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SPE/WPC/AAPG/SPEE Petroleum Resources Management System:
Changes in Reserves Classification and Categorization and Implementation Challenges

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AGENDA

- Basic Principles and Definitions
- Classification and Categorization Guidelines
- Evaluation and Reporting Guidelines
- Estimating Recoverable Quantities
- Implementation Challenges
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Basic Principles and Definitions
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SPE/WPC/AAPG/SPEE Petroleum Resources Management System (PRMS)

- Adopted by Sponsor Societies in March 2007
- Combines Definitions, Glossary, and Guidance from older documents in one document
- Further guidance is expected in one or two years in an Applications Document; the 2001 SPE “Guidelines for the Evaluation of Petroleum Reserves and Resources” remains a valuable reference
• PRMS is project based
  — Project must be applied to reservoir to determine recoverable quantities and economics
  — Project may be notional for new discoveries
• Resources and reserves are distinguished by chance of commerciality
• All resources are classified and categorized in the Resources Classification Framework
Resources Classification Framework

- **Reserves**
  - 1P: Proved
  - 2P: Probable
  - 3P: Possible

- **Contingent Resources**
  - 1C
  - 2C
  - 3C

- **Prospective Resources**
  - Low Estimate
  - Best Estimate
  - High Estimate

- **Total Petroleum Initially-In-Place (PIP)**
  - Discovered PIP
  - Undiscovered PIP

- **Range of Uncertainty**

- **Increasing Chance of Commerciality**

- **Not to scale**
Range of uncertainty is shown along x-axis
Chance of commerciality is shown along y-axis
Uncertainty is “categorized”
Commerciality is “classified”
• Resources (as used by itself) refers to all quantities of petroleum naturally occurring on or within the Earth’s crust
  – Discovered and undiscovered
  – Recoverable and unrecoverable
  – Cumulative production
• Resources includes all conventional and unconventional petroleum
• Note that the term above is ambiguous as used in the document, since “contingent resources” and “prospective resources” refer to recoverable quantities
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IMPORTANT DEFINITIONS

• Total Petroleum Initially in Place (PIIP) is that quantity of petroleum estimated to exist originally in naturally occurring accumulations prior to production (equivalent to “total resources”) – can be discovered or undiscovered
• Production is cumulative quantity of petroleum that has been recovered as of a given date
• Reserves are those quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions.
DEFINITIONS (cont.)

- Contingent Resources are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations, but the applied projects are not yet considered mature enough for commercial development due to one or more contingencies.

- Prospective Resources are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from undiscovered accumulations by application of future development projects.
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PROJECT-BASED RESOURCES EVALUATIONS

Resources Evaluation Data Sources.
• Project Status and Commercial Risk
  – Project maturity may be assessed to provide basis for portfolio management
  – As project moves to higher levels of maturity, there should be an increasing chance of commercial development
  – For Prospective Resources, the chance of discovery is the chance that a potential accumulation will result in a discovery
  – For Contingent Resources, the chance of development is the chance that the accumulation will be commercially developed
The project maturity subclasses (as shown on the diagram on the next slide) qualitatively describe the maturity level of the project. These can be modified to meet the user’s needs.

Table I in the PRMS gives descriptions of the subclasses to assist in assigning the appropriate subclassification to the project.
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• Reserves are commercial at current defined economic and operational criteria.
• Reserves can be allocated to two main subdivisions
  – Developed Reserves are those expected quantities to be recovered from existing wells and facilities.
  – Undeveloped Reserves are quantities expected to be recovered from future investments
• Contingent Resources can be classified into broad groups.
  – Marginal Contingent Resources
  – Sub-Marginal Contingent Resources
Categorization involves estimating the ranges of uncertainty in recoverable quantities of petroleum.

The uncertainties involve both technical uncertainty (PIIP, recovery efficiency of applied projects, etc.) and commercial uncertainty (markets, prices, contracts, etc.).

When commercial conditions are such that the complete project as defined will not proceed, a separate project classified as Contingent Resources should be created with an appropriate chance of commerciality.
DETERMINISTIC AND PROBABILISTIC RANGES

• Deterministic estimates should typically consist of low, best, and high estimates.
• Both Contingent Resources and Prospective Resources also utilize low, best, and high estimates.
• Contingent Resources have associated terms 1C, 2C, and 3C for the three scenarios.
• Prospective Resources have no specific terms other than low, best, and high estimates.
• Probabilistic estimates follow the P90/P50/P10 cumulative ranges.
DEFINITIONS OF RESERVES

- Table III in PRMS presents the category definitions and provides guidelines for applications of the definitions.

- Definitions are given for
  - Proved Reserves
  - Probable Reserves
  - Possible Reserves

- The definitions include deterministic and probabilistic parameters.
DEFINITIONS OF RESERVES (cont.)

• Uncertainty in resources estimates is best communicated by reporting a range of potential results.

• If a single estimate is to be reported, the best estimate is considered to be most realistic figure.

• This best estimate is considered in PRMS to be the 2P estimate.
INCREMENTAL PROJECTS

- Incremental projects are designed to increase recovery efficiency and/or accelerate production through changes to the original project.
  - Workovers, Treatments, and Changes of Equipment
  - Compression
  - Infill Drilling
  - Improved Recovery (supplementing natural reservoir energy)

- Incremental project resources should be classified according to same criteria as initial projects.

- Incremental quantities should be categorized on anticipated certainty of recovery.
UNCONVENTIONAL RESOURCES

• Two Types of Resources Considered
  – Conventional resources are associated with discrete accumulations which are significantly affected by hydrodynamic influences such as buoyancy
  – Unconventional resources exist in accumulations that are pervasive throughout a large area and are not significantly affected by hydrodynamic influences. Examples are:
    ▪ Coalbed methane (CBM)
    ▪ Basin-centered gas
    ▪ Shale gas
    ▪ Gas hydrates
    ▪ Natural bitumen
    ▪ Oil shales
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COMMERCIAL EVALUATIONS

• Cash-Flow-Based Resources Evaluations
  – Run for each project
  – All associated costs (capital, operating, royalties, taxes) must be considered
  – Must have entitlement to production
  – Base case is defined conditions, i.e., forecast conditions of prices and costs
Reference Point
- Location in production chain where produced quantities are measured or assessed
- Typically point of sale to third parties or where custody is transferred to entity’s downstream operation
- May be defined by relevant accounting regulations
- Equal to Raw Production less Non-sales Quantities
  - Fuel and flare
  - Non-hydrocarbons removed from sales stream
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Estimating Recoverable Quantities
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ANALYTICAL PROCEDURES

• Analogs
• Volumetric Estimates
• Material Balance and Simulation
• Production Performance Analysis
• All can be done deterministically or probabilistically
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AGGREGATION

• Two General Methods
  – Arithmetic
    ▪ Generally required by regulators
  – Statistical
    ▪ Must account for dependencies

• Aggregating across resources classes must account for discovery and commerciality risks

• PRMS is not specific on methodology of aggregation
Implementation Challenges
DATA CHALLENGES

• Reserves
  – Currently companies track proved reserves well
  – Must extend reservoir engineering and documentation work to unproved reserves

• Resources
  – Must track from prospective to contingent to reserves and finally to production
TRAINING CHALLENGES

• Classification
  – Distinguish between reserves and contingent resources
  – Workflow to properly capture the required documentation

• Categorization
  – Properly assess type of evaluation – deterministic or probabilistic – to maximize use of engineering and geoscience time
  – Assign correct uncertainty descriptor (proved, probable, possible, contingent, prospective) to estimates
Thanks for your attention.

Questions?