हाइड्रोकार्बन महानिदेशालय

(पेट्रोलियम एवं प्राकृतिक गैस मन्त्रालय के अधीन)

DIRECTORATE GENERAL OF HYDROCARBONS

(Under Ministry of Petroleum & Natural Gas)

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To

All E&P companies/Operators working in India

Subject: Guidelines for Uniform system of Classification of Hydrocarbon Resources/ Reserves

Sir,

With the opening up of Indian upstream hydrocarbon sector, a need was felt to formulate a uniform system of classification of hydrocarbon resources/reserves to be followed by all E&P companies operating under PSC as well as under nomination regime. Views of all the E&P companies on system being followed by the companies were requested and the same have been considered.

2. After approval by MOPNG, the guideline note on "Classification of Resources/Reserves" is enclosed. The proposed system broadly conforms to SPE/WPC/AAPG system of classification.

3. In order to follow a uniform system of classification in India, it is enjoined upon to all companies operating in India that henceforth the hydrocarbon resource and reserves reporting should be made as per the enclosed guidelines and in the formats/ tables.

This has the approval of competent authority
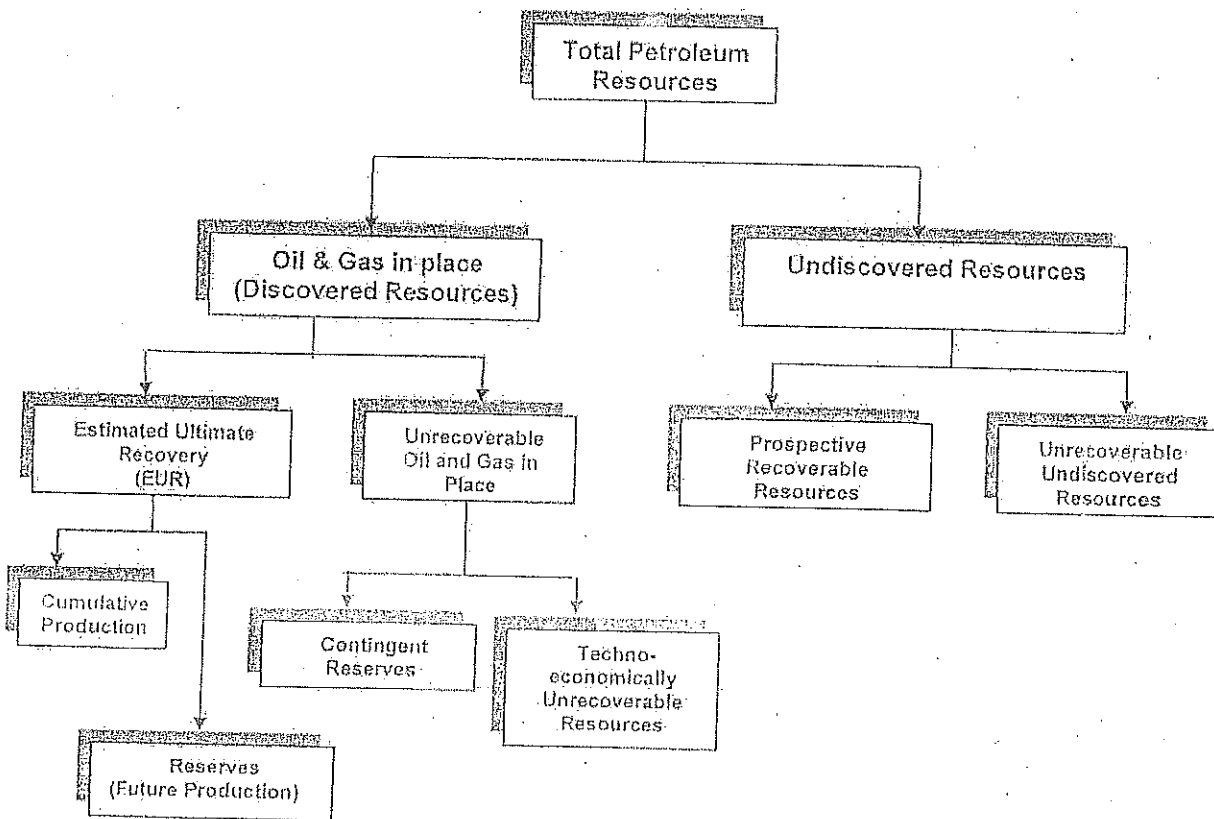
Thanking You

(Sanjay Chawla)
Chief Manager (Res)

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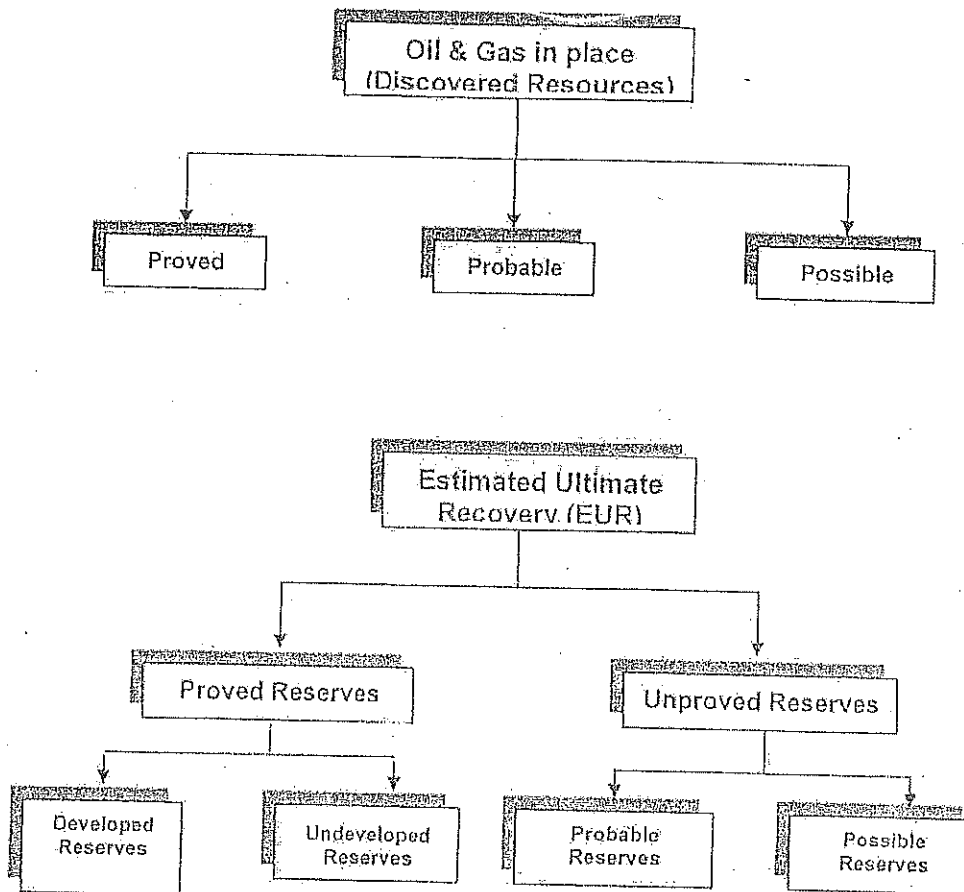With the opening up of the Indian oil sector to the multinationals, through New Exploration Licensing Policy (NELP), many oil / gas discoveries have been made which are being characterized and reported by the operating companies according to their governing policies. To facilitate a common platform for reporting the available resources and reserves in the Indian fields, it is felt that a uniform system of resource / reserves classification should be followed by all concerned in Indian operations.

A.   CLASSIFICATIONS

A system has been devised based on the SPE/WPC/AAPG guidelines for classification of Resources (Oil & Gas in place) and Reserves (Recoverable volumes of Oil & Gas in place), including Proved, Probable & Possible categories under Oil and Gas in Place (Discovered Resources). The broad structure of the proposed classification is as under,

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                  ┌─────────────────────────┐
                  │   Oil & Gas in place    │
                  │  (Discovered Resources) │
                  └─────────────────────────┘
                               │
        ┌──────────────────────┼──────────────────────┐
        ▼                      ▼                      ▼
  ┌───────────┐          ┌───────────┐          ┌───────────┐
  │  Proved   │          │ Probable  │          │ Possible  │
  └───────────┘          └───────────┘          └───────────┘
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                  ┌─────────────────────────┐
                  │   Estimated Ultimate    │
                  │     Recovery (EUR)      │
                  └─────────────────────────┘
                               │
           ┌───────────────────┴───────────────────┐
           ▼                                        ▼
    ┌───────────────┐                       ┌───────────────────┐
    │ Proved Reserves│                      │ Unproved Reserves │
    └───────────────┘                       └───────────────────┘
        │                                        │
   ┌────┴────┐                            ┌──────┴──────┐
   ▼         ▼                            ▼             ▼
┌─────────┐ ┌───────────┐          ┌───────────┐ ┌───────────┐
│Developed│ │Undeveloped│          │ Probable  │ │ Possible  │
│Reserves │ │ Reserves  │          │ Reserves  │ │ Reserves  │
└─────────┘ └───────────┘          └───────────┘ └───────────┘
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The lower two trees in the above classification system are the subsets of the first major tree, which describes the classification of the total resources. The total petroleum resources are divided into two major branches, oil-and-gas-in-place (discovered resources) and undiscovered resources. The oil-and-gas-in-place (discovered resources) is further divided into Estimated Ultimate Recovery (EUR) and Unrecoverable oil- and-gas-in-place (as of date, depending on the prevalent economics, technology, etc.). The Unrecoverable Oil and Gas in Place may be further divided into Contingent reserves (which are technically recoverable but uneconomical as on date) and Techno-economically Unrecoverable resources (both technically, and economically, not recoverable). The undiscovered resources (which are yet to be discovered) have further categorisations as Prospective Resources (Recoverable) and Unprospective (not recoverable) Resources. The oil-and-gas-in-place (discovered resources), may be estimated and put under Proved, Probable & Possible categories depending upon range of uncertainty and are limited to known accumulations.

The recoverable volume of discovered resources, as of date, which is referred to as Estimated Ultimate Recovery (EUR) is divided into Proved reserves and Unproved Reserves. These two categories of reserves are further sub-divided into developed & undeveloped and probable & possible categories, respectively.

The definitions of each category of resources and reserves are given below. These broadly conform to the accepted international definitions of SPE/WPC/AAPG.

1.   Total Petroleum Resources: Total Petroleum Resource is that quantity of petroleum which is estimated to exist originally in naturally occurring accumulations. It is, therefore, that quantity of petroleum which is estimated, on a given date, to be contained in known accumulations, plus those quantities already produced there from, plus those estimated quantities in accumulations yet to be discovered. It is divided into Discovered and Undiscovered Resources (oil and gas in place). This is also called *"Total Petroleum Initially in place"* as per SPE/WPC/AAPG classification (February 2000).

2.   Oil-and-Gas-in-Place (Discovered Resources):   Discovered Petroleum initially-in place is that quantity of petroleum which is estimated, on a given date, to be contained in known accumulations, plus those quantities already produced there from. The oil & gas in-place may be estimated by deterministic or probabilistic methods. The method of estimation is called deterministic if a single best estimate of oil & gas in-place is made based on known geological, engineering, and economic data. The method of estimation is called probabilistic when the known geological, engineering, and economic data are used to generate a range of estimates and their associated probabilities. The discovered oil and gas in place are classified into Estimated Ultimate Recovery (EUR) and Unrecoverable Discovered oil-and-gas-in-place.

> Estimated Ultimate Recovery (EUR): EUR is defined as those quantities of petroleum, which are estimated, on a given date, to be potentially recoverable from an accumulation, plus those quantities already produced there from.

> Unrecoverable Discovered oil-and-gas-in-place: These are those quantities that, on a given date, cannot be recovered from the accumulations due to technical, economic, logistics or commercial reasons. These are further divided into Contingent Reserves and Techno-economically Unrecoverable resources.

>> Contingent Reserves: Contingent Reserves are those quantities of oil and gas which are estimated on a given date to be potentially recoverable from known accumulations but which are not currently considered to be commercially recoverable. Contingent reserves include, for example, accumulations for which there are currently no viable market; or, their commercial recovery is dependent on the development of new technology, or, where the evaluation of the discovery is at the early stage. As per SPE/WPC/AAPG definitions, it is termed as "Contingent Resource".

>> Techno- economically unrecoverable resources: These are the quantities which cannot be techno-economically recovered in the foreseeable future. They also represent the quantities of petroleum which are in the reservoir after commercial production has ceased.

The discovered oil and gas in place shall be further estimated and classified as under, based on the status of exploration.

(a) Proved oil and gas in place: It is estimated volume / quantity of oil and gas as of date, which on evaluation of available geophysical, geological and engineering data, demonstrates with reasonable certainty, to be present in the reservoir. The following norms may be adhered to, in order to consider the oil & gas in-place as proven :

1) the structure, areal extent, volume and reservoir characteristics are well defined by adequate well control / testing.
2) Sustained flow has been established by wells located in different part of the reservoir.
3) Reservoir geometry, petro-physical and fluid parameters, and reservoir mechanism are well defined
4) In the absence of fluid contacts, the lowest known occurrence of hydrocarbons controls the proved limits.

(b)   Probable oil and gas in place: This is less certain than proved oil and gas in place, because of insufficient data or in-conclusive analysis. This category of OIIP/GIIP includes

1. reservoir delineated by geophysical and geological data with fair degree of certainty.
2. volumes with hydrocarbon indication (favourable log characteristics or RFT/SFT/MDT etc) or sustained flow established in at least one well.

The area is defined by fluid contacts or the base of pay/reservoir where fluid contacts are not seen, or the lowest perforation depth.

(c)   Possible oil and gas in place: This category describes the "less certain than probable" oil and gas in place, with lesser data or lesser conclusive interpretation of data, than required for placement in probable category. This category includes volumes estimated based on hydrocarbon indications or by structural extrapolation from the area proven by drilling.

This category does not include any recoverable component.

3.   Un-Discovered Resources: Undiscovered resources are defined as those quantities of petroleum which is estimated on a given date to be contained in accumulations yet to be discovered. The estimated potentially recoverable portion of these resources is classified as prospective recoverable resources.

Prospective Recoverable Resources are defined as those quantities of oil and gas estimated on a given date to be potentially recoverable from undiscovered accumulations.

Unrecoverable Undiscovered Resources: The part of undiscovered resources, which is potentially not recoverable as on date, is termed as unrecoverable undiscovered resources.

4.   Estimated Ultimate Recovery (EUR): EUR is defined as those quantities of petroleum, which are estimated, on a given date, to be potentially recoverable from an accumulation, plus those quantities already produced there from. Reserves are those quantities of petroleum which are anticipated to be commercially recovered from known accumulations from a given date forward. Reserves may be classified into proved reserves or unproved reserves, depending on the uncertainty of the degree of estimation. The uncertainty depends chiefly on the amount of reliable geologic and engineering data available at the time of the estimate and the interpretation of these data. The reserves may be estimated by deterministic or

probabilistic methods. The method of estimation is called deterministic if a single best estimate of reserves is made based on known geological, engineering, and economic data. The method of estimation is called probabilistic when the known geological, engineering, and economic data are used to generate a range of estimates and their associated probabilities.

Proved Reserves: Proved reserves are those quantities of petroleum which, by analysis of geological and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs and under current economic conditions, operating methods, and government regulations.

In general, reserves are considered proved if the commercial producibility of the reservoir is supported by actual production or formation tests. In certain cases, proved reserves may be assigned on the basis of well logs and/or core analysis that indicate the subject reservoir is hydrocarbon bearing and is analogous to reservoirs in the same area that are producing or have demonstrated the ability to produce on formation tests.

The area of the reservoir considered as proved includes

1. the area delineated by drilling and defined by fluid contacts, if any,
2. the un-drilled portions of the reservoir that can reasonably be judged as commercially productive on the basis of available geological and engineering data.

In the absence of data on fluid contacts, the lowest known occurrence of hydrocarbons controls the proved limit unless otherwise indicated by definitive geological, engineering or performance data.

Reserves may be classified as proved if facilities to process and transport those reserves to market are operational at the time of the estimate or there is a reasonable expectation that such facilities will be installed.

Proved Developed Reserves: These are those reserves that are expected to be recovered from existing wells and installed facilities or, if facilities have not been installed, that would involve a low expenditure to put the reserves on production. Developed reserves are expected to be recovered from existing wells including reserves behind pipe. Improved recovery reserves are considered developed only after the necessary equipment has been installed, or when the costs to do so are relatively minor.

Proved Undeveloped Reserves: Undeveloped reserves are those reserves which are expected to be recovered from known accumulations, where a significant expenditure is required to put them on production.

Reserves in undeveloped locations may be classified as proved undeveloped provided

(1)   the locations are direct offsets to wells that have indicated commercial production in the objective formation,

(2)   it is reasonably certain such locations are within the known proved productive limits of the objective formation,

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(3) incremental reserves attributable to infill drilling that could have been classified as proved if closer statutory spacing had been approved at the time of the estimate,

(4) reserves attributable to improved recovery methods that have been established by repeated commercially successful applications when
  (a) a project or pilot is planned but not in operation, and

  (b) rock, fluid, and reservoir characteristics appear favorable for commercial application,

(5) reserves in an area of the formation that appears to be separated from the proved area by faulting and the geologic interpretation indicates the subject area is structurally higher than the proved area,

(6) reserves attributable to a future work-over, treatment, re-treatment, change of equipment, or other mechanical procedures, where such procedure has not been proved successful in wells which exhibit similar behavior in analogous reservoirs, and

(7) incremental reserves in proved reservoirs where an alternative interpretation of performance or volumetric data indicates more reserves than can be classified as proved.

Possible Reserves

Possible reserves are those unproved reserves which analysis of geological and engineering data suggests are less likely to be recoverable than probable reserves. In this context, when probabilistic methods are used, there should be at least a 10% probability that the quantities actually recovered will equal or exceed the sum of estimated proved plus probable plus possible reserves.

In general, possible reserves may include

(1)   reserves which, based on geological interpretations, could possibly exist beyond areas classified as probable,

(2)   reserves in formations that appear to be petroleum bearing based on log and core analysis but may not be productive at commercial rates,

(3)   incremental reserves attributed to infill drilling that are subject to technical uncertainty,

(4)   reserves attributed to improved recovery methods when (a) a project or pilot is planned but not in operation and (b) rock, fluid, and reservoir characteristics are such that a reasonable doubt exists that the project will be commercial, and

(5)   reserves in an area of the formation that appears to be separated from the proved area by faulting and geological interpretation indicates the subject area is structurally lower than the proved area.

REMARKS:

* The proposed classifications broadly adhere to the recommended SPE/WPC/AAPG guidelines for reserves and resources classifications.

* Reserves estimates will generally be revised as additional geologic or engineering data becomes available or as economic conditions change. Reserves do not include quantities of petroleum being held in inventory, and may be reduced for usage or processing losses if required for financial reporting.

* Reserves may be attributed to either natural energy or improved recovery methods. Improved recovery methods include all methods for supplementing natural energy or altering natural forces in the reservoir to increase ultimate recovery. Examples of such methods are pressure maintenance, cycling, water-flooding, thermal methods, chemical flooding, and the use of miscible and immiscible displacement fluids. Other improved recovery methods may be developed in the future as petroleum technology continues to evolve.

* The Discovered Oil & Gas in Place have been placed under proved, probable and possible categories. The classification of SPE/WPC/AAPG as Low, Best & High estimates respectively are broadly equivalent to Proved (1P), Proved + Probable (2P) and Proved + Probable + Possible (3P) categories.

* In the above-proposed classifications, the Possible category of Discovered Oil and Gas in Place will not have any recoverable component, till the time it is upgraded to higher category.

B. AUDITING AND REPORTING OF OIL & GAS IN-PLACE AND RESERVES:

It is enjoined upon all the companies operating in Indian E&P sector to have their oil and gas in-place, and reserves, audited by reputed National / International agencies. The frequency of audits will be once every 3 year for companies having an Oil plus Oil Equivalent of Gas (O+OEG) base of more than 5 MMT. For companies whose O+OEG base is less than 5 MMT, such audits may be held once every 5 years.

The companies are required to submit the annual statement of hydrocarbon resources and reserves as per the formats given in Tables 1 and 2. In Table 1, the information indicated at Sl no. 1 and 3 are optional and may be provided if available. Rest of the information asked for in Table 1, and all in Table 2, are mandatory and have to be provided by all the companies.

Table - 1

Statement of Hydrocarbon Resources and Reserves

(as on ....)

Block:

Basin:

Operator:

1. Total Petroleum Resources	MMt	
2. Discovered Oil & Gas inplace	MMt / MMm^3	
a) Expected Ultimate Reserves (EUR)	MMt / MMm^3	
b) Contigent Reserves	MMt / MMm^3	
c) Techno-Economically unrecoverable resources	MMt / MMm^3	
3. Undiscovered Resources of Oil & Gas	MMt / MMm^3	
a) Prospective Recoverable Resources	MMt / MMm^3	
b) Unrecoverbale Resources	MMt / MMm^3	

Table - 2

Statement of Hydrocarbon Resources (In-place) and Reserves

(as on==================================)

	Discovered Resources (Oil & Gas Inplace)			Estimated Ultimate Recovery (EUR)			Reserves (EUR - Cumulative Production)			Cum. Prod. (
	Proved	Probable	Possible	Total	Proved	Probable	Possible	Total	Proved	Probable	Possible	Total	
Oil (Million Tonnes)												
Condensate (Million Tonnes)												
Total (Oil + Cond) Million Tonnes												
Asso. Gas (Million m3)												
Free Gas (Million m3)												
Total Gas (Asso.Gas + Free Gas) Million m3												