Subsea Fabrication and Tie-in
Wednesday, March 10\textsuperscript{th}, 2010

Presenters:
John Henley, Cahill Group of Companies
Gordon Phillips, Husky Energy
Cahill Group of Companies

Established in 1953

Employs over 200 full time staff, with a peak workforce in excess of 1,200 trades people

ISO 9001-2000 registered

Named one of Canada’s 50 Best Managed Companies for 4 consecutive years
Cahill Group of Companies

Cahill
Service
Companies

St. John’s, NL
Labrador City, NL
Dartmouth, NS
Saint John, NB

Bull Arm, NL
Fort McKay, AB

Cahill Service Companies

Husky Energy
Husky Energy Overview

- Fully integrated energy company
- Market capitalization approximately $25 billion
- Enterprise value $29 billion
- Operations in Canada, USA, Greenland, China and Indonesia
- Three business segments – Upstream, Midstream & Downstream
Global Career Paths

John Henley, Cahill Group of Companies
- Born in St. John’s
- Bachelor of Engineering (Mechanical), MUN
- Masters of Science in Ocean Engineering and Ocean Systems Management, Massachusetts Institute of Technology (MIT)

Gordon Phillips, Husky Energy
- Born in Glasgow
- B.Sc. Honours Degree Civil/Structural Engineer, University of Glasgow
- Career began in 1974

- Places worked with Operator
- * Places worked with a Contractor

Places worked:
- Western Canada
- St. John’s
- Halifax
- Dallas
- Houston
- Mobile
- North Sea
- UK
- Denmark
- Azerbaijan
- Kuwait
- Abu Dhabi
- Mumbai
- Chennai
- Dhaka
- Jakarta
- Sydney

- Places worked
- Operators
- Contractors
Canada’s East Coast Gas Potential

- Substantial gas in place
  - 6.6 TCF of gas in Grand Banks*
  - 4.2 TCF of gas in Labrador
- Significant potential for new discoveries
- Technology is evolving
- Challenge is still to unlock the potential of these resources
White Rose Field Facility

Northern Drill Centre

Central Drill Centre

Southern Drill Centre

North Amethyst Drill Centre
Southern Drill Centre
North Amethyst Project Cycle

NORTH AMETHYST PROJECT

Supply of X-Trees, Manifold Valves, Controls & Test Equipment

Manifold Detailed Design

Subsea Installation & Supply of Flowlines, Umbilical & UTA

Project Management & SIT

Manifold Fabrication

Technip

Husky Energy

AKCS

CAMERON

NECL
Project Schedule

- Manifold Detailed Design
- X-Trees
- Valves
- Controls
- Flowlines & Umbilical
- Fabrication
- Drilling & Comp
- SIT
- Installation

- Commissioning - SDC
- Commissioning - NADC

- First Oil

- Long Lead Item Ordering Milestone
- Project Sanction
- Field Installation Completion
A Typical Offshore Oil & Gas Project Team

<table>
<thead>
<tr>
<th>Project Management</th>
<th>Necessary Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health, Safety &amp; Environmental</td>
<td>Design Engineering</td>
</tr>
<tr>
<td></td>
<td>Planning &amp; Scheduling</td>
</tr>
<tr>
<td></td>
<td>Cost Control and Reporting</td>
</tr>
<tr>
<td></td>
<td>Quality Assurance &amp; Control</td>
</tr>
<tr>
<td>Construction/Fabrication</td>
<td>Procurement</td>
</tr>
<tr>
<td></td>
<td>Regulatory Interface</td>
</tr>
<tr>
<td></td>
<td>Marine Operations</td>
</tr>
<tr>
<td>Warranty Surveying</td>
<td>Weld Inspection</td>
</tr>
<tr>
<td></td>
<td>Platform &amp; Subsea Operations</td>
</tr>
<tr>
<td>Mechanical Completion &amp; Start-up</td>
<td>Commissioning</td>
</tr>
</tbody>
</table>

Project personnel typically have a technical background, often with an Engineering degree. For a successful project all functions need to participate in the overall project design spiral and understand the need to accommodate the various needs into the overall plan.
The Design Spiral

- Design (FEED, then Detailed Design)
- Project Review & Approval
- Fabrication
- Mechanical Completion
- Installation
- Commissioning & Project Start-up
- Lessons Learned
Engineering

• Start date: November 4, 2007
• Completion date: November 7, 2008
• Peak team size: 19
• Person hours: 31,694
• Drawings produced: 635
• Specifications written: 23
• Reports produced: 7
• Purchase Orders: 24
Work Locations

Bull Arm
Structural, Outfitting, FAT/FIT, SAT/SIT Support, Loadout

Cahill Fabrication Shop
Piping

Metal World
Structural
North Eastern Constructors Limited (NECL)

North Amethyst Subsea Manifold Fabrication

Project Scope:
Fabricated Subsea structures for final assembly, painting, mechanical outfitting and insulation for the North Amethyst field extension to the White Rose project.

Client: Husky Energy
Duration: April 2008-July 2009
Person Hours: ~200,000

Steel Fabrication: ~850 Tonnes
Pipe Fabrication: ~150 Tonnes
Ariel photograph of Module Hall on April 17, 2009

1. MSF#2 – Module Support Frame
2. Water Injection Module - MSF #2
3. Production Module #1 – MSF#2
4. MSF#1 – Module Support Frame
5. Water Injection Module – MSF #1
6. MSF to MSF Rigid Spools
7. SDU Frame #1
8. SDU Base #1
NECL Fabrication

Production Module
Metal World
Fabrication of structural frames and sub-assemblies at Metal World facility in Torbay

Spool Fabrication
Cahill Fabrication Shop, St. John’s
Fabrication of pipe spools at Cahill Fabrication Shop in St. John’s
NECL Fabrication

Production Module, Bull Arm

MSF, Bull Arm

Fabrication of Rigid Spools
Production Module being loaded on to Barge

MSF#2, MSF#1 & PFLTM on barge

Left: SDC Rigid Spool being loaded on to the Atlantic Kingfisher in Bull Arm
Pre-Installation Function Testing

Purpose:
To check complete subsea hardware/software before Installation in the Glory Holes and being put into service.

- **Critical activity** to ensure the design works as intended
- Ensures that the contractors have provided the equipment to the design requirements
- Confirms that the installation techniques will work
- Confirms that the design and installation techniques are safe and protect the environment
- **Allows for corrections to facilities before installation. Offshore repair/design modification is very expensive.**
- Shortens the time for first oil and thus revenue from the new facilities.

For North Amethyst, testing was completed at Bull Arm which allowed excellent integration of the fabrication and FIT/SIT process.
Function Testing
Cameron

Manifold Valves

Production X-Tree During Build Phase

Production X-Tree

Multi Phase Flowmeter installed on Rigid Spool
Stab Plates

SDU#1

Inside Subsea Distribution Unit #1

Subsea Distribution Unit #1 unloading from the Antonov, St. John’s

Branch Tee Connector

ICSS/MCS Test Area
Manufacturing TCL - Flowlines

- 10.9 km of 10" Production
  23 reels (incl. 1 spare section)
- 5.4 km of 9" Water Injection
  7 reels (incl. 1 spare section)
- 5.47 km of 4 1/4" Gas Lift
  2 reels
- April 2009 for Flexible Delivery

Total = 32 reels
Subsea Equipment Installed

Technip Office,
Water Street, St. John’s
Bay Bulls Marine Terminal

Marshalling Point for:

- Manifold equipment
- Controls equipment
- Flowlines
- Umbilical
- Logistic Support
- Personnel Movements
Offshore Installation, Jumbo Javelin

Installation of Module Support Frame #1

Installation of Module Support Frame #2

Installation of Subsea Distribution Unit Foundation #2

Jumbo Javelin en route to Field

Installation of Subsea Distribution Unit Foundation #1
Thinking ahead...

- The world uses about 86 MM Barrels of Oil Per Day (BOPD). It is expected to grow to ~110 MM BOPD by 2030.
- All oilfields decline in production over time typically ~5-6% per year.
- Just to maintain current production ~5 MM BOPD needs to be added each year.
- The easy oil is already developed. New oil will come from frontier areas such as the East Coast, the Arctic and very deep water.
- New offshore developments will primarily use subsea technology for the wells.
- There will be a great demand for smart, well trained engineers who are willing to work in these areas.
- To have a rewarding career you must be willing to learn and move to get the experience necessary to become an industry leader.
Thank you.

Questions?