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# Pipeline Design Critical Factors and The Impact on Pipeline Repair Feasibility

## SPE Workshop Abu Dhabi January 2009

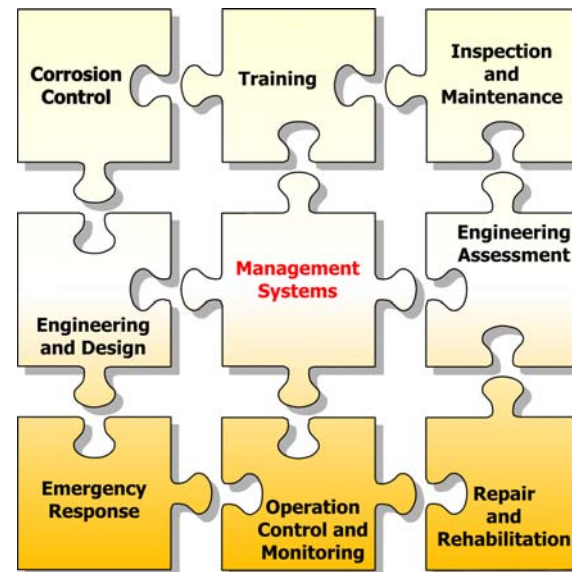
*Roland Palmer-Jones*  
*Penspen Integrity, UK*

# Penspen Integrity

## “Know and Manage your Pipeline Risk”

- Penspen Integrity is an independent specialist pipeline engineering consultancy. We provide services including:

- Integrity management
- Defect assessment
- Risk analysis
- Corrosion
- Cathodic protection (CP) advice and field support,
- Pigging consultancy
- Smart pig data analysis
- Direct assessment
- Training
- Research



# Pipeline Design

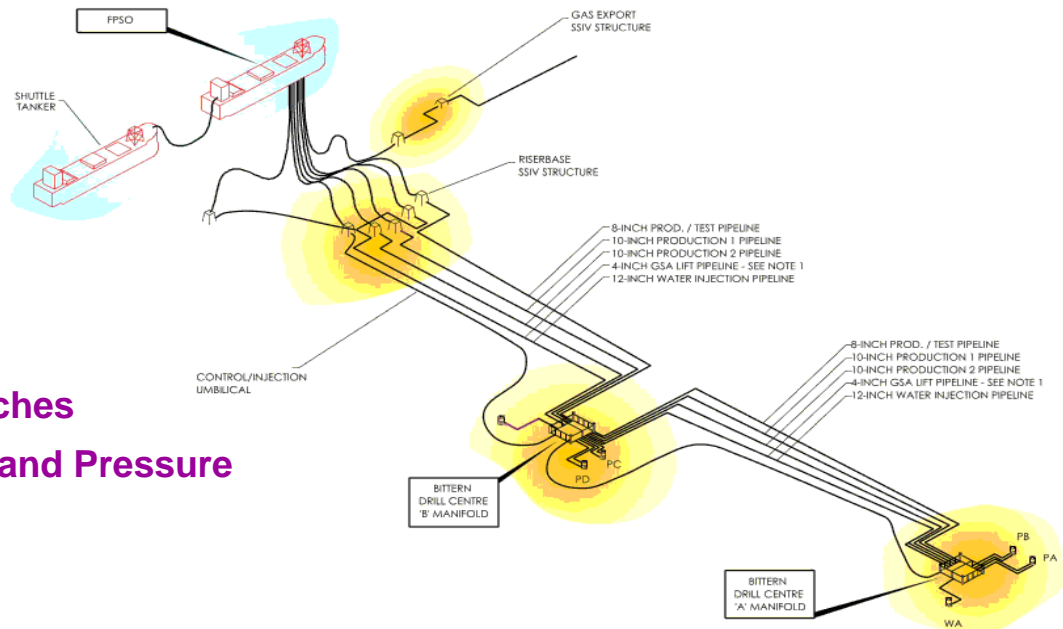
## ■ Drivers

- Cost
- Schedule

## ■ Issues Covered

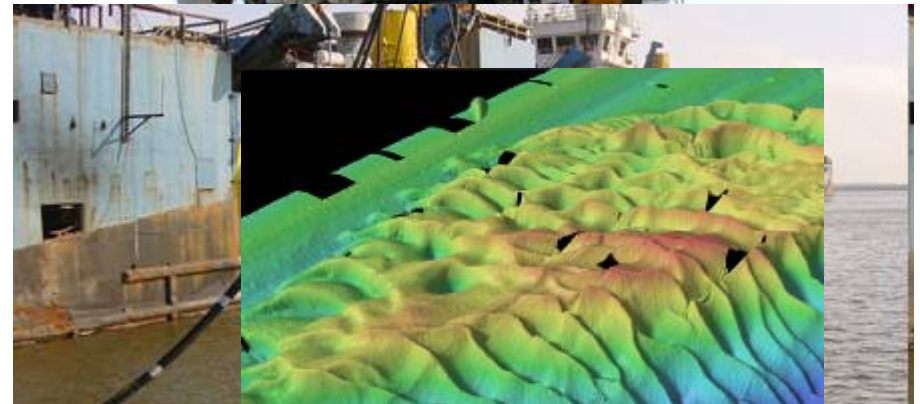
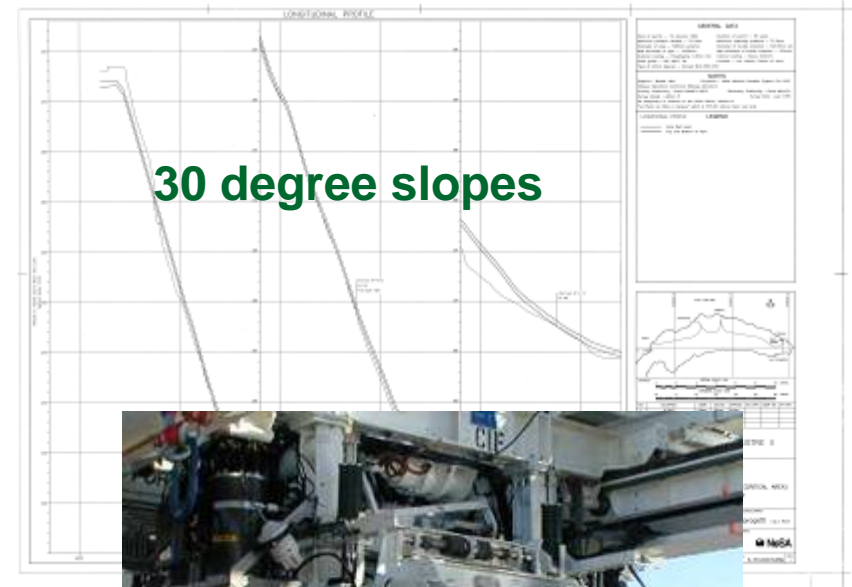
- Route + Shore Approaches
- Hydraulics – Diameter and Pressure
- Materials
- Configuration
- Construction
- Strength – Wall thickness
- Stability, Buckling, Spans
- Fittings (flanges, valves, pig traps etc.)

## ■ Design HAZID



# Route

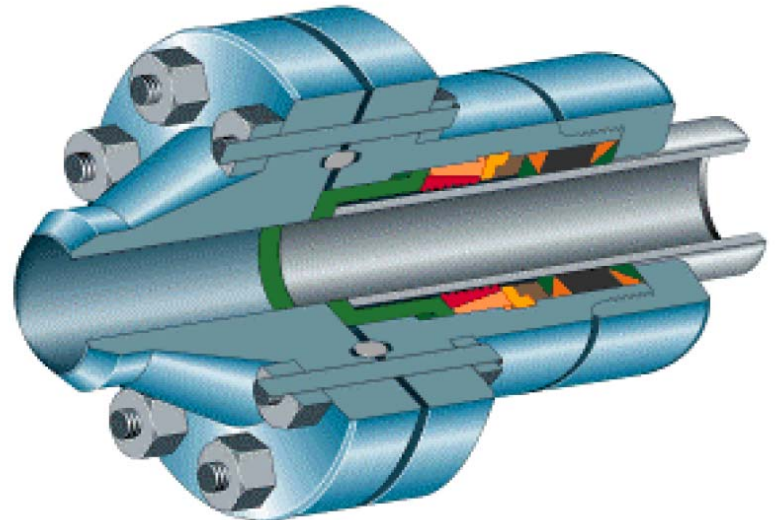
- **Steep Slopes**
  - Difficult to work
- **Deep Water**
  - Diverless systems
- **Burial**
  - Excavation required
- **Access problems**
  - e.g. Sand waves



sand waves

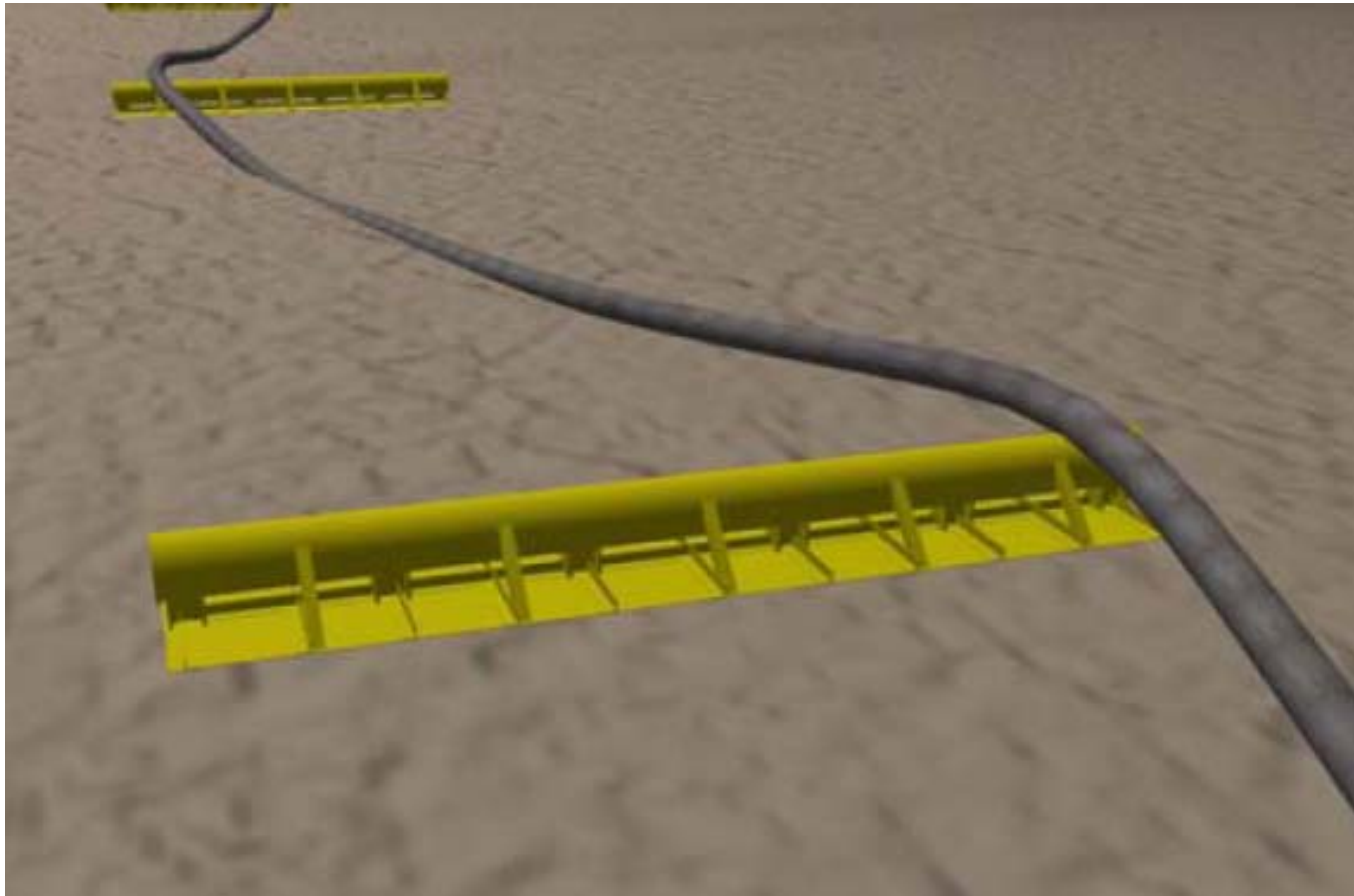
# Materials

- **High Toughness / Good Ductility**
  - Prevents running fracture
- **Corrosion control by CRA liner**
  - Clamps will not work
  - Special connectors required
- **Flexibles**
  - Different problems



# Configuration

- HPHT – Snake Lay
  - Repair may introduce local restraint



# Fittings

- **Flanges**
  - Ease section replacement
  - Potential source of leaks
- **Valves**
  - Allow isolation
- **Pig traps**
  - Enable the deployment of isolation tools





# Spare Pipe

- **Minimum 3 pipe lengths**
- **May be 1 to 2% of total length**

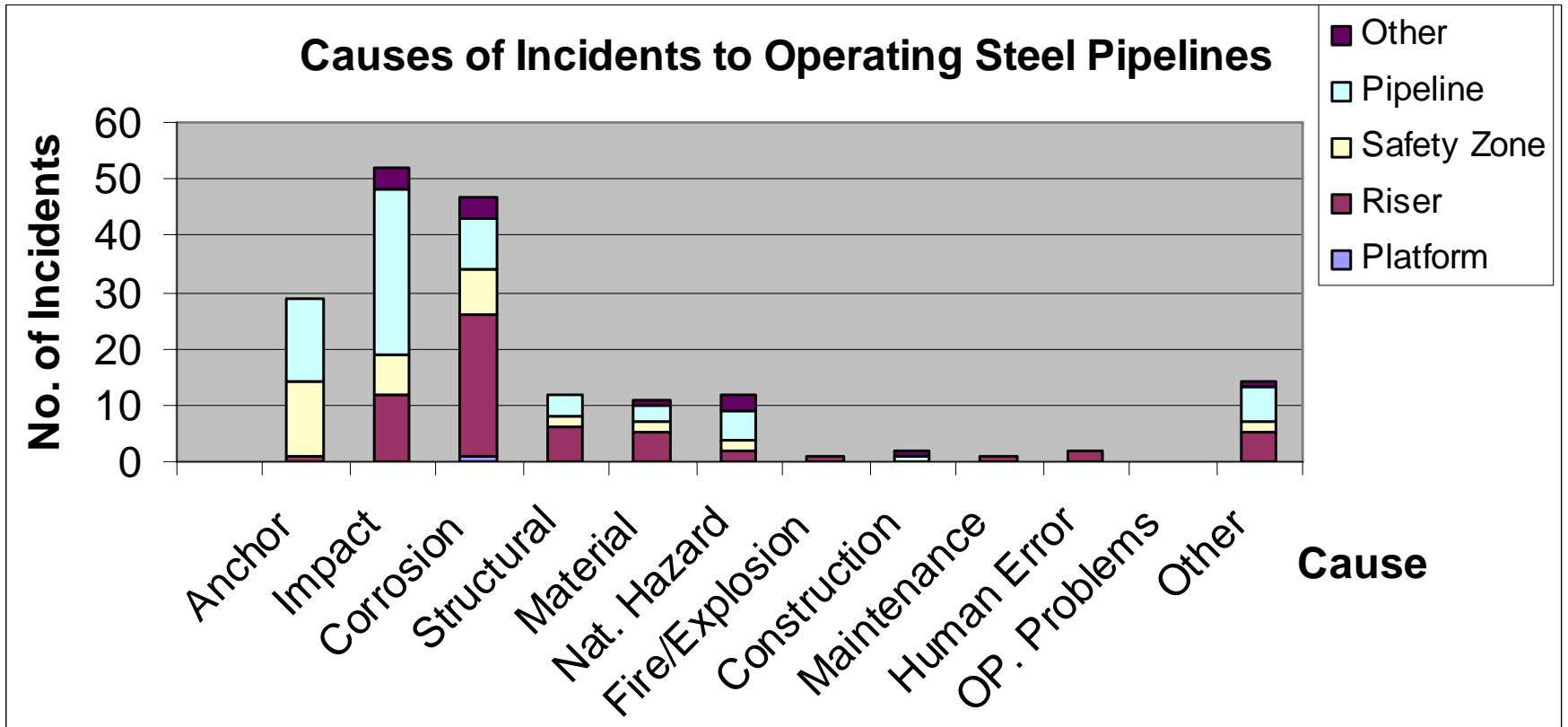


# Design HAZID

- Identify the Hazards
- Identify Potential Damage
- Identify Suitable Repairs



# Hazard Data UK North Sea



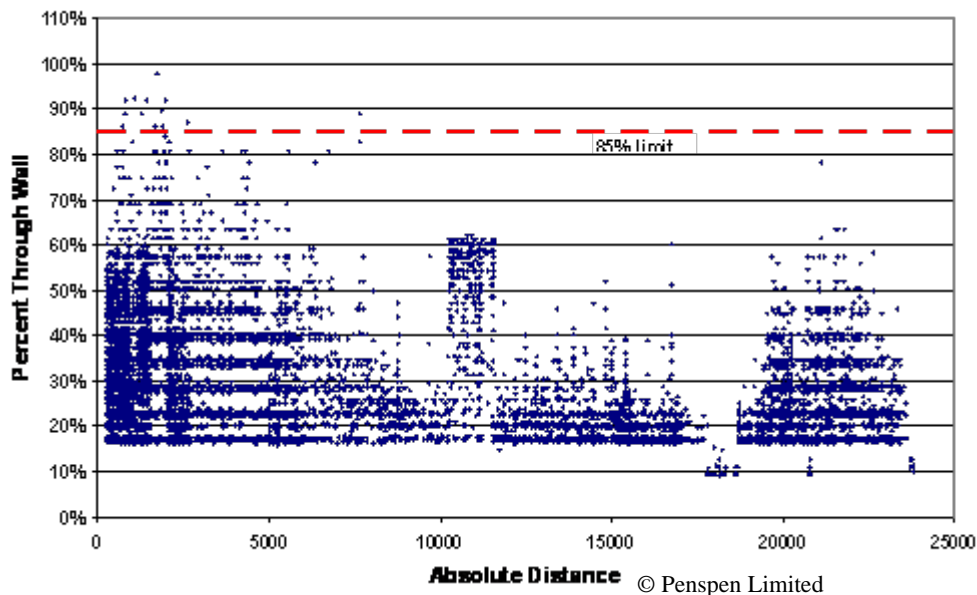
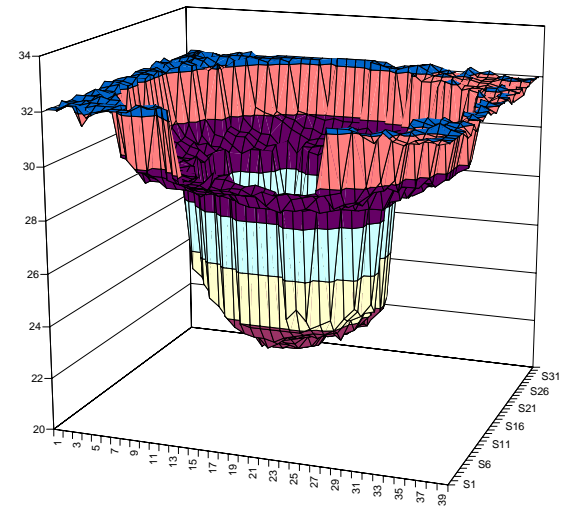
# Hazard - Internal Corrosion

## ■ Damage

- Deep pits
- Cracking
- Leaks

## ■ Repair

- Clamp - temporary solution
- Corrosion must be controlled
- Replacement



# Hazard – Anchor Damage

## ■ Damage

- Dent,
- Gouge,
- Bending,
- Rupture

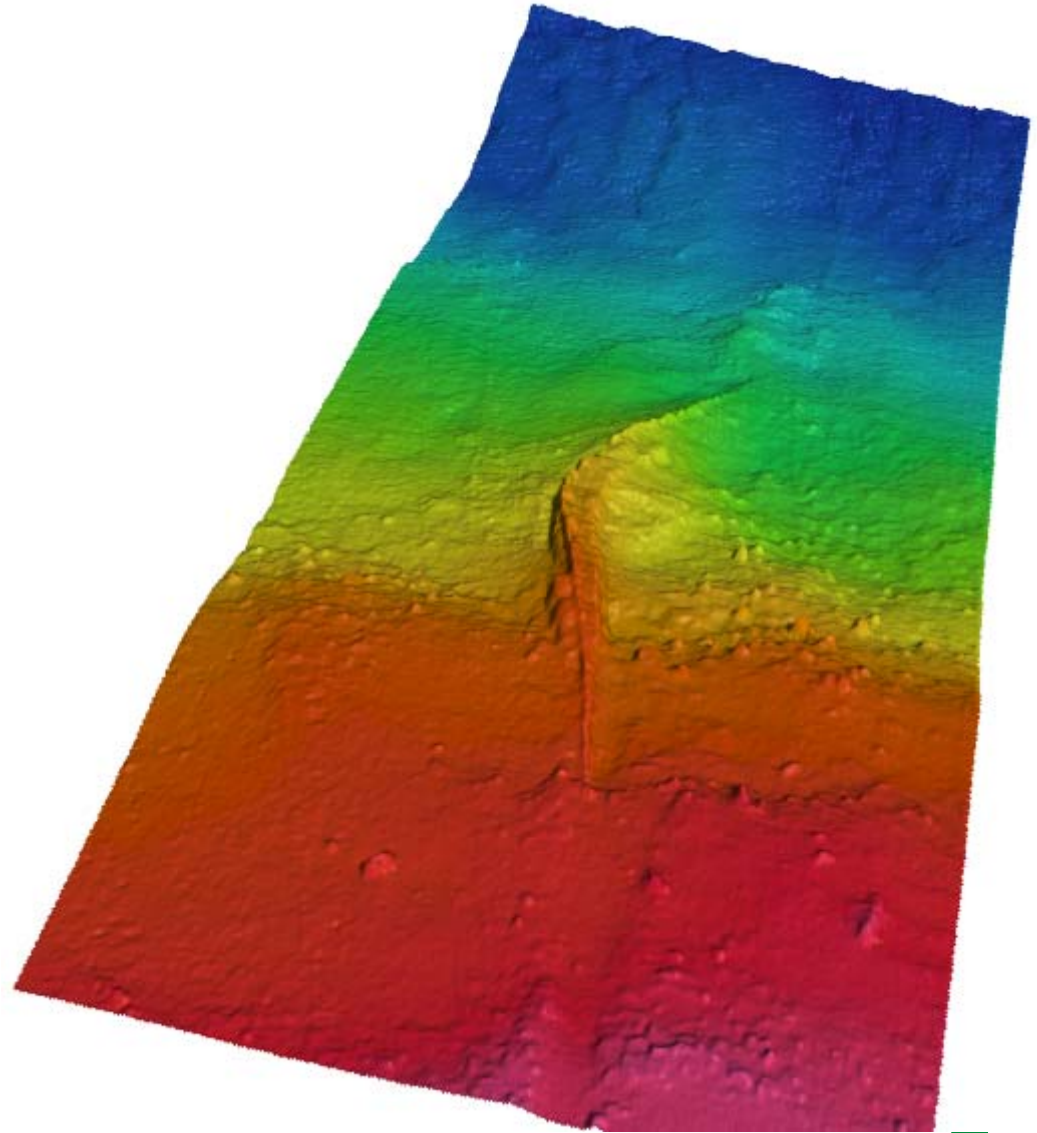
## ■ Repair

- Grouted sleeve
- Section replacement



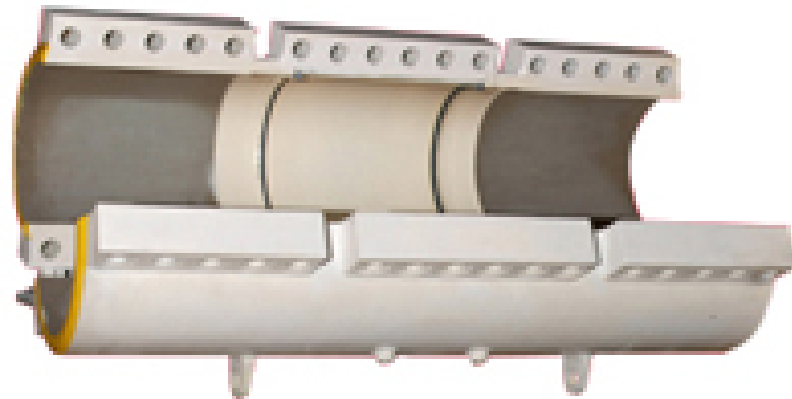
# Hazard – sea bed movement

- **Damage –**
  - **Bending strains**
  - **Collapse**
  - **Rupture**
- **Repair**
  - **Excavation**
  - **Replacement**



# Hazard - Spanning

- **Damage**
  - Fatigue cracking,
  - Rupture.
- **Repair**
  - Span support
  - Structural Clamp
  - Replacement



# Summary

- Pipeline design is generally not influenced by repair
  - Slopes
  - HPHT – snake lay
  - Bundles
  - Flexibles
- The design HAZID provides an opportunity to identify hazards, damage and repair options.