Production Measurement Management

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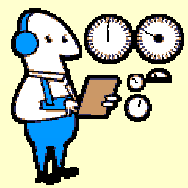

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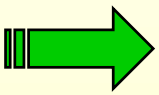
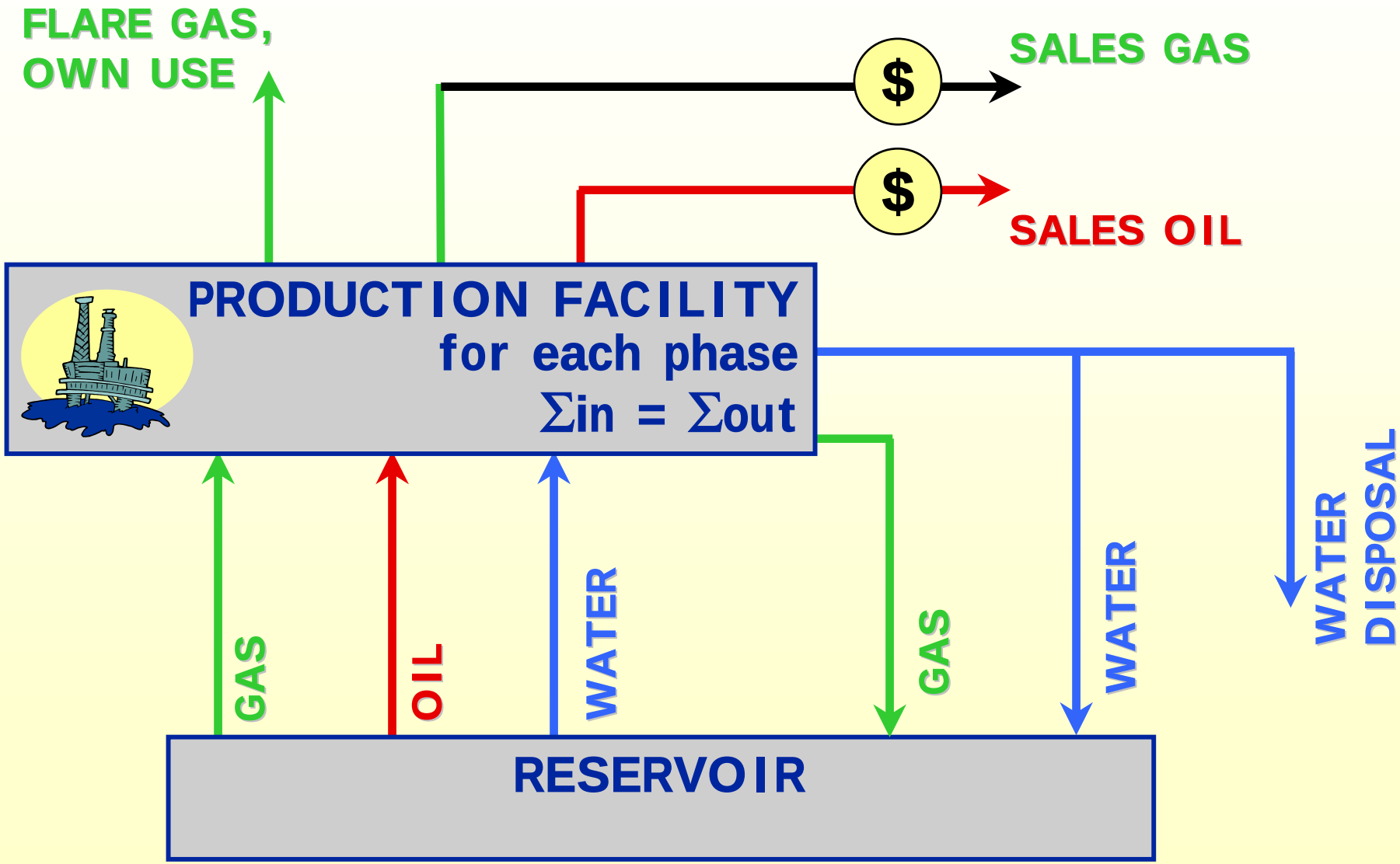


1. Introduction
2. Uncertainty and risk
3. Organisation
4. Production Measurement Management
5. Conclusions

Introduction
- The product balance



Introduction
- Flowrate measurements (1)

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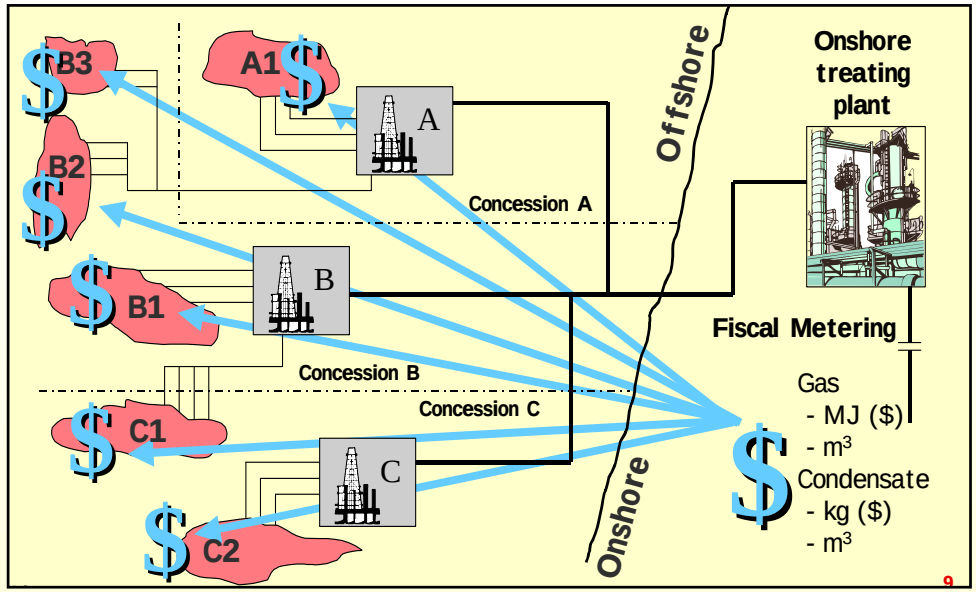
Fiscal allocation

- Taxation / royalty / sales
- Production allocation to partners in joint pipelines
- Mutually agreed accuracy
- Control by contract and/or legislation



Reputation management

- Environmental measurement
- Forecasting

Some upstream metering might also be categorized as fiscal metering !!!

Well allocation

- Allocate bulk measurements to individual wells or reservoir

Introduction
- Flowrate measurements (2)

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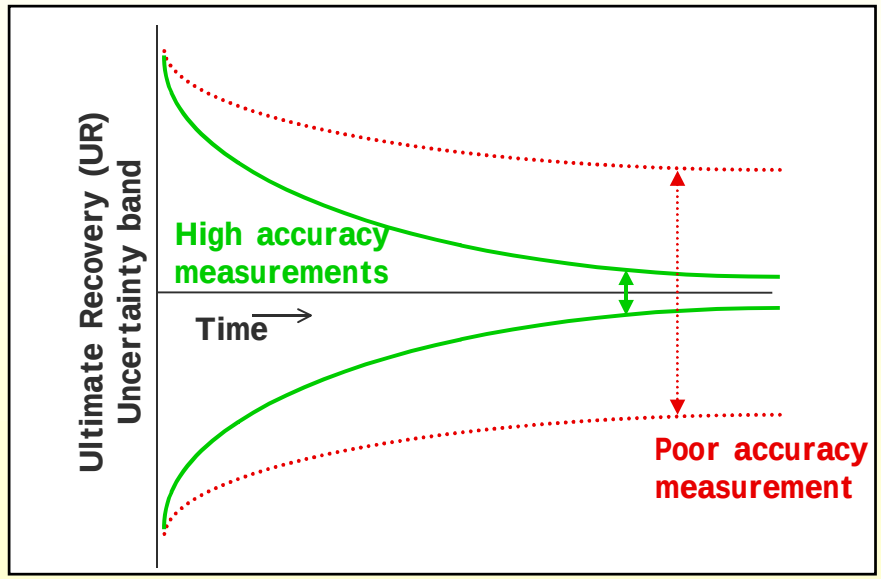
Reservoir management

- Maximise hydrocarbon recovery at prevailing economic and technical conditions, e.g.
  - Planning primary, secondary and tertiary development
  - Depletion policy
  - Injection/production balance
  - Production forecast
  - Future project ranking



Operational control

- Well surveillance
- Artificial lift optimisation
- Process and equipment performance
- Production targets and constraints

Introduction
- The product balance

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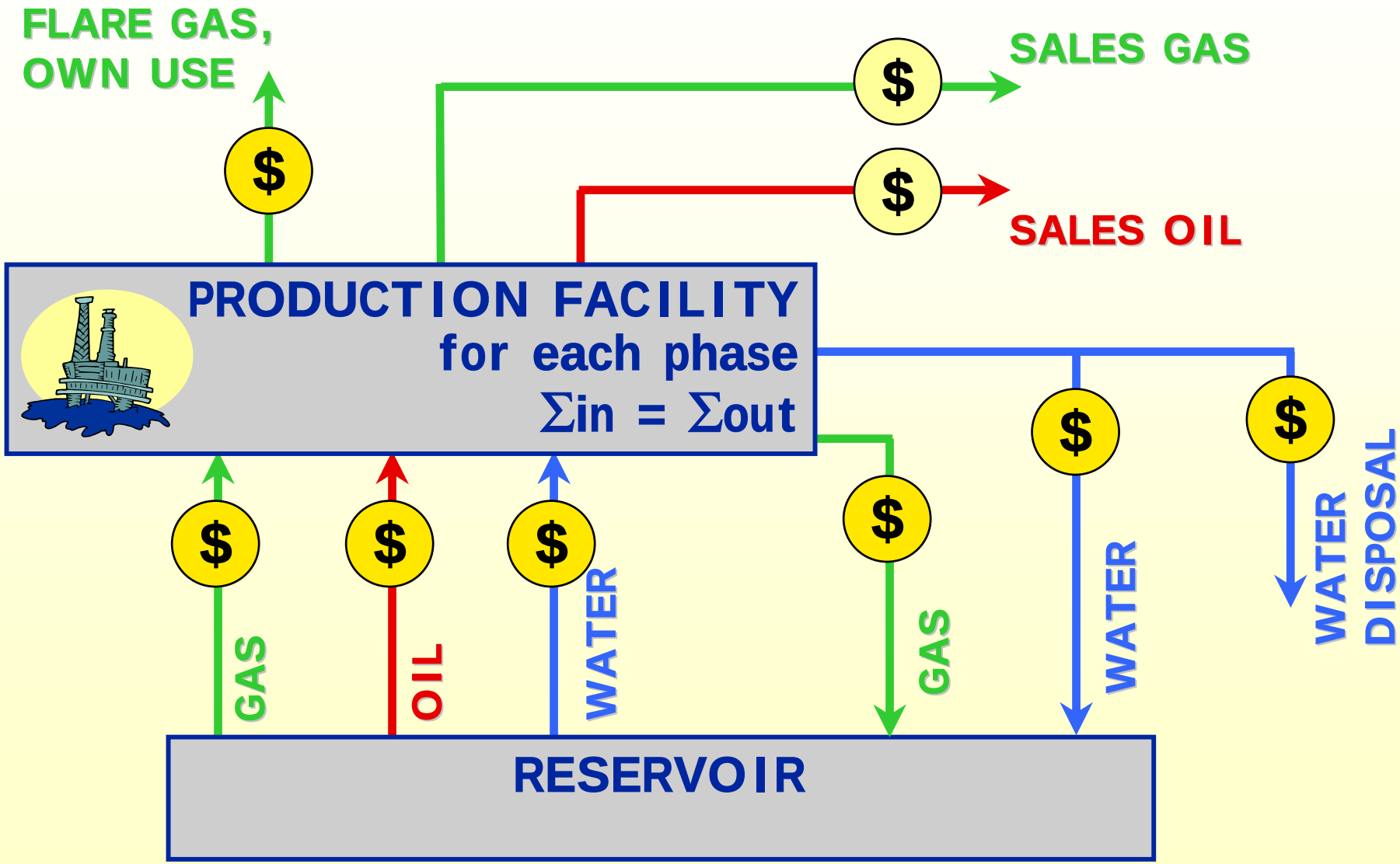

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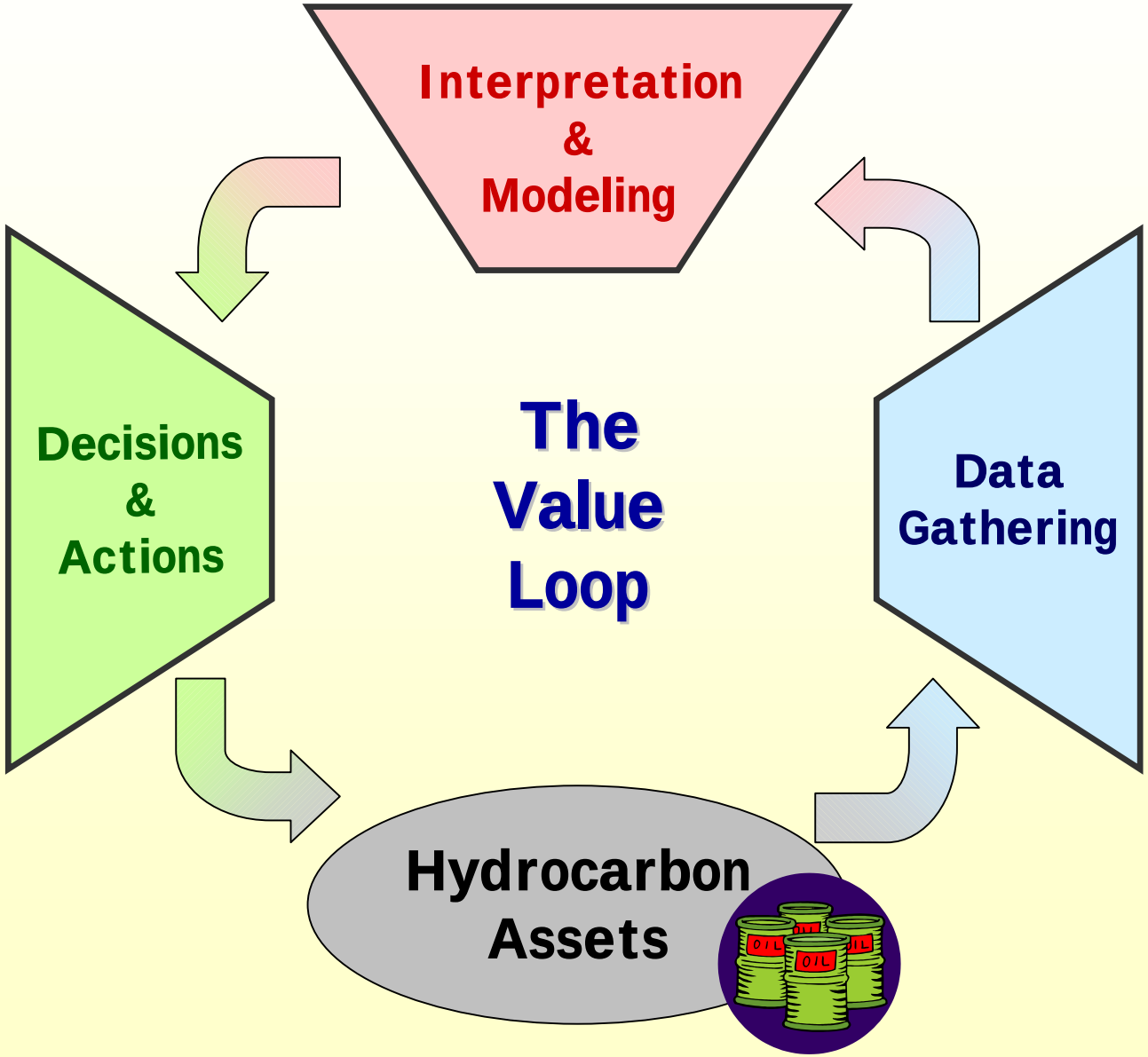
Closing the value loop



Economic considerations - Accuracy vs. Costs

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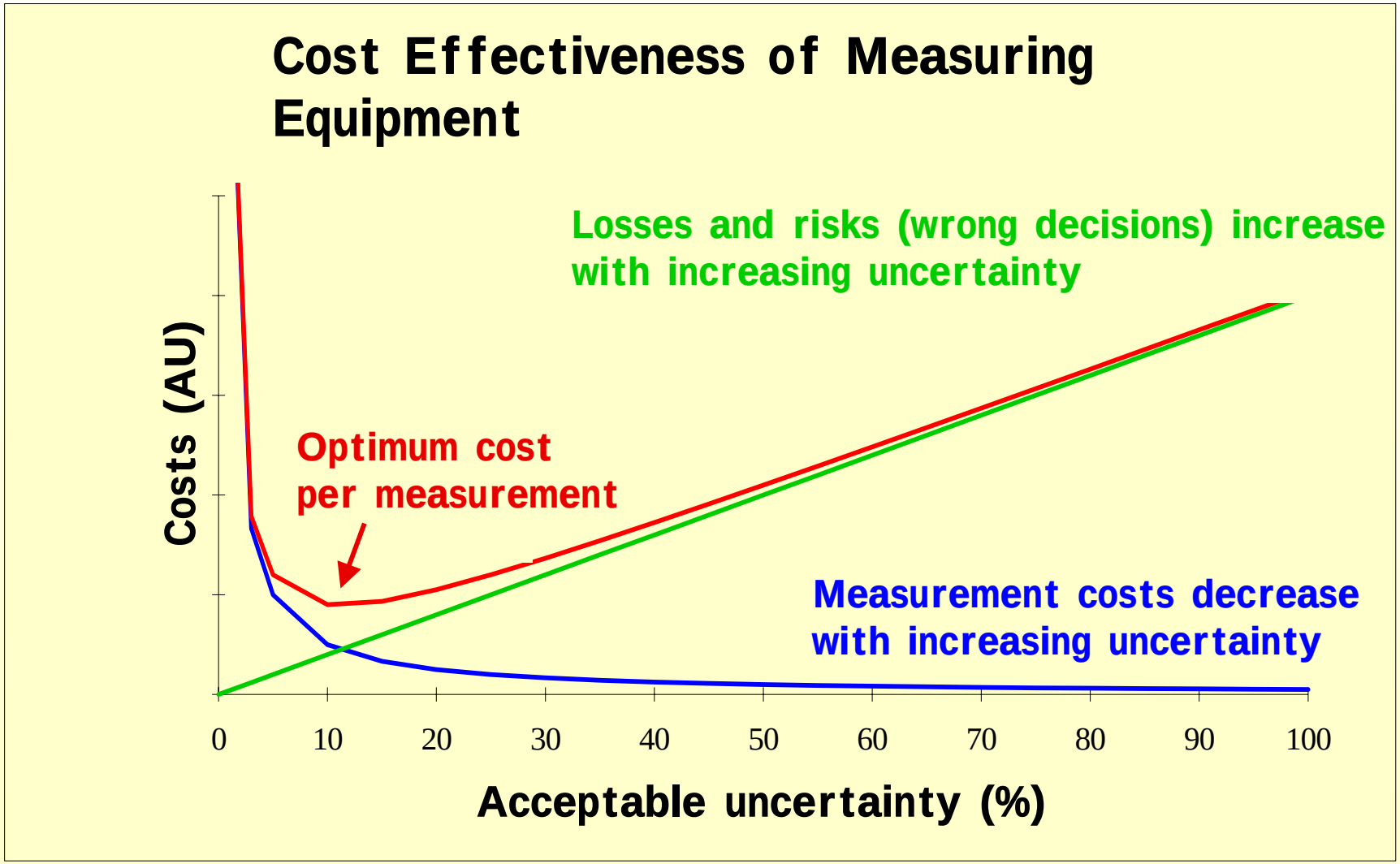

What are Critical Measurements

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For oil wells

1) Net oil flow rate
2) Gross liquid flow rate
3) Watercut
4) GOR - Gas/Oil Ratio
5) FGOR - Formation GOR

For gas wells

1) Gas flow rate
2) CGR - Condensate/Gas Ratio
3) WGR - Water/Gas Ratio

In contrast with the requirements in the 80-90's, which presented the requirements in terms of **oil, water and gas flow rates**, it now becomes clear that often **watercut** and **GOR** are also prominent parameters.

Definition of required accuracy - The changes

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1980's Shell report
Monthly reconciled figures should be 10% per phase and per production/injection well

Changes:

- Introduction of more computing power
- Availability of Multiphase (wet gas) flow meters
- More complex (shared) production systems
- Production Optimisation
- Throughput constraint facilities
- Abandonment decisions
- More stringent environmental constraints

2000 Accuracy should be negotiable and should be determined through a methodology rather than using a fixed number by default

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Production Measurement - Who is involved

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Operations
Maintenance free
Calibration free
Moderate accuracy
Trending

Petroleum and Reservoir Engineers
Moderate accuracy
Trending

Projects
Options development
Project execution

Custodian ?
Auditable ?

Contract and Finance
Fiscal standards
High accuracy
Reliable

Third Parties
Fiscal standards
Accuracy negotiable

Instrument Engineers
What the customer wants
Standards,procedures, etc.

Government Bodies
Fiscal standards
High accuracy
Reliable

Sales parties
Fiscal standards
High accuracy
Reliable
Traceable
Contracts

Production Measurement - Organisation

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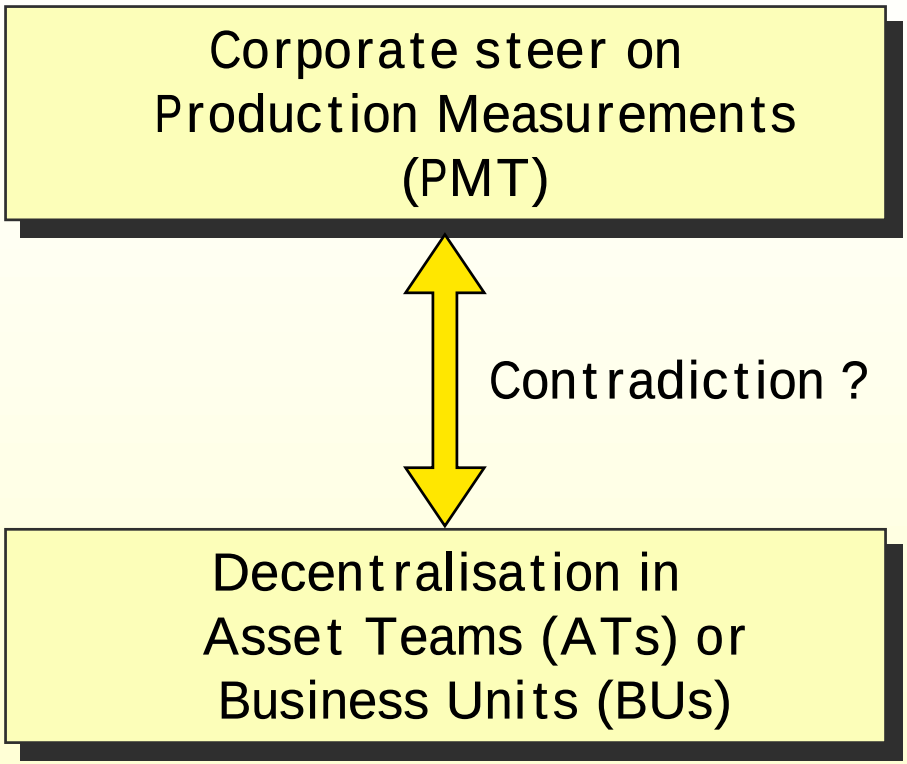
Production Measurement Team

- Preferably in corporate part of the company
- Knowledgeable of the entire metering chain (from sensor to final report)
- Focal point for companies metering philosophy/strategy
- In-depth technical metering support (new technology, standards, best practices, allocation processes, fluid parameter management)
- Liaison with both internal and external parties, feel for what is required by “customers”
- Company spokesman to 3rd parties and Government
- Execute audits and reviews in the Asset Teams or BU’s

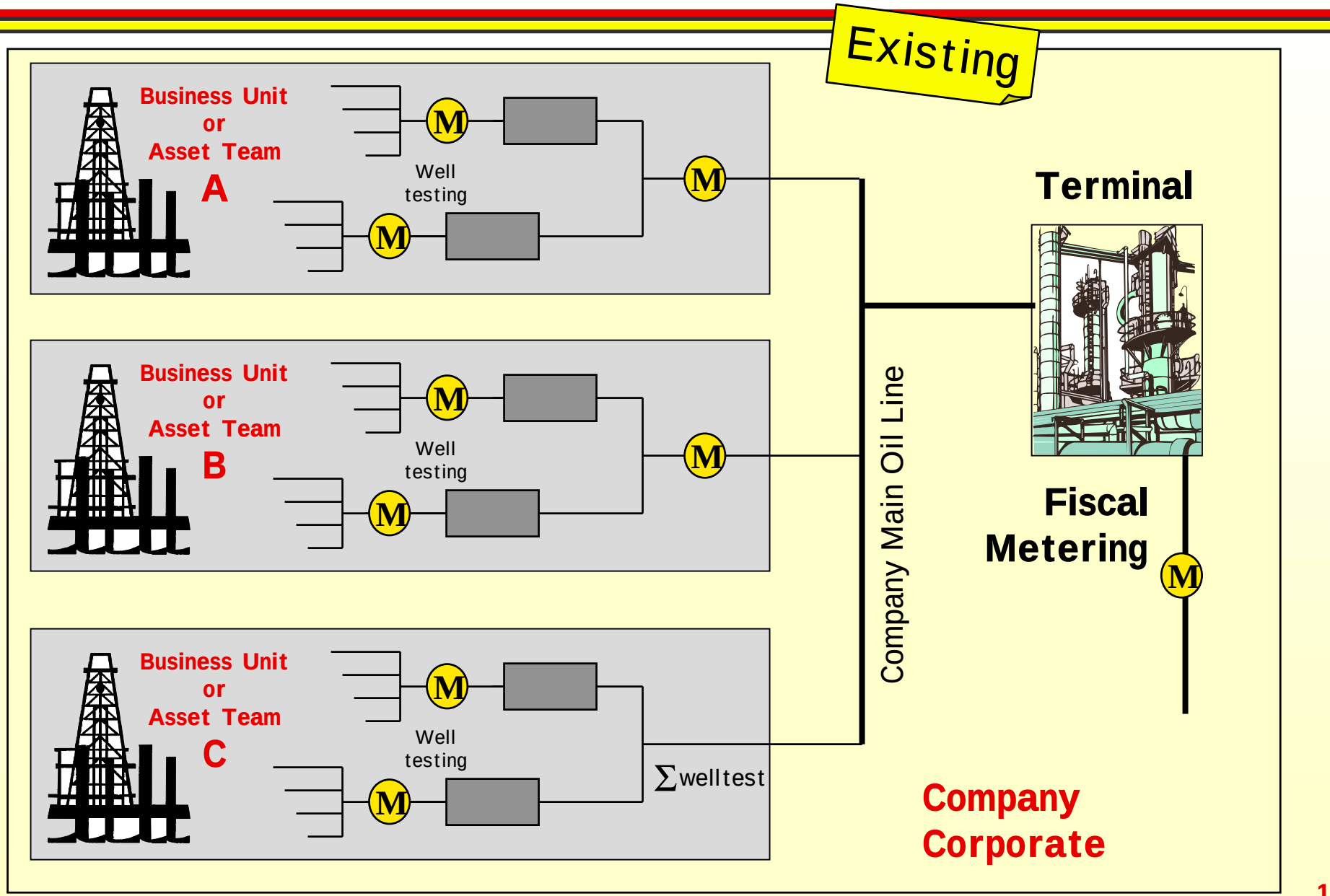
Production Measurement - Organisation



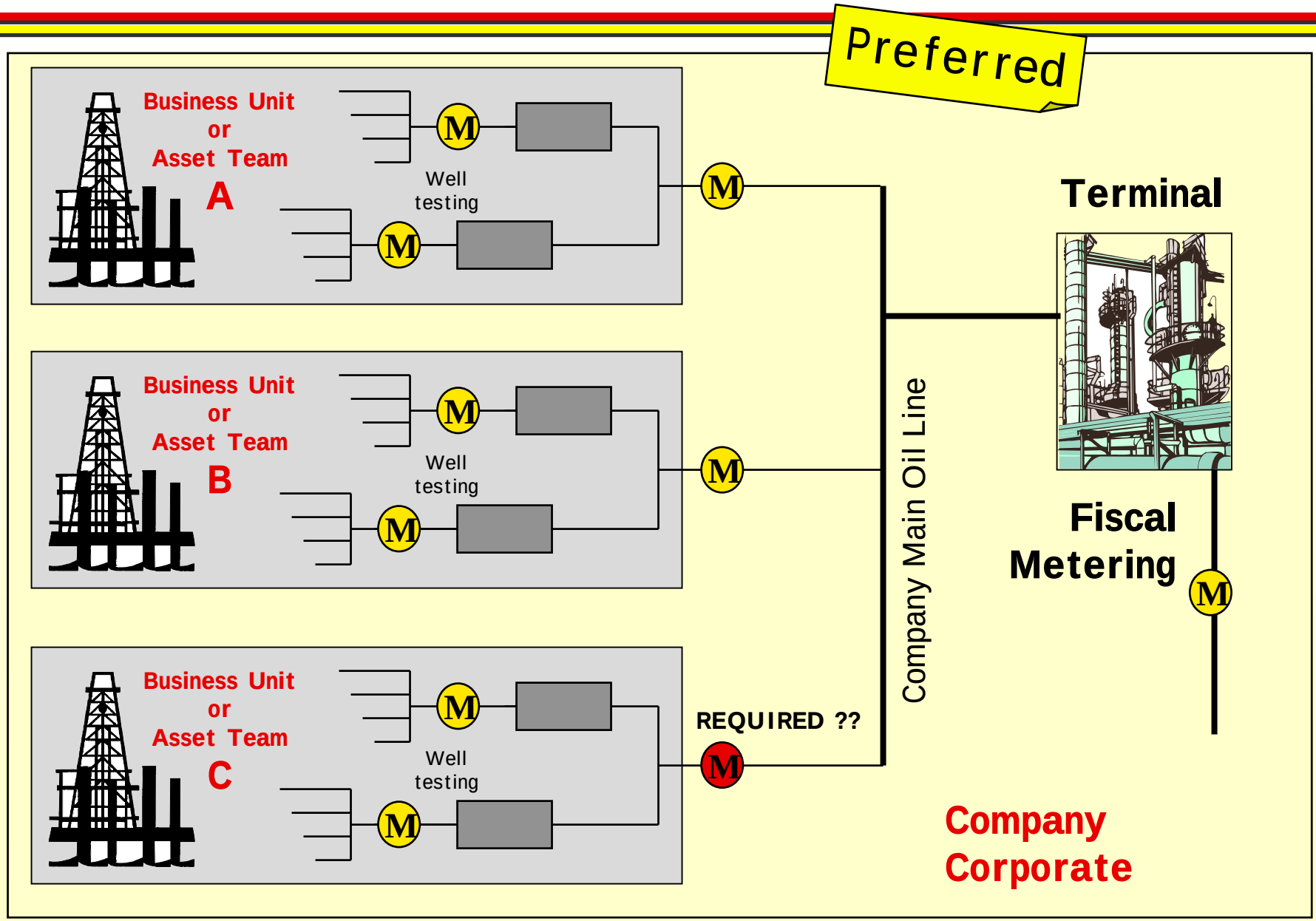
What is boundary between Corporate and AT or BU ?

Measurement that influences the business of other other ATs, BUs or 3rd parties, should fall under the Production Measurement Team responsibility.

"Company in-house fiscal metering"



"Company in-house fiscal metering"



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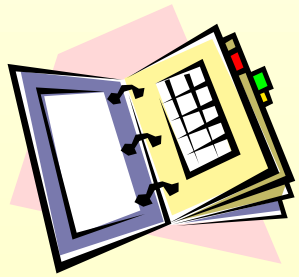
Production Measurement - Management Structure [Requirements]

Management structure should cover the entire chain from sensor(s) to final reported figures

- Algorithms (PVT corrections, reconciliation, allocation)
- Spreadsheets (!!)
- Communication
- Validation process
- Fluid properties (z-factor, base densities, etc.)

The measurement system should be transparent to all stakeholders i.e. documented

- Measurement philosophy
- Systems descriptions
- Metering descriptions/manual



Measurement systems should be transparent and auditable.

Production Measurement - Management Structure [Phases]

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1) Conceptual design phase

a) Custody transfer and allocation contracts
b) Government requirements
c) Surface control/monitoring (Operations Eng.)
d) Sub-surface control (Petroleum and Reservoir Eng.)

Should result in :

Production Measurement and Monitoring Philosophy
(with key production parameters and their accuracy)

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2) Detailed design phase

Production measurement system description covering
a) Production forecast
b) Production facilities and meter locations
c) Spec's of meters, performance envelopes, accuracies
    * New vs. conventional technology
d) Conversion factors (actual to standard)
e) Detailed reconciliation and allocation process
f) Sensitivity analyses, etc.
g) Management of fluid parameters (z-factor, fluid densities, etc.)
h) Operating, maintenance and calibration procedures.

Should result in :
Production Measurement Manual
(day-to-day working document and under custodian of PMT)

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3) Operations phase

a) Definition of roles and responsibilities
b) Responsible must be able to execute
c) Keep documentation up-to-date
    * Production Measurement and Monitoring Philosophy
    * Production Measurement Manual
d) Corporate PMT should provide procedures and tools
e) Peer reviews, audits, feedback

Production Measurement
- Example base fluid parameters

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Coriolis meter for net-oil measurement

If base oil and water densities are not managed properly
- Errors in watercut and net-oil measurement

MPFM for oil, water and gas measurement

If base fluid properties are not managed properly
- MPFM's will give errors

- Gamma absorption coefficients
- Base dielectric constants
- Conductivity
- Base densities, etc

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Production Measurement Management - Conclusions

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- Production Measurement Management should cover the entire chain of actions from sensor to final report
- Accuracy is negotiable, should be determined through a methodology rather that using fixed numbers
- Production Measurement Team that carries responsibility for corporate metering issues
- Changes in production metering during the last decade:
  - Increased equipment complexity
  - Increased complexity of infrastructures
  - Various operation constraints

  call for a change in how we design, operate and maintain the entire chain of our production measurement process.
- The 3-phases in the design and operation of measurement systems:
  - Conceptual design phase (philosophy)
  - Detailed design phase (measurement manuals)
  - Operations phase (procedures and tools)

Production Measurement Management

.... thank you for your attention ...

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