

## Technically Recoverable Resource

Technically recoverable resource is the volume of petroleum which is recoverable using current exploration and production technology without regard to cost, which is a proportion of the estimated in-place resource. Oil recovery factor is the percent of in-place oil resource which can be technically recovered, without regard to cost.

The USGS Open File Report 98-34 values are used as the baseline estimates for our drilling proposal's values. Our drilling proposal is for oil resource in the undeformed region of 1002 only. The oil values for the undeformed region, from the 1998 USGS assessment, yield the following oil recovery factors.

<b>Undeformed Region Oil volumes by Probability Fractiles</b>				
	Mean	95	50	5
In Place Oil (MMBO)	17483	9428	16880	27435
Tech. Recov. Oil (MMBO)	6420	3403	6186	10224
Oil Recovery Factor (%)	36.72	36.09	36.65	37.27

These oil recovery factors are slightly less than the recovery factors for the entire 1002 area, which has a mean recovery factor of 37.1%. In 1998, the oil recovery factor for the undeformed region was 36.7%.

### **Changes in Technically Recoverable Resource Over Time Due To Improvements In Technology**

Technically recoverable resource analysis assumes that technological improvements will be made to exploration and production technology over time, resulting in increased technically recoverable resource. Current technological improvements include 4D time-lapse seismic surveys, 4C multi-component seismic imaging, directional and multilateral drilling, logging tools for more accurate well placement, thermal enhanced recovery by steam injection and in situ combustion, and many forms of chemically enhanced oil recovery by polymer addition. These methods add between 5-15% to the oil recovery factor.

The trend for increasing technically recoverable resource over time is an average annual increase factor. Studies have been done by the National Petroleum Council (NPC) and DOE Energy Information Administration (EIA) which include data on this research. From the 1999 NPC study, there is an annual technically recoverable resource increase of 1.3-1.5% due to improvements in technology.

The Statfjord and Gullfaks oilfields in the Norwegian North Sea, however, have different trends for increase in oil recovery.

<b>Increase in Oil Recovery Factor over Time</b>				
	1986	1996	2000	Increase/year
Statfjord	49.4%	61.4%	65.6%	About 2.05%
Gullfaks	46.5%	49.4%	54.5%	About 1.15%

Sources: <http://www.mafhoum.com/press4/117T41.htm>  
[http://www.statoil.com/fin/nr303094.nsf/Attachments/gullfaks.pdf/\\$FILE/gullfaks.pdf](http://www.statoil.com/fin/nr303094.nsf/Attachments/gullfaks.pdf/$FILE/gullfaks.pdf)

These oilfields respond differently to improvements in technology with respect to oil recovery factor. Data from all of these different trends, combined by taking the average of the rates of increase, yields a technically recoverable resource annual rate of increase of 1.53% per year.

### Changes in Technically Recoverable Resource Due To Water Saturation

Water flooding is one of our proposal's most important methods of enhanced oil recovery. To minimize environmental damage, water used for reservoir flooding must either come from the saturated water content of the reservoir, or must be shipped in to the site by vehicles. The water saturation percent for the entire 1002 area and the undeformed region are given in the table below.

<b>Water Saturation (%) @ Fractile 50 (1:2 Probability)</b>		
Play	Entire 1002	Undeformed Region
Topset	20	20
Turbidite	33.3	33.3
Wedge	22.2	22.2
Thomson	33.3	33.3
Kemik	37.5	37.5
Undeformed Franklinian	14.3	14.3
<i>Deformed Franklinian</i>	14.3	
<i>Thin-Skinned Thrust-Belt</i>	40	
<i>Ellesmerian Thrust-Belt</i>	31.8	
<i>Niguanak-Aurora two-dome</i>	25	
Averages	27.17	26.77

There is slightly less average water content in the undeformed region than there is in 1002. This fact, however, is already taken into account in the slightly lower oil recovery factors for the undeformed region than for the entire 1002.

Reservoir flooding for enhanced oil recovery is used to a large extent in our proposal. Therefore, the effect of percent water saturation on our technically recoverable resource will be significantly different than for the USGS report's technically recoverable values. The limited volume of available water will increase the cost of reservoir flooding. But since cost is no object, as much water can be shipped in as necessary. Water saturation values, therefore, do not affect our oil recoverability factor, but do affect the economically recoverable values.

## Results

Technically recoverable resource depends on improvements in E & P technology over time. The USGS report's recovery factors were made without regard to cost. So the current technically recoverable resource is given by the USGS oil recovery factor for the undeformed region, adjusted for improvements in E & P over time. The mean undeformed region oil recovery factor: 36.72%. The increase in technically recoverable resource per year: 1.53%. The current oil recovery factor is then

$$.3672*(1.0153)^{(2003-1998)} = .3962 = 40\%$$

The technically recoverable resources are:

<b>Tech. Recov. Undeformed Region Oil Resource for 2003</b>				
	Mean	95	50	5
In Place Oil (MMBO)	17483	9428	16880	27435
Oil Recovery Factor (%)	40	40	40	40
Tech. Recov. Oil (MMBO)	6993	3771	6752	10974

There is a mean technically recoverable oil resource of 6993 million barrels of oil in the undeformed region, which is an 8% increase from the 1998 assessment.