**CHAPTER 3**

# EFFORTS OF OIL TOWARDS HYDROCARBON RESERVE ACCRETION

In order to determine how far OIL is effective in achieving its objective of hydrocarbon reserve accretion[11], audit reviewed reserve estimation process, efficiency in reserve accretion, success of OIL in hydrocarbon discoveries among the similar onshore upstream oil companies, monetization of discoveries and its efficiency in replacing production through RRR.

## 3.1 Reserve Estimation and Accretion

OIL initiated its first annual reserves estimation in the year 1956 through M/s Degolyer & MacNaughton, a consultant. The work of reserves estimation was conducted through in-house team of OIL from 1966. The estimation of reserve is carried out by incorporating the evidence gathered from various exploration and development activities, viz. drilling, work-over testing results, geological and engineering reviews, and pressure production behavior etc. of the reservoirs.

The historical perspective of oil and gas reserves under different estimation methods viz., 1P[12], 2P[13] and 3P[14] categories of OIL for the period from 2009-10 to 2013-14 are given in table 3.1 and figure 3.1 and 3.2:

**Table 3.1 - Oil and Gas reserves of OIL**

| Category of estimation method | Type of Reserves | Year | | | | |
|---|---|---|---|---|---|---|
| | | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
| 1P | Oil Reserves (MMSKL) | 44.8 | 44.5 | 43.6 | 41.4 | 38.9 |
| 2P | | 92.1 | 92.8 | 95.4 | 95.1 | 97.3 |
| 3P | | 145.4 | 137.9 | 139.7 | 135.1 | 138 |
| 1P | Gas Reserves (BCM) | 36 | 33.9 | 30 | 27.3 | 24.6 |
| 2P | | 56.2 | 53.7 | 50.7 | 47.3 | 45.18 |
| 3P | | 76.5 | 74 | 71.1 | 67.7 | 66.36 |

[11] Addition to recoverable hydrocarbon reserves
[12] equivalent to proved reserves
[13] equivalent to sum of proved plus probable reserves
[14] equivalent to the sum of proved plus probable plus possible reserves

Source: Reserve Appraisal Note

**Figure 3.1 - Oil Reserve**

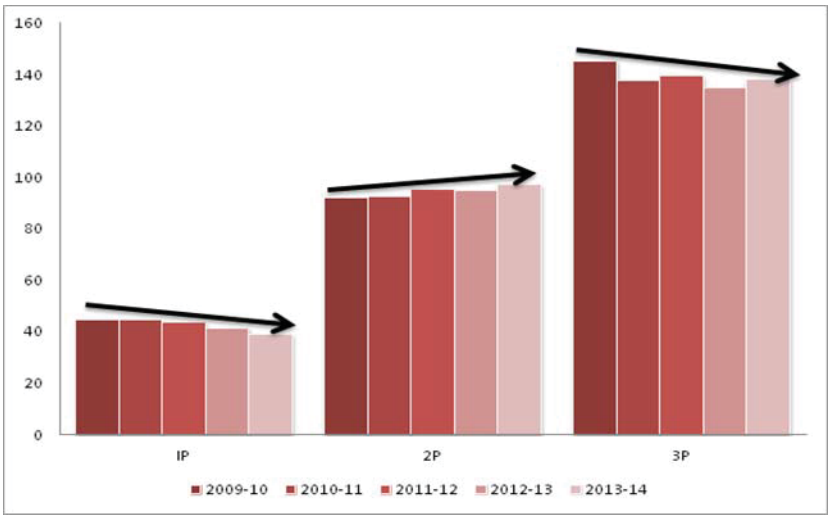
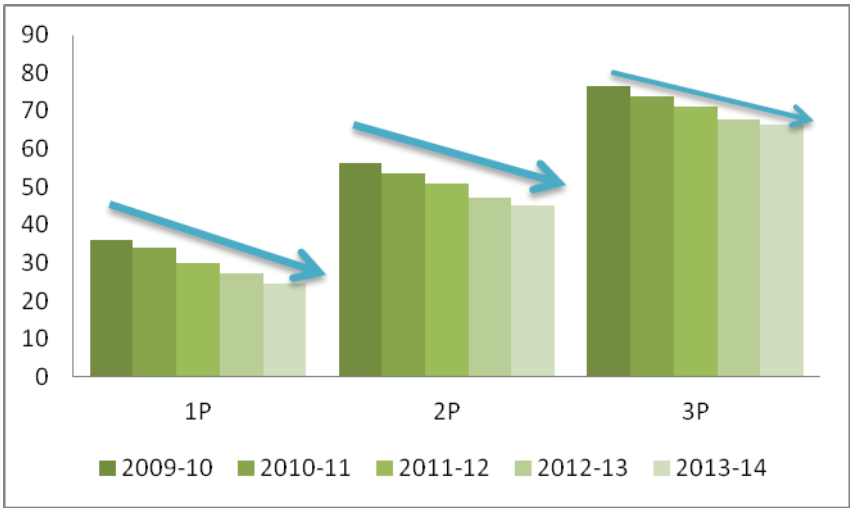



**Figure 3.2 - Gas Reserve**




Audit observed that:

- While oil reserves under 2P category increased, it decreased under 1P (i.e. proved) category. Hence net increase of reserves was only under probable category. The increase in 2P category can be attributed to geological and engineering reviews based on field development activities;
- Oil reserves under 3P (i.e. possible) category decreased indicating non-addition of new fields through exploration activities;

- Gas reserves under all the categories declined from 2009-10 to 2013-14. OIL stated in its Reserve Appraisal Note for the year 2013-14 that a decline in gas reserve trend was seen from 2008-09 onwards as no major MOU/Gas sale contract was signed in recent years.
- Although OIL had been producing gas from its Digboi and Kumchai fields, the same had to be flared and not considered in the reserve estimation in the absence of any contract for supply of such gas,

Hence, OIL underperformed in proving of reserves which is necessary for future sustainable development of hydrocarbon sector, as evident from declining trend in 1P category since 1P reflects proved reserves of hydrocarbon.

While accepting the audit contention, OIL stated (April 2015) that non-increase of 1P reserve was due to depletion of reserve on account of production and non-commensurate upgradation from existing lower category reserves. Similarly, lack of significant increase in 3P reserves indicated non-commensurate upgradation to probable category and new reserve accretion through exploration. Increase in 2P category was due to upgradaton of possible category to probable category reserve due to higher confidence through testing. Further, the gas sale agreement at Rajasthan was valid upto 31 March 2015 and action was in progress for renewal of the same. As regards flaring of gas, produced from EPA Digboi, the same was taking place mainly at Baghjan and Makum, out of which the major gas flaring was from Baghjan. OIL was laying a 16 inches gas pipeline from Baghjan to Duliajan for gas evacuation and installation of booster compressor at Hapjan, which was in progress. Gas produced from Kumchai field was largely flared for non-availability of customers. OIL was planning to set up Kumchai power plant project of 5 to 10 MW capacity to utilize the Kumchai Gas.

The fact remains that being a major NOC; OIL should have built necessary capability to ensure commensurate upgradation from 3P to 2P and 2P to 1P. Adding newer fields should be a key parameter for judging the performance of an E & P company. In view of the country's increasing need for new fields of hydrocarbon reserves, this has become more crucial.

In the Exit Conference (July 2015), MOPNG/OIL stated that due to exploration maturity in upper Assam basin which was the main operational area of OIL, size of discoveries and accretion to reserves were gradually decreasing. The decrease in 1P reserves over the years was because of depletion due to volume of oil and gas production and non-commensurate

upgradation of 2P reserves. The increase in 2P reserves was due to annual reserve accretion in 2P category. The decrease in 3P reserves was due to upgradation of a component of 3P to 2P category due to appraisal and developmental activities but limited accretion of new reserves in 3P category by exploration efforts.

Thus, OIL needs to focus its efforts towards accretion of new reserves in 3P category and commensurate upgradation of 3P to 2P and 2P to 1P category for sustainable oil and gas production.

## 3.2 Efficiency in Reserves Accretion

Reserves accretion targets are fixed after taking into account the total number of exploratory wells planned for drilling during a year and also the exploratory drilling success of previous years. In India, the major exploration and production activities of OIL are carried out in Assam & Assam-Arakan (A&AA) and Rajasthan (RJ). The year-wise targets and actuals of reserve accretion during the five years from 2009-10 to 2013-14 are shown in table 3.2 and figure 3.3:

**Table: 3.2 – Targets and Actuals of Reserve Accretion**

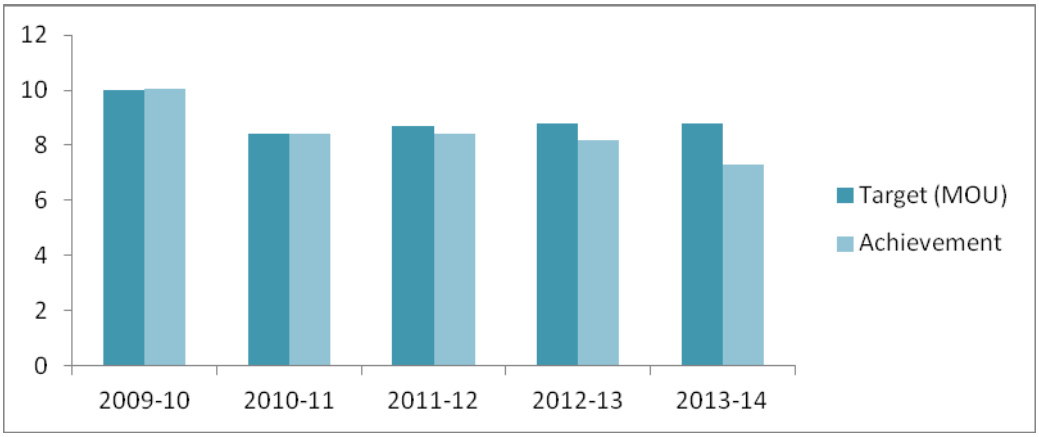
**(In MMToe)**

| | Assam & Assam-Arakan | | | | | | Rajasthan | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | Total | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | Total |
| Target (MOU) | 10 | 8.4 | 8.7 | 8.8 | 8.8 | 44.7 | NA | NA | NA | NA | NA | NA |
| Target (BE) | 9.5 | 8 | 8.4 | 8 | 8 | 41.9 | - | 0.25 | 0.25 | 0.15 | 0.15 | 0.8 |
| Target (RE) | - | - | - | 8.5 | 6 | 14.5 | - | 0.05 | 0.05 | 0.15 | 0.07 | 0.32 |
| Achievement[15] | 10.06 | 8.43 | 8.41 | 8.2 | 7.31 | 42.41 | 0 | 0 | 0 | 0.464 | 0.007 | 0.471 |
| Surplus/(Shortfall) from MoU target | 0.06 | 0.03 | -0.29 | -0.6 | -1.49 | -2.29 | - | (0.25) | (0.25) | 0.314 | (0.143)3 | (0.329) |

Note: In A&AA no RE Target fixed till 2011-12. No BE & RE Target fixed for 2009-10 in RJ. Since no MOU target was fixed for RJ, shortfall was calculated based on BE target.

[15] Excluding reserve accretion from Joint Venture blocks

**Figure 3.3 - Target (MOU) vis-à-vis Achievement of A&AA**




Audit observed that:

- In Assam & Assam-Arakan, during the years 2009-10 and 2010-11, the surplus came down and for the successive three years from 2011-12 to 2013-14 the shortfall increased. Thus, there was an overall decreasing trend in respect of reserve accretion.
- MOU targets were fixed by MOPNG in consultation with OIL each year for Assam and Assam-Arakan. No MOU target was fixed for Rajasthan.
- OIL did not achieve the target fixed in its MOU from 2011-12 onwards in Assam & Assam-Arakan and set the budgeted target and the revised target much below the MOU target during all the years.
- Though OIL achieved RE target in 2013-14, it is pertinent to note that in Assam & Assam-Arakan, OIL set RE target at 75 per cent of BE target and at 65 per cent of the MOU target. The reasons for such revision were not placed on record.
- In Rajasthan, during the period from 2010-11 to 2013-14, the aggregate BE Target of 0.80 MMToe was drastically reduced by 60 per cent in the RE target without any recorded reason;
- OIL did not achieve its target for reserve accretion in Rajasthan during last five years. The total reserve accretion was only 59 per cent of the targeted quantity.

OIL replied (April 2015) that R.E was based on half-yearly trend of physical activities to decide the revised plan. Only B.E. target is referred for performance evaluation and Government reporting. BE target of reserve accretion was based on the scientific evaluation

of possible contribution from planned drilling, work over and other evaluation efforts whereas MOU target of production was generally decided at higher level during negotiation by Task Force appointed by Government under a bilateral negotiation with growth perspective, limited to the core revenue earning from the producing areas. As a result, the accretion figures had to be upgraded to maintain RRR above 1(one). Thus, BE became lower than the MOU Target. OIL further stated that though exploratory drilling was carried out in all the years in Rajasthan, reserve accretion was established only in the year 2012-2013 and 2013-14. There was no reserve accretion in other years due to poor hydrocarbon prospects in other NELP blocks. It was also stated (May 2015) that they had not done any comparative study between MOU and Planning Commission's target relating to survey and drilling while fixing its own target.

The reply is not convincing as OIL has itself accepted that reserve accretion in Rajasthan was mainly due to geological and engineering reviews based on development drilling and not through exploratory drilling in new areas

The Standing Committee on Petroleum and Natural Gas (2010-11, 15th Lok Sabha) on demand for grants in its eighth report noted (August 2011) that the various targets set for oil PSUs are finalized by the Task Force consisting of experts, representatives from Ministries and oil companies taking all relevant factors into account. After finalization of targets, MOUs are signed between oil PSUs and the Ministry. However, these targets which are fixed with great deal of exercise are not adhered to by the companies and most of the targets set during the last three years remained unfulfilled on account of reasons which are often repetitive in nature. The Committee was of the view that with signing of MOUs, it becomes a commitment on the part of the companies to adhere to the targets. Any under-achievement was needed to be viewed seriously by the Ministry and suitable periodical corrective action taken to prevent shortfalls.

### 3.3 Decline in Reserve Replacement Ratio

Reserve Replacement Ratio (RRR)[16]measures the relationship between new reserves accreted and oil produced, reflecting how well an oil company is replacing its production. In order to ensure long term sustainability in E&P Sector, it is essential for OIL to replenish its reserves from which it produces oil and gas.

[16] RRR=Ultimate Reserve accreted during a year/Total production of hydrocarbons during the year

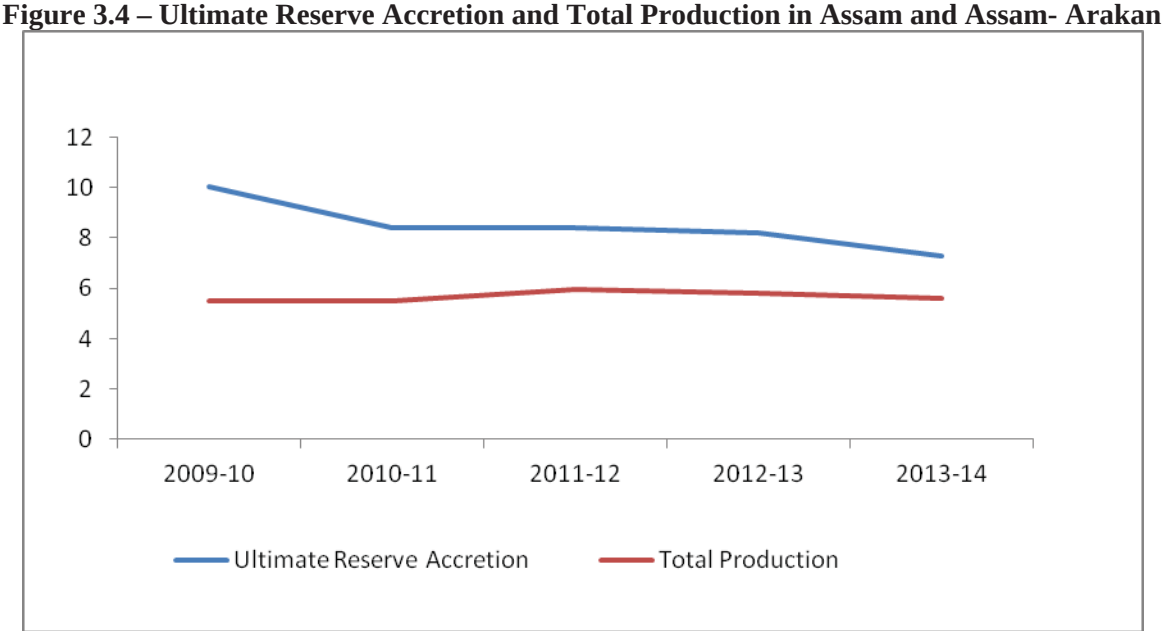
The production of crude oil and natural gas, Ultimate Reserve (UR) and RRR for the last five years ended 2013-14 of OIL's major producing areas of Assam & Assam-Arakan are given in Table 3.3 and figure 3.4 and 3.5 and in respect of Rajasthan the same are given in Table 3.4:

**Table 3.3 - Computation of Reserve Replacement Ratio in Assam & Assam-Arakan**

**(Quantity in MMToe)**

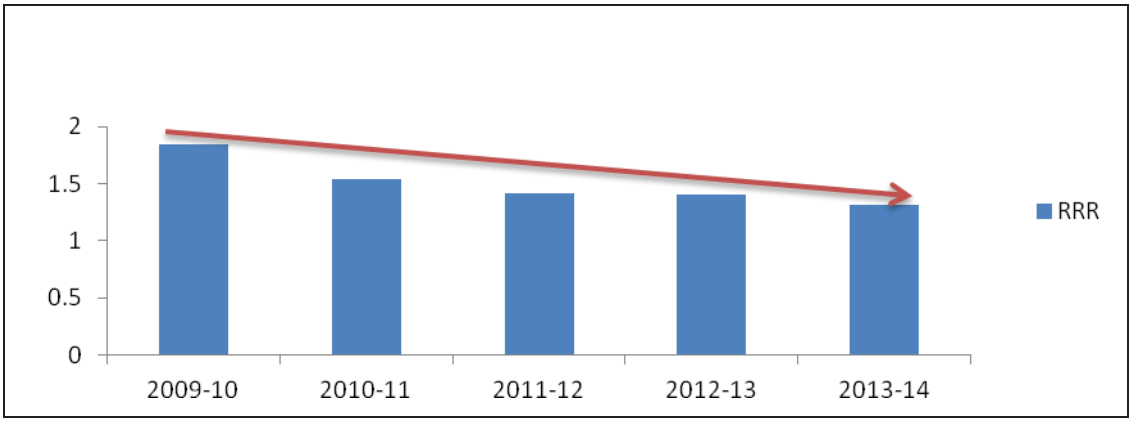
| Sl. No. | Particulars | YEAR | | | | |
|---|---|---|---|---|---|---|
| | | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
| 1 | Initial In-place Hydrocarbon | 1054.25 | 1055.43 | 1072.70 | 1088.09 | 1097.16 |
| 2 | Ultimate Reserve Accretion | 10.06 | 8.43 | 8.41 | 8.20 | 7.31[17] |
| 3 | Oil Production | 3.54 | 3.56 | 3.82 | 3.64 | 3.44 |
| 4 | Gas Production | 1.94 | 1.93 | 2.12 | 2.16 | 2.15 |
| 5. | **Total Production (Sl. No.3 + 4)** | 5.48 | 5.49 | 5.94 | 5.80 | 5.59 |
| **RRR (Sl.No.2/Sl.No.5)** | | 1.84 | 1.54 | 1.42 | 1.41 | 1.31 |

**Figure 3.4 – Ultimate Reserve Accretion and Total Production in Assam and Assam- Arakan**




[17] Excluding reserve accretion from Joint Venture blocks

**Figure 3.5 – Reserve Replacement Ratio in Assam and Assam-Arakan**




**Interpretation: While the total production has remained stagnant, "Ultimate Reserve Accretion" and "Reserve Replacement Ratio" has steadily declined over the period of five years**.

**Table 3.4 - Computation of Reserve Replacement Ratio in Rajasthan**

**(Quantity in MMToe)**

| Sl. No. | Particulars | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|---|---|---|---|---|---|---|
| 1 | Gas Initially In Place | 3.739 | 3.739 | 3.739 | 4.355 | 4.371 |
| 2 | Economically Ultimate Recoverable Gas Reserve | 2.771 | 2.771 | 2.771 | 3.235 | 3.243 |
| 3 | **Accretion in EUR** | 0.000 | 0.000 | 0.000 | 0.464 | 0.007 |
| 4 | **Gas Production** | 0.079 | 0.061 | 0.086 | 0.075 | 0.076 |
| | **RRR (Sl.No.3/Sl.No.4)** | 0.000 | 0.000 | 0.000 | 6.187 | 0.092 |

Audit observed that:

- Though OIL achieved RRR of more than 1 as prescribed in Assam & Assam-Arakan during the period from 2009-10 to 2013-14, the UR accretion registered a downward trend. Consequently, the RRR has a declining trend from 1.84 in 2009-10 to 1.31 in 2013-14.
- Rajasthan project registered RRR of more than 1 only in 2012-13. The reason for abnormally high RRR in Rajasthan in 2012-13 was noted to be the lack of reserve accretion upto 2011-12. However, reserve accretion in 2012-13 was mainly because of geological and engineering review.
- MOPNG exercises control in setting of MOU targets of OIL and does performance evaluation during and at the end of the year. Out of different parameters for which weightage is assigned, though exploration is a core business of OIL, the weightage given to “accretion to recoverable reserves” reduced from eight per cent in 2009-10 to

five per cent in 2013-14. This implies that OIL was being evaluated more on financial and non-financial parameters rather than on its core activity.

While accepting the audit contention regarding its Rajasthan operations, OIL stated (April 2015) that blocks in upper Assam were being extensively explored and significant discoveries were made over the years. However, discoveries made since last few years were comparatively smaller posing considerable challenges. Identifying and drilling these prospects were challenging both technically and economically. As such, reserves accreted from these discoveries showed a declining trend considering the degree of exploration already carried out in upper Assam petroliferous basin.

The reply is a reiteration of known facts and challenges. OIL needs to find out solutions to its problems by using its expertise gained over the years and to plan a proactive strategy for increasing the reserve accretion trends.

## 3.4 Success of OIL in hydrocarbon discoveries among peers

**Nomination Blocks**

OIL made 33 hydrocarbon discoveries in Assam & Assam-Arakan under Nomination regime during the period from 2009-10 to 2013-14, including four discoveries[18] which were yet to be monetized. Out of four discoveries pending for monetization, three discoveries were currently techno-economically unattractive for field development and one discovery is awaiting stimulation.

While accepting the audit contention, OIL stated (April 2015) that in respect of Madhakali-1 well, OIL did not have in-house expertise and technology and the same was outsourced. Similarly, it did not have adequate technology to produce heavy oil from Diroi-5. Further, Disaijan-1 had already been lined up for workover and results were expected in the early part of 2015-16. MOPNG stated (July 2015) that by induction of technology some production was established in April 2015 from Madhakali-1. Further, production from Mahakali was delayed due to lesser potential and isolated location which was lined up for workover to be completed in 2015-16.

[18] Madhakali-1, Diroi-5, Disaijan-1 and Mahakali-1

In this regard, the contention of OIL that it was lacking expertise on producing heavy oil is not convincing as being an upstream NOC, it is supposed to be abreast of latest technology to cope up with such challenges.

**NELP Blocks**

Standing Committee on Petroleum and Natural Gas (2014-15, 16th Lok Sabha) in its first report mentioned that under NELP, exploration blocks were awarded to Indian private and foreign companies through international competitive bidding process where NOCs viz., ONGC and OIL are also competing on equal footing.

Out of 254 blocks[19] awarded during NELP regime (Rounds-I to IX), 66 discoveries have been made by private/foreign companies as operators and 64 discoveries have been made by NOCs and State PSU (GSPCL). OIL, however, made only one discovery (block RJ-ONN-2004/2) from NELP blocks awarded in all the NELP rounds.

Audit compared OIL's success in hydrocarbon discoveries with its peers which are shown in table 3.5 and figure 3.6:

**Table 3.5 - Hydrocarbon Discoveries under NELP**

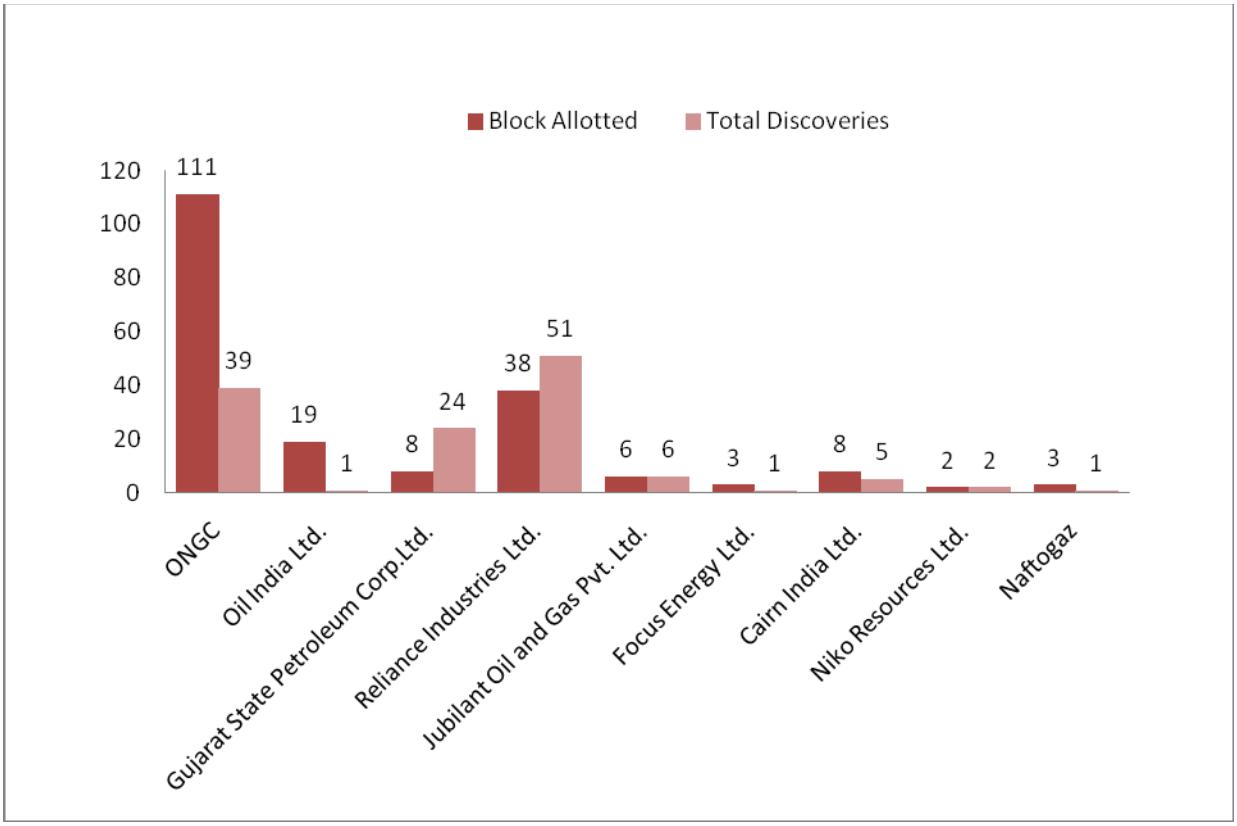
**(As on 31.03.2014)**

| Sl. No. | Company (Operator) | Block Allotted | Oil Discovery | Gas Discovery | Total Discoveries |
|---|---|---|---|---|---|
| 1 | ONGC | 111 | 10 | 29 | 39 |
| 2 | Oil India Ltd. | 19 | 1 | - | 1 |
| 3 | Gujarat State Petroleum Corporation Ltd. | 8 | 15 | 9 | 24 |
| 4 | Reliance Industries Ltd. | 38 | 14 | 37 | 51 |
| 5 | Jubilant Oil and Gas Pvt. Ltd. | 6 | 2 | 4 | 6 |
| 6 | Focus Energy Ltd. | 3 | - | 1 | 1 |
| 7 | Cairn India Ltd. | 8 | 4 | 1 | 5 |
| 8 | Niko Resources Ltd. | 2 | - | 2 | 2 |
| 9 | Naftogaz | 3 | 1 | - | 1 |
| | **Total** | **198** | **47** | **83** | **130** |

Source: DGH Report

[19] Out of 254 blocks awarded to different companies, 198 blocks pertain to those companies who have made discoveries.

**Figure 3.6 – Hydrocarbon Discoveries under NELP**




Audit observed that in spite of being one of the NOC having both financial resources and technical experience in the E&P sector, performance of OIL lagged behind peers in the industry. Out of the total discoveries during NELP period, OIL made only one discovery in Punam well in Rajasthan which is yet to be monetized (April 2015) though the discovery was made in July 2012.

OIL informed (December 2012) to DGH that it did not have adequate technology to produce heavy oil from Punam-1. The discovery was of potential commercial interest and merits appraisal. However, OIL submitted the Declaration of Commerciality (DOC) to DGH without drilling of any appraisal wells. The DOC was yet to be accepted by DGH (December 2014), resulting in delay in monetization of the discovery.

OIL stated (April 2015) that out of 40 blocks, OIL was operator in 19 blocks. Out of these 19 blocks, 3 blocks were relinquished without probing exploratory drilling due to logistics, MOD clearance etc. which were beyond OIL's control. Out of the remaining 16 blocks, 8

blocks were probed by exploratory drilling, and only 1 discovery was made upto 2013-14. In remaining blocks exploratory activities were going on and not yet probed.

The fact remains that OIL made only two discoveries till date. Standing Committee on Petroleum and Natural Gas (2012-13, 15th Lok Sabha) recommended that the country looks upon NOCs for achieving success in meeting the hydrocarbon requirement. As such, the NOCs should show greater commitment and achieve creditable results and fulfill the expectation placed on them. The committee recommended that MOPNG/DGH should monitor the progress in various exploration blocks to check timely achievement of various activities.

In the Exit Conference (July 2015) MOPNG stated that the audit observations contained in the Performance Audit Report would be useful in strengthening their mechanism for monitoring exploration efforts of OIL.