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COMMITTEE ON SUSTAINABLE ENERGY
Ad Hoc Group of Experts on the Harmonization
of Energy Reserves/Resources Terminology
Third session, 30- 31 October 2003

**UNITED NATIONS FRAMEWORK CLASSIFICATION
AS A SUPPORT TOOL FOR
WORLDWIDE ENERGY RESOURCES EVALUATION**

**- UNECE contribution to WEC Survey of Energy Resources -
(Document submitted by the secretariat)***

Introduction

During the recent years considerable progress has been made in finalizing uniform classification systems for fossil fuel resources of coal, uranium and petroleum covering the specific aspects of each fuel resource and having thus differing terms and definitions. In this respect, the UNECE Committee on Sustainable Energy has created an Ad Hoc Group of Experts, with the mandate to harmonise the three major internationally recognised energy resource classifications, namely: the UN/CMMI for coal, the SPE/WPC/AAPG for petroleum and the IAEA/NEA for uranium by applying the principles of the UN Framework Classification (UNFC). The Committee recommended to the World Energy Council to use it when collecting information for the publication of WEC three-annual Survey of Energy Resources (SER).

The codification tool of UNFC is applied to the individual classes of the fossil fuel resources. This allows their direct comparison and harmonisation, as seen in the table 1.

Table 1

Joint class	Codes		
	Coal	Petroleum	Uranium
Reserves/Economically extractable quantities	111,121,122	111,112,	111,121,122
Contingent Resources /Potentially economically extractable quantities	211,222	121,122,123,221,222,223	211, 221, 222,311,321,322
Prospective quantities in place /intrinsically economic in place quantities	331,332,333,334	234,321,322,323,334	331,332,333, 334

*/ Prepared with the support of Mr. D. Kelter, Consultant to UNECE; Mr. S. Heiberg, Chairman of the Ad Hoc Group of Experts; and Mr. J.R. Blaise, IAEA Secretariat.

The worldwide survey of WEC aims to provide an overall picture of energy resources availability. For this purpose the individual classes are summarized in three main reserve/resource categories, as indicated in table 2.

Table 2 Compatibility of Resource Terminology

SER Terminology	UNFC Code	UNFC Terminology and Definitions
Proved Recoverable Reserves	1r xx	Reserves respectively Economically Recoverable Quantities Quantities of petroleum, coal and uranium that are commercially recoverable from a given date forward as result of development and production commitments. Geological, technical and economic viability have been resolved including all relevant legal environmental and other relevant aspects of commercialisation.
Proved Amount in Place	1i xx	In Place quantities from which Reserves respectively Economic Quantities are recovered
Estimated Additional Reserves Recoverable	2r xx	Contingent Resources respectively Potentially Economically Recoverable Quantities Quantities of petroleum, coal and uranium which are not currently considered being commercially recoverable but estimated to be potentially so in the future. Geological, technical and economic viability have been assessed but not resolved, including all relevant legal environmental and other relevant aspects of commercialisation. They 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. Quantities of petroleum where evaluation of the accumulation is still at an early stage are included.
Estimated Additional Amount in Place	3ixx	In place quantities from which Prospective Resources respectively Intrinsically Economic in Quantities may be produced: Quantities of petroleum that are postulated from geological information and theory to be potentially recoverable from outside of known oil and gas fields. In the case of coal and uranium, quantities of geologically assessed deposits that have not yet been subject to extraction and economic assessment, are covered, and (for uranium) quantities that are expected to occur in deposits for which the evidence is mainly indirect and which are believed to exist in well-defined geological trends or areas of mineralization (Speculative Resources). The common aspect is that these quantities warrant further assessment.

Note to the above table: Letter “i” stands for “in place” and “r” for “recoverable”. The “xx” is used as summary symbol.

A reconciliation of SER and UNFC resource terminology by means of codification is proposed in the above table. It appears that a reconciliation of both terminologies is achievable by means of codification.

The attached enclosure contains all details of terms and definitions as used in the classifications of uranium, coal and petroleum as well as a description of UNFC codification.

Enclosure

The harmonization effort of the Ad Hoc Group of Experts is based on the major international energy resources classifications which have recently been elaborated and by which almost all fossil energy resources world wide are classified, namely the UN/CMMI for coal, the SPE/WPC/AAPG for petroleum and the IAEA/NEA for uranium.

Each of these major classifications use a number of individual reserves/resources classes to serve their different specific needs at national and institutional levels. The on-going harmonization effort aims to correlate the different classes by means of the UNFC codification whose principle behind is explained in the Enclosure.

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

Economic axis (E or Codes Exx)
Field/Feasibility project axis (F or Codes xFx)
Geologic axis (G or Codes xxG)

Application of the UNFC to coal, petroleum and uranium in the next SER evaluation allows improvements to be made in the underlying information while maintaining continuity at aggregated levels with the previous SER publications.

Continuity with SER 2001

Continuity between the SER 2001 and next SER 2004 could be achieved by proper combination of the UNFC categories. The categories proposed are shown in the tables below.

Table 3: Reconciliation of “in-place quantities”

Commodity	SER categories used in SER2001	SER definitions	Combination of UNFC categories proposed for SER 2004	UNFC codes
Coal	Proved amount in place	The tonnage that has been carefully measured and assessed as exploitable under present and expected local economic conditions with existing available technology	In place amount of Economically Recoverable Quantities	1i11, 1i21, 1i22
	Estimated additional amount in place	Indicated and inferred tonnage <i>additional</i> to the proved amount in place. It includes estimates of amounts which could exist in unexplored extensions of known deposits or in undiscovered deposits in known coal-bearing areas, as well as amounts inferred through knowledge of favourable geologic conditions. Speculative amounts are not included	Intrinsically Economic in Place Quantities	3i31 3i32 3i33 3i34
Petroleum	Proved amount in place	Tonnage originally occurring in known natural reservoirs which has been carefully measured and assessed as exploitable under present and expected local economic conditions with existing available technology.	- Proved in-place quantities. - Explored and delineated in-place quantities	I1 +I2
	Estimated additional amounts in place	Tonnage additional to the proved amount in place that is of foreseeable interest. Speculative amounts are not included	- Discovered and prospective in-place quantities	I3+I4
Uranium		WEC follows the practice of the NEA/IAEA and defines estimates of discovered reserves in terms of uranium recoverable from mineable ore, and not uranium contained in the ore (i.e. to allow for mining and processing losses). Although some countries continue to report in-situ quantities, the major producers generally conform to these definitions.	not defined	

Table 4: Reconciliation of “recoverable quantities”

Commodity	SER categories used in 2001	SER definitions	Combined UNFC categories proposed for SER 2004	UNFC codes 1
		Tonnage within the proved amount in place that can be recovered (extracted from the earth in raw form) under present and expected local economic conditions with existing available technology	Economically Recoverable Quantities	1r11 1r21 1r22
Petroleum	Proved recoverable reserves	Tonnage within the proved amount in place that can be recovered in the future under present and expected economic conditions with existing available technology	Reserves	111, 112
	Estimated additional reserves recoverable	Tonnage within the estimated additional amount in place which geologic and engineering information indicates with reasonable certainty might be recovered in the future	Contingent resources	121, 122, 123, 221, 222, 223, 224, 322
Uranium	Proved reserves	Corresponds to the IAEA/NEA category “Reasonably Assured Resources” (RAR), and refer to recoverable uranium that occurs in known mineral deposits of such size, grade and configuration that it could be recovered within the stated production cost ranges with currently proven mining and processing technology. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits, together with knowledge of deposit characteristics. Proved reserves have a high assurance of existence.	Reserves	111, 121, 122
	Estimated additional amounts recoverable	Corresponds to the IAEA/NEA category “Estimated Additional Resources – Category I” (EAR-I), and refers to recoverable uranium (in addition to proved reserves) that is expected to occur (mostly on the basis of direct geological evidence) in extensions of well –explored deposits and in deposits for which geological continuity has been established, but where specific data and measurements of the deposits and knowledge of their characteristics are considered to be inadequate to classify the resource as proved reserve. Such deposits can be delineated and the uranium subsequently recovered, all within the stated production cost ranges. Estimates of tonnage and grade are based primarily on knowledge of the deposit characteristics as determined in its best-known parts or in similar deposits. Less reliance can be placed on the estimates in this category than on those for proved reserves.	Contingent resources	211, 221, 222, 311, 321, 322

It should be noticed that a considerable semantic problem exists worldwide concerning the meaning of the terms reserve and resource. The issue is further complicated by the fact that in some languages, one of the terms reserve and resource does not exist and in other languages one or both of the terms have completely different meaning from that usually attached to them.

1 r is used to designate recoverable quantities

However, in the English speaking community dealing with geomatters, a growing trend has been to apply the term reserve to economically extractable, appropriately assessed quantities and the term resource to quantities that are currently not economic but may possibly be so in the future. Furthermore, there is a growing understanding that reserves are a part of the resources, which contradicted the above meaning of resources as being currently not economic.

For this reason, the term Total Resource was introduced. Thus, Reserve plus Additional Resource comprise the Total Resource, or Total Resource minus Reserve gives the Remaining Resource, depending on the viewpoint.

The Society of Petroleum Engineers, the World Petroleum Congresses and the American Association of Petroleum Geologists further reinforced and clarified these trends in the classification of petroleum resources issued in 2000. Here, the term resources is used for all quantities that are potentially recoverable. Resources are in turn divided into reserves, contingent resources and prospective resources.

In recognition of the semantic problems that still exist to some extent, it is important to distinguish clearly between quantities in place from which quantities are recovered and the recoverable quantities themselves. Codification may help in this regard, using “r” for recoverable (or potentially recoverable) quantities, and “i” for in place quantities.

Harmonisation by use of codes

During the last 5 years, since the UNFC was first established, the petroleum sector has improved its basis for resource management by allowing the classification to reflect some of the opportunities and risks that are attached to exploration and exploitation projects. Emphasising the projects rather than the petroleum accumulations forces consideration of alteration of projects, or in other words, of the real options to initiate changes that are so crucial for ensuring the success of large industrial efforts.

This has created a difference between the way petroleum on one hand and coal and uranium on the other are classified. Their harmonization is possible by means of the UNFC codification. This allows at the same time each sector to retain its individual terms in use. These terms have long standing traditions. The codification allows furthermore the content of the three major groups of terms for use by WEC to be joined as shown below.

Reserves respectively Economically Extractable Quantities

Quantities of petroleum, coal and uranium that are commercially recoverable from a given date forward as a result of development and production commitments. Geological, technical and economic viability have been resolved including all relevant legal environmental and other relevant aspects of commercialisation.

The following individual classes are grouped together:

Coal (UN/CMMI)

- Proved Mineral Reserve (Code 111)
- Probable Mineral Reserve (Code 121 + 122)

Petroleum

Reserves (Proved reserves, Code 111 + Unproved reserves, Code 112)

Uranium (IAEA/NEA)

- RAR (<US \$ 40/kg U) (Code 111)
- EAR-I (<US \$ 40/kg U) (Code 121 + 122)

Contingent Resources respectively Potentially Economically Extractable Quantities

Quantities of petroleum, coal and uranium which are not currently considered commercially recoverable but estimated to be potentially so in the future. Geological, technical and economic viability, including all relevant legal environmental and other relevant aspects of commercialisation have been assessed but not resolved. They 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. Quantities of petroleum where evaluation of the accumulation is still at an early stage are included.

The following individual classes are grouped together:

Coal (UN/CMMI)

- Feasibility Mineral Resource (Code 211)
- Prefeasibility Mineral Resource (Code 221 + 222)

Petroleum

Contingent resources that are commercial on economic grounds, with all degrees of discovered geologic definition (Proved, explored and delineated or just discovered) Codes 121, 122, 123.

Contingent resources that are contingent also on economic grounds, with all degrees of geologic definition. Codes 221, 222, 223. **Slav, put these two lines to the front as above**

Uranium

- RAR (US \$ 40–80/kg U) (Code 211)
- EAR-I (US & 40-80/kg U) (Code 221 + 222)
- RAR (US \$ 80-130/kgU) (Code 311)
- EAR-I (US \$ 80-130/kgU) (Code 321+322)

Prospective Resources respectively Intrinsically Economic Quantities

For coal and uranium; quantities of geologically assessed deposits that have not yet been subject to extraction and economic assessment, are covered, and (for uranium) quantities that are expected to occur in deposits for which the evidence is mainly indirect and which are believed to exist in well-defined geological trends or areas of mineralization (Speculative Resources). For

Petroleum; quantities that are postulated from geological information and theory to be potentially recoverable from outside of known oil and gas fields.

The common aspect is that these quantities warrant further assessment.

The following individual classes are grouped together:

Coal (UN/CMMI)

Measured Mineral Resource (Code 331)

Indicated Mineral Resource (Code 332)

Inferred Mineral Resource (Code 333)

Reconnaissance Mineral Resource (Code 334)

Petroleum

Prospective resources with contingent commerciality on economic grounds (Code 234)

Contingent resources that are non-commercial on economic grounds from accumulations with all degrees of geologic definition (proved, explored and delineated, or just discovered geology (Code 321, Code 322 and 323))

Prospective resources that are non-commercial on economic grounds (Code 334)

Uranium

RAR in-place (Code 331)

EAR-I in-place (Code 332)

EAR-II (Code 333)

Speculative (Code 334)

The natural reference point at which commercial energy carriers are quantified is the point of sale. For energy carriers that are not traded commercially, the natural reference point at which quantification takes place will be the point of use.

Appendix: Terms and definitions of individual codes

Coal

The terms and definitions for coal given below and in Appendix B are taken from the document: UNITED NATIONS INTERNATIONAL FRAMEWORK CLASSIFICATION FOR RESERVES/RESOURCES –Solid Fuels and Mineral Commodities- Final Version. ENERGY/WP.1/R.70; 17 February 1997 (page 15 to 17).

The definitions of the UN Framework Classification are abbreviated. All terms used like “economic”, “Feasibility Study” etc. is defined in the above-mentioned UN document from page 14 to 17. CMMI (Council of Mining and Metallurgy Institutions) agreed in November 1999 to join its definitions with the UN definitions. The content of both definitions is identical even though the wording is different.

The codification as introduced by the UN classification on page 8, of the above mentioned document is attached.

Table 5

Terms and Code	UN Framework Classification	CMMI
Proved Mineral Reserve (111)	Demonstrated to be economically mineable by a Feasibility Study or actual mining activity usually undertaken in areas of Detailed Exploration.	A 'Proved Mineral Reserve' is the economically mineable part of a Measured Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, and include consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate, with a high level of confidence at the time of reporting, that extraction is justified.
Probable Mineral Reserve (121+122)	Demonstrated to be economically mineable by a Prefeasibility Study usually carried out in areas of Detailed Exploration and General Exploration.	A 'Probable Mineral Reserve' is the economically mineable part of an Indicated and, in some circumstances, a Measured Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, and include consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is justified.
Feasibility Mineral Resource (211)	Demonstrated to be potentially economic by a Feasibility Study or prior mining activity usually carried out in areas of Detailed Exploration.	Not available
Prefeasibility Mineral Resource (221 + 222)	Demonstrated to be potentially economic by a Prefeasibility Study usually carried out in areas of Detailed Exploration and General Exploration.	Not available
Measured Mineral Resource (331)	Estimated to be of intrinsic economic interest based on Detailed Exploration establishing all relevant characteristics of a deposit with a high degree of accuracy.	A 'Measured Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence. It is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are spaced closely enough to confirm geological and/or grade continuity.
Indicated Mineral Resource (332)	Estimated to be of intrinsic economic interest based on General	An 'Indicated Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral

Terms and Code	UN Framework Classification	CMMI
	interest based on General Exploration establishing the main geological features of a deposit providing an initial estimate of size, shape, structure and grade.	content can be estimated with a reasonable level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed. An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource, but has a higher level of confidence than that applying to an Inferred Mineral Resource.
Inferred Mineral Resource (333)	Estimated to be of intrinsic economic interest based on Prospecting having the objective to identify a deposit. Estimates of quantities are inferred, based on outcrop identification, geological mapping, indirect methods and limited sampling.	An 'Inferred Mineral Resource' is that part of a Mineral Resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which is limited, or of uncertain quality and reliability. An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource.
Reconnaissance Mineral Resource (334)	Based on Reconnaissance, having the objective to identify areas of enhanced mineral potential. Estimates of quantities should only be made if sufficient data are available and when an analogy with known deposits of similar geological character is possible and then only within an order of magnitude.	Not available

Petroleum

Recoverable quantities

Code111: Proved reserves (SPE/WPC definition)

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 favourable 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.

Code 111+112: Reserves (proved and unproved): Quantities of petroleum that are anticipated to be commercially recovered from known accumulations with proved geological conditions and from explored and delineated accumulations from a given date forward as a result of development and production commitments.

Code 121: Quantities of petroleum anticipated to be commercially recovered from known accumulations with proved geological conditions from a given date forward as a result of development and production commitments contingent upon project conditions that may or may not be fulfilled.

Code 122: Quantities of petroleum anticipated to be commercially recovered from explored and delineated accumulations from a given date forward as a result of development and production commitments contingent upon project conditions that may or may not be fulfilled.

Code 221: Quantities of petroleum from known accumulations with proved geological conditions anticipated to be commercially recovered from a given date forward contingent upon commercial and project conditions that may or may not be fulfilled.

Code 222: Quantities of petroleum from explored and delineated accumulations anticipated to be commercially recovered from a given date forward contingent upon commercial and project conditions that may or may not be fulfilled.

Code 223: Quantities of petroleum from discovered accumulations that are not explored and delineated. The quantities are anticipated to be commercially recovered from a given date forward contingent upon commercial and project conditions that may or may not be fulfilled.

Code 322: Quantities of petroleum from explored and delineated accumulations that for the time being are not regarded as commercial on economic grounds and that also are contingent on project conditions that may or may not be fulfilled.

Code 323: Quantities of petroleum from discovered, but not explored and delineated accumulations that for the time being are not regarded as commercial on economic grounds and that also are contingent on project conditions that may or may not be fulfilled

Code 234: Quantities of petroleum from prospective accumulations (not yet discovered) anticipated to be commercially recovered from a given date forward contingent upon conditions that may or may not be fulfilled (the prospective discovery must be confirmed).

Code 334: Quantities of petroleum from prospective accumulations (not yet discovered) that for the time being are not regarded as commercial on economic grounds.

Code 321: Quantities of petroleum from known accumulations with proved geological conditions, that for the time being are not regarded as commercial on economic grounds, and that also are contingent upon project conditions that may or may not be fulfilled.

Code 322: Quantities of petroleum from explored and delineated accumulations that for the time being is not regarded as commercial on economic grounds, and that also are contingent upon project conditions that may or may not be fulfilled.

In Place quantities

For petroleum, in place quantities are not included in the classification proper, but given as an attribute, following the subdivision on the geologic axis. This recognises that an in place quantity may be the source of recoverable quantities in several different categories.

Code I1 : Proved in place quantities are quantities in place with proved geology. The geology is defined to the extent and detail specified in the definition of proved reserves.

Code I2: Explored and delineated in place quantities are quantities in place 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.

Code I3: Discovered in place quantities are quantities in place 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 quantities to be considered explored and delineated.

Uranium

Code 111: Reasonably Assured Resources (RAR) (<US \$ 40/kg U)
(Proved Mineral Resources)

Definition: Refers to uranium that occurs in known mineral deposits of delineated size, grade and configuration such that the quantities which could be recovered at a cost below \$ 40/kg U, with currently proven mining and processing technology, can be specified. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics.

Code 121, 122: Estimated additional Resources-Category 1 (EAR-1) (< \$ 40/kg U)
(Probable Mineral Resources)

Definition: Refers to uranium, in addition to RAR, that is inferred to occur, based on direct geological evidence, in extensions of well-explored deposits, or in deposits in which geological continuity has been established but where specific data, including measurements of the deposits, and knowledge of the deposit's characteristics are considered to be inadequate to classify the resource as RAR. Estimates of tonnage, grade and cost of further delineation and recovery are based on such sampling as is available and on knowledge of the deposit's characteristics as determined in the best known parts of the deposits or in similar deposits. Uranium could be recovered at a cost below \$ 40/kg U, with currently proven mining and processing technology.

Code 211: Reasonably Assured Resources (RAR) (\$ 40-\$ 80/kg U)
(Feasibility Mineral Resources)

Definition: Refers to uranium that occurs in known mineral deposits of delineated size, grade and configuration such that the quantities that could be recovered at a cost comprised between \$ 40/kg U and \$ 80/kg U, with currently proven mining and processing technology, can be specified. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics.

Code 221, 222: Estimated additional Resources-Category 1 (EAR-1) (\$40/kg U-\$80/kgU)
(Pre-feasibility Mineral Resources)

Definition: Refers to uranium, in addition to RAR, that is inferred to occur, based on direct geological evidence, in extensions of well-explored deposits, or in deposits in which geological

continuity has been established but where specific data, including measurements of the deposits, and knowledge of the deposits' characteristics are considered to be inadequate to classify the resource as RAR. Estimates of tonnage, grade and cost of further delineation and recovery are based on such sampling as is available and on knowledge of the deposit characteristics as determined in the best known parts of the deposits or in similar deposits. Uranium could be recovered at a cost comprised between \$ 40/kg U and \$ 80/kg, with currently proven mining and processing technology.

Code 311: Reasonably Assured Resources (RAR) (\$ 80-\$ 130/kg U)

(Potentially Economic Feasibility Mineral Resources)

Definition: Refers to uranium that occurs in known mineral deposits of delineated size, grade and configuration such that the quantities that could be recovered at a cost comprised between \$ 80/kg U and \$ 130/kg U, with currently proven mining and processing technology, can be specified (these deposits may have been economic or potentially economic at a certain period of time). Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics.

Code 321, 322: Estimated additional Resources-Category 1 (EAR-1) (\$80/kg U-\$130/kgU)

(Potentially Economic Pre-Feasibility Mineral Resources)

Definition: Refers to uranium, in addition to RAR, that is inferred to occur, based on direct geological evidence, in extensions of well-explored deposits, or in deposits in which geological continuity has been established but where specific data, including measurements of the deposits, and knowledge of the deposits' characteristics are considered to be inadequate to classify the resource as RAR. Estimates of tonnage, grade and cost of further delineation and recovery are based on such sampling as is available and on knowledge of the deposit characteristics as determined in the best known parts of the deposits or in similar deposits. Uranium could be recovered at a cost comprised between \$ 80/kg U and \$ 130/kg, with currently proven mining and processing technology. (These deposits may have been economic or potentially economic at a certain period of time).

Code 331: Reasonably Assured Resources (RAR) (< \$ 130/kg U)

(Measured Mineral Resources)

Definition: Refers to uranium that occurs in known mineral deposits of delineated size, grade and configuration such that the quantities that could be recovered at a cost comprised below \$ 130/kg U, with currently proven mining and processing technology, can be specified. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics. No feasibility study has been made on these deposits.

Code 332: Estimated additional Resources-Category 1 (EAR-1) (< \$130/kgU)

(Indicated Mineral Resources)

Definition: Refers to uranium, in addition to RAR, that is inferred to occur, based on direct geological evidence, in extensions of well-explored deposits, or in deposits in which geological continuity has been established but where specific data, including measurements of the deposits, and knowledge of the deposits' characteristics are considered to be inadequate to classify the resource as RAR. Estimates of tonnage, grade and cost of further delineation and recovery are based on such sampling as is available and on knowledge of the deposit characteristics as determined in the best known parts of the deposits or in similar deposits. Uranium could be recovered at a cost below \$ 130/kg, with currently proven mining and processing technology. . No feasibility study has been made on these deposits.

Code 333: Estimated additional Resources-Category 2 (EAR-2) (< \$130/kgU)

(Inferred Mineral Resources)

Definition: Refers to uranium, in addition to EAR-1, that is expected to occur in deposits for which the evidence is mainly indirect and which are believed to exist in well-defined geological trends or areas of mineralization with known deposits. Estimates of tonnage, grade and cost of discovery, delineation and recovery are based primarily on knowledge of deposit characteristics in known deposits within the respective trends or areas and on such sampling, geological, geophysical or geochemical evidence as may be available.

Code 334: Speculative Resources (< \$130/kgU)

(Reconnaissance Mineral Resources)

Definition: Refers to uranium, in addition to EAR-2, which is thought to exist, mostly on the basis of indirect evidence and geological extrapolations, in deposits discoverable with existing exploration techniques. The location of deposits envisaged in this category could generally be specified only as being somewhere within a given region or geological trend. As the term implies, the existence and size of such resources are speculative

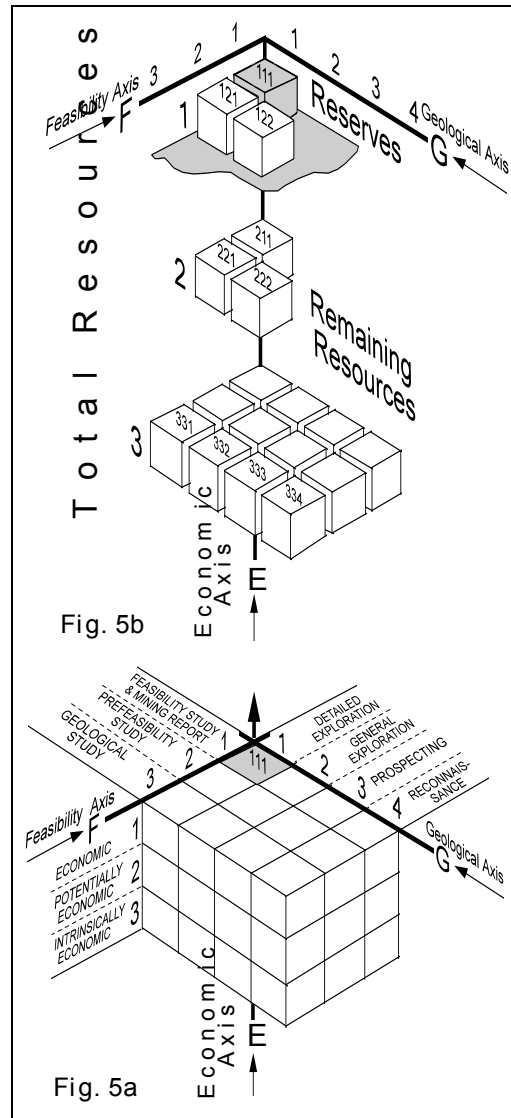
6. Codification (Source: ENERGY/WP.1/R.70 page 8)

The incorporation of existing classification systems into the UN Framework Classification and their comparison will be further simplified by means of codification acting as interface. Codification has the further advantage of providing a short, unambiguous identification of the reserve/resource categories¹ that facilitates computer processing of data and exchange of information. During the Workshop in Hanover, the codification systems in use were discussed in detail; finally it was agreed that numerical codification of the UN Framework Classification would be most advantageous [50].

Figure 5a shows the principle behind the proposed codification of the UN Framework Classification, the three dimensions of categorization represented by the edges of a cube, the E (Economic) axis for Economic Viability, the F (Feasibility) axis for Feasibility Assessment, and the G (Geology) axis for Geological Study. The digits are quoted in the order EFG firstly because alphabetical order is easy to memorise, and secondly because the first digit refers to the Economic Viability, which is of decisive interest to both mining company and investor.

Numbers are used to designate the different classes; the lowest number, in accordance with the usual perception that the 1st is the best, referring to the highest degree of Economic Viability on the E axis, and the highest degree of assurance on the F axis and G axis. Figure 5b represents an "exploded" three dimensional layout of Figure 5a showing the codified classes which are applicable in practice.

The class coded 111, which is shaded in Figure 5a and 5b, is of prime interest to an investor: it refers to quantities that are economically mineable (number 1 as the first digit), have been proved by means of a Feasibility study or actual mining (number 1 as the second digit), and are based on Detailed Exploration (number 1 as the third digit).



¹ Geostatistics have been proposed for this purpose. However, so far currently they are only used in the case of a Feasibility Study and occasionally in a Prefeasibility Study.

