blocks not currently leased. (This last figure does not include blocks leased as a result of Sale 178.)

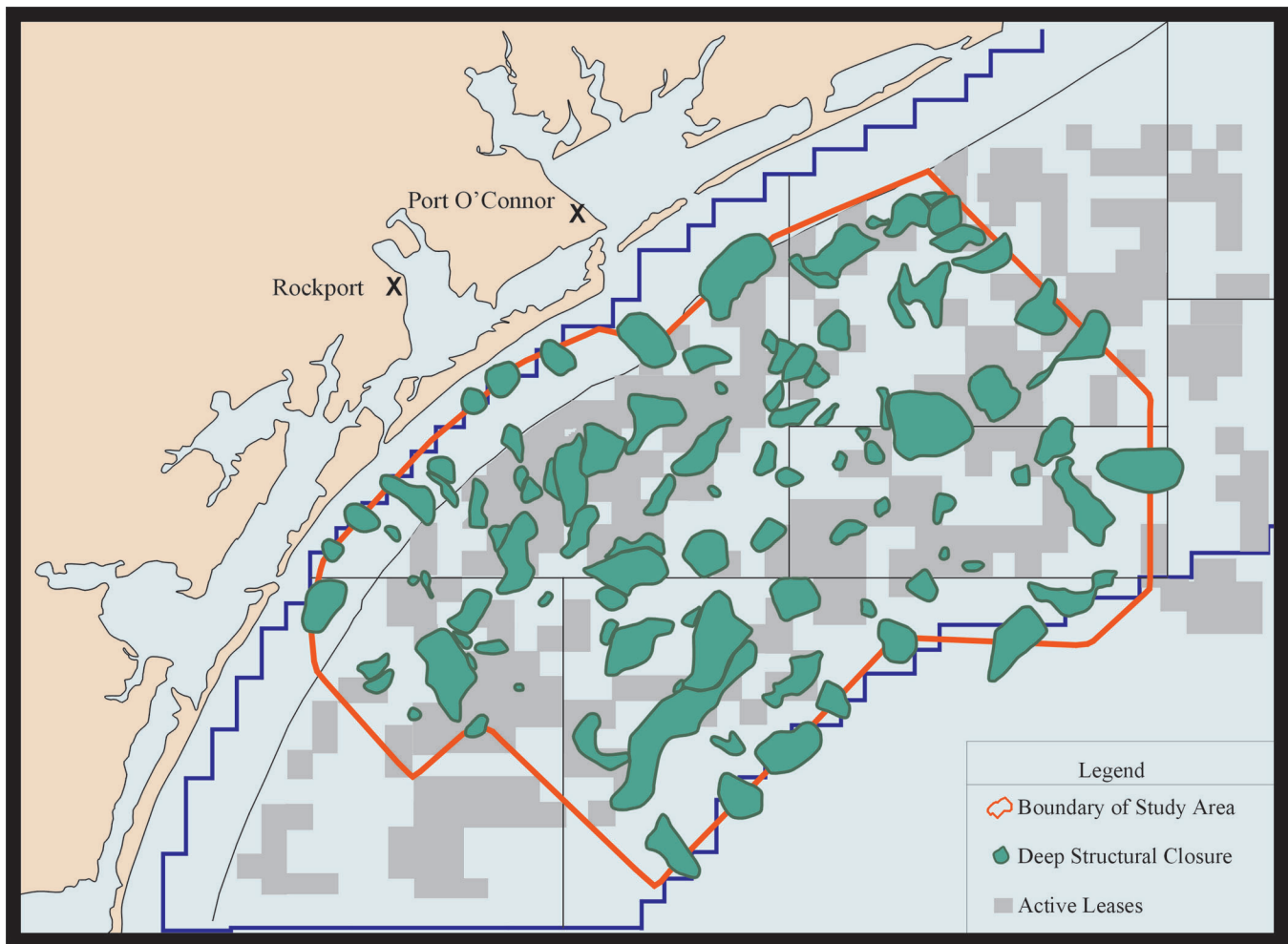
Deep gas may be found across all areas of the Gulf of Mexico, including the Western, Central, and Eastern Gulf. Maps included in this report show areas of possible deep gas near the shoreline in both the Western and Central Gulf of Mexico. Potential deep gas resources also exist out to the edge of the continental shelf, where some of that potential is located under thick sheets of salt (subsalt).

Deep OCS Drilling and Discoveries

Deeply buried sediments on the OCS are relatively unexplored. Out of 35,000 wells drilled on the OCS, there are only 1,842 wells drilled deeper than 15,000 feet subsea. These deep wells discovered 503 reservoirs below 15,000 feet subsea, having an estimated 10 Tcf of recoverable gas resources. The average discovery size of a deep gas reservoir was about 20 billion cubic feet (Bcf).

Some areas are much more likely to have large deep gas reserves than others. Approximately 2.5 Tcf of the 10 Tcf discovered was found in 24 reservoirs in the highly productive Norphlet trend, with an average discovery size of 105 Bcf per reservoir. In the remaining 479 reservoirs discovered outside of the Norphlet trend area, 7.5 Tcf was found, with an average discovery size of 15.7 Bcf per deep gas reservoir. Most of these reservoirs were uneconomic to drill and produce at the prices of the time, \$2 to \$3 per million Btu (Mmbtu), but nevertheless were produced, probably to meet long-term gas contracts.

Most of the large economic discoveries, including the Norphlet trend



Western Gulf of Mexico Deep Structure

discoveries, were deep structures drilled in the 1980's using two-dimensional (2-D) seismic data. Although the Norphlet trend is the most prolific deep gas producing area on the OCS, the amount of gas discovered per reservoir has declined and the number of wells drilled to discover each reservoir has increased since the five-year period 1985-1989. Outside the Norphlet trend, there have been 25 wells drilled greater than 20,000 feet on the OCS, with no economic discoveries found at depths greater than 20,000 feet.

Deep Gas Production Expected 2001 to 2006

The main goal of MMS's deep gas initiative is to increase the volume of

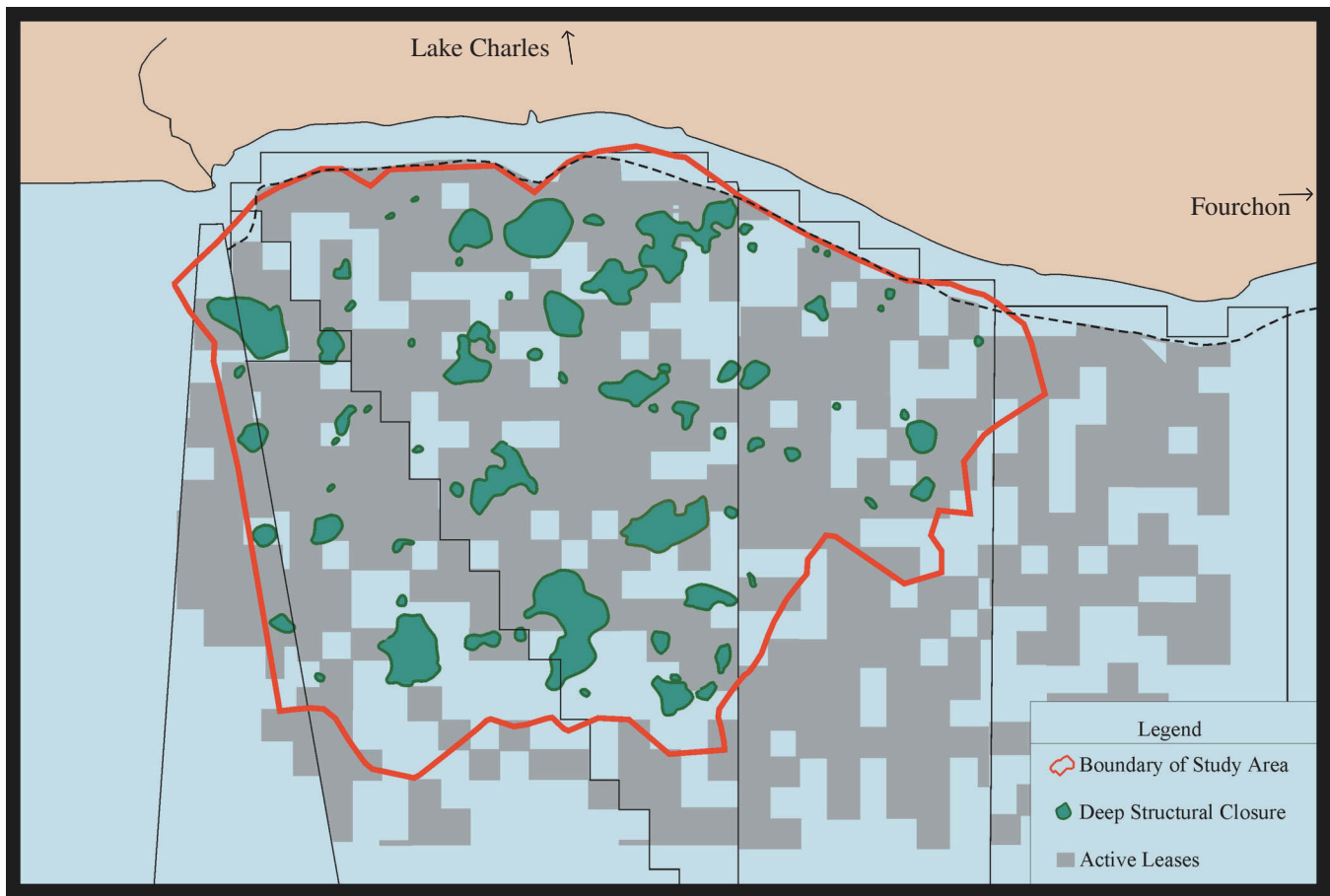
gas production from the OCS during the period 2001 through 2006. OCS gas production has been declining since 1997. Gas produced from the development of the largest undeveloped Gulf of Mexico deepwater fields, Alaska, and Canada is not expected to contribute significant enough increases in gas production to meet U.S. demand until after 2006. So, the time it takes for new production to come on line is a major reason the MMS is considering granting royalty relief for deep gas production on the OCS.

Thus, the deep gas initiative is designed to slow the rate of decline in OCS gas production through 2006-2007. For this reason, under terms of the initiative, deep gas production must begin within the initial 5-year primary term, or no later than 2006, in order

to receive royalty relief from leases awarded in Sale 178.

High-Rate Wells

New discoveries of deep gas on the OCS offer the best short-term opportunity for production increases to offset declining gas production from the shelf. For example, one deep gas well placed on production in the Western Gulf of Mexico OCS in 1999 produced at more than 65 million cubic feet per day for 32 days before problems with the completion caused the well to be shut in and abandoned. The operator of this high-rate well reported a flow rate of 84 million cubic feet per day. Another deep gas, below-salt discovery in the Central Gulf of Mexico OCS has been producing 80 million cubic



Central Gulf of Mexico Deep Structure
(Prior to Lease Sale 178)

feet per day from two combined gas completions this year, according to the operator. There is every reason to be optimistic that new, deep gas discoveries will be made as the result of this initiative. These discoveries will help America meet its need for dependable, clean-burning energy sources.

Logic of Relief Related to Difficult HP/HT Wells

Royalty suspension volumes for deep gas production are intended to help offset the high cost and high risk associated with drilling deep wells on the OCS. The royalty value of 20 billion cubic feet (Bcf) of gas at 1/6 royalty and \$3.50/MMBtu is approximately \$11.7 million. This value represents the low end of the estimated \$9- to \$23 million it costs to drill a deep well on the OCS.

Why are deep gas wells so expensive? Wells drilled greater than 15,000 feet subsea are much more expensive than shallow wells because of high pressure and high temperature conditions. Pressure increases with depth because of the overburden of sediments above and the amount of water trapped within the sediments. Temperature also increases with depth and can be even higher in areas with less salt intrusion into the sediments. The presence of salt has a cooling effect on the surrounding sediments, causing areas with salt intrusion to have lower temperatures. However, drilling around salt presents other problems, such as lost circulation of drilling mud systems, especially during drilling through salt to reach prospective targets. In addition to high pressure and high temperatures, corrosives such as carbon dioxide (CO₂) and hydrogen sulfide (H₂S) found with fluids in sediments can significantly

increase the cost of drilling deep wells.

Consideration of Deep Gas Royalty Relief for Existing Shelf Leases

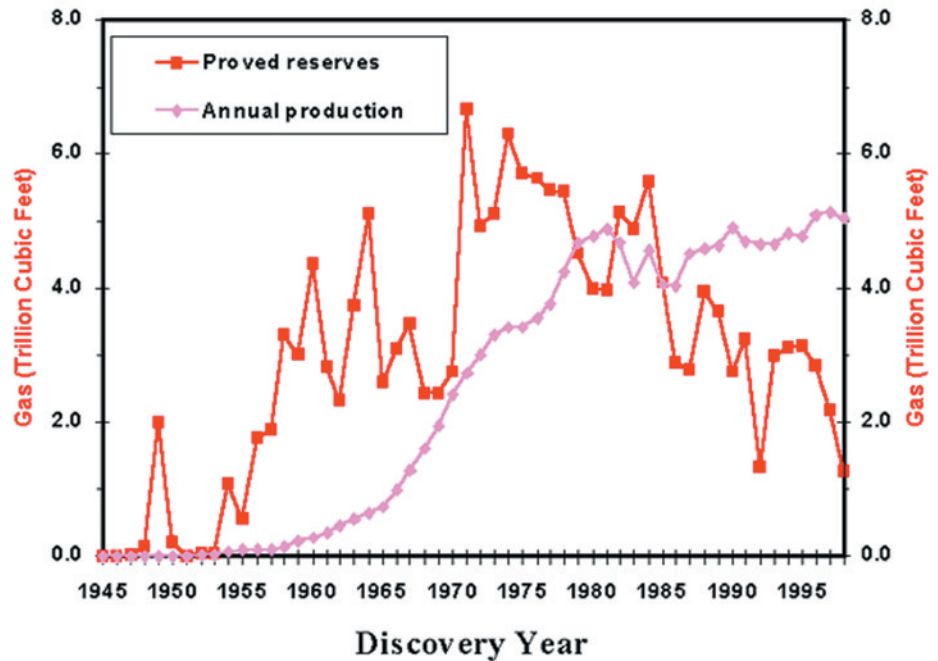
The MMS is considering various options regarding deep gas royalty relief on existing leases in less than 200 meters water depth. Existing shallow-water leases provide U.S. consumers and Gulf of Mexico operators the fastest opportunity for producing deep gas because the platforms, production facilities, and pipelines are already installed on the OCS. Any deep gas royalty relief offered for existing leases would probably require the operators to begin production within a specific period. This period could be similar to the primary term (5 years) for new leases.

The Future

A review of MMS Gulf of Mexico Region proved gas reserve additions by reservoir discovery year and annual gas production shows an ominous declining trend for gas. Annual gas production from Federal waters of the Gulf of Mexico has exceeded additions to proved gas reserves every year since 1984, causing a decreasing trend in remaining proved gas reserves. Proved gas reserve additions by reservoir discovery year have declined since the early 1970's. Approximately 78 percent of total gas production from Federal waters of the Gulf of Mexico was produced from less than 200 meters water depth in 1999. New discoveries in deepwater may eventually change this downward trend, but deepwater reserves have longer lead times for development, and America needs new gas discoveries as soon as possible.

The MMS is just now at the early stages of developing incentives to produce deep gas from the shallow water of the Gulf of Mexico. These efforts hold the promise to potentially accelerate near-term (pre-2006) gas production for the benefit of the entire Nation.

**Proved Gas Reserves and Production
Gulf of Mexico OCS**



Sale 178 Deep Gas Royalty Relief

(This is the text of Sale 178 royalty relief stipulation)

The purpose for the proposed deep well gas royalty relief is to encourage operators to explore and develop deep well gas reservoirs in the Gulf of Mexico Outer Continental Shelf (OCS) quickly in order to meet the challenges of the Nation's growing natural gas demand.

The following provisions apply to Royalty Suspension for Shallow Water Deep Gas Production:

1. A lease in less than 200 meters of water where a new deep gas reservoir (15,000 feet or greater subsea) is drilled and commences production within the first 5 years of the life of the leases (does not include lease extensions due to the granting of a suspension) will receive a royalty suspension on the first 20 billion cubic feet of its deep gas production. Deep gas is defined as any gas production from a completion with the top of perforated interval 15,000 feet or greater subsea (true vertical depth below the datum at mean sea level). You must notify the Regional Supervisor,

Office for Production and Development, Gulf of Mexico OCS Region in writing upon the commencement of such deep gas production.

2. Liquid hydrocarbons (oil and condensate) that exist in liquid form at standard conditions after passing through separating facilities will be subject to royalty payments.

3. The lease will receive the royalty suspension even if the field to which it is assigned by MMS is producing.

4. Any volumes of deep gas production that are not normally royalty-bearing under the lease or regulations (e.g., fuel gas) do not count against royalty suspension volumes.

5. The royalty suspension will continue through the end of the month in which cumulative production from the lease reaches the applicable royalty suspension volume or the lease period ends.

6. The lessee(s) must pay the rental fee at the

end of each calendar year during the period of royalty suspension. A rental fee is not due if the royalty payment for other lease production exceeds the rental amount.

7. The lessee(s) must pay royalty on natural gas production that would otherwise receive royalty suspension under the following conditions:

- a) In any calendar year during which the arithmetic average of the closing prices for the nearby delivery month on the NYMEX for natural gas exceeds \$3.50 per million British thermal units (threshold gas price).

- b) This price for natural gas is an annual average for 2000 and must be adjusted for subsequent calendar years by the percentage by which the implicit price deflator for the gross domestic product changed during the preceding calendar year.

- c) Production under this paragraph counts toward the royalty suspension volume.

