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Ad Hoc Group of Experts on the Harmonization
of Energy Reserves/Resources Terminology

**United Nations Framework Classification (UNFC)
Applied to Petroleum Resources**

(Document) elaborated by the UNECE Task Force on Petroleum^{1/}

Table of Contents

1.0	Introduction.....	2
2	Main subdivisions.....	2
2.1	Quantities in place and recoverable quantities.....	2
2.2	Classification of quantities in-place.....	3
2.3	Recoverable quantities.....	3
2.3.1	Economic subdivisions.....	4
2.3.2	Field Project (Feasibility) Subdivisions.....	4
2.3.3	Geologic subdivisions.....	5
2.4	Key number.....	5
3	Relationships between UNFC and the SPE/WPC/AAPG classification.....	6
4	Further subdivision of the UNFC.....	6
	Appendix A Draft definitions.....	9
	Appendix B The SPE/WPC/AAPG resource classification of 2000.....	15
	Appendix C The SPE/WPC reserves definitions of 1997.....	20
	Appendix D Petroleum Resource Classification of the Norwegian Petroleum Directorate.....	26

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¹ -*/In accordance with the decision of the Committee on Sustainable Energy (ECE/ENERGY/49,para.16).

1 Introduction

This document has been developed by the Petroleum Task Force, within the Ad Hoc Group of Experts on the Harmonization of Energy Reserves/Resources Terminology, a subsidiary body of the UNECE Committee on Sustainable Energy. It was considered by the Task Force meeting held in Stavanger, Norway, on 23-24 September 2002, and by the Ad Hoc Group meeting, held in Geneva, on 14-15 November 2002.

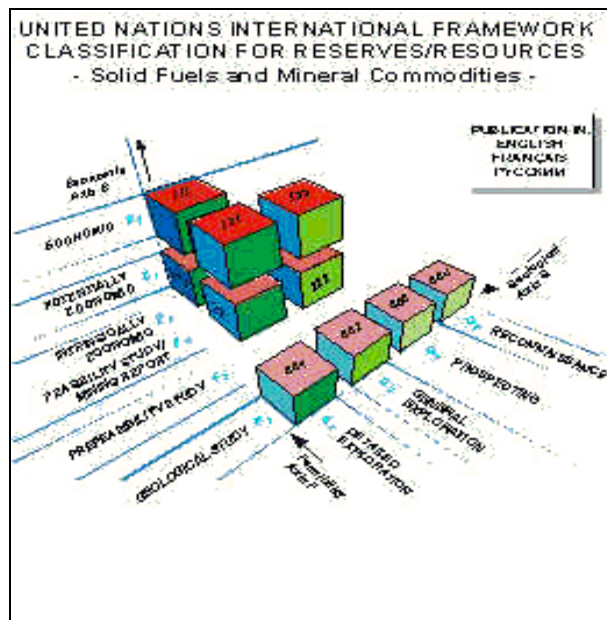


Figure 1 The UNFC

A strength of the United Nations Framework Classification (UNFC) is the use of three independent axes to categorize energy reserves and resources.

This strength should be exploited, but with caution so as to avoid the inconveniences of a large number of categories.

2 Main subdivisions

2.1 Quantities in place and recoverable quantities

Petroleum resources will be recovered from natural occurrences of petroleum in the subsoil through industrial projects. Recoverable quantities are therefore related primarily to the industrial projects. Recoverable quantities are therefore related primarily to the industrial projects.

Their classification reflects the economics, the field development and production status as well as the degree of geological definition of the projects, and as a consequence, their activities, costs, production and emissions.

The industrial projects are in turn related to the quantities in-place. There will always be an initial project, that first recovers petroleum from an in-place quantity. Normally, this is followed by additional projects for improved recovery that draws on the same in-place quantities. In the classification, the in-place quantities are part of the administrative information defining the projects. Accounts of in-place quantities are always kept separate from the accounts of recoverable quantities.

2.2 Classification of quantities in-place

The in-place quantities may be categorised using categories that reflect geologic definition (the G-axis). In order to distinguish in-place quantities from recoverable quantities, separate codes are introduced. A classification is proposed in the table below.

Key number	Geology axis in-place (GI)
I 0	In-place quantities unclassified
I 1 - 3	Discovered in-place quantities
I 1	Proved in-place quantities
I 2	Explored and delineated in-place quantities
I 3	Discovered in-place quantities
I 4	Prospective in-place quantities

Table 1 Codes for classification of in-place quantities

2.3 Recoverable quantities

The total recoverable petroleum resource base is divided into three main classes. These are:

- Reserves
- Contingent resources
- Prospective resources

The quantities in these classes are defined by the status of the industrial projects aimed at recovering them.

The quantity of petroleum recoverable through industrial production projects is uncertain in two distinct ways:

1. The quantity to be produced through the execution of any one project will have some uncertainty associated with it, normally expressed by use of a continuous probability distribution function or some other form reflecting such a function.
2. Whether a given project, or a required series of projects will be executed may be uncertain. For projects designated to produce reserves, this uncertainty will, for practical purposes have been eliminated. Projects to discover prospective resources and projects to mature contingent resources to reserves will all normally have a discrete probability (chance) of failure. This may be expressed qualitatively through the classification categories, or quantitatively as a probability, depending on the application.

In the UNFC, three independent axes are established to further enhance the characterisation of the resources. They are:

- The economic axis (E)
- The field project (feasibility) axis (F)

- The geologic axis (G)

Their short names are E, F and G respectively. It is recommended to use this alphabetic nomenclature consistently, and in that order. It is easy to remember and the sequence will be necessary when numbering the categories in order to produce a classification independent of languages.

In petroleum, there is a strong need to keep track of quantities that normally are more mature than those addressed in feasibility studies. In financial reporting, for instance, it is essential to distinguish developed reserves, where the capital expenditures have been made and are reflected in the financial accounts, from the undeveloped reserves, where the expenditures have not been incurred and are not reported. It is therefore suggested to rename the F-axis the Field project axis.

2.3.1 *Economic subdivisions*

Three main subdivisions of the economic axis are suggested:

1. Commercial
2. Contingent commerciality (Commerciality contingent on unresolved economic conditions)
3. Not commercial (on economic grounds)

Although the terms need to be defined precisely, they are more or less self-explanatory, with the possible exception of the first. Commercial will, as a sub-set, also include Commercial at standard (economic) conditions. There is a need to use standardised commercial conditions in instances where estimates of reserves need to be compared on a common commercial basis. Such standard conditions are used extensively when supplementing financial statements with reports on reserves. They are also used in portfolio management, both for project comparison and selection, and in portfolio risk management. Not commercial will include Intrinsically commercial.

2.3.2 *Field Project (Feasibility) Subdivisions*

The following main subdivisions are suggested:

1. Produced petroleum
2. Committed projects
3. Contingent projects
4. Exploration projects

Produced petroleum is not strictly a reserve or resource class. It is suggested for generating a convenient repository for accounts of past production, and as a mean of establishing a basis for estimates of ultimate recovery (EUR). Ultimate recovery is the remaining reserves or resources plus past production. The concept is used extensively in the process of estimating reserves¹.

Once resources are related to projects, it becomes clear that quantities recoverable through initial developments and quantities recoverable through improvement of existing or planned projects may be

¹ Ultimate recovery is more widely used in the petroleum industry than the mineral industry as many hydrocarbon estimation techniques provide estimates of EUR as a direct result.

categorised separately. This is practical strength, allowing resources, industrial efforts and financial requirements to be linked properly.

2.3.3 *Geologic subdivisions*

Four main geologic subdivisions are suggested:

1. Proven geology
2. Explored and delineated geology
3. Discovered accumulations
4. Prospective accumulations

The terms need precise definition. Their general meaning is self-explanatory.

2.4 **Key number**

In this note, a key number system with two digits is used. This allows sub-categories to be defined if needed and identified in an easy way. The Key number refers to each of the three independent axes (Table 2 and Table 3). A negative Key number is used for Produced amounts to avoid Produced amounts to be added to the Remaining amounts (Reserves, Contingent resources and Prospective resources).

Key Number	Economic axis(E)	Field project (Feasibility) axis (F)	Geology axis(G)
-10		Produced	
10	Commercial	Committed	Proved
20	Contingent commerciality	Contingent project	Explored and delineated
30	Not commercial	Exploration	Discovered
40			Prospective

Table 2 Suggested main subdivisions of the UNFC for the petroleum sector

3 Relationships between UNFC and the SPE/WPC/AAPG classification

UNFC as outlined above conforms closely with the SPE/WPC/AAPG classification.

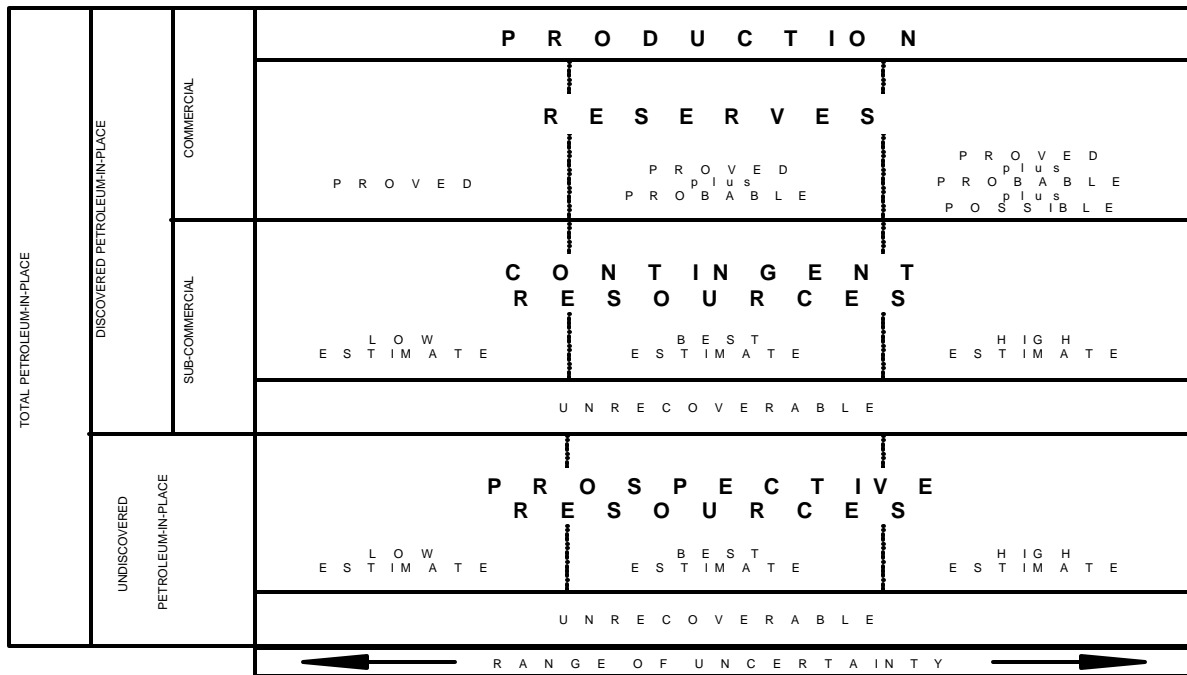


Figure 1 The SPE/WPC/AAPG classification

The field project axis is in line with the project status approach of the SPE/WPC/AAPG classification:

- Production is found in both classifications
- Reserves conform to committed projects. Reserves will be commercial on the economic axis and have proven or explored and delineated geology on the geologic axis. Proved reserves will need to be commercial at standard commercial conditions on the economic axis (sub-set of Commercial) and have proven geology on the geology axis.
- Contingent resources will always be produced by contingent projects on the F axis. They may fall in any of the categories on the E axis and in any of the discovered categories on the G axis. This demonstrates the strength of the cubic nature of the UNFC.
- Prospective resources will always be under exploration projects on the F axis, and as undiscovered on the G axis. On the E axis they will normally be contingent (at least on confirming their presence) or non-commercial.

4 Further subdivision of the UNFC

Further subdivision of the UNFC axes should be given careful consideration. The Ad Hoc group may wish to consider whether to recommend such subdivision, or to leave it to the region, country, energy commodity or company to make their own.

A discussion of specific examples may facilitate these considerations. Suggestions are proposed for the F axis only:

1. **Produced petroleum:** Subdivision may be desirable for accounting and management purposes. The reserves reference point may typically be the sales flange in order to create correspondence between reserves, production and financial accounts. For technical use it may be desirable to also keep accounts at other points, such as at wellheads and at inlets and outlets to processing facilities in order to monitor recovery and processing efficiencies, usages, losses etc. Flare, fuel and losses will not be included if they occur upstream the reference point, except where fuel is accounted for as an operating cost.
2. **Committed projects:** These may be subdivided to agree with the SPE/WPC/AAPG reserve status categories of Producing and Developed reserves. In addition, it may be valuable to distinguish projects in development from projects where development has not yet started.
3. **Contingent projects:** There may be a general need to subdivide contingent projects in order to allow the continuation of an older industry practise of quoting as probable and possible reserves also part of the more mature contingent resources.
Tests conducted on the national and company levels in Norway have led to a subdivision into Projects in Planning, Unclarified Projects, Undefined Projects and Not very likely Projects.
4. **Exploration projects:** The justification for general subdivision of exploration projects is not rooted in as strong requirements and traditions as the quoted subdivisions of the other categories. Again the tests in Norway have concluded that it is practical to subdivide exploration projects in exploration of prospects and exploration of leads/plays. Management requirements may demand further subdivision into exploration of prospects ready for drilling, exploration (or the lack of exploration) of prospects not ready for drilling, exploration for prospects in leads and plays and reconnaissance exploration (including no exploration) of leads and plays.

Key Number	Economic axis (E)	Field project axis (F)	Geology axis (G)
-10		Produced petroleum	
-11			
10	Commercial	Committed projects	Proved geology
11		Developed	
12		In Development	
13		Undeveloped	
20	Contingent commerciality	Contingent projects	Explored and delineated geology
21		In planning	
22		Unclarified	
23		Undefined	
24		Not very likely	
30	Not commercial	Exploration projects	Discovered geology
31		Exploration of prospect matured for drilling	
32		Exploration of prospect not matured for drilling	
33		Lead/play under exploration	
		Unexplored lead or play under reconnaissance, or without exploration effort	
40			Prospective geology
41			

Table 3 UNFC for the petroleum sector with full subdivision of the F-axis

APPENDIX A
DRAFT DEFINITIONS

Reference	Term	Definition
Merriam-Webster online	Commercial	Suitable, adequate, or prepared for the exchange or buying and selling of commodities on a large scale involving transportation from place to place
New	Committed project	A project where the parties who have the rights to undertake it have done so. Projects are committed when they produce hydrocarbons, are developed, or are in development. Undeveloped projects are committed only when the relevant parties have undertaken to carry them out within a reasonable timeframe, or when decisions of the parties and prior committed projects de facto provide a commitment to define and execute them later. These commitments should be unconditional, except for timing that may be dependent on the development of prior committed projects. An example of this would be where fields are dedicated to a long-term supply contract and will only be developed as and when they are required to satisfy the contract.
New	Contingent	Dependent upon conditions that may or may not be fulfilled.
New	Contingent project	Project dependent upon conditions that may or may not be fulfilled.
Adapted from SPE	Contingent resources	<p>Contingent resources are those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from known accumulations, but which are not currently considered to be commercially recoverable.</p> <p>A discovered resource will remain contingent as long as there is no prudent basis for making a commitment to produce it. When such a basis exists, the resources will remain contingent until the commitment is made (explicitly or de facto).</p> <p>Contingent Resources may include, for example, accumulations for which there is currently no viable market, or where commercial recovery is dependent on the development of new technology, or where evaluation of the accumulation is still at an early stage.</p>
Adapted from SPE	Developed projects	Developed projects are those from which reserves are expected to be recovered from existing wells including reserves behind pipe. Developed projects are committed and may be sub-categorized as producing or non-producing.

Reference	Term	Definition
New	Discovered (on the geology axis)	Discoveries where the geologic conditions in which petroleum occurs have been observed directly through drilling, but where they are not known to the extent required for the geology to be considered explored and delineated.
Adapted from NPD	Discovery	A discovery is one petroleum accumulation (also called deposit or pool), or several petroleum accumulations collectively that have been discovered in the same wildcat well, in which there has been established a probability of the existence of mobile petroleum (includes both a commercial and a technical discovery) through testing, sampling or logging. This includes the hydrodynamically accumulated as well as the distributed or continuous resources. Examples of such distributed or continuous resources are heavy oil, basin centre gas, gas hydrates, coal bed methane, etc.
New	Exploration project	Exploration (prospecting) of undiscovered quantities of petroleum that are estimated, on a give date, to be potentially recoverable.
New	Explored and delineated geology	Discoveries where the geologic conditions, fluid properties and flow characteristics are well enough known to form the basis for a development commitment for the production of reserves.
New	Field	A field is one or more discoveries together that are comprised in one plan for development and operation.
Webster New World Dictionary	Hydrocarbons	Any compound containing only hydrogen and carbon: benzene and methane are hydrocarbons.
Adapted from NDP	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.
New	Lead/play under exploration	A lead or play for which a decision has been taken to gather geological, geophysical, geochemical and other adequate data to map and delimit the reservoir. The pupose shall be to prepare a decision of whether or not to proceed to direct detection of petroleum through drilling.
New	Lead or play under reconnaissance	Unexplored lead or play under reconnaissance or without exploration effort.
New	Not commercial	Not commercial under current economic conditions and fiscal terms, nor under such conditions and terms that may be expected in the future based on current information.

Reference	Term	Definition
SPE has been requested to consider refining the definition with respect to the heavy fractions	Petroleum	All liquid and gaseous hydrocarbons, including gas hydrates and bitumen which exist in their natural state in the subsoil, as well as other substances produced in association with such hydrocarbons.
Adapted from NPD	Play	<p>A play is a geographically and stratigraphically delimited area where a specific set of geological factors exists that are required for petroleum to be found in commercial quantities. Such geological factors are reservoir rock, trap, mature source rock and migration paths. The trap must have formed before termination of the migration of petroleum. All discoveries and prospects within the same play are characterised by the specific set of geological factors of the play.</p> <p><i>Confirmed play</i> contains at least one discovery of commercial quantities of petroleum. It is thus confirmed that the critical geological factors are simultaneously present for the play.</p> <p><i>Unconfirmed play</i> is a play in which no petroleum has been discovered, either because exploration has still not started, or because only dry wells have been drilled in the play.</p>
New	Produced Petroleum	Petroleum removed from its natural state in the subsoil, properly processed and measured at its reference point.
New	Project in development	A committed project whose plan for development has been approved as required and where the development works have started or are imminent.
New	Project in planning	A project where a decision to develop a full plan for development and operation has been taken. Normally, critical elements that may prevent development will have been eliminated before planning of the full development starts.
New	Project not very likely	Discovered and technically recoverable petroleum resources for which a project to recover them is not very likely, even in the long term. This includes resources in small, untested discoveries whose recovery seems unlikely. This category

Reference	Term	Definition
		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 would take place.
NPD:	Prospect	A prospect is a possible petroleum trap with a mappable, delimited reservoir rock volume.
New	Prospect matured for drilling	A prospect for which the decision to explore by drilling has been taken.
New	Prospect not matured for drilling	A prospect for which the decision to explore by drilling has not been taken.
New	Prospective resources	Prospective resources are those quantities of petroleum that are postulated from geological information and theory, on a given date, to be potentially recoverable from outside of known oil and gas fields.
SPE	Proved reserves	<p>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. Proved reserves can be categorized as developed or undeveloped.</p> <p>If deterministic methods are used, the term reasonable certainty is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90% probability that the quantities actually recovered will equal or exceed the estimate.</p> <p>Establishment of current economic conditions should include relevant historical petroleum prices and associated costs and may involve an averaging period that is consistent with the purpose of the reserve estimate, appropriate contract obligations, corporate procedures, and government regulations involved in reporting these reserves.</p> <p>In general, reserves are considered proved if the commercial producibility of the reservoir is supported by actual production or formation tests. In this context, the term proved refers to the actual quantities of petroleum reserves</p>

Reference	Term	Definition
		<p>and not just the productivity of the well or reservoir. 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.</p> <p>The area of the reservoir considered as proved includes (1) the area delineated by drilling and defined by fluid contacts, if any, and (2) the undrilled 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.</p> <p>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. 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, (3) the locations conform to existing well spacing regulations where applicable, and (4) it is reasonably certain the locations will be developed. Reserves from other locations are categorized as proved undeveloped only where interpretations of geological and engineering data from wells indicate with reasonable certainty that the objective formation is laterally continuous and contains commercially recoverable petroleum at locations beyond direct offsets.</p> <p>Reserves which are to be produced through the application of established improved recovery methods are included in the proved classification when (1) successful testing by a pilot project or favorable response of an installed program in the same or an analogous reservoir with similar rock and fluid properties provides support for the analysis on which the project was based, and, (2) it is reasonably certain that the project will proceed. Reserves to be recovered by improved recovery methods that have yet to be established through commercially successful applications are included in the proved classification only (1) after a favorable production response from the subject reservoir from either (a) a</p>

Reference	Term	Definition
		representative pilot or (b) an installed program where the response provides support for the analysis on which the project is based and (2) it is reasonably certain the project will proceed.
New	Proved geology	Geology is considered proved when it is known to the extent and detail specified in the definition of proved reserves.
Adapted from SPE	Reserves	Reserves are those quantities of petroleum that are anticipated to be commercially recovered from known accumulations from a given date forward as a result of development and production commitments.
New	Resources	Resources are comprised of reserves, contingent resources and prospective resources.
New	Standard commercial conditions	Standard economic conditions are fixed by agreement or regulation. They normally include relevant historical petroleum prices and associated costs (including listed future prices) and may involve an averaging period that is consistent with the purpose of the reserve estimate, appropriate contract obligations, corporate procedures, and government regulations involved in reporting these reserves.
New	Unclarified project	A project that has been properly evaluated, and where the possibility for development is high. The planning of a development project has not been initiated, normally pending the clarification of certain critical factors that may prevent successful development and production.
New	Undefined project	New discovery where the evaluation of the acquired data are not yet evaluated. An undefined project may also be a possible, or conceptual improved recovery project aimed at improving the recovery that may be achieved through other, more firmly defined projects in the reserves or contingent resources categories.
New	Undeveloped project	Projects that the parties who have the right to undertake development and production are committed to undertake but where the plans are not yet prepared for approval and execution.
New	Unexplored lead or play	An unconfirmed lead or play where at most reconnaissance exploration has been conducted

App A The SPE/WPC/AAPG resource classification of 2000

Resources

In March 1997, the Society of Petroleum Engineers (SPE) and the World Petroleum Congresses (WPC) approved a set of [petroleum*](#) reserves definitions which represented a major step forward in their mutual desire to improve the level of consistency in reserves estimation and reporting on a worldwide basis. As a further development, the SPE and WPC recognized the potential benefits to be obtained by supplementing those definitions to cover the entire resource base, including those quantities of petroleum contained in accumulations that are currently sub-commercial or that have yet to be discovered. These other resources represent potential future additions to reserves and are therefore important to both countries and companies for planning and portfolio management purposes. In addition, the American Association of Petroleum Geologists (AAPG) participated in the development of these definitions and joined SPE and WPC as a sponsoring organization.

In 1987, the WPC published its report "Classification and Nomenclature Systems for Petroleum and Petroleum Reserves," which included definitions for all categories of resources. The WPC report, together with definitions by other industry organizations and recognition of current industry practice, provided the basis for the system outlined here.

Nothing in the following resource definitions should be construed as modifying the existing definitions for petroleum reserves as approved by the SPE/WPC in March 1997.

As with unproved (i.e. probable and possible) reserves, the intent of the SPE and WPC in approving additional classifications beyond proved reserves is to facilitate consistency among professionals using such terms. In presenting these definitions, neither organization is recommending public disclosure of quantities classified as resources. Such disclosure is left to the discretion of the countries or companies involved.

Estimates derived under these definitions rely on the integrity, skill, and judgement of the evaluator and are affected by the geological complexity, stage of exploration or development, degree of depletion of the reservoirs, and amount of available data. Use of the definitions should sharpen the distinction between various classifications and provide more consistent resources reporting.

DEFINITIONS. The resource classification system is summarized in Figure 1 and the relevant definitions are given below. Elsewhere, resources have been defined as including all quantities of petroleum which are estimated to be initially-in-place; however, some users consider only the estimated recoverable portion to constitute a resource. In these definitions, the quantities estimated to be initially-in-place are defined as Total Petroleum-initially-in-place, Discovered Petroleum-initially-in-place and Undiscovered Petroleum-initially-in-place, and the recoverable portions are defined separately as Reserves, Contingent Resources and Prospective Resources. In any event, it should be understood that reserves constitute a subset of resources, being those quantities that are discovered (i.e. in known accumulations), recoverable, commercial and remaining.

TOTAL PETROLEUM-INITIALLY-IN-PLACE. Total Petroleum-initially-in-place is that quantity of petroleum which is estimated to exist originally in naturally occurring accumulations. Total Petroleum-initially-in-place is, therefore, that quantity of petroleum which is estimated, on a given date, to be contained in known accumulations, plus those quantities already produced therefrom, plus those estimated quantities in accumulations yet to be discovered. Total Petroleum-initially-in-place may be subdivided into Discovered Petroleum-initially-in-place and Undiscovered Petroleum-initially-in-place, with Discovered Petroleum-initially-in-place being limited to known accumulations.

It is recognized that all Petroleum-initially-in-place quantities may constitute potentially recoverable resources since the estimation of the proportion which may be recoverable can be subject to significant uncertainty and will change with variations in commercial circumstances, technological developments and data availability. A portion

of those quantities classified as Unrecoverable may become recoverable resources in the future as commercial circumstances change, technological developments occur, or additional data are acquired.

DISCOVERED PETROLEUM-INITIALLY-IN-PLACE. 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 therefrom. Discovered Petroleum-initially-in-place may be subdivided into Commercial and Sub-commercial categories, with the estimated potentially recoverable portion being classified as Reserves and Contingent Resources respectively, as defined below.

RESERVES. Reserves are defined as those quantities of petroleum which are anticipated to be commercially recovered from known accumulations from a given date forward. Reference should be made to the full SPE/WPC Petroleum Reserves Definitions for the complete definitions and guidelines.

Estimated recoverable quantities from known accumulations which do not fulfil the requirement of commerciality should be classified as Contingent Resources, as defined below. The definition of commerciality for an accumulation will vary according to local conditions and circumstances and is left to the discretion of the country or company concerned. However, reserves must still be categorized according to the specific criteria of the SPE/WPC definitions and therefore proved reserves will be limited to those quantities that are commercial under current economic conditions, while probable and possible reserves may be based on future economic conditions. In general, quantities should not be classified as reserves unless there is an expectation that the accumulation will be developed and placed on production within a reasonable timeframe.

In certain circumstances, reserves may be assigned even though development may not occur for some time. An example of this would be where fields are dedicated to a long-term supply contract and will only be developed as and when they are required to satisfy that contract.

CONTINGENT RESOURCES. Contingent Resources are those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from known accumulations, but which are not currently considered to be commercially recoverable.

It is recognized that some ambiguity may exist between the definitions of contingent resources and unproved reserves. This is a reflection of variations in current industry practice. It is recommended that if the degree of commitment is not such that the accumulation is expected to be developed and placed on production within a reasonable timeframe, the estimated recoverable volumes for the accumulation be classified as contingent resources.

Contingent Resources may include, for example, accumulations for which there is currently no viable market, or where commercial recovery is dependent on the development of new technology, or where evaluation of the accumulation is still at an early stage.

UNDISCOVERED PETROLEUM -INITIALLY -IN-PLACE. Undiscovered Petroleum-initially-in-place is that quantity of petroleum which is estimated, on a given date, to be contained in accumulations yet to be discovered. The estimated potentially recoverable portion of Undiscovered Petroleum-initially-in-place is classified as Prospective Resources, as defined below.

PROSPECTIVE RESOURCES. Prospective Resources are those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from undiscovered accumulations.

ESTIMATED ULTIMATE RECOVERY. Estimated Ultimate Recovery (EUR) is not a resource category as such, but a term which may be applied to an individual accumulation of any status/maturity (discovered or undiscovered). Estimated Ultimate Recovery 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 therefrom.

AGGREGATION. Petroleum quantities classified as Reserves, Contingent Resources or Prospective Resources should not be aggregated with each other without due consideration of the significant differences in the criteria associated with their classification. In particular, there may be a significant risk that accumulations containing Contingent Resources or Prospective Resources will not achieve commercial production.

RANGE OF UNCERTAINTY. The Range of Uncertainty, as shown in Figure 1, reflects a reasonable range of estimated potentially recoverable volumes for an individual accumulation. Any estimation of resource quantities for an accumulation is subject to both technical and commercial uncertainties, and should, in general, be quoted as a range. In the case of reserves, and where appropriate, this range of uncertainty can be reflected in estimates for Proved Reserves (1P), Proved plus Probable Reserves (2P) and Proved plus Probable plus Possible Reserves (3P) scenarios. For other resource categories, the terms Low Estimate, Best Estimate and High Estimate are recommended.

The term "Best Estimate" is used here as a generic expression for the estimate considered to be the closest to the quantity that will actually be recovered from the accumulation between the date of the estimate and the time of abandonment. If probabilistic methods are used, this term would generally be a measure of central tendency of the uncertainty distribution (most likely/mode, median/P50 or mean). The terms "Low Estimate" and "High Estimate" should provide a reasonable assessment of the range of uncertainty in the Best Estimate.

For undiscovered accumulations (Prospective Resources) the range will, in general, be substantially greater than the ranges for discovered accumulations. In all cases, however, the actual range will be dependent on the amount and quality of data (both technical and commercial) which is available for that accumulation. As more data become available for a specific accumulation (e.g. additional wells, reservoir performance data) the range of uncertainty in EUR for that accumulation should be reduced.

RESOURCES CLASSIFICATION SYSTEM

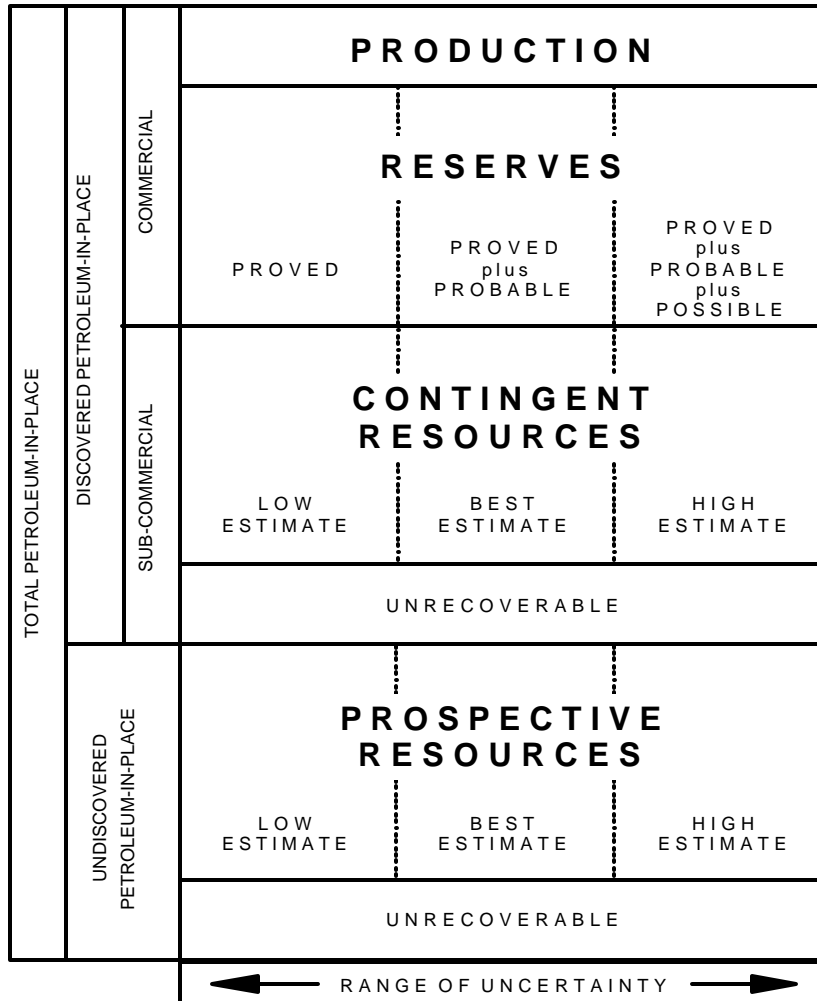
Graphical Representation

Figure 1 is a graphical representation of the definitions. The horizontal axis represents the range of uncertainty in the estimated potentially recoverable volume for an accumulation, whereas the vertical axis represents the level of status/maturity of the accumulation. Many organizations choose to further sub-divide each resource category using the vertical axis to classify accumulations on the basis of the commercial decisions required to move an accumulation towards production.

As indicated in Figure 1, the Low, Best and High Estimates of potentially recoverable volumes should reflect some comparability with the reserves categories of Proved, Proved plus Probable and Proved plus Probable plus Possible, respectively. While there may be a significant risk that sub-commercial or undiscovered accumulations will not achieve commercial production, it is useful to consider the range of potentially recoverable volumes independently of such a risk. If probabilistic methods are used, these estimated quantities should be based on methodologies analogous to those applicable to the definitions of reserves; therefore, in general, there should be at least a 90% probability that, assuming the accumulation is developed, the quantities actually recovered will equal or exceed the Low Estimate. In addition, an equivalent probability value of 10% should, in general, be used for the High Estimate. Where deterministic methods are used, a similar analogy to the reserves definitions should be followed.

As one possible example, consider an accumulation that is currently not commercial due solely to the lack of a

FIGURE 1 - RESOURCE CLASSIFICATION SYSTEM



market. The estimated recoverable volumes are classified as Contingent Resources, with Low, Best and High estimates. Where a market is subsequently developed, and in the absence of any new technical data, the accumulation moves up into the Reserves category and the Proved Reserves estimate would be expected to approximate the previous Low Estimate.

(not to scale)

Approved by the Board of Directors, Society of Petroleum Engineers (SPE) Inc., the Executive Board, World Petroleum Congresses (WPC), and the Executive Committee, American Association of Petroleum Geologists (AAPG), February 2000

App B The SPE/WPC reserves definitions of 1997

Preamble

Petroleum² is the world's major source of energy and is a key factor in the continued development of world economies. It is essential for future planning that governments and industry have a clear assessment of the quantities of petroleum available for production and quantities which are anticipated to become available within a practical time frame through additional field development, technological advances, or exploration. To achieve such an assessment, it is imperative that the industry adopt a consistent nomenclature for assessing the current and future quantities of petroleum expected to be recovered from naturally occurring underground accumulations. Such quantities are defined as reserves, and their assessment is of considerable importance to governments, international agencies, economists, bankers, and the international energy industry.

The terminology used in classifying petroleum substances and the various categories of reserves have been the subject of much study and discussion for many years. Attempts to standardize reserves terminology began in the mid 1930's when the American Petroleum Institute considered classification for petroleum and definitions of various reserves categories. Since then, the evolution of technology has yielded more precise engineering methods to determine reserves and has intensified the need for an improved nomenclature to achieve consistency among professionals working with reserves terminology. Working entirely separately, the Society of Petroleum Engineers (SPE) and the World Petroleum Congresses (WPC) produced strikingly similar sets of petroleum reserve definitions for known accumulations which were introduced in early 1987. These have become the preferred standards for reserves classification across the industry. Soon after, it became apparent to both organizations that these could be combined into a single set of definitions which could be used by the industry worldwide. Contacts between representatives of the two organizations started in 1987, shortly after the publication of the initial sets of definitions. During the World Petroleum Congress in June 1994, it was recognized that while any revisions to the current definitions would require the approval of the respective Boards of Directors, the effort to establish a worldwide nomenclature should be increased. A common nomenclature would present an enhanced opportunity for acceptance and would signify a common and unique stance on an essential technical and professional issue facing the international petroleum industry.

As a first step in the process, the organizations issued a joint statement which presented a broad set of principles on which reserves estimations and definitions should be based. A task force was established by the Boards of SPE and WPC to develop a common set of definitions based on this statement of principles. The following joint statement of principles was published in the January 1996 issue of the SPE Journal of Petroleum Technology and in the June 1996 issue of the WPC Newsletter:

There is a growing awareness worldwide of the need for a consistent set of reserves definitions for use by governments and industry in the classification of petroleum reserves. Since their introduction in 1987, the Society of Petroleum Engineers and the World Petroleum Congresses reserves definitions have been standards for reserves classification and evaluation worldwide.

SPE and WPC have begun efforts toward achieving consistency in the classification of reserves. As a first step in this process, SPE and WPC issue the following joint statement of principles.

SPE and WPC recognize that both organizations have developed a widely accepted and simple nomenclature of petroleum reserves.

² For the purpose of these definitions, the term petroleum refers to naturally occurring liquids and gases which are predominately comprised of hydrocarbon compounds. Petroleum may also contain non-hydrocarbon compounds in which sulfur, oxygen, and/or nitrogen atoms are combined with carbon and hydrogen. Common examples of non-hydrocarbons found in petroleum are nitrogen, carbon dioxide, and hydrogen sulfide.

SPE and WPC emphasize that the definitions are intended as standard, general guidelines for petroleum reserves classification which should allow for the proper comparison of quantities on a worldwide basis.

SPE and WPC emphasize that, although the definition of petroleum reserves should not in any manner be construed to be compulsory or obligatory, countries and organizations should be encouraged to use the core definitions as defined in these principles and also to expand on these definitions according to special local conditions and circumstances.

SPE and WPC recognize that suitable mathematical techniques can be used as required and that it is left to the country to fix the exact criteria for reasonable certainty of existence of petroleum reserves. No methods of calculation are excluded, however, if probabilistic methods are used, the chosen percentages should be unequivocally stated.

SPE and WPC agree that the petroleum nomenclature as proposed applies only to known discovered hydrocarbon accumulations and their associated potential deposits.

SPE and WPC stress that petroleum proved reserves should be based on current economic conditions, including all factors affecting the viability of the projects. SPE and WPC recognize that the term is general and not restricted to costs and price only. Probable and possible reserves could be based on anticipated developments and/or the extrapolation of current economic conditions.

SPE and WPC accept that petroleum reserves definitions are not static and will evolve.

A conscious effort was made to keep the recommended terminology as close to current common usage as possible in order to minimize the impact of previously reported quantities and changes required to bring about wide acceptance. The proposed terminology is not intended as a precise system of definitions and evaluation procedures to satisfy all situations. Due to the many forms of occurrence of petroleum, the wide range of characteristics, the uncertainty associated with the geological environment, and the constant evolution of evaluation technologies, a precise classification system is not practical. Furthermore, the complexity required for a precise system would detract from its understanding by those involved in petroleum matters. As a result, the recommended definitions do not represent a major change from the current SPE and WPC definitions which have become the standards across the industry. It is hoped that the recommended terminology will integrate the two sets of definitions and achieve better consistency in reserves data across the international industry.

Reserves derived under these definitions rely on the integrity, skill, and judgment of the evaluator and are affected by the geological complexity, stage of development, degree of depletion of the reservoirs, and amount of available data. Use of these definitions should sharpen the distinction between the various classifications and provide more consistent reserves reporting.

Definitions

Reserves are those quantities of petroleum which are anticipated to be commercially recovered from known accumulations from a given date forward. All reserve estimates involve some degree of uncertainty. 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 relative degree of uncertainty may be conveyed by placing reserves into one of two principal classifications, either proved or unproved. Unproved reserves are less certain to be recovered than proved reserves and may be further sub-classified as probable and possible reserves to denote progressively increasing uncertainty in their recoverability.

The intent of SPE and WPC in approving additional classifications beyond proved reserves is to facilitate consistency among professionals using such terms. In presenting these definitions, neither organization is recommending public disclosure of reserves classified as unproved. Public disclosure of the quantities classified as unproved reserves is left to the discretion of the countries or companies involved.

Estimation of reserves is done under conditions of uncertainty. 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. Identifying reserves as proved, probable, and possible has been the most frequent classification method and gives an indication of the probability of recovery. Because of potential differences in uncertainty, caution should be exercised when aggregating reserves of different 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, waterflooding, 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.

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. Proved reserves can be categorized as developed or undeveloped.

If deterministic methods are used, the term reasonable certainty is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90% probability that the quantities actually recovered will equal or exceed the estimate.

Establishment of current economic conditions should include relevant historical petroleum prices and associated costs and may involve an averaging period that is consistent with the purpose of the reserve estimate, appropriate contract obligations, corporate procedures, and government regulations involved in reporting these reserves.

In general, reserves are considered proved if the commercial producibility of the reservoir is supported by actual production or formation tests. In this context, the term proved refers to the actual quantities of petroleum reserves and not just the productivity of the well or reservoir. 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, and (2) the undrilled 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. 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, (3) the locations conform to existing well spacing regulations where applicable, and (4) it is reasonably certain the locations will be developed. Reserves from other locations are categorized as proved undeveloped only where interpretations of geological and engineering data from wells indicate with reasonable certainty that the objective formation is laterally continuous and contains commercially recoverable petroleum at locations beyond direct offsets.

Reserves which are to be produced through the application of established improved recovery methods are included in the proved classification when (1) successful testing by a pilot project or favorable response of an installed program in the same or an analogous reservoir with similar rock and fluid properties provides support for the analysis on which the project was based, and, (2) it is reasonably certain that the project will proceed. Reserves to be recovered by improved recovery methods that have yet to be established through commercially successful applications are included in the proved classification only (1) after a favorable production response from the subject reservoir from either (a) a representative pilot or (b) an installed program where the response provides support for the analysis on which the project is based and (2) it is reasonably certain the project will proceed.

Unproved Reserves

Unproved reserves are based on geologic and/or engineering data similar to that used in estimates of proved reserves; but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved. Unproved reserves may be further classified as probable reserves and possible reserves.

Unproved reserves may be estimated assuming future economic conditions different from those prevailing at the time of the estimate. The effect of possible future improvements in economic conditions and technological developments can be expressed by allocating appropriate quantities of reserves to the probable and possible classifications.

Probable Reserves

Probable reserves are those unproved reserves which analysis of geological and engineering data suggests are more likely than not to be recoverable. In this context, when probabilistic methods are used, there should be at least a 50% probability that the quantities actually recovered will equal or exceed the sum of estimated proved plus probable reserves.

In general, probable reserves may include (1) reserves anticipated to be proved by normal step-out drilling where sub-surface control is inadequate to classify these reserves as proved, (2) reserves in formations that appear to be productive based on well log characteristics but lack core data or definitive tests and which are not analogous to producing or proved reservoirs in the area, (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 workover, 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.

Reserve Status Categories

Reserve status categories define the development and producing status of wells and reservoirs.

Developed: 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. Developed reserves may be sub-categorized as producing or non-producing.

Producing: Reserves subcategorized as producing are expected to be recovered from completion intervals which are open and producing at the time of the estimate. Improved recovery reserves are considered producing only after the improved recovery project is in operation.

Non-producing: Reserves subcategorized as non-producing include shut-in and behind-pipe reserves. Shut-in reserves are expected to be recovered from (1) completion intervals which are open at the time of the estimate but which have not started producing, (2) wells which were shut-in for market conditions or pipeline connections, or (3) wells not capable of production for

mechanical reasons. Behind-pipe reserves are expected to be recovered from zones in existing wells, which will require additional completion work or future recompletion prior to the start of production.

Undeveloped Reserves: Undeveloped reserves are expected to be recovered: (1) from new wells on undrilled acreage, (2) from deepening existing wells to a different reservoir, or (3) where a relatively large expenditure is required to (a) recomplete an existing well or (b) install production or transportation facilities for primary or improved recovery projects.

Approved by the Board of Directors, Society of Petroleum Engineers (SPE) Inc., and the Executive Board, World Petroleum Congresses (WPC), March 1997.

App C Petroleum Resource Classification of the Norwegian Petroleum Directorate

		RESOURCE CLASS		PROJECT STATUS CATEGORY	
		Sold and delivered petroleum		0	Sold and delivered
TOTAL PETROLEUM-INITIALLY-IN-PLACE	DISCOVERED PETROLEUM-INITIALLY-IN-PLACE COMMERCIAL	RESERVES		1	In Production
				2A/F	Approved Development Plan
				3A/F	Decided recovery
				4A/F	In planning
	DISCOVERED PETROLEUM-INITIALLY-IN-PLACE SUB-COMMERCIAL	CONTINGENT RESOURCES		5A/F	Unclarified
				6	Not very likely
				7A/F	Not evaluated
				UNRECOVERABLE	
	UNDISCOVERED PETROLEUM-INITIALLY-IN-PLACE	PROSPECTIVE RESOURCES		8	Prospect
				9	Lead
UNRECOVERABLE					

← RANGE OF UNCERTAINTY →

LOWER RISK ↑ PROJECT MATURITY ↓ HIGHER RISK

App D Comparison of classifications