

Subsea Umbilical Systems

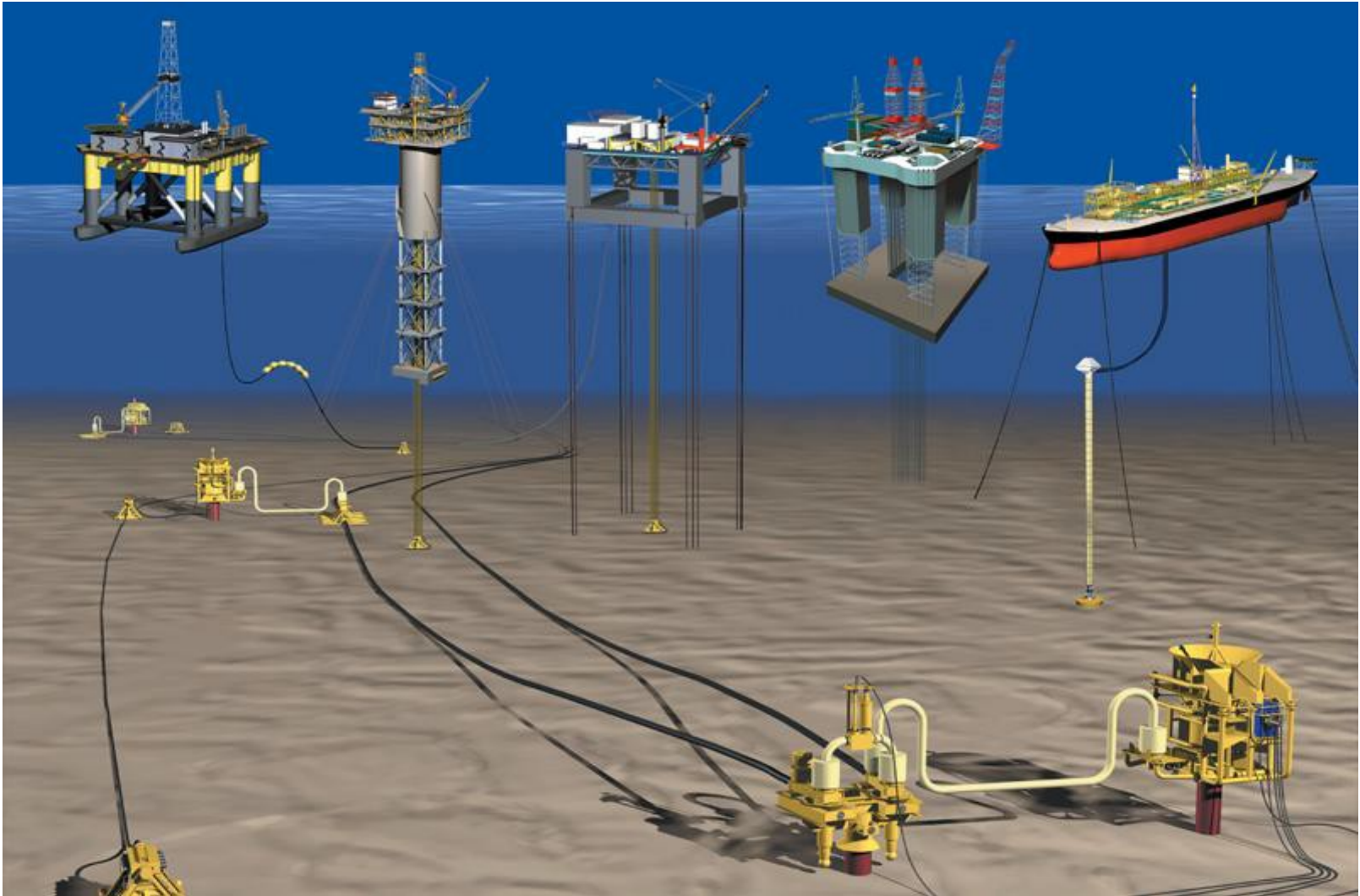
**Revised & Presented by:
Steve Johnson**

**Author:
Phil Collins**

Steve Johnson, my background

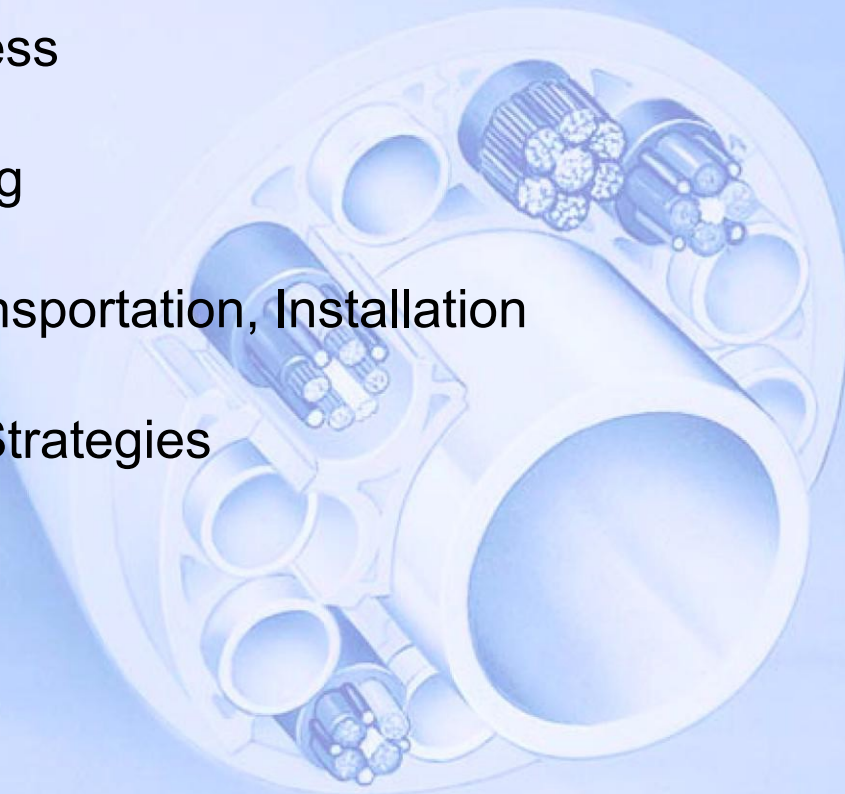
- 40+ years subsea oil & gas experience
 - North Sea, West Africa, Mediterranean, Eastern Canada, South America, S E Asia, GoM, Australia, Barents Sea
 - Design, PM, construction, installation
 - Worked for various engineering/ PM companies as well as equipment supply companies
 - 15 years with Chevron, retiring today
 - SUT member for some 35 years
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- Will also be presenting Operator Perspectives later this afternoon

SUBSEA UMBILICAL SYSTEMS

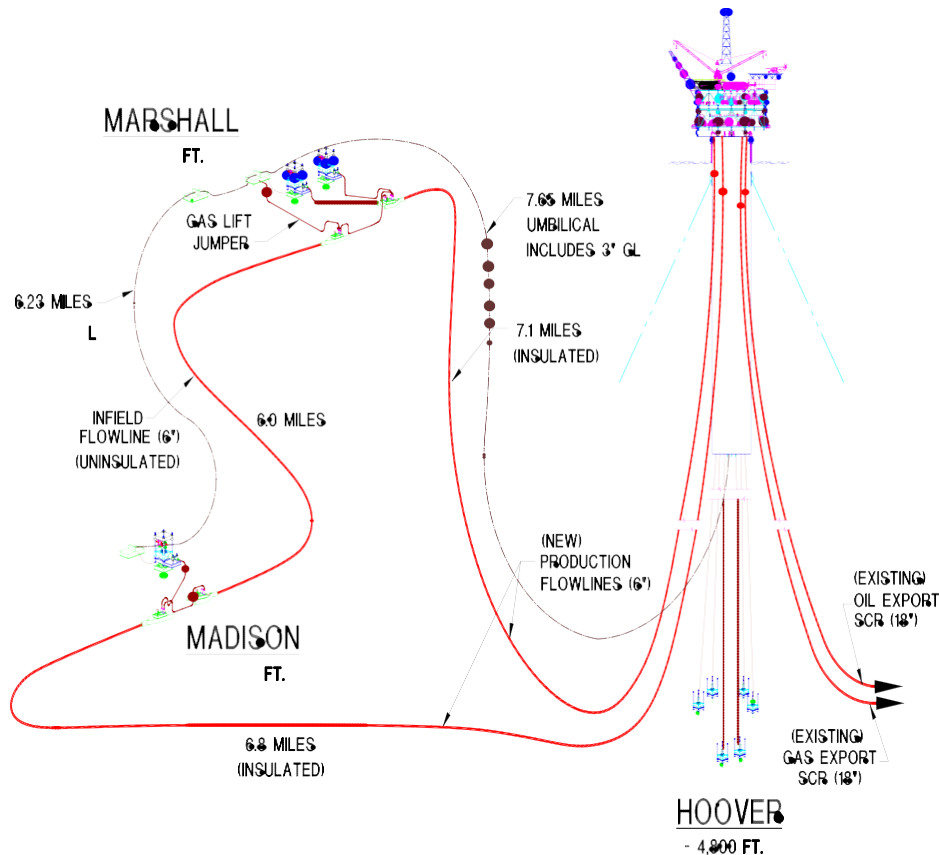


AGENDA

- What Is an Umbilical and What Does It Do
- Subsea Terminations and Flying Leads
- Design Process
- Manufacturing
- Loadout, Transportation, Installation
- Contracting Strategies
- Questions

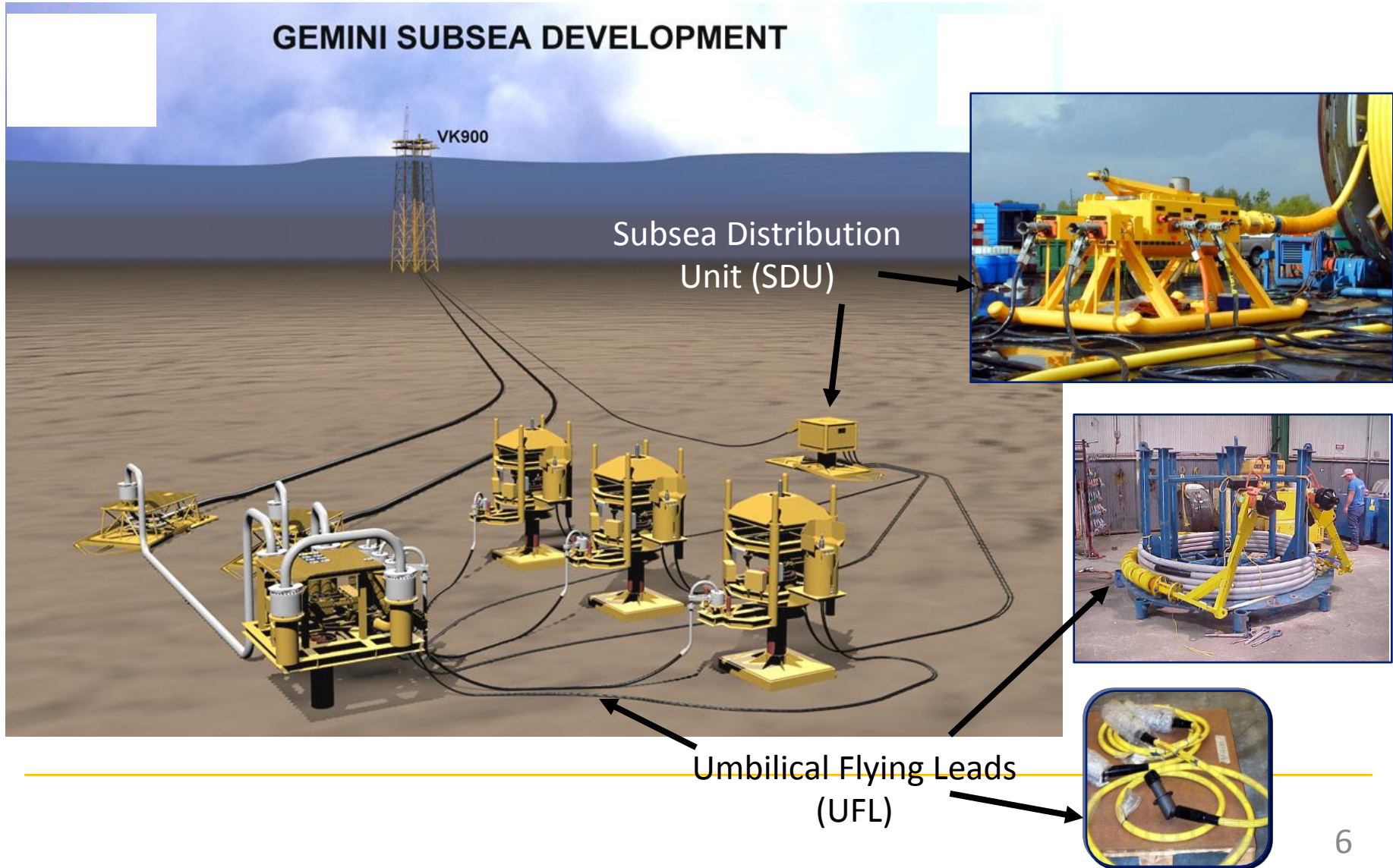


UMBILICALS – BUNDLE OF TUBES AND CABLES

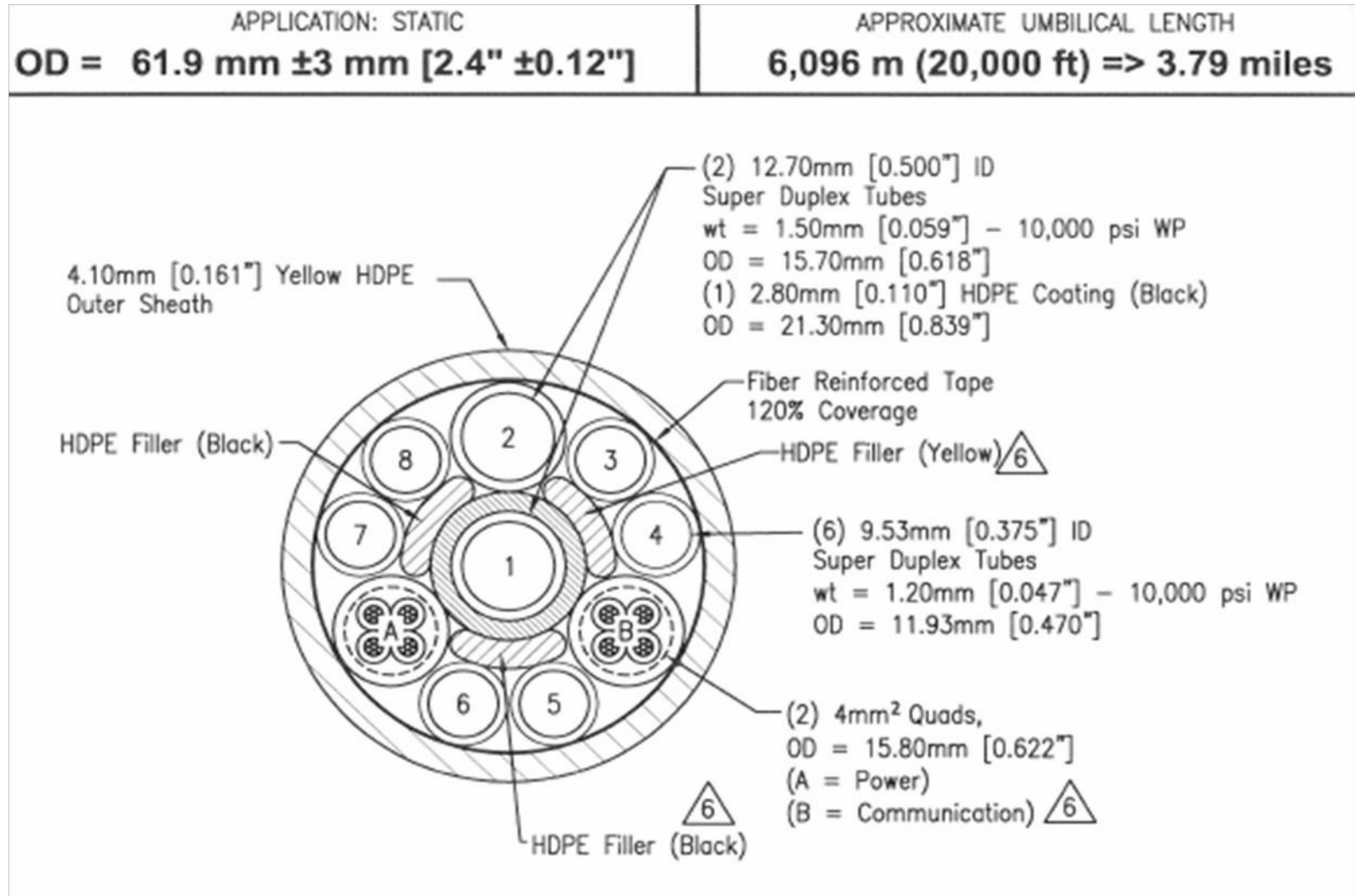


- Provide hydraulic power to subsea control systems
- Provide electrical power and signals to subsea control systems
- Deliver chemicals for subsea injection at manifold, tree or downhole
- Provide bulk Methanol, (ISU)
- Deliver gas for gas lift (ISU)

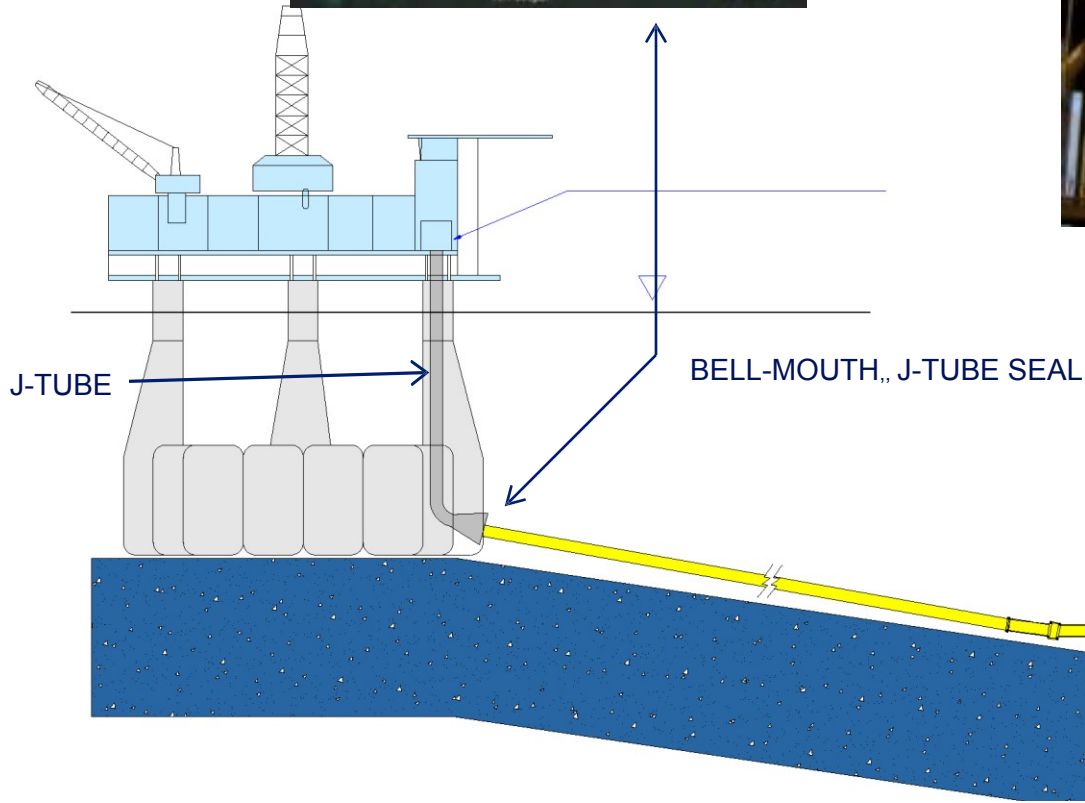
GEMINI SUBSEA DEVELOPMENT



STATIC E/H UMBILICAL FOR SMALL FIELD

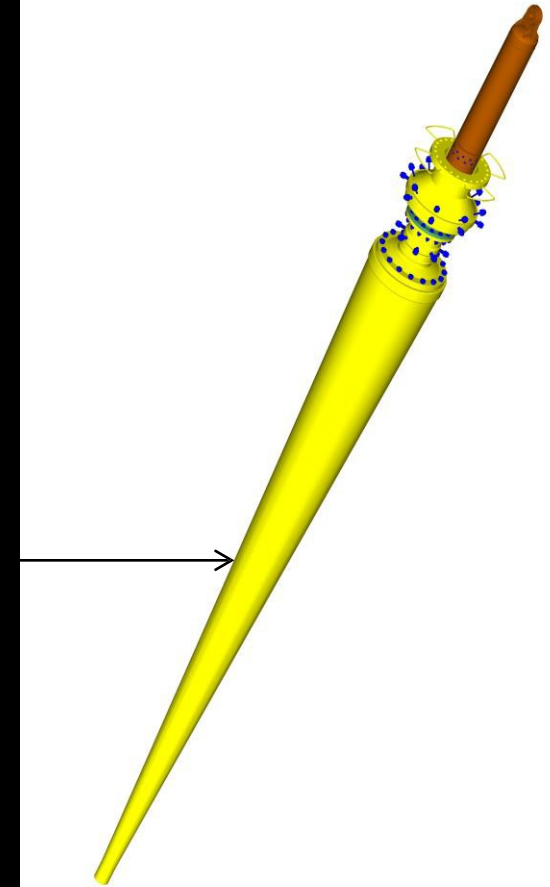
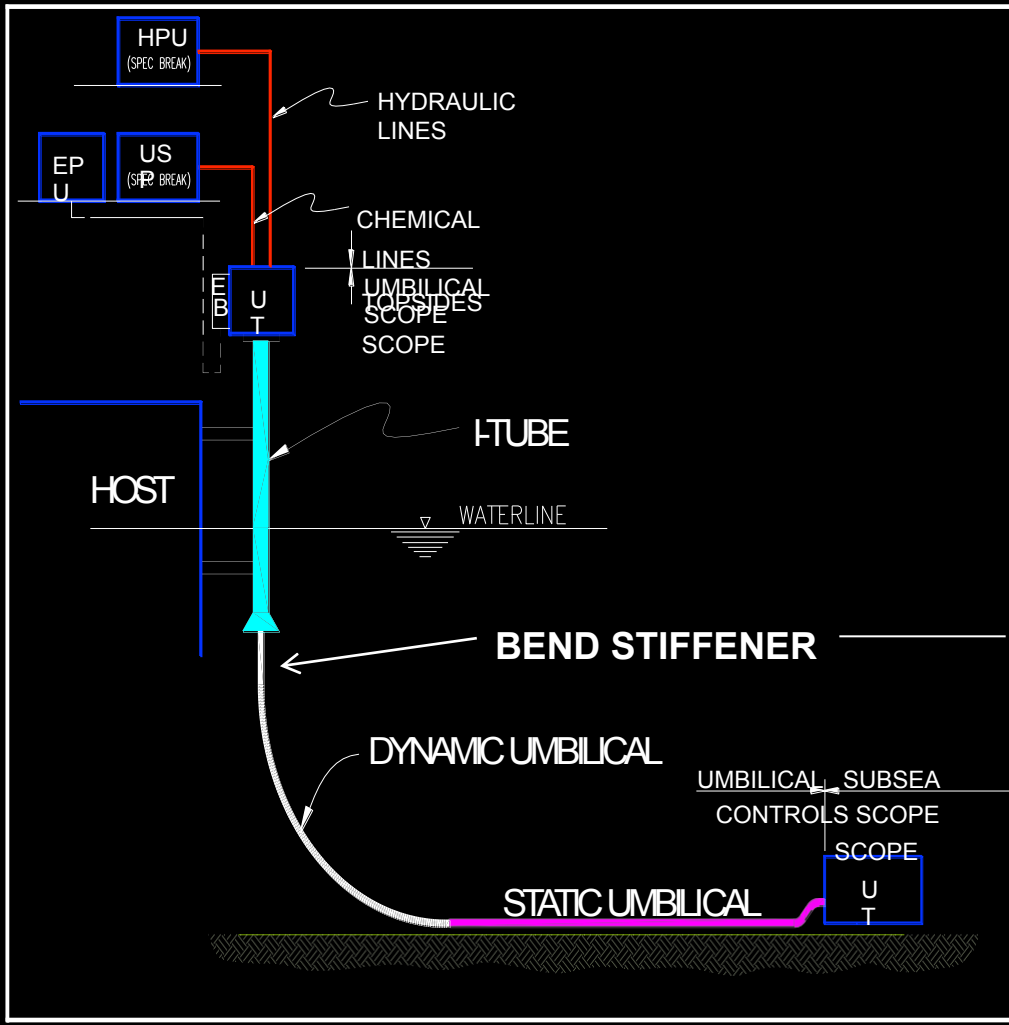


STATIC UMBILICAL, FIXED PLATFORM INTERFACES



J-TUBE SEAL DURING INSTALLATION

DYNAMIC UMBILICAL INTERFACE DIAGRAM & BEND STIFFENER



UMBILICAL TUBE MATERIALS

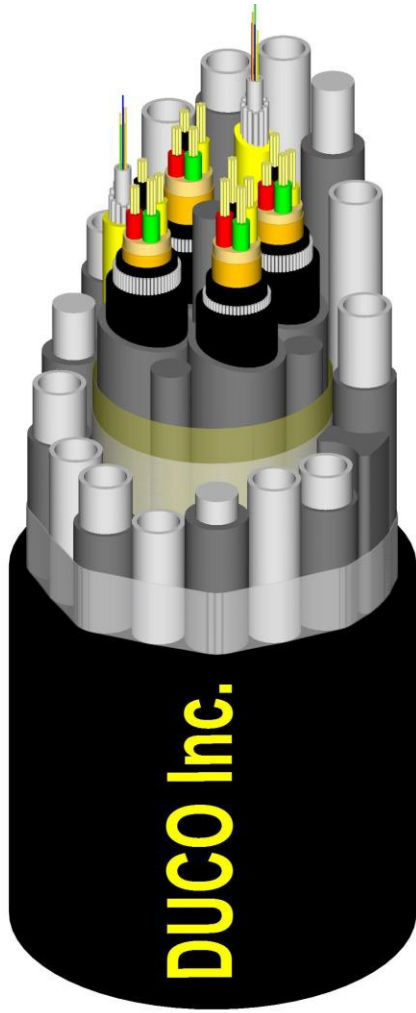
- Thermoplastic Tubes
 - Low tensile strength & better flexibility
 - Shallow water
 - Lower cost
- Steel Tube
 - Higher tensile strength & reduced flexibility
 - Deeper water
 - Higher pressure
 - Materials
 - Super Duplex Stainless Steel
 - Zinc coated Nitronic 19D lean duplex stainless steel
 - 3-layer fusion-bonded-epoxy-coated coiled tubing
 - Stainless Steel 316L

THERMOPLASTIC UMBILICAL

- Kevlar-armored thermoplastic hoses
- High collapse resistance (HCR) hoses
- Can include cables
- Oscillating construction –no helix assembly machine required
- HDPE outer sheath
- Armored for on-bottom stability, tensile and crushing strength



TYPICAL DEEPWATER STEEL TUBE ELECTRO-HYDRAULIC UMBILICAL

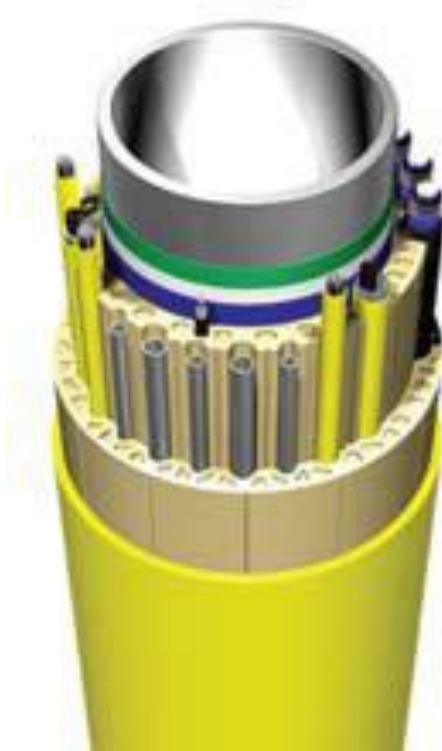


- Chemical Injection tubes
- Hydraulic supply tubes
- Electrical signal cables
- Electrical Power cables
- Fiber optic signal



INTEGRATED SERVICE UMBILICALS (ISU)

- Includes large, central tube as a service line



HIGH VOLTAGE HYBRID UMBILICALS

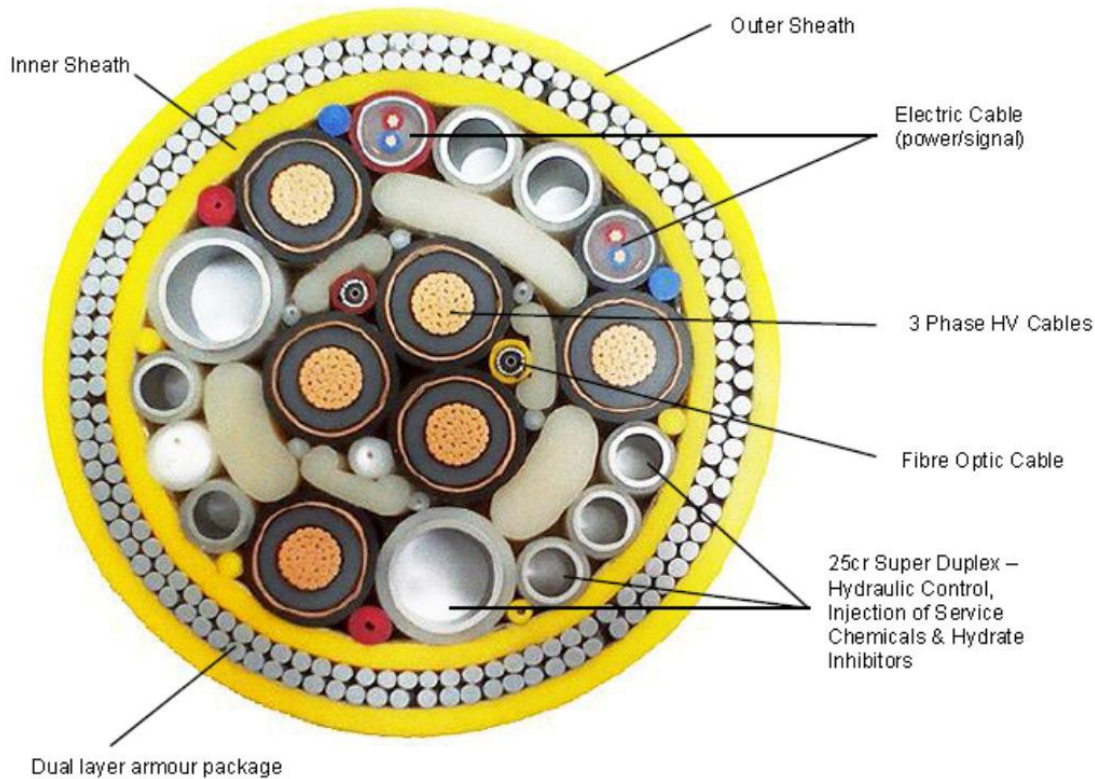
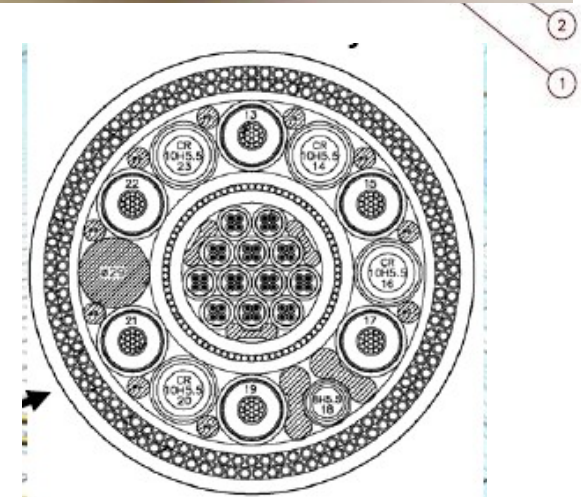
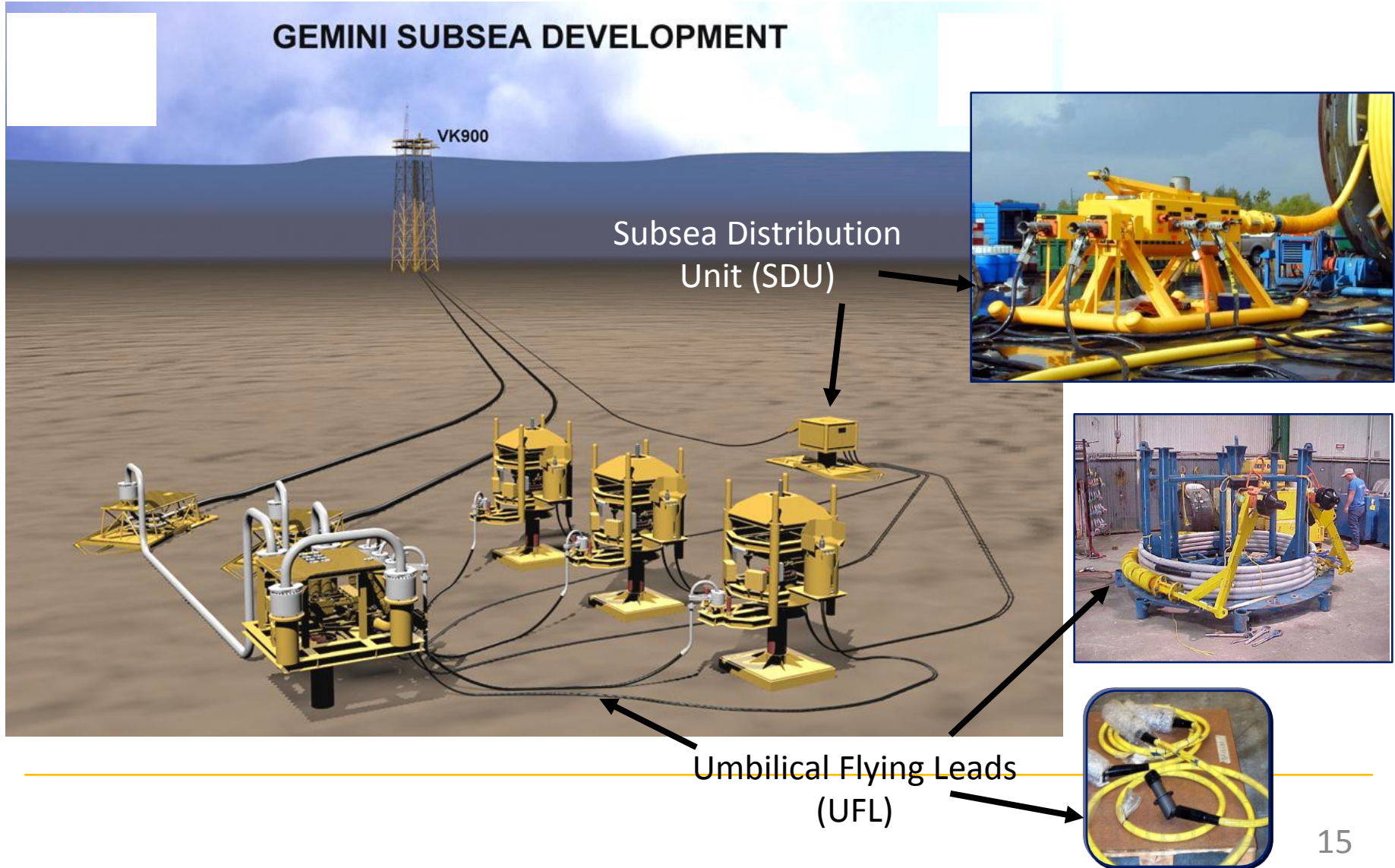


Figure 3 – Umbilical Cross Section Example



GEMINI SUBSEA DEVELOPMENT



SUBSEA DISTRIBUTION UNIT (SDU)

- Electrical/fiber optic wet-mateable connectors
- Hydraulic/chemical junction plates
- Bend restrictor
- Mud mat



FLYING LEADS



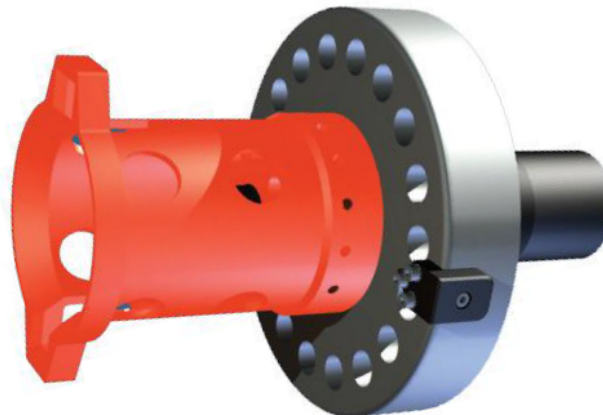
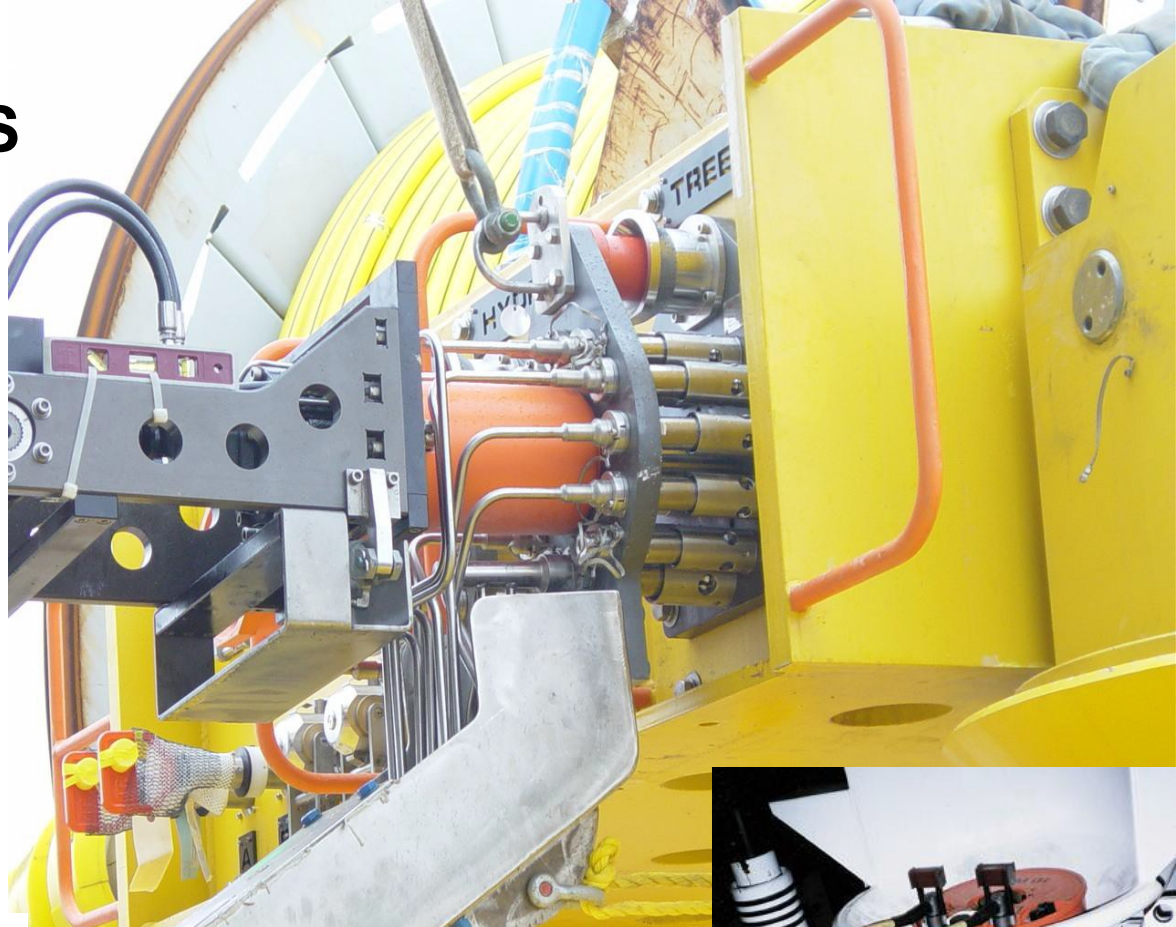
- Thermoplastic or steel tubed, with electrical cables
- Connects Umbilical Termination Assembly to subsea tree/control pod
- Installed after umbilical
- Connected by ROV



Cobra Head

FLYING LEADS

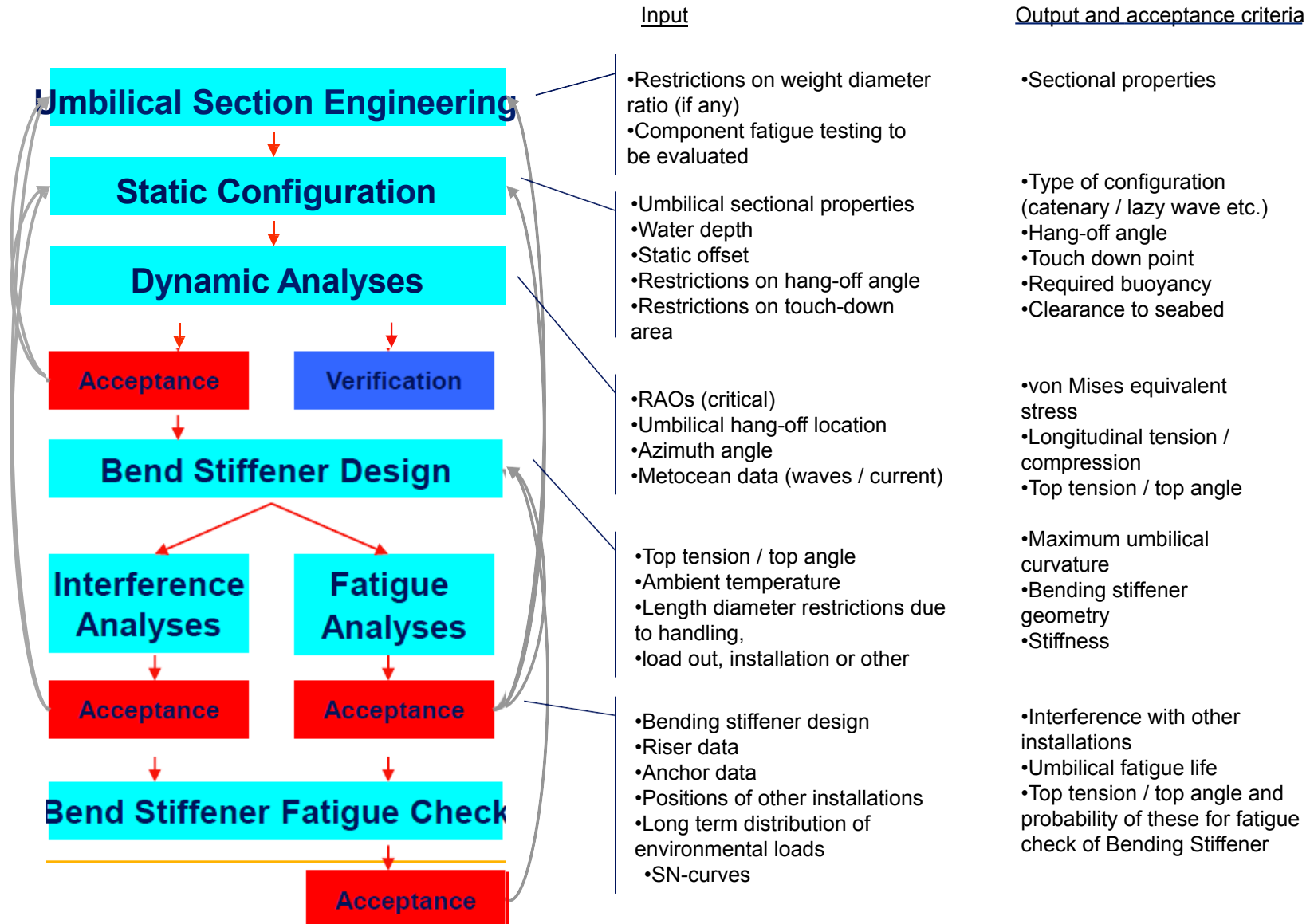
- Flying Lead Orientation Tool (FLOT)
- API 17D ROV bucket – standard ROV interface
- Junction plate
- Hydraulic couplers
- Cobra head adaptor
- Electrical, Fiber Optic wet-mateable connectors



DYNAMIC UMBILICAL - CONCERNS

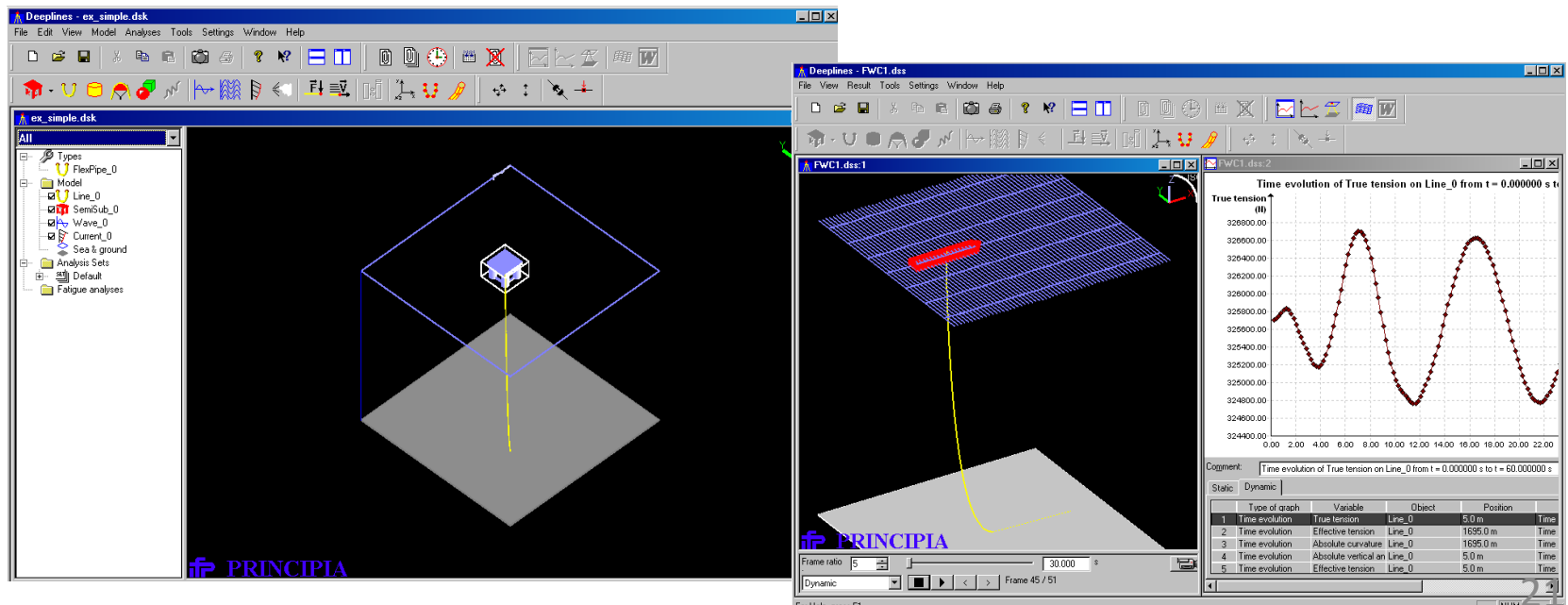
- Cross Section
- Fatigue
 - Vessel motions
 - Currents
 - Vortex Induced Vibration
- Clashing with other risers
- Hangoff weight
- Tensile strength

DYNAMIC UMBILICAL DESIGN PROCESS

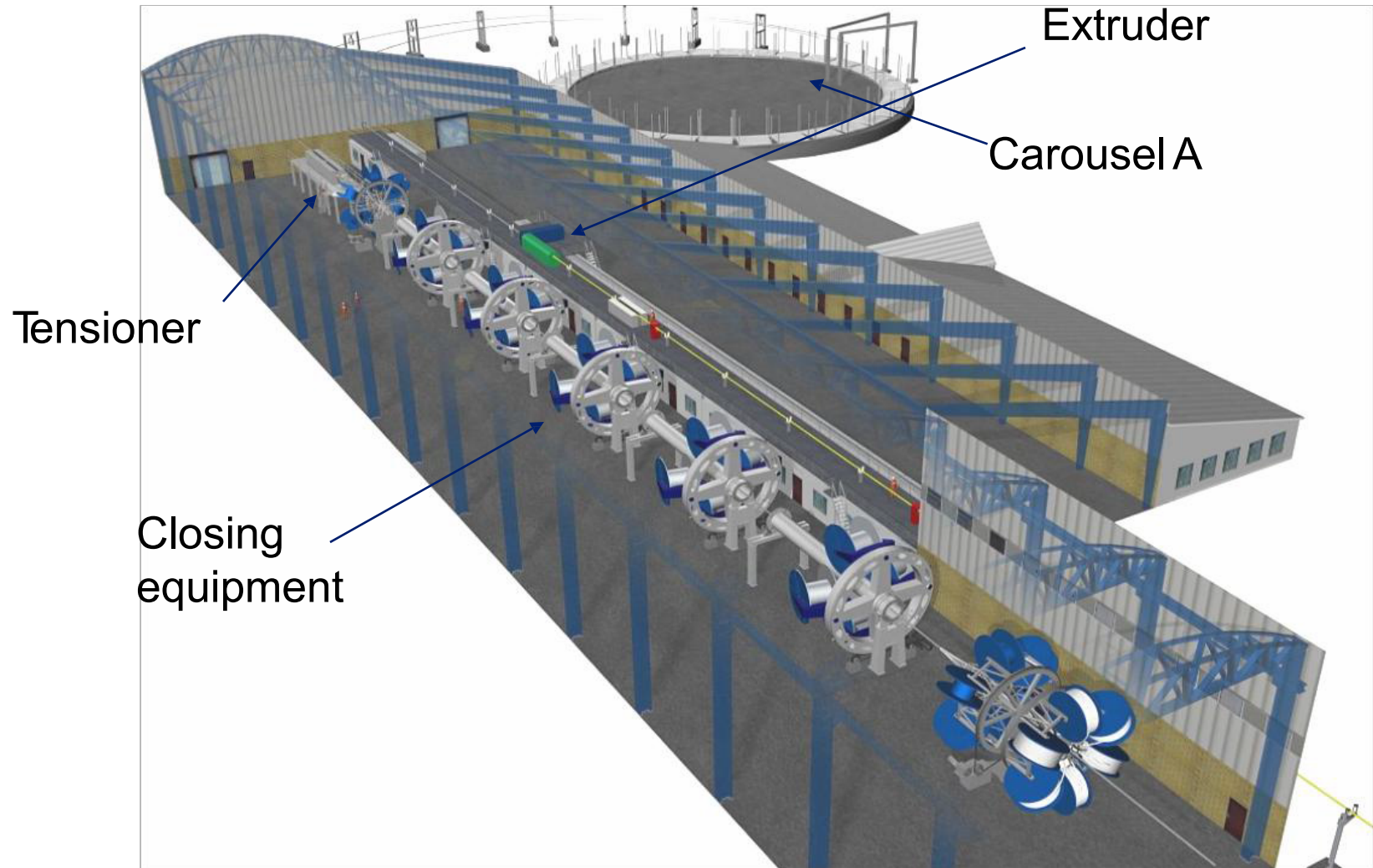


DYNAMIC UMBILICAL DESIGN PROCESS

- Dynamic analysis software (e.g. Orcaflex) analyse the dynamic stability of the umbilical configuration with respect to:
 - Vessels Response Amplitude Operators
 - Environmental Loading Data
 - Umbilical Design Data



MANUFACTURING

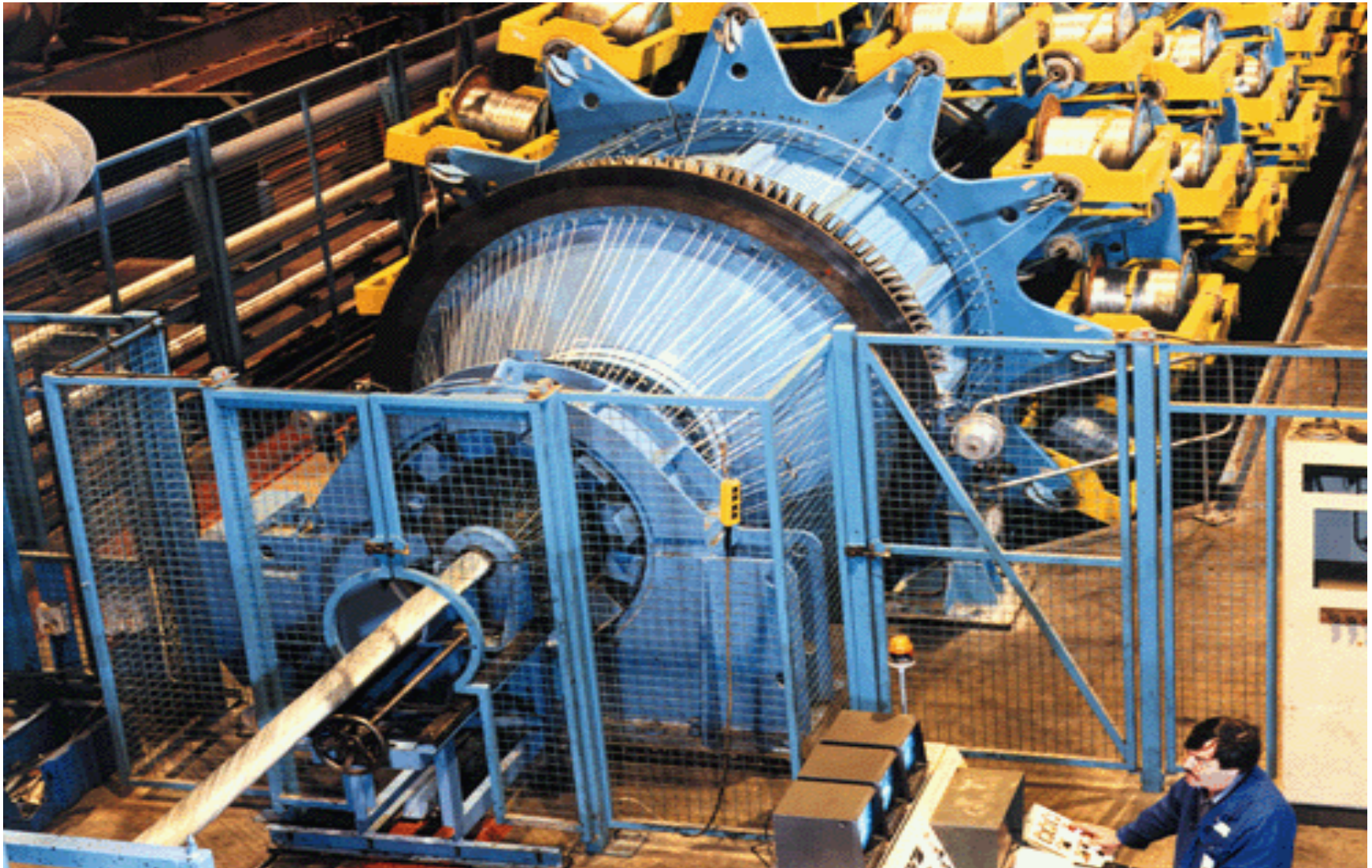


STEEL TUBE UMBILICALS

- Helically wound
- Requires counter-rotating bobbins to remove torsion from tubes



ARMORING MACHINE



FINISHED MANUFACTURED UMBILICAL

- Storage on reels or carousels
- Factory Integration Test (FAT)
- Termination work (applications)
- Site Integration Test (SIT)
- Preparation for loadout



QUAYSIDE STORAGE AND LOADOUT



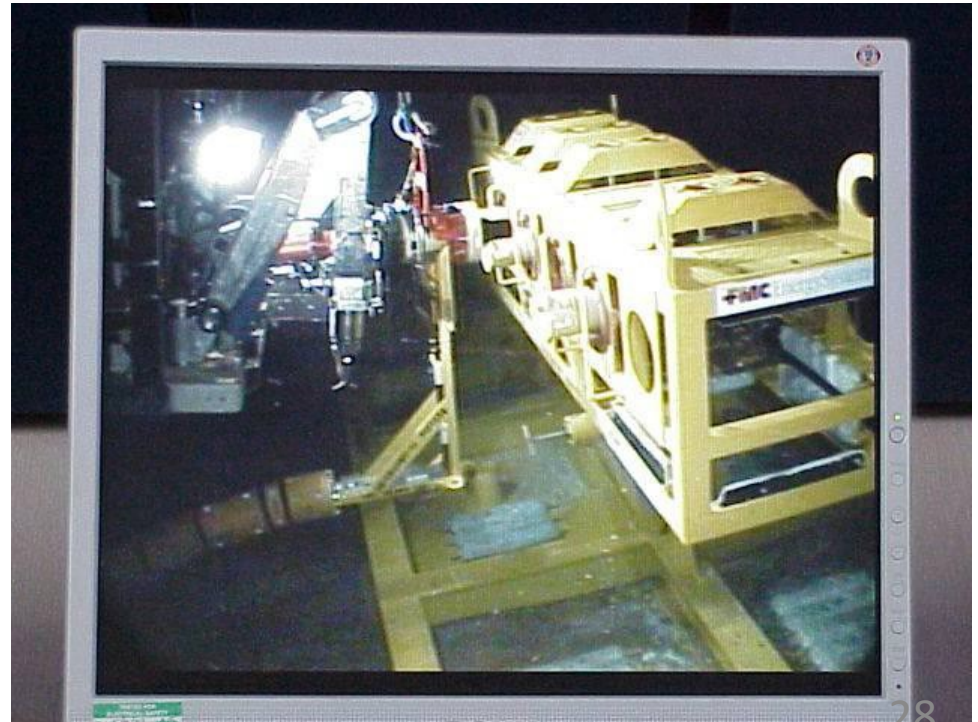
- Transpooling to carousel
- Lifting of reels
- Preparation for sail-away



INSTALLATION – CAROUSELS AND REELS



INSTALLATION



CONTRACTING STRATEGIES

- Umbilical Purchased by Operator
 - Common where there is much infrastructure – GoM, North Sea, Brazil
 - Direct control & inspection by Operator
- Supply and Install by Installation Contractor
 - Reduced installation risk - umbilical is purchased delivered, installed, and tested
 - Common in remote areas with little infrastructure
 - Popular in locations such as Nigeria and Angola
- Supply with Subsea Equipment & Installation Package
 - Full subsea EPCI Contract
 - Reduced interface risk - entire equipment package delivered as a unit
 - Gaining popularity for projects worldwide

Questions

