THESIS:

Definitions and guidelines governing the categorization and classification of petroleum reserves are an industry necessity to achieve a degree of standardization that ultimately assures consistency from individual to individual, company to company or country to country. Unfortunately, the engineers and geoscientists charged with the assessment of a company's or country's reserves and resources are confronted with a myriad of different rules and reporting requirements. Reserve and resource estimation is a complex process which involves the integration of diverse technical disciplines and relies upon a combination of knowledge, experience, and judgment. In the course of the estimation process, the evaluator's judgments are influenced by the interpretation of technical data and the knowledge of the applicable reserve and resource definitions. Only by knowing the rules and how to apply them to the situation for which they are intended can an evaluator provide consistent and reliable estimates. With the globalization of the oil and gas industry, the importance of developing a common understanding of the underlying "rules" for the different classification systems has been heightened.

Reserve and resource classification systems are intended to allow the evaluator to follow the progression of changes in the exploration and production life cycle of a reservoir, field, or project that arise as a result of obtaining more technical information or as a result of a change in the economic status. Most systems incorporate terminology to describe the progression of a project from delineating an initial prospect to the confirmation of the prospect through exploration drilling, onto the appraisal and development phase, and finally from initial production through depletion.

The term "resources' is generally applied to all quantities of petroleum (recoverable and unrecoverable) naturally occurring on or within the Earth's crust, discovered and undiscovered, plus those quantities already produced. The term "reserves" is a subset of resources generally applied to the discovered quantities of petroleum anticipated to be commercially recoverable from known accumulations from a given date forward under defined conditions.

Although the terminology varies, there is a high degree of commonality between the definitions and guidelines adopted by the SPE/WPC/AAPG/SPEE in 2007 as the Petroleum Resources Management System (SPE-PRMS 2007) and those of the Russian Federation Classification (RF-2005) as proposed in 2005. Both classification schemes share a similar overall structure denoting petroleum initially in-place, recoverable and unrecoverable volumes.

The total petroleum initially in-place (PIIP) is further subdivided as either undiscovered or discovered. The undiscovered petroleum initially in-place (PIIP) is referred to as Geological Resources in the RF-2005 classification or Undiscovered Petroleum Initially In-Place in the SPE-PRMS 2007. The discovered petroleum initially in-place (PIIP) is referred to as Geological Reserves in the RF-2005 or Discovered Petroleum Initially In-Place in the SPE-PRMS 2007.

The recoverable portion of the petroleum initially in-place (PIIP) is further subdivided into four major classifications (as presented in Figure 1): **undiscovered** (Potentially Profitable Recoverable and In-Place Resources and the Indefinitely Profitable In-Place Resources in RF-2005 or (Recoverable) Prospective Resources in SPE-PRMS 2007), **discovered sub-commercial** (Economic Contingently Profitable Recoverable Reserves and the Sub-economic In-Place Reserves in RF-2005 or (Recoverable) Contingent Resources in SPE-PRMS 2007), **discovered commercial** (Economic Normally Profitable Recoverable Reserves in RF-2005 or (Recoverable) Reserves in SPE-PRMS 2007) and the **produced volumes** (Produced Reserves in RF-2005 or Production in SPE-PRMS 2007). Both the RF-2005 and SPE-PRMS 2007 relate the recoverable volumes to discovery or project maturity and commerciality status.

The unrecoverable portion of the petroleum initially in-place (PIIP) is further subdivided as either undiscovered unrecoverable (Unrecoverable Resources in RF-2005 or Unrecoverable in SPE-PRMS 2007) and discovered unrecoverable (Unrecoverable Reserves in RF-2005 or Unrecoverable in SPE-PRMS 2007).

Figure 1 correlates the major classification divisions between those of the SPE-PRMS 2007 and the RF-2005.

Figure 1 Correlation of Status Categories

The SPE-PRMS 2007 classification scheme has overall alignment at the major classification boundaries with the RF-2005 classifications as denoted in Figure 2 by the high lighted sections.
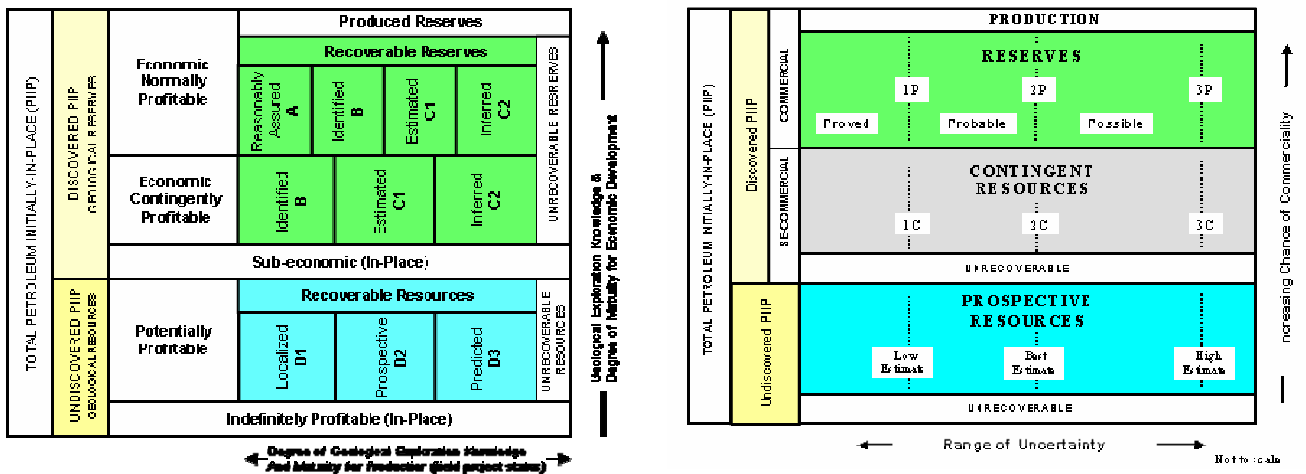

Figure 2 Correlation of RF-2005 and SPE-PRMS 2007 Classifications

To apply the SPE-PRMS 2007 classification scheme, an evaluator must consider the commercial factors that impact the project's economic feasibility, its productive life and its related cash flows. In the case of

Prospective Resources, the evaluator must address the chance of discovery as part of assessing the chance of the project's commerciality. Prospective Resources are defined as "those quantities of petroleum estimated, as of a given date, to be potentially recoverable from undiscovered accumulations by future development projects. For Contingent Resources, the evaluator must address the chance of development as part of assessing the chance of the project's commerciality. Contingent Resources are defined as "those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations, but which are not currently considered commercially recoverable. Contingent Resources may include 1) projects with no viable market, 2) projects dependent on technology under development or 3) projects in the early stage of evaluation. Reserves are defined as "those quantities of petroleum anticipated to be commercially recoverable from known accumulations from a given date forward under defined conditions. Reserves must further satisfy four criteria. They must be 1) discovered 2) recoverable 3) commercial and 4) remaining as of a given date as well as associated with an identified development project.

The RF-2005 classification scheme is based on a similar consideration for the degree of (project) maturity for economic development and the level of geological exploration knowledge.

While there is overall similarity between RF-2005 and SPE-PRMS 2007 reserves and resources classifications, there are subtle differences that should be noted. The RF-2005 uses the term "reserves" for all types of discovered volumes (Economic Normally Profitable and Economic Contingently Profitable recoverable volumes and Sub-economic in-place volumes) whereas the SPE-PRMS 2007 restricts the use of the term reserves for the remaining, commercially recoverable portions of the discovered volumes only and defines sub-commercial recoverable volumes as resources rather than as "reserves".

Under the new SPE-PRMS 2007 definitions reserves and resources are expressed only as recoverable volumes, while the RF-2005 defines certain resource or reserves categories as either recoverable volumes or as in-place volumes or may include both. The RF-2005 estimates recoverable and in-place volumes for the Potentially Profitable D1, D2 and D3 categories and in-place volumes for the Indefinitely Profitable portion of the Undiscovered Resources and in-place volumes for the Sub-economic portion of their Discovered Reserves. In part, the estimation of only in-place volumes in certain instances may be due to the view that lacking sufficient definition for computing development plan economics, it is not feasible to forecast recovery to an economic limit as would be necessary in the assessment of commerciality under the SPE-PRMS 2007 guidelines. In the SPE-PRMS 2007 approach, analogous development projects would be used to estimate the project economics as well as the recovery efficiency applied in the evaluation of the recoverable volumes.

The RF-2005 classification splits the Undiscovered Recoverable Resources into three subdivisions roughly described as prospects (D1), leads (D2) and plays (D3). The SPE-PRMS 2007 encompasses these variations in project maturity within the single classification of Prospective Resources.

The RF-2005 classification of Discovered Economic Contingently Recoverable Reserves is similar to the corresponding SPE-PRMS 2007 Discovered Contingent Resources in that these are discovered volumes with some contingency (economics and/or technology) that make it unfeasible to proceed with development at the time of the evaluation. Those in-place volumes categorized as Sub-economic by the RF-2005 due to access constraints, such as being within urban areas or within the potable aquifer system (environmental), or due to lack of local pipelines and/or other infrastructure, may still have economic potential and in the SPE-PRMS 2007 classification system would not be segregated apart from recoverable volumes typically classified as Discovered Contingent Resources.

The greatest level of divergence in terminology between the two classification systems occurs within the class categories for technical certainty. Classification schemes generally recognize three cumulative estimates or scenarios based on decreasing technical certainty: low, best, and high estimates. The SPE-PRMS 2007 classification adopts a cumulative volume scheme which is applied in principle but using

differing terms for both resources and reserves. The SPE-PRMS 2007 classification also adopts a system of discrete incremental volume estimates when applied to the Discovered Reserves as the Proved, Probable and Possible reserves categories. The SPE-PRMS 2007 reserves and resource categories are based on the uncertainty of the hydrocarbon sales volumes associated with a project. This uncertainty encompasses technical uncertainty for the reservoir in-place volumes plus the uncertainty of the project recovery efficiency, plus the commercial uncertainty for such constraints as 1) a reasonable timetable for development, 2) reasonable assessment of future economic conditions, 3) reasonable expectation of a market, 4) evidence that facilities are or will be made available, 5) evidence that legal, contractual, social, environmental and economic concerns will be met, 6) evidence of commitment by the company, partners, and that government approvals can be reasonably expected and 7) documentation that the project is economic according to the criteria defined by the evaluator.

The RF-2005 classification adopts a somewhat different methodology in which the Undiscovered Recoverable Resources are classified by the geological certainty and maturity of development into discrete subclasses (D1, D2, and D3); however, technical certainty within each subclass may not be specifically delineated. Both the RF-2005 and SPE-PRMS 2007 share similar terminology for describing the cumulative range of technical certainty for the discovered and recoverable portion of the Contingent Reserves and Contingent Resources. The RF-2005 Recoverable Reserve classes A, B, C1 and C2 address both technical certainty and producing status on an incremental basis but the arithmetic summation of these individual reserve classes may not be directly correlative on a cumulative volume basis to the SPE-PRMS 2007 1P, 2P and/or 3P Reserves classes (Refer to Figures 2 and 3).

The RF-2005 Recoverable Reserves classes A, B, and C1 roughly correlate to the SPE-PRMS 2007 Proved Developed Producing (PvDP), Proved Developed Non-Producing (PvDNP) and Proved Undeveloped (PvUD) respectively (refer to Figure 4 for graphic comparison). Recoverable reserves estimates in Category B have similar technical certainty to those in Category A but are not on production for some reason. Category C1 correlates to the SPE-PRMS 2007 Proved Undeveloped (PvUD) in areas where the well or location in question is within one drainage unit and offsets a well or wells with volumes in the proved developed categories of PvDP or PvDNP. The RF-2005 Category C1 does not specifically address instances where there is an existing well which will need a relatively large expenditure to initiate production. For example, significant expenditures might be necessary for a re-completion or to install production or transportation facilities for primary or improved recovery projects. In this instance, the SPE-PRMS 2007 guidelines would generally categorize the well or project as PvUD due to the expenditure.

The RF-2005 Category C2 roughly encompasses the SPE-PRMS 2007 unproven categories of Probable and Possible combined; however, this is not a direct correlation and evaluators should conduct a detailed examination of the information available to appropriately relate C2 volumes to either Probable and/or Possible SPE-PRMS 2007 equivalent volumes. Furthermore, the SPE-PRMS 2007 allows the evaluator to apply the same producing status categories of producing, shut-in, behind pipe or undeveloped to Proved, Probable and/or Possible category volumes. The producing status category defined as shut-in under the SPE-PRMS 2007 definitions has no equivalent under the RF-2005 Recoverable Reserves category.

Figure 3 Correlation of Certainty Classes for Recoverable Volumes

Figure 4 Correlation of Reserves and Producing Status Categories

The RF-2005 does not address the treatment of unconventional hydrocarbons such as tight gas, coal bed methane, shale gas, gas hydrates, natural bitumen or oil shales whereas the SPE-PRMS 2007 guidelines do contain guidelines for their inclusion as either resources or reserves.

In conclusion, by comparing and contrasting the overall structure, terminology and key principals of each hydrocarbon classification scheme, evaluators can develop a better understanding of both, assuring a measure of comparability in the reserves and resources estimation process. The comparisons made by the author rely primarily on the work contained in the SPE Oil and Gas Reserves Committee (OGRC) Mapping Subcommittee Final Report of December 2005 and the final PRMS guidelines. The author is grateful to Mr. Dmitri P. Zabrodin, Ph.D and the staff of FDP Engineering, LLP, Moscow for the critical review and the revisions relating to the SPE's interpretation of the RF-2005. This paper is intended to provide a generalized comparison and does not purport to represent the authoritative version of these agencies' guidelines. Readers should obtain official copies of the guidelines directly from the issuing agencies.

References:

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