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APPLICATION OF THE UNITED NATIONS FRAMEWORK CLASSIFICATION (UNFC) FOR RESERVES/RESOURCES

Case Study: Neves-Corvo Copper-Tin Mine, Portugal[1]

Introduction

1.   In May 2003 a meeting was held at the Neves-Corvo Mine between Mr. Lemos de
Sousa and Mr. Fernando Noronha from the Faculdade de Ciências da Universidade do Porto
(Department of Geology) and Mr. Alfredo Ferreira and Mr. Francisco José da Silva from
Somincor, concerning the application of the United Nations International Framework
Classification for Reserves/Resources to a deposit like Neves-Corvo. As the outcome of this
meeting Mr. Lemos de Sousa proposed formally to Somincor a study about the application of the
UN Classification to our case. Somincor, through its Managing Director Mr. Correa de Sá, gave
the approval to the exercise. Next follows the comments on the results of the application of the
UN classification to the Neves-Corvo mineral deposit.

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1 Prepared by Mr. Francisco Silva, SOMIMCOR, Portugal

Overview of the UN Framework Classification

2.   Somincor has been applying since 1997 the Australasian Code for Reporting of Mineral Resources and Ore Reserves (The JORC Code). Prior to 1997 it applied the United States Bureau of Mines (USBM) classification. The choice of the JORC Code, which is in the framework of the definitions set down by the Council for Mining and Metallurgical Institutions (CMMI), aimed at homogeneity in the resources/reserves reporting among the mines of the Rio Tinto Group.

3.   The JORC code was chosen also because of its technical qualities such as easy to apply, maturity, legally tested in several court cases and its widespread use by the main international mining houses and English speaking countries with a tradition in the mining industry.

4.   The United Nations International Framework Classification (UNFC), 'is designed to allow the incorporation of existing terms in order to make them comparable and compatible'. It also aims to increase communication, supply a better understanding and a more solid knowledge of the reserves and resources in such a way that investments can be more attractive and safe.

5.   The UNFC defines three base components in its classification which are related to the type and quality of information, namely Geological Assessment, Feasibility Assessment and Economic Viability. The principle of the UNFC reserves/resources classification is based upon a methodology where each component represents an axis in a tridimensional matrix, which is divided into stages according to the level of information, knowledge and level of confidence.

        Figure 1 shows the UNFC classification, in a three dimensional format, where stages of the three axis can be combined.

        Figure 2 presents, in a table format, only the categories most commonly used.

6.   The three axes correspond to the Economic Axis E, Feasibility Axis F and the Geological Axis G, with the first two divided into three stages each and the third one divided into four stages. This division sums a total of 36 individual blocks, each one having a specific definition. The blocks of this matrix are referenced by a numeric index system whose values follow the order of EFG. The first digit corresponds to the Economic Axis, the second corresponds to the Feasibility Axis and the third is related to the Geological Axis. The value of the index is inversely proportional to the level of knowledge and confidence. For instance, classifying a resource in the category 221 means that the material has economic potential, has a prefeasibility study and was defined by a detailed geological/exploration study.

Comparison of the Classifications

7.   In relation to the Neves-Corvo Mine the Department of Geology only reports mineral resources and not ore reserves. The application of economic, mining, environmental, metallurgical, etc. factors to the resources and the conversion to ore reserves is beyond the competence of this department. Therefore, the classification studies carried out here, in the perspective of the UNFC, are restricted to the categories E_3 (Intrinsically Economic) and E_2 (Potentially Economic) of the Economic Axis E, not applying in this case the category E_1 (Economic) whose application would inequivocally mean that the resource is exploitable, that is, an ore reserve.

8.   In this study, a close parallel of both classifications (JORC and UNFC) was found regarding the Neves-Corvo data. The comparison was done bearing in mind that ore bodies are classified according to the level of geological knowledge and sampling characteristics such as quality, density and spatial distribution. In relation to the measured and indicated resources *sensu* Somincor, there is the following correspondence with the UNFC Classification:

JORC (Somincor)	UNFC Terms	UNFC Class Code
Measured Mineral Resource	Feasibility Mineral Resource	211
Indicated Mineral Resource	Prefeasibility Mineral resource	221 and 222

9.   Regarding the mineral resources of the Neves-Corvo Mine which are classified as measured and indicated, according to the JORC classification, they fit into the category E_2 of the Economic Axis E of the UNFC, which corresponds to the Potentially Economic category. The mineral resources which fit into that category are covered by a Feasibility Study or a Mining Report or a Prefeasibility Study (Feasibility Axis F - categories F_1 and F_2) and, in terms of geology, compatible with a General Exploration or Detailed Exploration (Geological Axis G - categories G_1 and G_2).

10.   It is worth noting that relative to the Indicated Mineral Resources of Somincor there are two equivalent categories in the UNFC, namely classes 221 and 222, whose difference lies in the level of geological knowledge. In fact, at the Neves-Corvo Mine there are two indicated types. One results from information from the u/g evaluation drilling campaigns and the other from the number of samples used in the estimating process of each block grade. Both indicated types are constantly being updated according to new geological interpretation/data.

11.   It is important to highlight that there exists one difficulty in classifying the Measured and Indicated Mineral Resouces of Somincor in the category E_2 of the Economic Axis E (Potentially Economic). This is related to the definition attached to this category where it states that such resources do not justify exploitation under the conditions which exist at the moment of the evaluation but it is possible in the future. In practice, the biggest proportion of the resources of the mine (Indicated + Measured) justifies their extraction which therefore places them in this respect nearer to the category E_1 (Economic) of the Economic Axis E, which is destined for Ore Reserves.

12.   Although the UNFC definition does not entirely agree with the Somincor's mineralization context, the characterization of these resources into the category E_2 (Potentially Economic) of the Economic Axis E represents a better fit than to link them to the category E_1 (Economic), which is destined for ore reserves, or to associate them with the category E_3 (Intrinsically Economic), whose required level of information is significantly lower than that currently held at Neves-Corvo.

13.   There are some difficulties in the correlation between the Inferred Resources, *sensu* Somincor, with the UNFC similar categories due to some differences. A comparison table is as follows:

JORC (Somincor)	UNFC Terms	UN-FC Class Code
Inferred Mineral Resource	Measured Mineral Resource	331
	Indicated Mineral Resource	332
	Inferred Mineral Resource	333
Resource not available	Reconnaissance Min. Res.	334

14.   The term Inferred Mineral Resouce applied by Somincor could apparently be related with the term Inferred Mineral Resource of the UNFC holding the class code 333. The material related to this code has a value of Intrinsically Economic (E_3 – Economic Axis E), a Geological Study (F_3 – Feasibility Axis F) and a geological knowledge compatible with the level of Prospecting (G_3 – Geological Axis G).

15.   Somincor could define its Inferred Mineral Resources as Intrinsically Economic   (E_3 – Economic Axis E) with a Geological Study (F_3 - Feasibility Axis F). But in relation to the Geological Axis G it is recognized that these resources would be better classified in the category G_2 – General Exploration, whose definition points to a initial delimitation of a deposit already identified. In general terms, without going into detail, we can relate the Inferred Mineral Resources of Somincor's terminology with the Indicated Mineral Resource (class code 332) of the UNFC.

Mineral Resources of the Neves-Corvo

16.   Regarding the points already raised the table below gives the total resources of Somincor, reference date 31 December 1999, presented according to both reserves/resources classifications:

JORC Code

Description		Tonnage and Grade				Resource Classification		
Area	Ore Code	KTon	%Cu	%Zn	%Sn	Measured	Indicated	Inferred
Total	MC/RC/FC	32,249	5.17	0.92	0.20	22,890	740	8,919
	MS/MT/RT/FT	1,856	9.54	1.95	2.36	1,709	109	38
	Complex	50,353	0.50	5.99	0.07	-	26,183	24,170

UN Framework Classification

Description		Tonnage and Grade				Resource Classification		
Area	Ore Code	KTon	%Cu	%Zn	%Sn	211	221 & 222	332
Total	MC/RC/FC	32,249	5.17	0.92	0.20	22,890	740	8,919
	MS/MT/RT/FT	1,856	9.54	1.95	2.36	1,709	109	38
	Complex	50,353	0.50	5.99	0.07	-	26,183	24,170

Conclusions

17.   The United Nations Classification for Reserves/Resources can be applied to the ore bodies and mineralizations of the Neves-Corvo Mine.

18.   This document does not consider in detail the complex subject of reserves/resources classification due to the multiple technical aspects such as geological diversity, type of mineralization and different sampling strategies in use at Neves-Corvo. Nevertheless, it is important to highlight that the triaxial methodology of the UNFC allows a vast spectrum of situations to be covered, if not all, including those which exist in the Neves-Corvo mine.

19.   Certain difficulties were revealed, however, in comparing the two classifications (JORC and UNFC) regarding the measured and indicated resources (*sensu* Somincor) in the class E_2 (Potentially Economic) of the Economic Axis E, due to the definitions which characterize this stage.

20.   In relation to the resources defined as inferred (*sensu* Somincor) there is a better correlation with the indicated resource category of class code 332 of the UNFC. This is mainly due to the fact that the existing geological knowledge of this type of resources is superior to the level of Prospecting (Geological Axis G – class G_3).