

LECC 2011

FLEXIBLE RISERS

AGR EmiTeam A5  
Video insp. av Flerbrukslinje 5, SNORRE B

11:01:21  
30.09.2008

19.30m

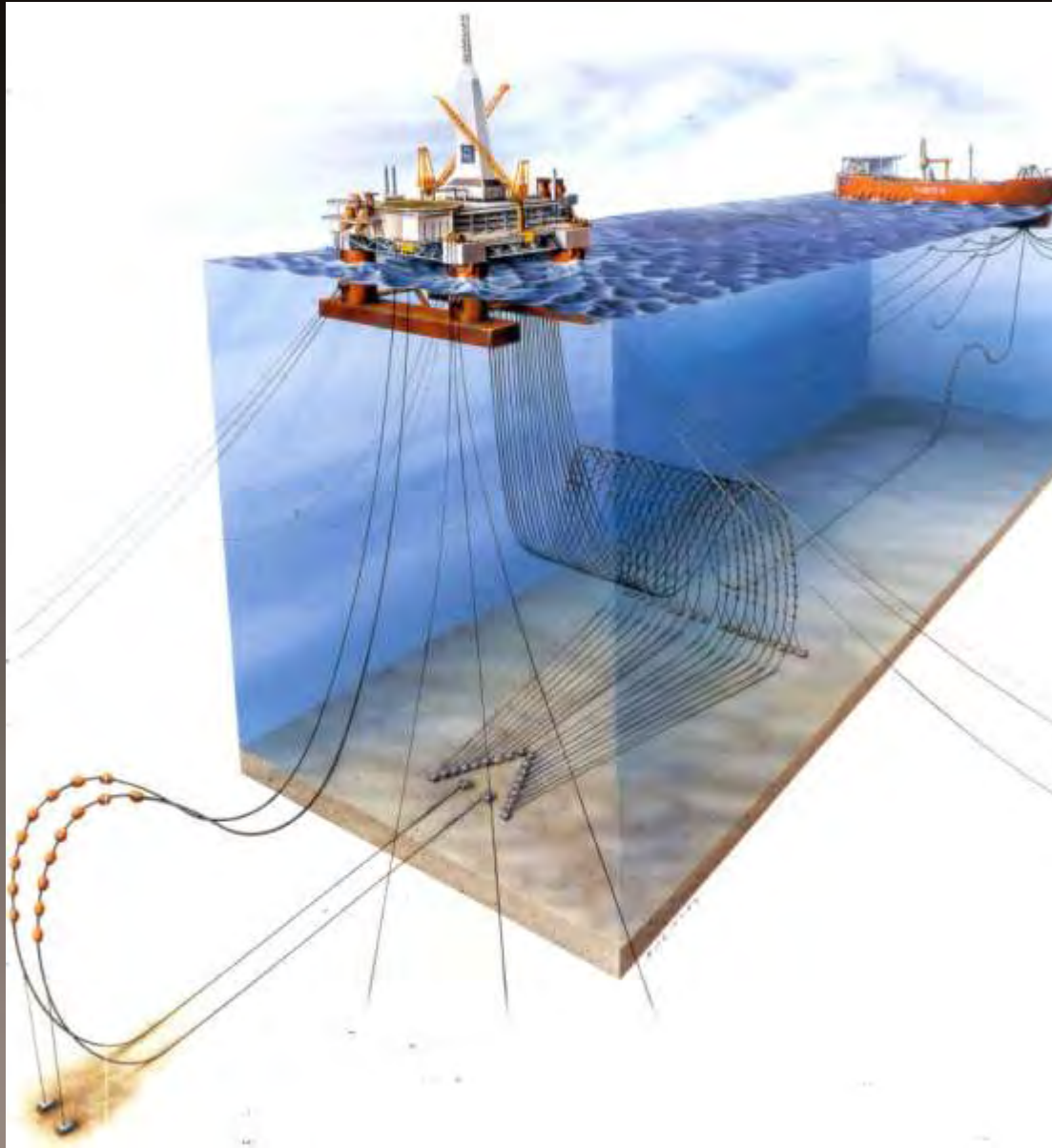
# Risers

- Seabed to surface
- Gas, oil, water
- Production, Injection, Export
- Floating platforms need flexible risers

# FPSO

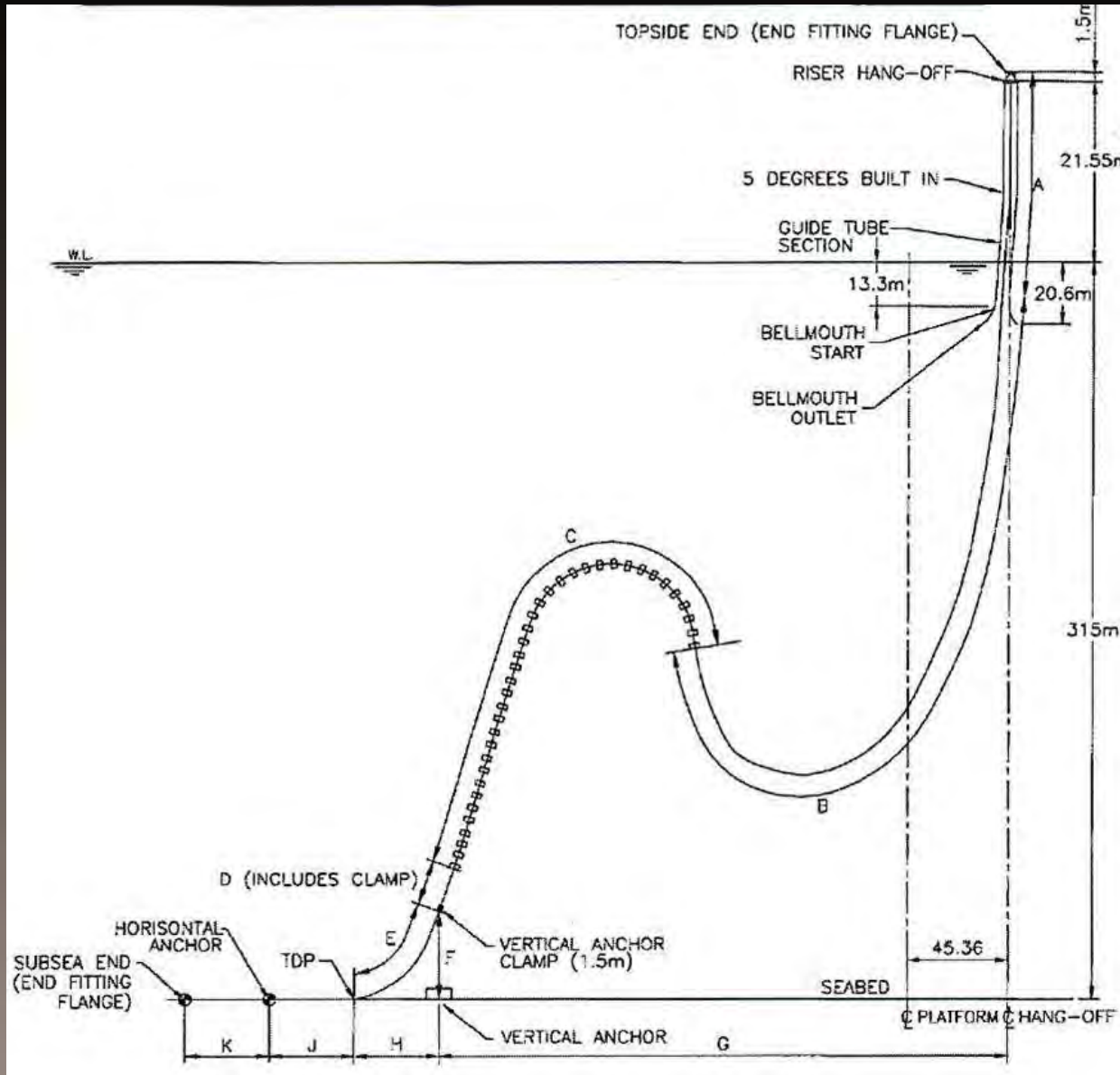


# FPF



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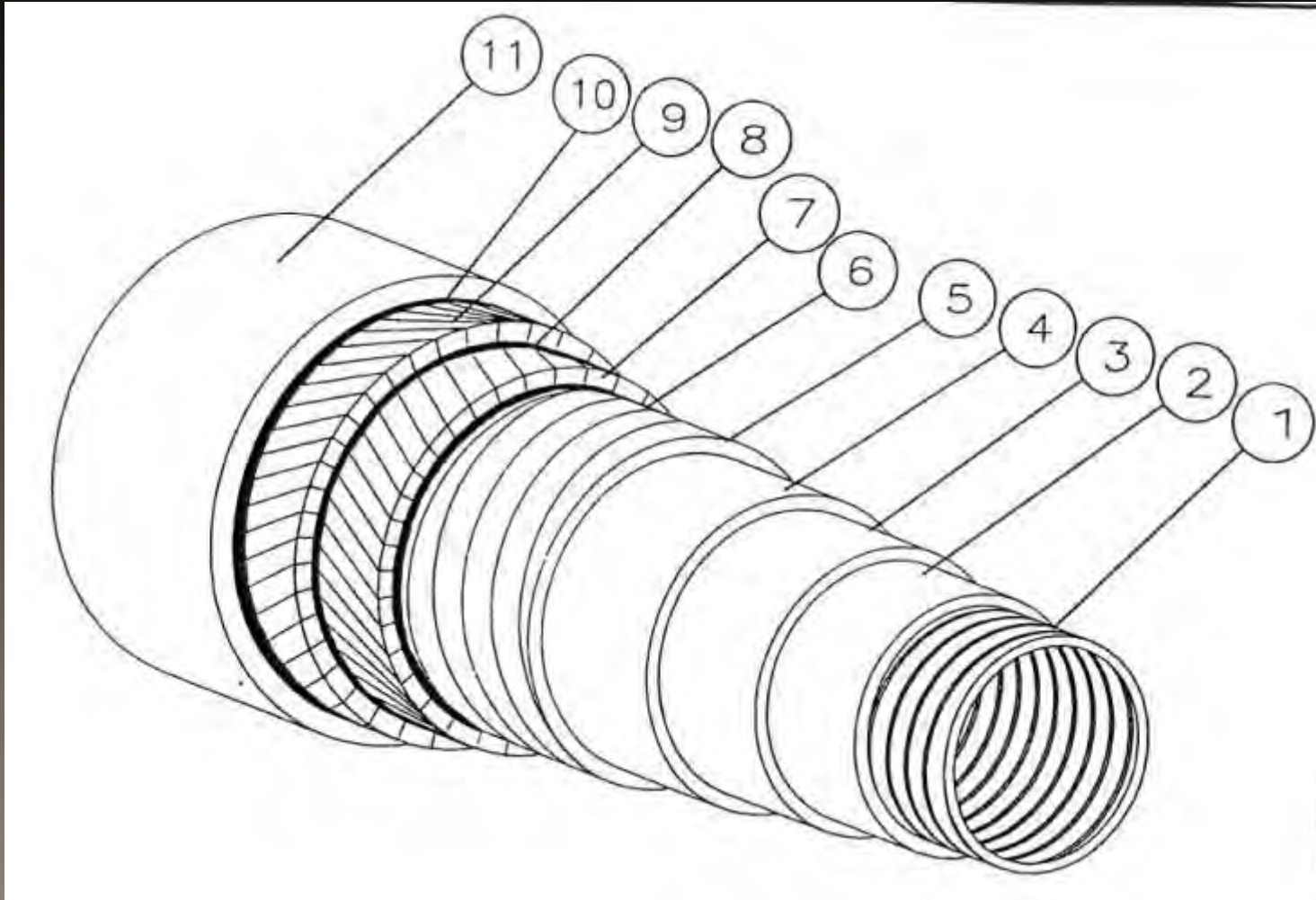
# Pliant wave



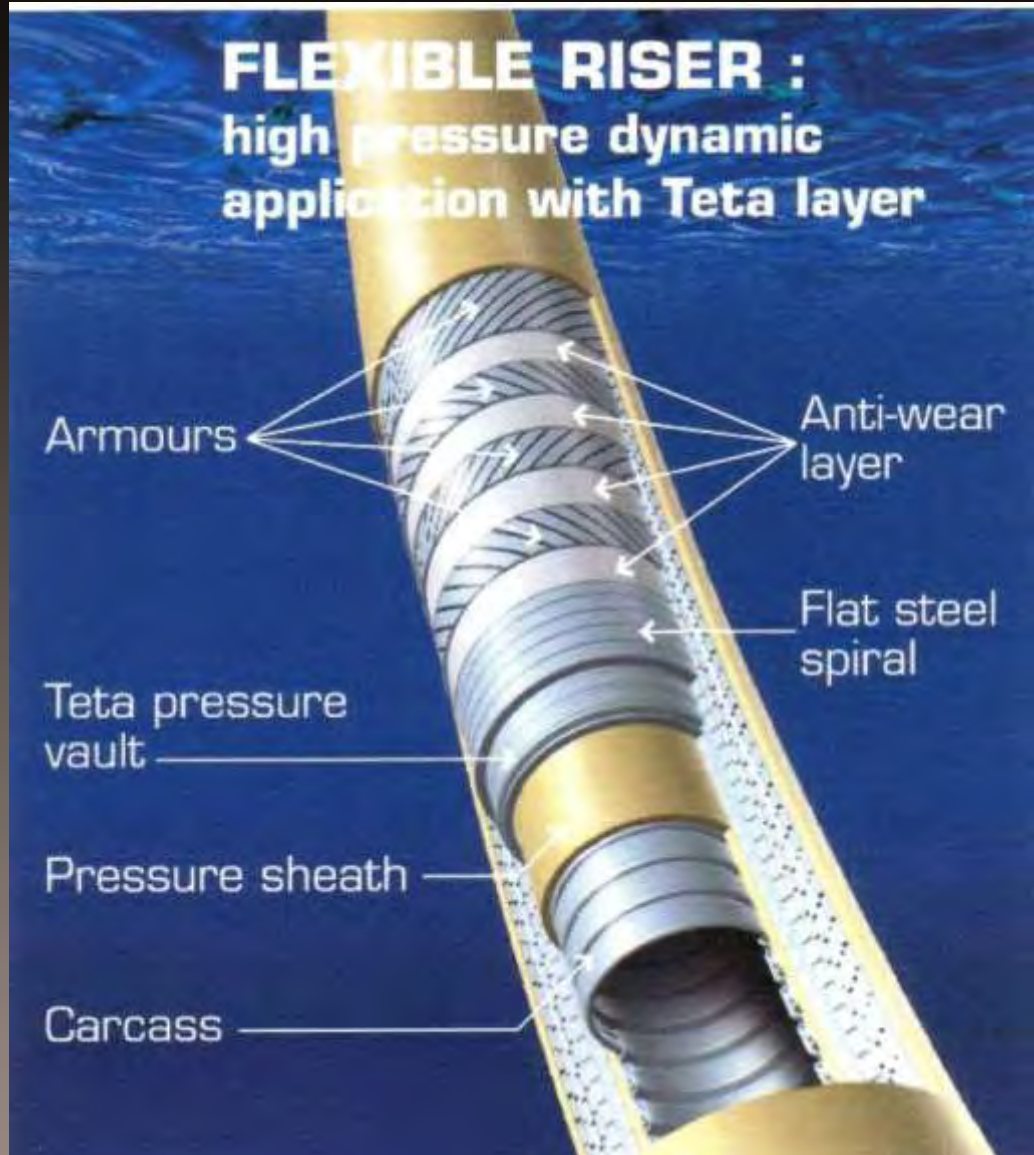
# Parameters (typical)

- Design life – 20 years
- Length – 800 metres +
- Internal Diameter – 6 to 16 inches
- Operating pressure – up to 350 bar (80%)
- Operating temperature – up to 100C
- Water depths – up to 1000m (70%)

# Structure



# Structure



# Manufacture



# Principal Manufacturers

- Technip
  - Wellstream
  - NKT
- 
- Some 1400 km of flexible pipe manufactured, of which 58% are risers

# Failures

- Recent survey
- 1400 static lines
- 1900 risers
- 315 reported damage/failure incidents

# Failure modes include:

- Sheath damage / Flooded annulus
- Ageing of Pressure Sheath
- End fitting pull-out
- Vent system malfunction
- Carcass collapse
- Overbending
- Abrasive wear

# Puncture



# Internal collapse





# Carcass collapse



# Abrasion



# Sheath burst



# Robert Boyle 1627 - 1691



# Condition monitoring

- Visual observation (ROV)
- Annulus vacuum/pressure testing
- Gas sampling
- Coupon testing

# Repair / Replacement

- Timescale
- Inspection of damaged riser
- Cost of manufacture
- Cost of changeout

# Future Focus

- Water depth – limit?
- Operating pressures up to 1300 bar(?)
- Operating temperatures
- New monitoring techniques
- Annulus vent system design
- Reassessment of corrosion fatigue
- Investigation of new failure modes

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CONTROL UMBILICALS

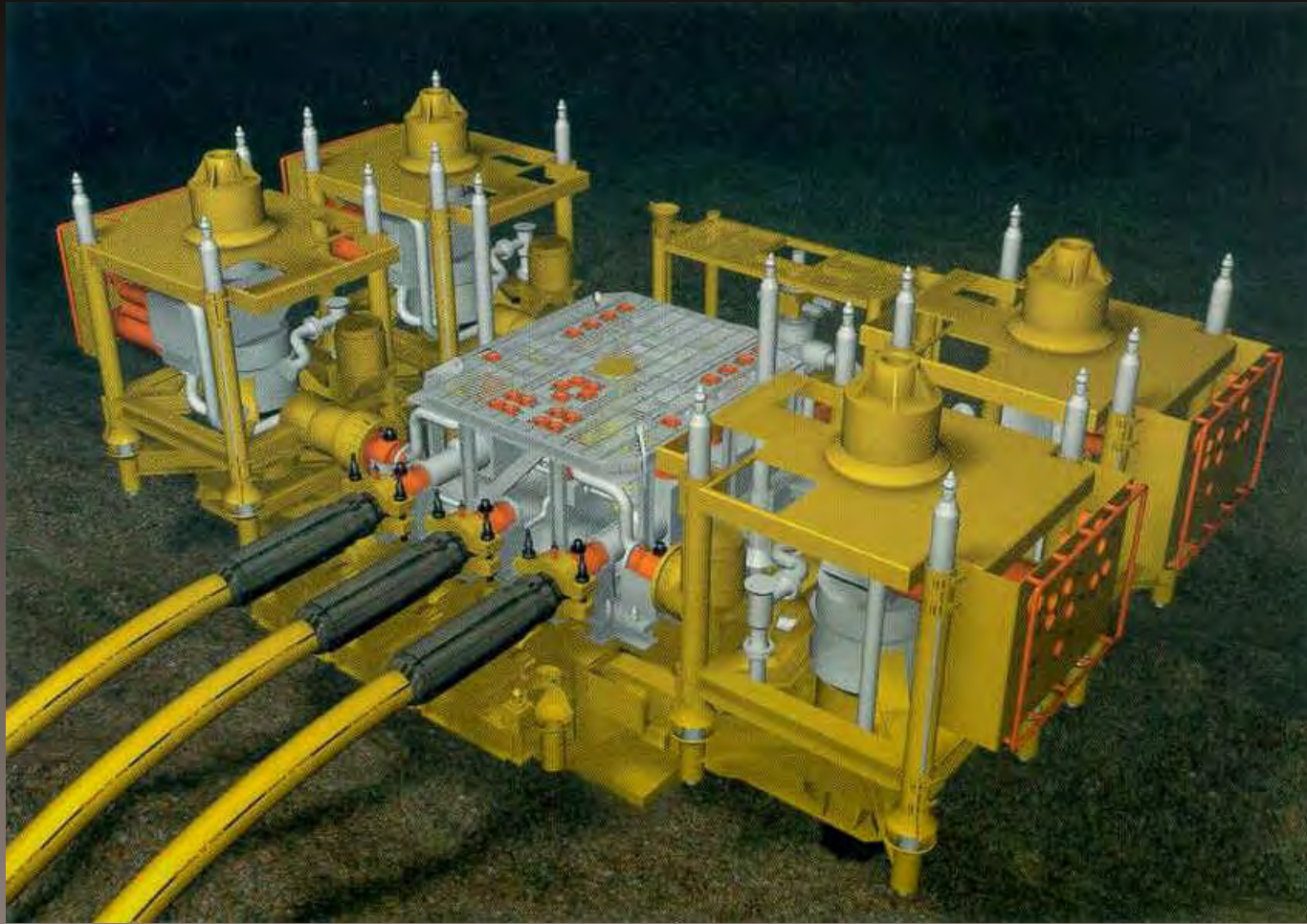
# Subsea installations





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# Template



The coated templates are supplied as sets of modules weighing about 30 tonnes apiece.



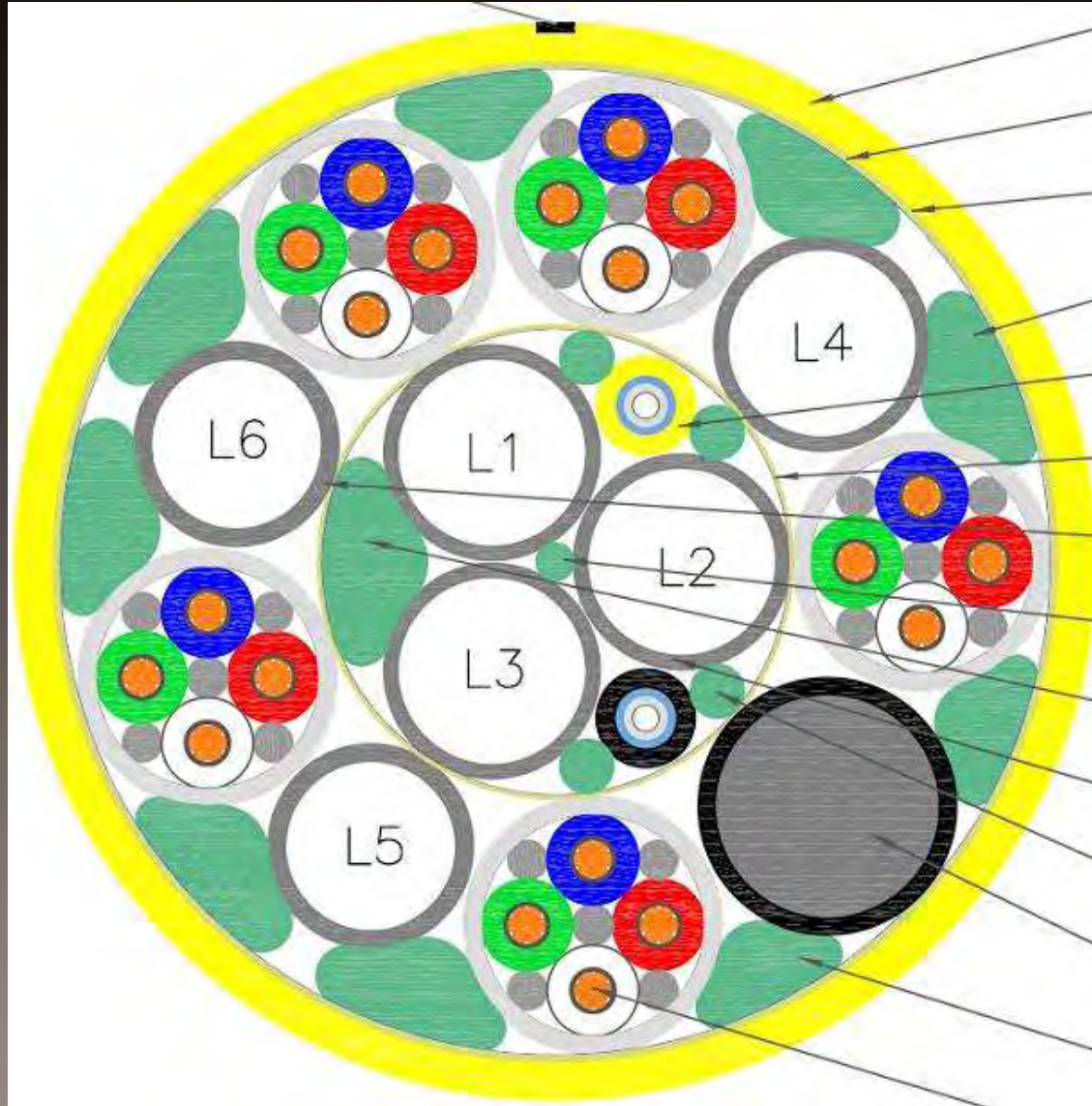
# Control functions

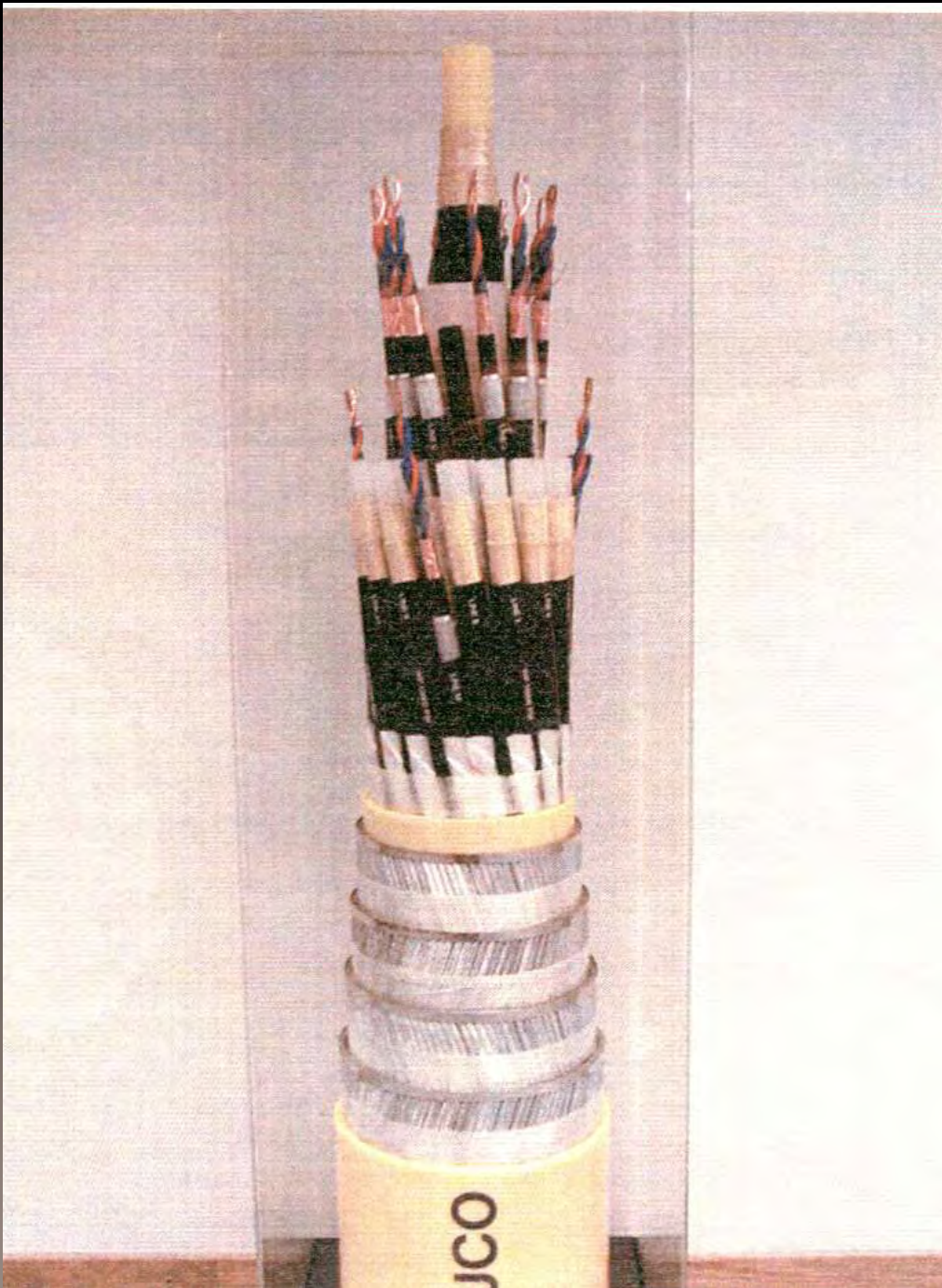
- Control/monitoring from surface installation (or shore)
- Static and/or dynamic
- Valve operations
- Downhole monitoring
- MEG injection

# Typical makeup

- Hydraulic lines to power valve actuators
- Power / signal electric cables
- Fibre optic cables
- Chemical injection lines
- Armouring for dynamic applications
- External sheath
- Sealed or free-flooding
- Trenched and buried

# Structure

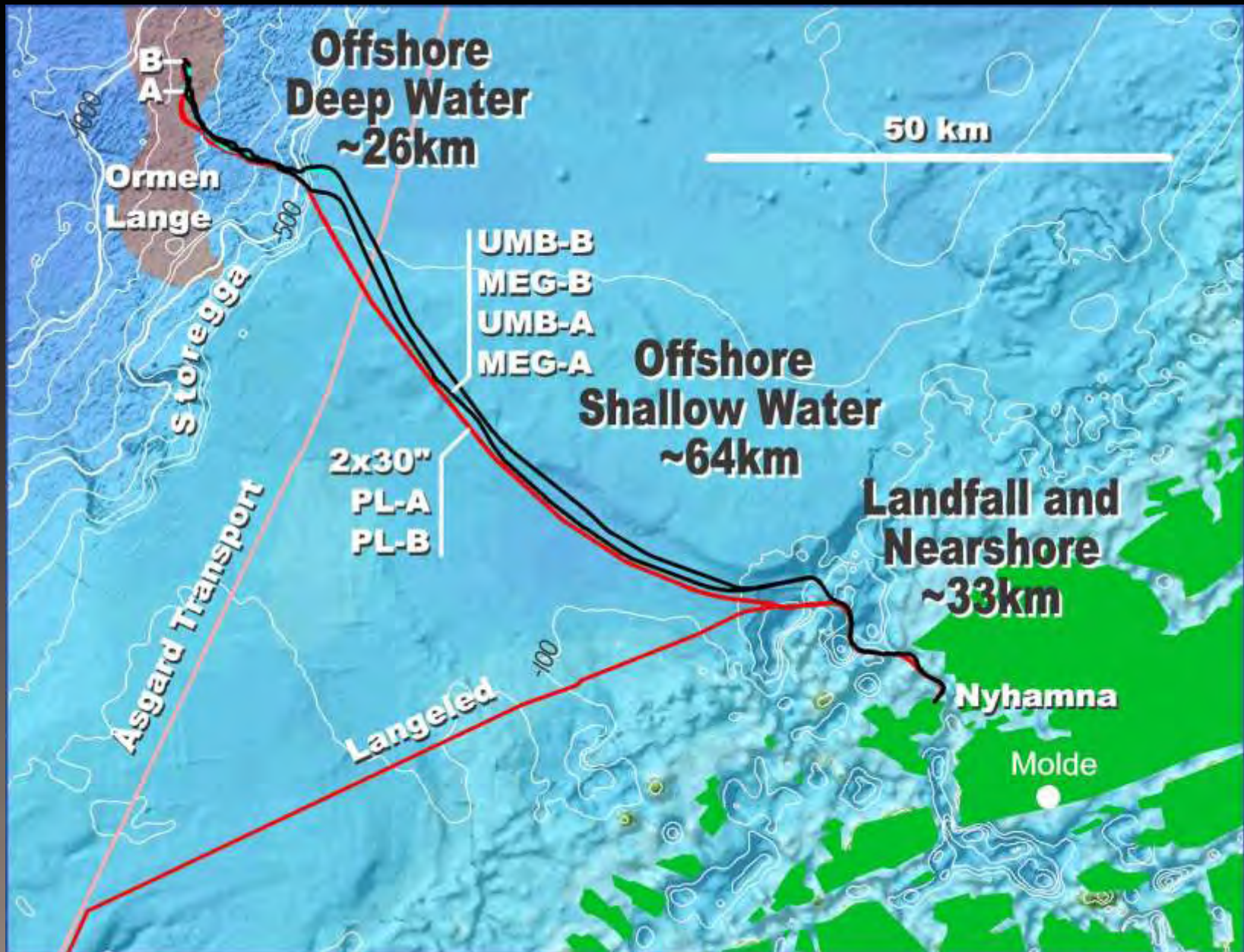




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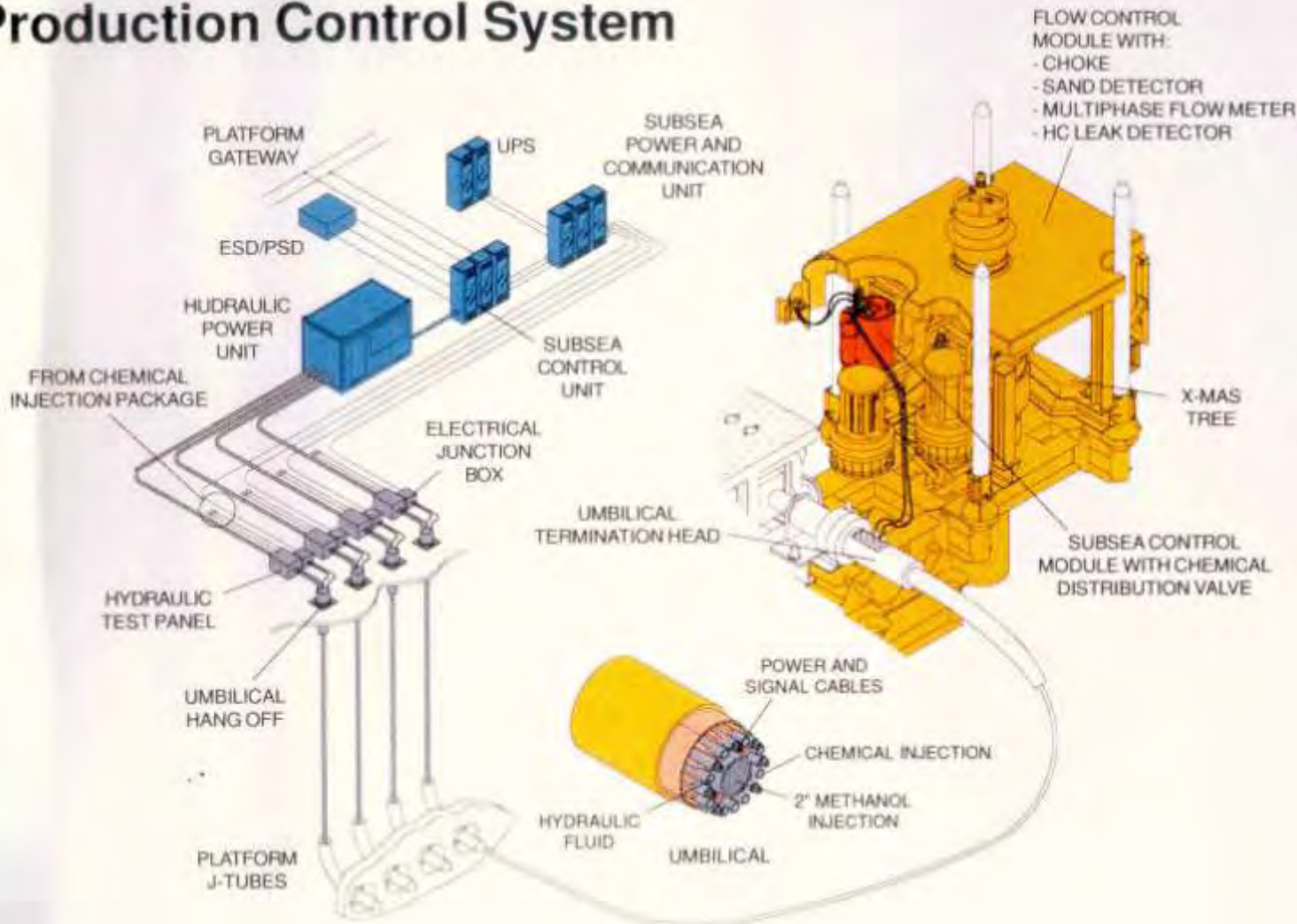
# Record breaker?



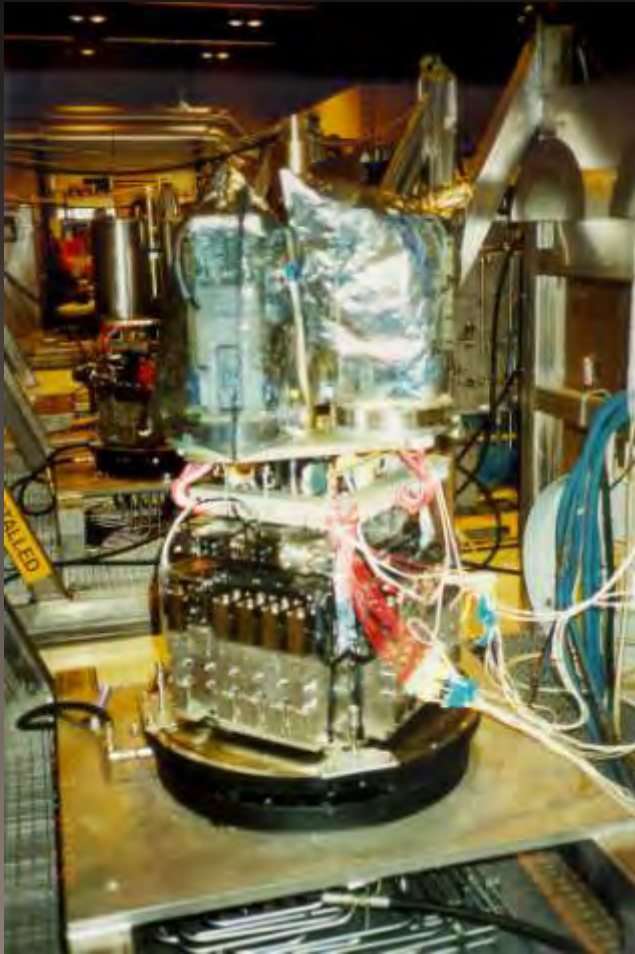


# Control from platform

## Production Control System



# Subsea Control Module



# Control from floating installation



# Failure modes

- Damage during manufacture
- UTH damage / jumper cables
- Leakage in hydraulic lines
- Contamination of hydraulic oil
- Installation damage including ploughing
- Water ingress to electrical components
- Loss of insulation resistance (Cables)
- Interface with surface installation



19:22:43

HYDRO

LYNX 1109

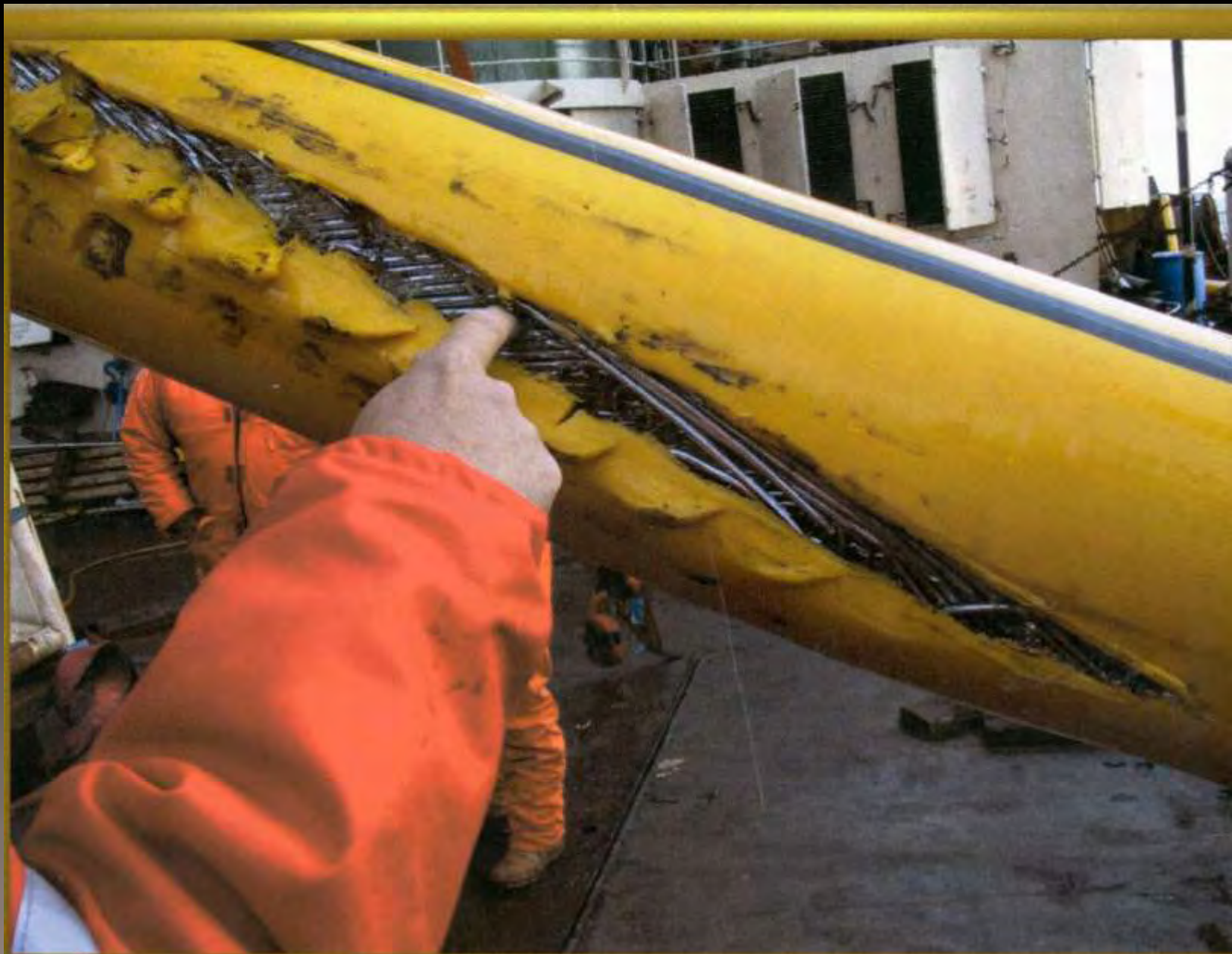
THE SOUTH A1

25/11/04



Fram Vest  
Template A1

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# Future Focus

- Increasing water depth
- Increasing complexity of subsea developments
- Fault tracing
- Advanced repair methods

# Charles Taylor adjusting

## INTERNATIONAL LOSS ADJUSTERS

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