

**GUIDELINES TO
CLASSIFICATION OF
THE PETROLEUM RESOURCES ON
THE NORWEGIAN CONTINENTAL
SHELF**

NORWEGIAN PETROLEUM DIRECTORATE

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1 INTRODUCTION

Managing the petroleum resources on the continental shelf is an important task for the authorities, as the management of the business processes to recover them is for the industry and the management of their financial needs for those funding them. One of the principal tasks of the Norwegian Petroleum Directorate (NPD) is to maintain an overview of all the petroleum resources so that the authorities can have the best possible basis for planning measures to ensure that they are well managed and to forecast future production and activity.

The classification of the resources for further analysis can be performed in various ways, depending on the needs:

- Resource management by the authorities
- Business process management by the oil companies
- Providing standardised information to shareholders to allow a fair comparison of their investment options

Even though the classification requirements differ, the industry and authorities have in recent years become increasingly aware of the need to develop a more standardised system. This has, in part, been reflected in the publication in February 2000 by the World Petroleum Congress (WPC), the Society of Petroleum Engineers (SPE) and the American Association of Petroleum Geologists (AAPG) of a resource classification system that goes a long way towards making a standardised classification possible.

In connection with the Norwegian Petroleum Directorate's annual updating of the resource account for the expected recoverable resources, where the resources are classified according to their maturity, it is important to have an unambiguous system for classifying the resources. Such a system, which reflected the maturity of the resources, was devised in 1997. Based on experience gained in using this system, and in co-operation with the oil companies through the "Forum for Forecasting and UNcertainty Evaluation related to Petroleum Production" (FUN) the Directorate has now decided to revise the classification system somewhat. This revision takes the maturity principle applied in the current system a step further and approaches the proposal made by the WPC, SPE and AAPG.

The main principle in the revised classification system is that the originally recoverable resources in a field or discovery must be classified according to their position in the development chain from a discovery being made, or a new measure to increase the recoverable resources in a field being identified, until production of the resources is complete. The system is designed to allow for a single field or discovery being able to contain resources classified in different project status categories, i.e. resources at different stages of maturity in the development chain.

Emphasis has also been placed on the system being able to take in future changes that are still not specifically planned. The main purpose of including such changes is to have a better opportunity to predict the trend in the resources in the individual fields and discoveries, as well as on the entire continental shelf. One such change might be improving the recovery factor for a field as a consequence of an expectation of future technological development,

perhaps expressed in a long-term strategy or target stated by the operator. The classification also covers the undiscovered resources.

All resources must, as far as possible, be reported with a high and a low estimate, in addition to the base estimate. This allows an opportunity to describe the uncertainty in the resource quantities in both the individual fields and the full resource account.

The resources are divided in ten different project status categories. Categories 0 to 7 cover the discovered, recoverable resources. Possible future measures to improve the recovery factor are placed in category 7 along with new discoveries that have not yet been evaluated. Categories 8 and 9 cover the undiscovered resources. The ten categories form the basis for NPDs resource account and are an important basis for its production forecasts. The system also provides a guideline for the oil companies when they are submitting resource estimates or production forecasts to the Petroleum Directorate.

This new system thus replaces the system described in *Classification of petroleum resources on the Norwegian continental shelf*, published in July 1997.

Among the aims of this revision have been

- to strengthen the connection between resource categories and formal decisions by the authorities and the holders of production licences
- to harmonise the classification system with existing international systems based on the maturity of resources, in order to facilitate the communication of data
- to approach industrial standards and at the same time take care of the needs of the authorities from a management viewpoint.

The new classification system follows the main structure of the system presented in February 2000 by WPC, SPE and AAPG, and at the same time takes care of and develops the main features of the Directorate's former system. The most important changes from the old system are as follows:

- The term "class" in the new system denotes the main classes (Historical production, Reserves, Contingent resources and Undiscovered resources). The term "resource class" has been replaced with the term "project status category". These changes follow the practice used by SPE, WPC and AAPG.
- Reserves comprise only remaining, recoverable resources in fields that are in production and resources which it has been decided will be recovered.
- Quantities of petroleum that have been produced (historical production) are shown as a separate project status category, category 0 (nought), and are no longer covered by the term reserves.
- Reserves also include quantities which the licensees have decided to recover, but for which the authorities have still not approved recovery.
- Petroleum quantities (chiefly gas) which have not been sold, but which can be sold at a later date without significant investments, are also included in the reserves
- Additional attributes for some of the categories show the originally recoverable quantities (F: First oil/gas) and additional quantities without changing the originally-in-place

resources (A: Additional oil/gas) to be able to identify quantities that can be ascribed to measures to improve production (improved recovery and improved oil recovery (IOR)).

The classification system is a thematic guideline relating to section 13 in the Resource Management Regulations, issued by the Norwegian Petroleum Directorate 18 June 2001.

2 RESOURCE CLASSES AND CATEGORIES

The petroleum resources are divided into classes and project status categories, and comprise recoverable resources. The resource classes are: historical production (S), reserves (R), contingent resources (C) and undiscovered resources (P). The project status categories are numbered from 0 to 9. Additional attributes, "First" (F) and "Additional" (A), are shown in some categories (categories 2, 3, 4, 5 and 7). The resource figures are sometimes also stated in relation to the status of the field or discovery to which the resources are linked. The resource classes and project status categories are shown in the table below.

		Resource class	Project status category		
			Category	Description	
Total recoverable petroleum resources	Discovered	Historical production (S)	0		Sold and delivered petroleum
		Reserves (R)	1		Reserves in production
			2	F A	Reserves with an approved plan for development and operation
			3	F A	Reserves which the licensees have decided to recover
		Contingent resources (C)	4	F A	Resources in the planning phase
			5	F A	Resources whose recovery is likely, but not clarified
			6		Resources whose recovery is not very likely
	7		F A	Resources that have not been evaluated	
	Undiscovered	Un-discovered resources (P)	8		Resources in prospects
			9		Resources in leads, and unmapped resources

F = First oil/gas

A = Additional oil/gas

3 Project status categories

3.1 Category 0 Sold and delivered petroleum

Petroleum resources in deposits that have been produced and have passed the reserves reference point. It includes quantities from fields in production as well as from fields that have been permanently closed down.

3.2 Category 1 Reserves in production

Remaining, recoverable, marketable and deliverable quantities of petroleum which the licensees have decided to recover, and which are covered by plans for development and operation (PDO) which the authorities have approved or granted exemption from. Should production be temporarily shut down, the reserves must, nevertheless, be added to this category. The reserves in this category are shown by subtracting the sold and delivered petroleum quantities from the originally recoverable reserves.

Quantities of gas covered by approved plans for development and operation and on hold in fields from which delivery has started are also reckoned as reserves in this category.

3.3 Category 2 Reserves with an approved plan for development and operation

3.3.1 Category 2 F

Recoverable quantities of petroleum described under category 1, but which have not been put into production.

3.3.2 Category 2 A

Additional (or deducted) reserves that are in categories 1 or 2F, which are a consequence of projects to improve production, and which have the same status as regards decisions as reserves in category 2F.

3.4 Category 3 Reserves which the licensees have decided to recover

3.4.1 Category 3 F

Recoverable, marketable and deliverable quantities of petroleum which the licensees have decided to recover, but for which the authorities have not yet approved a PDO or granted exemption therefrom. This category also contains supplementary reserves from new deposits with the same status as regards decisions, and which can be connected to fields in categories 1 and 2.

The category also covers quantities of petroleum (mainly gas) that have been held back, but which can be sold without significant investments at a later date.

3.4.2 Category 3 A

Additional (or deducted) quantities of petroleum in categories 1, 2 or 3F, which are a consequence of projects to improve production and which the licensees have decided to recover, but for which the authorities have not yet approved a PDO or granted exemption therefrom.

The category also covers quantities of petroleum (mainly gas) that have been held back, but which can be sold without significant investments at a later date.

3.5 Category 4 Resources in the planning phase

3.5.1 Category 4 F

Discovered, recoverable, petroleum resources that are expected to be covered by a PDO or granted exemption therefrom, and where specific activity is taking place with a view to clarifying whether a development will be implemented. Development is expected to be decided by the licensees within about 4 years. This category also contains supplementary resources which can be connected to existing fields that have reserves in categories 1 and 2, and discoveries that have reserves in category 3.

3.5.2 Category 4 A

Additional (or deducted) quantities of petroleum in categories 1, 2, 3 or 4F, which are a consequence of projects to improve production and which have the same status as regards decisions as resources in category 4F.

3.6 Category 5 Resources whose recovery is likely, but not clarified

3.6.1 Category 5 F

Discovered, recoverable petroleum resources whose recovery is likely, but not clarified. This category contains discovered, recoverable petroleum resources which are not being considered for development at the moment, but which can be developed in due course. It also contains supplementary resources from new deposits which can be tied in to fields and discoveries with resources in categories 1, 2, 3 and 4, but where matters regarding recovery have still not been clarified.

3.6.2 Category 5 A

Additional (or deducted) quantities of petroleum that are in categories 1, 2, 3, 4 or 5F, which are a consequence of projects to improve production, and which have the same status as regards decisions as resources in category 5F.

3.7 Category 6 Resources whose recovery is not very likely

Discovered, recoverable petroleum resources which are not expected to be profitably recoverable even in the long term, and resources in small, untested discoveries whose recovery seems unlikely. Option values will normally be included in assessments of profitability. The option values emerge as a result of uncertainties surrounding future recovery factors (price, technology, etc.), and where recovery of the resource is considered to be an option (a right, but not an obligation) that will be realised only if the situation develops sufficiently favourably.

This category contains petroleum resources that require substantial changes in technology, prices, etc., to be recovered profitably, and where it is not very likely that the changes required will take place.

3.8 Category 7 Resources that have not been evaluated

3.8.1 Category 7 F

Recoverable petroleum resources in new discoveries where the discovery evaluation report have not yet been submitted to the authorities so that only a provisional resource estimate exists.

3.8.2 Category 7 A

Recoverable petroleum resources in fields and discoveries which have resources in categories 1, 2, 3, 4 or 5 and which may be recoverable with the help of production techniques beyond those that are considered to be conventional, or with the help of known methods which there is still no basis for employing.

For the individual field or discovery, this estimate of the resource will typically be based on rough valuations. There may be great uncertainty as to whether the measures can be implemented. Estimates are normally only stated for the total potential of the measures, not in respect of individual measures.

(This category covers resources, which were previously categorised as "Resources from possible future measures to increase the recovery factor").

3.9 Category 8 Resources in prospects

Undiscovered, recoverable quantities of petroleum in mapped prospects that have not been discovered by drilling. It is uncertain whether the estimated resources are present. They have been risk-weighted, i.e. they reflect estimated volumes multiplied by the probability of making a discovery. This probability must be stated.

3.10 Category 9 Resources in leads, and unmapped resources

Undiscovered, recoverable petroleum resources attached to leads. It is uncertain whether the leads, and if so the estimated resources, are actually present. The resource estimates reflect estimated volumes multiplied by the probability of making a discovery. This probability must be stated. The unmapped, recoverable resources are calculated by analysing plays. The total resources of the plays include both discovered and undiscovered resources. The unmapped resources are the difference between the aggregate resources of the plays and the discovered and mapped resources.

4 DEFINITIONS

4.1 Definitions of terms, stated in Act 29 November 1996 No. 72 relating to petroleum activities, section 1-6, used in the description of resource classes and categories

4.1.1 Petroleum deposit

A petroleum deposit is an accumulation of petroleum in a geological unit, limited by rock characteristics by structural or stratigraphic boundaries, contact surface between petroleum and water in the formation, or a combination of these, so that all the petroleum comprised everywhere is in pressure communication through liquid or gas.

4.1.2 Production (utvinning)

Production (utvinning) of petroleum, including drilling of production wells, injection, improved recovery, treatment and storage of petroleum for transport, and shipment of petroleum for transport by ship, as well as the construction, placing, operation and use of a facility for the purpose of production.

4.2 Definitions of terms, stated in regulations relating to resource management in the petroleum activities (Resource Management Regulations, NPD 18 June 2001), used in the description of resource classes and categories

4.2.1 Discovery

A discovery is one petroleum deposit, or several petroleum deposits collectively, which have been discovered in the same wildcat well, in which through testing, sampling or logging there has been established a probability of the existence of mobile petroleum (includes both a commercial and a technical discovery).

4.2.2 Field

A field is one or more discoveries, which together are comprised by an approved plan for development and operation (PDO) or for which exemption from the PDO requirement has been granted.

4.2.3 Play model

A play model is a geographically and stratigraphically delimited area where a specific set of geological factors exists in order that petroleum may be provable in producible quantities. Such geological factors are reservoir rock, trap, mature source rock and migration paths, and

the trap must have been formed before termination of the migration of petroleum. All discoveries and prospects within the same play model are characterised by the specific set of geological factors of the play model.

Confirmed plays contain at least one discovery of producible quantities of petroleum. It is thus confirmed that the critical geological factors are simultaneously present for these plays.

Unconfirmed plays are plays in which no petroleum has so far been discovered, either because exploration has still not started, or only dry wells have been drilled in the play.

4.2.4 Prospect

A prospect is a possible petroleum trap with a mappable, delimited reservoir rock volume.

4.2.5 Reserves

Reserves comprise the remaining, recoverable, marketable petroleum resources from a petroleum deposit which the licensees have decided to develop and for which the authorities have approved a PDO or granted exemption for the requirement relating to a PDO. Reserves also comprise petroleum resources which the licensees have decided to develop but for which the authorities have not yet approved a PDO or granted exemption from.

With reference to the resource classification, reserves comprises petroleum resources in categories 1, 2 and 3,

4.2.6 Petroleum resources

All estimated volumes of petroleum.

4.2.7 Resources originally in place

Volumes of petroleum, which have been mapped according to geological methods, and which according to geological and reservoir engineering methods have been estimated to be present in a deposit. The estimate shall indicate volumes at market conditions.

Originally-in-place gas is divided into free gas and associated gas (dissolved in oil). Originally-in-place NGL means components dissolved in free gas, which will pass over into the NGL phase when the relevant, planned processing takes place. Originally-in-place oil resources are generally referred to as STOOIP (Stock Tank Oil Originally In Place) and corresponding originally-in-place gas resources as GOIP (Gas Originally In Place). Resources originally in place are classified as discovered or undiscovered.

4.2.8 Originally recoverable petroleum resources

Total, marketable volumes of petroleum, from production start until production has ceased, based on the applicable estimate of volumes in place and the recovery factor.

4.3 Other definitions used in the description of resource classes and categories

4.3.1 Unmapped resources

Unmapped resources in a play are the resources that come as a supplement to the discovered resources in the play and mapped resources in any prospects and leads.

4.3.2 Lead

A lead is a petroleum trap (or more than one trap) where the quantity and quality of available data are inadequate to map and delimit the reservoir rock volume.

4.3.3 Reserve reference point

The reserve reference point is the point of transfer of ownership or entitlement to produced petroleum from the licensee to another party. If the licensee transfers produced resources to his own activity, the reference point is looked upon as the point where transfer to another party would normally have taken place. Examples of such points are points for transferring to another production licence, or the first point where sale at an arm's length to another party can take place.

4.3.4 First oil/gas (F)

The petroleum resource is given the designation First (F) if it is linked to the initial recovery project for the relevant petroleum-in-place. First (F) is used in project status categories 2, 3, 4, 5 and 7. Supplementary resources are also given the designation F.

4.3.5 Additional oil/gas (A)

Petroleum resources are given the designation Additional (A) if they are linked to measures intended to improve production relative to initial plans. The A resources are normally positive, but may be negative, for instance in cases where oil recovery improvements require gas consumption, or where the improved production aims at accelerating production or reducing production costs with no or negative effect on the recoverable resources. Additional (A) resources are used in categories 2, 3, 4, 5 and 7.

4.3.6 Supplementary resources

Supplementary resources are recoverable resources that can be produced in addition to reserves and/or resources in a field or discovery by increasing the in-place resources. This will generally be brought about when new petroleum deposits are developed as part of the field or discovery. These may be petroleum deposits whose development has been postponed because of low profitability or as a consequence of the field being developed in stages. They may also be new discoveries. Supplementary resources are designated (F) in the classification system.

4.3.7 Contingent resources

Petroleum resources that have been discovered, but no decision has yet been taken regarding their production.

4.3.8 Undiscovered resources

Petroleum resources that are assumed to be present in defined plays (confirmed and unconfirmed), but which have still not been discovered.

4.3.9 Probability of discovery

The probability of discovery describes the possibility of proving petroleum in a prospect by drilling. The probability of discovery emerges through the product of the probabilities that the play exists, the presence of reservoirs, traps, migration of petroleum into traps and preservation of petroleum in the traps.

4.3.10 Improved production

Measures to enhance the production result compared with existing plans. This may take place through the recovery of a greater proportion of the in-place quantities, and/or that these are recovered more profitably. The quantities resulting from improved production may be positive or negative. The use of gas to increase the oil reserves will, for example, reduce the gas reserves.

4.3.11 Historical production

Historical production is the aggregated production of petroleum for sale and delivery from a field. Historical production refers to a time of reporting, generally the end of the previous year.

4.3.12 Recovery factor

The recovery factor is the ratio between the recoverable volume of petroleum from a petroleum deposit and the volume of petroleum originally in place in the deposit.

”Increased recovery factor” is used here for the increase in the expected recovery factor in relation to existing plans as a result of measures to improve recovery.

4.3.13 Oil

Oil is the total volume sold, or expected to be sold, as crude oil.

4.3.14 NGL

NGL (Natural Gas Liquids) are light products which it is assumed will be sold separately. If sold as part of the crude oil flow, NGL must be reported as crude oil.

4.3.15 Gas

Gas comprises quantities of gas that are sold and physically delivered, or planned to be delivered, from a field, but does not include gas which the field may receive from other fields.

4.3.16 Condensate and light oil

Condensate and light oil refers to the total volume of light products, which it is presumed will be sold as condensate and light oil. If they are sold as part of the crude oil flow, their volume must be reported as crude oil.

4.3.17 Resource estimate

All resource estimates must be stated with a low estimate, a base estimate and a high estimate. In the case of recoverable gas, a sales contract often decides how much will be produced. In some of these cases, only a volume estimate will be relevant. This must be the base estimate.

4.3.18 Low estimate

The low estimate must be lower than the base estimate. The probability of being able to recover the stated estimate or more must be stated (e.g. P90 or P80). Unlike the base estimate, the low estimate should be an expression of possible negative changes with respect to the mapping of the reservoir, reservoir parameters, or the recovery factor.

4.3.19 Base estimate

The base estimate must reflect the current understanding of the extension, characteristics and recovery factor of the reservoir. The base estimate will be calculated deterministically or stochastically. If the base estimate is calculated by a stochastic method, it should correspond to the mean value.

4.3.20 High estimate

The high estimate must be higher than the base estimate. The probability of being able to recover the stated estimate or more must be stated (e.g. P10 or P20). Unlike the base estimate,

the high estimate must be an expression of possible positive changes with respect to the mapping of the reservoir, reservoir parameters, or the recovery factor.

4.4 Conversion factors

Oil equivalents (abbreviated o.e.) are used when quantities of oil, gas, NGL and condensate resources are to be added up. Such a summation may take place by employing a common property, e.g. energy, mass, volum or sales value. The Norwegian Petroleum Directorate employs a volumetric conversion factor of NGL to liquid and an energy based conversion of gas, based on typical properties(*) for the Norwegian continental shelf:

1000 Sm³ of gas corresponds to 1 Sm³ o.e.

1 Sm³ of oil corresponds to 1 Sm³ o.e.

1 tonne of NGL corresponds to 1.9 Sm³ o.e.

Conversion factors between SI units and "oil field units" are:

1 Sm³ = 6.29 barrels

1 Sm³ = 35.3 Scf (standard cubic feet)

1 barrel = 0.159 Sm³

1 Scf = 0.028 Sm³

** The properties of oil, gas and NGL varies from field to field, and by time. In the resource account a common and constant conversion factor is used for all fields and discoveries.*

5 Examples of the use of the classification system

5.1 Oil field in production

The field used as a hypothetical example, Alfa, has resources in two petroleum deposits, called Alfa and Beta. The Alfa deposit has been in production for several years. The originally recoverable reserves (before production started) were calculated to be 380 million Sm^3 of oil. 70 million Sm^3 of oil have been produced (category 0). The remaining marketable reserves (category 1) are the difference between the originally recoverable resources and the quantity produced.

The licensees have had a PDO approved to install new wellhead equipment to increase the number of production and injection wells. This will increase the recovery by 50 million Sm^3 of oil (category 2A).

The operator believes it is realistic to expect that future technological development will enable 70 per cent of the oil in the Alfa deposit to be produced. This will increase the recovery by a further 40 million Sm^3 of oil (category 7A).

The Beta petroleum deposit is smaller and has poorer reservoir characteristics than the Alfa deposit. It has therefore not been developed. The Beta deposit has been drilled from Alfa and 10 million Sm^3 of recoverable oil have been discovered. The licensees have prepared a PDO and decided to submit this to the authorities (category 3F).

If production from the Beta deposit is successful, the well slots from two closed down Alfa wells may be able to be used as new production wells within 5 years. The recoverable resources in the Beta deposit will then increase by 15 million Sm^3 of oil (category 4A).

The operator has mapped three prospects, which will soon be drilled. These can be connected directly to the field. The risk-weighted resources amount to a total of 3 million Sm^3 of oil (category 8).

The resources in this field must then be classified in the following manner (note that high and low sums are calculated stochastically and do not emerge by directly adding up the high and low estimates):

Field: Alfa, oil production

Deposit	Status	5.1.1.1	C	5.1.1.1	5.1.1.1	5.1.1.1
			a			
			t			
			e			
			g			
			o			
			r			
			y			
Alfa	Sold and delivered	0		70	70	70
Alfa	Reserves in production	1		250	310	380
Alfa	Decision to install wellhead equipment	2A		35	50	70
Beta	Licensees decide to submit a PDO	3F		5	10	20
	5.1.1.2 Sum reserves			319	370	423
Beta	Planning phase; new wells being considered	4A		3	5	8
	Sum discovered resources			323	375	430
Alfa	Resources from possible future measures to improve the recovery factor	7A		20	40	70
	Prospects	8		1	3	8
	Total remaining recoverable resources			345	418	500

5.2 Gas field in production

The field used as a hypothetical example, Gamma, has two petroleum deposits, called Gamma and Omega. The Gamma deposit has been in production for several years. The originally recoverable resources were calculated to be 50 billion Sm³ of gas. 30 billion Sm³ of gas have been produced (category 0) within a sales contract for 100 billion Sm³.

The remaining reserves (category 1) are the difference between the quantity stated in the sales contract and the quantity produced, 70 billion Sm³. The remaining recoverable resources that have not been sold, which constitute the difference between the originally recoverable resources and the quantity stated in the sales contract (50 billion Sm³), are expected to be sold later without requiring significant investments (category 3A).

The Omega petroleum deposit has been discovered by drilling, but its reservoir characteristics are poor and the extension of the reservoir is uncertain. There is no pressure communication

between the two petroleum deposits. The calculated resources, 15 billion Sm³, are very uncertain and it is necessary to drill more delineation wells. The project is therefore very uncertain. It is assumed that the deposit can be put into production when the Gamma deposit reaches its decline phase (category 5F).

A prospect, Kappa, has been mapped close to the field. The risk-weighted recoverable resources, 8 billion Sm³, are expected to be produced from the installation on the gas field, and are classified as an additional prospect to the field (category 8). The resources in the field must then be classified in the following manner (note that high and low sums are calculated stochastically and do not emerge by directly adding up high and low estimates):

Field: Gamma, gas production

5.2.1.1.1	Status	Category	Low	Base	High
Gamma	Sold and delivered	0	30	30	30
Gamma	Reserves in production; quantity of gas remaining in the sales contract	1	50	70	90
Gamma	Gas that has not been sold, but can be sold later without significant investments	3A	35	50	70
	Sum remaining reserves		94	120	130
Omega	Likely, but not clarified recovery	5F	5	15	30
Kappa	5.2.1.2 Prospect	8	2	8	35
	5.2.1.2.1 Total remaining recoverable resources		102	143	180

6 Diagram summarising the new resource classification system

