Direct Electrical Heating of Flowlines

by Audun Haglo

OUTLINE

1. History of DEH
2. What is direct electrical heating?
3. Design of a DEH system
4. Cables in a DEH system
5. Nexans project experience, DEH systems

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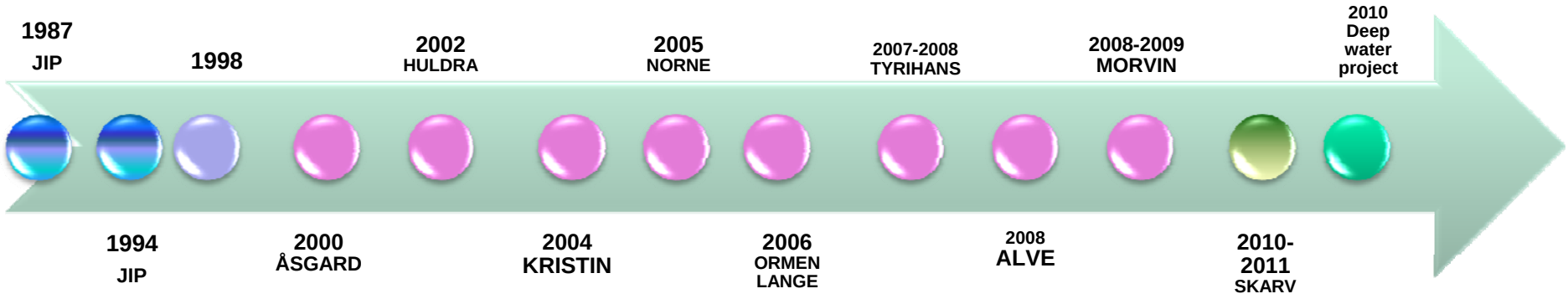
History of DEH



- In total Nexans has delivered more than 200 km with DEH cables to heat 18 pipelines
- Built up substantial experience on DEH systems and components
- Nexans holds several patents related to cables and accessories to DEH

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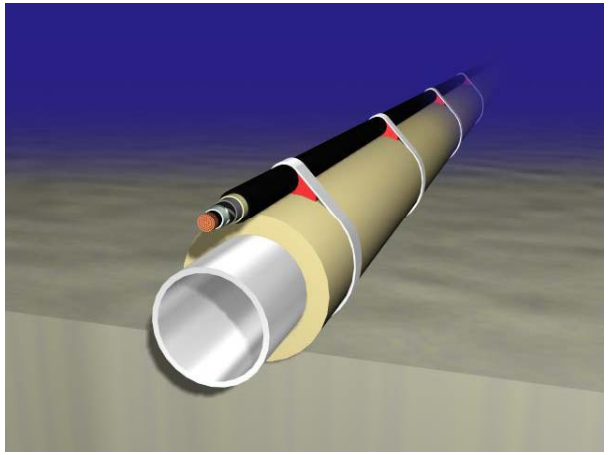
Working Principle DEH

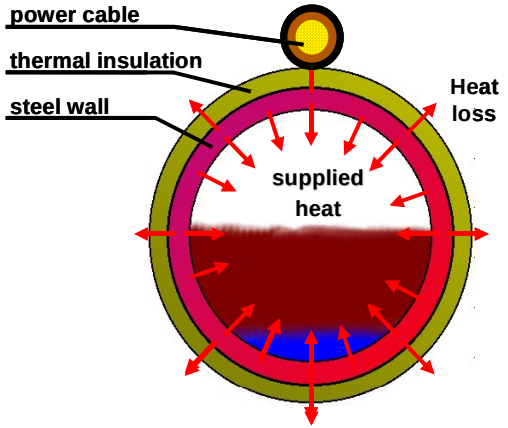
Flow assurance by actively controlling the temperature on the pipe

Electric alternating current (AC) is passed through the pipe wall.

Heat is generated by resistive current losses

The pipeline inner wall is kept above critical temperatures at all times

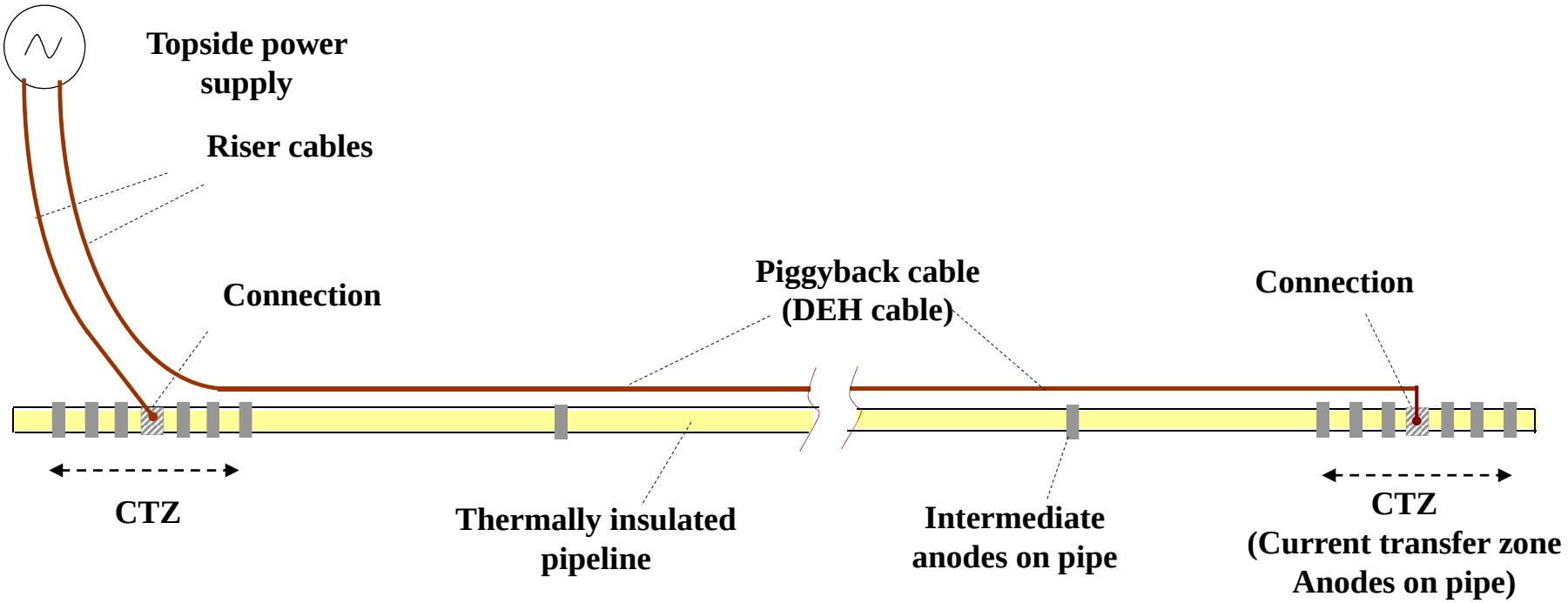




Working Principle DEH

Principle of Direct Electrical Heating

- Single phase system
- Cable as forward conductor, pipe and seawater as return conductor



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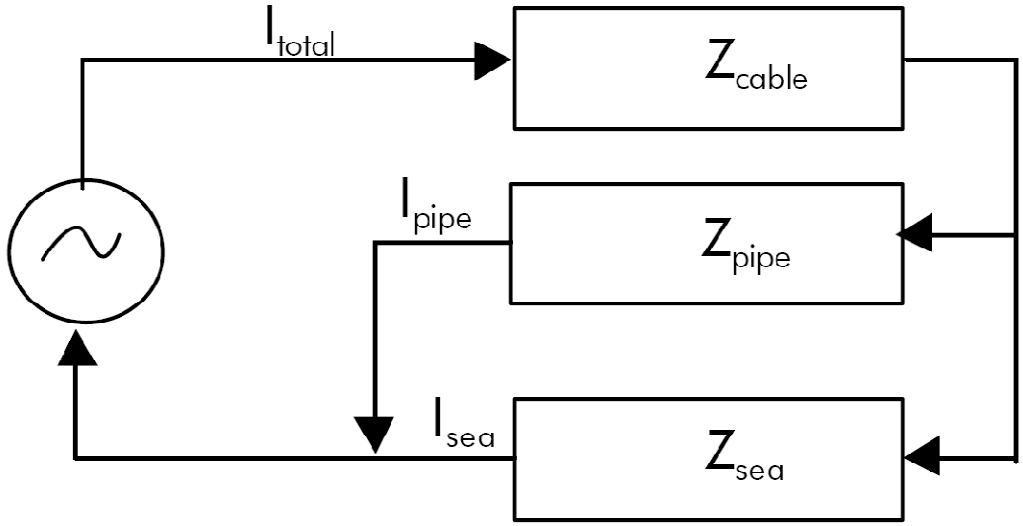
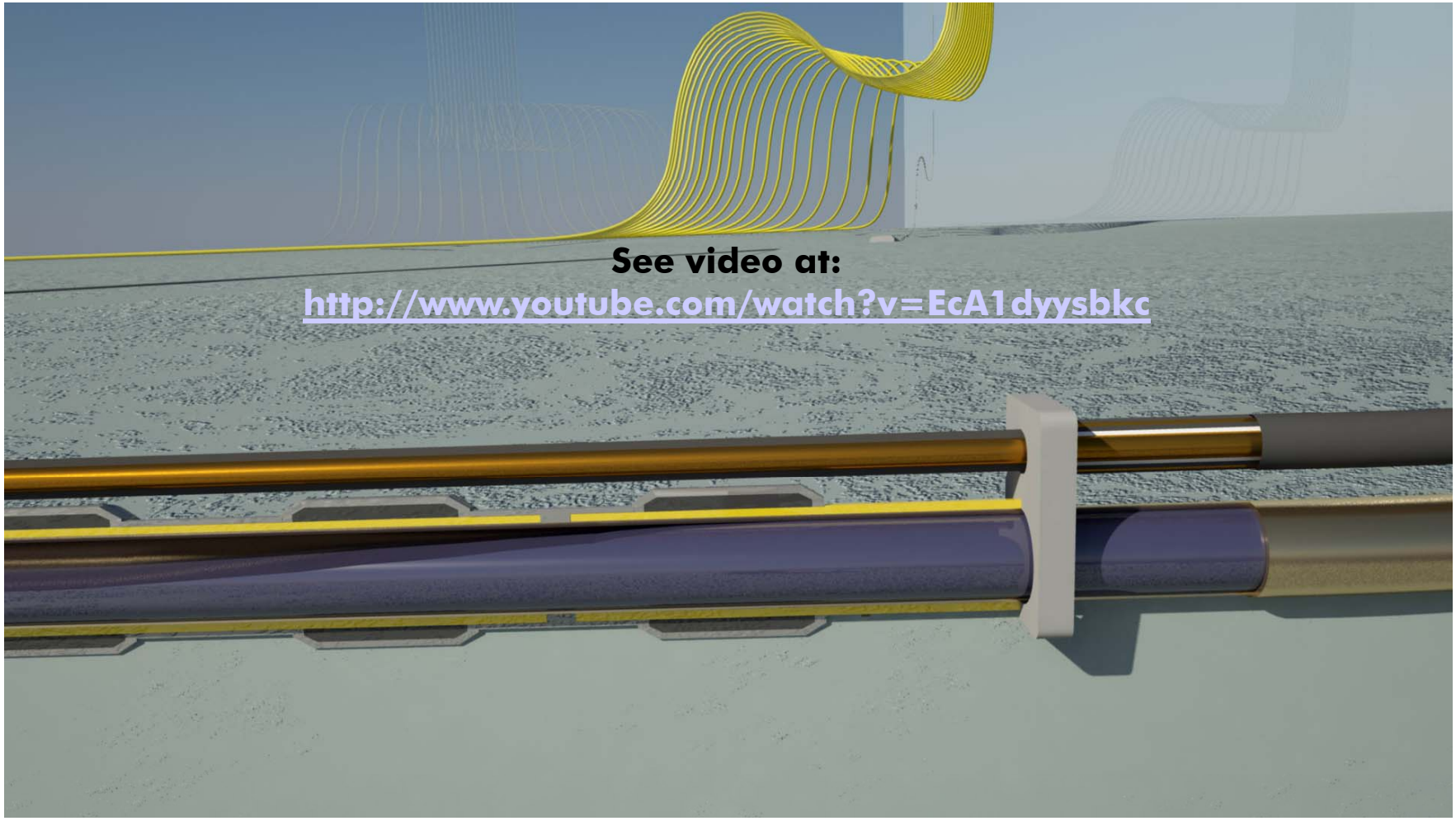


Circuit connection diagram for the DEHS

Working Principle DEH



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Design of a DEH System

The DEH systems are generally designed to meet the following design criteria:

- Maintain fluid temperature to prevent hydrate formation during shutdowns
- Raise the temperature of the fluid from ambient to above hydrate formation temperature within a specified time period
- For “tail production” or long pipelines the temperature drop along the line may require continuous heating

Design of a DEH System

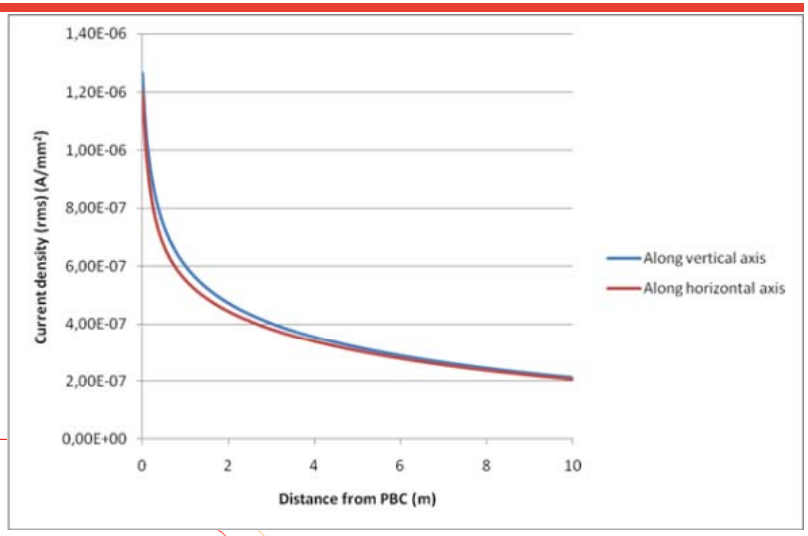
Design Factors Influencing Power Requirement

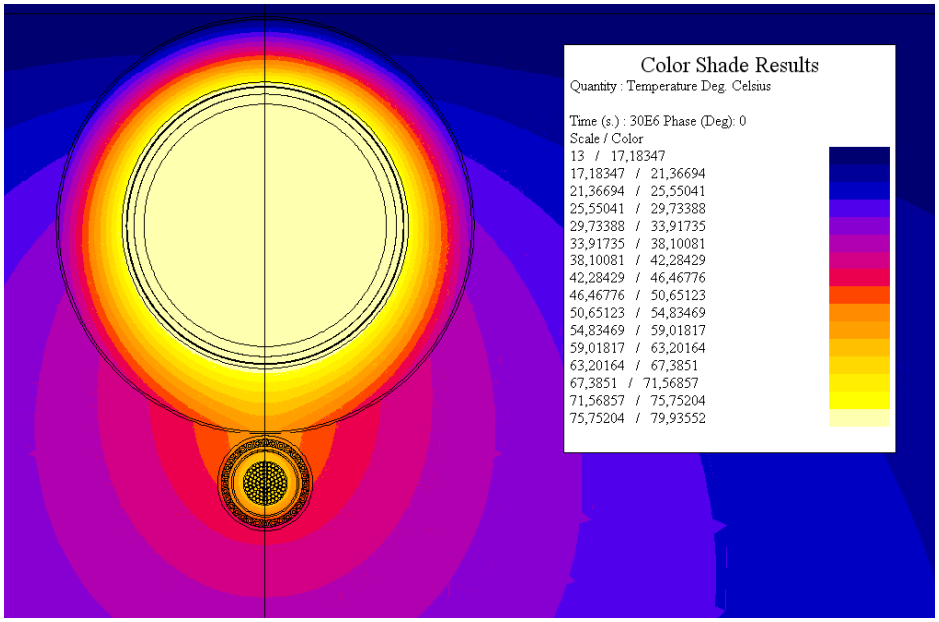
- Pipeline properties
  - Length
  - Thermal insulation on pipe
  - Magnetic and electrical properties
  - Diameter/wall thickness
- Operational aspects
  - Temperature requirements
  - Required heating time
  - Pipe fluid
  - Temperature profile
- Installation configuration
  - Spacing pipe-cable
  - Burial depth
  - Backfill, clay, rockdump etc.

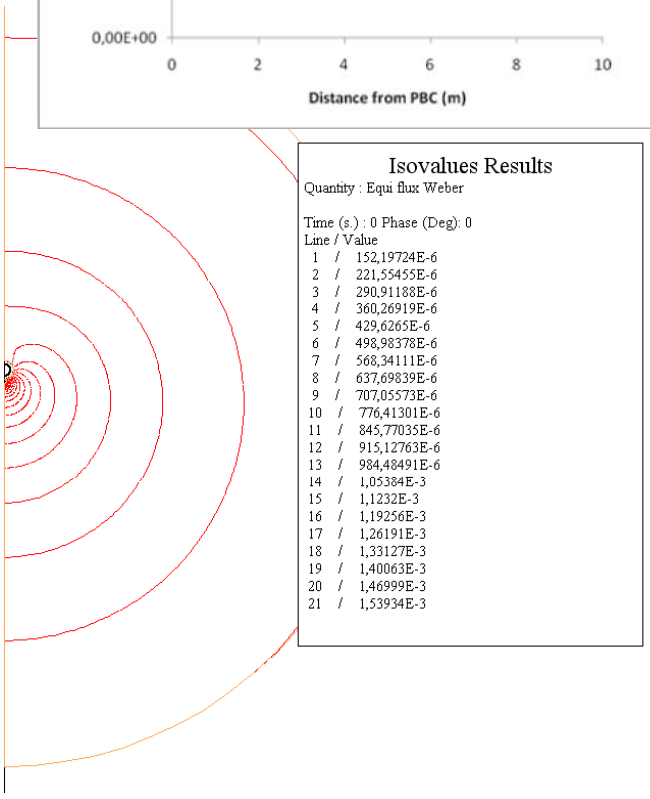
Design of a DEH System

DEH system modelling

- Finite Element modelling tool Flux2D verified through full scale test measurements
- Complex thermal/electromagnetic modelling







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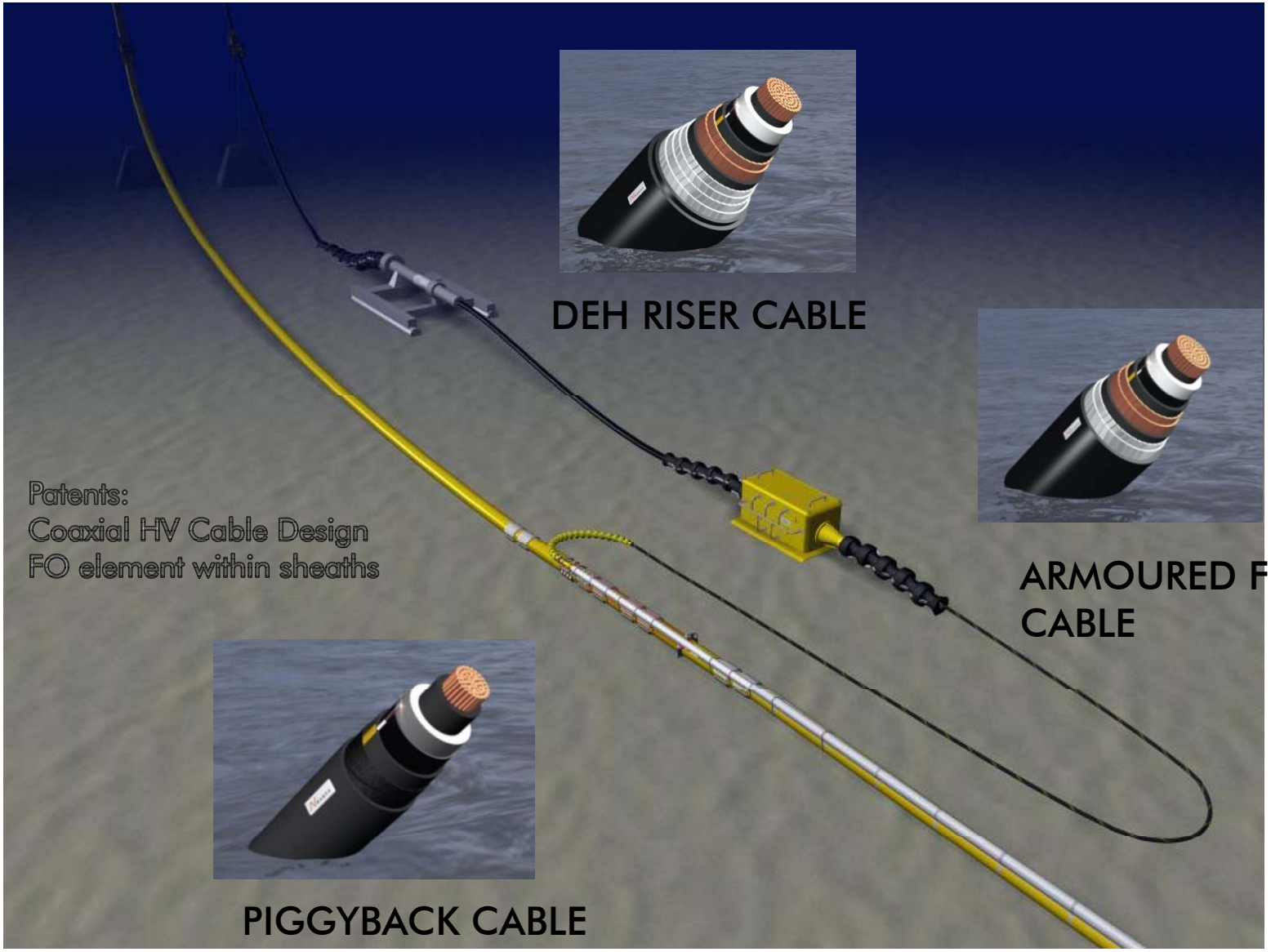
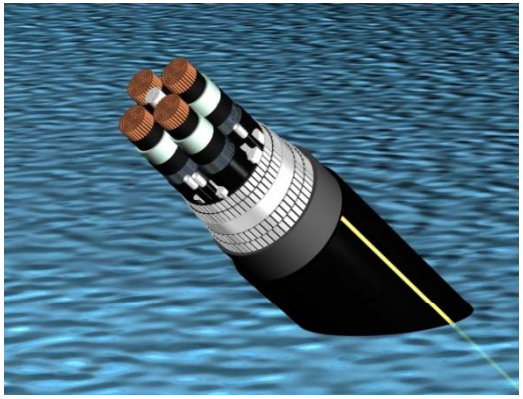
Cables in a DEH System

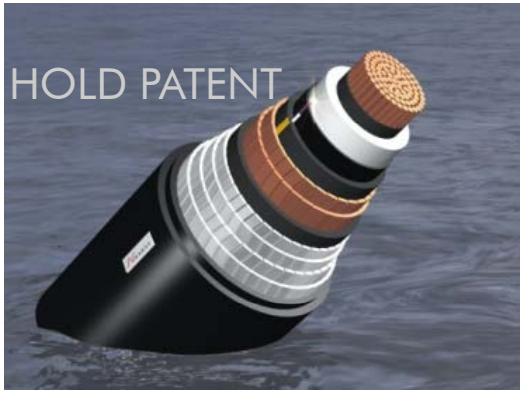


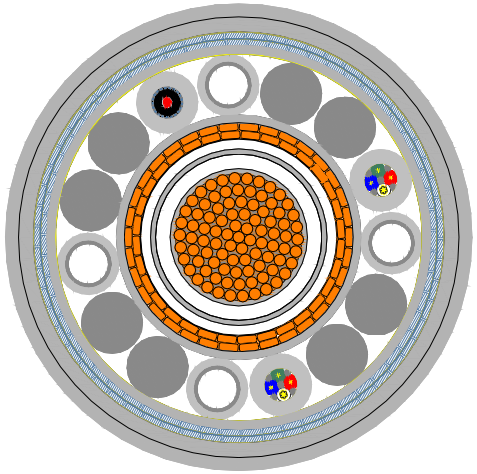
DEH Riser Cable

Dynamic DEH Riser Cable Design

Different designs used in existing DEH systems.



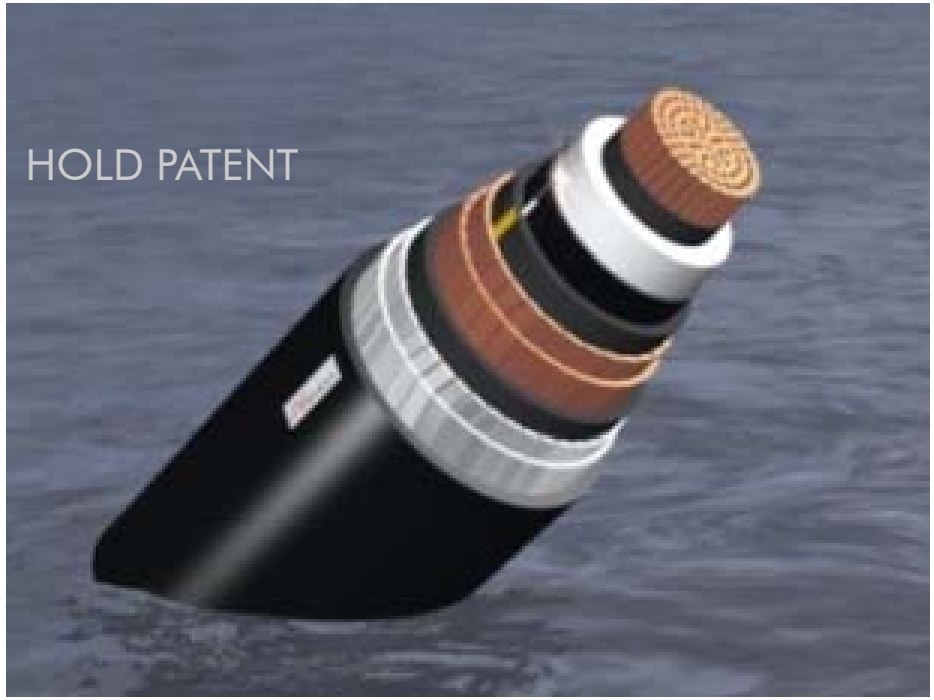




Armoured Feeder Cable

Armoured Feeder Cable Design

Recommended design for Armoured Feeder Cable



Piggyback Cable Design Challenges

1. No metallic armour or sheaths
2. Mechanical stress and strain
3. Ageing properties at high temperatures
4. Impact resistance
5. Electric screen
6. Fault detection

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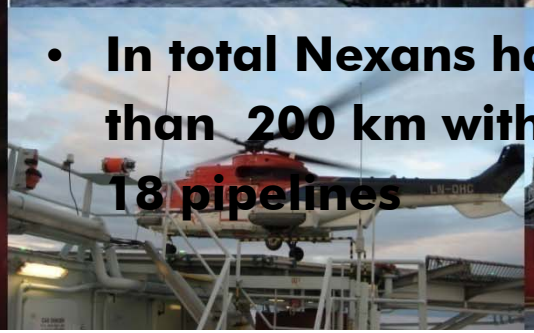
NEXANS DELIVERY IN A DEH SYSTEM IS MUCH MORE THAN JUST CABLES










1987-1998 Participated in development and qualification of the DEH technology

2000 Åsgard
2002 Huldra
2004 Kristin
2005 Norne
2006 Ormen Lange
2007 Tyrihans
2008 Alve
2009 Morvin
2010 Skarv

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Thank you for your attention!

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