

Deepwater Oil & Gas Facilities

6th China-US OGIF, New Orleans, USA

June 28 – 29, 2005

2005年6月28日至29日

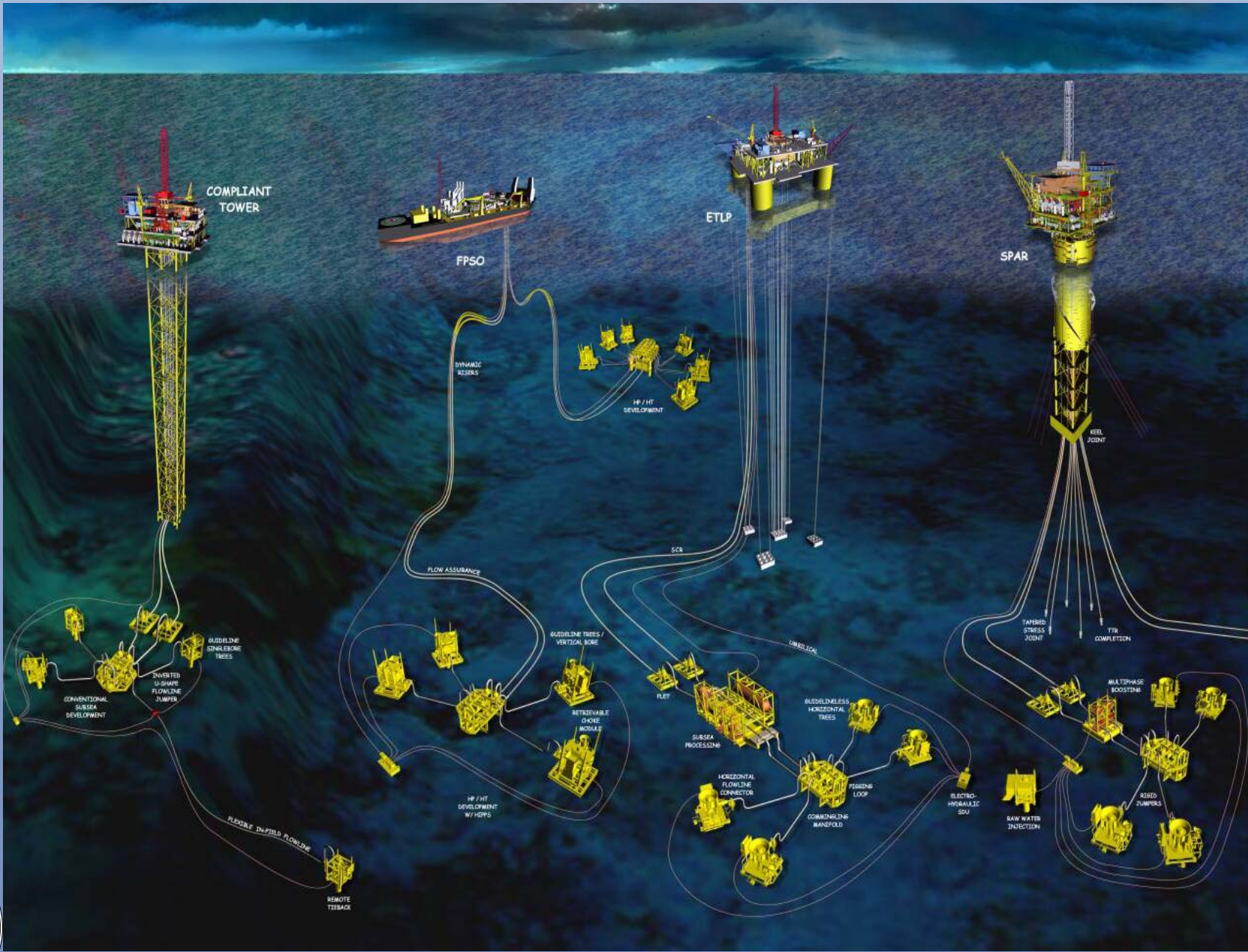


**Bill Soester
V.P. Engineering
J. Ray McDermott**

Definitions of Deepwater

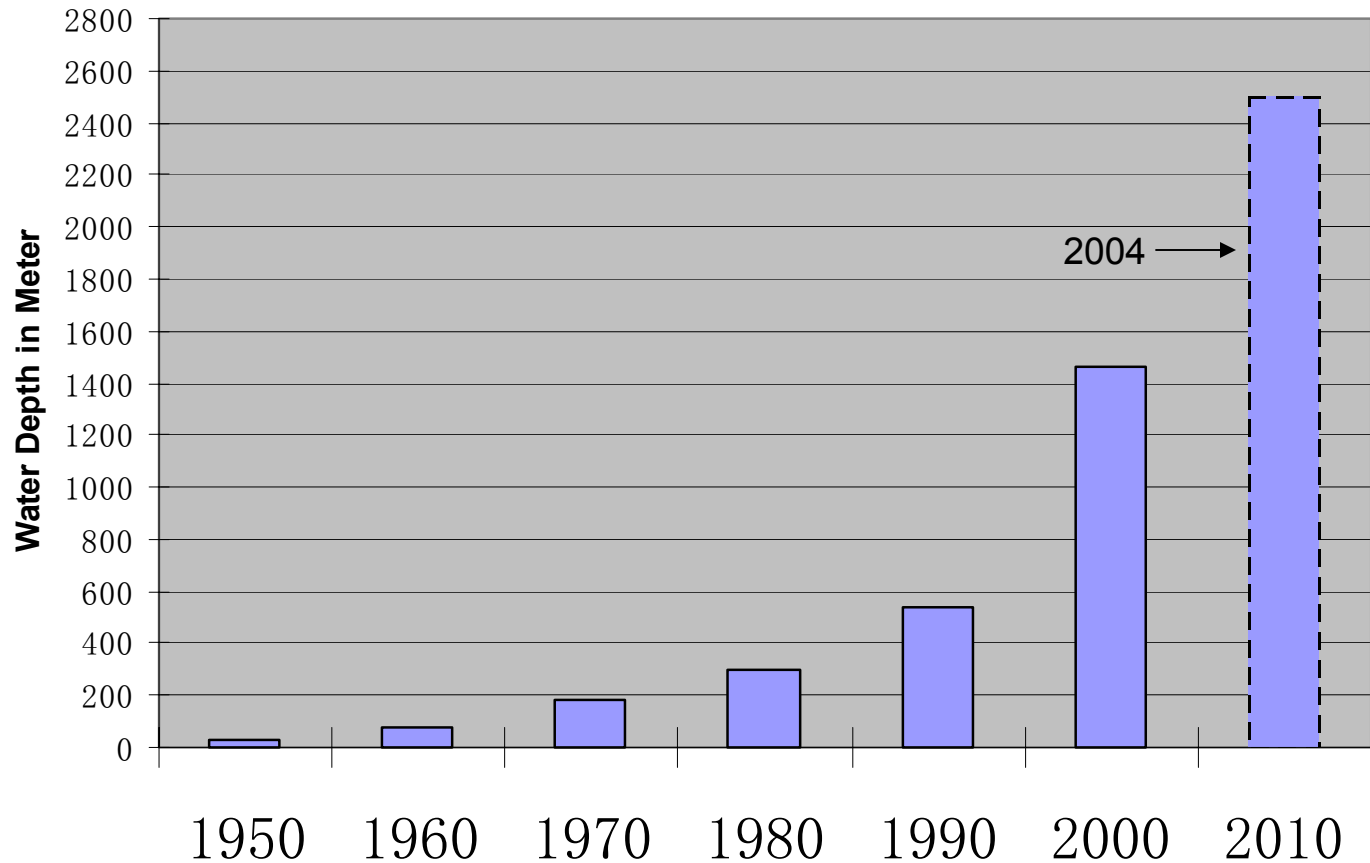
- **Relative, change as technologies progress**
- **10 Years ago**
 - Deepwater: >300 meters
- **Today**
 - Deepwater: > 500 meters
 - Ultra-deepwater: > 1,500 meters
- **Water Depth Records (2004)**
 - Production – dry tree: 1,710 m, Devils Tower Spar, GOM
 - Production – wet tree: 1,920 m, NaKika Semi, GOM
 - Drilling: 3,051 Meters, Toledo #1, GOM



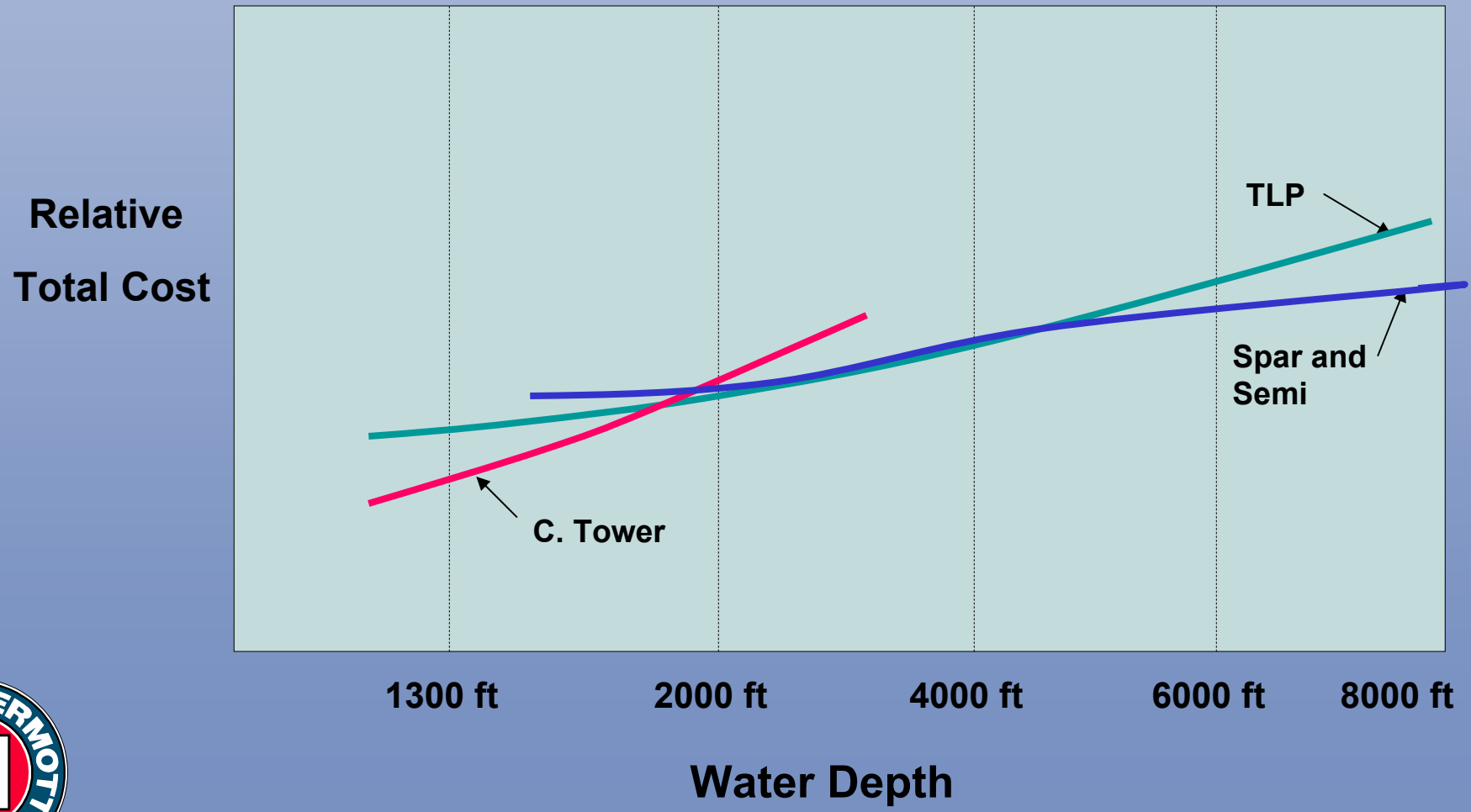


Deepwater Development Solutions

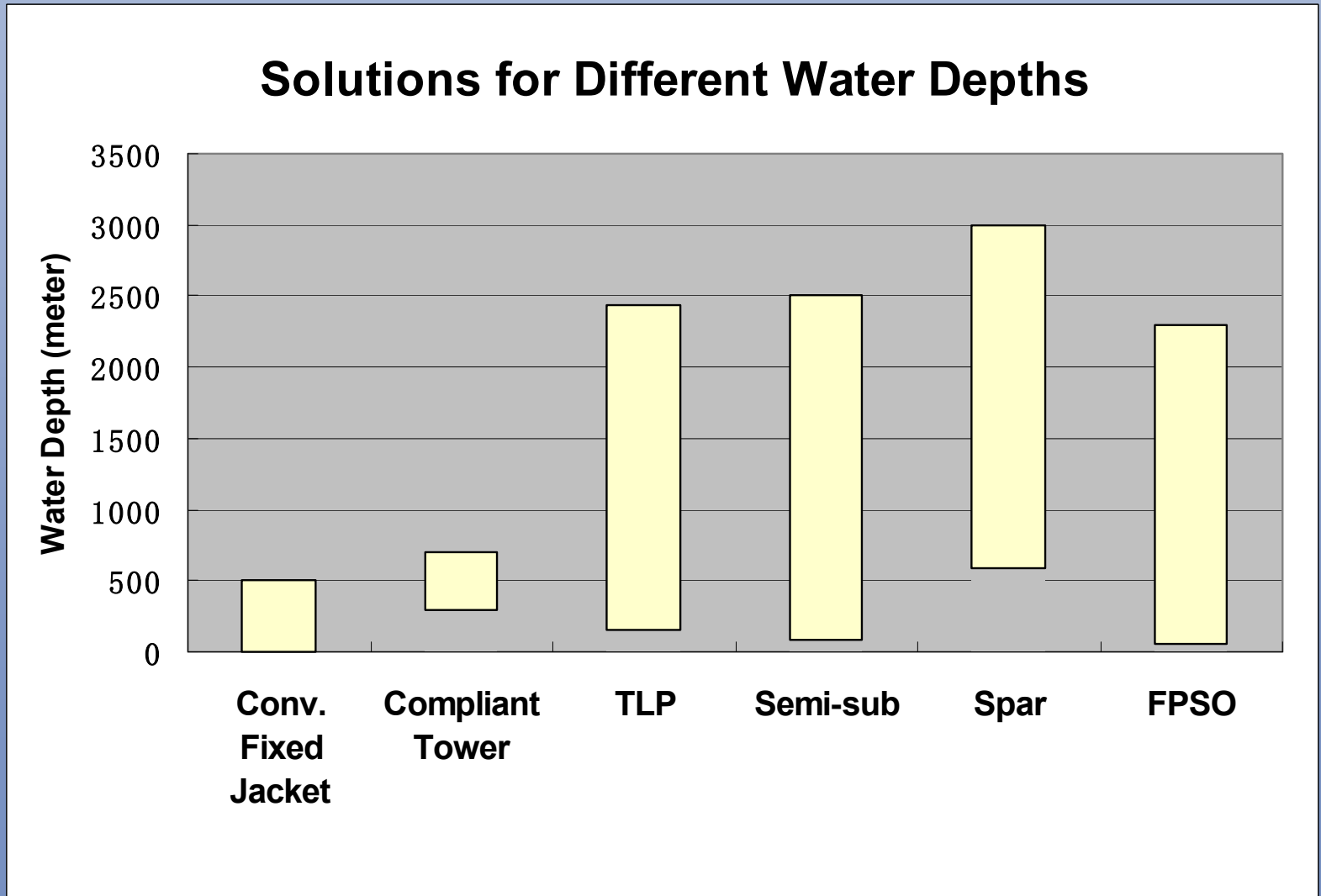
Advances in Deep Water Production Capability



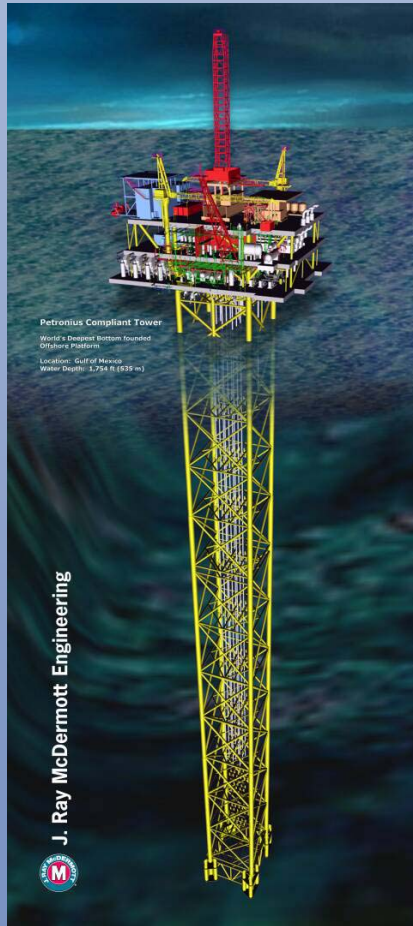
Deepwater Development Solutions



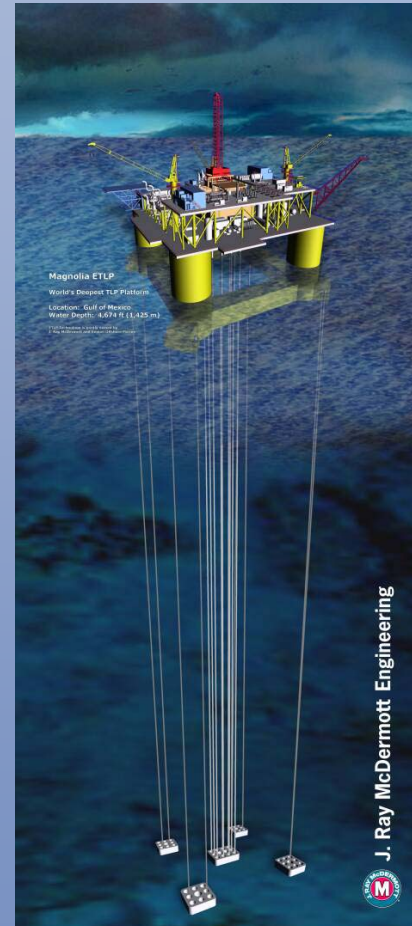
Deepwater Development Solutions



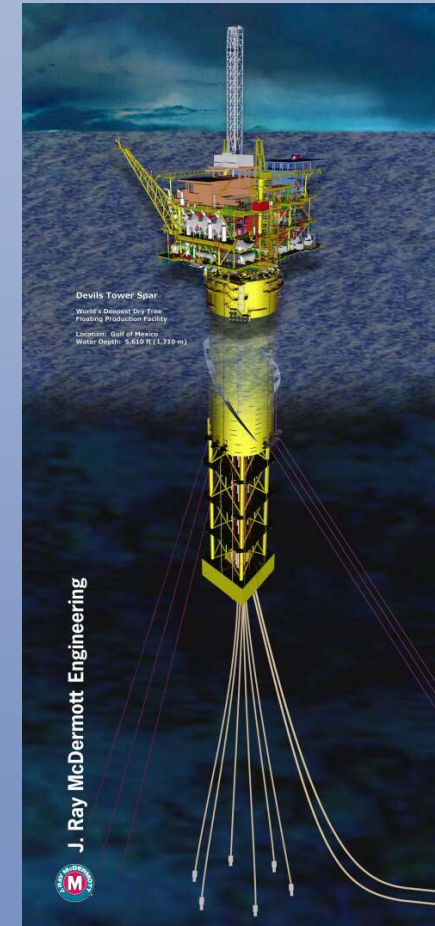
Deepwater Production Facilities – for Dry Trees



Compliant Tower



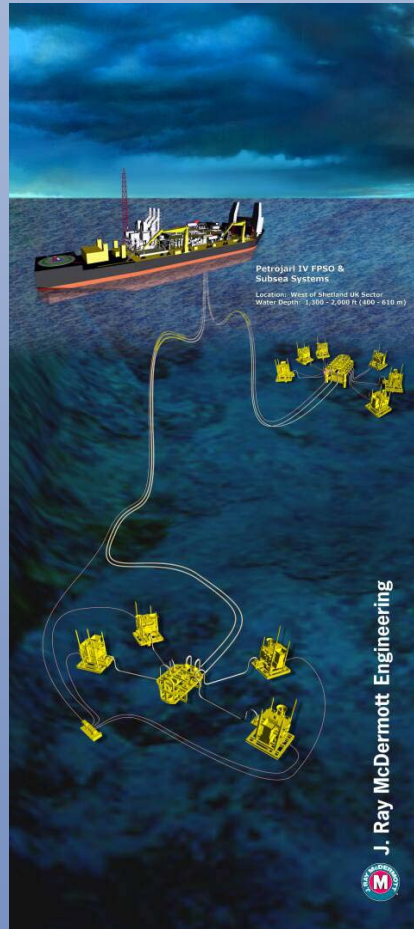
Tension Leg Platform
(TLP)



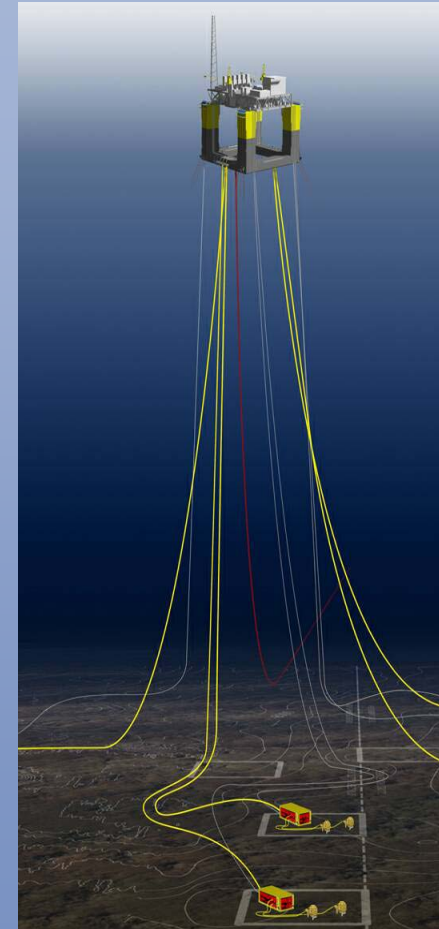
Spar



Deepwater Production Facilities – for Wet Trees



**Floating Production,
Storage and Offloading (FPSO)**



**Semi-submersible
(Semi)**

Inputs to the FPSO vs. non-FPSO Decision

- Access to Pipeline Grid or shore
- Oil Export Site – Political or Economical factors
- Life of Field
- Dry Tree vs. Wet Tree
- Reservoir Development Plan
- Tolerance to Production Down Time



Factors in Choosing between Non-FPSO Solutions (Spars, Towers, TLPs, Semis)

- **Water Depth**
- **Environment Conditions**
- **Initial vs. future Topside Weight**
- **No. of Risers**
- **Drilling Program**
- **Access to Wells: Wet vs. Dry**
- **Installation Capabilities**
- **Initial vs. Total Life Cycle Cost**

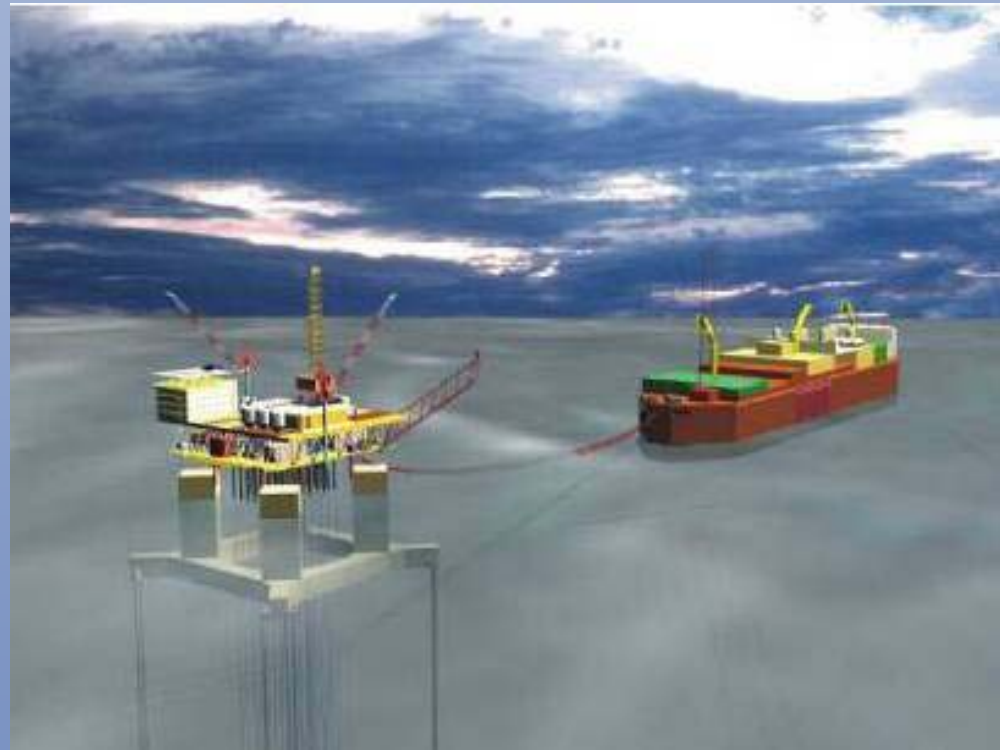


Hybrid Solution – Obtaining the Benefits of both Types of Facilities

- **TLP or Spar**
 - Drilling
 - Dry Trees
 - Easy Intervention

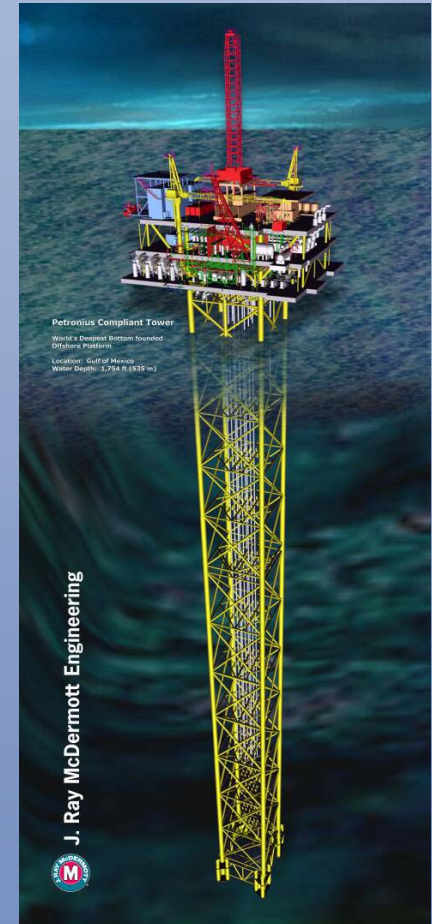
and

- **FPSO**
 - Processing
 - Storage
 - Offloading

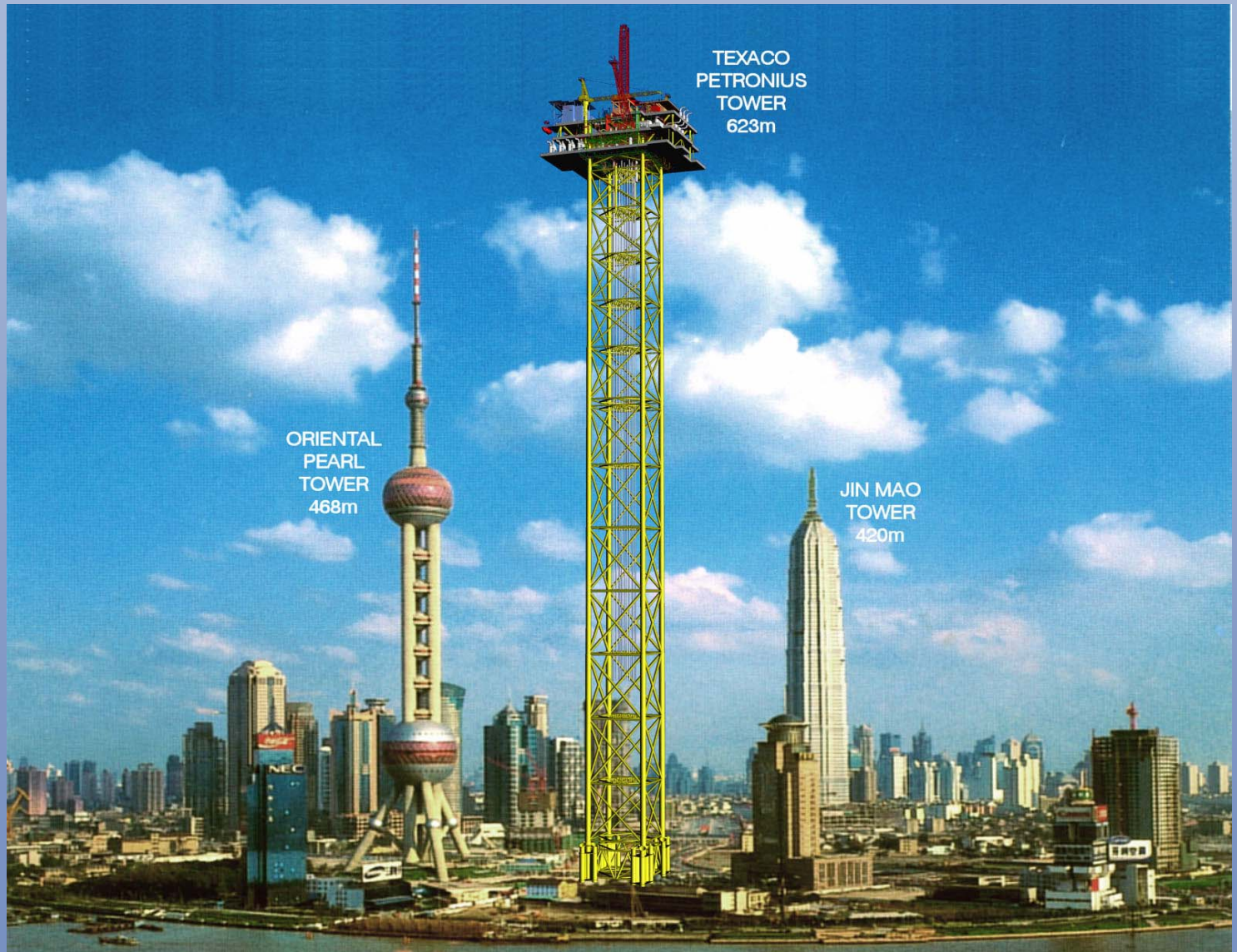


Compliant Tower

- **Design:**
 - Tower – Slender jacket
 - Compliant – designed to avoid resonance with large waves
- **Application** – most cost effective in 300 to 670 m.
- **Advantages:**
 - Dry tree
 - Robust relative to payload changes
 - Less steel tonnages required (in the above depth range)
 - Simpler, conventional fabrication
 - Installation flexibility
- **Disadvantages :**
 - Limited water depth range

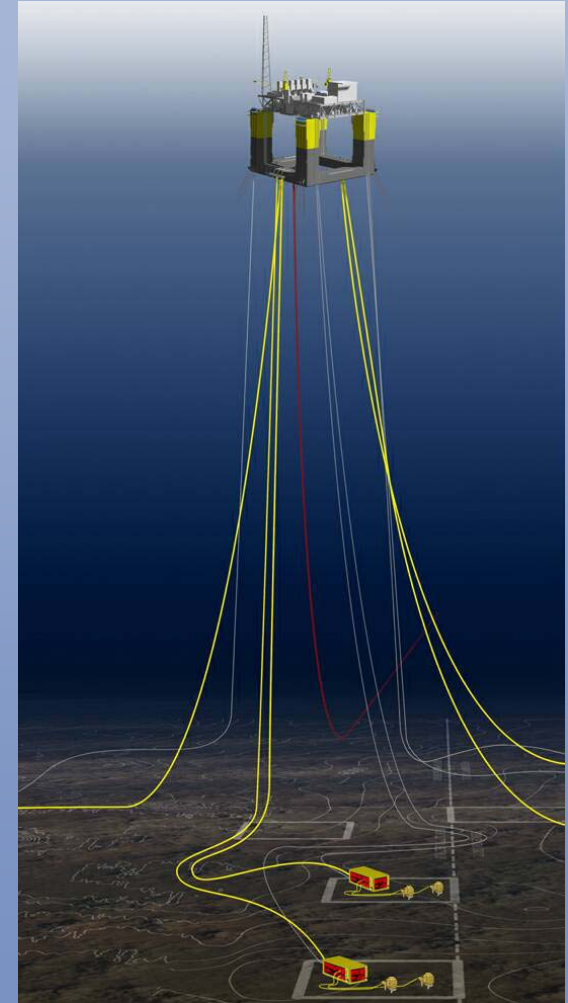


Compliant Tower – Tallest Man Made Structure



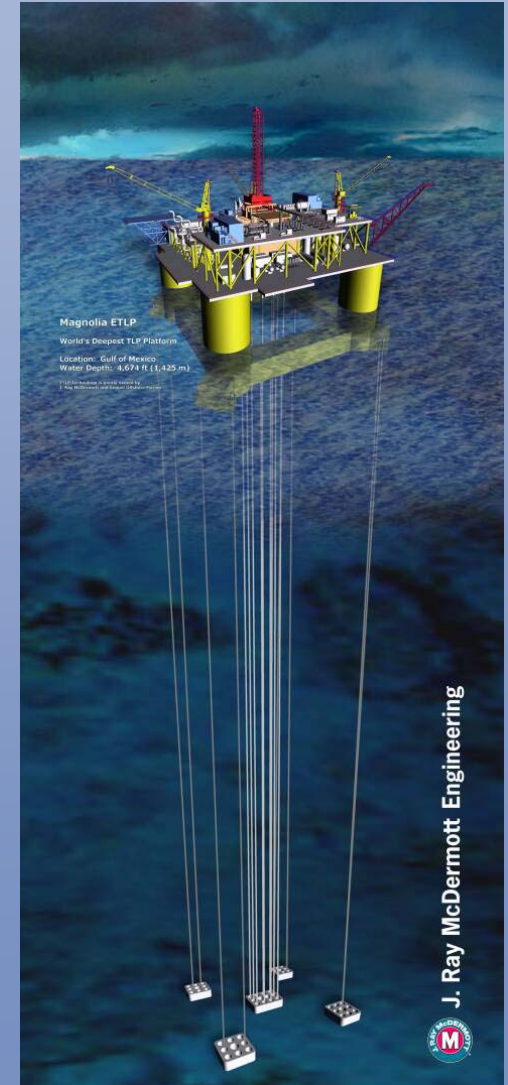
Semi-submersible

- **Design** – vertical columns supporting topsides and supported on large pontoons, anchored to the seafloor with spread mooring lines.
- **Applicable W.D.** – 80 m to 2,500 m
- **Advantages:**
 - Large number of flexible risers possible
 - Quayside Topsides-hull integration
- **Disadvantages:**
 - Wet tree only
 - high maintenance cost
 - Fatigue motion – not friendly to risers
 - Sensitive to deck payload



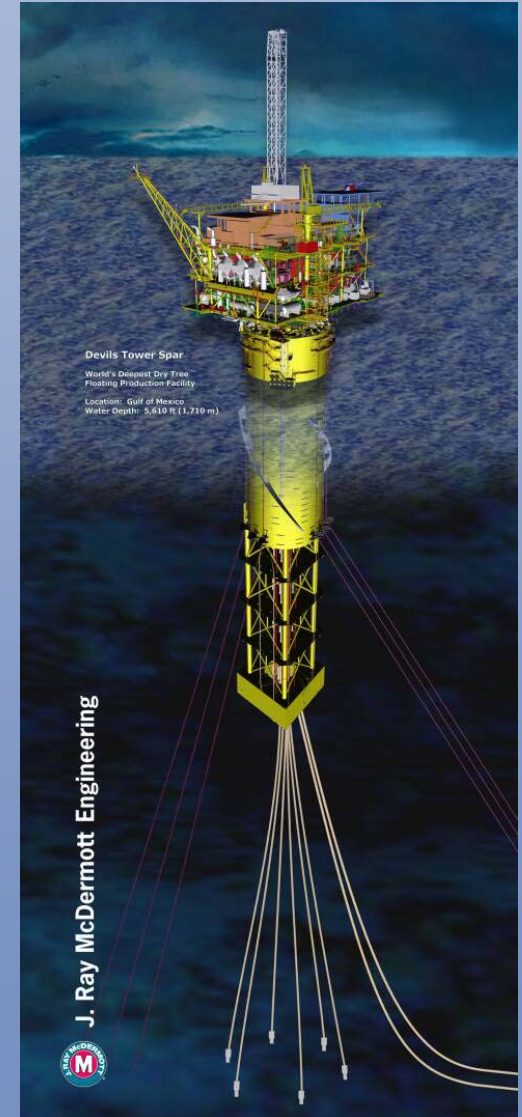
Tension Leg Platform (TLP)

- **Design** – Similar to a semi-submersible but anchored to the seafloor with vertical tendons.
- **Application** - more cost effective from 600 m to 1,200 m
- **Advantages:**
 - Dry tree
 - Friendly to SCR
 - Quayside topsides-hull integration
 - Low maintenance cost
- **Disadvantages:**
 - Sensitive to deck payload change
 - Active hull system
 - Not friendly to offset drilling
 - Tendon fatigue



Spar

- **Design** – Large vertical column supporting topsides and connected below to the ballast tank with a truss section. A spread mooring system is used for station-keeping.
- **Application** – 550 m to 3,000 m
- **Advantages:**
 - Superior stability
 - Dry trees
 - Friendly to SCR
 - Accommodates payload changes
 - Friendly to offset drilling
 - Passive hull system
 - Low maintenance cost
- **Disadvantages:**
 - Topside lift at installation site
 - Large derrick barge required for topsides installation



Deepwater Technology Suppliers

- **Compliant Tower**
 - J. Ray McDermott
 - Wood Group

- **TLP**
 - J. Ray McDermott (JV with Keppel)
 - MODEC
 - SBM
 - Aker-Kvaerner

- **Spar**
 - J. Ray McDermott
 - Technip

- **FPSO**
 - Various

- **Semi-submersible**
 - Various



The Industry's Deepwater Experience

- **Compliant Tower – 3 each**
- **Spar – 13**
- **TLP – 21**
- **Semi (production type) – 43**
- **FPSO – 119**



The Future

- Improved design tools – providing lower weight and less expensive hulls
- Improved hull shapes – greater motion stability and payload capacity
- Improved deepwater riser technology
- Synthetic mooring lines for ultra deep water



Conclusion

- **China is proceeding with deepwater exploration**
- **Deepwater solutions are available for China's O&G development plans, from 300 meters to 3000 meters**
- **Cooperation between China and the deepwater technology contractors makes good business sense**

Thank You

