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MMS July 29th 2003

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An Assessment of Safety, Risks and Costs Associated with Subsea Pipeline Removals

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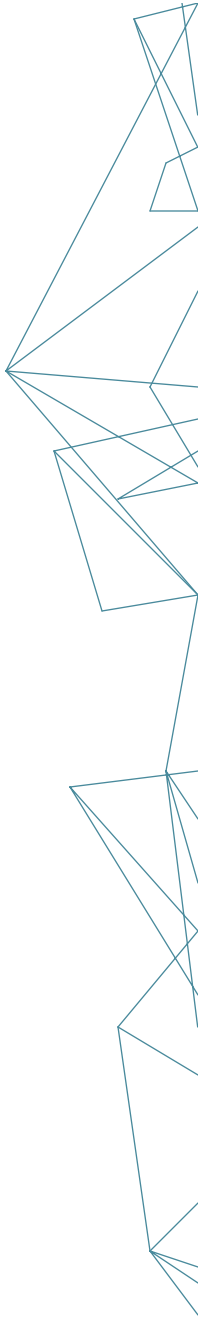
Scandpower Risk Management

Regulations

- **US Regulation**
  - DOT, MMS etc.
- **International regulations and guidelines**
  - OSPAR, IMO etc.

Pipeline data

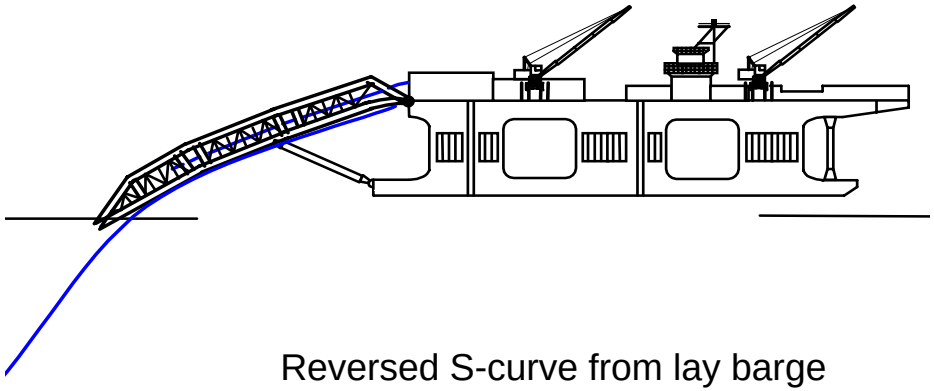
- **Number of pipelines in GOM**
- **Length**
- **Dimensions**
- **Buried/Surface**
- **Water depth**



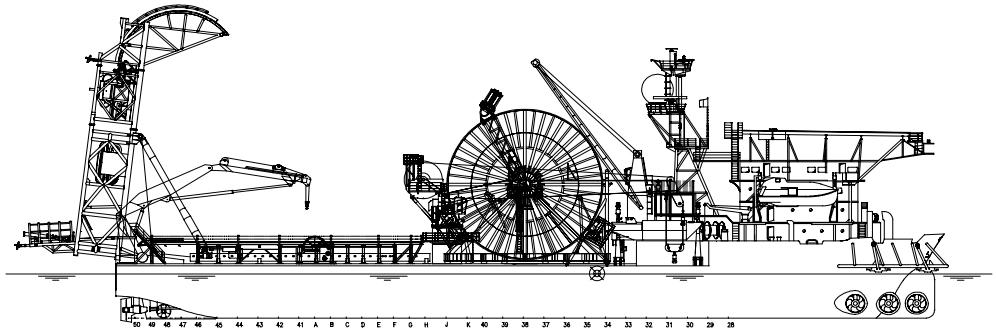
Pipeline disposal options

(from John Brown HSE report)

1. Leave in situ
2. Bury/trenching
3. Removal by reverse lay (including handling and transport on land)
4. Removal by deep sea tow (including handling and transport on land)
5. ……

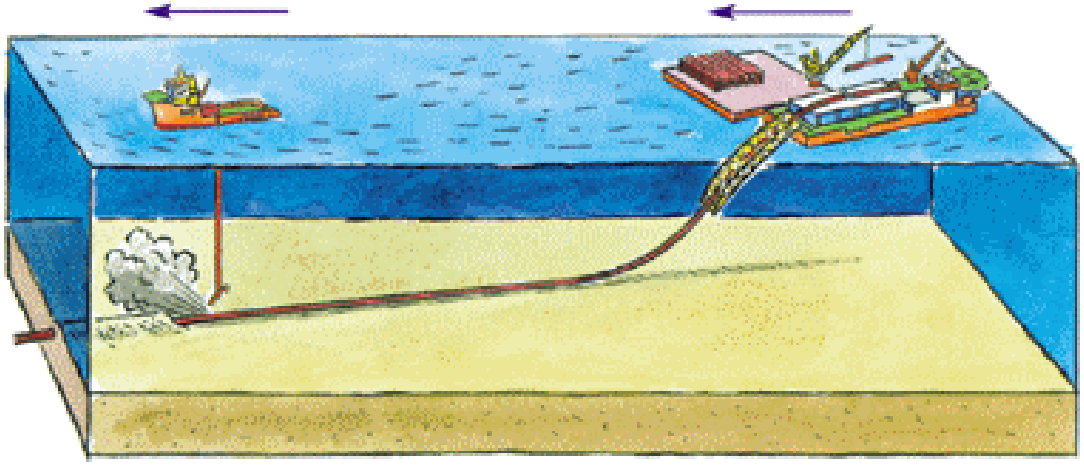


Reversed S-curve from lay barge

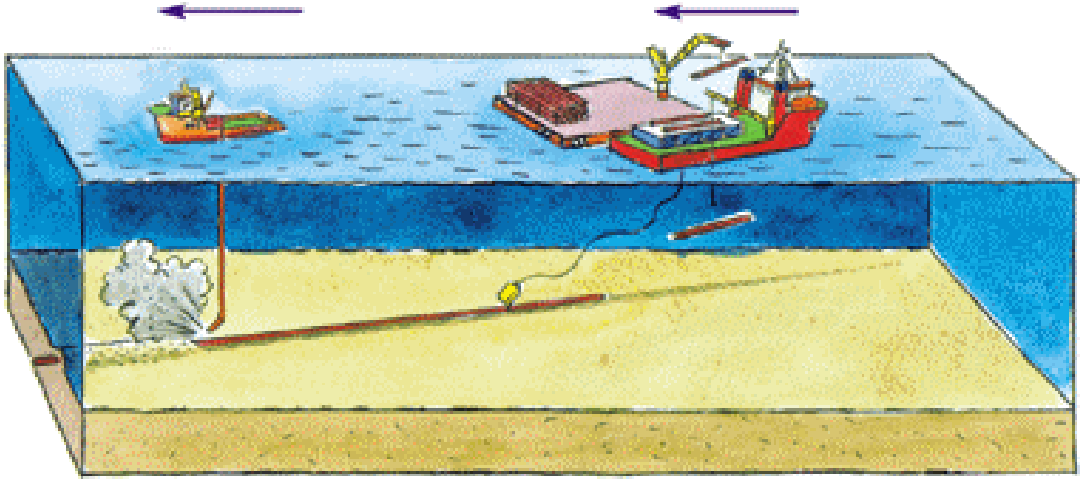


Reel barge

Reverse lay



Cutting on seabed



Handling and transport onshore

- Unloading pipe
- Purging the pipe
- Removing anodes
- Removing concrete
- Removing the protective coating
- Cutting pipe
- Cutting concrete
- Recycling/reuse

Risk Assessment

- **Hazard Identification**
- **Fault Tree Analysis**
- **Probabilities and Consequences**

Hazard Identification

SAFOP: Systematically review the sequences of the different disposal options to identify possible hazards and unsolved issues.

Guidewords:

- WEATHER
- IMPACT
- POSITION
- DROP
- POWER
- INSTRUMENTS
- COMMUNICATION
- EXECUTION
- PROCEDURES
- MOVEMENT
- STABILITY
- RUPTURE
- ACCESS
- OVERLOADING

Fault Tree Analasys

- **Based on the SAFOP, a fault tree analysis can be applied to illustrate the coherence between an undesired event and the causes of this event.**
- **Logical dependencies between different events causing the undesired top event in the system.**
- **The Hazard may be caused by both equipment failure, external conditions/factors, or human errors.**
- **How can this happen?**
- **Scandpower tool CARA**

Probability and Consequences

- **Determined on a qualitatively basis, based on the top events in the fault tree.**
- **Can be done by a matrix reflecting probabilities and consequences.**
- **Challenging since historic track-records may be difficult to obtain.**

Cost Estimates

- **The disposal options will be assessed with regard to cost for operations in the U.S. waters.**
- **The complete disposal activity from removal to final deposition/reuse will be included in the estimates.**
- **Information and experience from installation of pipelines may be beneficial for calculating removal costs.**
- **Abandonment cost will also be estimated and included in the report.**

Environmental Assessment

- **Energy (Consumptions and Total Energy Impact)**
- **Emissions to atmosphere**
- **Discharges to sea or ground**
- **Physical impacts/effects on habitat**
- **Aesthetic impacts**
- **Waste / resource utilization**
- **Littering**

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