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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**
- **Replaces SPE/WPC/AAPG Petroleum Reserves and Resources Definitions (1997 and 2000)**
- **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**

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SPE/WPC/AAPG/SPEE PRMS

- **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**

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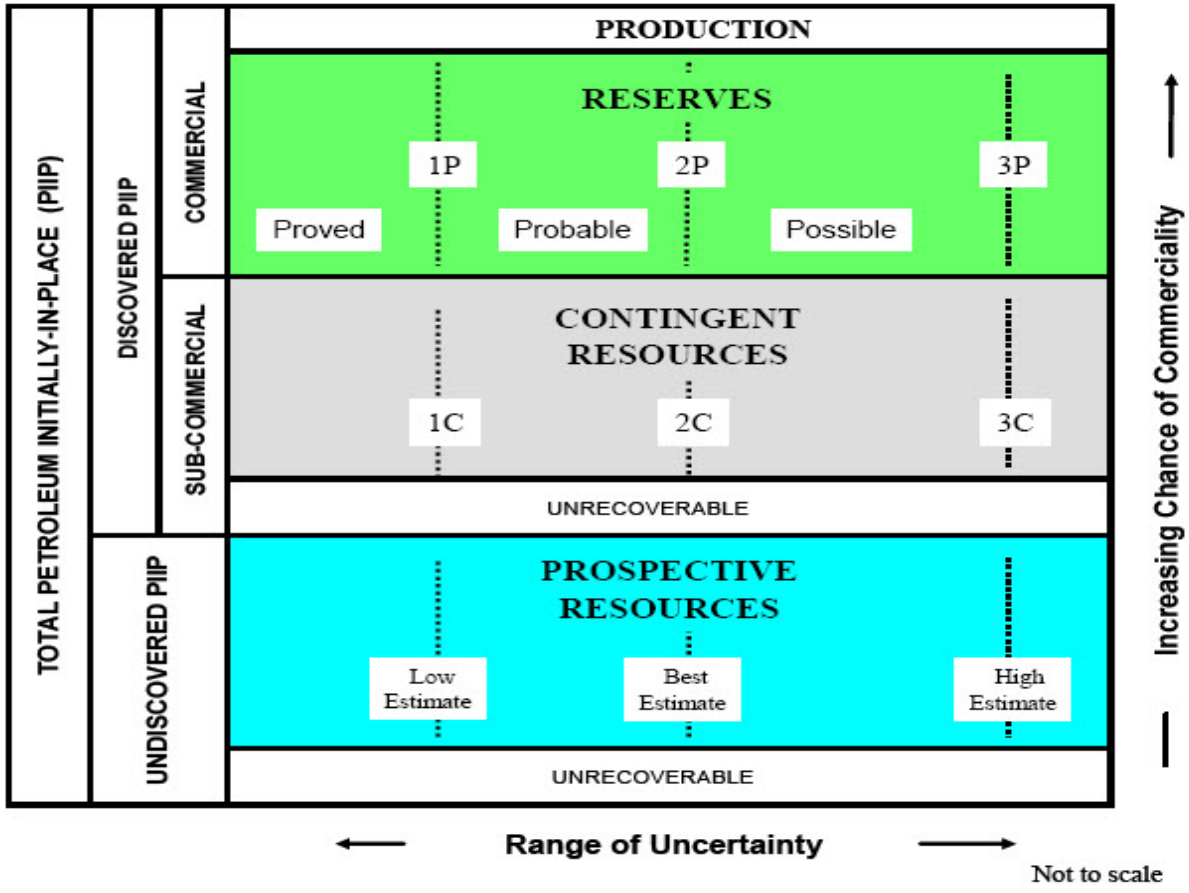

Resources Classification Framework.

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- Range of uncertainty is shown along x-axis
- Chance of commerciality is shown along y-axis
- Uncertainty is "categorized"
- Commerciality is "classified"

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- **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.**

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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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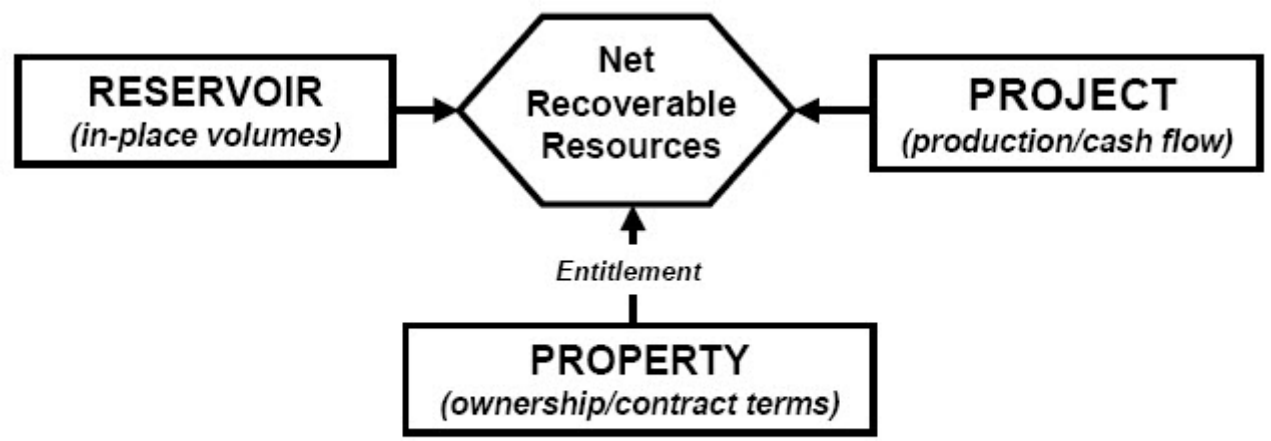
PROJECT-BASED RESOURCES EVALUATIONS



Resources Evaluation Data Sources.

Resources Evaluation Data Sources

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Classification and Categorization Guidelines

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- **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**

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- **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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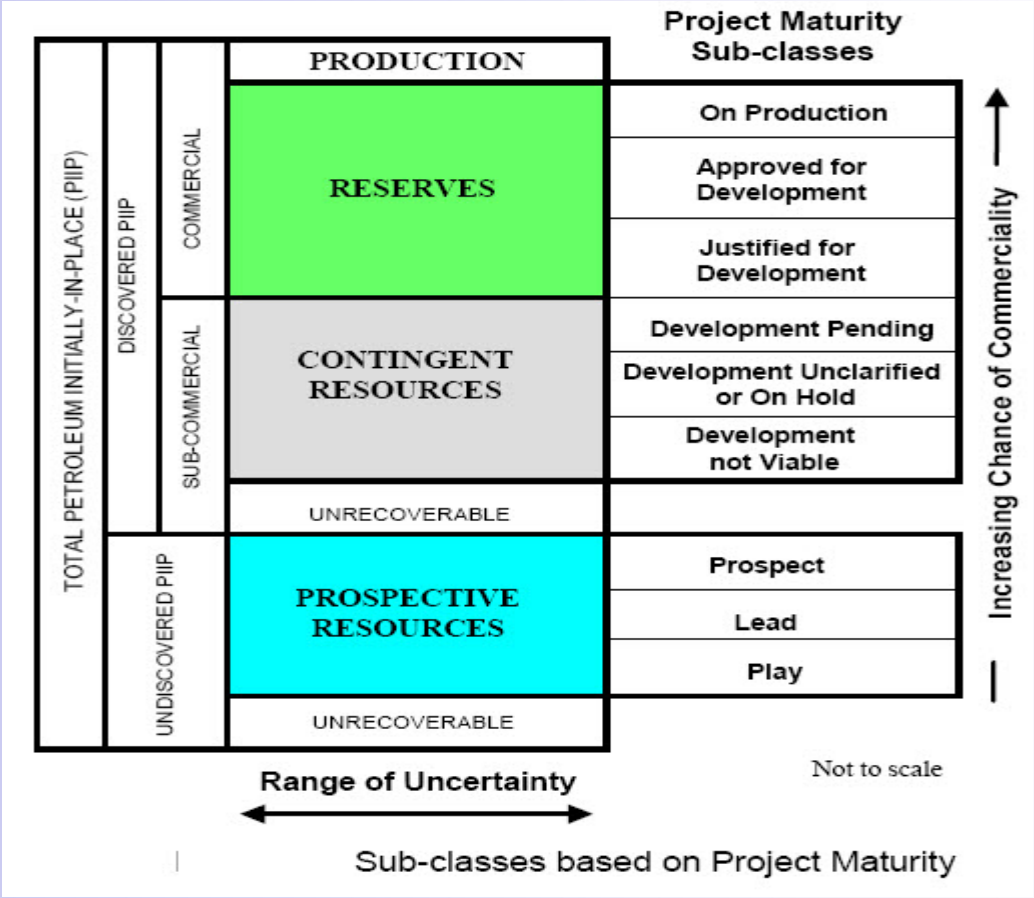

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- **Reserves are commercial at current defined economic and operational criteria.**
- **Reserves can be allocated to two main subdivisions**
  - **Developed Reserves are those expected quantities to be recovered from existing wells and facilities.**
  - **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**

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- **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**

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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.

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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.**

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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.**

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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.**

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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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Evaluation and Reporting Guidelines

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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**

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PRODUCTION MEASUREMENT

- **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**

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Implementation Challenges

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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**

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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**

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Thanks for your attention.

Questions?