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Planlegging av undervannsoperasjoner under utbygging og drift – Ormen Lange

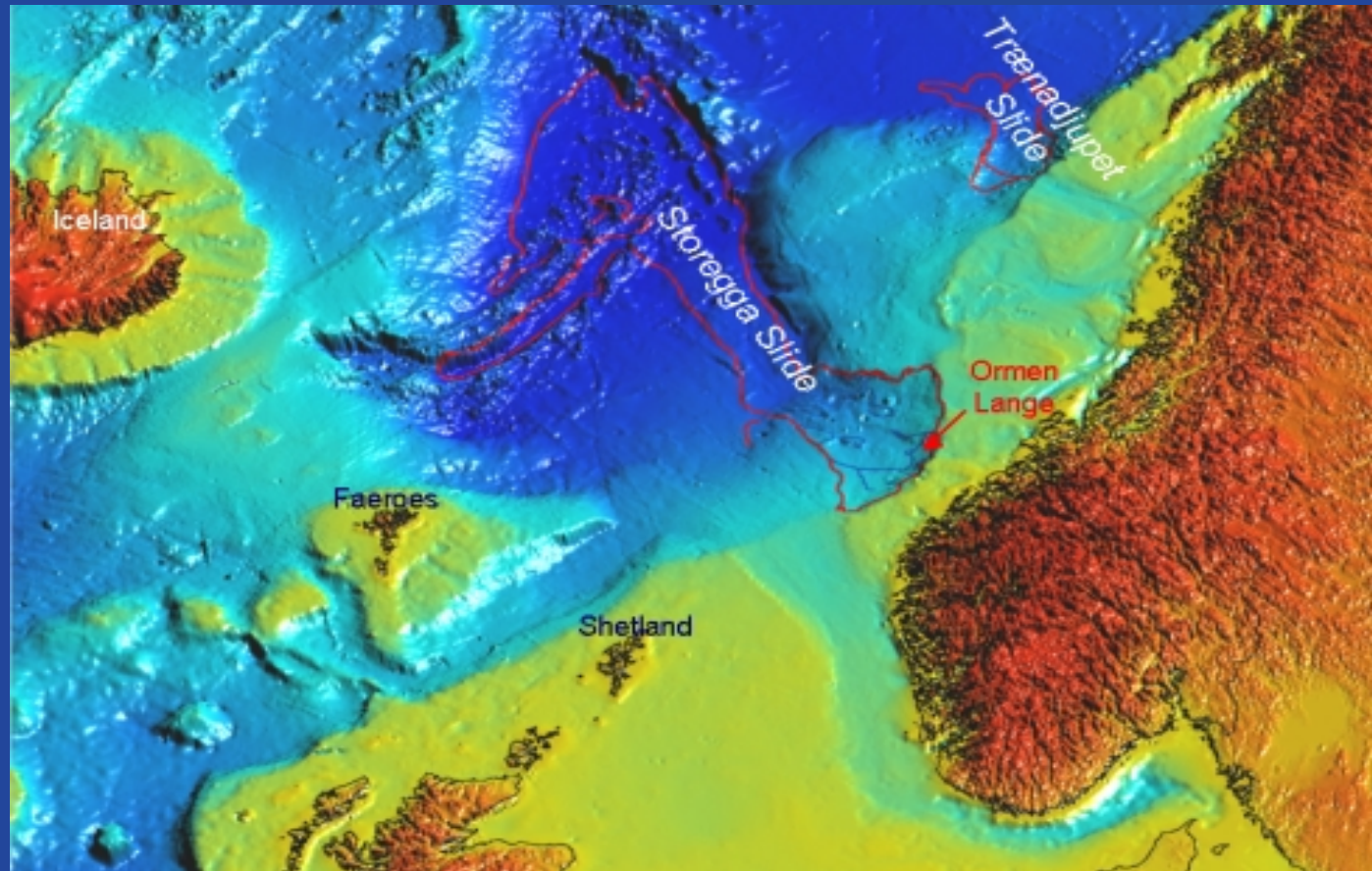
Ormen Lange

- The Ormen Lange field is situated approx. 100 km NW of the Møre coast
- Main production area is located close to the edge of the Storegga slide at 850m water depth
- Processing will take place at Nyhamna on the west coast of Norway
- Gas will be exported to Easington on the east coast of England through a 1200 km long export pipeline

The Ormen Lange Pipeline Transportation System



Ormen Lange is localized near the edge of one of the worlds biggest submarine slides



Ormen Lange

Production start: 1 October 2007

Reserves: Approx. 397 billion Sm³ dry gas
Approx. 28,5 million Sm³ condensate

Reservoir: Discovered by Hydro in 1997
Around 40 km long and 8 km wide
Approx. 3000 m below sea surface

Ormen Lange

Sea depth: 800 to 1100 metres

Wells: 24 wells in up to 4 subsea templates
Initially 2 x 8-slot subsea templates

Production capacity: Condensate: 6000 – 8500 m³ per day
Gas: 70 million Sm³ per day

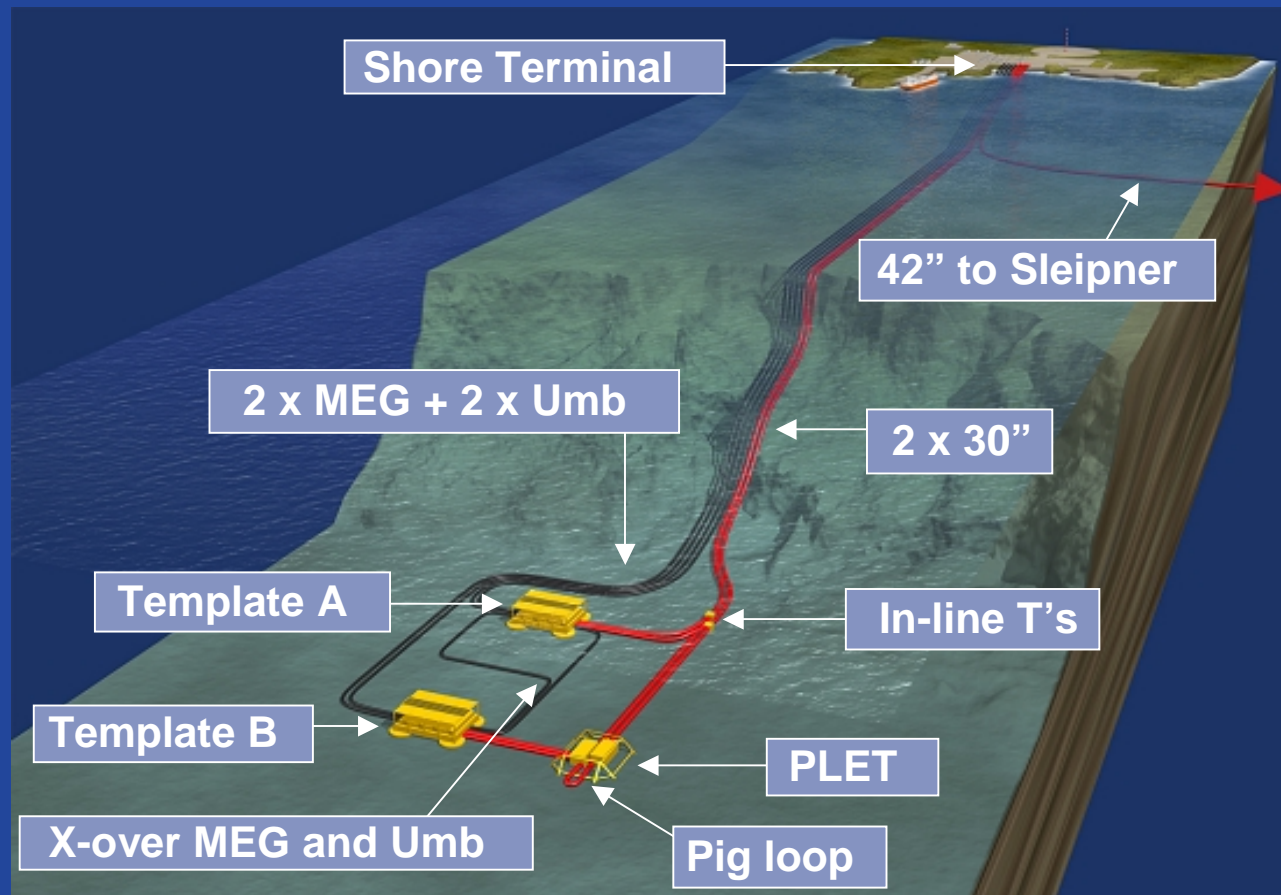
Total investments: Approx. 46,5 BNOK for the field development
Approx. 19,5 BNOK for the transport system

Key Development Challenges

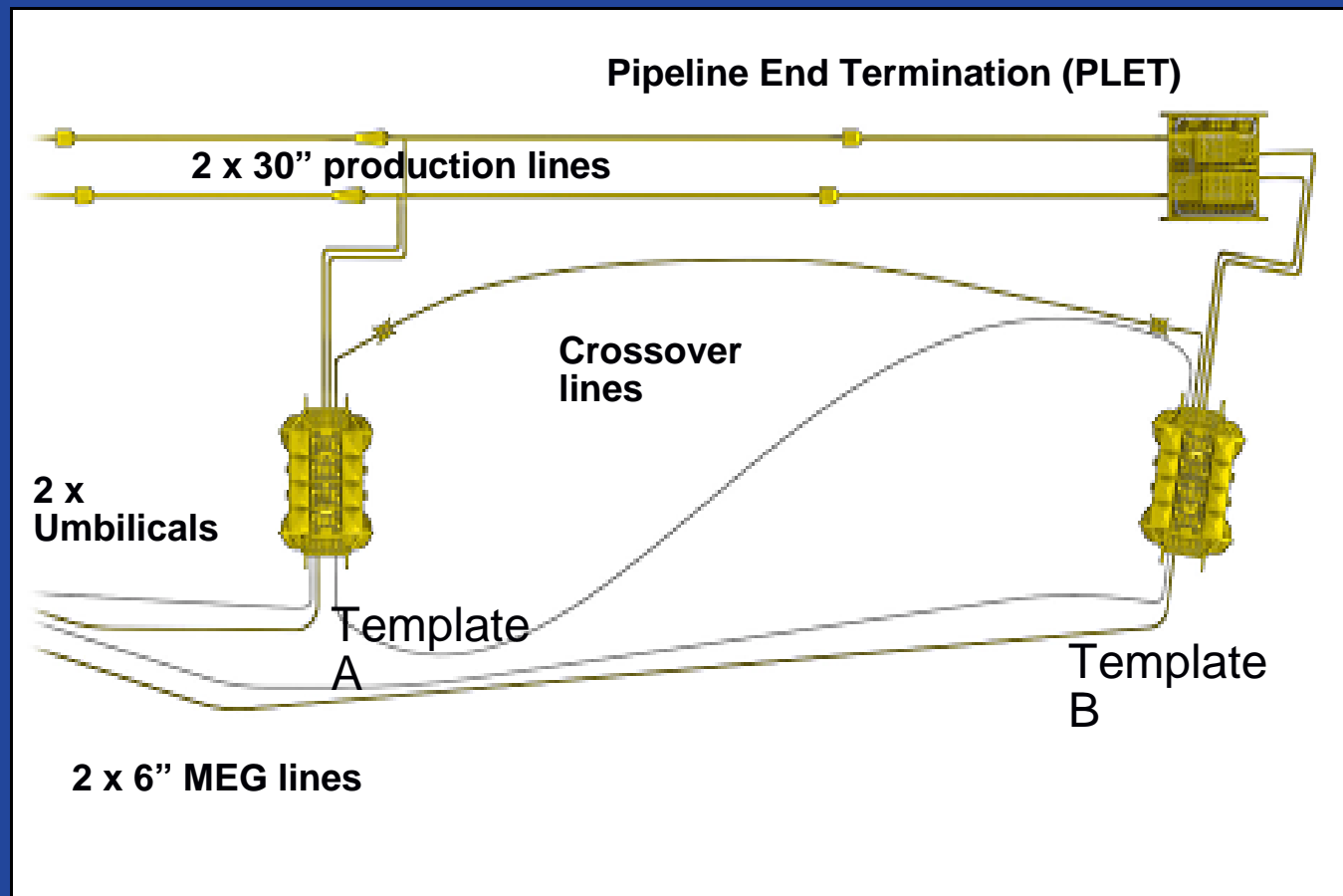
Technology

- Uneven seabed for subsea- and pipeline design and installation
- Main production area in an avalanche / slide area
 - Seabed lay-out
 - Seabed slope, Soil, Flowline corridors, Rig anchor patterns, Rig- and template heading, Equipment handling zones, etc. (Iterative process to optimise lay-out)
- Temperatures, minus 1 - 2°C at seabed
 - Flowassurance - Avoid potential for hydrates (internal and external!)
- Large bore wells (9 5/8" and 7" tubing)
- Extreme waves and winds
- Strong currents
- Water depth

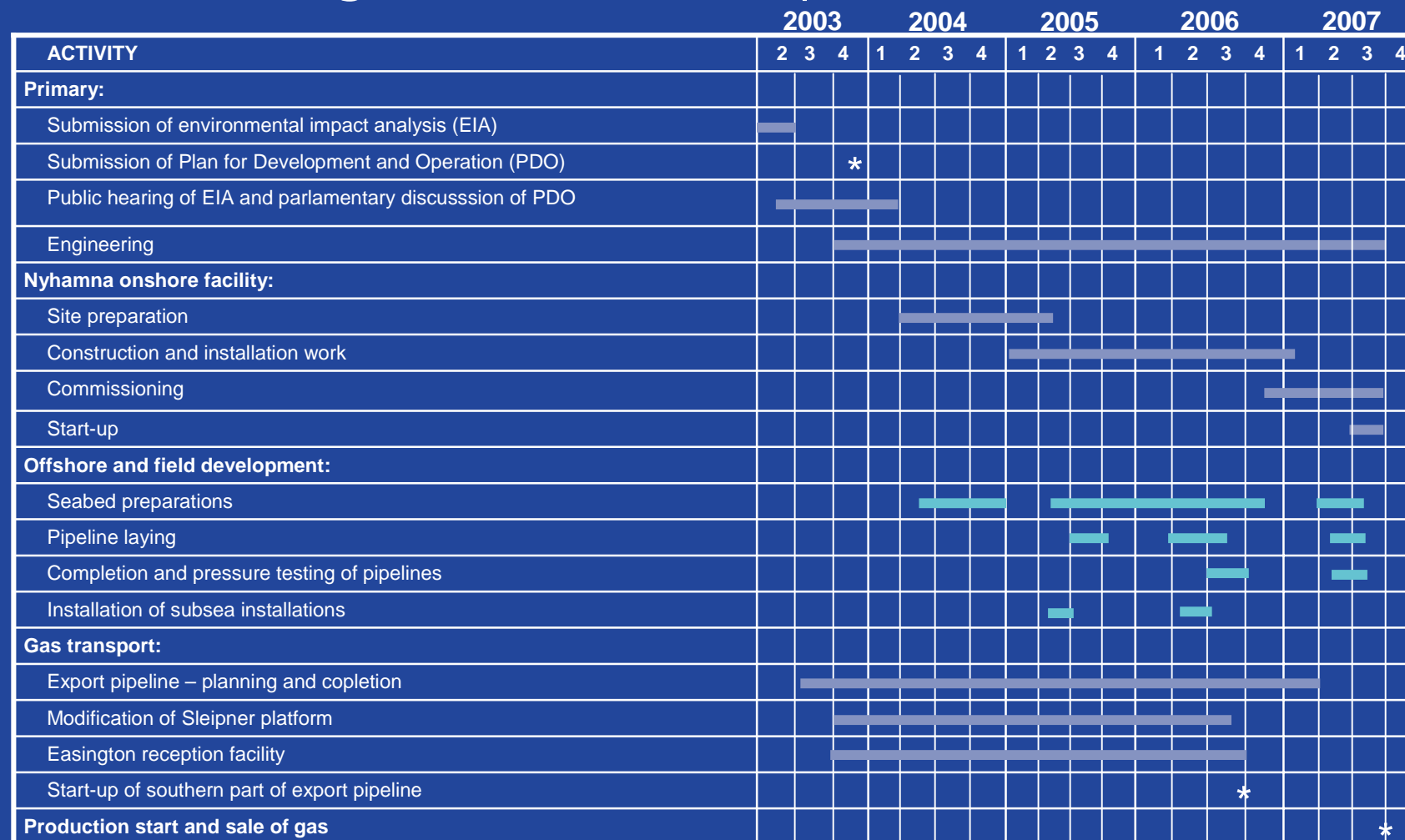
Initial Subsea Development phase



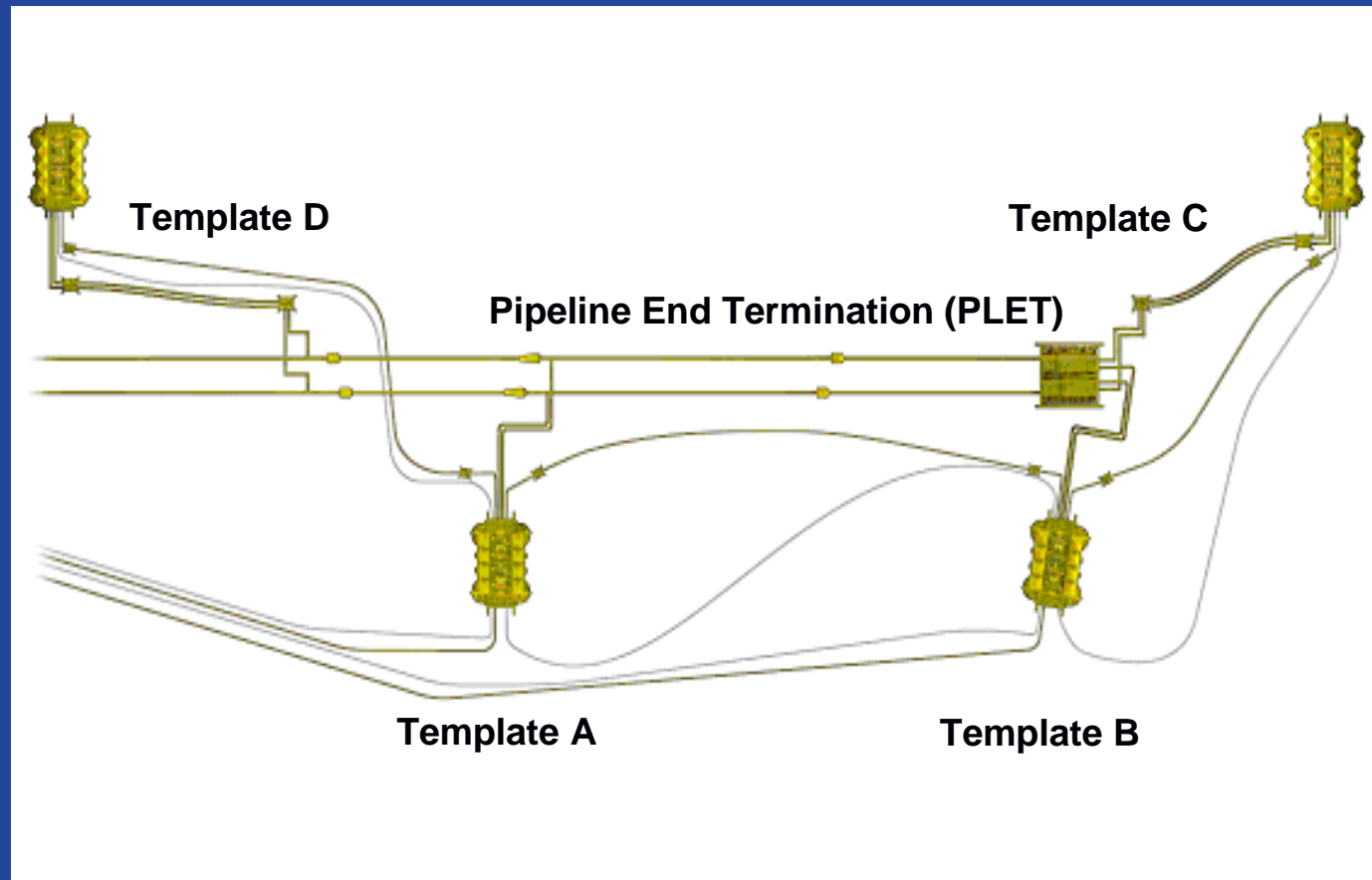
Initial Development



Ormen Lange initial development



Future Development



Subsea operations

- Installation and construction phase:
 - Planned activities normally performed once, and taken into account within Scope of Work for all contracts
 - Engineering, Procurement, Fabrication, Installation, Commissioning and Start-up
- Operational phase – Intervention strategy is subject to evaluation:
 - Defined IMR activities!
 - General inspection, equipment change out for upgrading!
 - “Preventive maintenance” or await failure indications!
 - Production system RAM analysis
 - Summer and winter operations!
 - Campaign based interventions!
 - Criticality evaluations
 - Environmental-, economical- and risk of equipment handling, availability of vessels etc.

Installation and Construction phase

- Seabed and soil survey
 - Avoid seafloor crossing corals, free span areas, soft layer and slide blocks, foundation for structures
- Seabed preparations
 - Excavations, trenching, rock dumping
- Installations
 - Operations during launch and after installation on seabed
 - Metrology, levelling, tie-in and connections, valve operations, testing and commissioning activities

Tasks

- Main tasks are identified during the field development evaluation and pre-engineering
- Detailed listing of all tasks shall be developed during the engineering
 - Access shall be in acc. with ISO 13628
 - Contingency operations shall be planned for
 - “Computerized model testing” can be an advantage both during engineering and for training of personnel
- Physical verification of access and “dry performance” shall be carried out during system and integration testing
- Close co-operation between interfacing contractors is mandatory

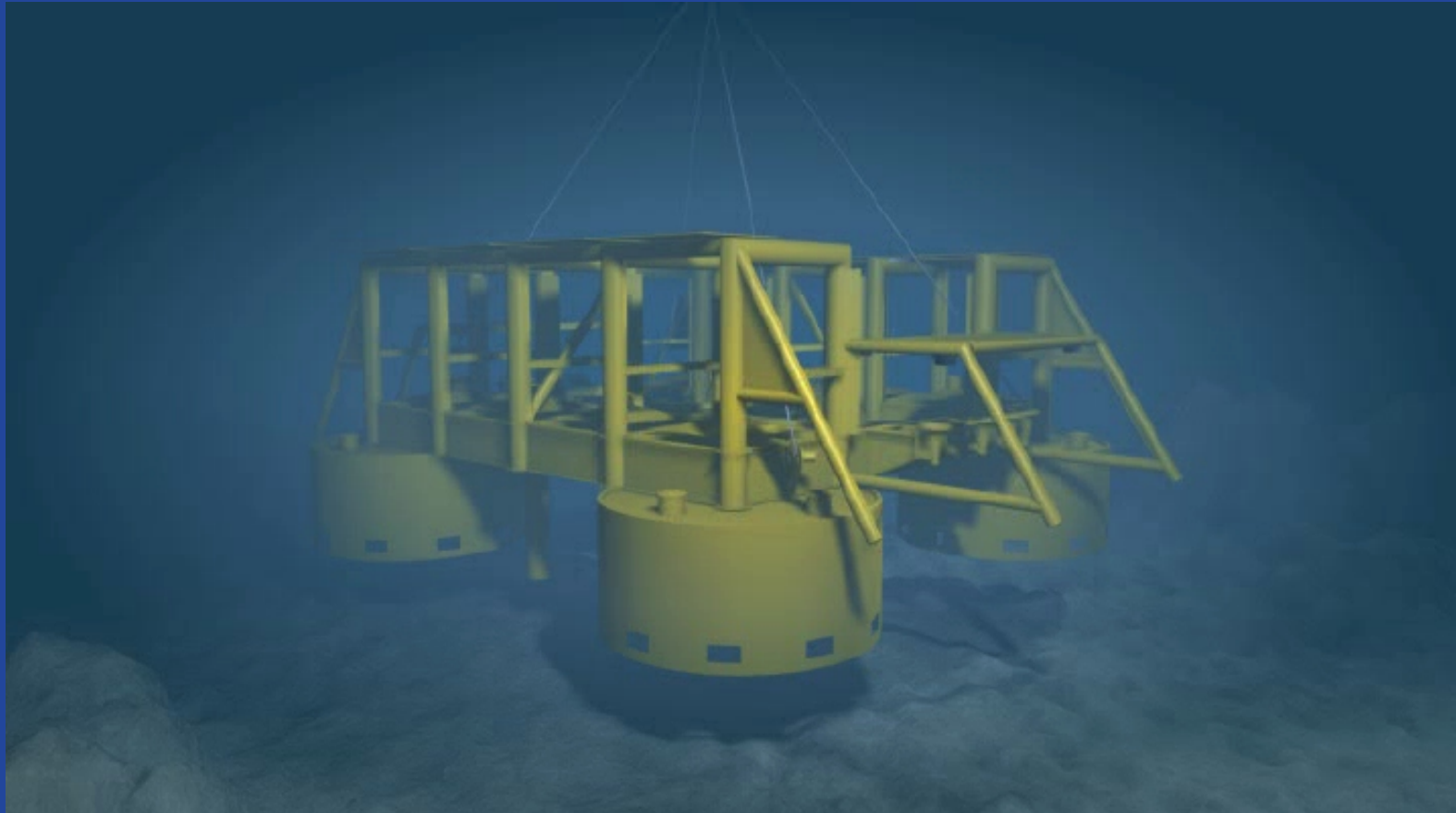
Template related tasks (ROV and ROT - brief)

- Levelling
- Disconnect lifting sling arrangement
- Assist lifting well slot protective hatches in position
- Valve operations
 - Flushing out hydrates from cavities - if required
- Assist drilling operations
 - Open hatches, monitoring, CCDS ...
- Tie-in and connection of spools and umbilicals to manifold
 - 2 X 20" connections, 2 X 6" MEG incl. crossover, umbilical from shore and crossover
 - 3" flexible line between template and PLET
- Manifold control module / Xmas tree control pods
- Choke bridge module
- Make up connections between manifold branch hub, choke bridge module and production Xmas tree
- Etc, etc.

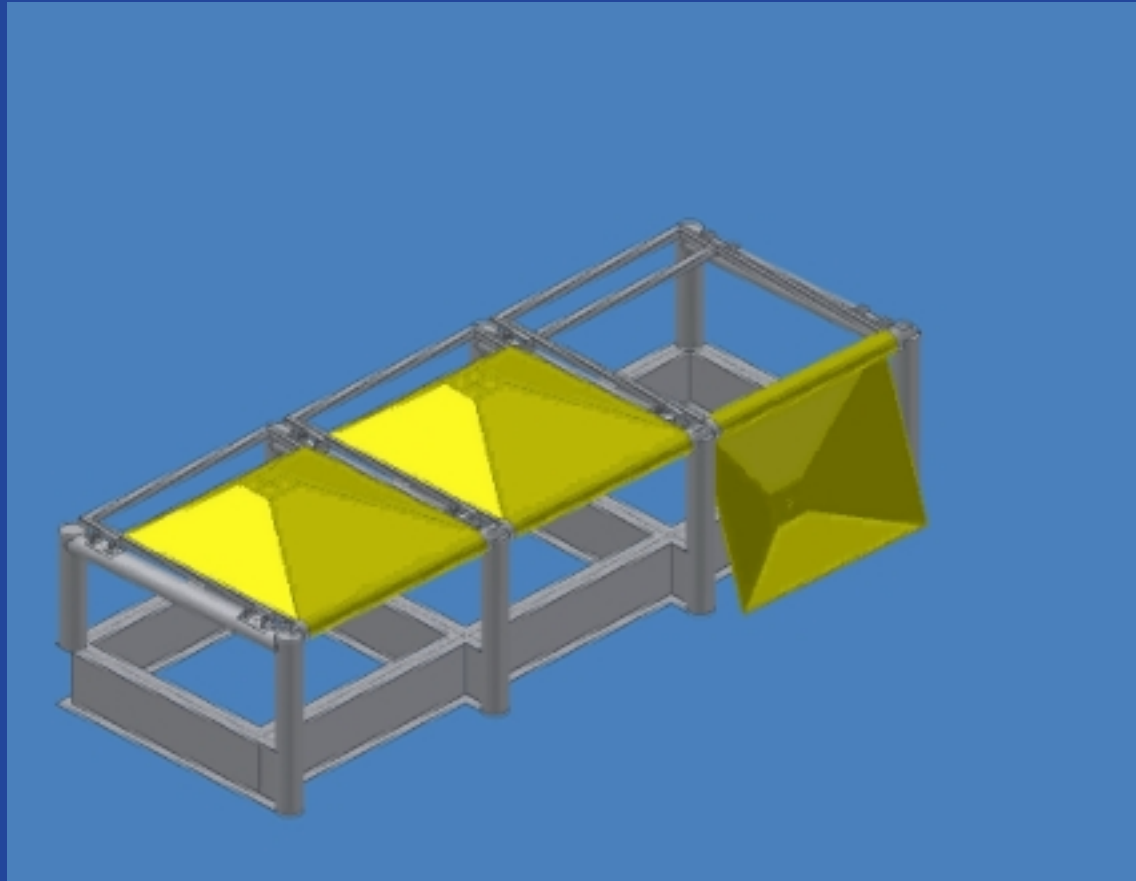
Qualification of equipment and personnel

- Intervention system evaluation for each task
 - ROT or ROV based interventions
 - Installation capabilities (weather, current, vessel and equipment handling requirements)
 - Tools and equipment shall be interfaced and tested/qualified prior to mating subsea
 - Identical equipment are historically found not to be “identical”
 - As a minimum: tools and equipment shall be interfaced with jigs or mock-ups prior to installation
- Personnel
 - Experienced personnel shall be trained to perform the tasks (No “on the job training” can be accepted). “Computerized” training!
 - Tool installation and task performance
 - Equipment and system understanding

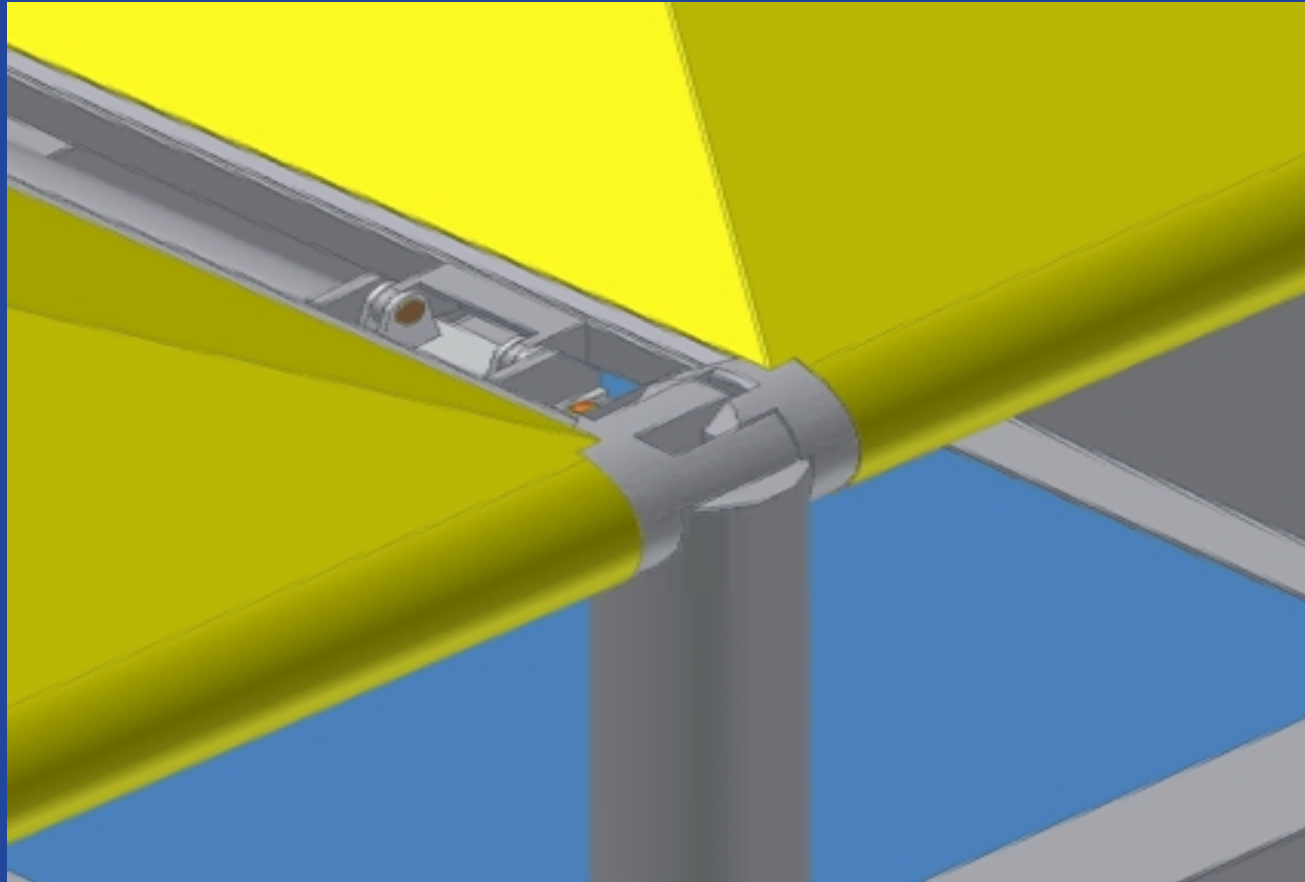
Template Installation



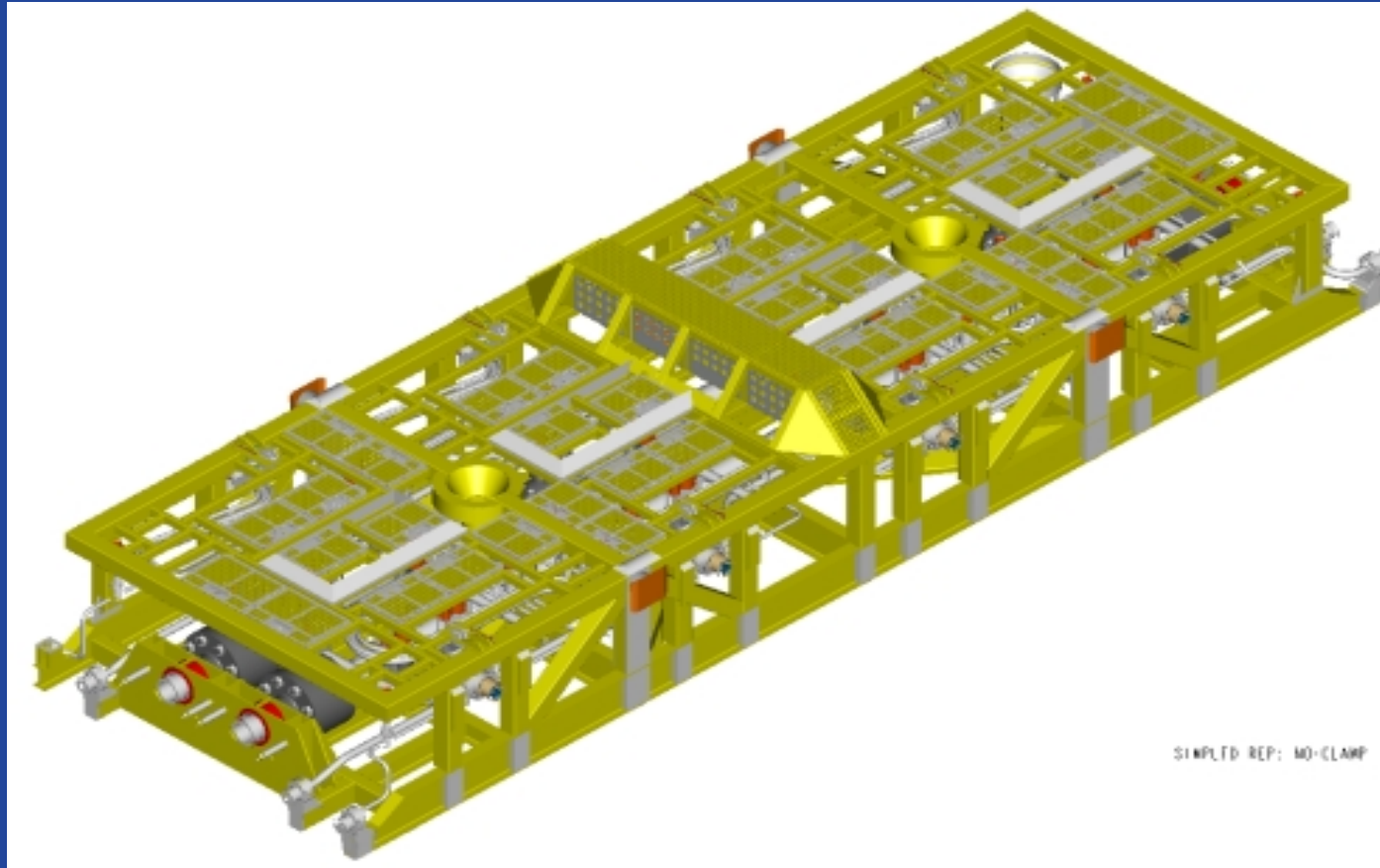
Closing template hatches



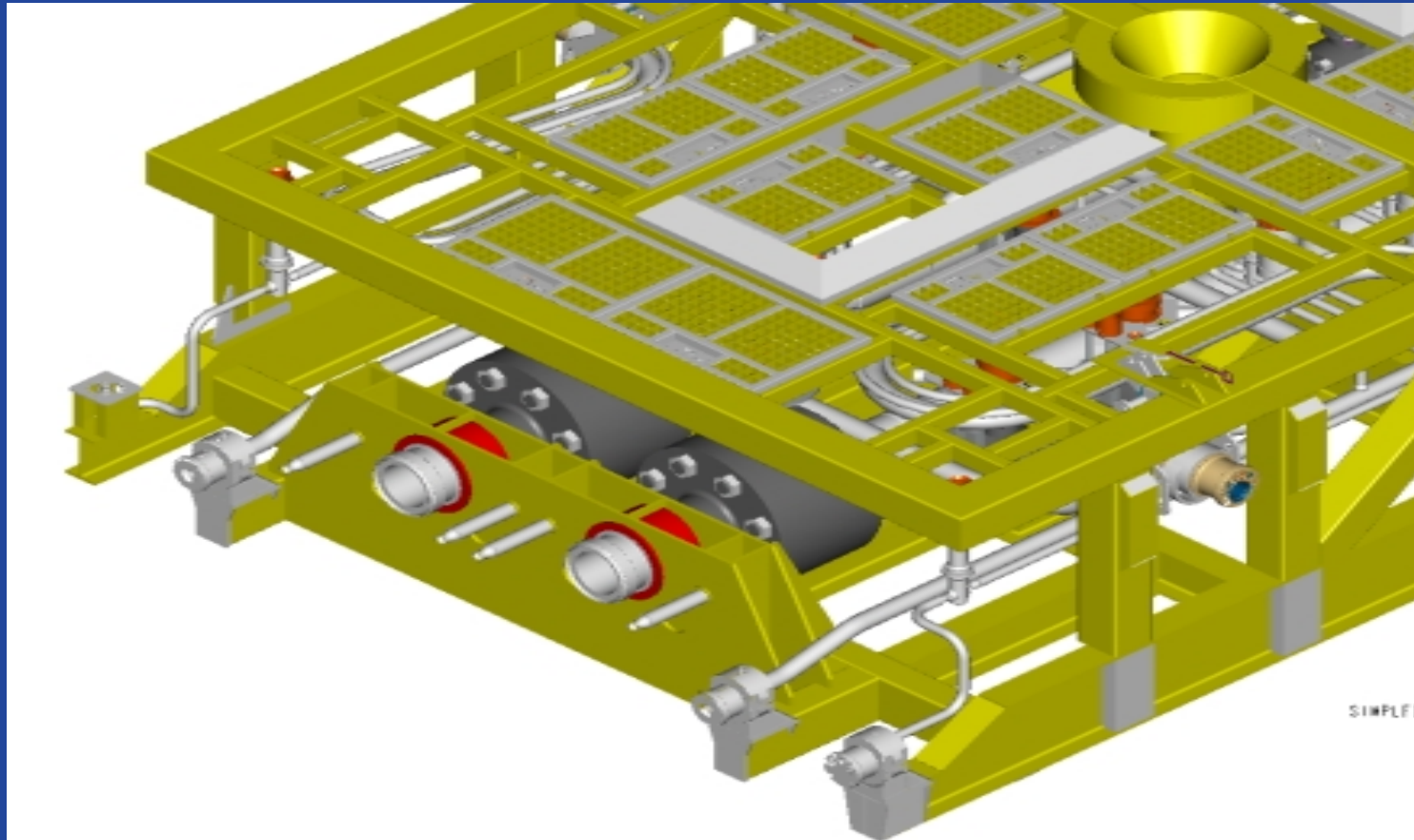
Opening template hatches



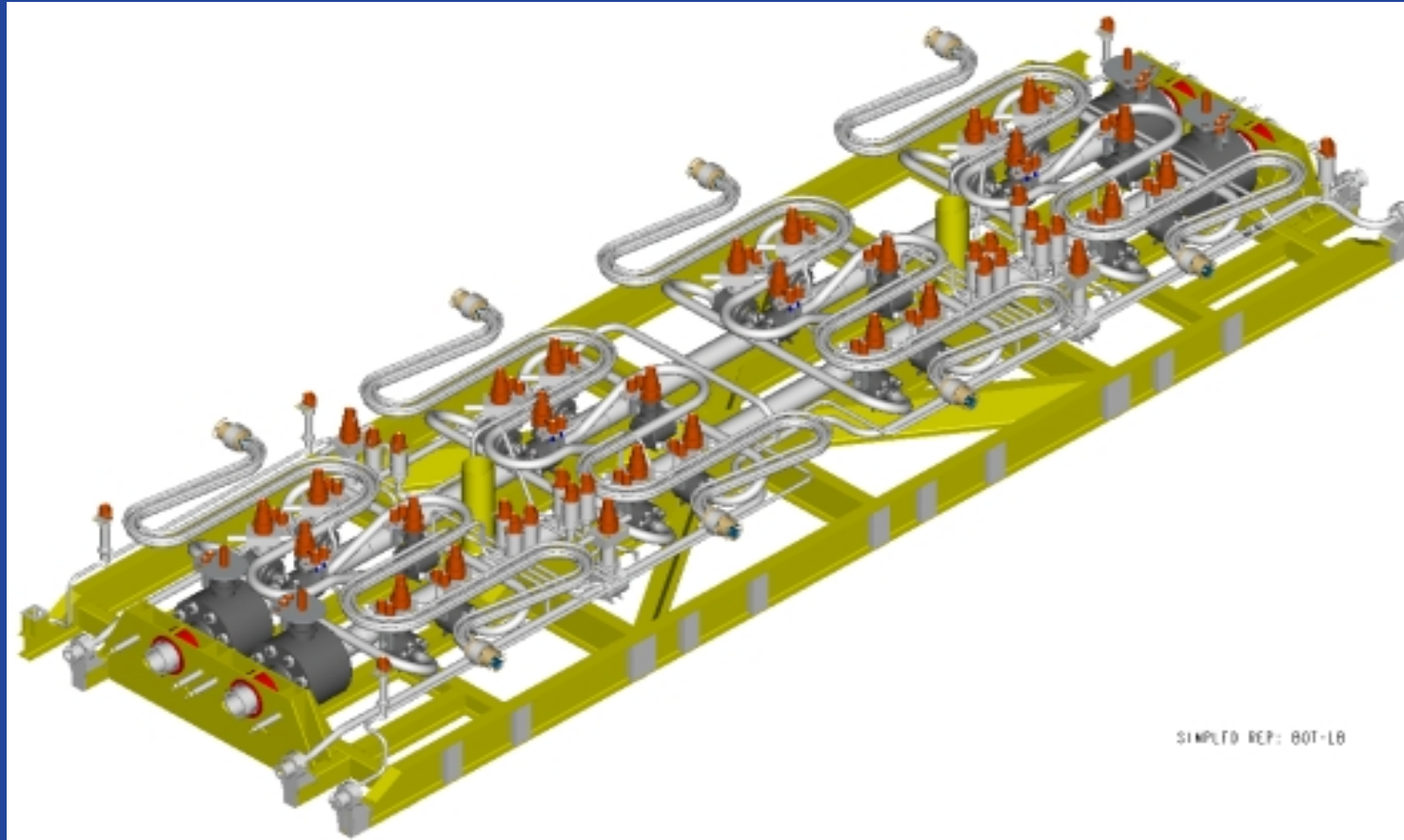
Manifold module



Tie-in and connection area

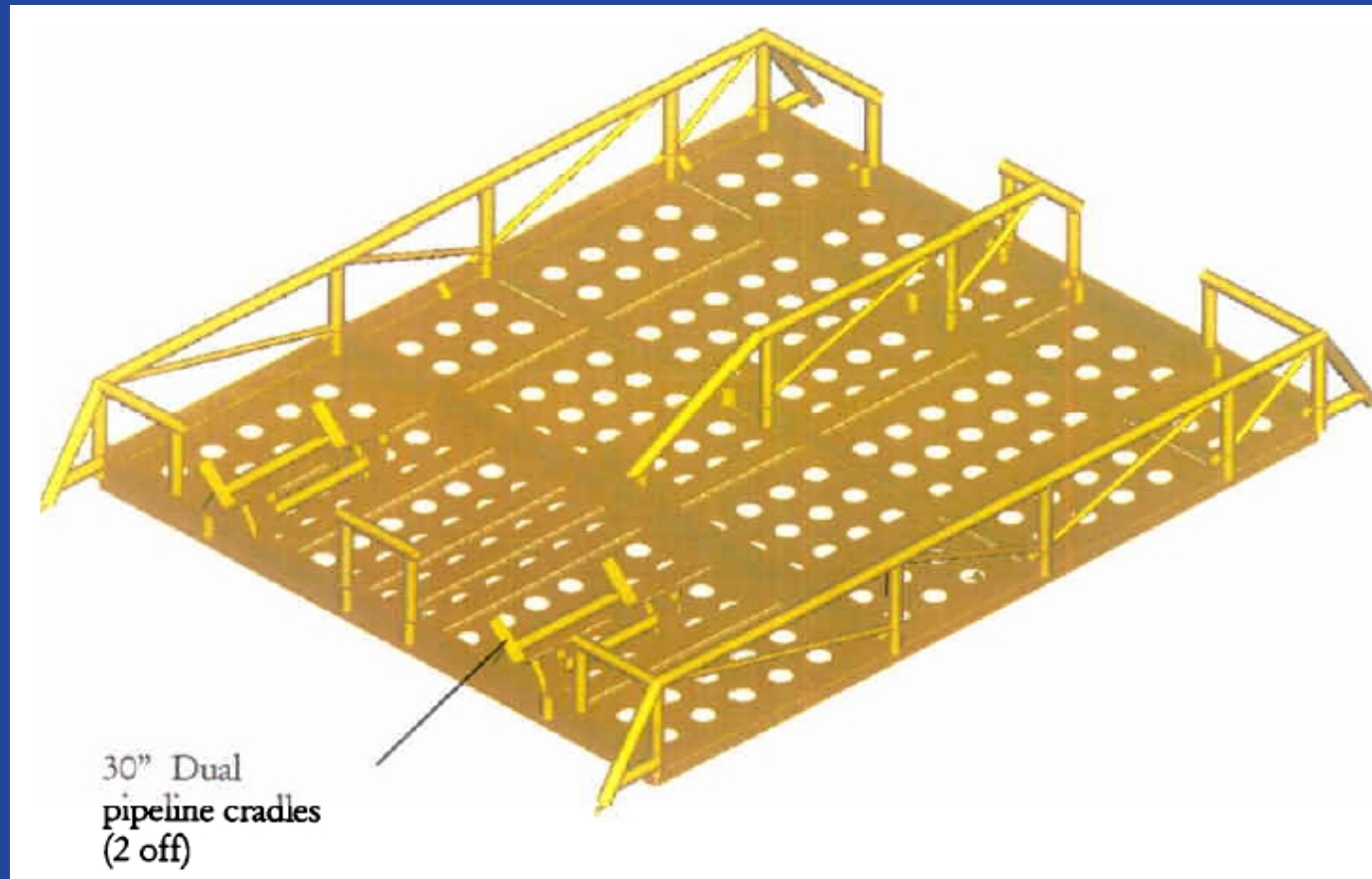


Manifold piping and valves

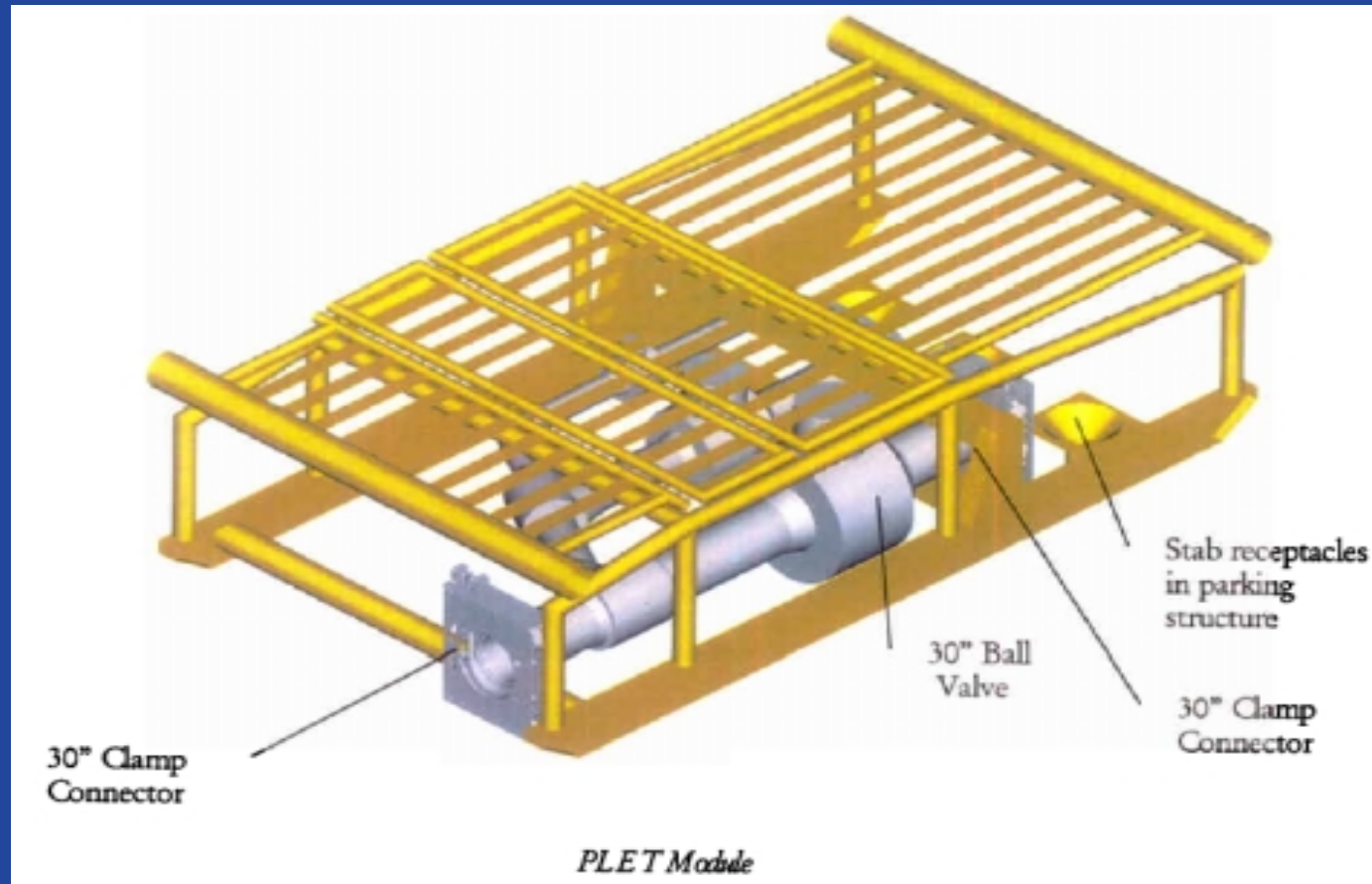


SIMPLTD REP: BOT-LB

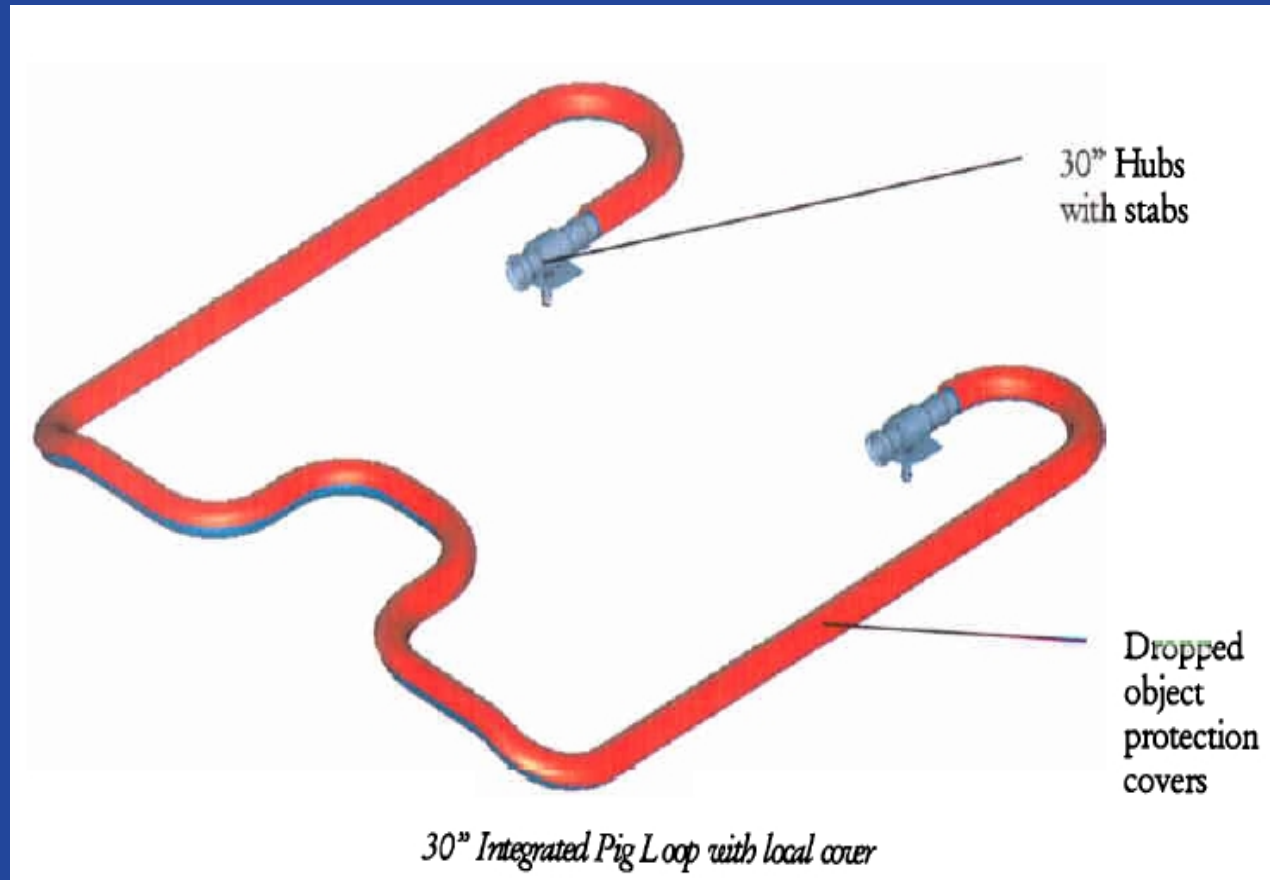
PLET Bottom Structure (PBS)



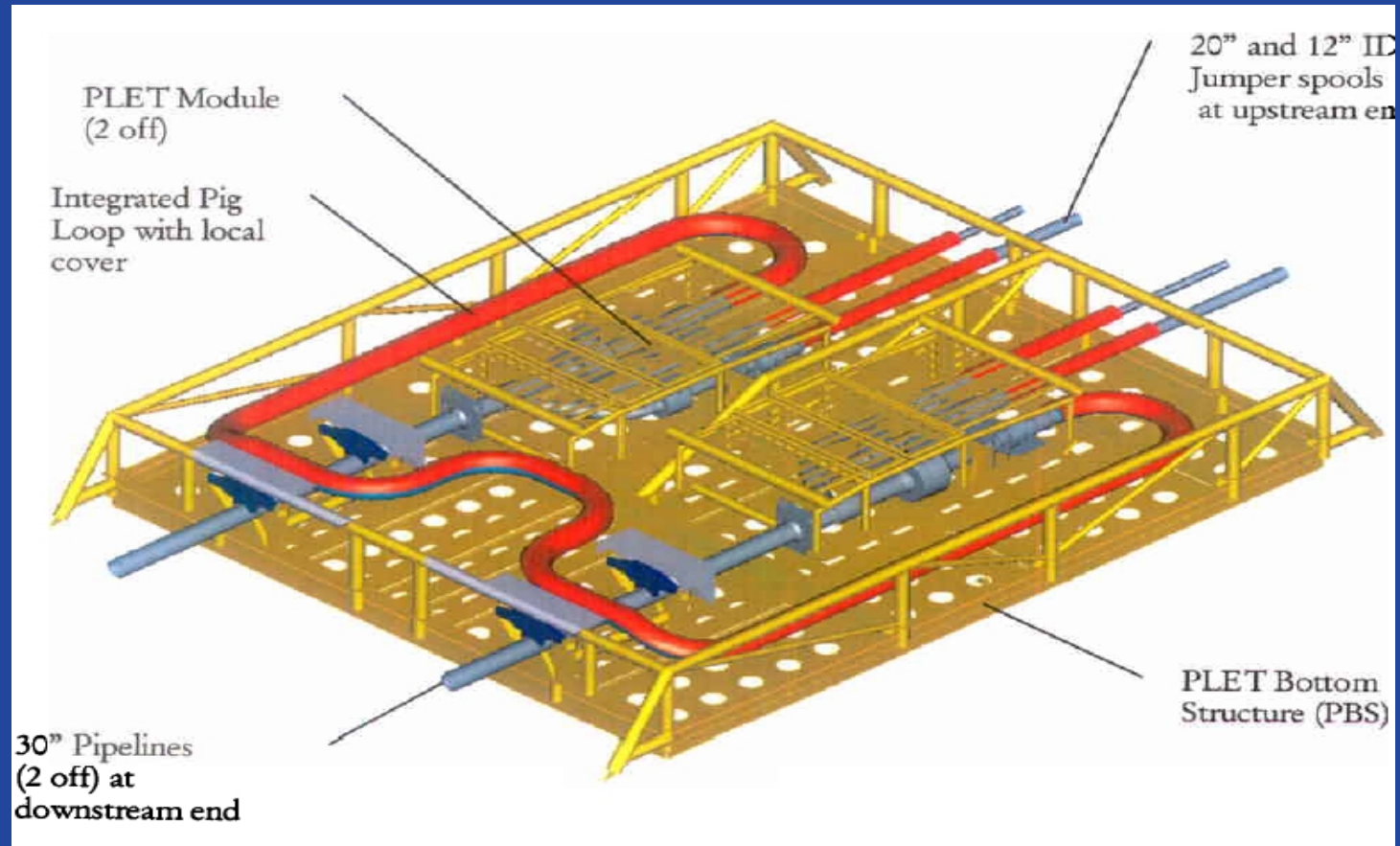
PLET Valve Modules



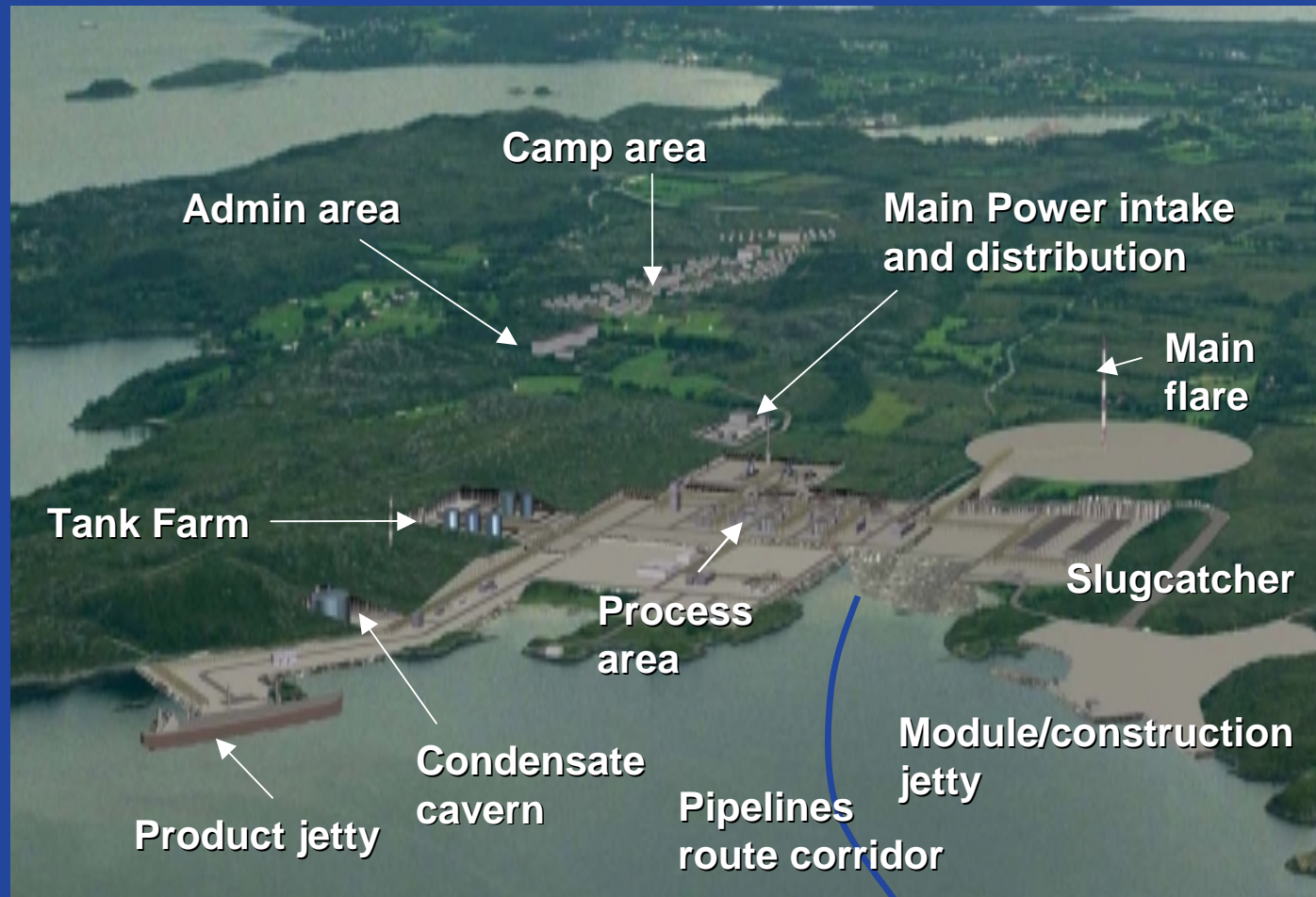
30" Pig Loop



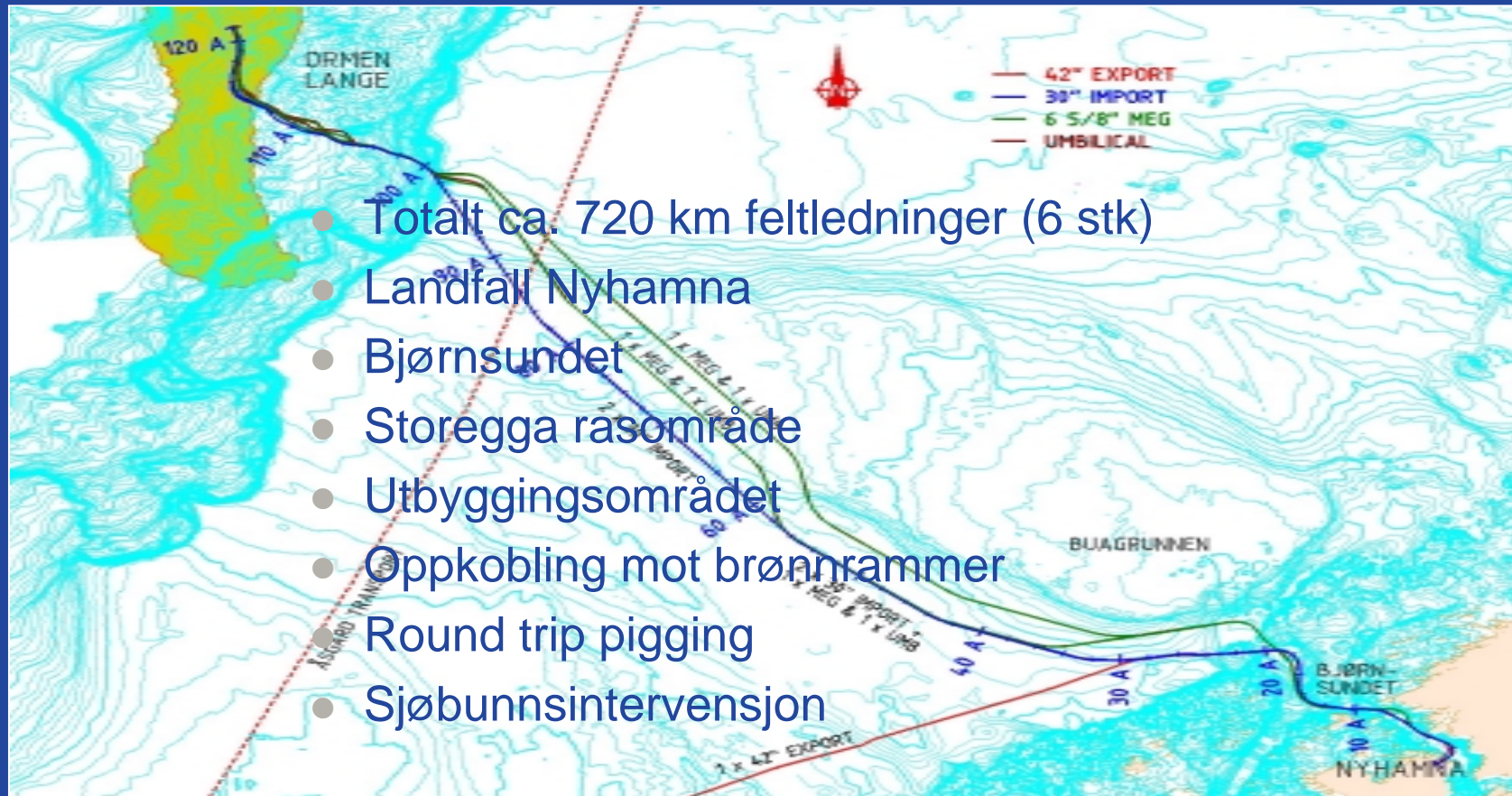
Pipeline end termination (PLET) overview



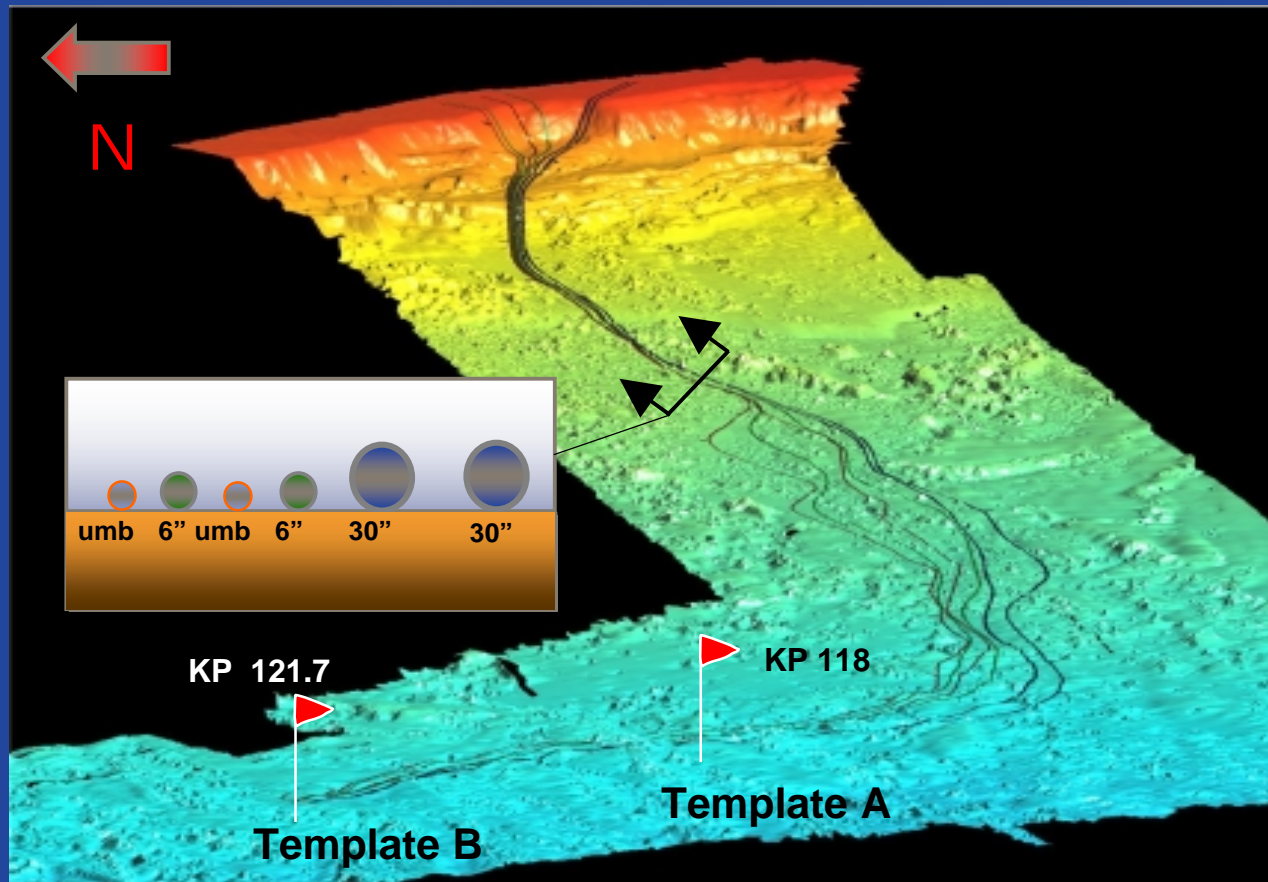
Onshore Process Plant, Nyhamna



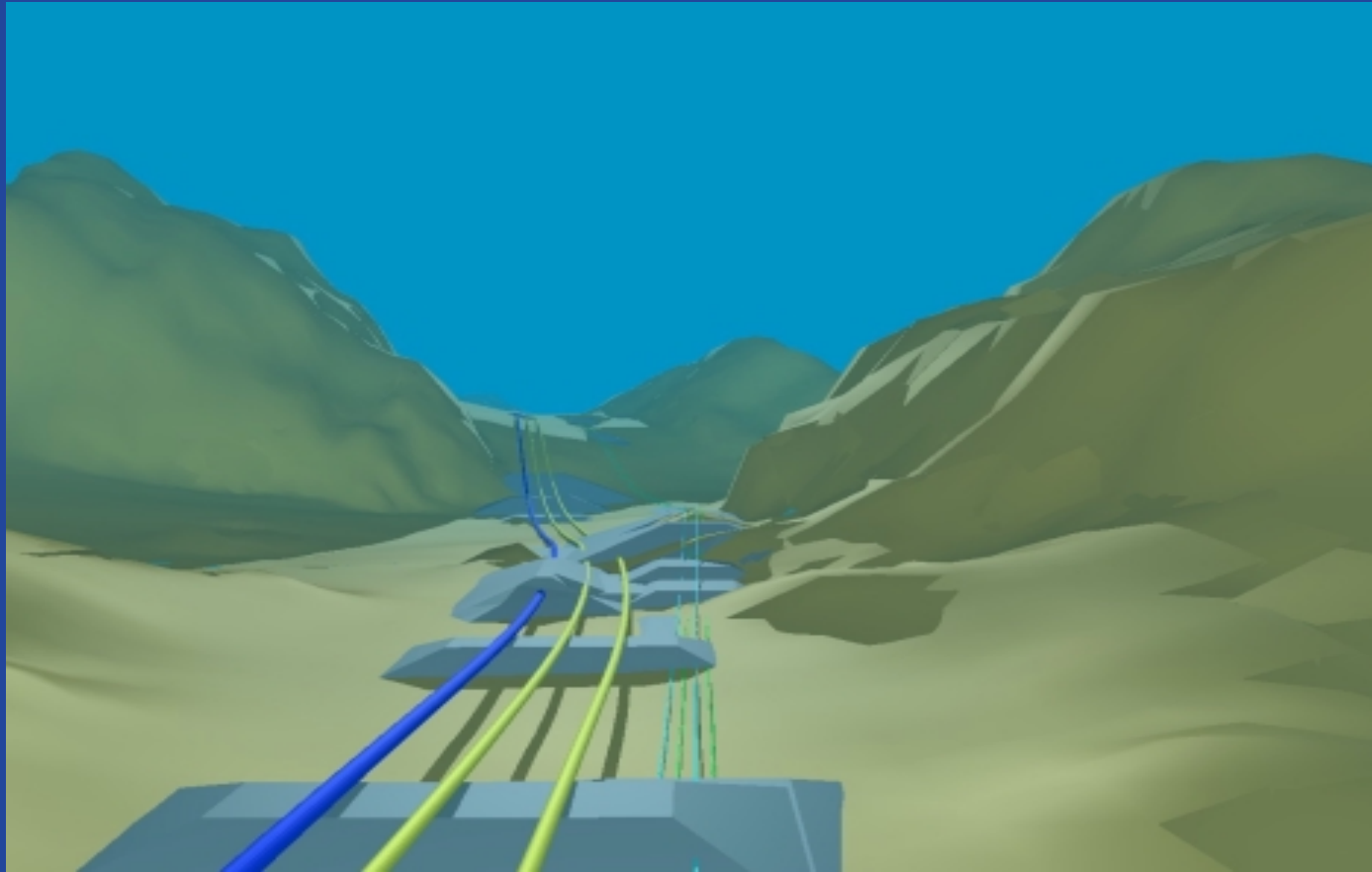
Legging og oppkobling av rørledninger



Initial Development area



Nearshore Area



Ormen Lange subsea in production from 2007

Robust and reliable equipment with minimum subsea intervention requirements!

