ATMA 2005






PRESENTATION OF TWO PLATFORMS: The TPG500 For shallow waters, The SPAR for Deepwater.

Pierre-Armand Thomas
Technip

May 25th, 2005

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RANGE OF PLATFORMS FOR SHALLOW WATERS

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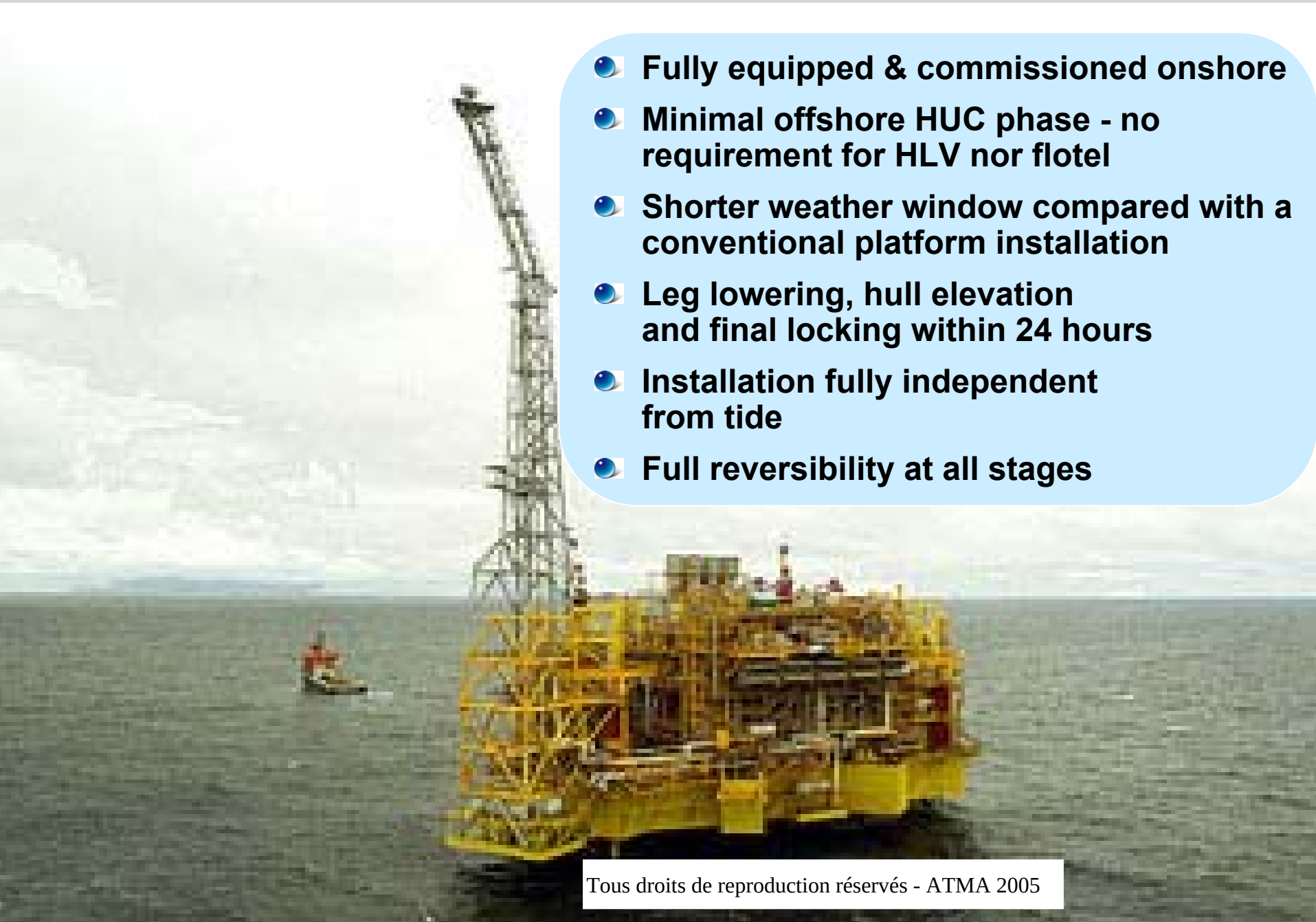
TPG500 - KEY FEATURES

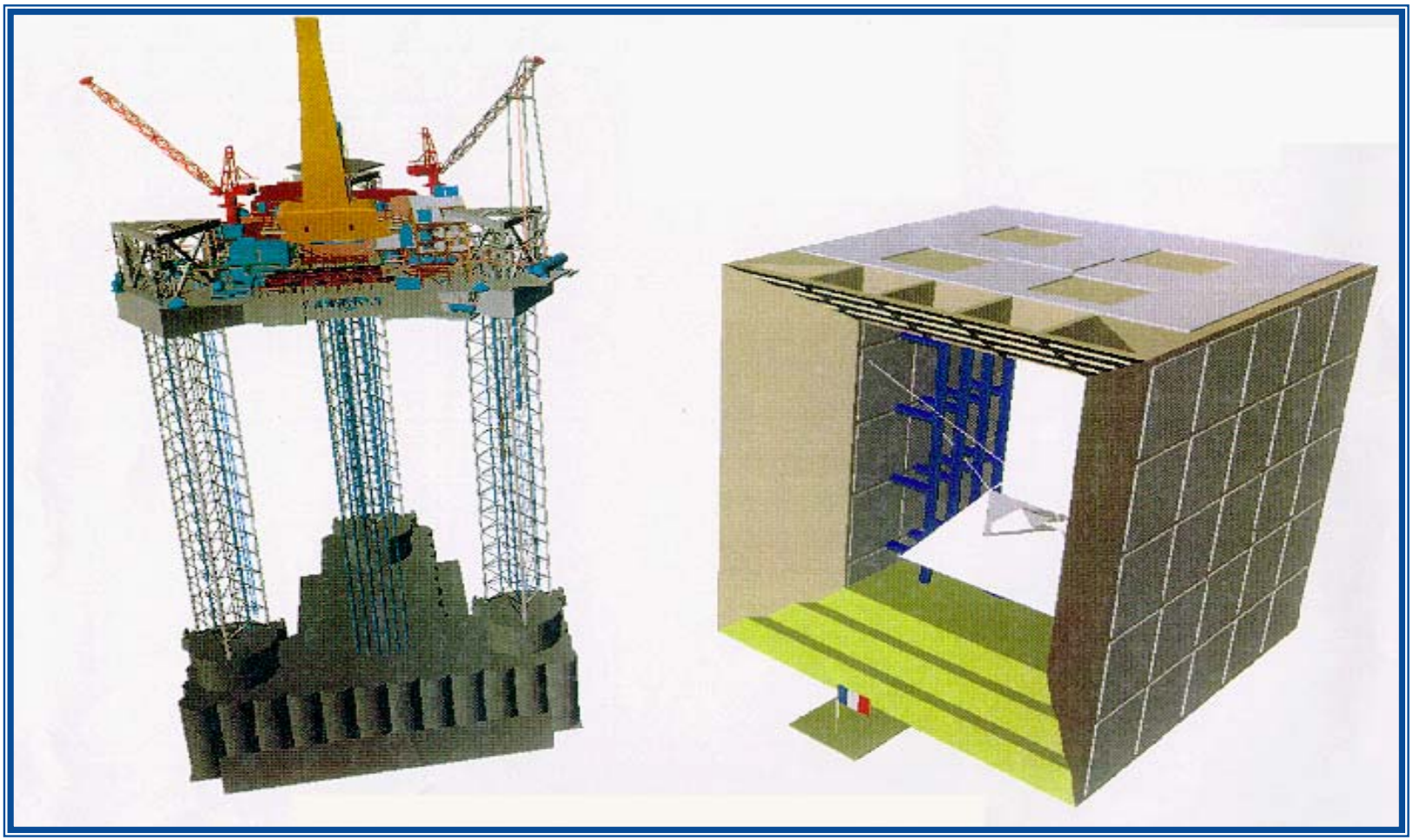
- Proprietary self-installing platform
- Field proven solution
- Fulfils fixed platform regulations
- Fixed but removable and reusable platform
- Low abandonment cost
- Designed with standard components
- Up to 500 feet (150m) water depth

TPG500 - LOW OFFSHORE COSTS



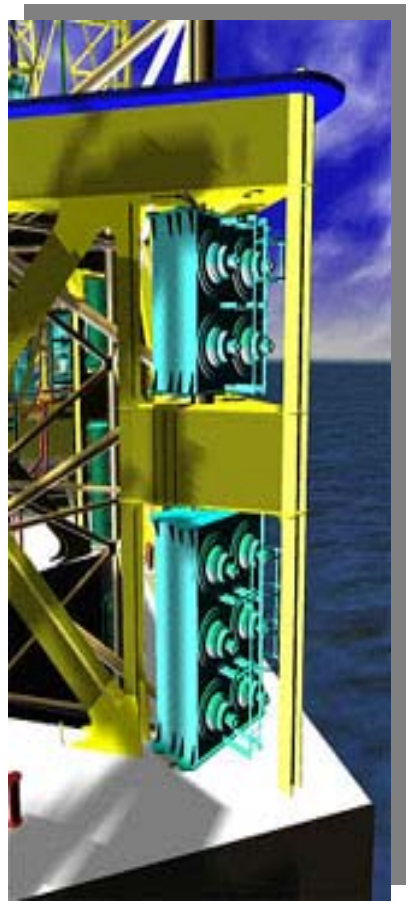
- Fully equipped & commissioned onshore
- Minimal offshore HUC phase - no requirement for HLV nor flotel
- Shorter weather window compared with a conventional platform installation
- Leg lowering, hull elevation and final locking within 24 hours
- Installation fully independent from tide
- Full reversibility at all stages

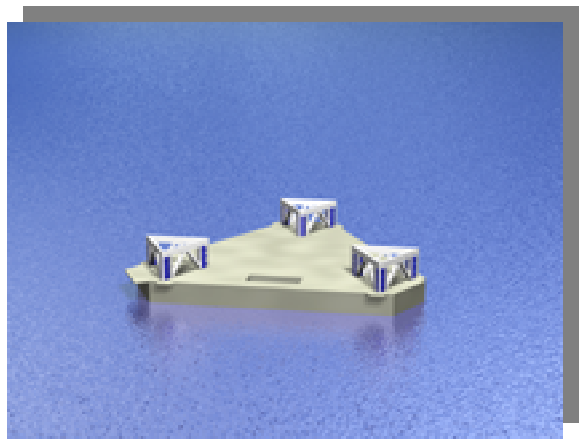
BP HARDING & La Grande Arche (Paris)



MAIN COST & SCHEDULE DRIVERS

- **Lower cost of engineering**
  - **Standard details & components**
- **Repetitive procurement process**
  - **Frame agreements**
  - **Proprietary items**
- **Simple hull construction**
  - **Mass production of leg nodes**
  - **« Manufacturing process » for leg assembly**
  - **Hull flat plate construction**
  - **Minimum equipment in hull**
  - **Large choice of fab yards**

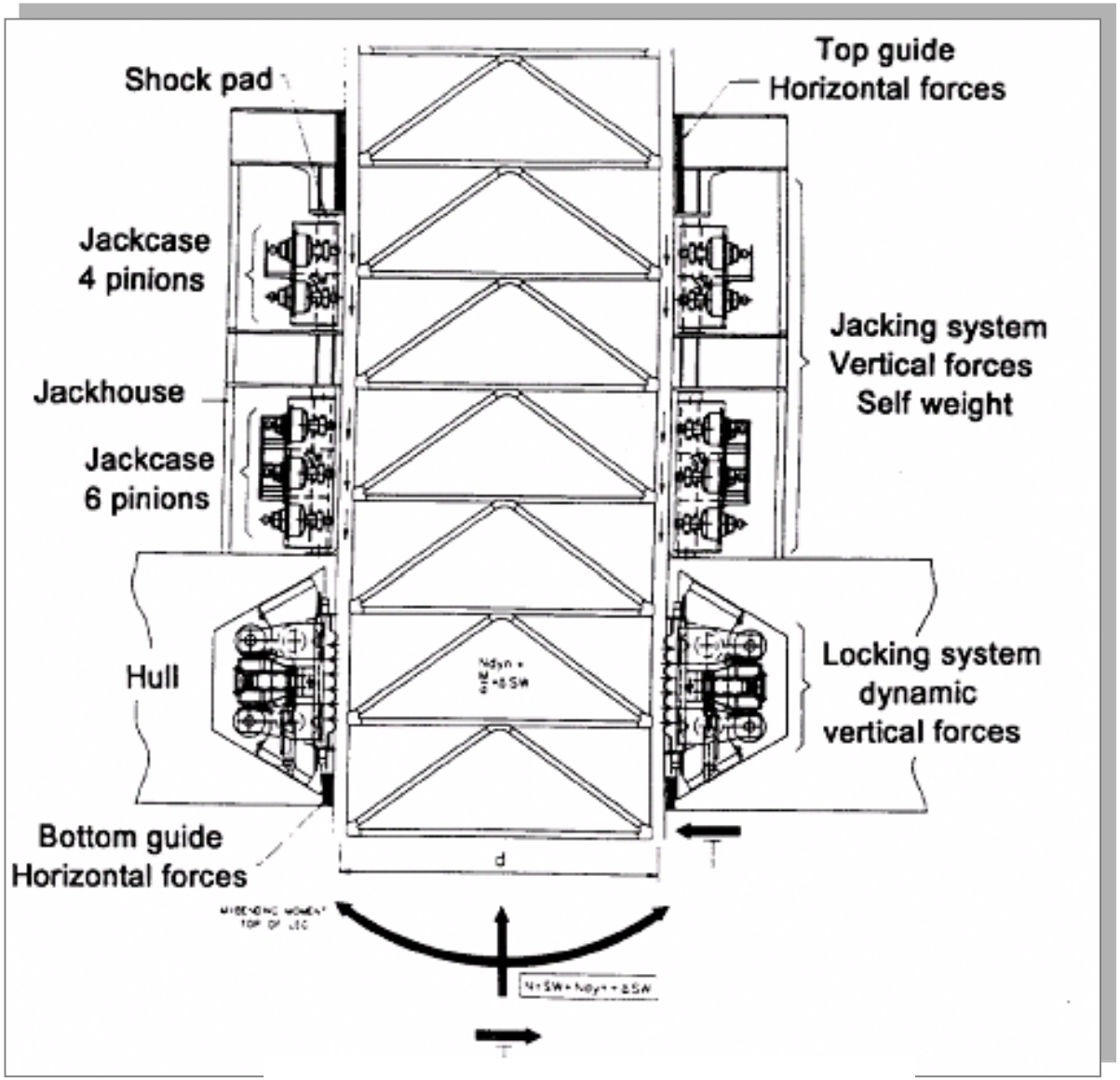




TPG 500 PLATFORM – CONSTRUCTION ADVANTAGES

- Construction on a quay or in a dry dock
- Large choice of yards world-wide
- Conventional offshore fabrication activities
- Low cost flat plate construction of the hull
- Leg components free issued to yard
- Large flat deck - min. equipment stacking

LEG TO HULL INTERFACE



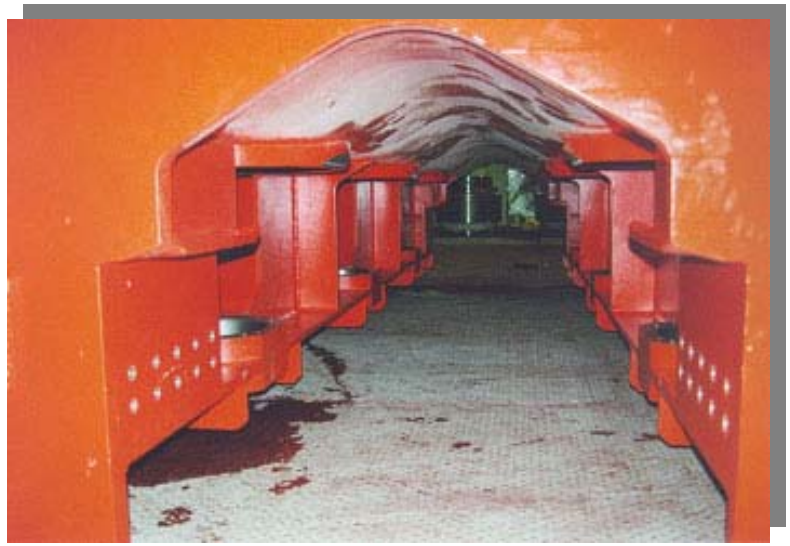
JACKING SYSTEM

- Flexible design to match the elevated weight - selectable number of pinions
- Typical # of pinions
  - Harding: 90
  - Elgin: 108
  - Shah Deniz: 72
- Hydraulic driven variable speed system
- Typical jacking speed is 0,45 m /minute

Jack Cases

7 Teeth Pinions

JACKING SYSTEM



Jack Cases

Jack cases with gearboxes and hydraulic motors installed

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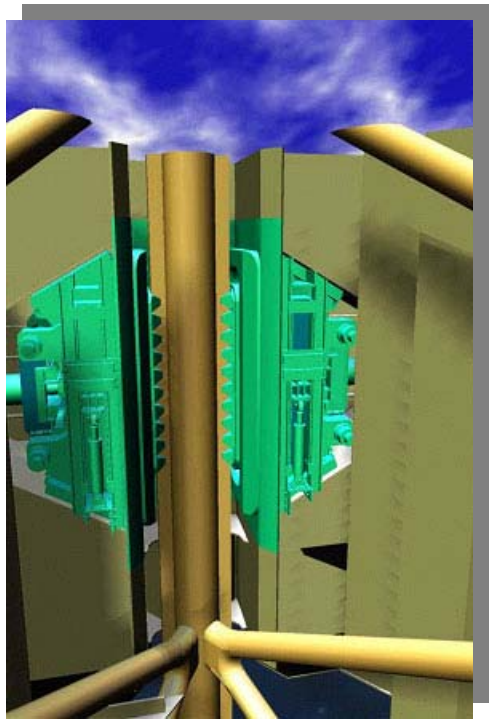
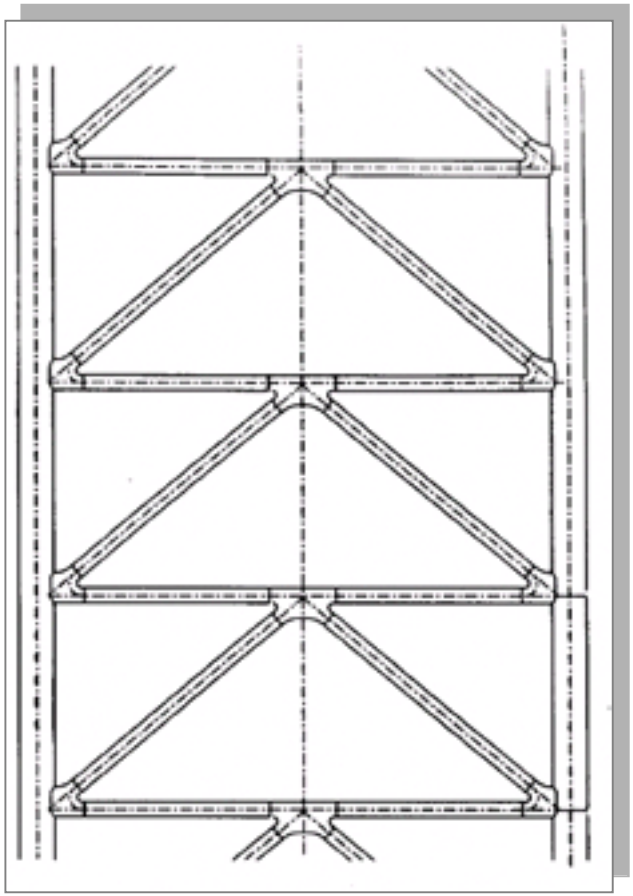
LOCKING SYSTEM

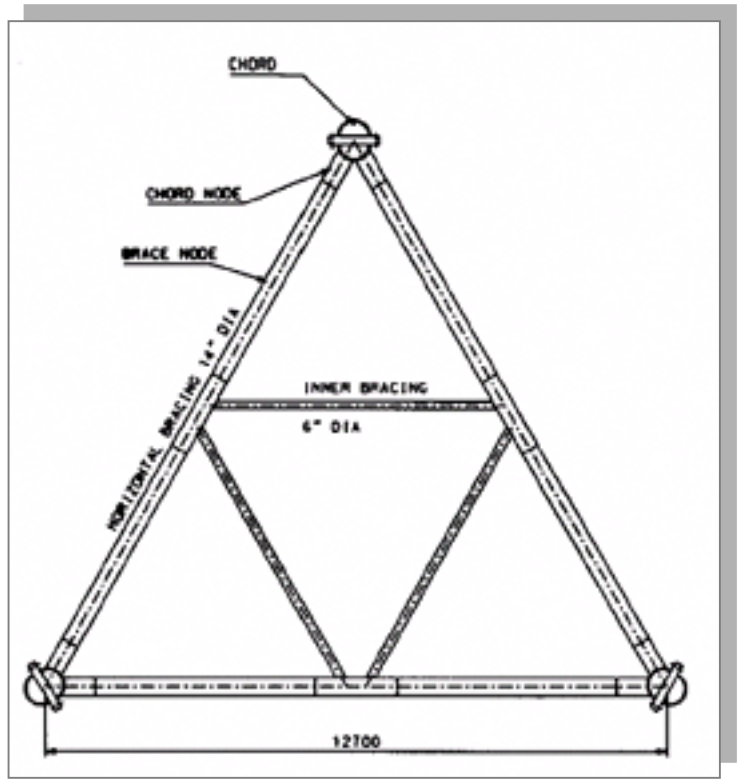
- Fully automatic procedure for locking and unlocking
- Optimised distribution of loads on the rack teeth
- 8300 tonne capacity per chord



Rack chock with lever arms

TYPICAL LEG

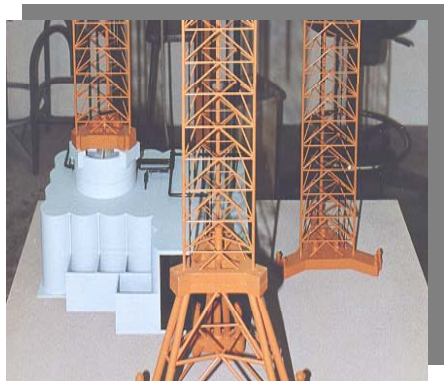




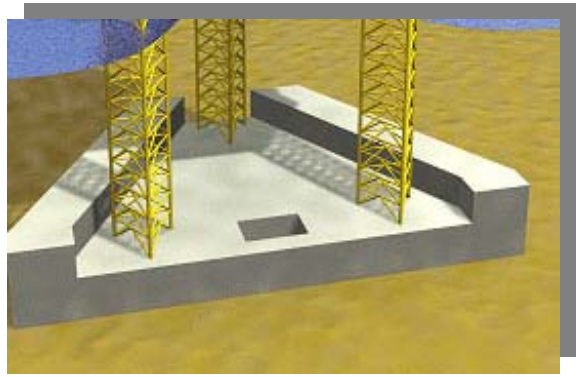
LEGS & NODES

- Forged nodes technology using hot forming and heat treatment during the forging process
- Ensures 30 year fatigue life
- Reduced horizontal load on chords
- Repetitive Process
- Proprietary Rights

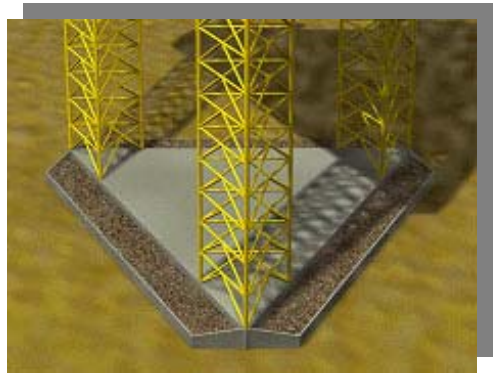
FOUNDATION OPTIONS



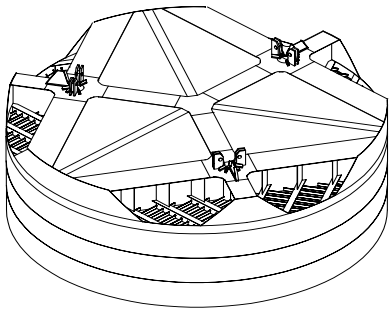
Piled (Elgin)
or elevated



Integrated Oil Storage

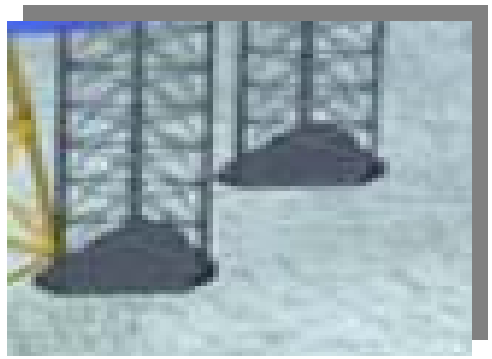


For poor soil
conditions



Large Suction Skirt Foundation
(Shah Deniz)

Oil Storage (Harding)



Traditional spud tanks

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EXECUTION

Fabrication in dry dock

Fabrication on quay

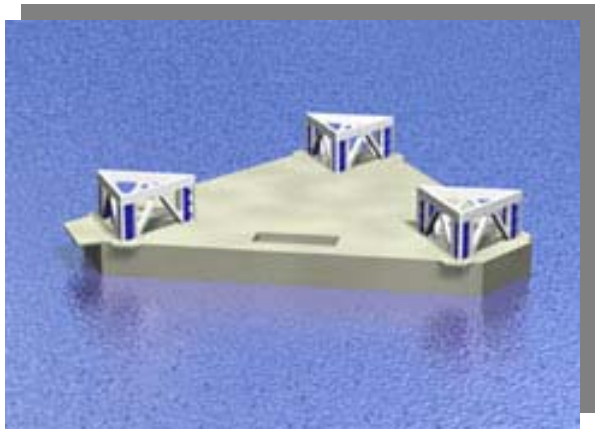
Hook-up & com quay side

Dry tow to site

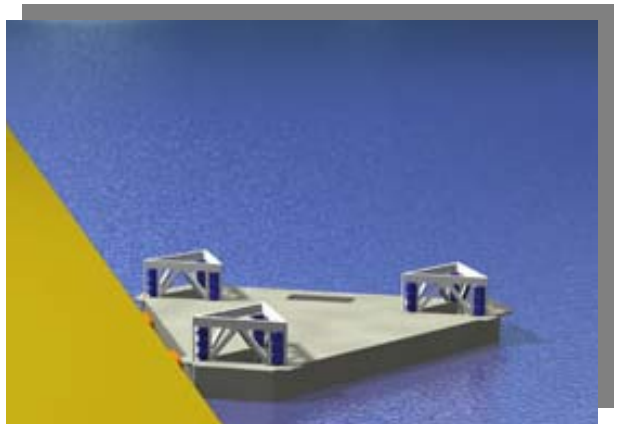
Alternatively wet tow to site

Self elevation at site

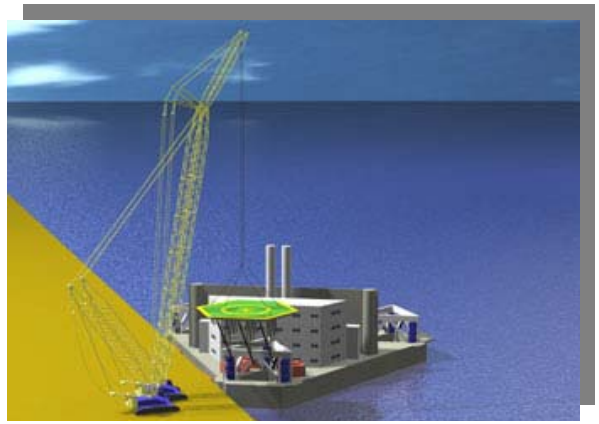
EXECUTION OPTION



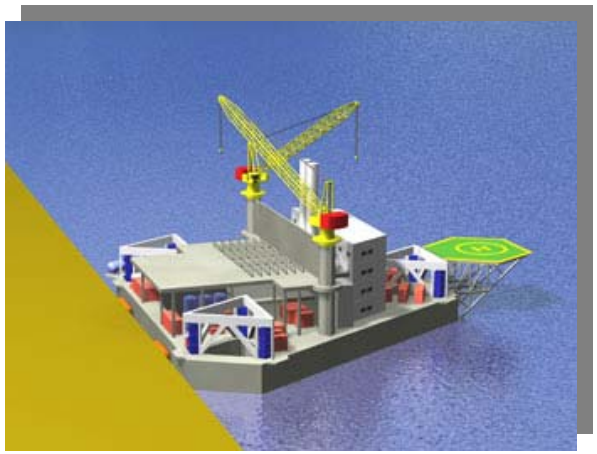
Dry or wet tow from fab
to integration yard



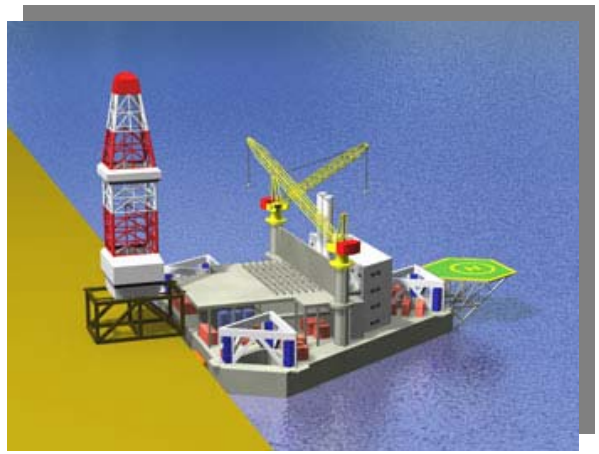
Moor quay side for
topside installation



Topside Integration - 1



Topside Integration - 2



Topside Integration - 3

Topside integration
& hull completion

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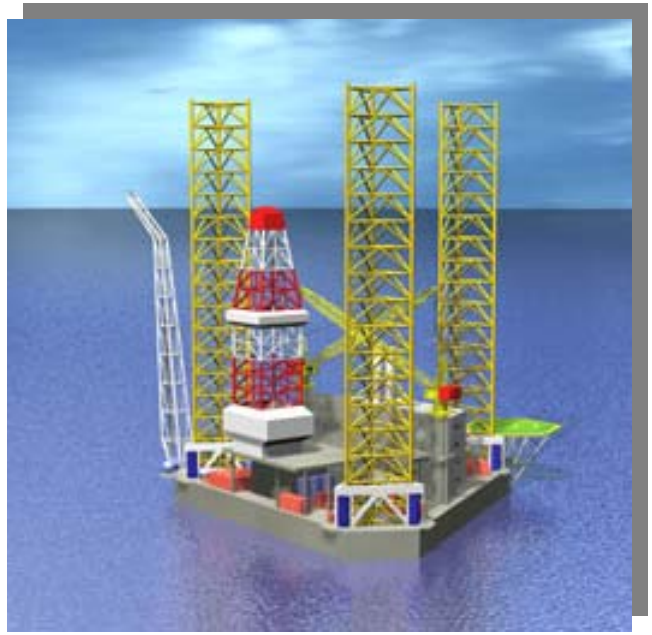
LEG ERECTION INSHORE, BUT IN DEEPWATER



TPG 500: ONE CONCEPT - A RANGE OF APPLICATIONS

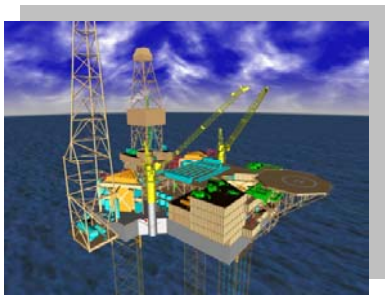
BP HARDING (Completion 1996)

- Drilling, Production Utilities and Quarters (DPUQ) platform
- Concrete Gravity Storage Base tank of 500,000 bbl
- 109 metres of water depth in the North Sea harsh environment (UK)

ELF Exploration UK ELGIN & FRANKLIN (Completion 2000)

- Production, Utilities and Quarters (PUQ) platform
- HP / HT gas condensate field (830 bar) requiring H_2S removal
- Self-piled foundations
- 92 metres of water depth in the North Sea harsh environment (UK)

BP SHAH DENIZ (Completion Scheduled 2005)



- Drilling, Production, Utilities and Quarters (PDUQ) platform
- Hull built in self-buoyant strips and suction can foundations
- HP gas field (750 bar)
- 101 metres of water depth in the Caspian Sea (Azerbaijan)

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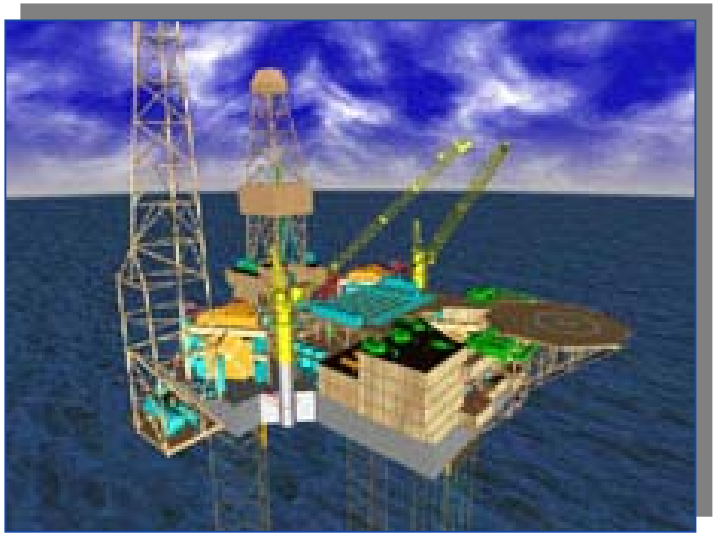
TPG 500 REFERENCES: SHAH DENIZ



SHAH DENIZ Field - TPG 500

Client:	**BP Exploration**
Location:	**Caspian Sea, Azerbaijan**
Date:	**2001- 2006**
Facilities:	**Production, Drilling, Utilities & Quarters Platform**
Scope:	**Conceptual, Basic and FEED Engineering and Procurement services Engineering and Supply of Proprietary items**

Key data:

- **101 m water depth**
- **20,000 tonne topsides with drilling facilities**
- **Suction can foundations**
- **900 mmscfd gas**

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Platform weight summary

TOPSIDES	9,300 tonnes	(incl 3,200 tonnes of drilling equipment)
HULL	11,000 tonnes	
LEGS & RISERS	5,600 tonnes	
FOUNDATIONS	3,300 tonnes	
TOTAL	29,200 tonnes	

SITE PRESENTATION

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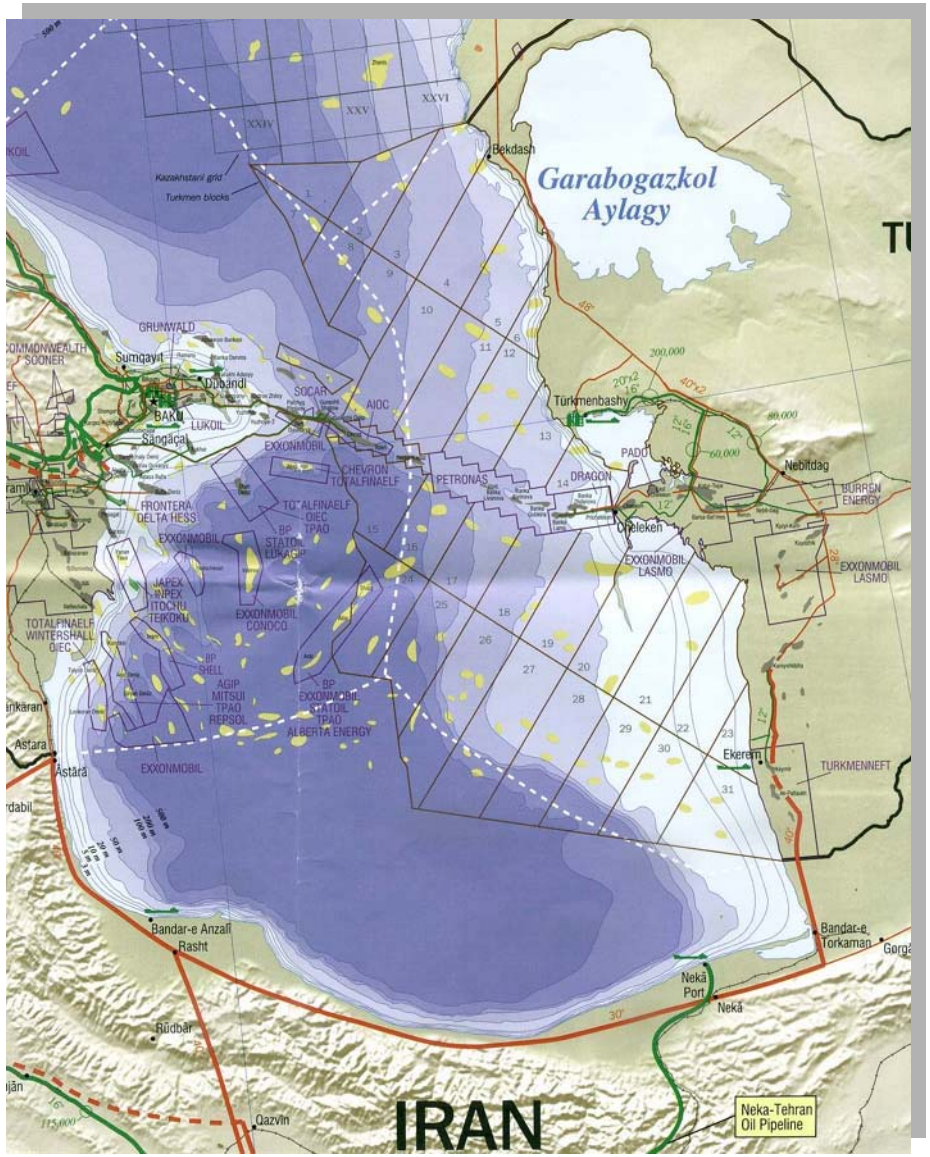

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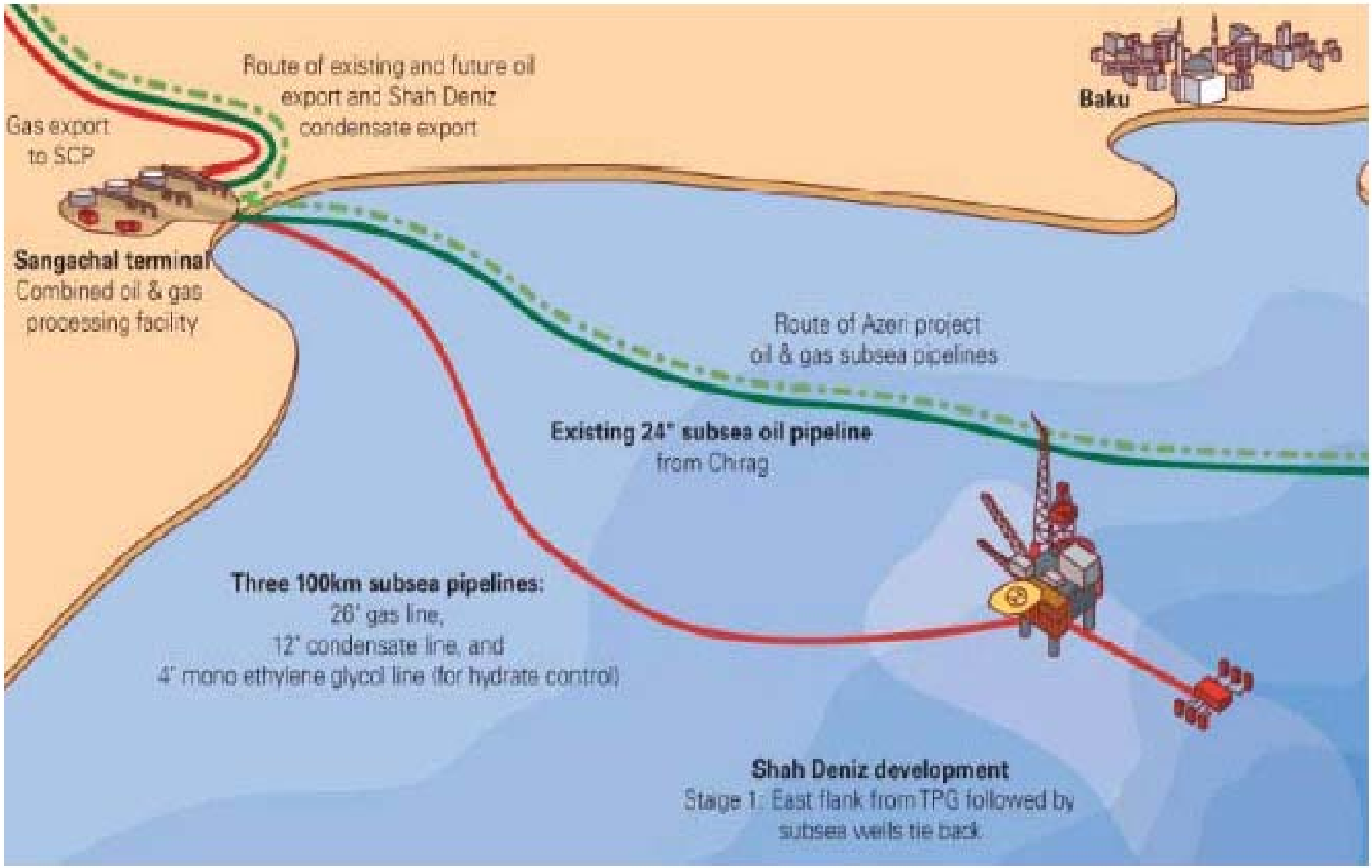
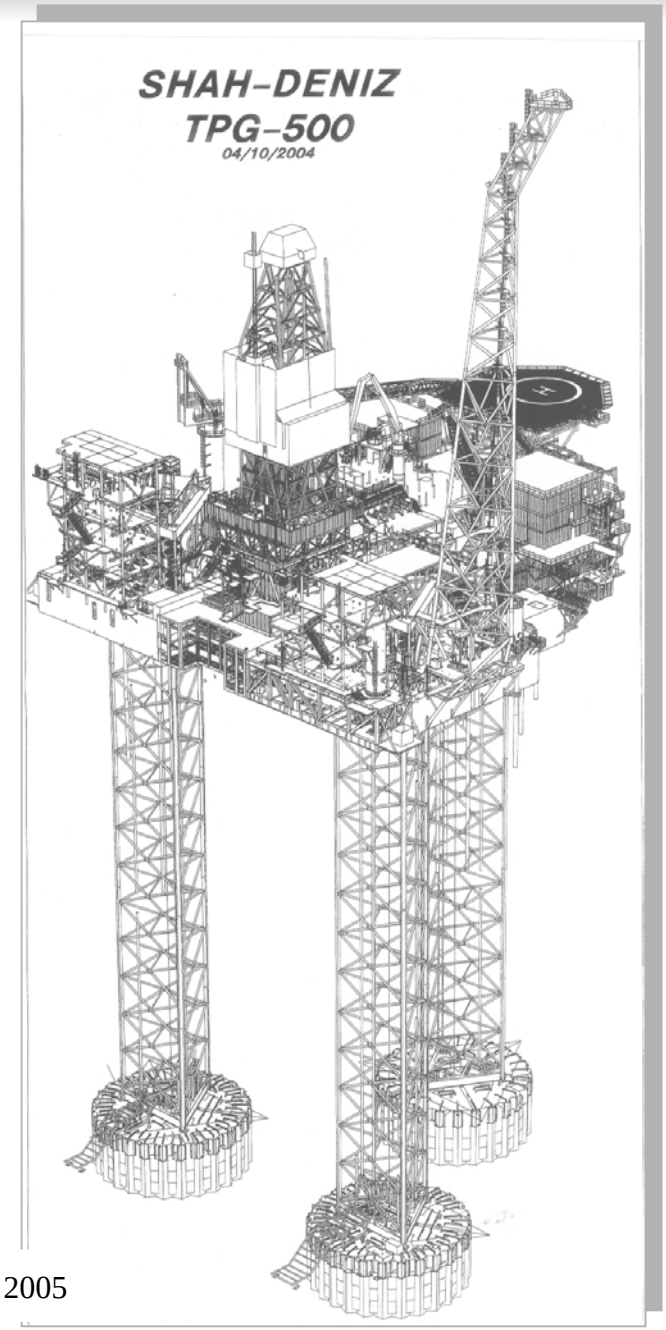


SHAH DENIZ – Paris/Singapore/Baku

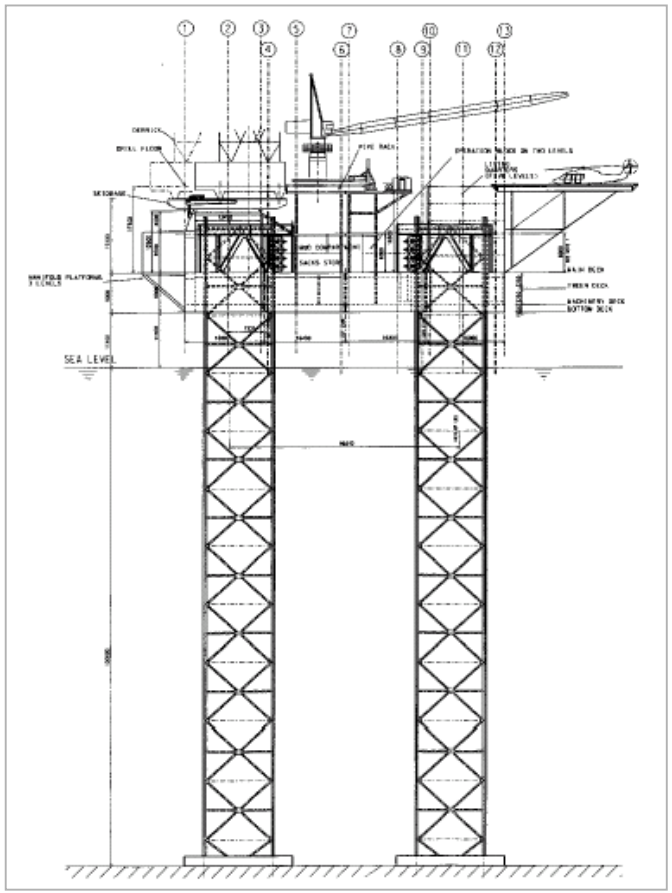
PLATFORM PRESENTATION

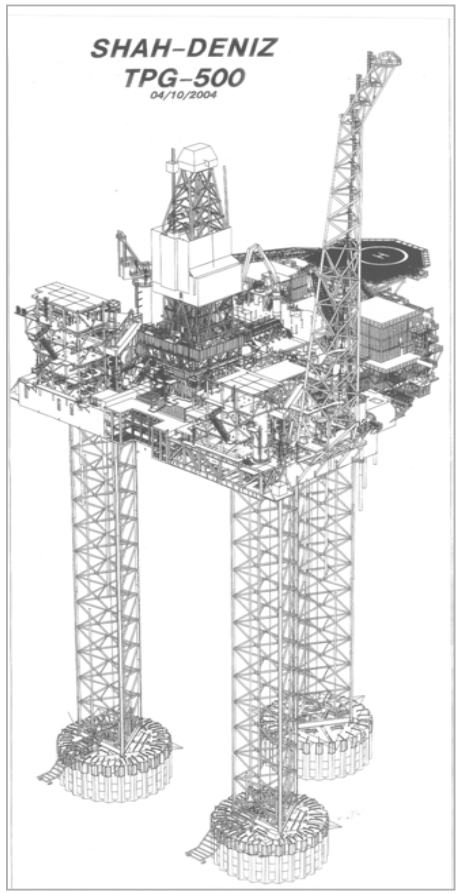
- **MAIN CHALLENGES**
  - **FOUNDATIONS**
  - **STRIPS**
  - **DRILLING OF WELL (limit of technology, reservoir, geology)**
  - **PROCESS (pressure)**



PLATFORM EVOLUTION – IMPACT OF WEIGHT INCREASE ON DESIGN

	CONCEPTUAL		DETAIL
LEG SIZE (triangular) (distance between chord)	**16.00 m**	→	**17.00 m**

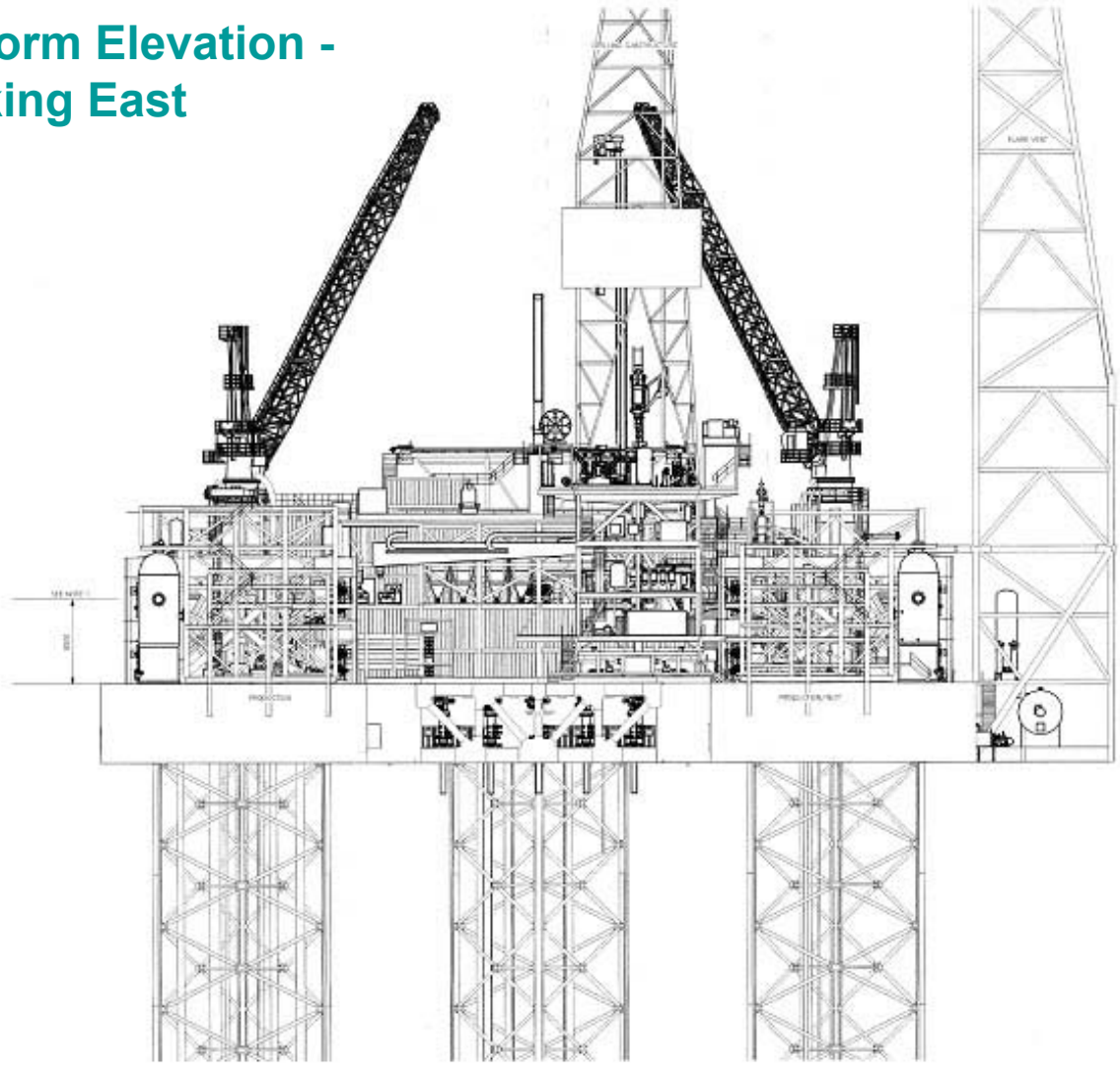




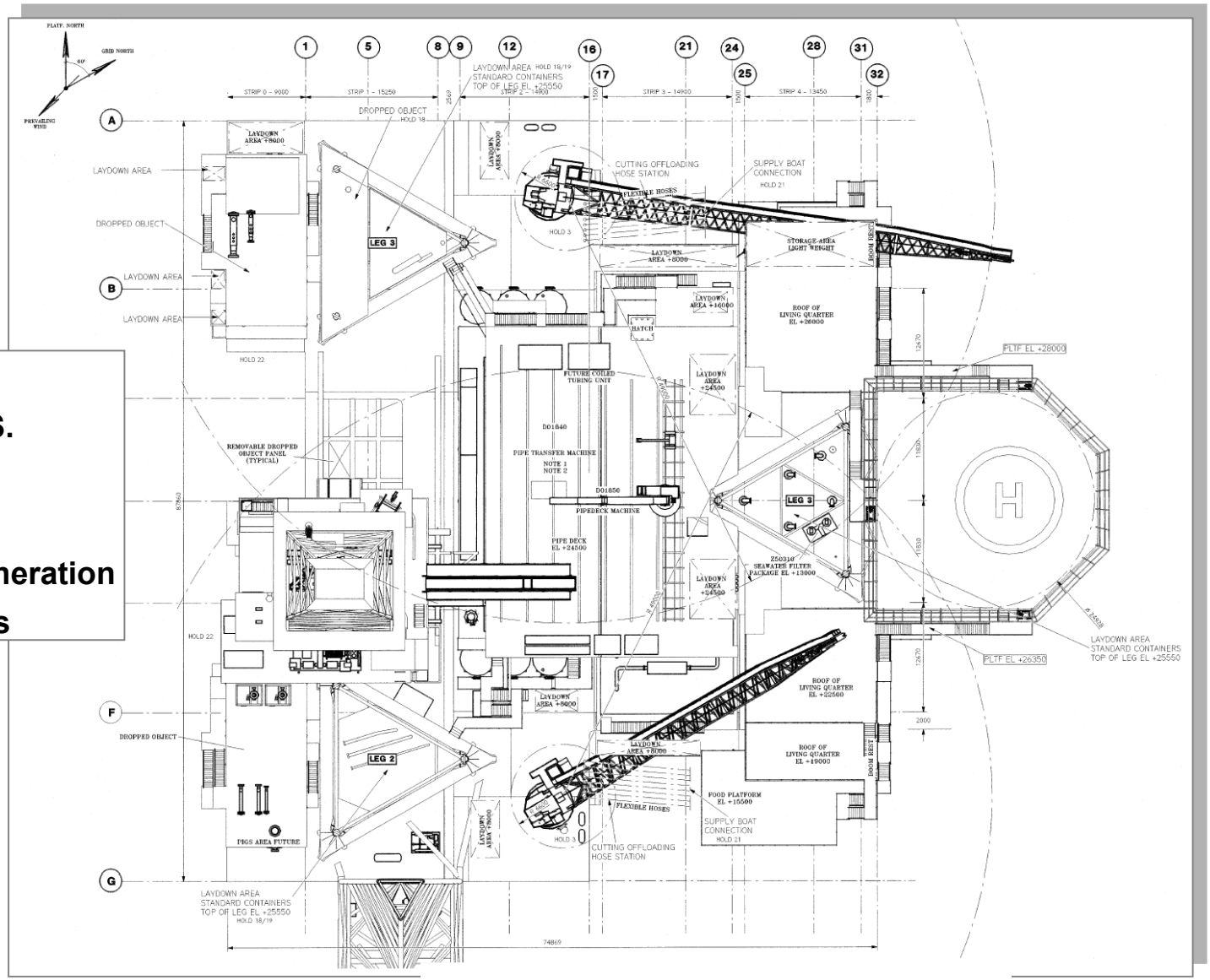
CONCEPTUAL ELEVATION

RECENT DETAILED ELEVATION

Platform Elevation - Looking East



PLATFORM TOP LEVEL PLAN VIEW



Strip 0 : Process

Strip 1 : Wellbay / D.E.S.

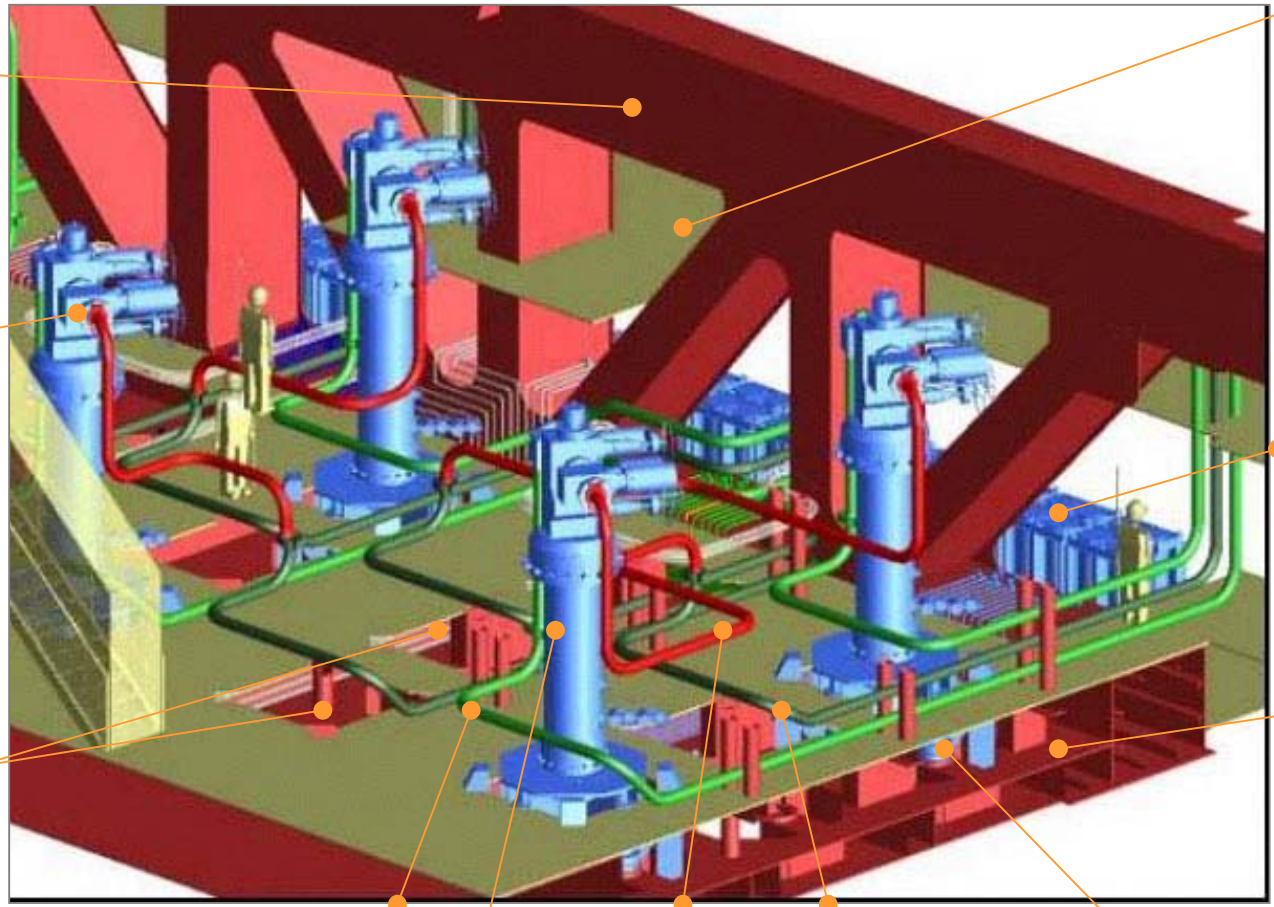
Strip 2 : Drilling

Strip 3 : Utilities

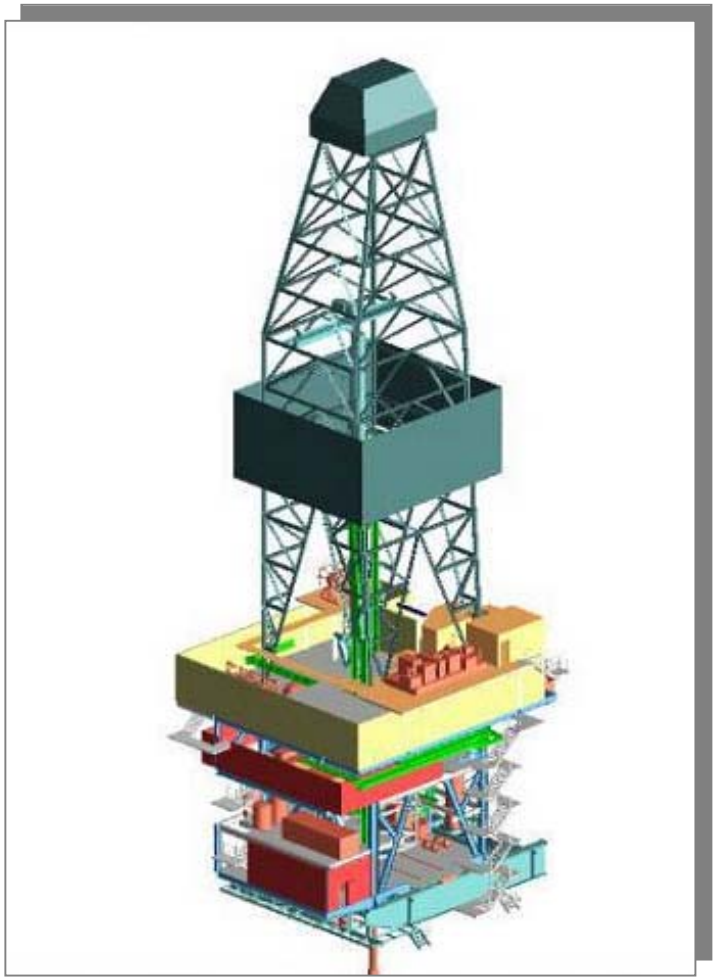
Main Power Generation

Strip 4 : Living Quarters

Well-bay arrangement



Drilling facilities - specification



Prefabricated in Norway (NYMO)
Assembly in Baku

- **Derrick**
  - 1,500,000 lbs capacity
  - 510 t setback capacity
  - 60,000 ftlbs @ 120 rpm topdrive
  - 3,000 hp drawworks
- **Mud System**
  - 3 x 2,200 hp mud pumps, 7500psi
  - 4000bbls tank capacity
  - 4 x high performance shale shakers
  - Provision for OBM cuttings transfer system
- **18 ¾" 15,000 psi BOP**
- **Well Intervention**
  - Rig Assisted HWU for perforating
  - Wireline through derrick or simultaneously
  - From main deck
- **Future Provisions**
  - Centrifuges
  - Installation of CTU
  - 21 ¼ 5m BOP and/or diverter

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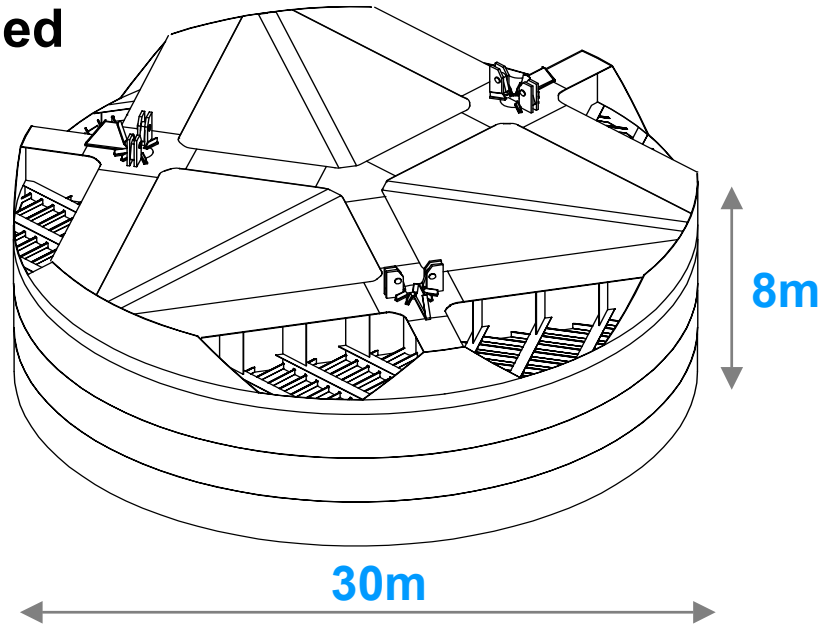
- **Foundation options reviewed**
  - spud cans
  - pre-installed piled structure
  - suction cans
- **Suction can design assurance obtained**
  - NGI, Prof Houlsby
- **Solution adopted**
  - design for 600mm settlement
  - provide re-jacking contingency
  - impacts wellbay, trees, tensioners flowlines & export risers
- **Offshore Installation of Suction can**

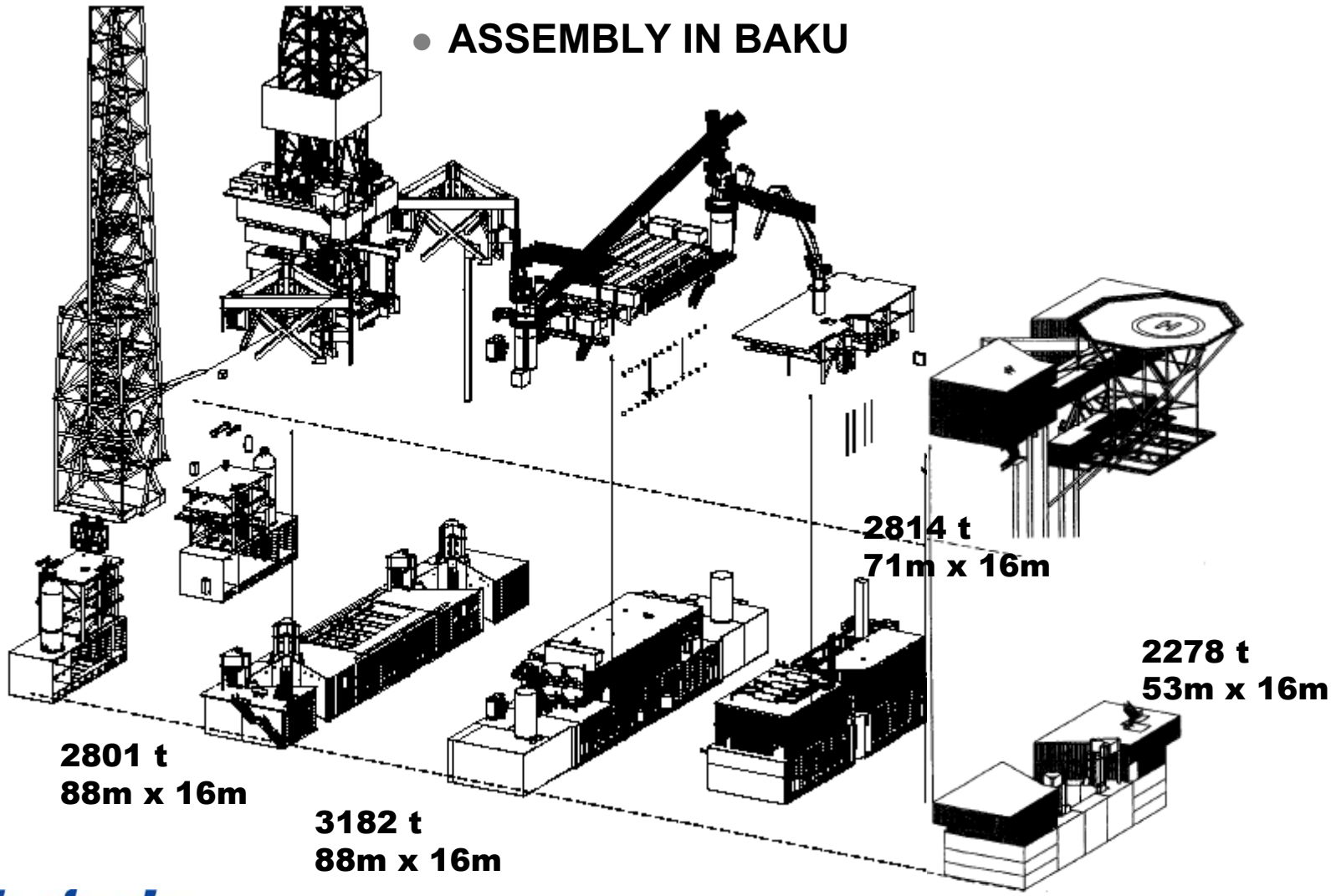
Suction skirt foundation



EXECUTION PLAN

HULL

- PREFABRICATED AS 4 MAIN STRIP IN SINGAPORE
- ASSEMBLY IN BAKU



STRIPS IN SINGAPORE

STRIPS IN SINGAPORE

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TRANSPORT OF STRIPS

LEG ASSEMBLY IN BAKU

- **LEG SECTIONS ASSEMBLY AND SKIRT-CANS FABRICATION**

RACK TO RACK WELDING

WINDOW WELDING

LEG SECTIONS ASSEMBLY AND SKIRT-CANS FABRICATION

X BRACING PREPARATION

LEG ASSEMBLY IN BAKU

- **LEG SECTIONS ASSEMBLY AND SKIRT-CANS FABRICATION**

LEG ASSEMBLY

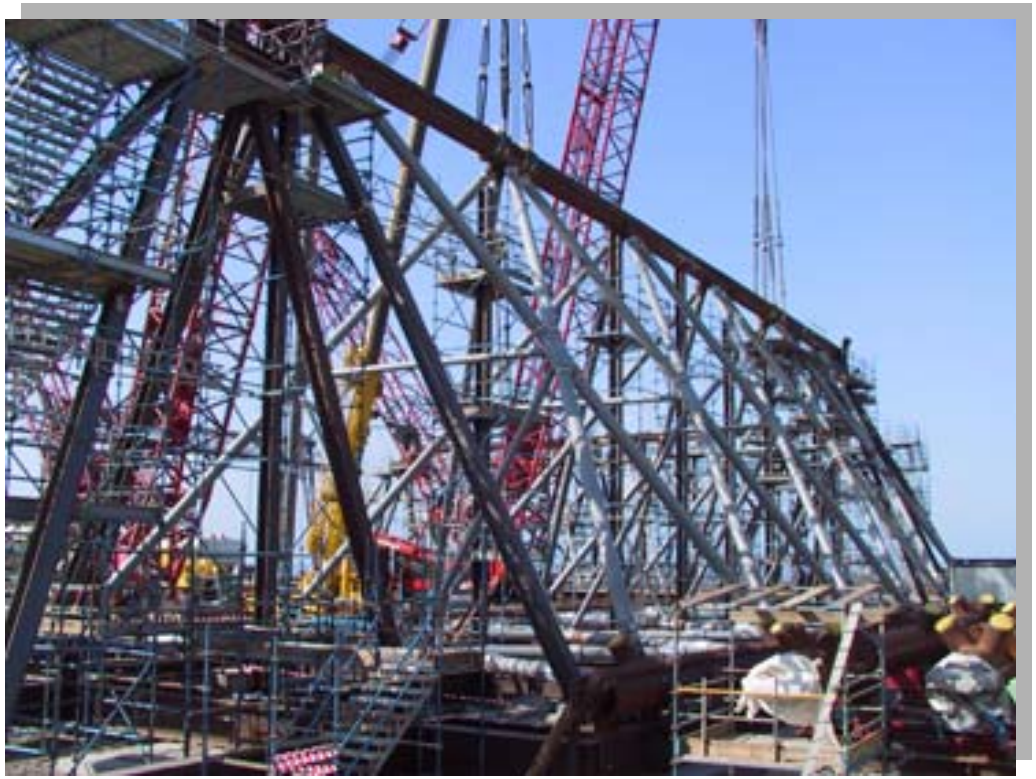
LEG SECTION JIG
(Leg sections assembly 50 m length)

LEG ASSEMBLY IN BAKU

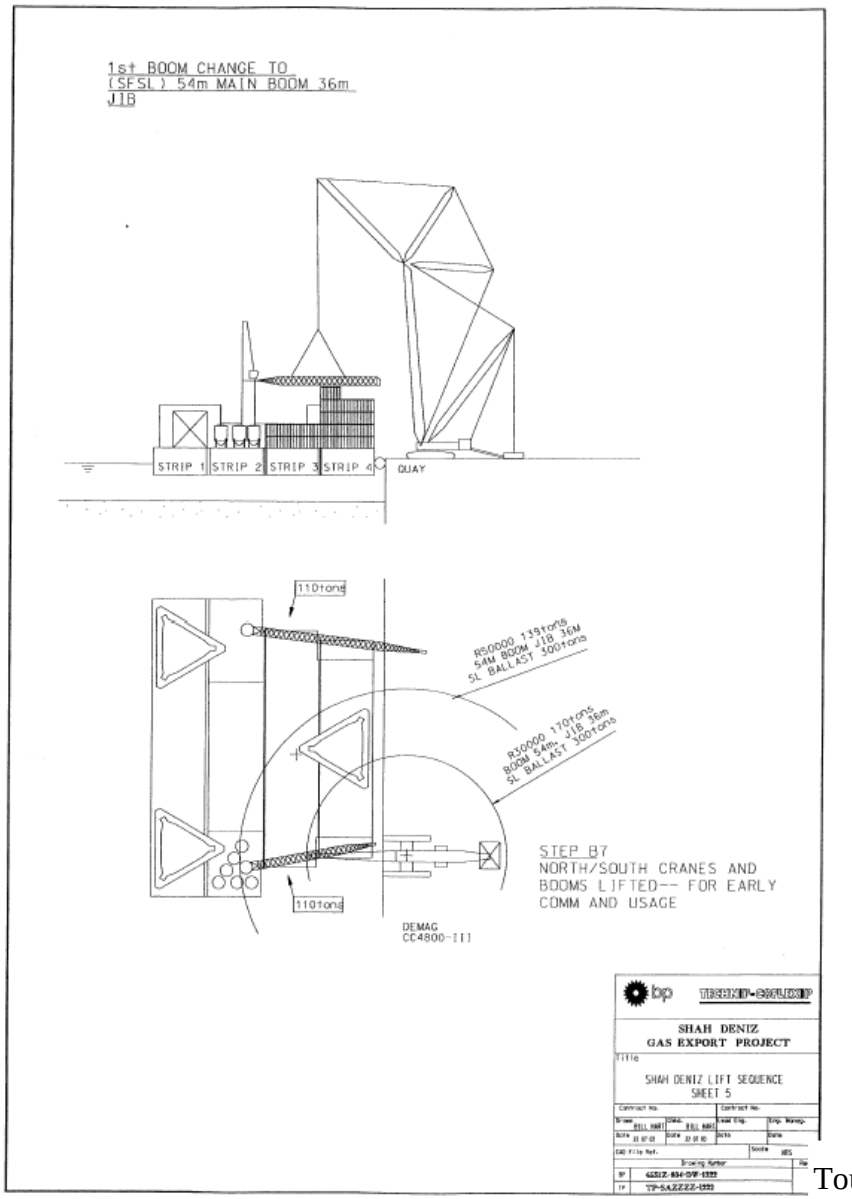
LEG SECTIONS ASSEMBLY AND SKIRT-CANS FABRICATION

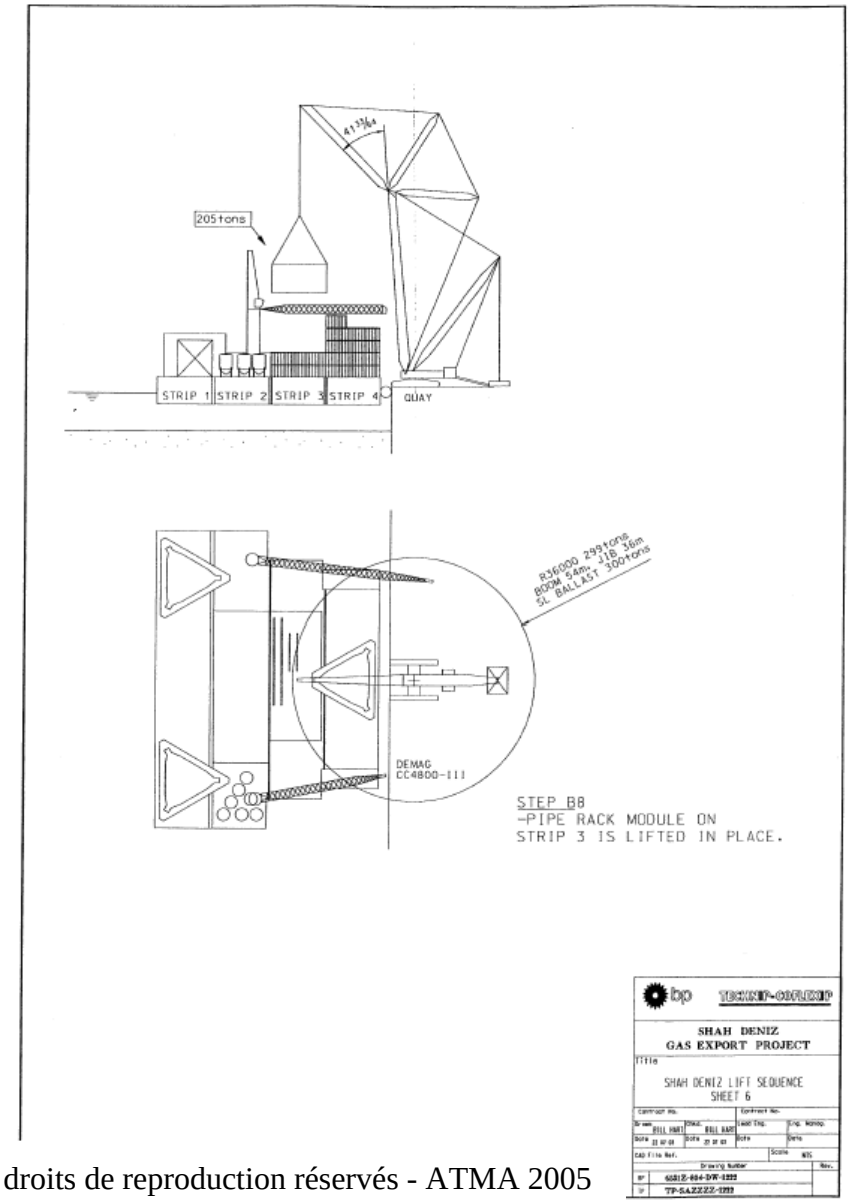
LEG ASSEMBLY IN BAKU

- **LEG SECTIONS ASSEMBLY AND SKIRT-CANS FABRICATION**



PLATFORM INTEGRATION / SEQUENCING





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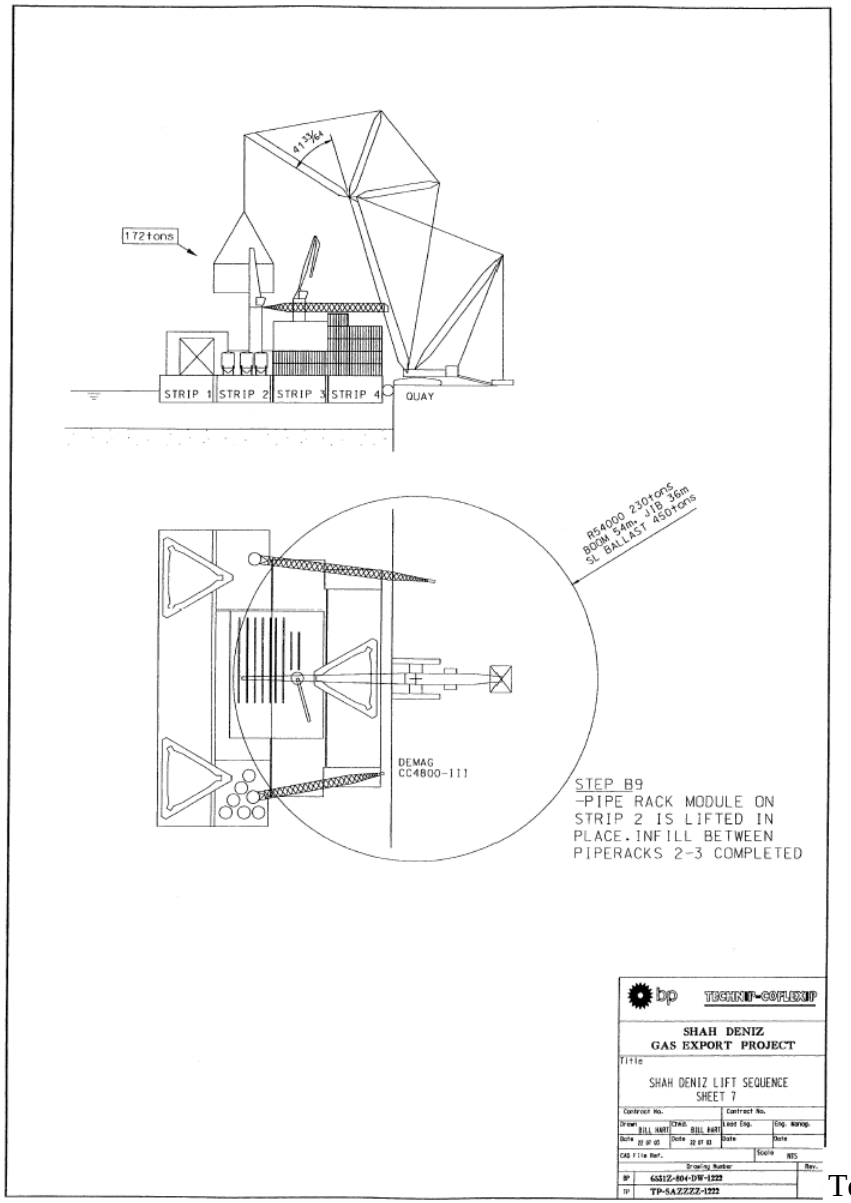

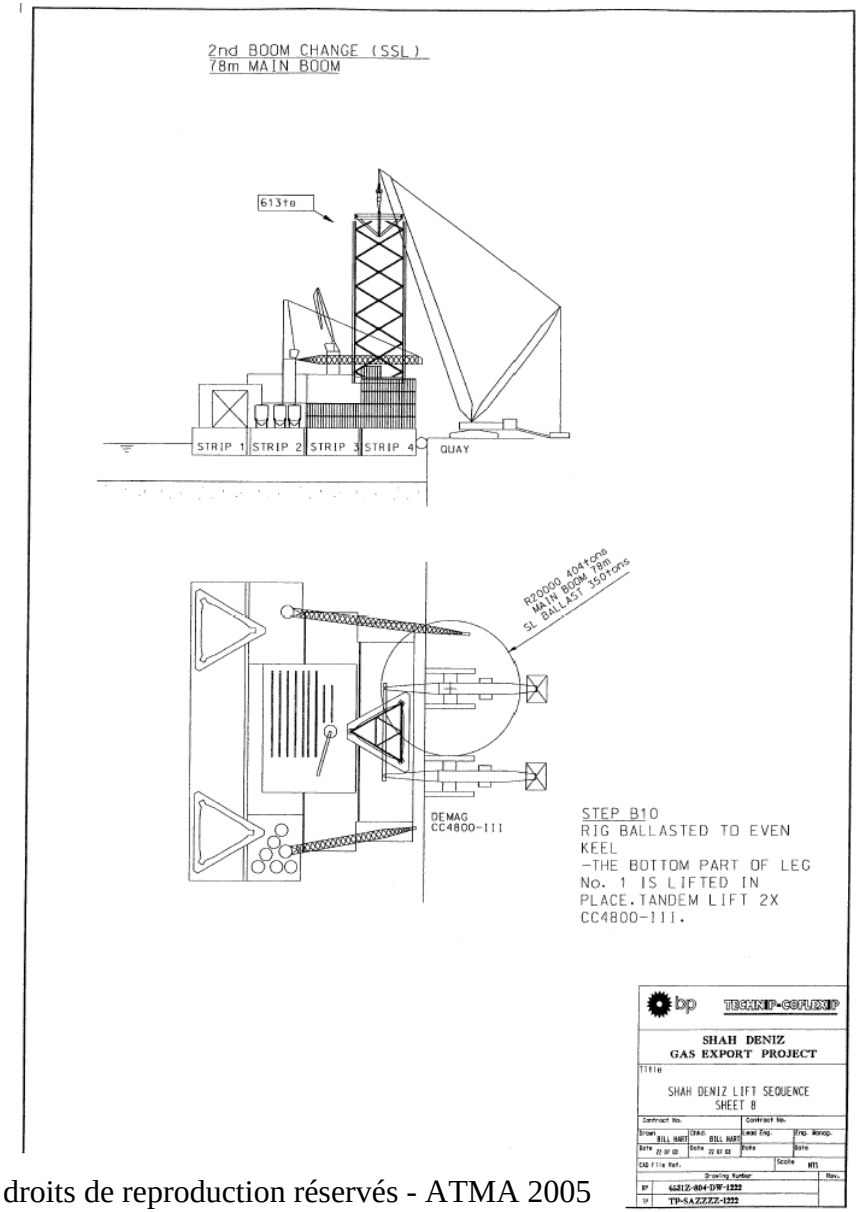

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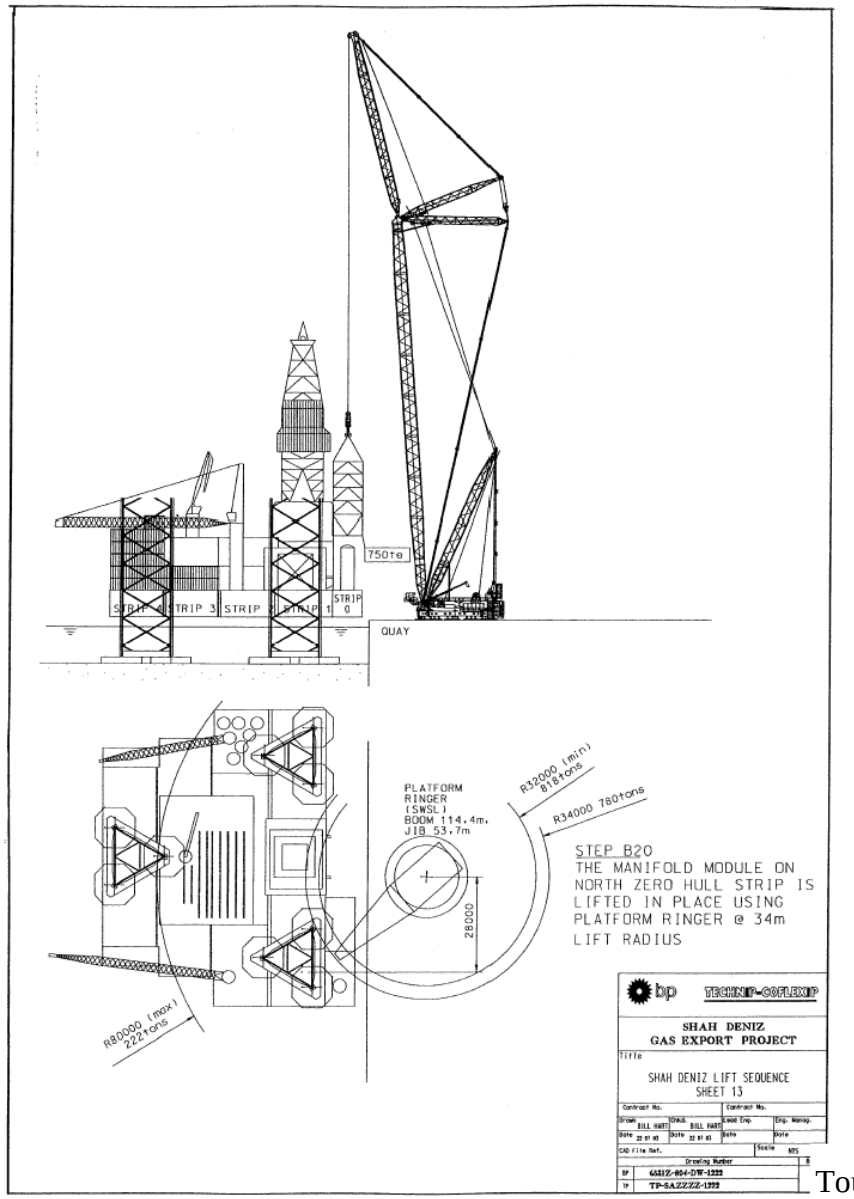

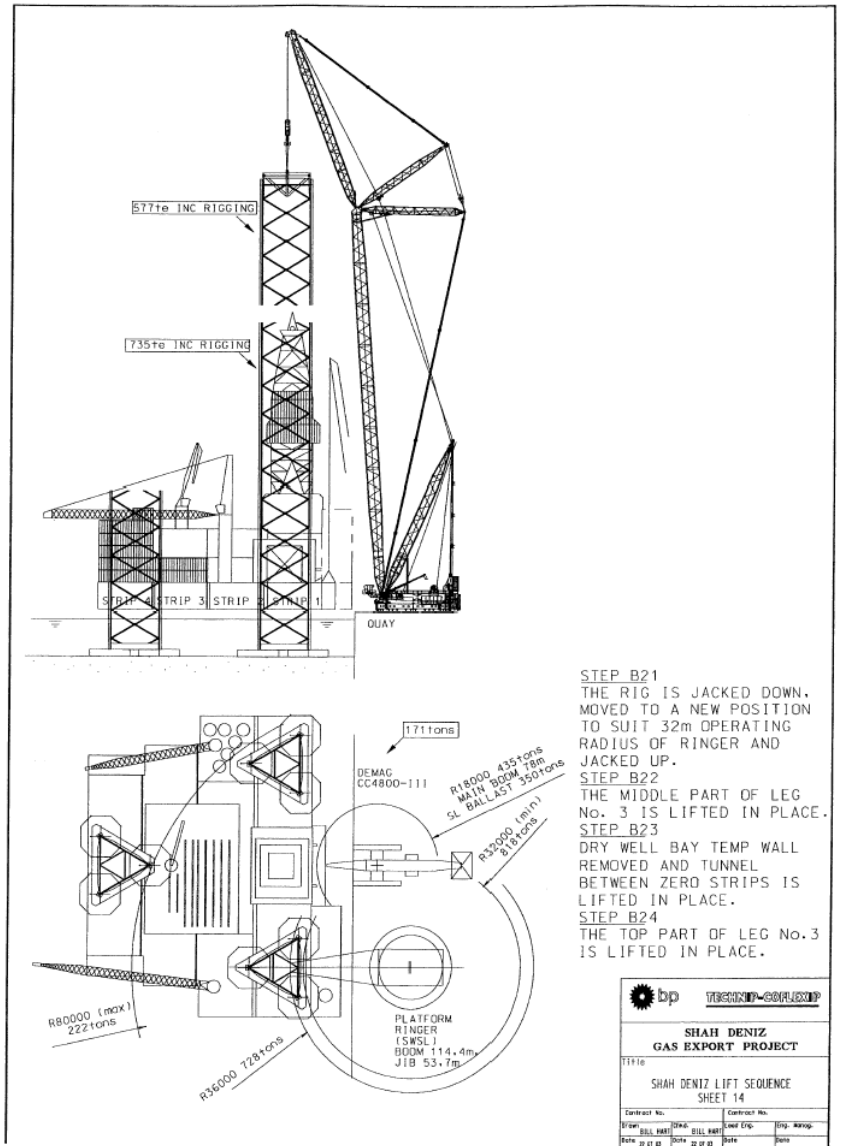

FABRICATION YARDS

- **JACKING/LOCKING**
  - **FABRICATED IN FRANCE (CMD/REXROTH)**

  - **ASSEMBLY OF LOCKING IN SINGAPORE**
  - **ASSEMBLY OF JACKING IN BAKU**

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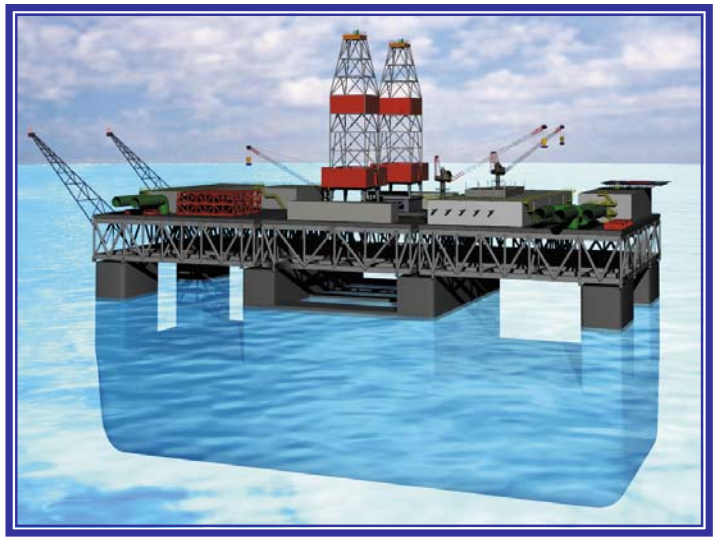
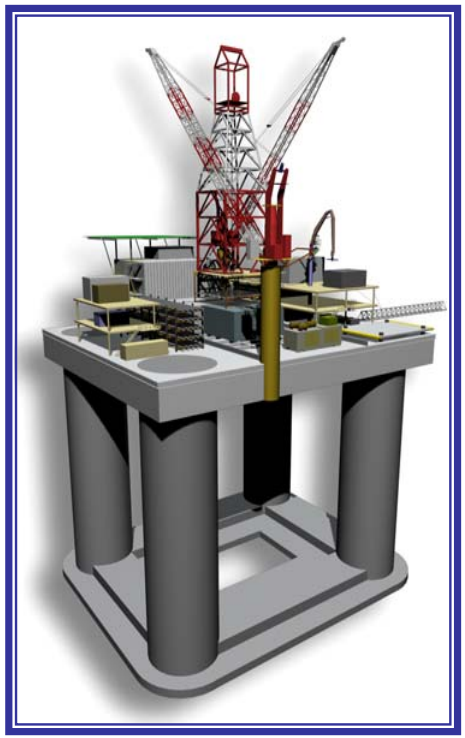
RANGE OF PLATFORMS FOR DEEPWATER

Spar et Deep Blue



DPS-2000

FPSO



EDP

SPAR FUNCTIONS

- Drilling
- Workover
- Production
- Wellhead
- Oil storage and offloading
- Any combination of the above

SPAR CAPABILITIES

- **Water depth** — 1,000 to 10,000 ft
- **Well slots** — 0 to 40
- **Oil throughput** — to 400 Mbopd
- **Gas throughput** — to 750 MMscfd
- **Topside payloads** — 1,500 to 45,000 s. tons
- **Hull diameters** — 20 to 200 ft
- **Hull drafts** — 280 to 800 ft
- **Storage** — 5 to 10 days production

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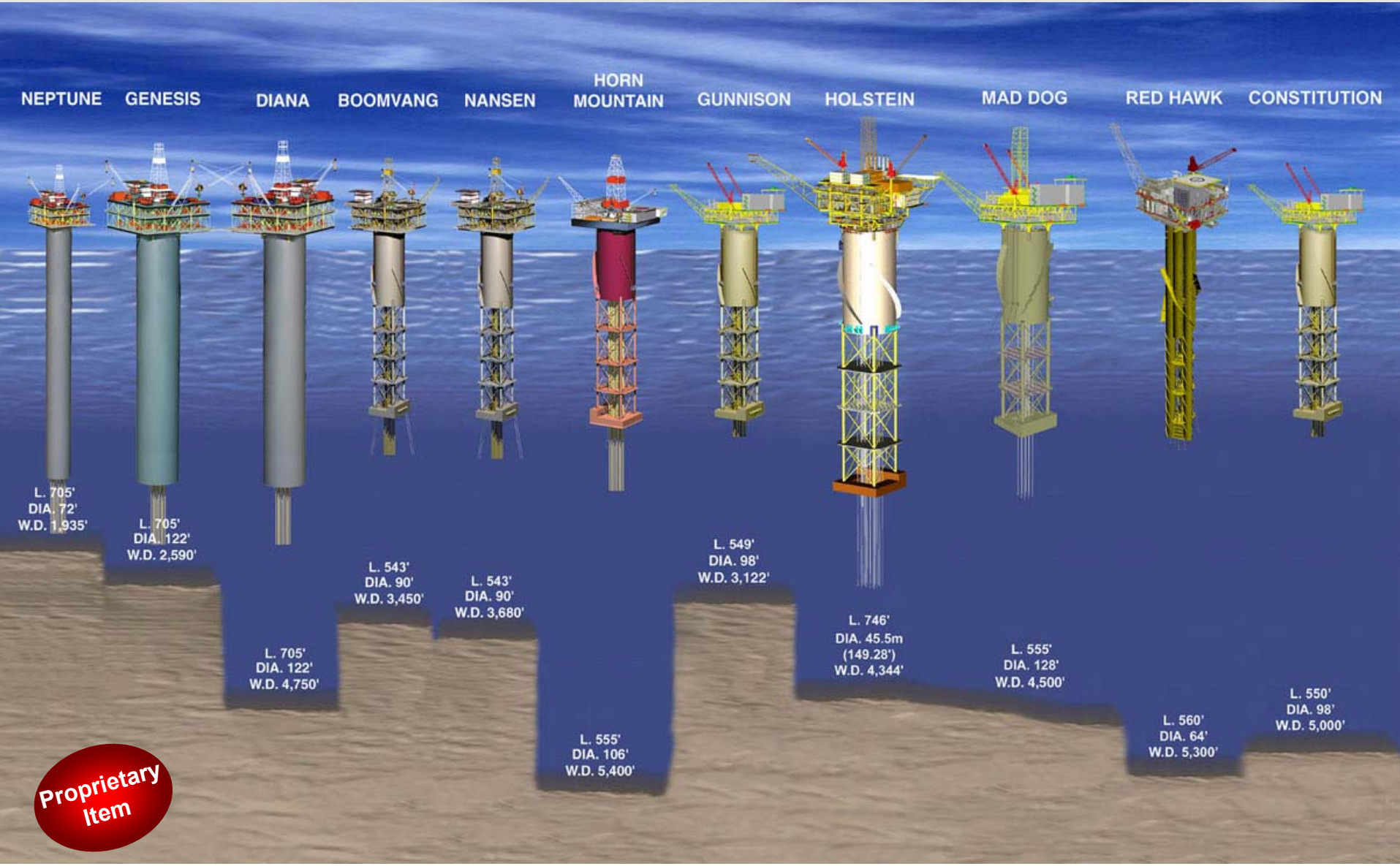
SPAR ADVANTAGES

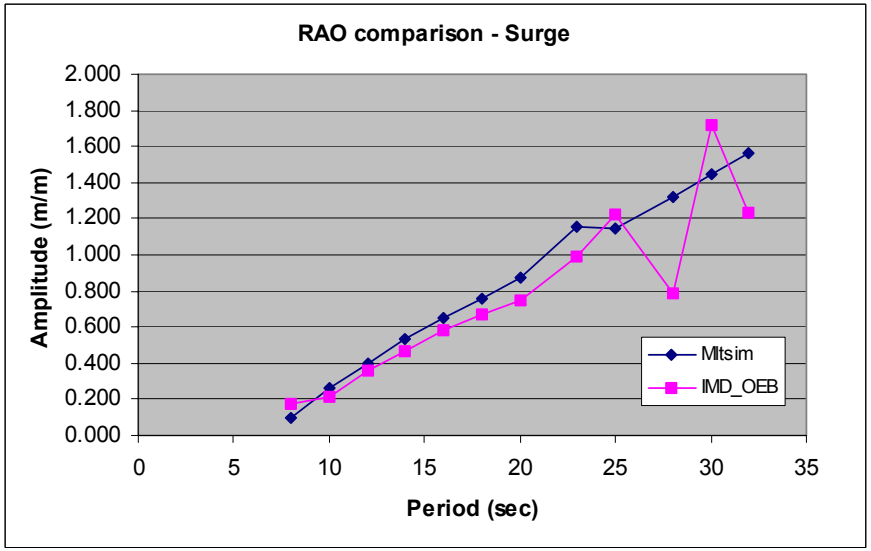
- Dry Trees
  - Reduced drilling time (optimized to operators program)
  - Reduced drilling costs
  - Workovers
- Proven Execution Model
- Flexibility
- Decoupled system
- Unconditional Stability

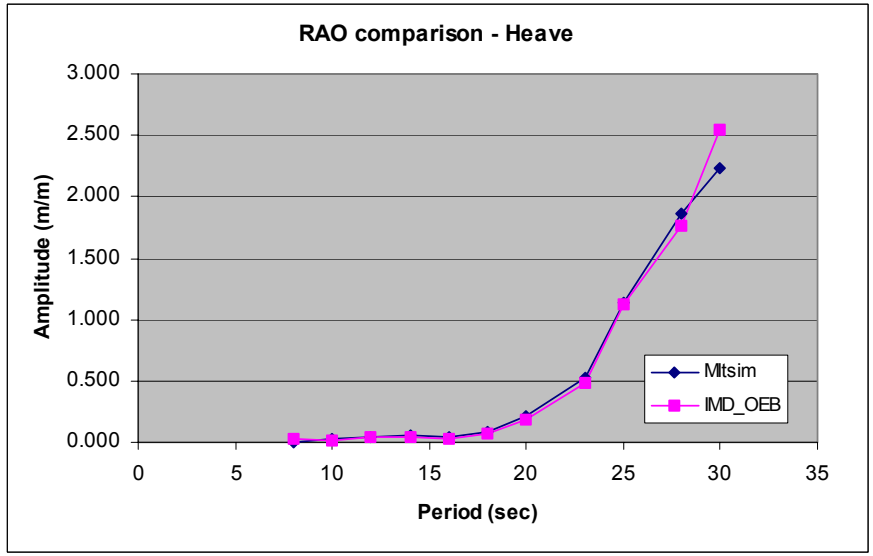
SPAR PROGRESSION

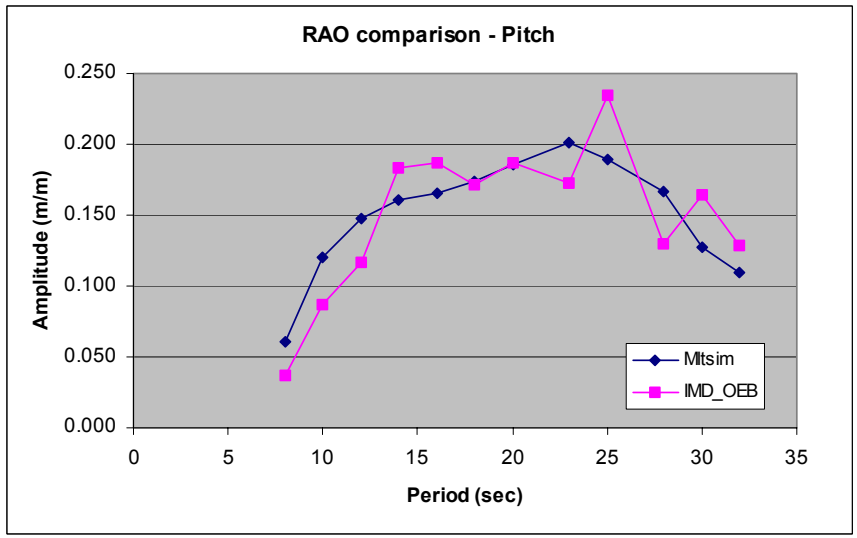


SPAR AT FABRICATION YARD IN FINLAND

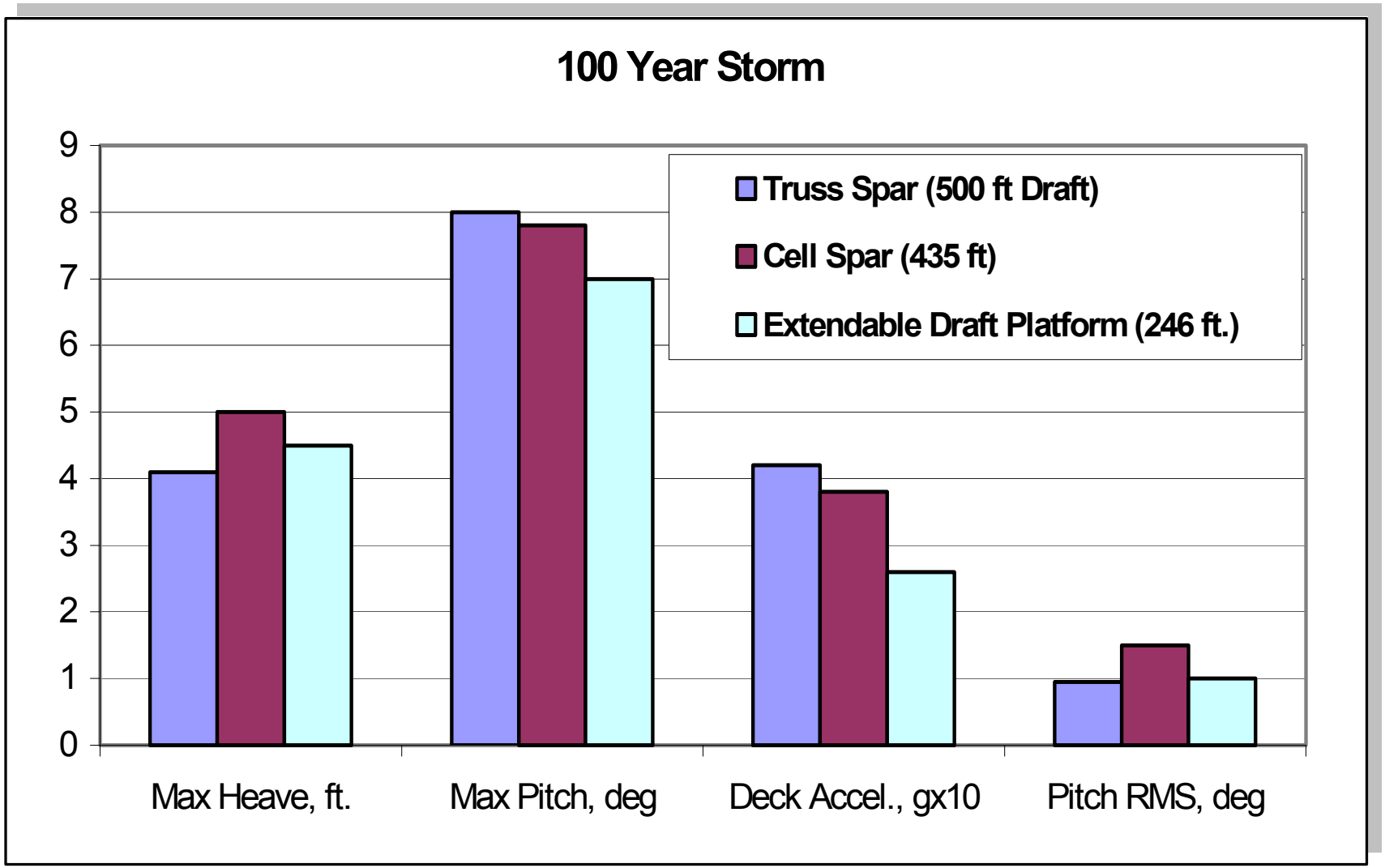
SPAR RAOs



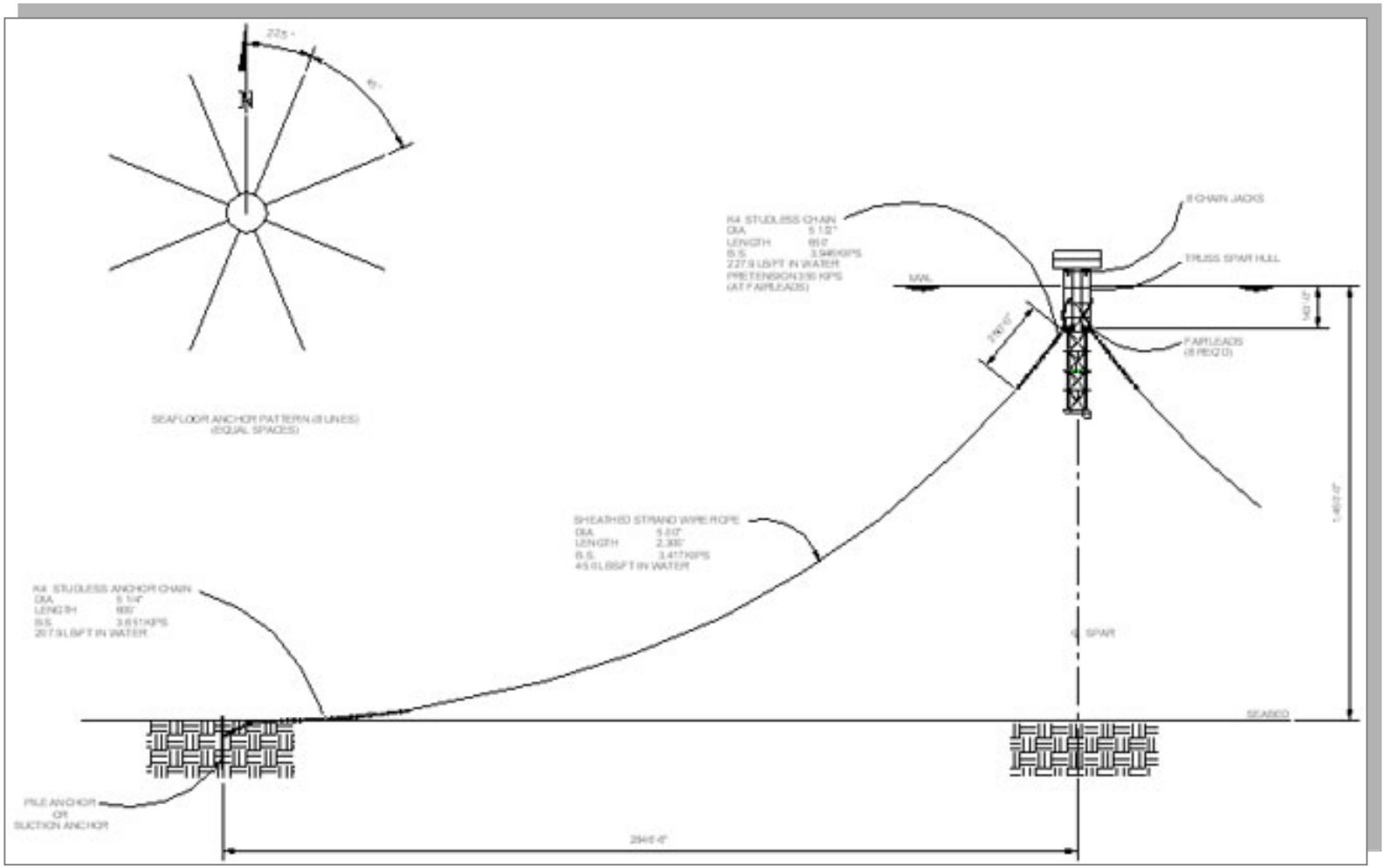




COMPARISON OF PLATFORM MOTIONS



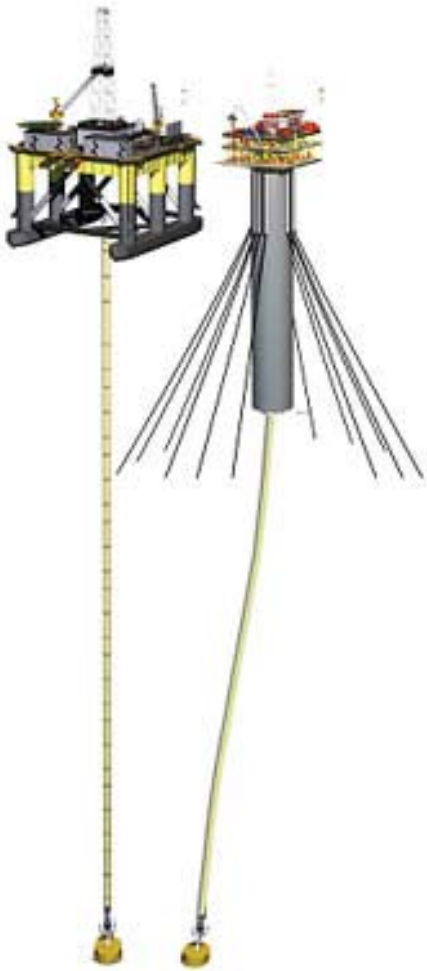
TAUT CATENARY MOORING



DRILLING OPTIONS

Pre-Drill

Offset Drill



Platform Drill

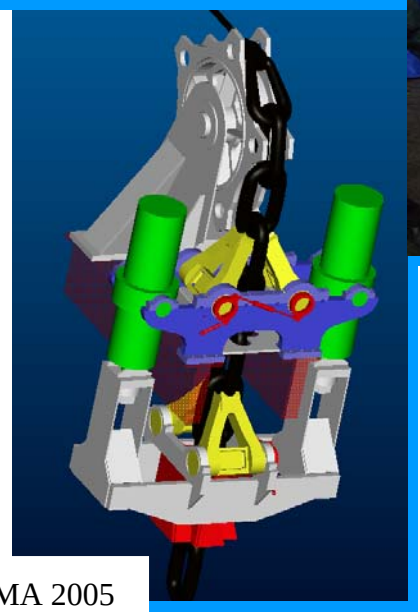
Technip

OFFSET DRILLING

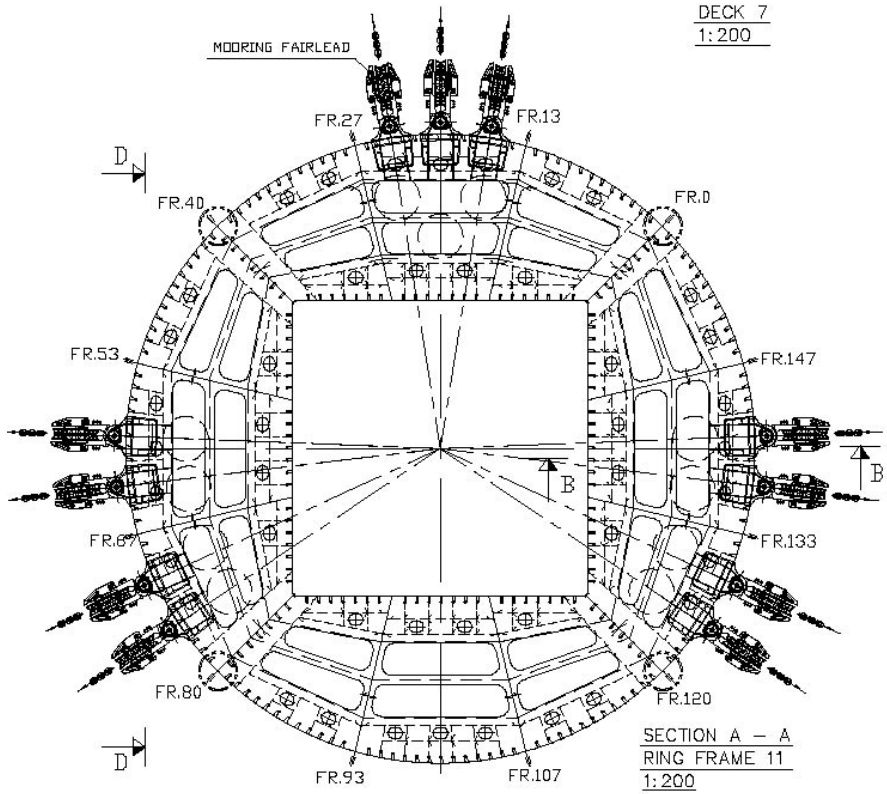
DB-50 NEPTUNE SPAR MODU

PLATFORM-BASED MOORING EQUIPMENT

- **Winching equipment**
  - → Rotary winches (wire)
  - → Linear winches (wire)
  - → Chain windlasses or capstans
  - → Chain jacks or devil's claws
- **Fairleads**
  - → Rotary-type
  - → Bending shoe type
- **Stoppers**
  - → Passive
  - → Active

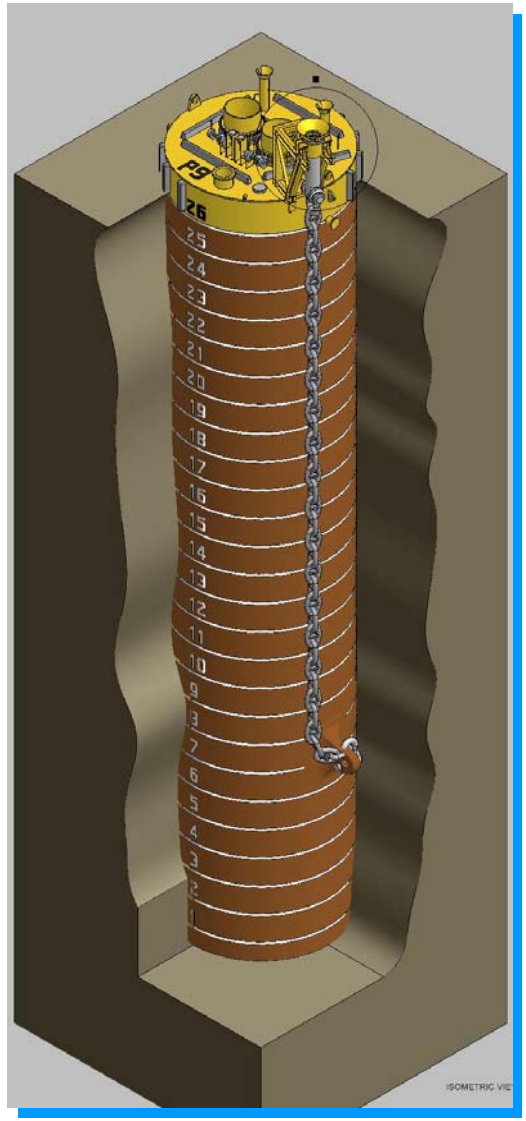


- **Mooring System (Typical for Technip Spars)**
  - **Mooring Arrangement:**
    - **3 x 3 grouped legs (Boomvang, Nansen, Gunnison, Horn Mountain)**
    - **3 x 4 grouped legs**
    - **4 x 3 groped legs (Diana)**
    - **Mixture of 3 and 4 grouped (Mad Dog – 11, Genesis - 14)**
    - **4 x 4 grouped legs (Holstein)**
  - **Mooring Size:**
    - **Typical: 5 ¾'' (146 mm) dia. R4 studless chain, 5'' (127 m) dia. wire**
    - **Max. 6 ¾'' (171 mm) dia. R4 studless chain, 5 ¾'' (147.5 mm) wire**
    - **Max. 10 ¼'' (260 mm) dia. polyester**



- **On-vessel Mooring / 2**
  - **Chain jacks:**
    - **Hydralic, 1 air-cooled HPU - less than 200 HP**
    - **Pulling capacity abt. 500 tons**
    - **Stopper capacity same as chain MBL**
    - **Turndown sheave**
    - **''Removable'' chain jack system possible**

- **Anchor Point**
  - **Base case assumption is suction anchor:**
    - **Diana (21 ft dia. X 105 ft, 290 stons)**
    - **Horn Mountain 918 ft x 94 & 91 ft, 200 stons**
    - **Holstein (18 ft dia. 126 ft, 290 stons)**
    - **Mad Dog (18 ft x diff. lengths, 25 ft dia. x diff. lengths, up to 250 stons)**
    - **Red Hawk (18 ft dia. X 78 ft)**



MOORING/INSTALLATION – CONCLUSIONS

- **Conclusions**
  - **Mooring technology exists today to moor in 2400 meters water depth**
  - **Several enhancement to existing technology can be still studied to make moorings more cost effective**
  - **Polyester and wire options are both feasible**
  - **Lowering and installation tools and procedures exist today to safely and successfully install the moorings in 2400 meters water depth**

DECK INSTALLATION METHODS

Floatover

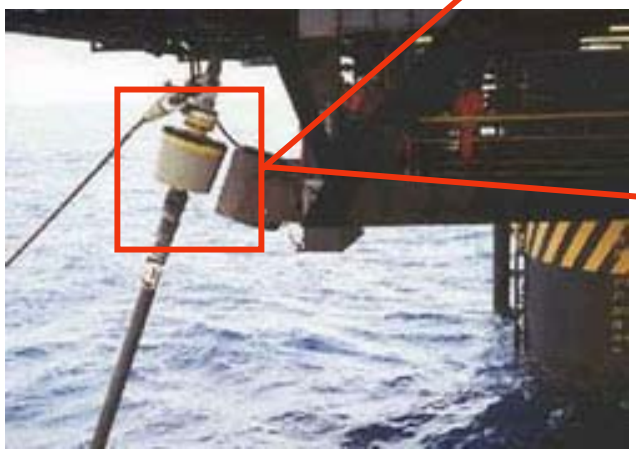
Heavy Lift

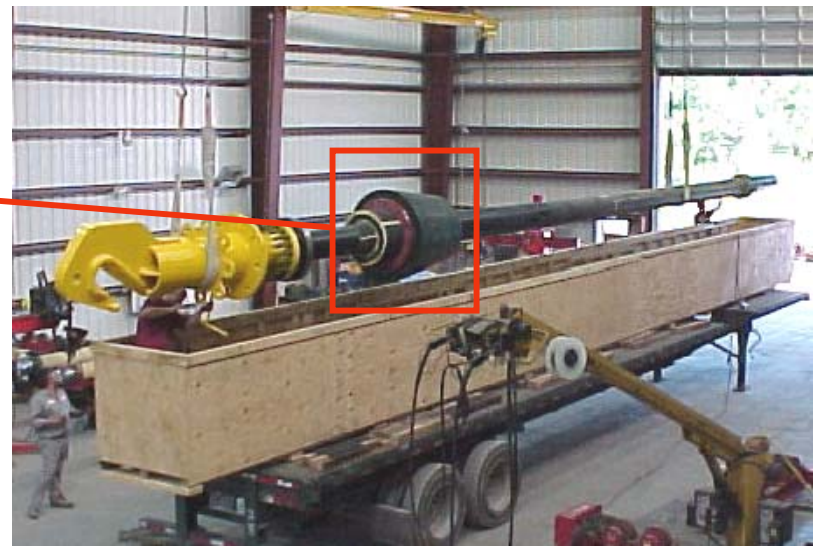
EXAMPLES : PULL TUBE HULL EQUIPMENT

- **Kerr McGee Boomvang & Nansen**
  - **Pre-Installed Pull Tubes**

EXAMPLES : PORCH – SCR INTERFACE

- **Porch interface suitable for FlexJoint or Taper Stress Joint**

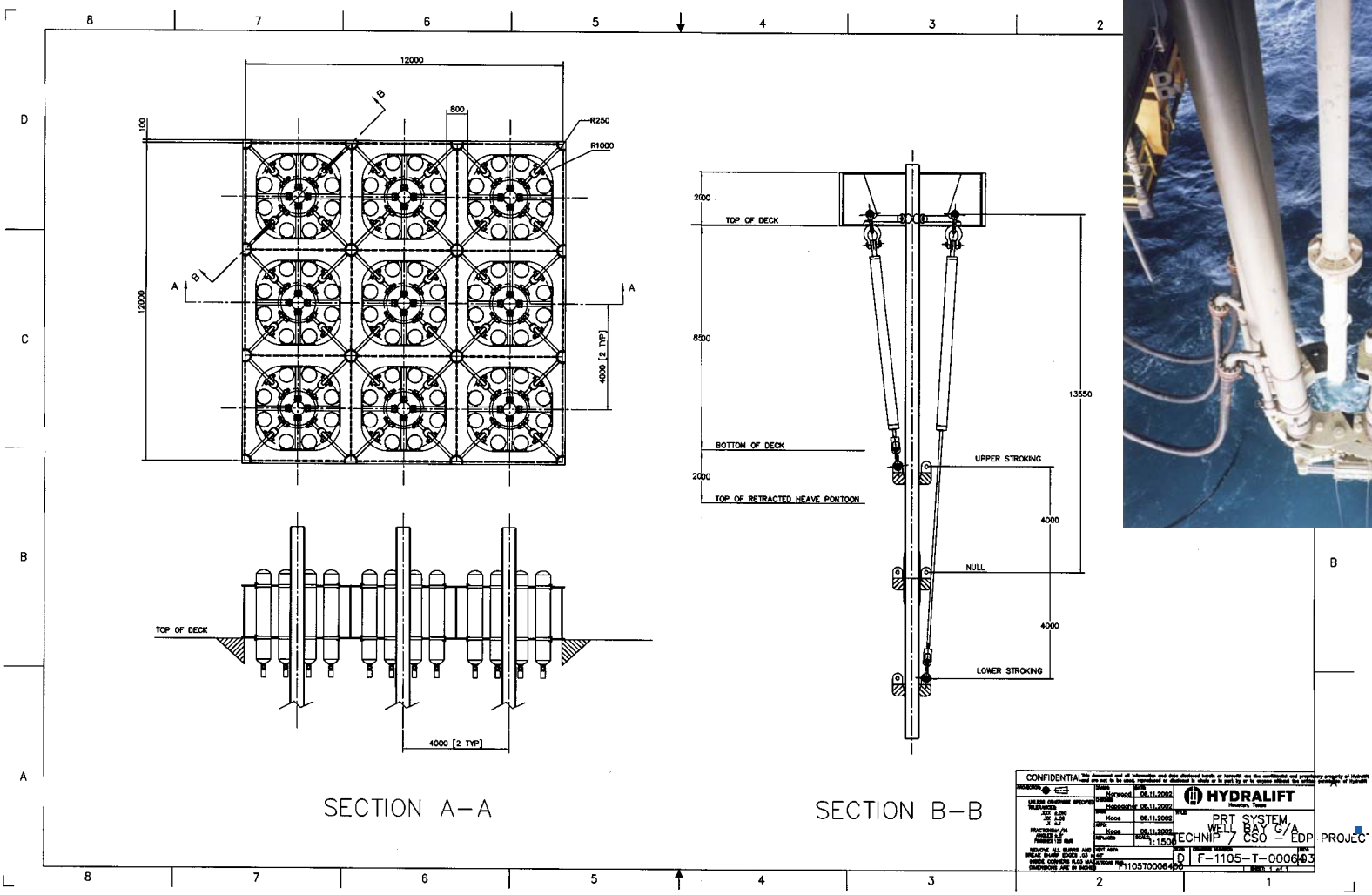




Technip

SPAR DRY TREES RISERS TENSIONERS

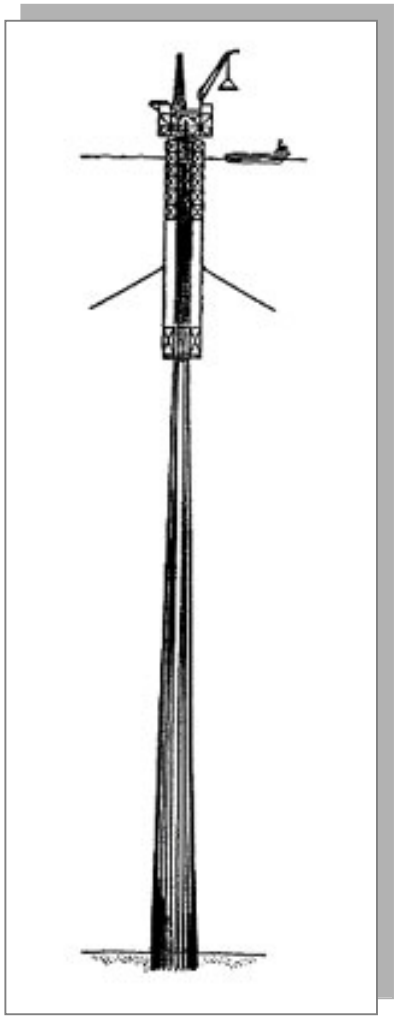
- **Hydro pneumatic tensioners**

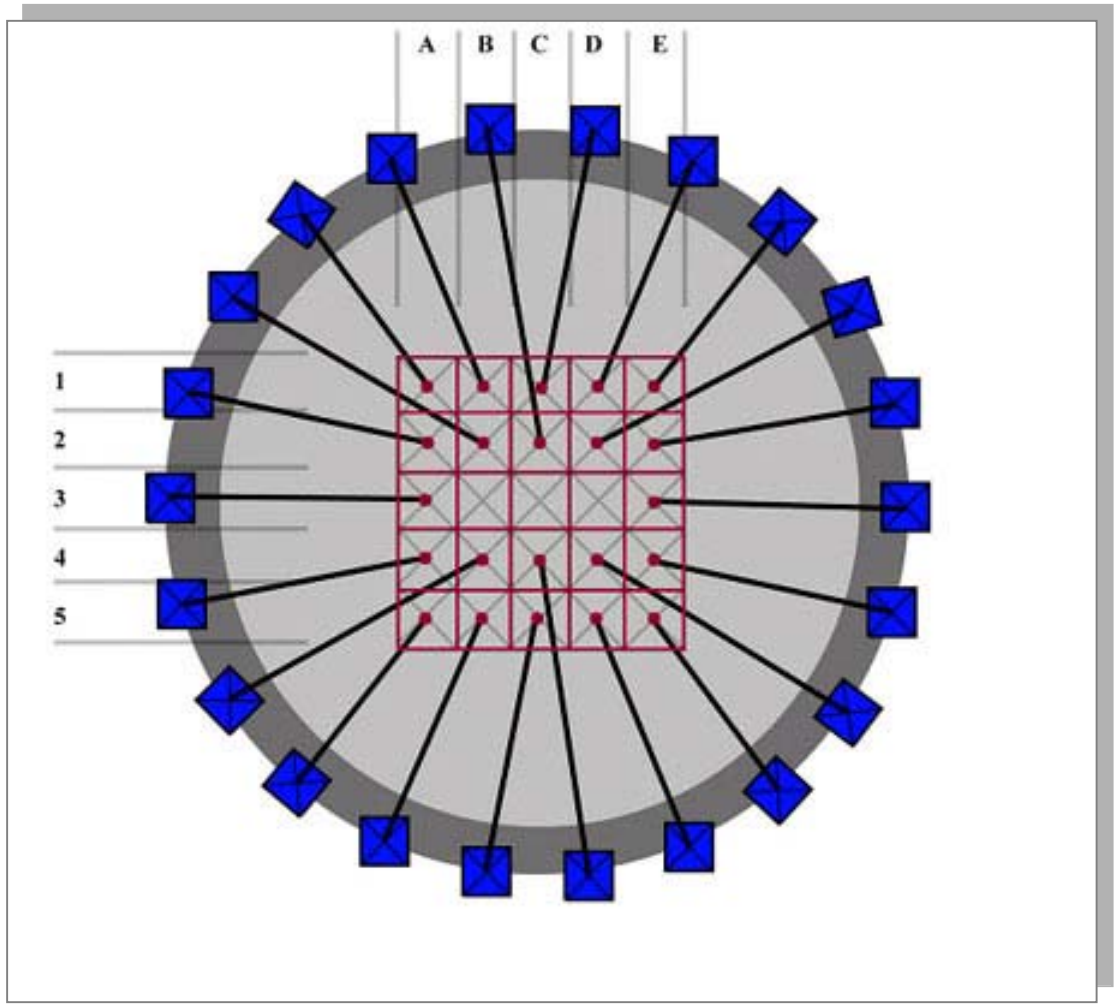


RISER BENEFITS

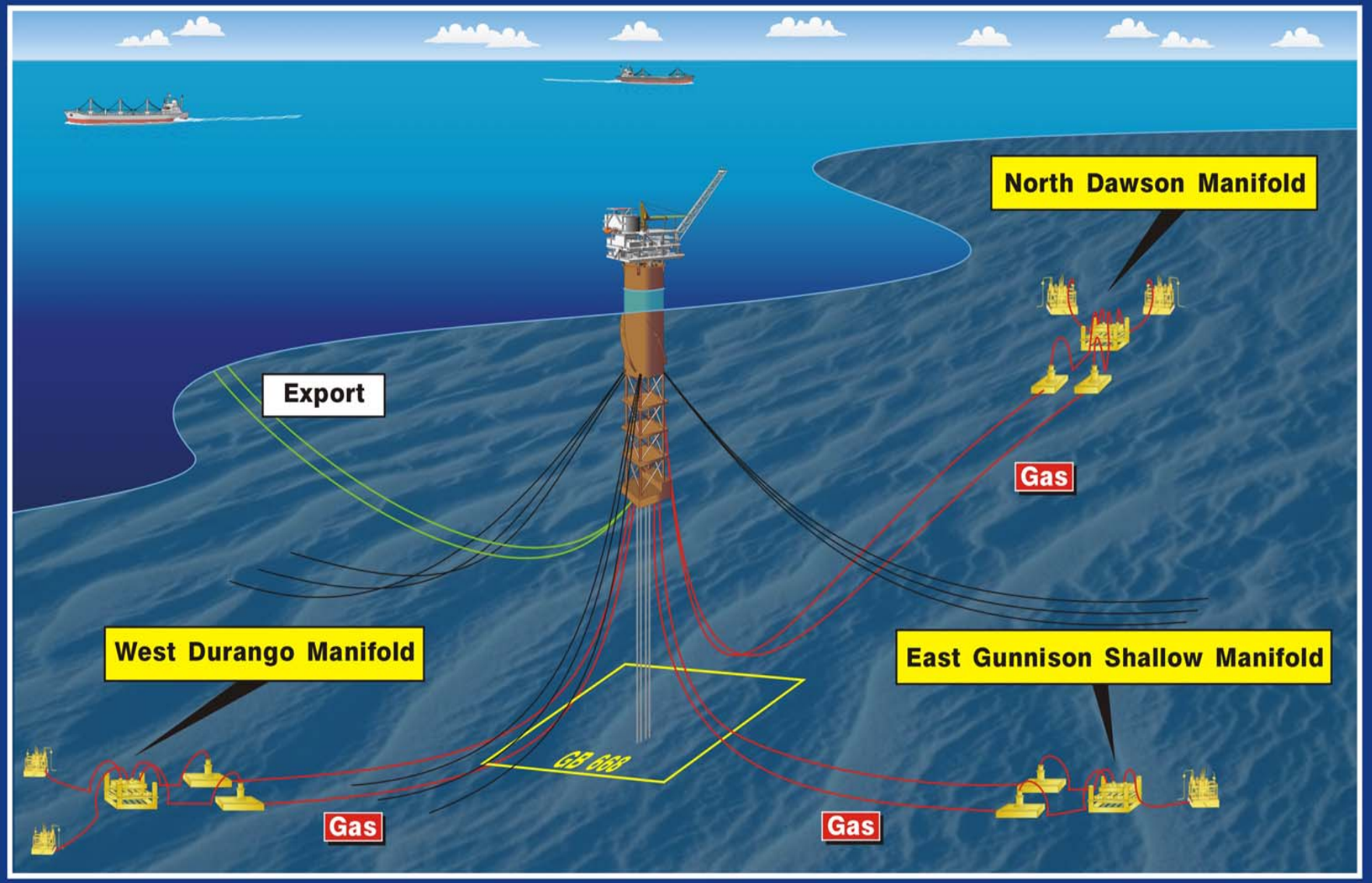
- Risers shielded from highest currents
- Risers shielded from wave forces
- Minimal wave frequency motions reduce dynamic excitation of riser to almost zero
- Low heave

DRY TREE RISERS

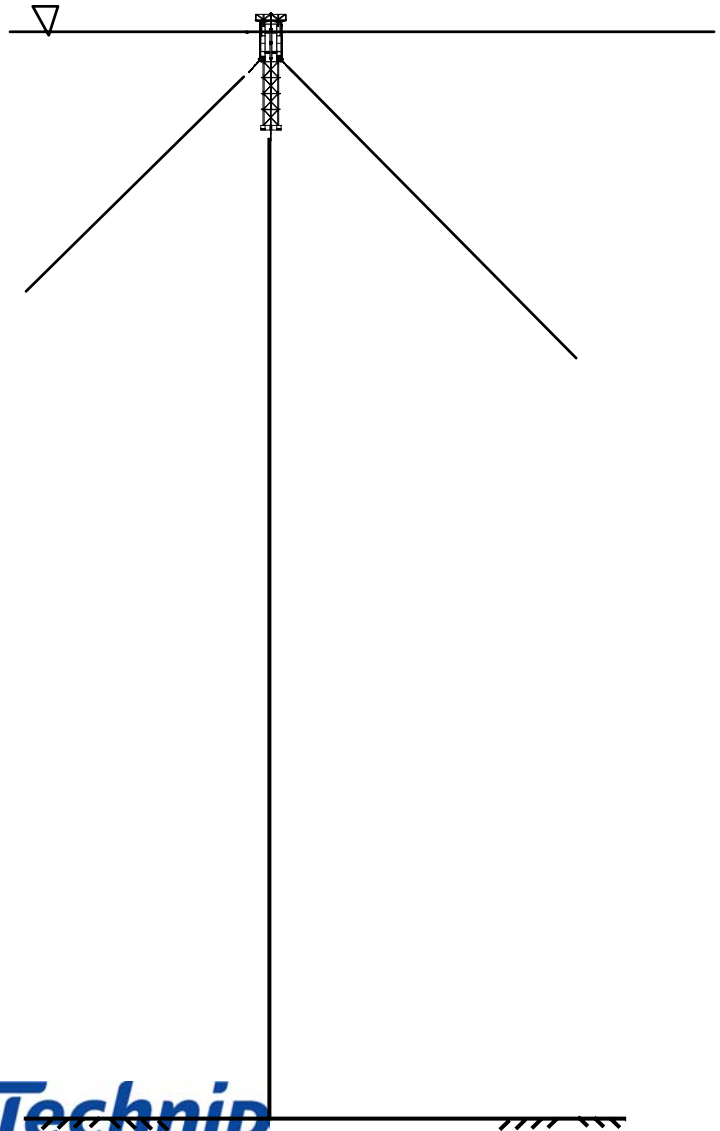


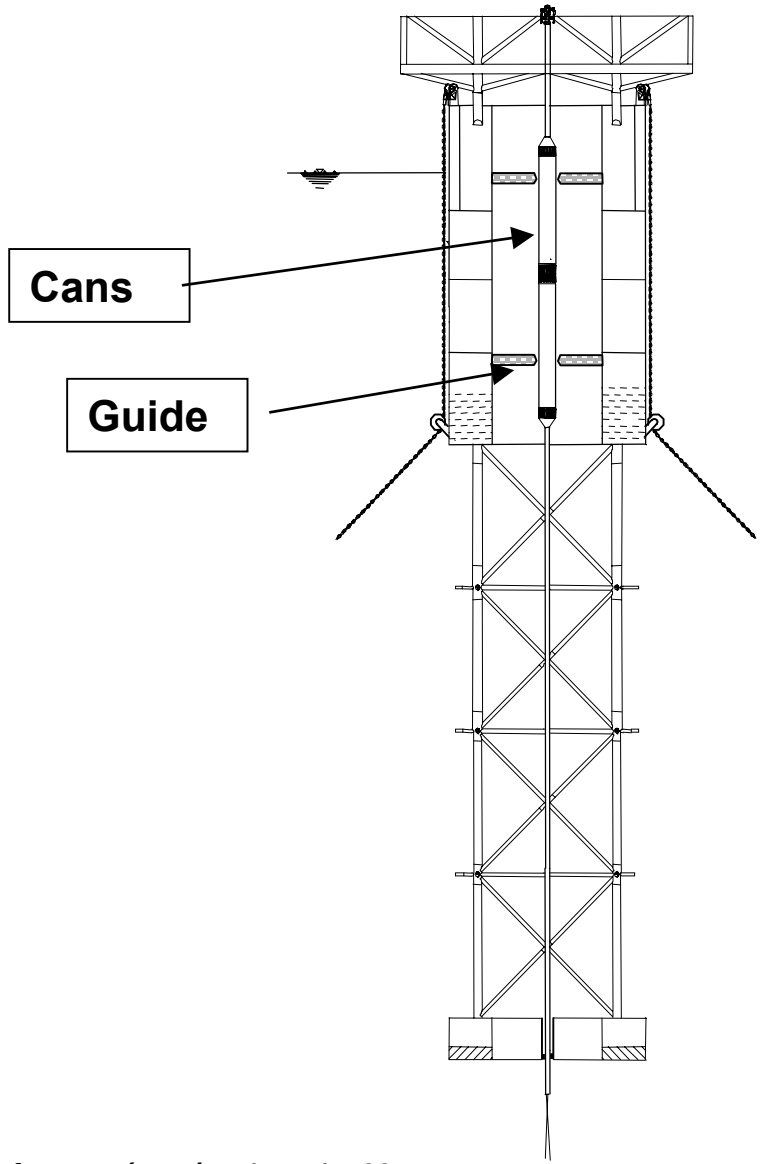


GUNNISON DEVELOPMENT CONCEPT

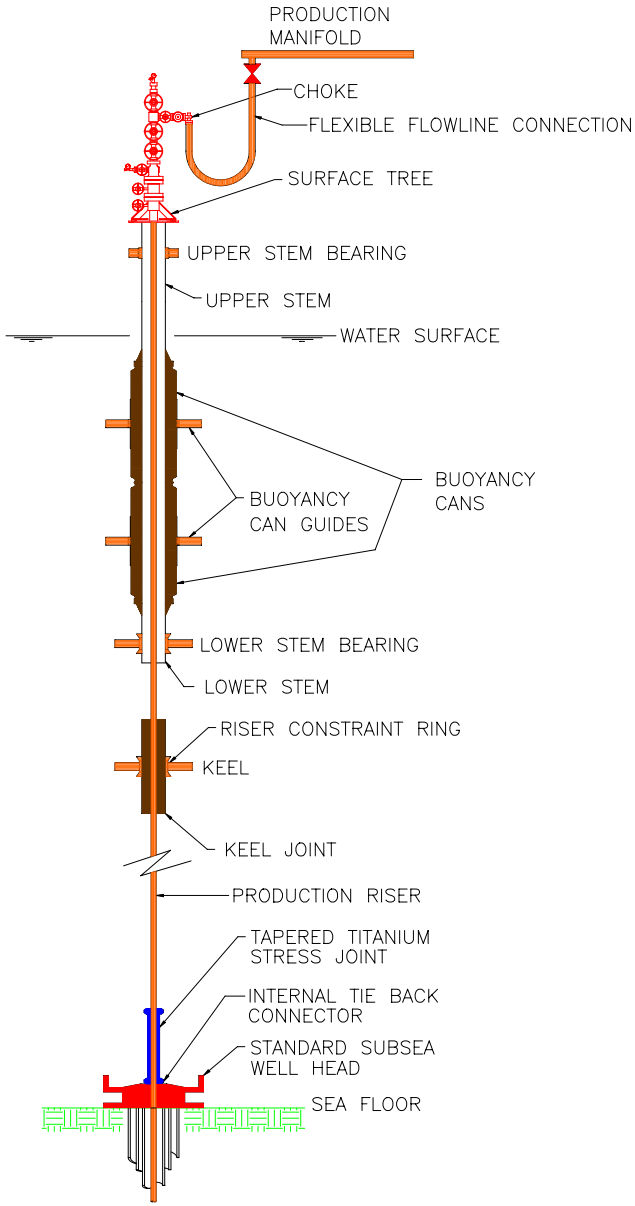


Spar Top Tension Riser System – Air Cans



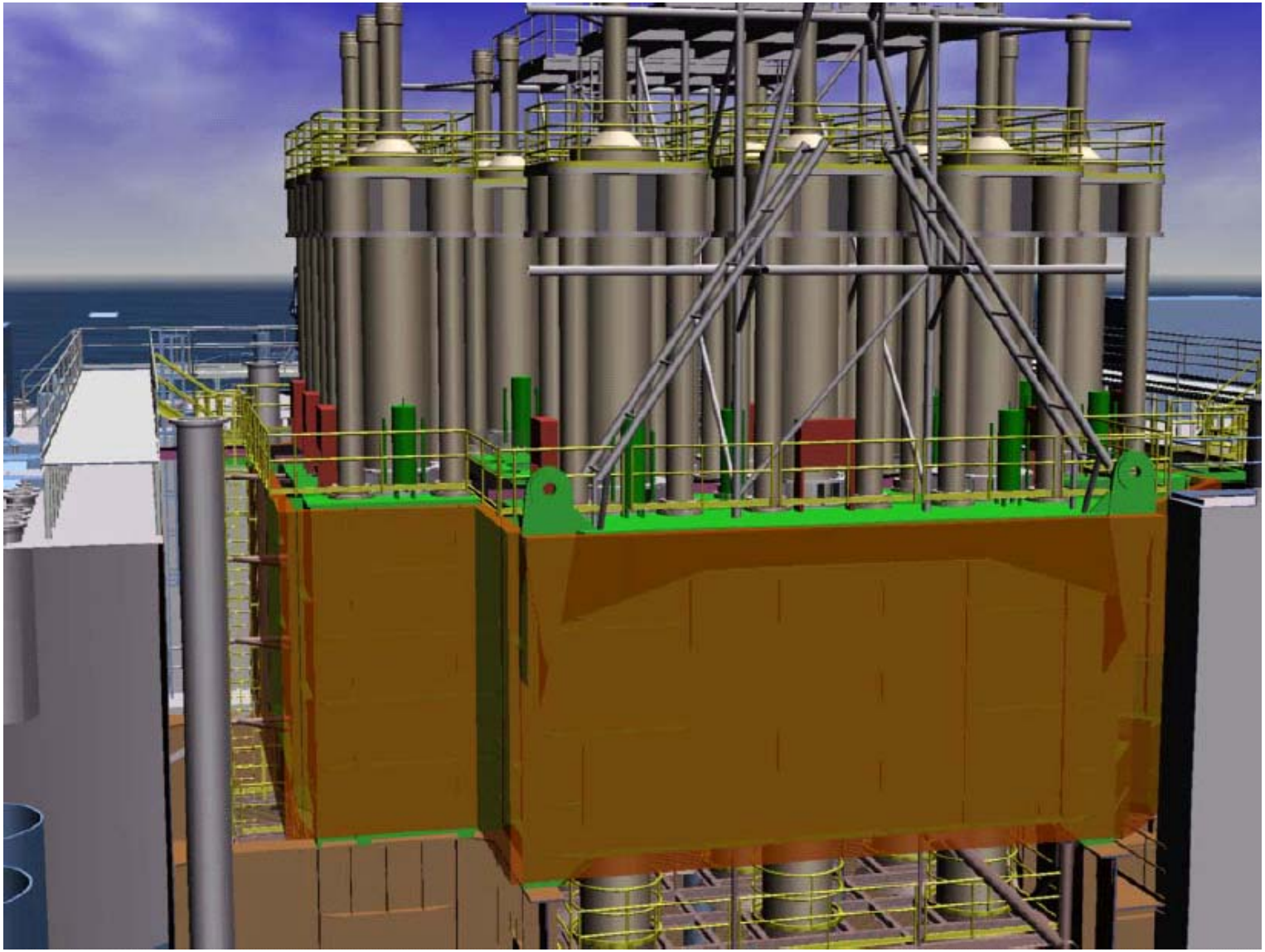


TYPICAL DRY TREE PRODUCTION RISER SYSTEM



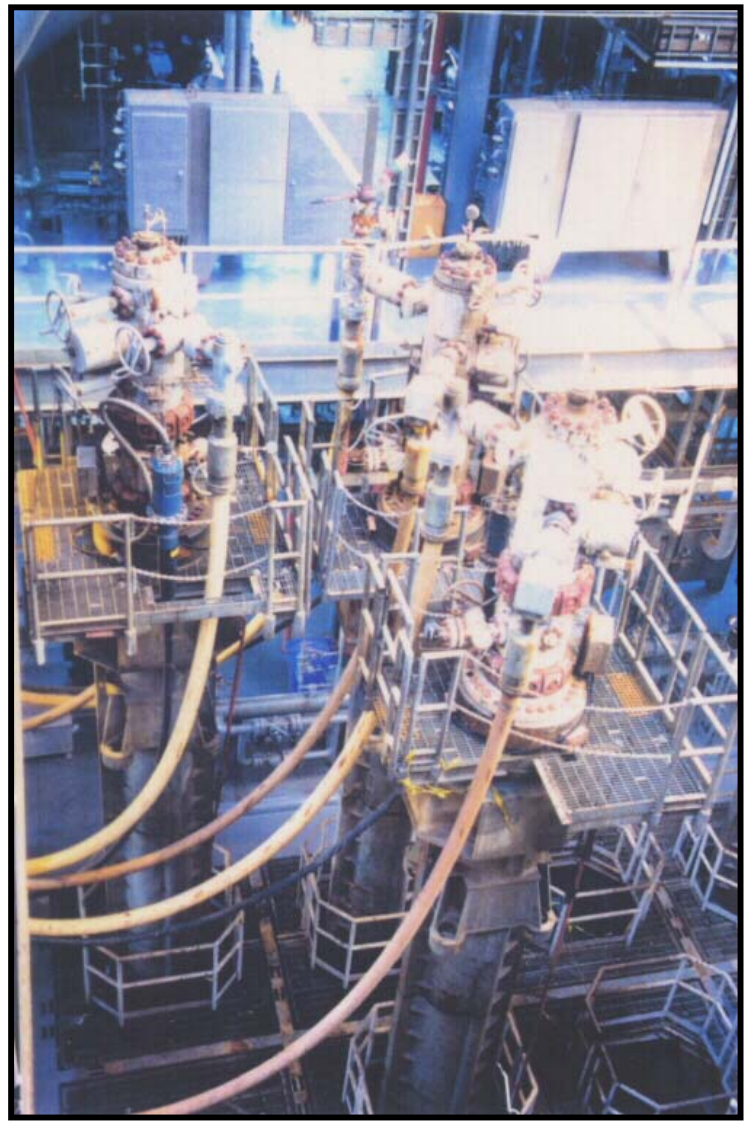
ORYX SPAR PRODUCTION RISER SYSTEM

TENSIONER SUPPORTED VERTICAL RISERS– UNDER CONSTRUCTION

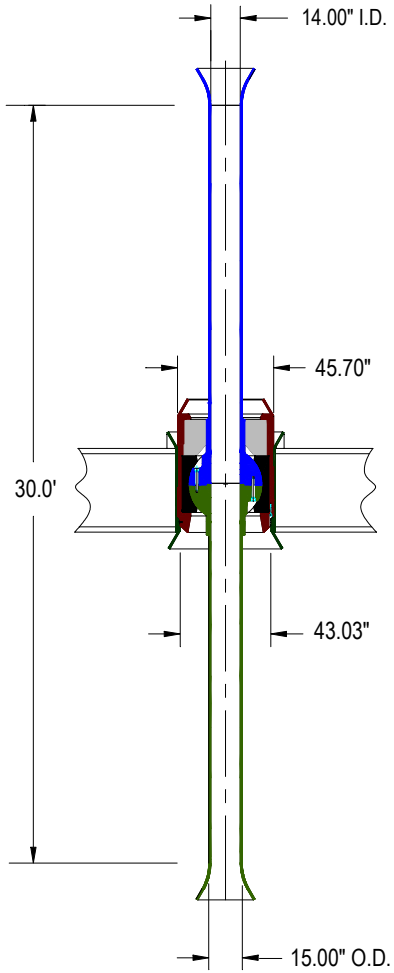


TOPSIDE FLEXIBLE JUMPERS

- **Design Drivers**
  - **Fluid Properties**
    - Pressure
    - Temperature
    - Composition
  - **Stroke Motion**
    - MBR
    - Clashing with Structure
    - Tension / Bending
    - Fatigue

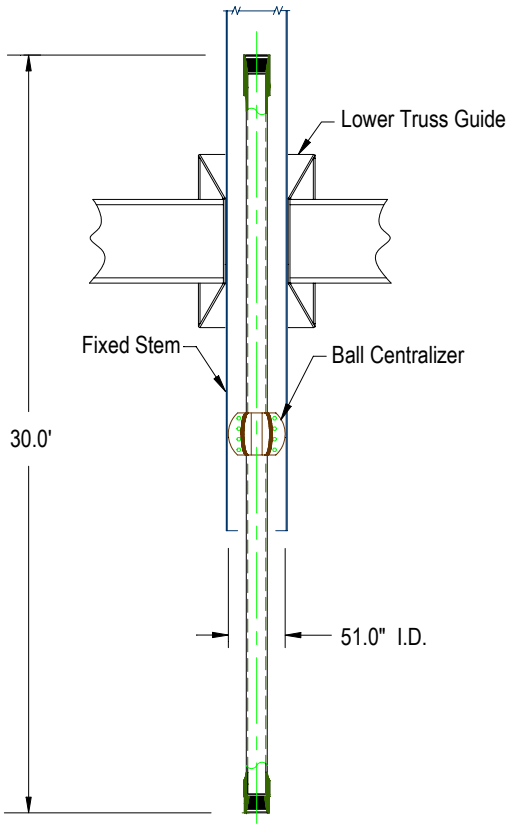


KEEL JOINTS



Truss Spar

9 5/8" Production Riser
Keel Joint Sleeve

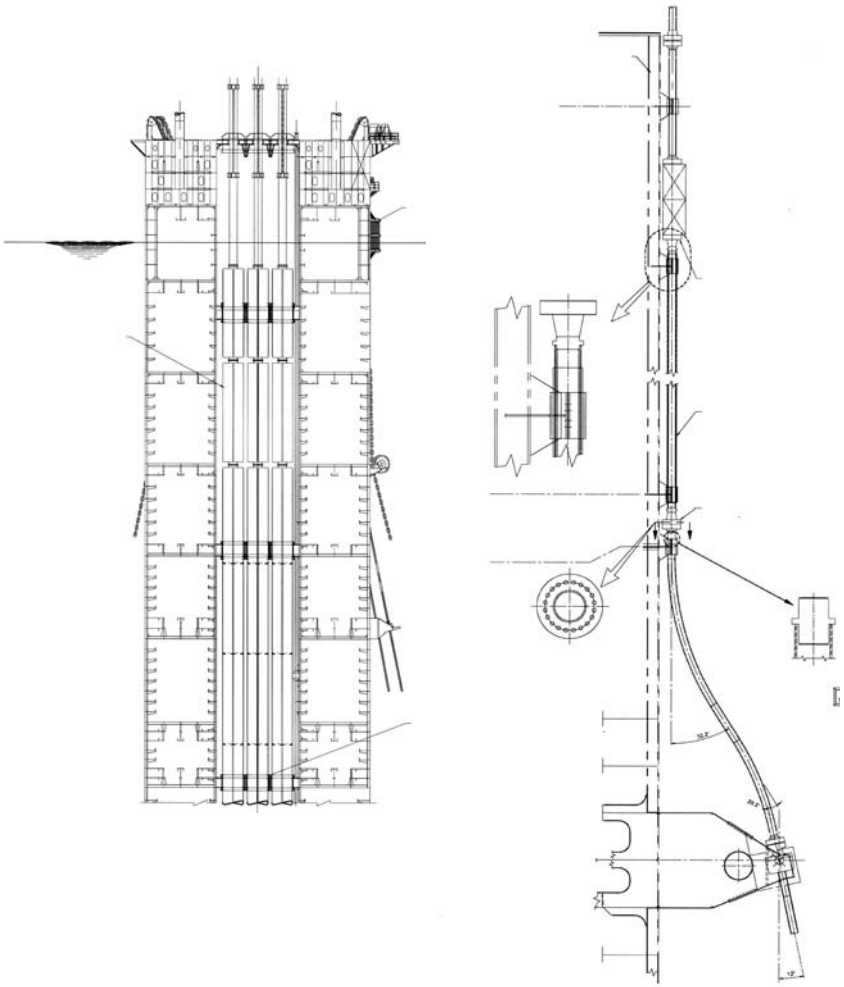


Classic Spar

9 5/8" Production Riser
Retrievable Keel Joint Sleeve

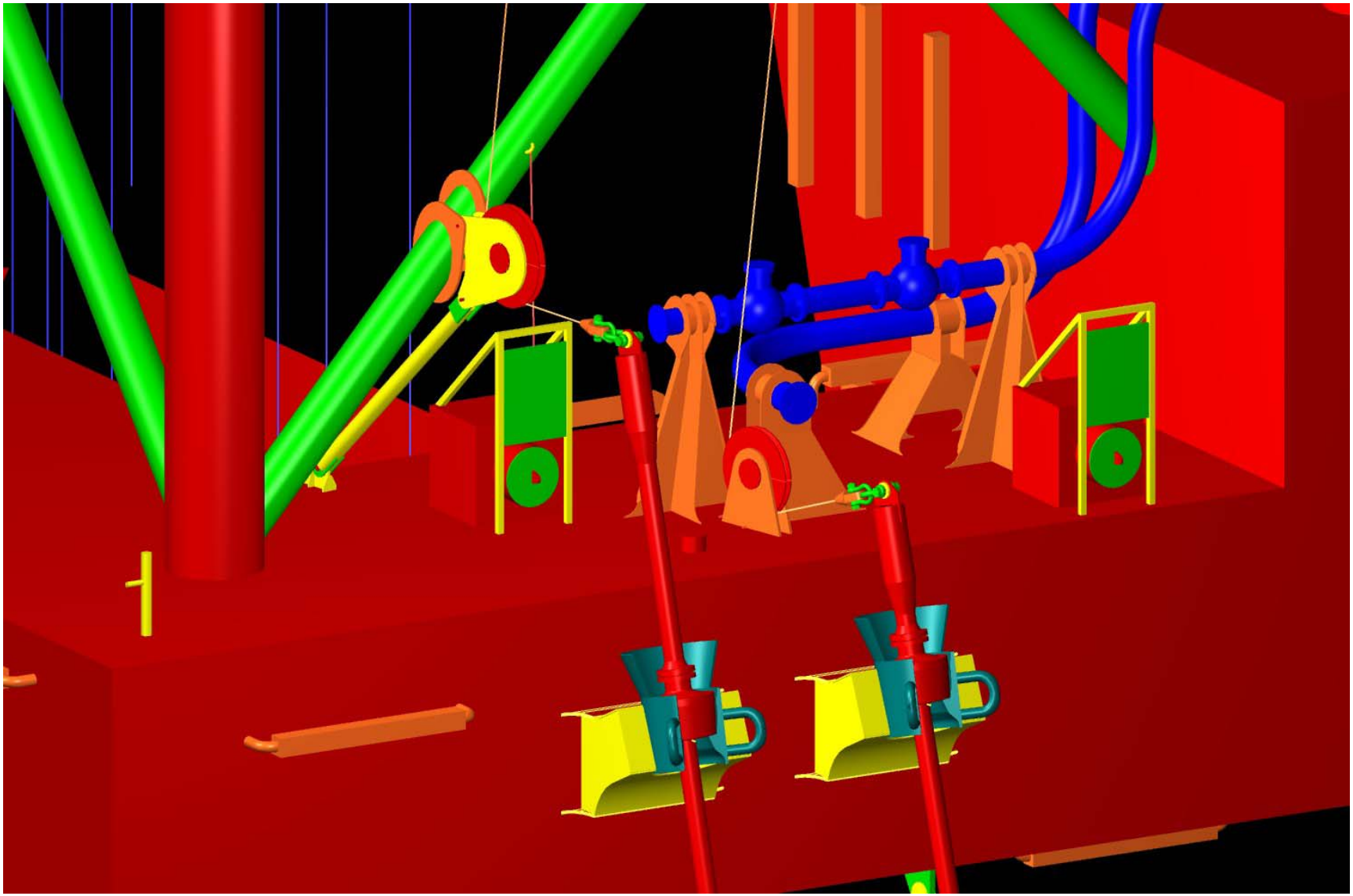
Examples : Porch Hang-off Locations

- **ExxonMobil Diana**
  - **Hard Tank**

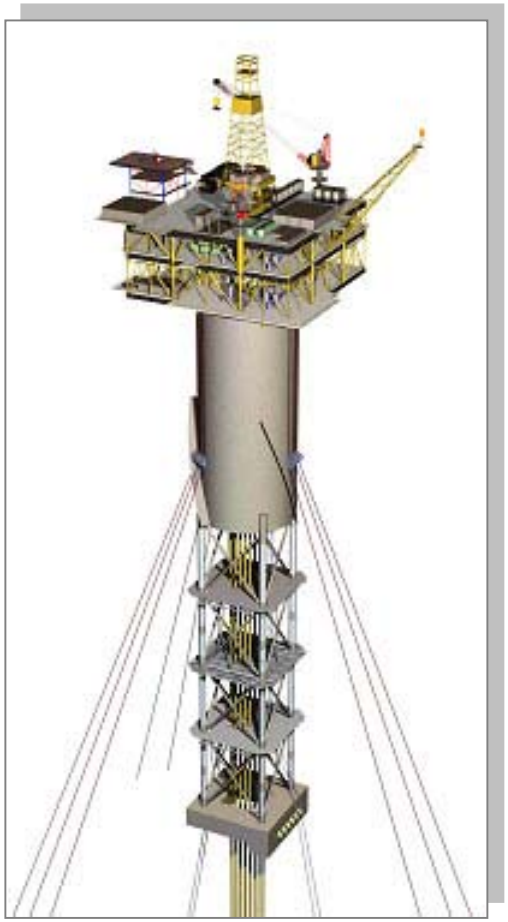


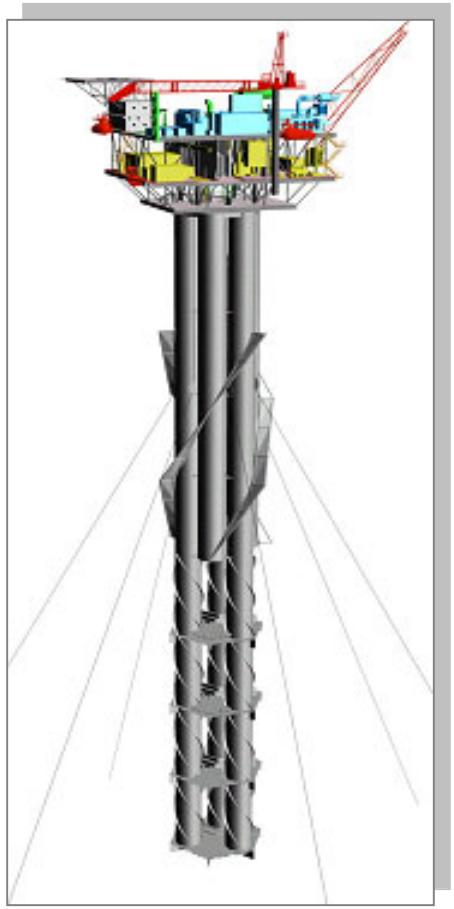
- **KMG Gunnison**
  - **Soft Tank**

Hull Piping & SCR Pull-in Equipment



TRUSS SPAR, CELL SPAR AND EDP





WHY A TRUSS SPAR?

- **More optimal structure**
  - **Replace high weight midsection with more efficient truss structure**
- **Higher damping allows reduction of draft**
  - **Single piece fabrication and transport brings cost, schedule advantages**
- **Extra wellbay real estate is cheaper than with a classic spar**
- **Reduction of drag loads in current-dominated areas allows reduction of mooring component sizes, costs**

Technip

NANSEN

- Water Depth - 3,600 ft
- Diameter - 90 ft
- Draft - 493 ft
- Topsides Payload - 7,700 tonnes
- Hull Steel Weight - 10,700 tonnes
- TTR Production Risers - 9 slots
- Workover/offset drilling
- Export - SCRs

RING SECTION ASSEMBLY AT YARD ASSEMBLING RAILS

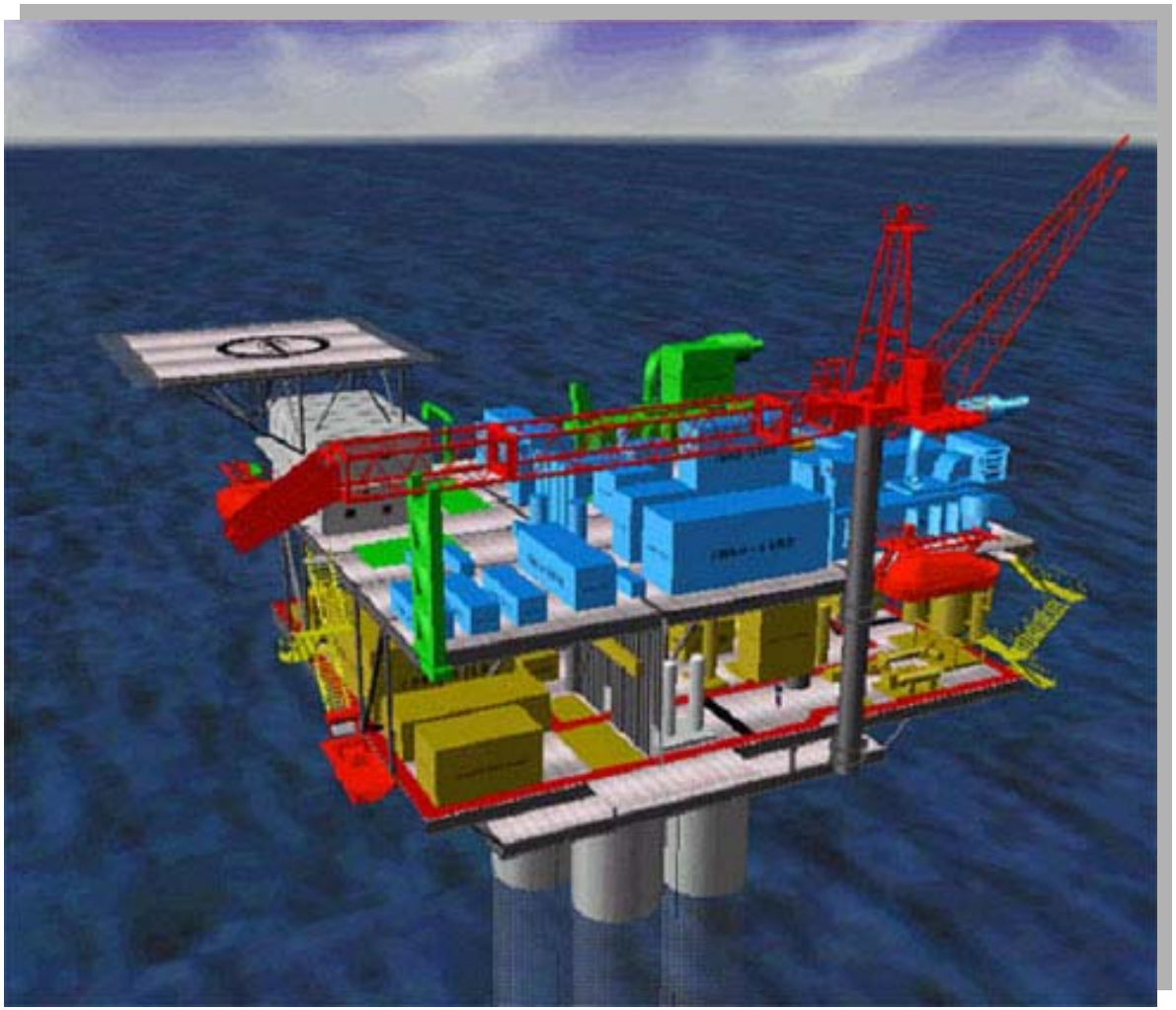
Technip

BARGE HARRY AT THE END OF ASSEMBLY RAILS

HOLSTEIN HARD TANK

HULL TRANSPORT

CELL SPAR



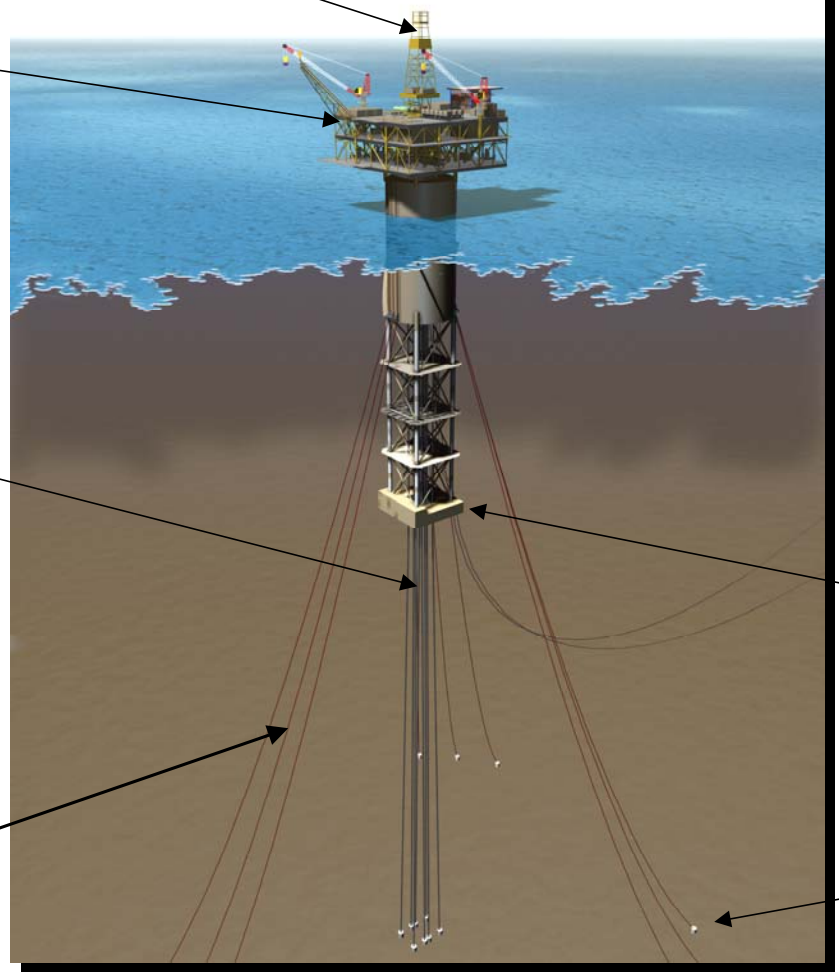
BP HOLSTEIN DRILLING AND PRODUCTION SPAR

DRILLING SYSTEMS
Sail Area
Drill Package Transit Speed

TOPSIDES
Seachest
Utilities to Hull
Overboard Discharges
Material Handling
Hull-to-Deck Connection
Spar Deck Layout
Liquid Storage in Hull Tanks
Weight and C.G.
Sail Area
Disposal Caisson

WELL SYSTEMS
Future Flowlines
Umbilicals
Well Bay Arrangement
Riser Loads
Riser Stroke
Center Well Size
Number of Wells
PRT Support Frame Loads
Size of Slots
Vessel Motions

BP HIGH VALUE COMMODITY
Mooring Wire
Mooring Chain



HOLSTEIN INSTALLATION TEAM
Weights
Towout
Upending Analysis
Hull-to-Deck Connection
Setting of Decks
Installation Aids

MARDI GRAS TRANSPORTATION SYSTEM
Export Riser Pipe in Hull
Riser Guide Pipe in Hull
Riser Porch
SCR Chain Jack Platform
Installation Aids
Testing

GEOTECHNICAL
Soils Data (For Mooring)
Geohazards (For Mooring)

Technip

WHY A CELL SPAR

- **Less Expensive to Build**
  - Simple Design - Automated Design
  - Standard Design - Duplication
  - Automated Fabrication
    - Machine Rolled Cells (Cans)
    - Submerged Arc Welding
- **Schedule Incentives**
  - Reduced Engineering Effort & Time
  - Fast Hull Fabrication
  - Standard Topsides Modules
    - Do Not Optimize
    - Lease Existing Equipment

CELL SPAR

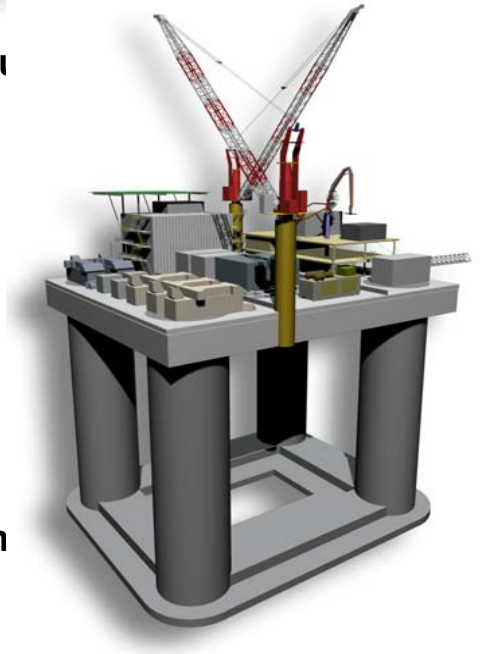
RED HAWK

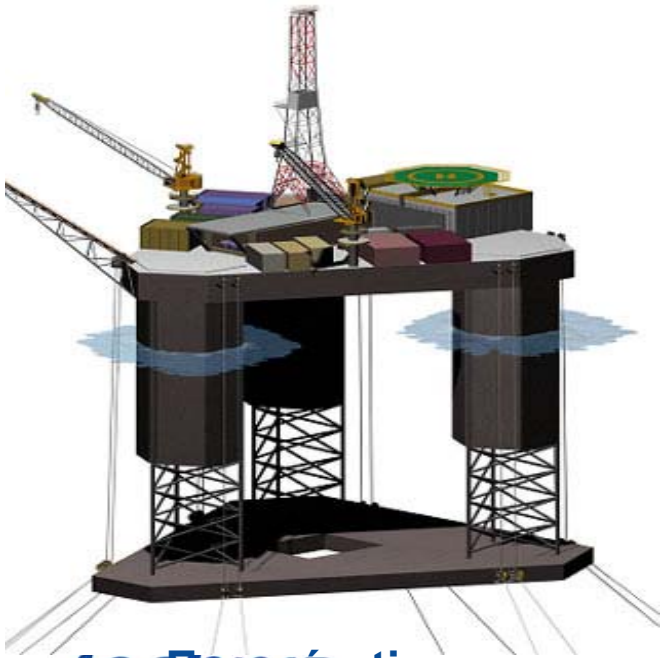
THIS IS THE FIRST APPLICATION OF A CELL SPAR (2004)

EXTENDABLE DRAFT PLATFORM (EDP)

Remorquage en mer

- Extendable Draft Platform (EDP) pour forage et/ou production et/ou opérations sur puits existants
- Tous les systèmes de la plate-forme sont testés à terre, travaux de démarrage en mer réduits au minimum
- Convient pour de grosses exploitations, en eaux très profondes et un nombre importan de puits





Composé de :

- Pont de type barge
- Installations de traitement situées sur le pont
- Jambes (buoyant column + truss)
- Ponton (amortisseur de pilonnement)