

UNFC Mapping Task Force Report – October 9, 2007

Attachment 2 - Discussion of Key Issues

The following documents the key issues reviewed by the task force, *the consensus conclusions reached, and the logic behind these conclusions. Issues and provisional recommendations highlighted in blue continue to be reviewed without total consensus.*

1. UNFC Use of Mapped External Systems and Guidelines

The current document provides only SPE-PRMS (petroleum) and CRIRSCO (solid minerals) mapping. These are the most recently developed systems for commercial applications and, given their alignment with UNFC principles and the detailed mapping to UNFC codes, these guidelines may be used as the basis for assessments with results reported in UNFC codes. No changes have been made to either PRMS or CRIRSCO's classification or guidelines through this mapping project. These systems are externally developed and maintained on the sponsors' websites; it is the responsibility of these organizations, in concert with the AHGE, to maintain the mapping should any of the three systems be revised in the future.

Do these become the default guidelines and specifications for UNFC?

The majority opinion is that the PRMS and CRIRSCO guidelines may be applied to evaluations with results reported using the UNFC system codes according to the provided mapping. PRMS and CRIRSCO potentially become the default guidelines for UNFC.

An alternative opinion is that the mapping exercise is designed to test and improve the UNFC and PRMS/CRIRSCO guidelines may serve as "interim" guidelines. However, the ultimate goal is that the texts of these (and other) guidelines would be consolidated, modified, and incorporated within UNFC to create a stand-alone global system. (Resolving these views is beyond the task force's mandate)

Can other guidelines be used?

The option exists for other systems to conduct similar mapping and where alignment of principles and validity of mapping is confirmed by the AHGE, there is the option to use these systems in preference to PRMS and/or CRIRSCO, with results reported in UNFC codes. The responsibility to develop and maintain such mappings rests with the system owners. Such approach is in line with the Task Force's mandate, which states that the result of the initial mapping effort can be leveraged to support mapping of other national and international classification systems to the UNFC.

Resource Disclosures versus Resources Assessments

The CRIRSCO Template was developed to bring consistency to public disclosures of Mineral Reserves and Mineral Resources. Thus the Template provides no guidelines for sub-economic discovered and limited guidance for undiscovered resources as these are considered too speculative for disclosure; however, such estimates are required to fulfill the UNFC principle of achieving material balance and serving the needs of all stakeholders. Companies may internally track these classes as part of their internal project and portfolio management.

Thus the solid minerals system has been supplemented by additional categories that are specifically identified as not part of the Template; this approach may satisfy the requirements for comprehensive solid minerals assessment guidance.

Minerals – Petroleum Mapping

The document presents a 3-way mapping of UNFC, CRIRSCO and PRMS. The CRIRSCO-PRMS mapping is based on a prior study completed for the International Accounting Standards Board. A table was developed that compares detailed definitions for each system's resources classes and categories and further comments on similarities and differences. Should this information be included in the task force report?

The task force recommends that this table be considered for inclusion as an appendix within a revised UNFC document as addressed under (item 5).

Impact on Prior Applications of UNFC

UNFC 2004 has already been directly accepted as a national system and applied to solid minerals by a number of countries like China, India, Indonesia, Ukraine and other countries.. How do we accommodate these prior applications that may not fully align with the task force's recommended changes?

Since these applications were developed before there was an agreement on consistent guidelines and specifications, there is no assurance that the underlying assessments and resulting allocation to UNFC codes are globally consistent. It appears that these national systems will need to be re-mapped to UNFC 2007 and adjusted where required. Such re-mappings may be required periodically in all mapped systems when UNFC is updated. (Resolving this specific issue is beyond the task force's mandate).

Another option would be to develop separate interim guidelines for countries which already apply UNFC to be used before eventual adoption of UNFC 2007 definitions into current system takes place.

2. Project versus Quantity Modifiers

A project is the development program or mine plan applied to an accumulation/deposit to recover the valued product and deliver it to a reference point at required specifications. It may include surface processing. Under UNFC principles, more than one project may be applied to an accumulation/deposit simultaneously or in sequence. Each project has unique economic and status modifiers and when applied to an accumulation has an associated range of recoverable quantities.

Project Economic Viability is described on the E-axis.

Does economic include other commercial contingencies/modifying factors (legal, environmental, etc)?

There remains confusion between the terms "economic" and "commercial" and needs to be further addressed in the mapping modules and/or category definitions. PRMS defines accounts for contingencies under their marginal and sub-marginal modifiers

Others interpret that "Factors related to the social and economic domain are represented on the E-axis while factors related to the industrial and technical domain are represented on the F-axis."

We need to test our current definitions with examples to ensure that we have consistency in interpreting this guidance.

Note that under E3, UNFC recognizes projects where extraction is of a non-commercial nature, that is, it is not economic to extract, or economic viability has not yet been determined.

Some projects produce quite legitimately, but do not sell. Going forward we see that LNG, heavy oil and CO₂ capture and storage have enormous internal energy consumption needs (5-20%). This could become non-commercial production from the same or a completely different project. In addition we still have the barter/household economies in parts of the world.

Project Technical Feasibility and/or Maturity Status is described on the F-axis. Status depends on technical study sufficiency to make a decision to take action that moves the project towards development. Assuming that the in-situ resources are present, what is the status of the development program/mine plan? Does this include commercial contingencies/modifying factors (legal, environmental, etc)?

There are factors beyond technical studies status that impact chance of commerciality, these are generally accounted for on the E-axis in petroleum! But a commercial contingency may indirectly prevent a project from moving to the next level of maturity. There are cases where the contingency is technical (e.g. new technology is still in the development stage.)

In this recommendation, projects that are either economic under current conditions or reasonably expected improvements in conditions but are not proceeding due to unsatisfied contingencies are coded as F2.1 with an associated chance of development. Where a project is economic and not constrained by significant contingencies, implementation may still be deferred for strategic reasons and be coded either F2.1 or F1.3 with accompanying documentation on the logic.

In the minerals system, F2.1 would be projects where Geological/ Order of Magnitude Studies, and in some cases Pre-Feasibility studies, confirm potential viability (more likely than not) of development but are insufficient to fully confirm a project and there is some chance that implementation will not proceed. Once a project is endorsed by management based on either a Feasibility or Pre-Feasibility study that provides assurance that all modifying factors will be satisfied, the project is coded F1 and mineable portions of Mineral Resources are re-classified as Mineral Reserves.

It is assumed that all projects coded as F1 will be technically and commercially mature. There may be special cases where projects are committed and implemented without firm commercial agreements for sale of the production.

Mapping of Solid Minerals to Project Status

PRMS relies heavily on project maturity status as a form of sub-classification on their vertical axis. While the increasing detail of studies from exploration through geological to feasibility studies is implicit in the Template, project maturity is not used as an explicit form of classification. Nevertheless, the project evaluation process undertaken in a minerals project is very similar to that in a petroleum project.

The mapping module (section 2) provides a correlation table (figure 2) that aligns project maturity status as applied in petroleum evaluations to similar project stages in solid minerals but applies terminology as used in that industry. Although such a complete project status subdivision is not part of the Template for public disclosures, it is provided to guide internal assessments.

While the UNFC coding that applies to petroleum is also shown, the CRIRSCO Template does not utilize these sub-codes for characterizing solid minerals.

Geologic Assurance is described on the G-axis

It is acceptable for petroleum to combine sampling detail to define in-place presence and quality with other engineering factors controlled by development program that will deliver quantities to a defined reference point. Although solid minerals evaluators use a different approach, can this be simplified to simply represent degree of confidence in delivery of quantities to a defined reference point (run-of-mine extraction for minerals and sales point for petroleum)?

Yes, despite all the specialized wording, it is essentially low/best/high estimates or equivalents in incremental terminology used to define uncertainty. The minerals definitions are focused on in situ geologic assurance associated primarily with sampling density while petroleum definitions are focused on uncertainty in estimating sales quantities. Solid mineral definitions relate to Mineral Resources categories; Mineral Proved and Probable Reserves are equivalent in terms of technical confidence to Measured and Indicated Mineral Resources but may not be directly comparable due to the impact of Modifying Factors.

G- axis applied to In-situ Quantities

Can the same uncertainty descriptions used for recoverable quantities be applied to in-situ quantities?

Yes, as long as it is clarified that it is applied to in-situ, not recoverable, or sales quantities. Solid mineral definitions relate directly to Mineral Resources categories where estimates are in situ tonnage and grade prior to mine design.

How to code undiscovered resources?

Regarding petroleum, in UNFC 2004, F3 was used for both Contingent Resources and Prospective Resources. In this revision F3 is always undiscovered = petroleum Prospective Resources and F2 is always petroleum Contingent Resources. All undiscovered resources are coded E3.3 being not enough information to define economic status (which means although we have done detailed economic analysis it is still subject to discovery risk).

What about the G axis? Petroleum evaluators nearly always generate a low/best/high estimate combining in-place uncertainty and recovery plan efficiency uncertainty. So we want to express those estimates yet do not want them added to discovered G1/2/3.

The recommended solution is to use G4.1/G4.3/G4.3 as an analogy to G1/2/3 but identifies them as subject to discovery risk. In the probabilistic-based exploration approach, evaluators generate a distribution of recoverable quantities and then are low/best/high estimates are aligned with P90/P50/P10 from the distribution. It is not

mandatory to use the probabilistic approach; a deterministic scenario approach is equally valid. If only a single “best estimate” is reported, it is deemed to be G4.1+G4.2. Summary results may only be presented as risked best estimate or risked mean.

Does this have any application to minerals?

Minerals exploration evaluators may also postulate a range of success outcomes so there may be an application outside of the CRIRSCO Template.

Others claim that undiscovered quantities are outside the reserve/resource classification and not part of the UNFC system. Indications of mineralization without specified geological certainty are termed Mineral Occurrences. Mineral concentrations of no economic interest are termed Uneconomic Occurrences. *(This appears to conflict with UNFC basics principles to track all resources whether remaining or already produced!)*

It is recommended that the option to use similar coding for undiscovered mineral deposits should be allowed where a range of results is predicted. Otherwise, such occurrences” are simply included as E3,F3,G4.

Is there an alternative approach that better harmonizes the minerals and petroleum methods?

An alternative approach, which has never been thoroughly tested, would be to retain the minerals G1 to G4 definitions and have petroleum use sub-codes for the distribution of outcome estimates. The current recommendation may be viewed as a hybrid approach.

Expressing Uncertainty using Incremental versus Cumulative Scenarios

UNFC codes are based on incremental terminology and align with the typical minerals approach to uncertainty. In the recommended approach, G1 is high confidence, G2 is that additional increment that can be estimated with a reasonable level of confidence, and G3 is the incremental quantities beyond G2 that can be estimated with a low level of confidence.

Petroleum evaluators may use this same incremental approach and/or a cumulative scenario approach, that is, they estimate low/best/high scenarios using either deterministic or probabilistic methods. Thus low estimate = G1, best estimate = G1 + G2 and high estimate = G1 + G2 + G3. PRMS guidelines further recommend alignment between these scenario estimates and associated probability targets. Under PRMS, within the Reserves class the increments are labeled Proved/Probable/Possible and the scenarios are labeled 1P/2P/3P. Within the Contingent Resources class, the scenarios are labeled 1C/2C/3C. The PRMS authors recognized that incremental methods could be applied to Contingent Resources but the community was unable to reach consensus on a naming convention.

For purposes of this (and the IASB) study, the terms C1/C2/C3 are used for incremental estimates in Contingent Resources and are broadly equivalent on a confidence basis to minerals Measure/Indicated/Inferred (and G1/G2/G3) with the caveat that petroleum is estimating sales volumes while minerals is estimating in situ tonnage and grade that may not match run-of-mine or sales quantities.

Developed and Undeveloped Reserves

Those quantities classified as Reserves may be further allocated to Developed (Producing and Non-Producing) and Undeveloped according to funding and operational

status of related wells and facilities. While, in some ways, this refers to the status of quantities, it is more closely related to project status with proved developed producing (PDP) being the most mature status. It is noted that undeveloped quantities may exist in all three sub-classes of Reserves. It is further noted that for each Reserve status, there is a range of uncertainty. Thus even PDP Reserves may have a Possible category based on low certainty of upside recovery.

The task force recommends that such allocations be represented by assigning quantities to sub-categories on the F- Axis.

While not part of the CRIRSCO Template, Developed and Undeveloped allocations are applied by some minerals companies to satisfy specific regulatory and accounting reporting requirements; again it is an allocation of quantities based on the funding and operational status of the extraction program (including facilities) being applied.

3. Issues Regarding Unrecoverable Resources

The following concepts were developed for petroleum assessments. Original in-situ quantities are the sum of production and remaining. Remaining is the sum of those quantities that are estimated to be recovered by all defined development plans that meet either Reserves or Contingent Resource class criteria. To maintain material balance, any of the in-situ quantities that are not remaining as estimated reserves or resources become estimates of Unrecoverable. Some of the quantities may be recovered in the future given dramatic improvements in economics or other conditions including recovery technology. The remainder may be physically impossible to recover. The same logic is applied to undiscovered Prospective Resources

What is the difference between Petroleum Not Viable and Unrecoverable?

In the case of "Not Viable", an extraction plan has been developed which is technically and/or economically not viable without a dramatic, but still feasible, improvement in price, technology or other conditions. Where no such recovery plans are defined, the remaining in situ is classed as Unrecoverable. Sometimes it is a small difference in interpretation and is thus always a gray area!

How to code Petroleum Unrecoverable?

Lacking associated recovery projects, Unrecoverable quantities are clearly not economic.

Coding as E3.3 ("Estimated quantities that are in-situ, but where there is currently considered to be no potential for eventual economic extraction") flags "Unrecoverable" although the reason for no recovery may be either technical (some law of physics) or economic.

We do estimate a range of in situ for an accumulation. Once we have subtracted produced and reserves/contingent resources, that which remains is Unrecoverable. It may become recoverable in the future if price and/or technology change.

We end up with a range of in situ hydrocarbons so we can use G1/2/2 (although in this case it does not refer to recoverable quantities)?

What about the F-axis? Unrecoverable can occur in a project of any maturity including undiscovered. So we could code E3.3; F1, 2, etc. but we typically want to give only separate sum totals of discovered and undiscovered unrecoverable as illustrated in the PRMS classification graphic. The 2004 UNFC matrix uses transparent boxes in front of F3 and then proceeds to quote unrecoverable as the sum of codes, e.g. E3.3; F1.1+F2.1 etc. which is pretty awkward and confusing.

The recommendation is to create two new F sub-codes codes: 2.4 for the total Discovered Unrecoverable and 3.4 for total Undiscovered Unrecoverable. These are not exactly project maturity levels but do uniquely identifying these quantities as having no associated feasible projects. It basically deletes the transparent boxes of UNFC 2004 F-axis and creates a F2 and F3 sub-category as a repository for total Unrecoverable. Within petroleum, discovered unrecoverable (F2.4) will be the source of future enhanced recovery projects.

Unrecoverable in Minerals

Is the same issue relevant in minerals? It is excluded in Mineral Resources estimates using grade cut-offs. But the mining process will extract all in situ material whether the degree of mineralization meets technical and economic cut-offs or not? Should the below cut-off material be accounted for? There may be some portion that can not be technically recovered under current processing and thus the grade is zero (but may be recoverable in the future given dramatic technology improvements). If this below cut-off component is estimated, is it "Not Viable" or "Unrecoverable" or a combination? In underground mining, pillars are left to support mine gallery roofs and would thus be excluded in Mineral Reserves but may be included in Mineral Resources prior to finalizing a mine plan.

Unrecoverable is currently not reported in the Template. It is not apparent that the concept of Unrecoverable (and associated coding) as used in petroleum assessments is directly applicable to solid minerals nor is the need to track such quantities seen as a requirement by the industry!

4. Sales and Non-Sales Production

It is recognized that not all quantities produced/extracted will ultimately be sold in the commercial market. In petroleum, the extracted material may be consumed (lease fuel), lost (e.g. flared gas), or simply re-injected.

Petroleum tracks both raw wellhead production and sales quantities (after surface processing, lease fuel use and losses) and all reserves and resources are quoted in terms of sales quantities at a defined transfer point. E3.1 is used for remaining quantities projected to be non-sales in the development plan.

Minerals use the term Run-of-Mine to define the raw extraction in terms of tonnes and grade and this forms the basis of Mineral Reserves estimates. If there are any losses prior to transfer, they may be noted but are typically not significant or tracked separately. Such losses end up in tailings which may be re-worked in the future. Even if there is stockpiling, it has already been captured in Run-of-Mine production and reserves. *Thus there may logically be no Non-sales (E3.1) for F1 Mineral Reserves.*

Minerals maintain material balance between original reserves and remaining reserves using raw production = Run-Of-Mine. Whatever portion of Mineral Resources that does not get mined just stays in Mineral Resources. Material balance is maintained.

Mineral Resources are stated in terms of in situ tonnage (before any losses in mine design) and grade after cut-off. At this stage, it is assumed that it will all be recovered through to a theoretical run-of mine measurement so no “non-sales” are projected for this class. At this stage no stockpiling or pillars are envisaged as there is yet no mine plan.

This sub-category E3.1 creates problems in aligning petroleum and minerals production. That is why it may not be appropriate to show a “box” for non-sales in the solid minerals UNFC matrix (Figure 1) and perhaps there is no E3.1;F2 for Mineral Resources.

This issue needs to be addressed either in the section 2 text or under E3.1 definitions.

5. Re-structuring of the 2004 UNFC document

The revision of the 2004 UNFC definitions into generic cross-commodity type and the mapping exercise of UNFC to PRMS and CRIRSCO, have provided a back-drop for reconsidering the structure and format of the current UNFC. It has not been the Task Force mandate to review the structure and to propose such changes, but several attempts have been made to restructure the text to better accommodate the results of the mapping.

The simplification of the definitions demonstrates that there is a potential for improvement of the UNFC document by simplifying this further to benefit clarity and accessibility. This can be done in several ways. One possibility is to simplify and concentrate the definition in a format that cover four to five pages, supported by specifications, mapping modules and commodity-specific guidelines.

It is recommended that a separate task force be charged to develop such a document incorporating the mapping modules.

It is also recommended that a restructured UNFC consider inclusion as appendices two tables that were developed as part of the IASB mapping project. one table provides a detailed comparison of PRMS and CRIRSCO reserves and resources definitions with an accompanying text commenting on similarities and differences. A second table is a glossary and compares terminology commonly used in petroleum and mineral assessments and results reporting; again a comments section discusses similarities and differences.