OIL AND GAS PROCESSING FACILITIES

• OVERALL FLOW SCHEME
• PURPOSE OF EACH COMPONENT
  • HOW THEY WORK
  • CHALLENGES
  • OPTIONS
• OIL AND GAS FACILITIES OPERATING MODELS
• KEY PERFORMANCE METRICS CONSIDERATIONS
WELL CONTROL

PURPOSE
• CONTROL PRODUCTION RATES
• MAXIMISE PRODUCTION
• PROTECT FROM UNCONTROLLED RELEASE OF WELL FLUIDS

CHALLENGES
• CHANGING WELL CONDITIONS
• CHANGING FLUID PROPERTIES
• SAND EROSION

OPTIONS
• SUBSEA
• TOPSIDE
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• TOPSIDE
OIL AND GAS GATHERING

PURPOSE

• MOVE FLUIDS TO CENTRAL PROCESSING
• MINIMISE COST
• PRODUCTION METERING

CHALLENGES

• CHANGING WELL CONDITIONS
• CHANGING FLUID PROPERTIES
• COMINGLING FLUIDS
• CORROSION/EROSION

OPTIONS

• SUBSEA/TOPSIDE
• REMOTE/CENTRALISED
• MANNED/UNMANNED
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• SUBSEA/TOPSIDE
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Conoco Phillips Assets Operated by Centrica

Rivers Terminal

Millom West

Millom East

Dalton

Calder

DPPA

South Morecambe

Heysham Logistics Base

Bains

South Morecambe Central & Remote Installations
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METERING CONSIDERATIONS
- ACCURACY
- CALIBRATION
- ALLOCATION
- OBsolescence
- TURN DOWN RATIO
- DATA INTERFACE
- COMPLEXITY
- AUDIT TRAIL
- REGULATORY NEEDS
- TECHNICAL SUPPORT
- PROVING
- FLUID COMPOSITION

GS Management Consultants Ltd.
SEPARATION

PURPOSE
- SEPARATE THE WELL FLUIDS, I.E. OIL, GAS, WATER AND SAND
- STABILISE THE OIL

CHALLENGES
- UNCERTAINTY OF DESIGN BASIS
- OPTIMISATION OF SEPARATION AND COMPRESSION
- WEIGHT AND SPACE LIMITATIONS

OPTIONS
- DEGREE OF SEPARATION
- NUMBER OF SEPARATION STAGES
- REDUNDANCY
- HORIZONTAL OR VERTICAL SEPARATORS
SEPARATION

PURPOSE

• SEPARATE THE WELL FLUIDS, I.E. OIL, GAS, WATER AND SAND
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GAS TREATMENT

PURPOSE
• REMOVE WATER, ACID GASES AND MERCURY
• CONDITION GAS
• MEET GAS SALES QUALITY SPECIFICATION

CHALLENGES
• CHANGING FLUID COMPOSITION
• DISCHARGE GAS QUALITY
• WASTE DISPOSAL

OPTIONS
• EXTENT OF TREATMENT
• COMBINATION TREATMENTS

WATER AND ACID GASES TYPICALLY REMOVED USING LIQUID SOLVENTS THAT ARE REGENERATED AND REUSED

DRY/SWEET GAS
WATER/ACID GAS
LEAN SOLVENT
RICH SOLVENT
HEAT

WET/SOUR GAS
GAS TREATMENT

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• REMOVE WATER, ACID GASES AND MERCURY
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OPTIONS
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• COMBINATION TREATMENTS
GAS TRANSPORT

PURPOSE

• TRANSPORT GAS TO END USER

CHALLENGES

• ENERGY USAGE
• CHANGING FLUID PROPERTIES
• TECHNICAL COMPLEXITY
• ACCESS TO INFRASTRUCTURE
• PROCESS SAFETY RISK

OPTIONS

• PIPELINE
• LNG/LPG SHIP
• COMPRESSION STAGES
• DRIVE TYPE

THE BOTTLE CONTAINS 0.026 CUBIC METRES OF LIQUID AT ATMOSPHERIC PRESSURE THE GAS WOULD HAVE A VOLUME OF 6.9 CUBIC METRES
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OPTIONS

• PIPELINE
• LNG/LPG SHIP
• COMPRESSION STAGES
• DRIVE TYPE

Boeing 747-400 (71m long)

Queen Mary 2 (345m)

Shell’s proposed floating LNG plant (468m)
GAS TRANSPORT

PURPOSE

- TRANSPORT GAS TO END USER

CHALLENGES

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• ACCESS TO INFRASTRUCTURE
• PROCESS SAFETY RISK

OPTIONS
• PIPELINE
• LNG/LPG SHIP
• COMPRESSION STAGES
• DRIVE TYPE
OIL TREATMENT

PURPOSE

- REMOVE WATER/SAND/SALT
- MEET OIL SALES QUALITY SPECIFICATION

CHALLENGES

- CHANGING FLUID PROPERTIES
- ENERGY USAGE
- WEIGHT CONTROL
- DISCHARGE OIL QUALITY CONTROL
- LOGISTICS

OPTIONS

- DEGREE OF OFFSHORE TREATMENT
- TREATMENT METHODS
OIL TREATMENT

PURPOSE
• REMOVE WATER/SAND/SALT
• MEET OIL SALES QUALITY SPECIFICATION

CHALLENGES
• CHANGING FLUID PROPERTIES
• ENERGY USAGE
• WEIGHT CONTROL
• DISCHARGE OIL QUALITY CONTROL
• LOGISTICS

OPTIONS
• DEGREE OF OFFSHORE TREATMENT
• TREATMENT METHODS
OIL TRANSPORT

PURPOSE
• TRANSPORT GAS TO END USER

CHALLENGES
• CHANGING FLUID PROPERTIES
• ENERGY USAGE
• LOGISTICS
• TECHNICAL COMPLEXITY
• ACCESS TO INFRASTRUCTURE
• PROCESS SAFETY RISKS/SECURITY

OPTIONS
• PIPELINE
• TANKER – SHIP OR ROAD
OIL TRANSPORT

PURPOSE
• TRANSPORT GAS TO END USER

CHALLENGES
• CHANGING FLUID PROPERTIES
• ENERGY USAGE
• LOGISTICS
• TECHNICAL COMPLEXITY
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• LOGISTICS
• TECHNICAL COMPLEXITY
• ACCESS TO INFRASTRUCTURE
• PROCESS SAFETY RISKS/SECURITY

OPTIONS
• PIPELINE
• TANKER – SHIP OR ROAD
WASTE TREATMENT

PURPOSE

• DISPOSE OF WASTE STREAMS IN ACCORDANCE WITH ENVIRONMENTAL REGULATIONS

CHALLENGES

• CHANGING FLUID PROPERTIES
• MEASUREMENT
• LOGISTICS

OPTIONS

• LOCAL/CENTRALISED PROCESSING
## Operating Models

<table>
<thead>
<tr>
<th></th>
<th>In-House</th>
<th>Outsourced</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Services, e.g., Operations, Engineering and Maintenance</td>
<td>Owner/Operator</td>
<td>3rd Party</td>
<td>Operations &amp; Engineering in-House; Maintenance Outsourced</td>
</tr>
<tr>
<td>Non-Core Services e.g., Logistics, Fabric Maintenance, Facilities Management</td>
<td></td>
<td>Various 3rd Parties</td>
<td></td>
</tr>
<tr>
<td>Culture &amp; Key Decisions</td>
<td>Strong Influence</td>
<td>Limited Influence</td>
<td>Variable</td>
</tr>
<tr>
<td>Operating Knowledge and Experience</td>
<td>Retained In-House</td>
<td>Lost from the Owner/Operator</td>
<td>Variable</td>
</tr>
<tr>
<td>Support Functions</td>
<td>Significant Effort Required</td>
<td>Minimum Effort</td>
<td>Medium</td>
</tr>
<tr>
<td>Cost</td>
<td></td>
<td></td>
<td>Depends on the Contract</td>
</tr>
</tbody>
</table>
**KEY OPERATIONAL PERFORMANCE METRIC EXAMPLES**

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVAILABILITY - % OF TIME ASSET IS PRODUCING</td>
<td>MEASURE OF EQUIPMENT RELIABILITY</td>
</tr>
<tr>
<td>28 DAY PLAN COMPLIANCE</td>
<td>MEASURE OF PLANNING EFFECTIVENESS</td>
</tr>
<tr>
<td>OVERDUE SAFETY CRITICAL MAINTENANCE</td>
<td>MAINTENANCE EXECUTION EFFECTIVENESS AND POTENTIAL FOR UNREVEALED FAILURES</td>
</tr>
<tr>
<td>FAILED SAFETY CRITICAL ELEMENTS</td>
<td>INDICATION OF NUMBER OF FAILED SAFETY BARRIERS</td>
</tr>
<tr>
<td>SAFETY CRITICAL STAFF COMPETENCE</td>
<td>ABILITY OF STAFF TO UNDERTAKE THEIR DUTIES</td>
</tr>
<tr>
<td>OVERDUE SAFETY INCIDENT/AUDIT FOLLOW UP ACTIONS</td>
<td>INDICATION OF ORGANISATIONAL EFFECTIVENESS</td>
</tr>
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</table>
Thank you.
Questions...?