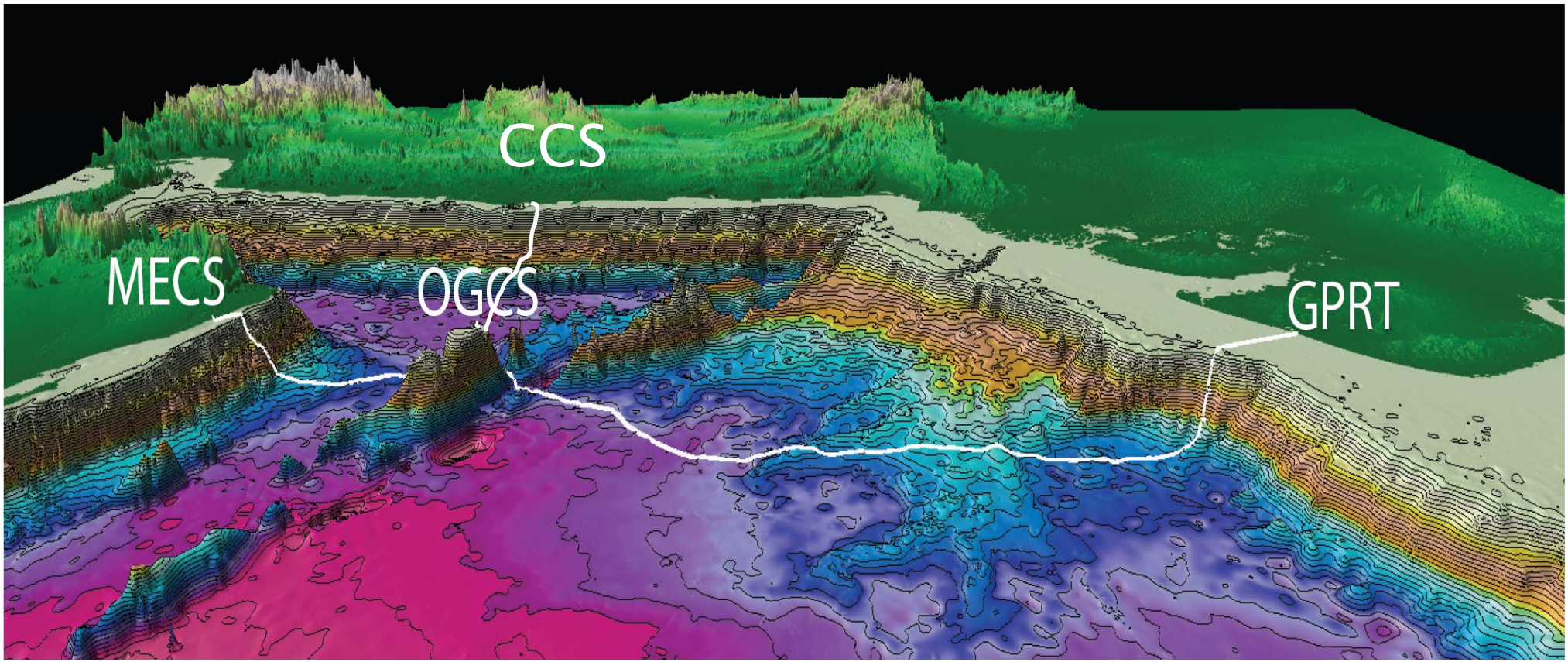
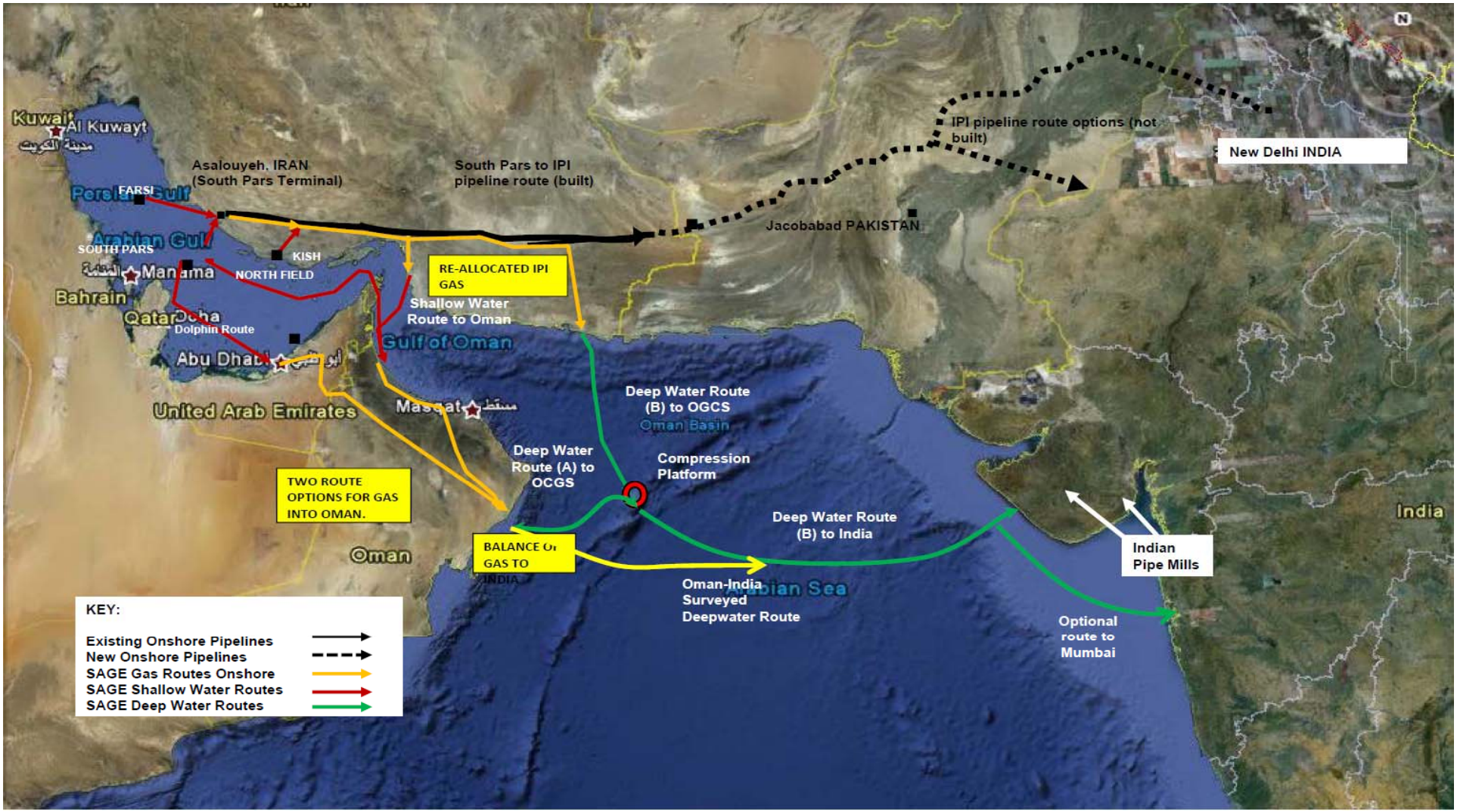
SAGE Joint Working Group Meeting
Middle East to India Deepwater Pipeline



Agenda

1. Project Structure
2. Technical Development Update.
3. Road Map for further Actions
4. Discuss Draft of Term Sheet for GSPA.

Gas Routes to India



SAGE MOU's and Agreements

MOUs/Agreements to Co-operate with SAGE in developing MEIDP have been signed with:

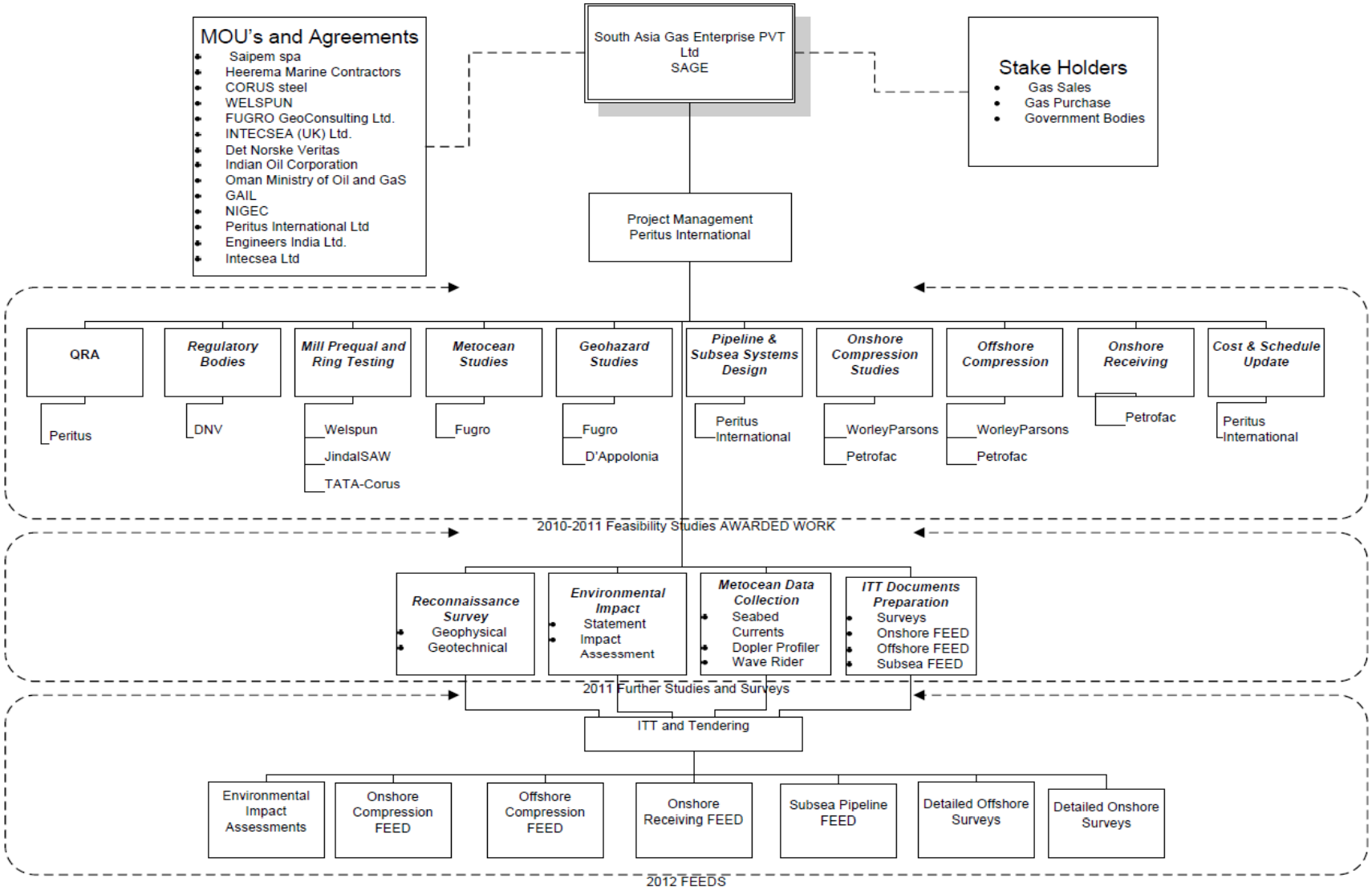
- Indian Oil Corporation
- Oman Ministry of Oil and Gas
- GAIL
- NIGEC
- Peritus International Ltd.
- Engineers India Ltd.
- Saipem spa
- Heerema Marine Contractors
- CORUS steel
- WELSPUN
- FUGRO GeoConsulting Ltd.
- INTECSEA (UK) Ltd.
- Det Norske Veritas

SAGE Project Contributors

Project Contributions have been made by the following companies:

- Peritus International Ltd.
- TATA (CORUS) steel
- WELSPUN
- JindalSaw
- FUGRO GeoConsulting Ltd.
- FUGRO William Lettis Inc
- D'Appolonia Spa
- INTECSEA/WorleyParsons Ltd.
- Det Norske Veritas
- Saipem Spa
- Petrofac Ltd

Project Structure



Project Update

- 2010 Completed Studies
- 2011 Completed Studies
- 2011 Awarded – Ongoing Studies
- 2011 Planned Activities
- 2012 Planned Activities

2010 Activities Completed

2010 feasibility activities included

- Overall Project Management of all activities
- Design Basis definition
- Flow Assurance Studies
- Mechanical Design
- Onshore Compression Station Definition
- Offshore Compression Station Definition
- Quantified Risk Assessment - OIP Update
- Geohazard and Fault Crossing Assessment Phase 1
- Metocean data Phase 1
- GIS Data collection Phase 1
- Assessment of the effects of moderate heat treatment

2011 Completed and Ongoing studies

Completed Studies

- Vessel & equipment capabilities review
- Pipeline intervention review
- Riser and subsea by-pass definition
- Onshore compression station review
- Offshore layout optimisation
- Receiving terminal conceptual design
- Emergency repair equipment review

Awarded Ongoing Studies

- Project Management
- Establish no hydrotest principle
- Project Schedule review and update
- Project Cost Estimate review and update
- Geohazard and fault crossing assessment (Iran Leg)
- GIS data collection
- Reconnaissance Survey definition and scope of work
- Collapse Ring testing Definition

2011 Planned Studies

- Metocean & Geotechnical extension (Iran Leg)
- GIS data collection (Metocean)
- Survey definition and scope of work
- Define survey ITT and tender
- Environmental statement
- Examine the effect of moderate heat treatment
- Indian Pipe Mill Prequalification
- Collapse Ring testing Programme with Indian Mills
- Reconnaissance Survey Campaign
- Commencement of Metocean Data Collection
- Preparation of FEED ITT's
  - Onshore facilities
  - Offshore Facilities
  - Subsea pipelines and systems

2012Planned Activities

SAGE

Studies & Tendering

- Insurance risk review
- Environmental Impact Assessment
- Completion of Metocean Data Collection
- Tender & Award FEED's
  - Onshore facilities
  - Offshore Facilities
  - Subsea pipelines and systems

Execute FEED Studies

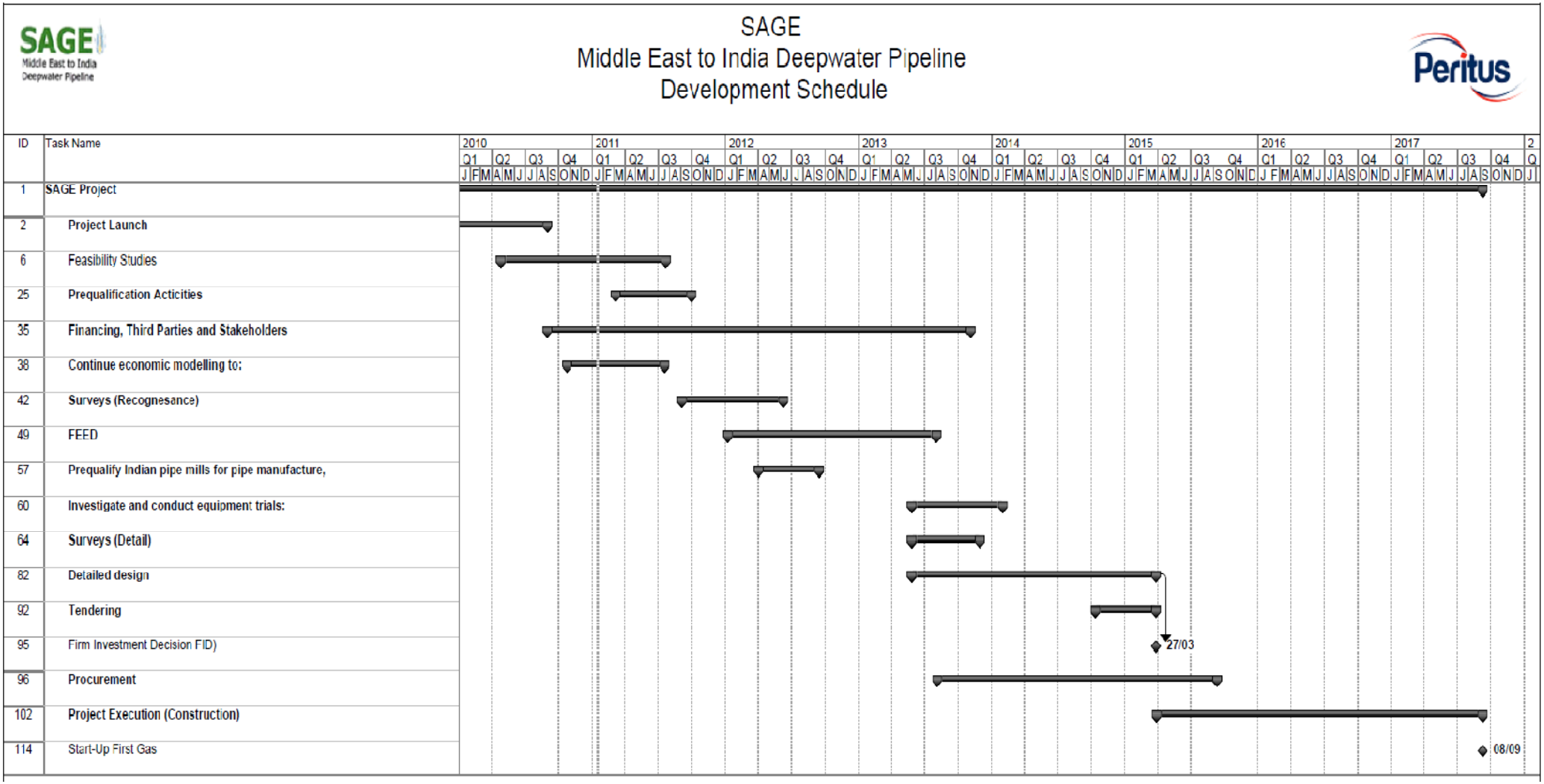
- Execute Onshore Compression Facilities FEED
- Execute Onshore Receiving Facilities FEED
- Execute Offshore Compression Facilities FEED
- Execute Subsea pipelines and systems FEED

Project Development Schedule

- The project Goal =>first Gas in 2017
  - 2010-2011 Feasibility Studies
  - 2011-2012 Reconnaissance Surveys
  - 2012-2013 FEED Studies, Detailed surveys.
  - 2013-2015 Detailed Design, Equipment Trials,
  - 2013-2015 Procurement of long lead items
  - 2015-2017 Installation

Project Development Schedule

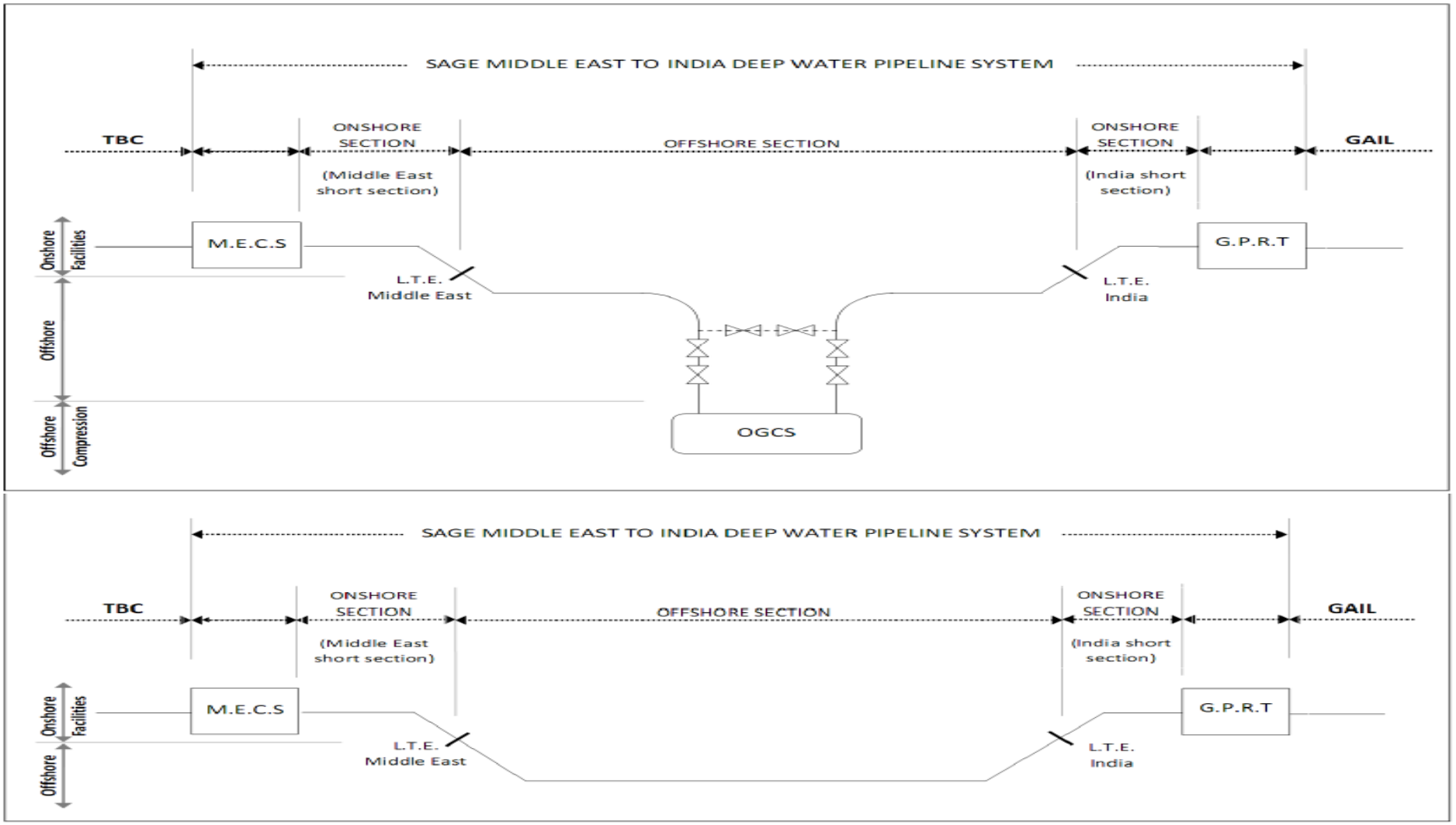
SAGE
Middle East to India Deepwater Pipeline
Development Schedule



Technical Update July 2011

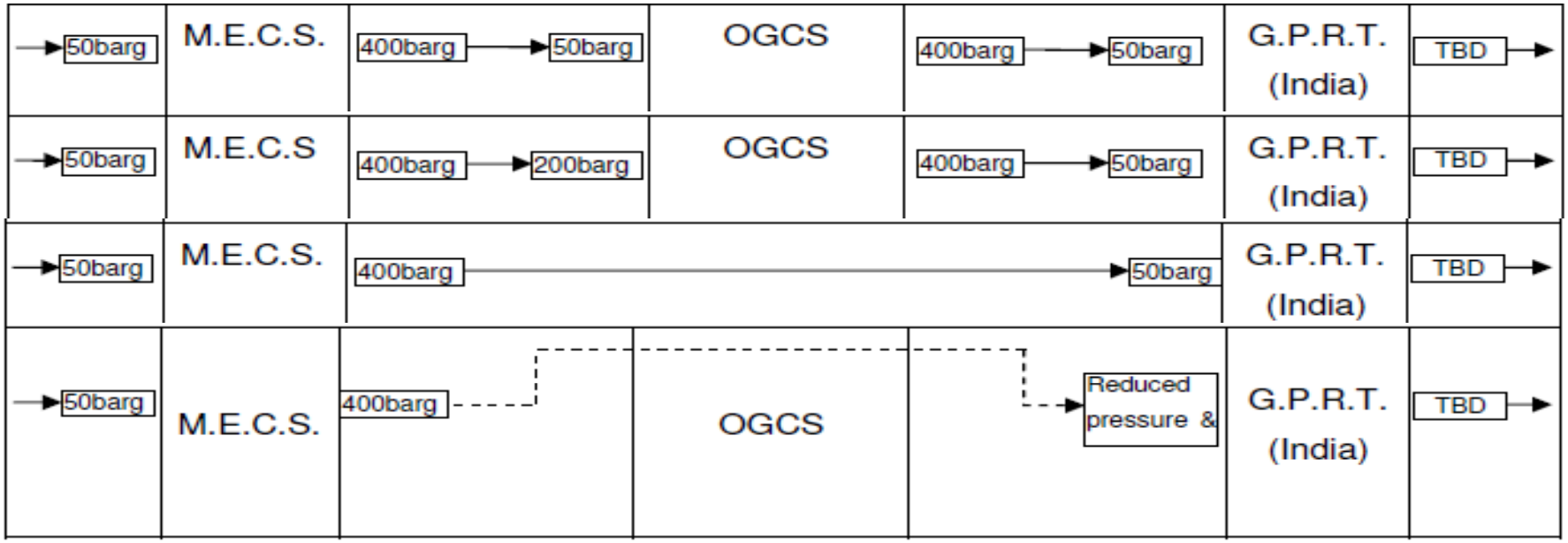
- Design Basis
- Pipeline Routing/Profile
- Geohazard Assessment
- Metocean Parameters Definition
- Mechanical Design
- Flow Assurance
- Onshore Compression Definition
- Offshore compression Definition
- Riser and Subsea By-pass definition
- QRA Update
- Vessel Capabilities review
- Intervention requyirements
- Emergency Pipeline Repair Systems (EPRS)

MEIDP Battery Limits

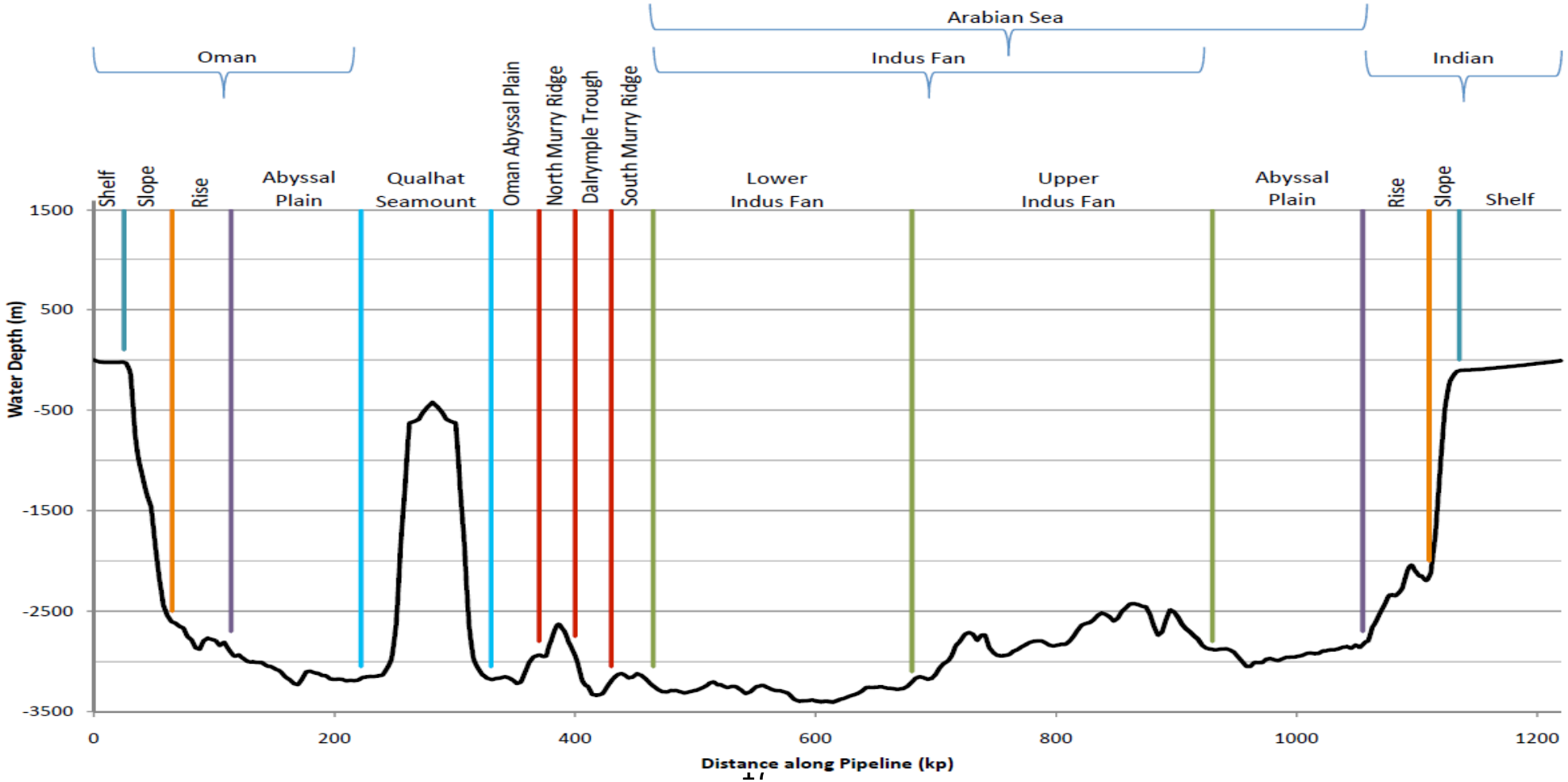


Design Basis

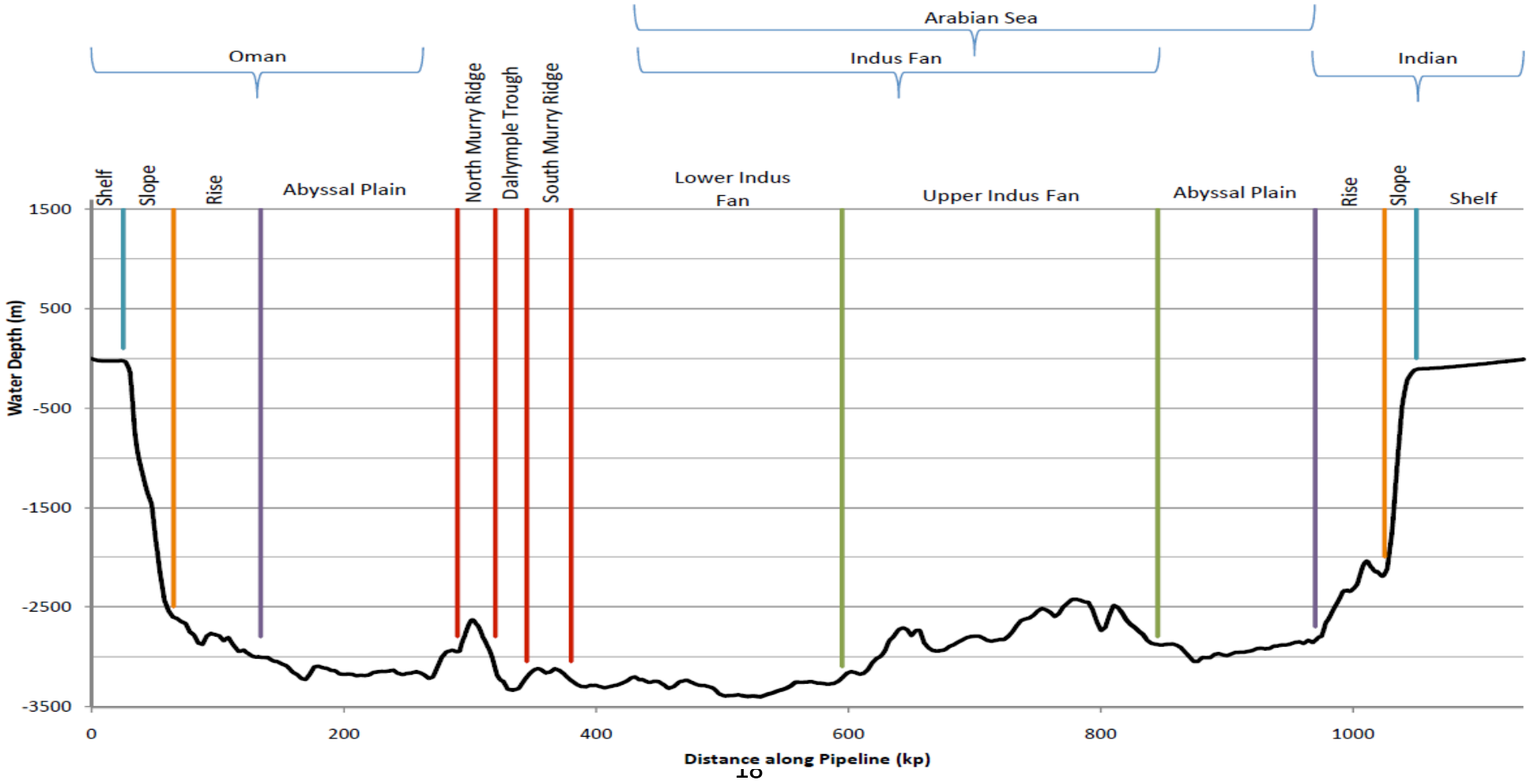
- MECS
  - 1.1BSCFD
  - Sales Quality Natural Gas
  - Dehydrated at MECS
  - Compression to 400Barg
  - Cooling
- OGCS
  - Water Content Monitoring
  - Compression to 400Barg
  - Cooling



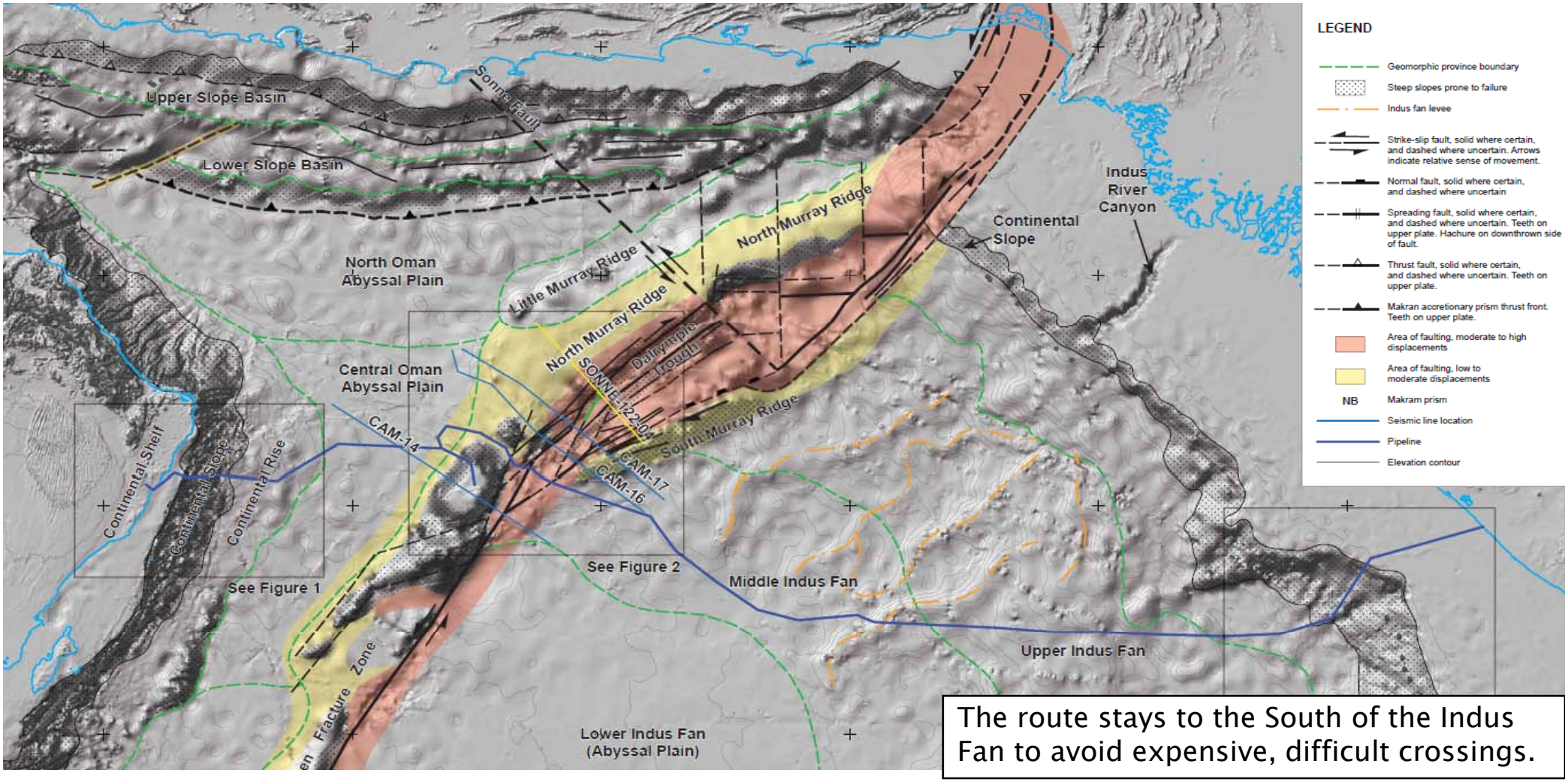
Pipeline route Profile MECS => *OGCS* => *GPRT*



Pipeline route Profile MECS => *GPRT*

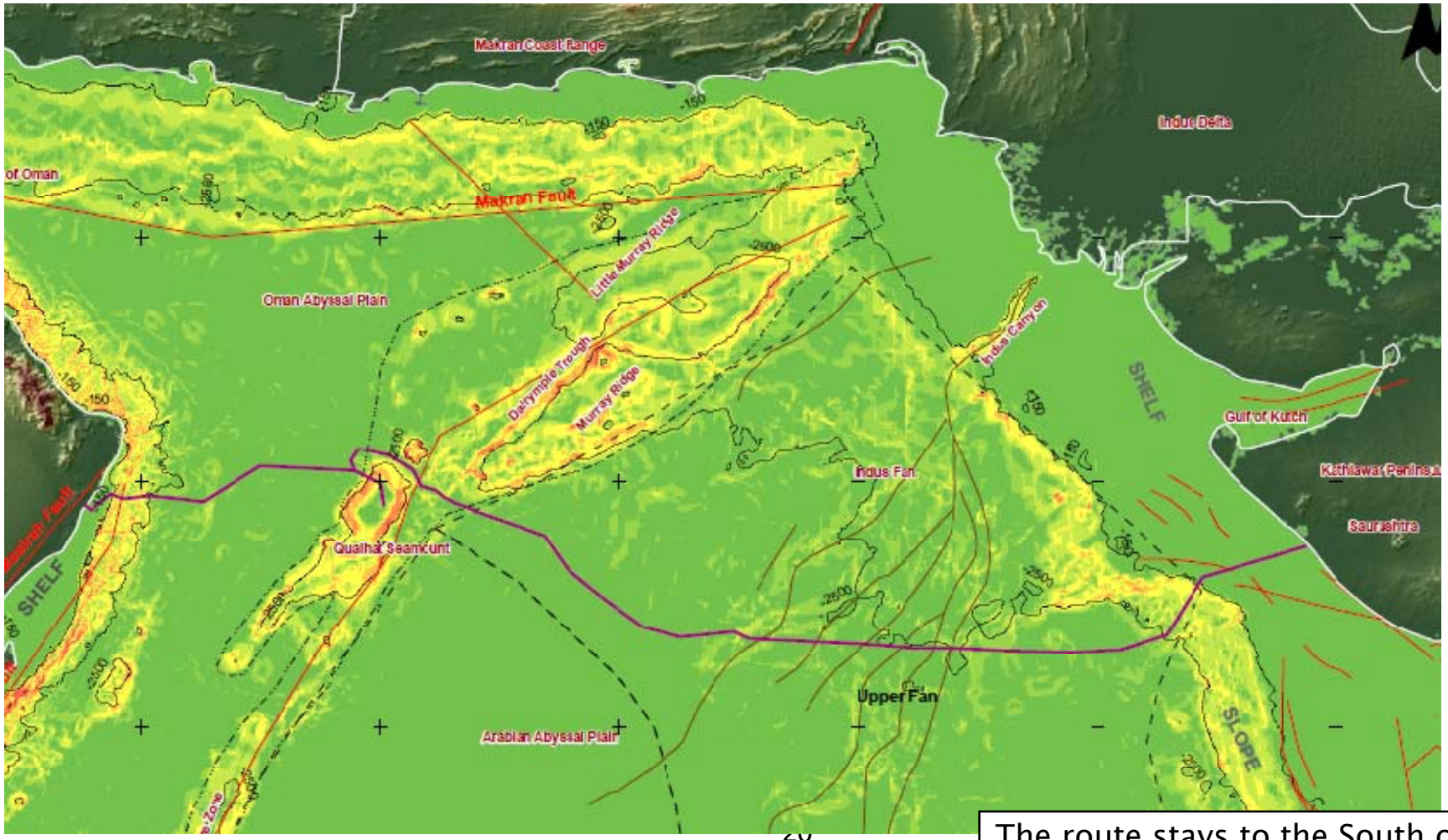


Morpho-Techtonic Features



The route stays to the South of the Indus Fan to avoid expensive, difficult crossings.

Seabed Slope Map

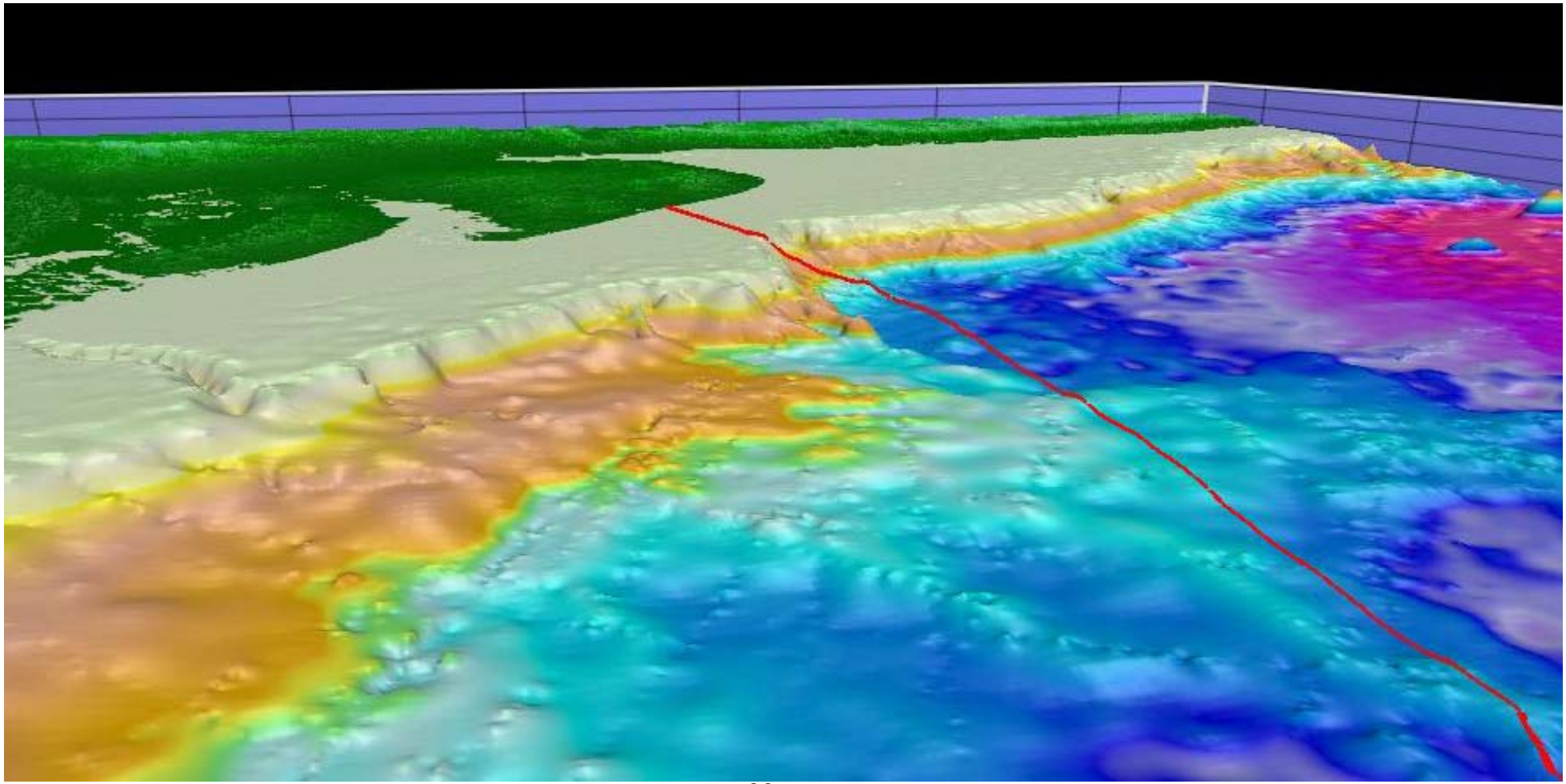


The route stays to the South of the Indus Fan to avoid expensive, difficult crossings.

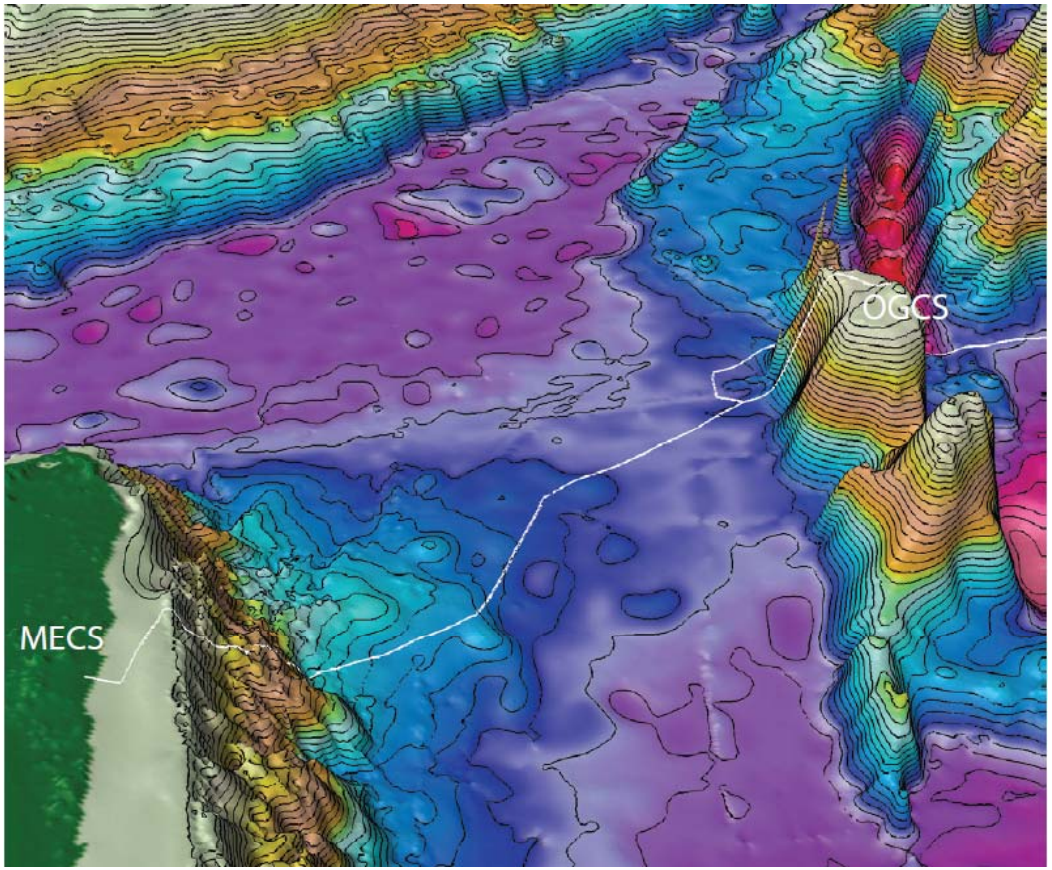
Identified Risks

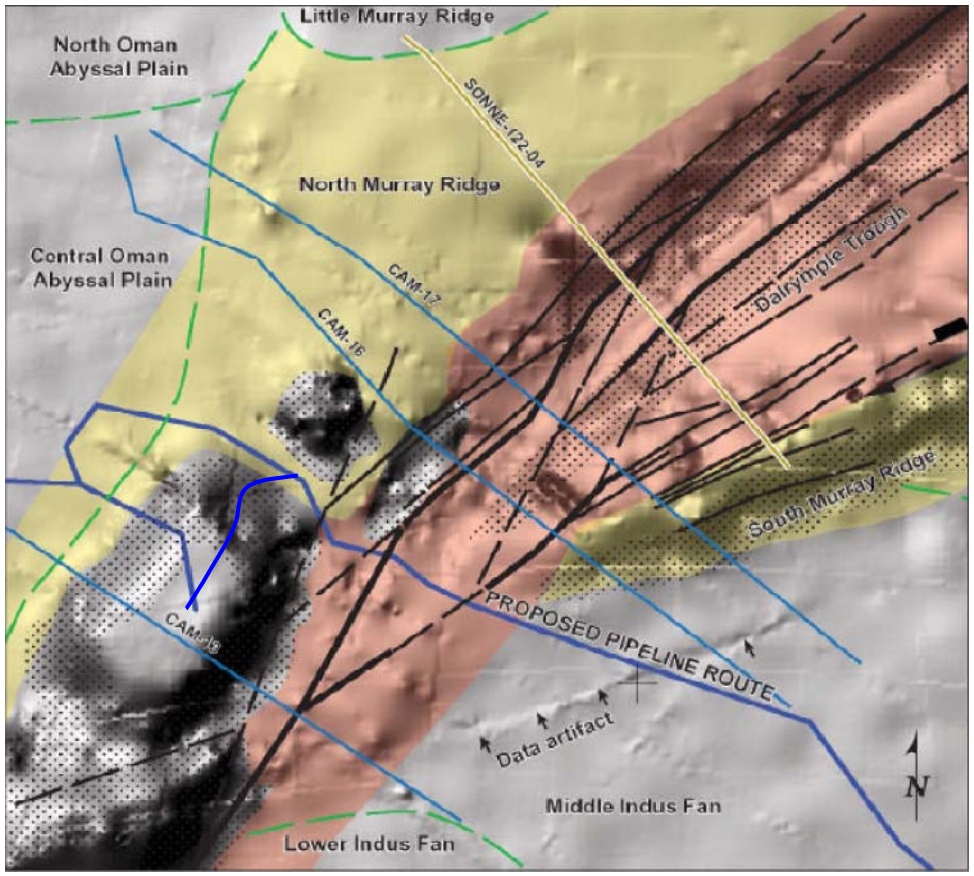
Geohazard	Location
Tsunami	Oman and Indian coastline
Steep slopes	Oman and Indian continental slopes and the Qualhat Seamount
Seismic activity	Northern Oman, Kathiawar Peninsula (Gujarat, India) and along the Owen Fracture Zone
Fault displacements	Faults of the Owen Fracture Zone and the Indian shelf and slope
Liquefaction	Oman and Indian (inner) shelf
Slope failures	Oman and Indian Continental slope, Qualhat Seamount, channels of the Indus Fan
Turbidity currents	Indus Fan

Indus Fan and Indian Slope



Murray Ridge and Qualhat Seamount



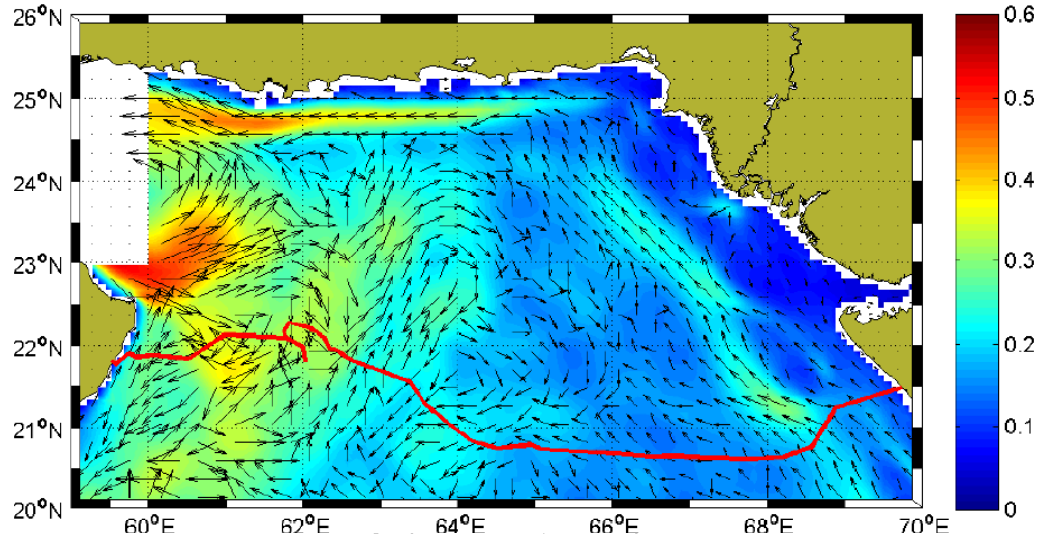


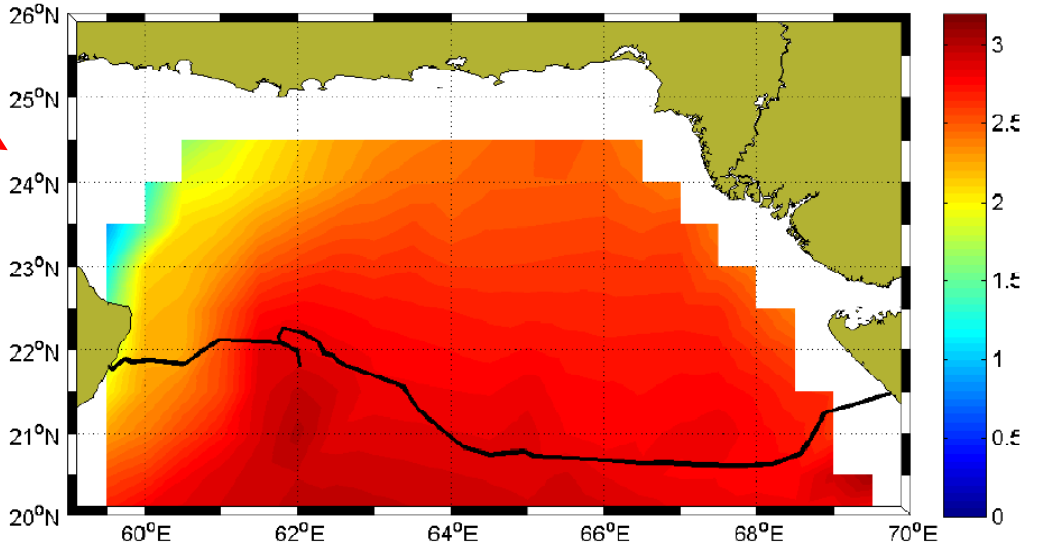
- The seamounts at the South-West end of the Murray Ridge present a location for an in-line Compression facility, outside of all Territorial Waters but within helicopter supply range.
- Max Slope 20deg on Northern side similar to Landfalls.

Completed Studies – Metocean

- Environmental Parameters
  - Mean Surface Currents
  - ***Mean Significant Wave Heights (3hr Storm)***
  - Seabed Currents
  - Temperatures
  - Winds

North West Monsoon





South East Monsoon

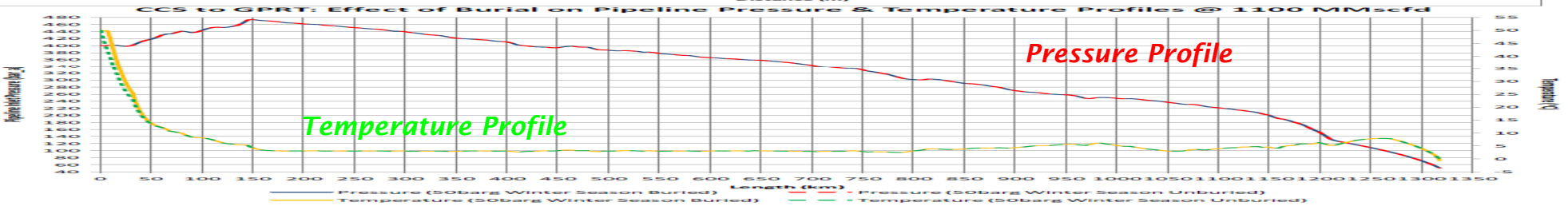
Completed studies – Flow Assurance

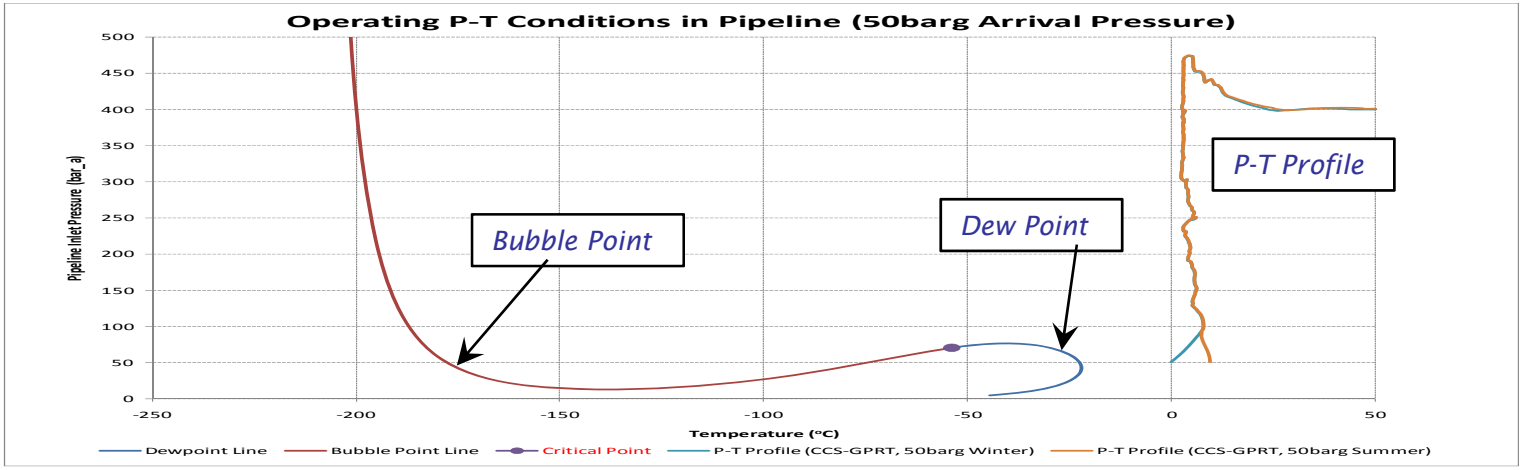
- The following pipeline sizes have been selected for the various options considered for the Middle East to India Deepwater Pipeline from Chabahar to Gujarat for an export (sizing case) flowrate of 1100 MMscfd or 31.1 MMSCMD :
  - MECS to OGCS, 400barg-50barg, ID=487mm (Low pressure arrival)
  - MECS to OGCS, 400barg-200barg, ID=530mm (High pressure arrival)
  - OGCS to GPRT, 400barg-50barg, ID=579mm
  - MECS to GPRT, 400barg-50barg, ID=610mm

- Of the two OGCS arrival pressures considered in the high arrival pressure case is the preferred option for the following reasons:
  - By operating in dense phase, the velocities are manageable (6 m/s).
  - By operating at lower velocities the gas arrival temperature at the offshore facilities is approximately 7°C which is manageable.

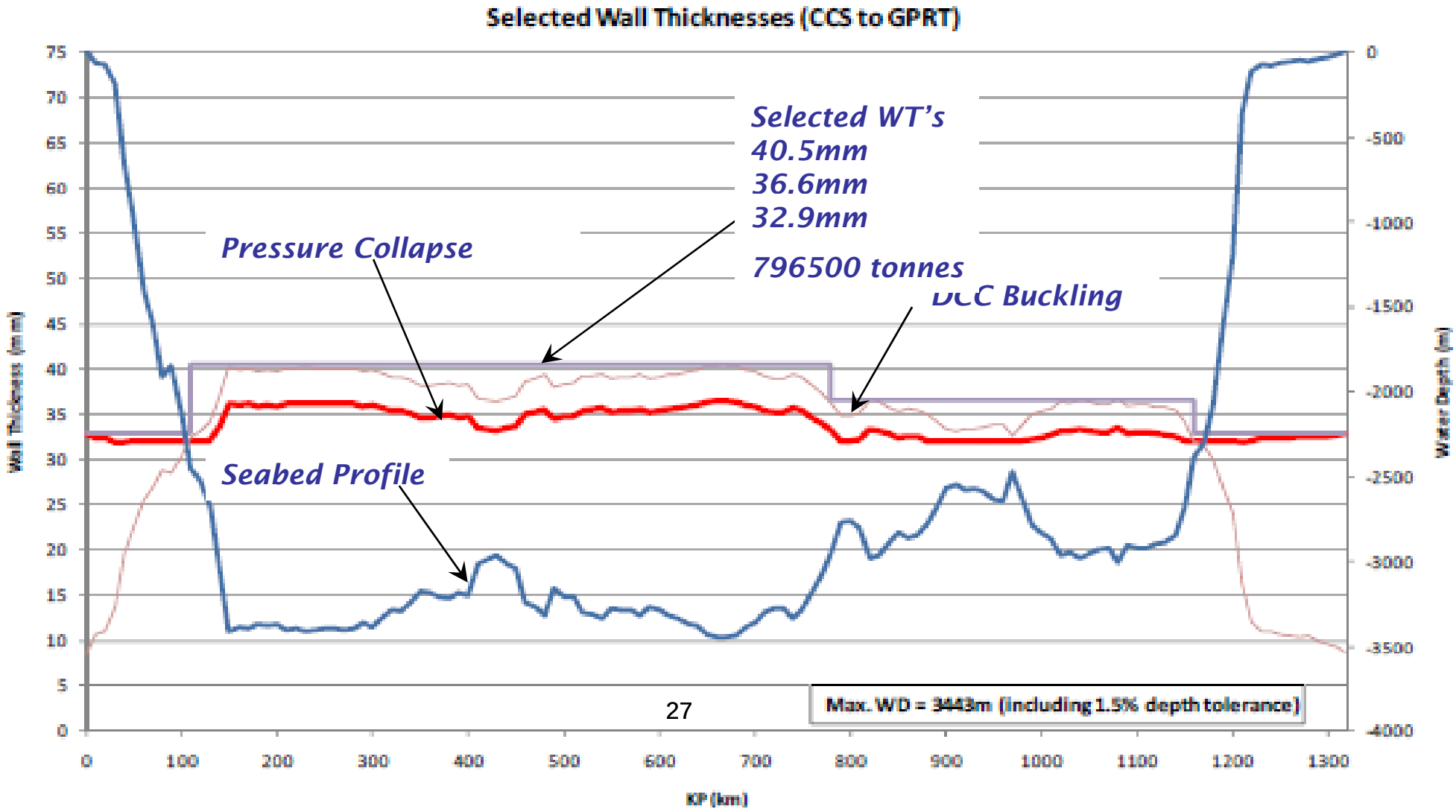
Completed studies – Flow Assurance

- Seabed Profiles, Temperatures and Pressures (MECS to GPRT)





Completed Studies - Mechanical Design

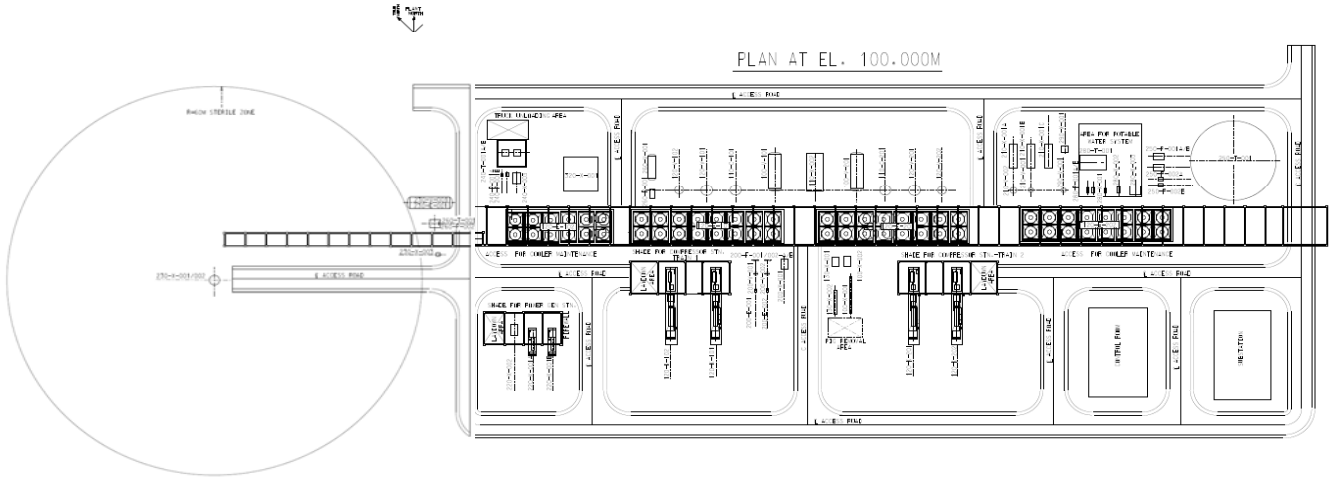


Completed Studies - Mechanical Design

KP Range (km)	WD Range (m)	Section Length (km)	Pipe ID (mm)	Selected Wall Thickness (mm)	Buckle Arrestor Required	Tonnage of Steel Required for Line Pipe (Tonne)
0 – 6.8	-82 - 8.8	6.8	610	40.5	No	4,418
6.8 - 40	8.8 - 659	33.2	610	32.9	No	17,318
40 - 110	659 - 2448	70	610	32.9	Yes	36,514
110 - 770	2448 - 3084	660	610	40.5	Yes	428,811
770 - 1150	3084 - 2690	380	610	36.6	Yes	221,779
1150 - 1210	2690 – 361	60	610	32.9	Yes	31,298
1210 - 1317.5	361 – 1.5	107.5	610	32.9	No	56,075
1317.5 - 1318	1.5 - 0	0.5	610	40.5	No	325
					Total	**796,537**

Completed studies – Onshore Terminal

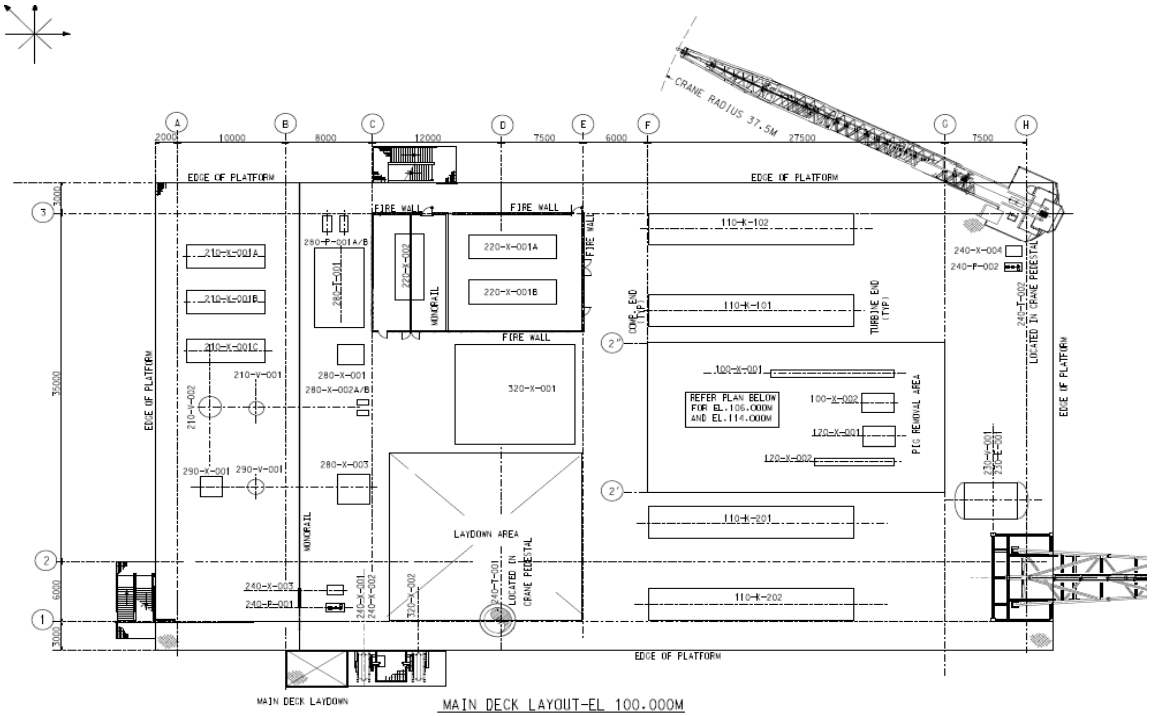
- Concept Definition
  - Equipment Lists
  - PFD's
  - UFD's
  - Weight Take-off
  - Layouts
  - Cost Estimate



- Equipment
  - Compression (2 Stages)
  - Pigging facilities
  - Fuel gas Systems
  - Instrument air systems
  - Gas turbine generation
  - Flare systems
  - Fire water systems
  - Potable water systems
  - Accommodation requirements

Completed studies – Offshore Compression

- Concept Definition
  - Equipment Lists
  - PFD's
  - UFD's
  - Weight Take-off
  - Layouts
  - Cost Estimate



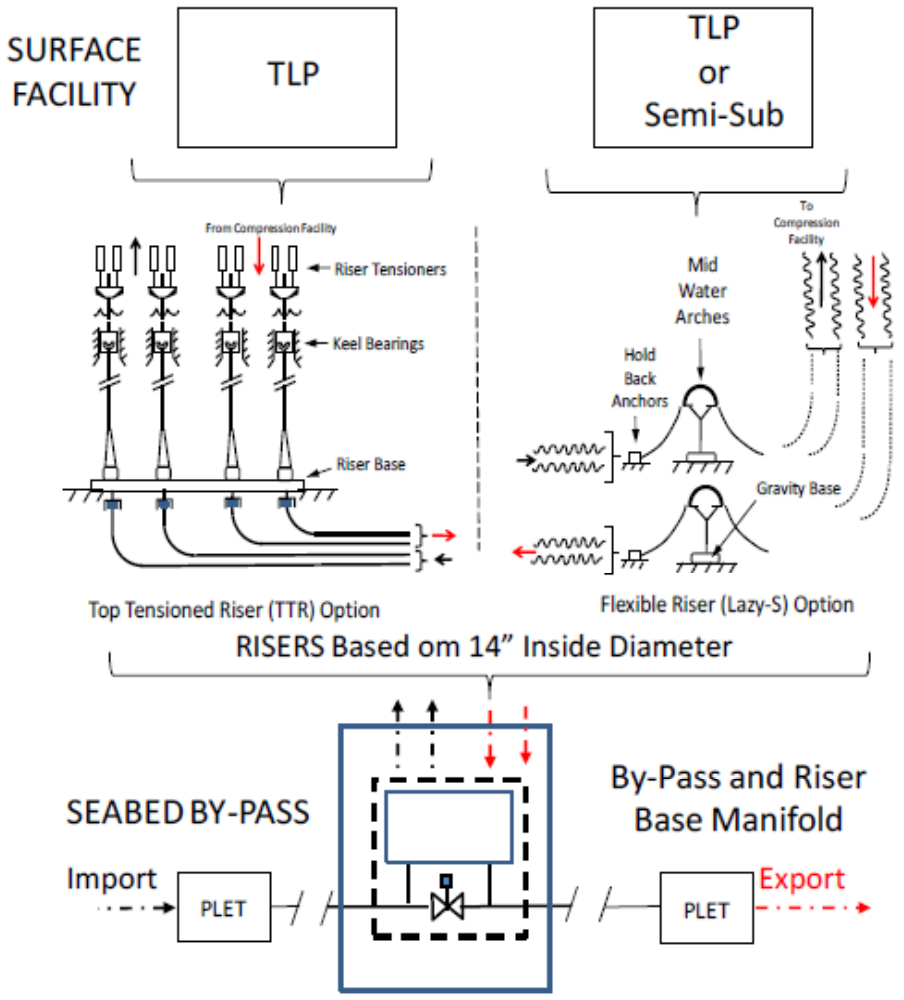
- Equipment
  - Compression (2 Stages)
  - Pigging facilities
  - Fuel gas Systems
  - Instrument air systems
  - Gas turbine generation
  - Cooling systems
  - Flare systems
  - Fire water systems
  - Seawater lift systems
  - Potable water systems
  - Transfer systems
  - Accommodation requirements
  - Sewage disposal systems

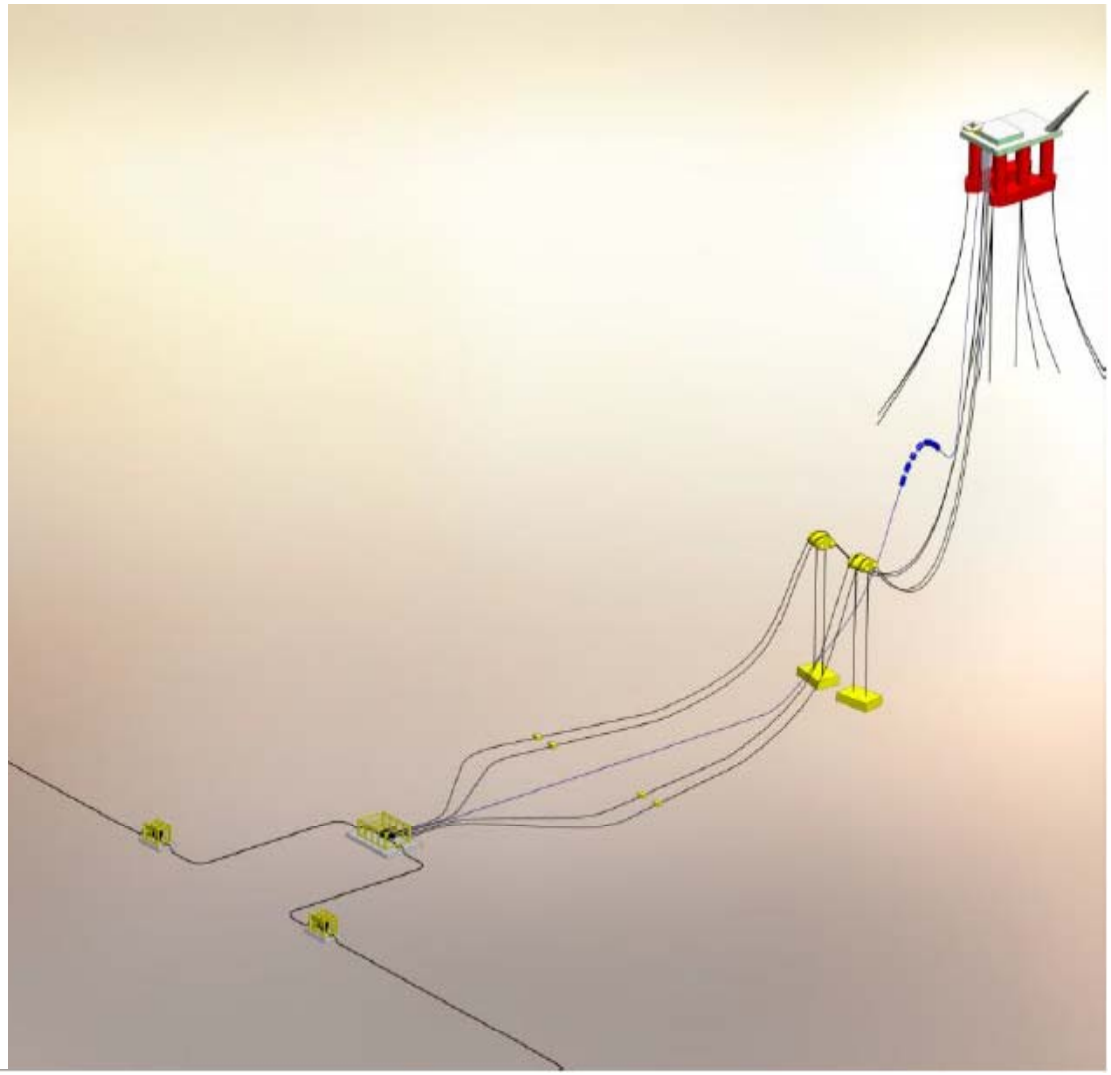
Completed Studies – Substructure Options

Different types of production platforms (NOAA)

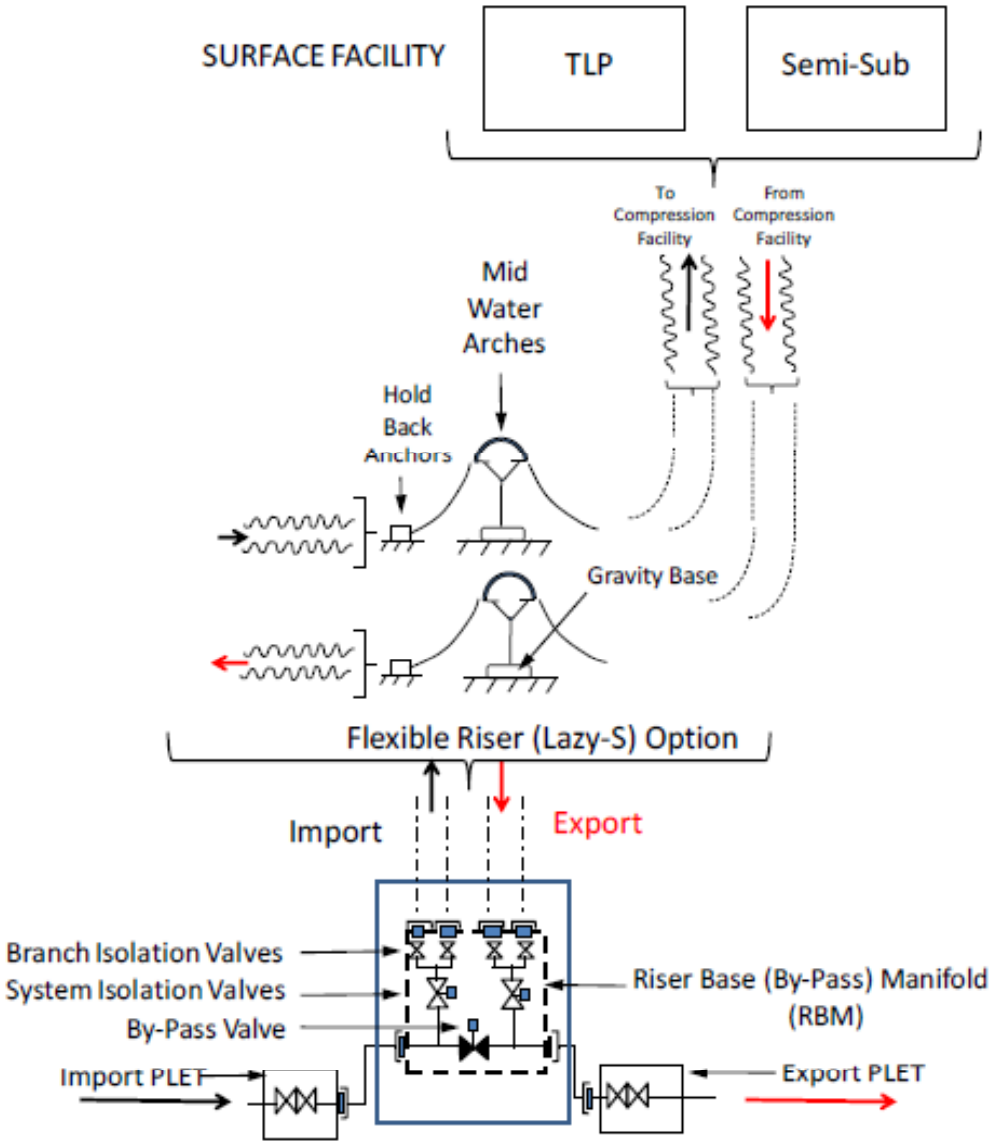
Substructure Type	Technical Drivers								Commercial Drivers					Overall	
	Water Depth Range	Payload	Metocean - Environment	Riser Feasibility	Offshore Integration	Active Seismic Ren	Score	Ranking	Reuse of Existing ~~Maximise~~ Indian		Future Expansion	Score	Ranking	Score	Ranking
Semi Submersible	3	3	3	2	3	3	17	2	3	2	2	7	**1**	24	1
Tension Leg Platform	3	3	3	3	3	3	18	**1**	1	2	1	4	2	22	2
Fixed Jacket	3	3	3	3	1	2	15	4	1	3	3	7	**1**	22	2
Spar	3	3	3	3	1	3	16	3	1	1	1	3	3	19	3
Compliant Tower	2	3	3	3	1	3	15	4	1	1	1	3	3	19	3

Completed Studies – OGCS Riser Options

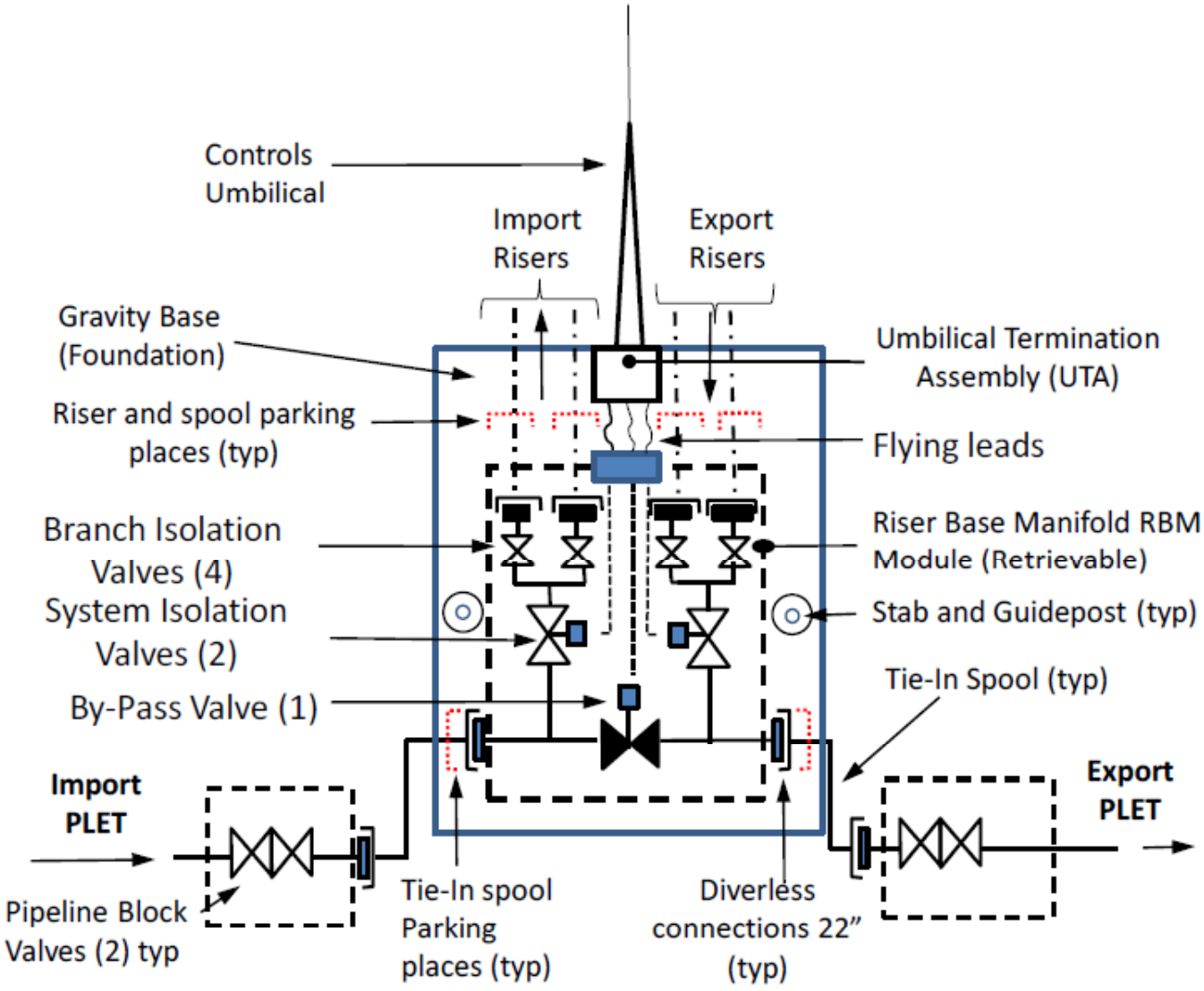




Selected Riser Configuration



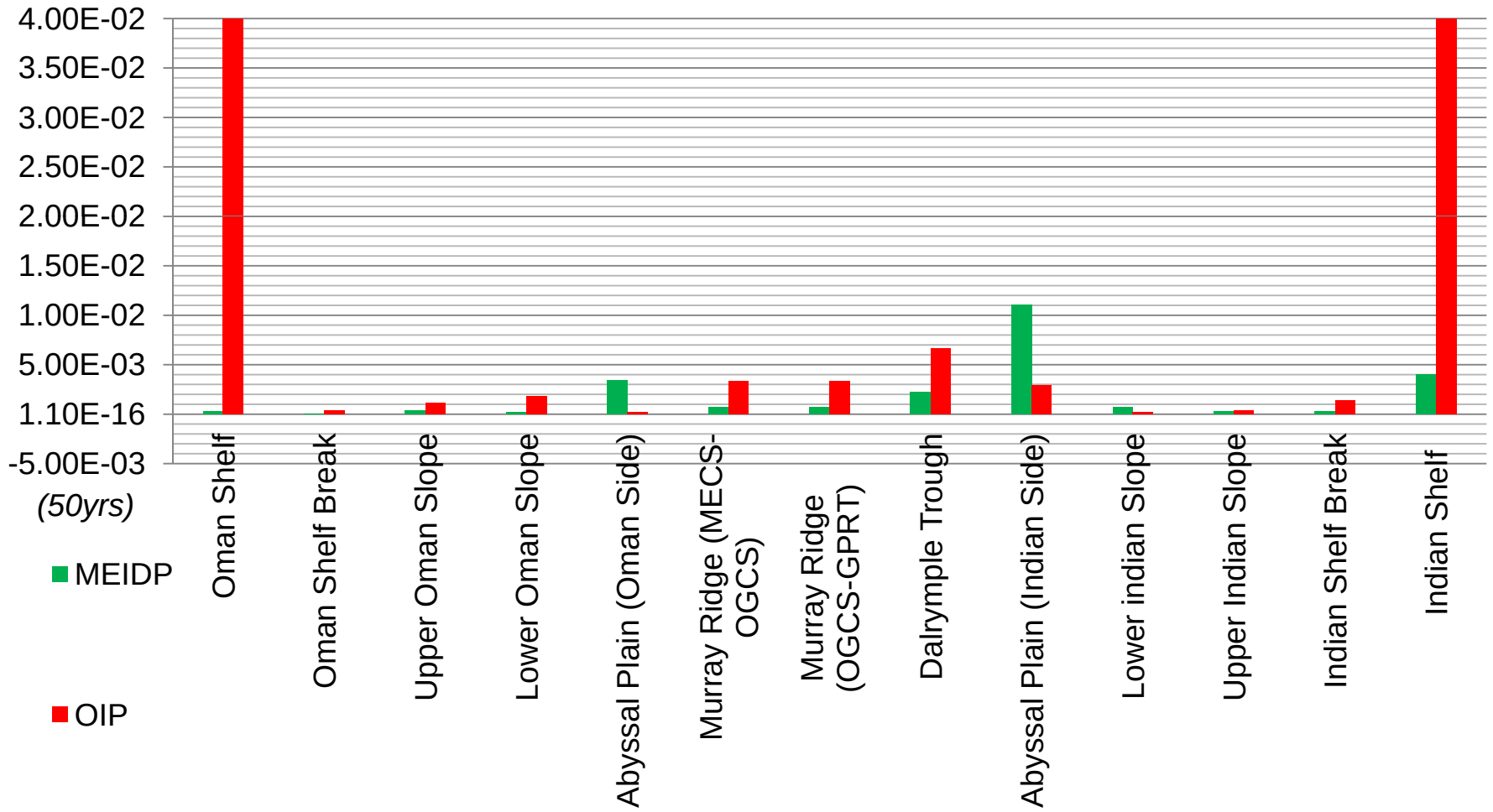
Subsea By-Pass Configuration



Completed Studies - QRA Update

- The following hazards have been quantified:
  - Trawling
  - Anchoring
  - Objects dropped from ships
  - Ship sinking
  - Ship grounding
  - Internal corrosion
  - External corrosion
  - Material and construction defects

MEIDP v's OIP Failure Frequency



Completed Studies – Installation Vessel Requirements J-Lay

- J-Lay Vessel Demand
  - 1060tonne normal laying
  - 2000tonne Flooded and abandonment

$T_c = T_d . S_f . S_d$

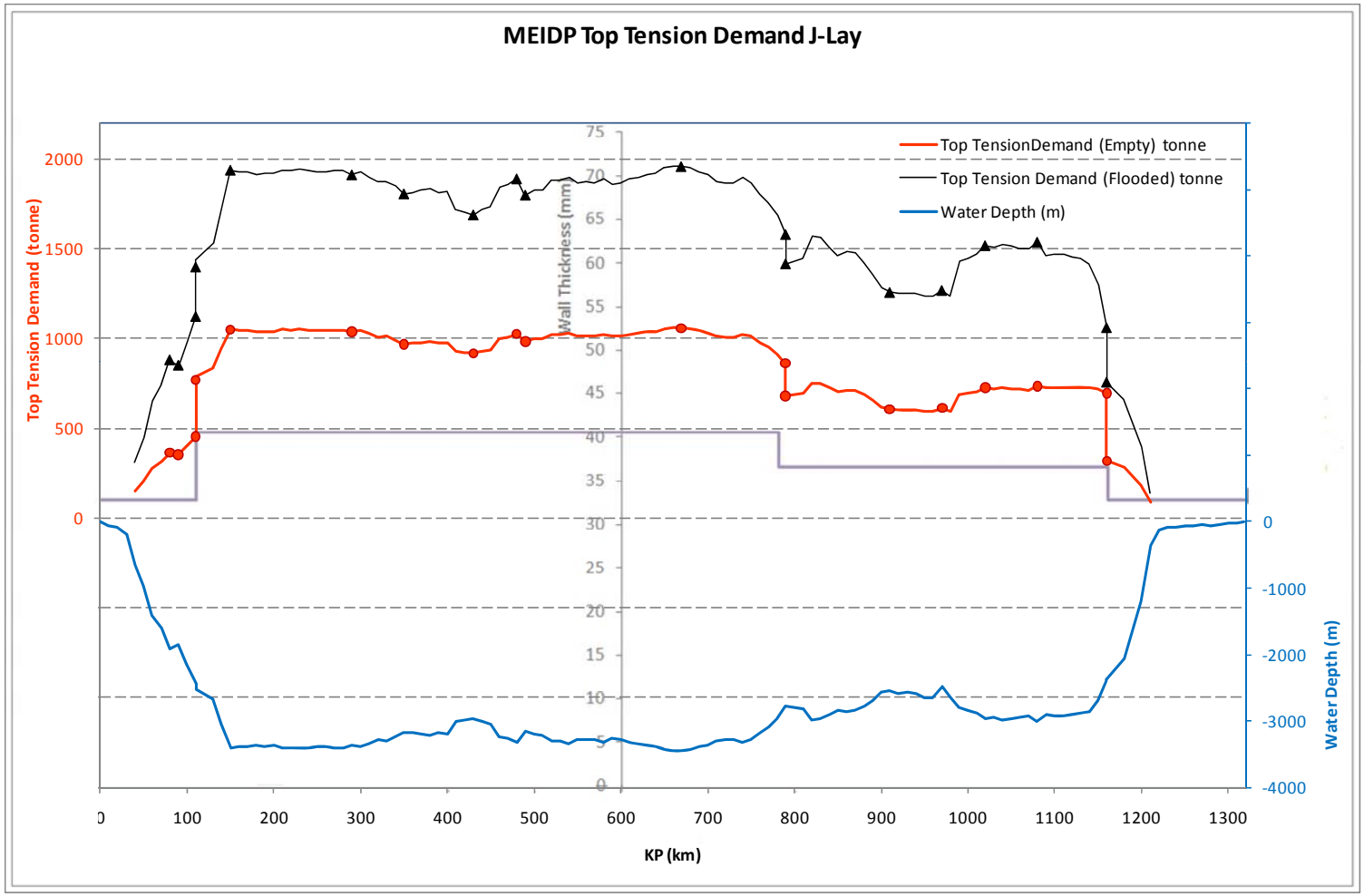
T_d = *Tension Demand*

T_c = *Tension Capacity*

S_f = *Safety Factor (1.15)*

S_d = *Dynamic Amplication (1.3)*

- J-Lay Vessel Capacity
  - 1600tonne normal Laying
  - 2500tonne flooded and abandonment



New Pipelay Vessels under Construction

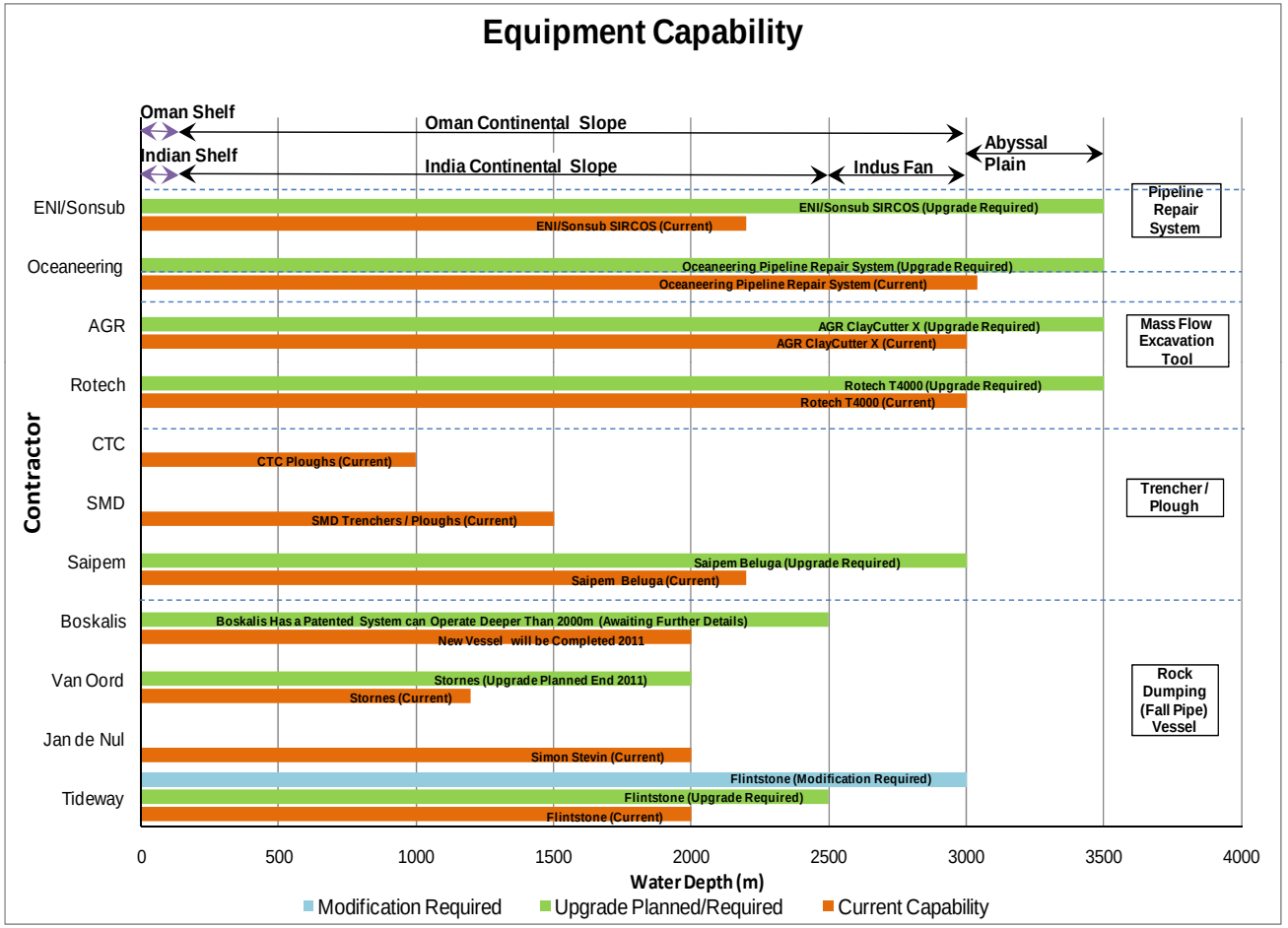
- Saipem SpA new laybarge CastorONE, now under construction
- Ready for offshore operations early in 2012. Saipem has confirmed that the MEIDP is feasible and can be installed in a water depth of 3500m

- HMC New Build vessel Aegir, now under construction
- proposed to be complete by mid 2013, ready for offshore operations early in 2014.

- Allseas vessel Pieter Schelte, now under construction
- Proposed to be complete by end 2013, ready for offshore operations in 2014.

Completed Studies – Intervention Vessels and Equipment Capabilities

- Intervention will be required either pre-lay or post-lay in the following zones along the pipeline route:
  1. Shallow Water Section (0 to 150m WD)
  2. Oman and Indian Continental Slope Sections (150m to 2500m WD)
  3. Deep Water Dalyrimple Trough/Owen Fracture zone Section (2500m to 3450m WD)
  4. Qualhat Seamount Section (300m to 3000m WD)
  5. Upper Indus Fan Levees Section (2500m to 3000m WD)



Completed Studies – EPRS System Components

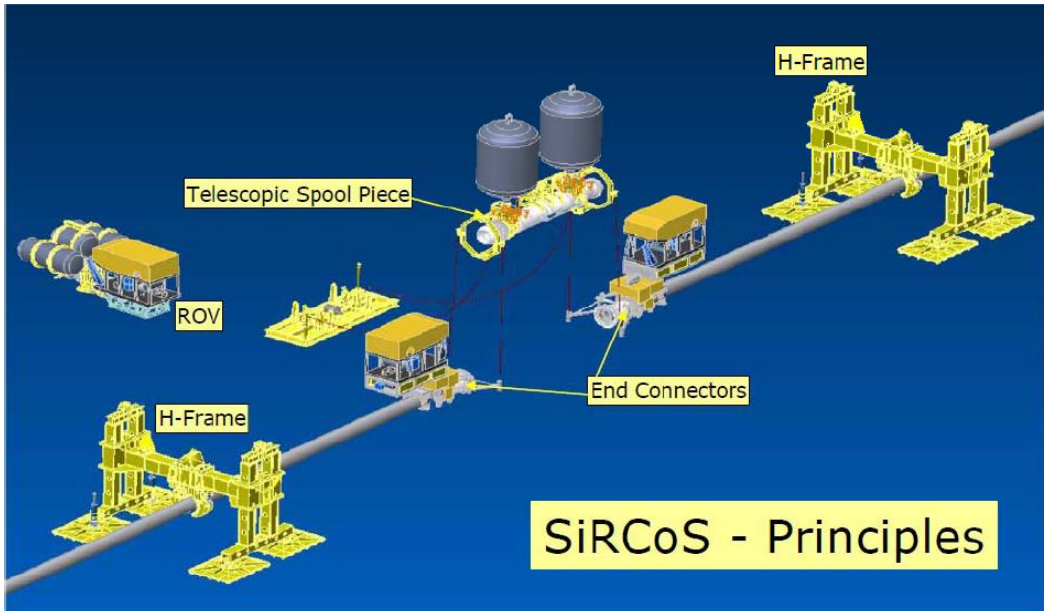
SAGE

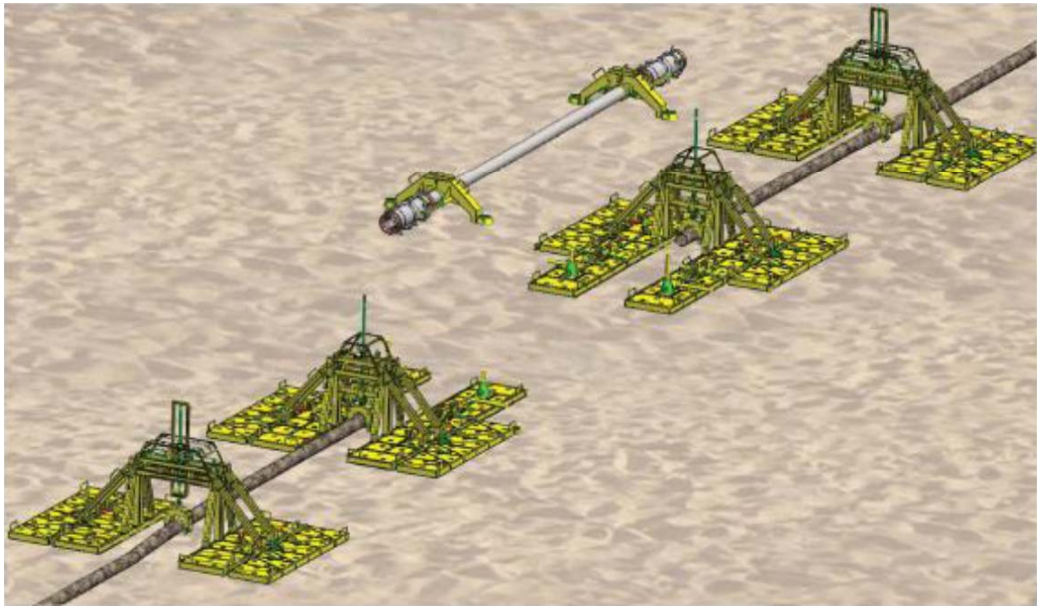
Equipment	Purpose
DP Support Vessel	Platform from which to operate ROV's and conduct repair operations.
Pipelay Vessel	Working platform in the event that an extensive section of damaged pipeline has to be relaid/replaced.
Flooding/Dewatering/Drying Spread	Various purposes including :- Pressure equalisation prior to cutting (flooding) " Couplant for intelligent pigging (flooding) " Removal of water (dewatering) " Drying prior to returning to service to minimise water content and risk of hydrates "
Seabed Dredging/Levelling Equipment	Exposure of the pipeline, if locally trenched or buried, to allow for survey and/or repair operations.
Pipeline Lifting Frames	Elevation of pipeline off the seabed in the vicinity of any repair, for the purpose of improving access for repair equipment and operations.
Subsea Measurement Tool	Performance of measurements between pipeline ends for accurate spoolpiece and connector assembly.
Pipeline Cutting Tool	Cutting of pipeline (and coatings) to allow removal of any damaged sections.
Pipeline Coating Removal Tool	Removal of external pipeline coatings in the vicinity of any section that has been cut (by the Pipeline Cutting Tool). Required in the event that the Pipeline Recovery Tool grips the pipeline on its external steel surface.
External Weld Bead Removal Tool	Removal of external longitudinal weld seam (SAW linepipe) to prevent interference on connector seal.
End Preparation Tool	Machining of the end face of the pipeline to prevent interference on connector seal.
Pipeline Recovery Tool	Tool connected to the end of the cut pipeline to allow recovery to surface. Designed to allow the pipeline be dewatered and isolated prior to recovery.
Pipeline Repair Clamp	Permanent clamp installed around the pipeline in the vicinity of minor damage (i.e. dent) for the purpose of ensuring the structural integrity of the pipeline without the need for cutting out and replacing an entire section of pipe.
Subsea Pipeline Connectors	Connector assembly and modular system used for the installation and connection of a new section of pipeline.
Replacement Spoolpiece	New section of pipeline used to replace area of damage.

EPRS Repair Scenarios

	Pipelay Vessel	ROV Support Vessel	Flooding/Dewatering / Drying Spread (Onshore)	Deep Water Repair System Components							Seabed Dredging / Levelling Equipment	Hydrate Removal Spread	Intelligent Pigging Equipment	Repair Clamp (i.e. Split Sleeve)
				Pipe Lifting Device (i.e. H-frames)	Pipe Cutting Tool	Coating Removal Tool	Pipeline Recovery Tool (with d/w capability)	Metrology Unit	Weld Bead Removal Tool	Connection System and Spoolpiece				
Dry Local Buckle (recoverable)	✓	✓												
Dry Local Buckle (non-recoverable)	✓	✓	✓	✓	✓	✓	✓							
Dry Propagating Buckle (non-recoverable)	✓	✓	✓	✓	✓	✓	✓							
Local Wet Buckle (non-recoverable)	✓	✓	✓	✓	✓	✓	✓							
Hydrate plug												✓		
Localised damage, no leak		✓									✓		✓	
Localised damage with leak		✓		✓		✓					✓	✓		✓
Rupture, local		✓	✓	✓	✓	✓		✓	✓	✓	✓			
Rupture, extensive length	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			

Completed Studies Emergency Pipeline Repair Systems (EPRS)





Saipem SiRCOS Currently rated to 2200m

Capable of upgrade to 3500m

Oil States /Chevron Currently rated to 3000m

Capable of upgrade to 3500m

Technical summary

- The progress into the water depths expected for MEIDP are no longer a giant leap forward, but rather the logical next step
- The development of deepwater pipelay vessels capable of installing MEIDP and due for commissioning in 2013, will provide the required equipment to install MEIDP
- Studies performed in 2009 and 2010 have proven that the feasibility of the MEIDP project to be designed in accordance with accepted deepwater codes such as DnV OS-F101
- Fabrication technologies exist within current mill capacities to achieve pipe size/wall thickness combinations required for MEIDP
- Routes have been established from Oman to India that give options for a midline compression station and avoid the worst features of the Indus Fan, minimising project technical risks