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.

#### Breakout Sessions

#### 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





### 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 Rollers or guides Spacer/Bulkhead Insulation Inner product pipe

Pipeline Configurations Pipe-in-Pipe Pipelines Single Pipe-in-Pipe (Concentric)



- increased insulation/protection
- controlled buoyancy for installation



#### **Pipeline Configurations** Pipe-in-Pipe Pipelines Single Pipe-in-Pipe with Fixed Bulkhead



- insulation/protection
- two lines to optimize design
- offsets collapse stresses during installation



# Pipeline Configurations

Cased Bundles



- unique and complex operating conditions
- need for utility lines, power, data
- additional insulation
- ease of installation

## Pipeline Configurations Cased Bundles - Drake F-76



# 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



#### Pipeline Installation Equipment Conventional Lay Barges



- open, calm water
- ice-free

#### Pipeline Installation Equipment Reel Barges or Ships



#### Pipeline Installation Equipment Reel Barges or Ships



- open, ice-free water
- deep water

### Pipeline Installation Equipment Conventional Pipeline Spread



### Pipeline Installation Equipment Conventional Pipeline Spread



- shore approach
- over-ice
- shallow water

#### Pipeline Installation Method Open Water Lay



- open, calm water
- ice-free

#### Pipeline Installation Methods Towed Bundles



#### Pipeline Installation Methods Towed Bundles



#### Pipeline Installation Methods Towed Bundles





- 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



- arctic locations
- shallow water
- shoreline transitions





### Pipe-in-Pipe and Bundle Statistics

Total Projects vs. Time



#### Pipe-in-Pipe and Bundle Statistics

Total Length vs. Time



## Pipe-in-Pipe and Bundle Statistics Geographical Distribution



#### Pipe-in-Pipe and Pipe Statistics Percentage of Total Pipeline Population

	<u>North Sea</u>	<b>Gulf of Mexico</b>
<b>Total Offshore Pipe</b>	11,000 mi	23,000 mi
Pipe-in-pipe/bundle	1.0% (103 mi)	0.3% (64 mi)

#### Pipe-in-Pipe and Pipe Statistics Water Depth for Projects



#### Pipe-in-Pipe and Bundle Statistics Installation Method



#### Pipe-in-Pipe and Bundle Statistics Inner Pipe Diameter



#### Pipe-in-Pipe and Bundle Statistics Outer Pipe Distribution



## 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

reel ship



lay barge



# 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-inpipe/bundles, most insulated
- high percentage used in deeper water
- towed installation method common
- wide range of sizes

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