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PRACTICAL APPLICATION OF THE UNITED NATIONS FRAMEWORK CLASSIFICATION FOR RESERVES/RESOURCES

Classification of the Greek Lignite Deposits according to the UN Framework Classification

(Submitted by the Government of Greece) */

I. INTRODUCTION

In Greece there is no unique system for the classification of the mineral commodities reserves/resources. The mining companies and the Institutes have their own classification systems, which are mainly based on other countries' classifications, such as the American, the Russian and French systems. However the correlation of these classifications is implemented with difficulty.

The mineral commodities reserves/resources of Greece are categorized as "proven","possible" and "probable" reserves. The limits between the three categories are not clearly indicated, therefore the results from their evaluation may not be considered reliable. However, the "economically

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*/ Prepared by the Centre for Solid Fuels Technology and Applications (CSFTA), Athens

recoverable reserves" is another category which is broadly used by the mining companies to characterize their deposits even though the reserves are estimated by each individual company using its own criteria and system.

In the past the Institute of Geology and Mineral Exploration and other Organizations have proposed several classification systems for the reserves/resources of the country, but none has been adopted by the State.

On the contrary, as concerns solid fuels, the Institute of Geology and Mineral Exploration has already established and applies a Classification System for the estimation of the lignite reserves of the country. This system has been adopted by the State and the Public Power Corporation.

II. CLASSIFICATION OF THE SOLID FUELS (LIGNITE) RESERVES IN GREECE

The solid fuels of Greece mainly consist of lignite, while there are some small-sized uneconomic occurrences of hard coal in three areas of the country and peat deposits that have not yet been exploited. The lignite production is around 58 million tons per year and contributes to approximately 30% of the country's energy consumption and 75% of the electricity generation. About 95% of the lignite production is extracted from the public power corporation open pit mines which belong to the State.

The Institute of Geology and Mineral Exploration, which conducts - on behalf of the State and the Public Power Corporation - the exploration of lignite deposits in the country, has classified the lignite reserves as "measured", "indicated" and "inferred". The main features of this classification system are:

1. The term "reserves", which is used in the Greek Classification System for the Lignite Deposits, corresponds to the "reserves" and "resources" of the UN International Classification System.

2. The Greek Classification System refers only to the Lignite Deposits, as the hard coal and the sub-bituminous coal deposits are not considered economically recoverable.

3. The Classification of the Lignite Reserves performed according to geological assessment:
   The Greek lignite reserves are classified as measured, indicated and inferred.
   (a) The measured reserves are estimated according to the geological data of high reliability derived from points of observation - boreholes or mining works - with length less than 800 metres. The length varies occasionally in relation to the stratigraphy and

tectonism of the basin, the geometry of the deposit, the thickness and the quality of the lignite layers. The measured reserves concern data which usually derive from the Detailed Exploration Stage of Geological Study. The quantities of lignite which are included in the area with distance less than 400 metres from the thickness measurement point (point of observation) are considered measured reserves (Figure 1).

(b) Indicated reserves are considered to be the lignite which is included in the area at a distance of between 400 and 1200 metres from the point of observation. The indicated reserves correspond to the reserves which are determined in basins where exploration is in the stage of the General Exploration or Prospecting Study.

(c) Inferred reserves are considered to be the quantities of lignite which are included in the area at a distance of between 1200 and 4800 metres from the point of observation. In addition to the previous quantities of lignite, the lignite which is determined by geological and geophysical research implemented during the Stages of Prospecting and Reconnaissance is also included in this category.

4. The Geological Study of the UN International Classification System is implemented in Greece for the research of lignites in four stages (Detailed Exploration, General Exploration, Prospecting and Reconnaissance). These stages are similar to those described on page 13 of ENERGY/WP.1/R.70 of the UN International Classification System.

5. The lignite which is included in the three categories of reserves (measured, indicated and inferred) according to the Greek Classification must have a thickness greater than 0.40 m, dry ash content less than 50-60% (depending on the degree of coalification of lignite) and depth - from the surface - less than 500 metres.

6. The reserves of the lignite deposits are usually reported in tons. They are also reported in toe and in GJ - due to the fact that the majority of the lignite production in Greece is consumed for electricity generation.

7. The Economic Viability of the deposits is estimated from the mining reports - for the active open-pit mines - and from the Feasibility and the Prefeasibility Study - for the deposits that will soon be exploited. Additionally, a draft estimation of the Economic Viability of the deposits is undertaken in the last stage of the Geological Study by comparison of the new information with data from mining activities which are conducted in the currently exploited lignite deposits. Based on the economic viability of the deposits, the Greek lignites are distinguished

as “Minable” or “Extractable” reserves and “Remaining measured reserves” that compose the “measured” reserves.

8. The minable reserves are considered the reserves which, under the current economic conditions, may be exploited. The ratio “minable lignite” (L) : “waste material” (S) is a significant criterion for the categorization of the lignite reserves to the “minable reserves”. In Greece, this ratio must be equal to or less than 1:10 t/m^3 for lignite with calorific value (n.c.v.) 1000 kcal/kg. By increasing or decreasing the n.c.v., the ratio L:S is changed respectively.

9. According to the aforementioned paragraphs, the lignite reserves of Greece are categorized as follows:

Measured reserves	6780 Mt	(942 Mtoe or 41370 GJ)
out of which Minable reserves	4045 Mt	(563 Mtoe or 23650 GJ)
Indicated reserves	1600 Mt	(280 Mtoe or 11600 GJ)
Inferred reserves	2300 Mt	(510 Mtoe or 21200 GJ)

III. COMPARISON WITH THE UN INTERNATIONAL FRAMEWORK CLASSIFICATION FOR RESERVES/RESOURCES

Tables 1 and 2 show the lignite reserves of Greece as classified according to the UN International Framework Classification for Reserves/Resources (Figs. 2 and 3, ENERGY/1998/17). The information is derived from various reports of the Institute of Geology and Mineral Exploration, the Public Power Corporation and the private Mining Companies. The figures of the reserves are calculated according to the regulations provided in ENERGY/WP.1/R.57 and ENERGY/1998/17.

The adaptation of the Greek lignite reserves to the UN system did not meet with extreme difficulty, as is also demonstrated in Table 3, which shows the comparison of the Greek and the UN International Framework Classification Systems. The deviation of the two Classification Systems is insignificant and only concerns the economic reserves (the minable reserves according to the Greek Classification and the proved and probable reserves (111, 121 and 122) according to the UN Classification System). The same small deviation is determined for the subeconomic reserves (the remaining measured reserves according to the Greek Classification and the feasibility and prefeasibility resources and measured resources (211, 221, 222 and 331) according to the UN Classification System.

Significant differences are present in the indicated and the inferred reserves. The indicated reserves of the Greek Classification System correspond to the indicated resources of the UN System and part of the

inferred and reconnaissance resources of the same System. This is due to the fact that the estimation of the indicated reserves, in the Greek Classification System, is based on the distance from the point of observation and the thickness of lignite and not on the stage of geological study of the area, as the UN system proposes. In other words, according to the Greek Classification System the indicated and the inferred reserves are determined in the areas with a long-distance borehole network and/or limited number of reconnaissance boreholes. In the same case, according to the UN Classification System, these reserves are called inferred or reconnaissance resources.

The difference which is present between the total reserves/resources and the remaining reserves/resources values (Figure 2) is due to the fact that according to the Greek Classification System the term reserves includes also the quantities of lignite which cannot be exploited without major technological and economic changes and are not currently predictable, i.e. the uneconomic occurrences of the UN International Framework Classification.

We therefore have to state that the proposed classification is suitable for adapting it to the domestic conditions of Greece.

However we would like to suggest, if that has not already been predicted, that in the case of the classification of solid fuels, the reserves/resources may be reported also in toe or other units that correspond to their energy content. This may facilitate the comparison between the various solid fuels deposits. This can probably also be implemented for the classification of mineral commodities where the reserves/resources may be reported in ore content.

Another interesting point is the degree of the updating of the data which will be obtained from each country. In other words, when are the data collected? This is of great importance for the reserves/resources which are recorded based on the feasibility assessment and the economic viability.

References

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Table 1: Classification of the Lignite Deposits of Greece according to the United Nations International Framework Classification for Reserves/Resources
(Fig.2 - ENERGY/1998/17)

Deposit/ Mine	**Feasibility Study** and/or **Mining Report**		**Prefeasibility Study**		**Geological Study**			
	Economic	Potentially economic	Economic	Potentially economic	Detailed Exploration	General Exploration	Prospecting	Reconnais-sance
	(111)	(211)	(121) (122)	(221) (222)	(331) Measured	(332) Indicated	(333) Inferred	(334)
Ptolemais (1)	1708.7 (240.75)	704.1 (98.64)	389.4 (77.88)	211.6 (42.32)	255.6 (55.11)	105.0 (18.92)	624.0 (109.21	—
Megalopolis	365.0 (34.67)	35.0 (3.32)	—	—	—	—	50.0 (4.75)	—
Florina (1)	103.3 (25.82)	24.7 (6.17)	151.7 (32.2)	194.3 (40.28)	—	54.0 (12.4)	55.0 (12.60)	—
Drama	—	—	962.4 (96.24)	587.6 (58.76)	—	—	500.0 (50.0)	100.0 (10.0)
Elassona	—	—	89.6 (20.20)	25.4 (5.80)	—	—	70.0 (14.0)	—
Kozani	—	—	180.0 (19.80	328.4 (36.12)	—	—	—	200.0 (46.0)
Orestias	—	—	—	—	115.0 (24.85)	25.0 (6.56)	190.0 (51.0)	—
Various minor deposits	38.55 (9.46)	23.65 (6.44)	46.0 (3.90)	38.0 (3.86	261.2 (46.04)	126.9 (21.48)	466.0 (101.06)	560.0 (168.86)
Total	**2215.55 (310.7)**	**787.45 (114.57)**	**1819.1 (250.22)**	**1385.3 (187.14)**	**631.8 (126.0)**	**310.9 (59.36)**	**1955.0 (342.62)**	**860.0 (224.86)**

Note: (1) Several deposits of different stages of geological study and economic consideration are included
The reserves are reported in 10^6t, and the figures in brackets correspond to tons of oil equivalent (toe)

Source: Institute of Geology and Mineral Exploration, Public Power Corporation and Mining Companies Reports

Table 2: Classification of the Lignite Deposits of Greece according to the United Nations International Framework Classification for Worldwide Survey
(Fig. 3 - ENERGY/1998/17)

Country	**Prefeasibility Study, Feasibility Study** and/or **Mining Report**		**Geological Study**	
	Economic	Potentially economic	Detailed & General Exploration	Prospecting & Reconnaissance
	(111) (121) (122)	(211) (221) (222)	(331) (332)	(333) (334)
GREECE	**4034.65** **(561)**	**2174.75** **(301.71)**	**942.70** **(185.36)**	**2815.00** **(567.48)**

Note: The reserves are reported in 10^6t, and the figures in brackets correspond to tons of oil equivalent (toe)

Table 3: Classification of the Lignite Deposits of Greece according to the Greek Classification System and the United Nations International Framework Classification for Reserves/Resources

Greek Classification	Reserves	UN Classification	Reserves	Code
Minable Reserves	4035 Mt	Economic (or Proven and Probable) Reserves	4035 Mt	111, 121, 122
Remaining Measured Reserves	2735 Mt	Feasibility and Prefeasibility Resources and Measured Resources	2804 Mt	211, 221, 222, 331
Indicated Reserves	1600 Mt	Indicated Resources	311 Mt	332
		Inferred Resources	1955 Mt	333
Inferred Reserves	2300 Mt	Reconnaissance Resources	860 Mt	334
Total Reserves	10680 Mt	Total Reserves/Resources	9965 Mt	
Remaining Reserves	6635 Mt	Remaining Resources	5930 Mt	

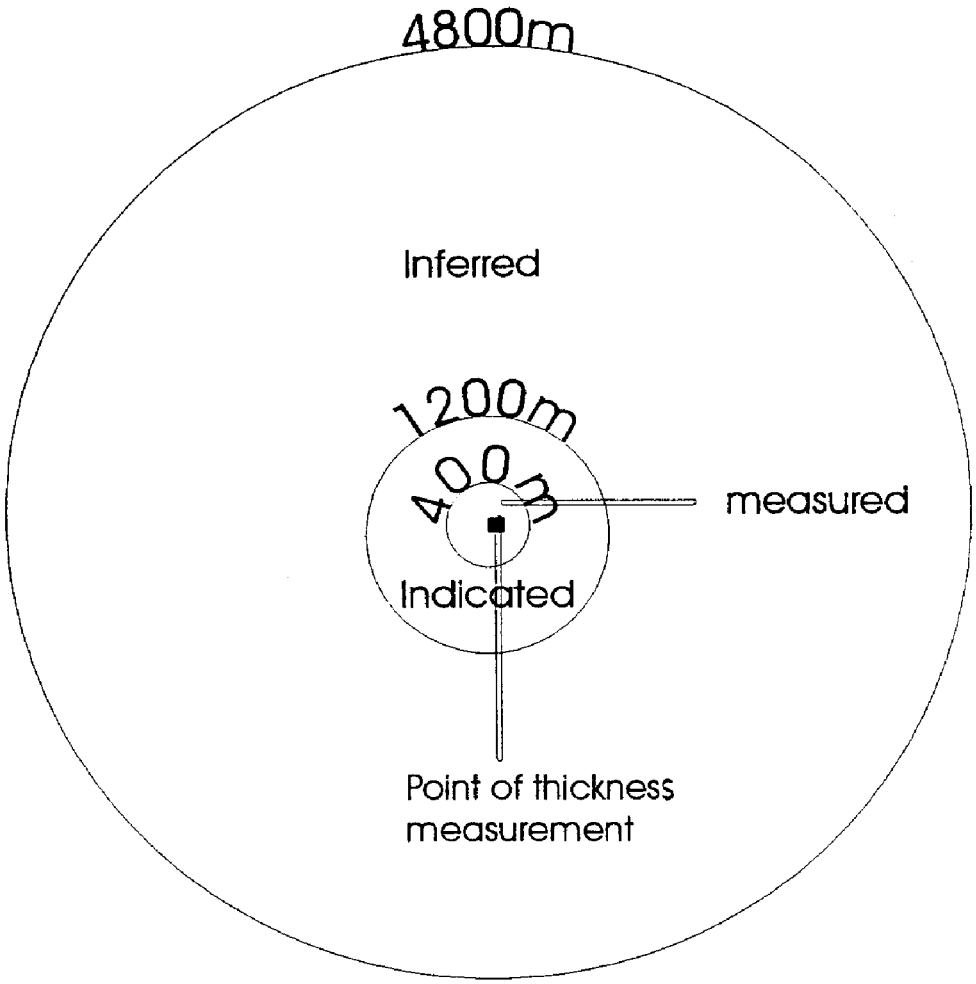

Figure 1: Diagram showing reliability categories of lignite reserves based on the distance from the point of measurement, according to the Greek Classification System

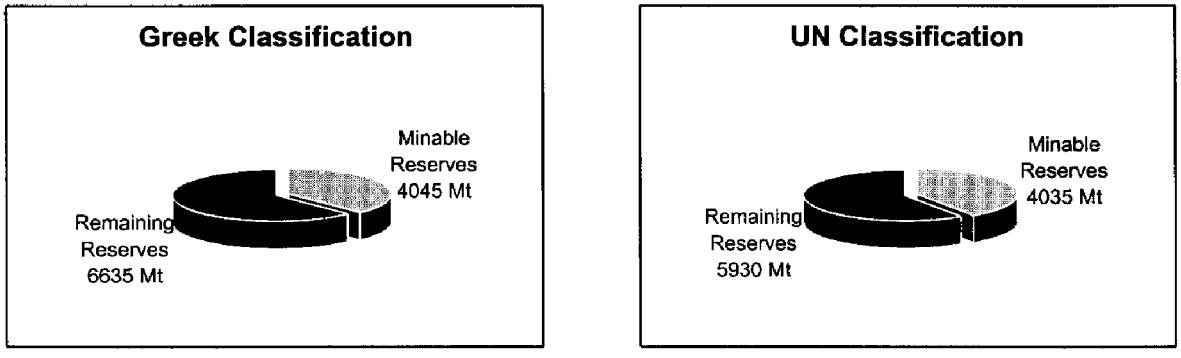

Figure 2: The minable and the remaining reserves of Greek lignite deposits according to the UN and the Greek Classification Systems