Presentation 3: Flowlines
Flowline Systems

• **Bare Pipe**
  - Gas Developments
  - Short Offset Oil Developments
  - Warm waters

• **Flexible Pipe**
  - Dynamic Applications
  - Installed with smaller vessels (vessel availability)

• **Insulated Pipe**
  - Pipe-In-Pipe
  - Cast or Wrapped Insulation (also known as wet insulation)
Terminations

- **PLET – Pipeline End Termination**
  - Single Hub/Flange/Connector
  - Single valve

- **PLEM – Pipeline End Manifold**
  - Two or more hubs/flanges
  - Two or more valves (manual & actuated)

- **Manifold**
  - Typically used to develop fields with 4 or more trees
PLETs
PLEMs
Manifolds

2-Slot Overtrawlatable Manifold

4-Slot Manifold

6-Slot Manifold

8-Slot Manifold
Subsea Manifold
• Vertical Connectors

• Horizontal Connectors
  – Deflect-to-Connect
  – Pull-in and Lay Away

• Stab and Hinge Over
Vertical Connectors

Non Integral Connectors
Integral Connectors

1. The collect connector assembly is lowered to the receiver structure.

2. The receiver structure provides coarse alignment of the hubs.

3. Soft-land cylinders are stroked to engage the hubs. Collect actuating cylinders close the collects, locking and preloading the connection.

4. After the metal seal is tested, the actuator assembly is retracted to the surface.

12 inch, 6,000-psi WP (408 bar) jumper
Horizontal Connection System

Connection pull-wire to pipeline
Pull-in of pipeline
Make up of connector
Tie-in completed
Horizontal Connection System

1. The collet connector assembly is lowered to the receiver base. Guide post ensures alignment of the hubs.

2. The ROV inserts a hot-stab, then retracts hydraulic cylinders to pull the connectors hubs together.

3. The collet actuating cylinders close the collet, locking and preloading the connection.

4. After the seal is tested via ROV panel, the actuator is retrieved to the surface.

Horizontal Flowline Connection Tool

Horizontal Connection
Stab & Hinge Over
Well & Flowline Jumpers

- **Rigid Jumpers**
  - U shaped (Vertical Connection)
  - U shaped with Langner Loop (Vertical Connection)
  - M shaped (Vertical Connection)
  - L or Z shaped (Horizontal Connection)

- **Flexible Jumpers**
  - Vertical Connection
  - Horizontal Connection
Jumpers
Jumpers
Jumper Design Issues

- **Thermal Expansion**
  - Movement of Flowline/Pipeline
  - Well to Fixed Manifold

- **Installation**
  - Measurement accuracy for rigid jumper fabrication
  - Fabrication Time (Critical Path with Lay / Installation Vessel in the field)
  - Installation Vessel capabilities
How To Put It All Together

- **Where are the wells to be located**
  - Reservoir & Drilling Program
  - Relative location to Host

- **Flow Assurance**
  - Line Sizes
  - Operability (chemicals, insulation, etc)

- **Host**
  - Distance
  - Available Riser Slots

- **Other Issues**
  - Well Test (Allocation, metering)
  - Future Expansion
ZINC Subsea Template & Manifold

- Designed to support 10 trees
- Each Control Pod was designed to support two well Slots. All Pods were located at one end of the Template
- Horizontal pull-in flowline connection system
- All hydraulic and electrical functions were buried in the manifold
- Conventional Dual Bore Trees that had to make up two (2) connections (wellhead and flow loop) at the same time
- Manifold was designed to be removed/retrieved from the template (trees have to be removed first) as was the pigging loop/valve assembly
- Large capital investment
- PROBLEMS
Shell Rocky – Single Well

- Processing facilities
- Existing "Bullwinkle" platform A "GC 65" (water depth 1350 ft.)
- Surface choke @ platform
- Insulated steel flowlines (4.3 miles) (3"-7,200 PSI W.P. inside a 6" carrier pipe)
- Approximately 4.3 miles from platform to well
- UMBILICAL
  PILOTED HYDRAULIC CONTROL
  (MULTIFLEX)
- Approximately 3.9 miles
- Flowline connector
- First end jumper unit
- Second end jumper connector
- Cameron 3" x 2" - 10,000 PSI conventional subsea tree guideline w/3" pigging loop
- PILOTED CONTROL POD (K-FSSL) (RETRIEVABLE)
- Production guide base (PGB)
- Downhole gauge
- GC 110 (water depth 1750 ft.)
- Flexible pipe 2-9/16" - 10,000 PSI W.P.
- Flowline termination skid

Delivers. Evolves.
Whole Life Solutions for Pipeline and Subsea Systems
Kizomba
Diana Subsea Development

Hoover Host
Llano
Ceiba Development
Early Production System

Ceiba-3
FLOWLINE 2
MANIFOLD

Ceiba-1
UMBILICAL
JUMPER

Ceiba-2
SUBSEA TREE

Ceiba-4
FLOWING LEADS

FPSO

Ceiba
Canyon Express

Canyon Express Pipeline

Methanol recovery and gas compression

Canyon Express
TFE operated, with BP-Amoco & MOC
Flowlines 2 x 17", 48 miles each
500 MMBbl/d, 1000 bbl/d water,
100 bbl/d condensate

MOC operated,
7100' water depth,
2 wells, 100 MMscfd

BP-Amoco operated,
9200' water depth,
4 wells, 175 MMscfd

DELIVERS. EVOLVES.
WHOLE LIFE SOLUTIONS FOR PIPELINE AND SUBSEA SYSTEMS
Trends

- Independents overtaking the big boys as to number of field developments
- More PLEMs & PLETs, few Manifolds
- More emphasis on subsea meters
- Maximize riser slots by expandability of flowline systems
- Flow Assurance simulations will remain a critical element
- More standardization of equipment used by any given operator
Hybrid Field
Hybrid Field
Minimal Risers
Risers – The Bottle Neck
Develop a cookie cutter approach to marginal field developments that allows for expansion with minimal capital investment.

Standardize on trees, controls, valves and connectors. The only thing that is “custom” for each development would be umbilical and flowline system.

This approach would cut development time (fewer bid cycles), cut engineering time and allow spare parts to be used across multiple fields.

Consider this……
Typical Field Well Layouts
Manifold with Field Tie-back
Remote Gathering Manifold
Remote Gathering Tie-Ins
Piggy-Backed Gathering Manifolds
Subsea Production Center

- 6" Pigging Header
- 10" Prod. Header
- 10" Prod. Header
- 6" Test Header
Subsea Production Center Piping