An Overview of Pipeline Configuration Alternatives
Presentation Objectives

- basic concepts
- simplified definitions
- historical background
Basic Concepts and Definitions

- single wall pipelines
- pipe-in-pipe pipelines
- pipe bundle pipelines
- typical installation equipment
- typical installation methods
Historical Background

- pipe-in-pipe and pipe bundle installation
- statistics on worldwide installation
- installed lengths, sizes, water, depth, etc.
Discussion of:

• comparison of pros and cons of various alternatives
• preferred pipeline configuration for Alaska’s offshore
Pipeline Configurations

Single Wall Pipelines

- Single wall pipeline
- Internal corrosion coating or factory installed inlays
- External corrosion coating
- External concrete coating
Pipeline Configurations

Single Wall Pipelines - with external bundled line

External bundled line
Pipeline Configurations

Single Wall Pipelines

Applications:
- most areas of the world
- wall thickness and coating variations match requirements
- external bundles requiring operating flexibility
Pipeline Configurations

Pipe-in-Pipe Pipelines

Single Pipe-in-Pipe (Concentric)

- Outer jacket pipe
- Spacer/Bulkhead
- Inner product pipe
- Rollers or guides
- Insulation
Pipeline Configurations
Pipe-in-Pipe Pipelines
Single Pipe-in-Pipe (Concentric)

Typical Applications:
• increased insulation/protection
• controlled buoyancy for installation
Pipeline Configurations

Pipe-in-Pipe Pipelines

Single Pipe-in-Pipe with Fixed Bulkhead

Outer jacket pipe

Fixed bulkhead

Inner product pipe
Pipeline Configurations

Pipe-in-Pipe Pipelines

Single Pipe-in-Pipe with Fixed Bulkhead

Typical Applications:
- insulation/protection
- two lines to optimize design
- offsets collapse stresses during installation
Pipeline Configurations

Cased Bundles

- multiple inner product lines
- internal coatings
- external insulation
- external corrosion coatings
- weight coatings
Pipeline Configurations

Cased Bundles

Typical Applications:
- unique and complex operating conditions
- need for utility lines, power, data
- additional insulation
- ease of installation
Pipeline Configurations
Cased Bundles - Drake F-76

- Refrigerant return line
- 24” Outer jacket pipe
- 18” Carrier Pipe
- Spacer
- Thermon heat tracing cables
- Heat tracing
- Methanol and Hydraulic Control Lines
- Flowlines
- Annulus
- Figure 12
Offshore Pipeline Installation Equipment and Methods

Installation Equipment
- lay barge
- reel barge/ship
- conventional pipeline spread

Installation Methods
- open water pipe lay
- tow or pull
- over-ice pipe lay
Pipeline Installation Equipment

Conventional Lay Barges

Pipe storage fit up and welding
Stinger
Pipeline Installation Equipment

Conventional Lay Barges

Typical Applications:

- open, calm water
- ice-free
Pipeline Installation Equipment

Reel Barges or Ships

Pipe reel

Stinger
Pipeline Installation Equipment

Reel Barges or Ships

Typical Applications:

- open, ice-free water
- deep water
Pipeline Installation Equipment

Conventional Pipeline Spread
Pipeline Installation Equipment

Conventional Pipeline Spread

Typical Applications:
- shore approach
- over-ice
- shallow water
Pipeline Installation Method

Open Water Lay

Typical Applications:

- open, calm water
- ice-free
Pipeline Installation Methods

Towed Bundles
Pipeline Installation Methods

Towed Bundles
Pipeline Installation Methods

Towed Bundles

Typical Applications:

- deep water
- pipe-in-pipe
- reduce installation forces on lay barge or reel barge
- narrow construction window
Pipeline Installation Methods

Over-ice Installation
Pipeline Installation Methods

Over-ice Installation

Typical Applications:
- arctic locations
- shallow water
- shoreline transitions
Pipe-in-Pipe and Bundle Statistics

Total Projects vs. Time

NOTE: 85% of all lines were insulated
Pipe-in-Pipe and Bundle Statistics

Total Length vs. Time

- 1970-79: 32 miles
- 1980-89: 97 miles
- 1990-99: 161 miles

Total miles installed offshore
Pipe-in-Pipe and Bundle Statistics

Geographical Distribution

1. Mediterranean/Adriatic 5.8% (17 ml)
2. North America 22.1% (64 ml)
3. Africa/Middle East 3.8% (11 ml)
4. South America 12.2% (36 ml)

Figure 21
## Pipe-in-Pipe and Pipe Statistics

Percentage of Total Pipeline Population

<table>
<thead>
<tr>
<th></th>
<th>North Sea</th>
<th>Gulf of Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Offshore Pipe</td>
<td>11,000 mi</td>
<td>23,000 mi</td>
</tr>
<tr>
<td>Pipe-in-pipe/bundle</td>
<td>1.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td></td>
<td>(103 mi)</td>
<td>(64 mi)</td>
</tr>
</tbody>
</table>
Pipe-in-Pipe and Pipe Statistics

Water Depth for Projects

Distribution of projects (%)

Water Depth (ft)

- 0 - 200: 29%
- 200 - 400: 24%
- 400 - 600: 24%
- 600 - 800: 3%
- 800+: 20%
Pipe-in-Pipe and Bundle Statistics

Installation Method

Distribution of installation methods (%)

- Lay Barge: 23%
- Reel Barge: 9%
- Towed: 68%

Figure 24
Pipe-in-Pipe and Bundle Statistics

Inner Pipe Diameter

Frequency of Inner Pipe Sizes for all Projects

Inner Pipe Diameter (Nominal Inches)
Pipe-in-Pipe and Bundle Statistics

Outer Pipe Distribution

Frequency of Outer Pipe Sizes for all Projects

Outer Pipe Diameter (Nominal Inches)
Summary: Various Configurations

- Single wall and external bundle
- Pipe-in-pipe with spacer
- Pipe-in-pipe with bulkhead
- Drake F-76 bundle
Summary:
Various Installation Equipment

lay barge

reel ship

conventional pipeline spread
Summary:
Various Installation Methods

- over-ice
- open water pipe lay
- tow or pull
Summary: Statistics

• >99% of all offshore lines are single wall
• increasing number of projects using pipe-in-pipe/bundles, most insulated
• high percentage used in deeper water
• towed installation method common
• wide range of sizes
An Overview of Pipeline Configuration Alternatives