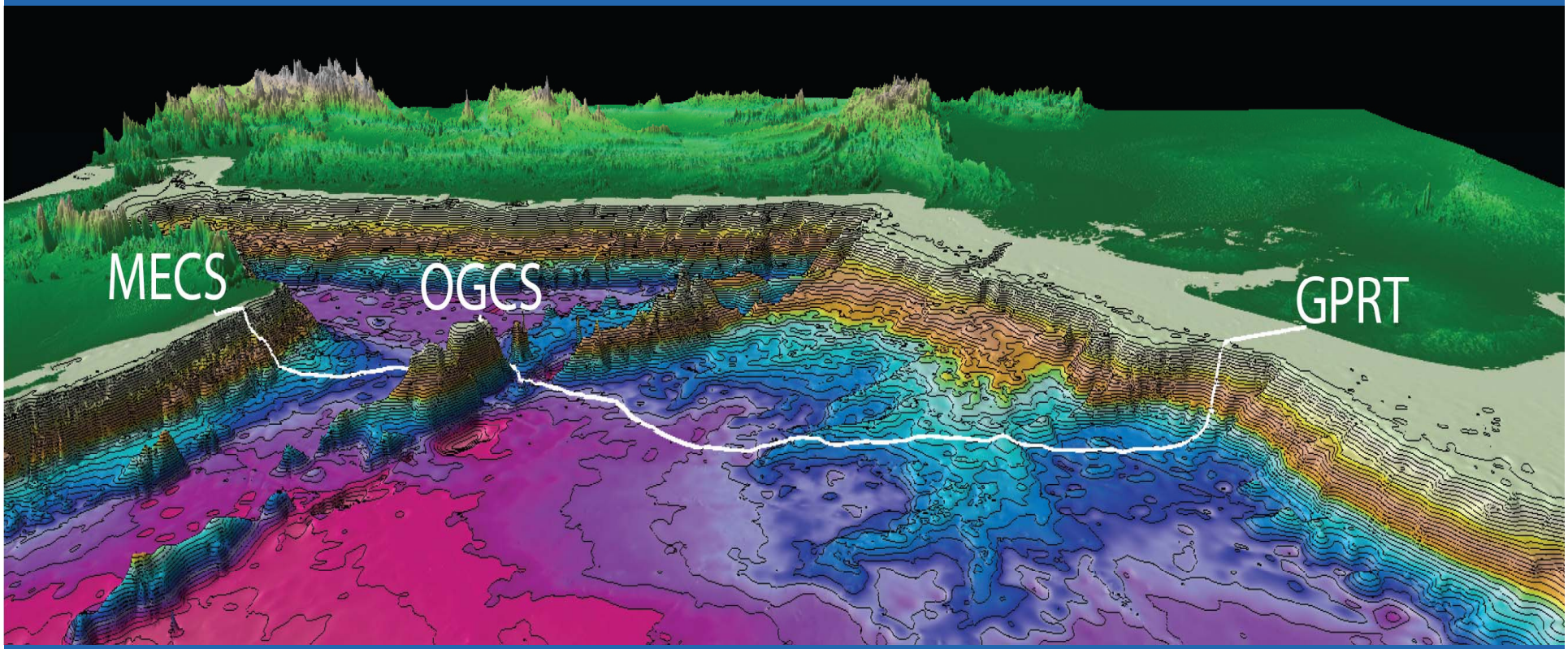
MEIDP The Deepwater Gas Route to India



SAGE Peritus

Introduction

- **Who?** *SAGE*
  - South Asia Gas Enterprise Pvt Ltd (SAGE),
  - Joint venture between the Indian Siddhomal group and UK based deepwater technology company
  - Considering building a deepwater, transnational, natural gas pipeline system from the Middle East to India

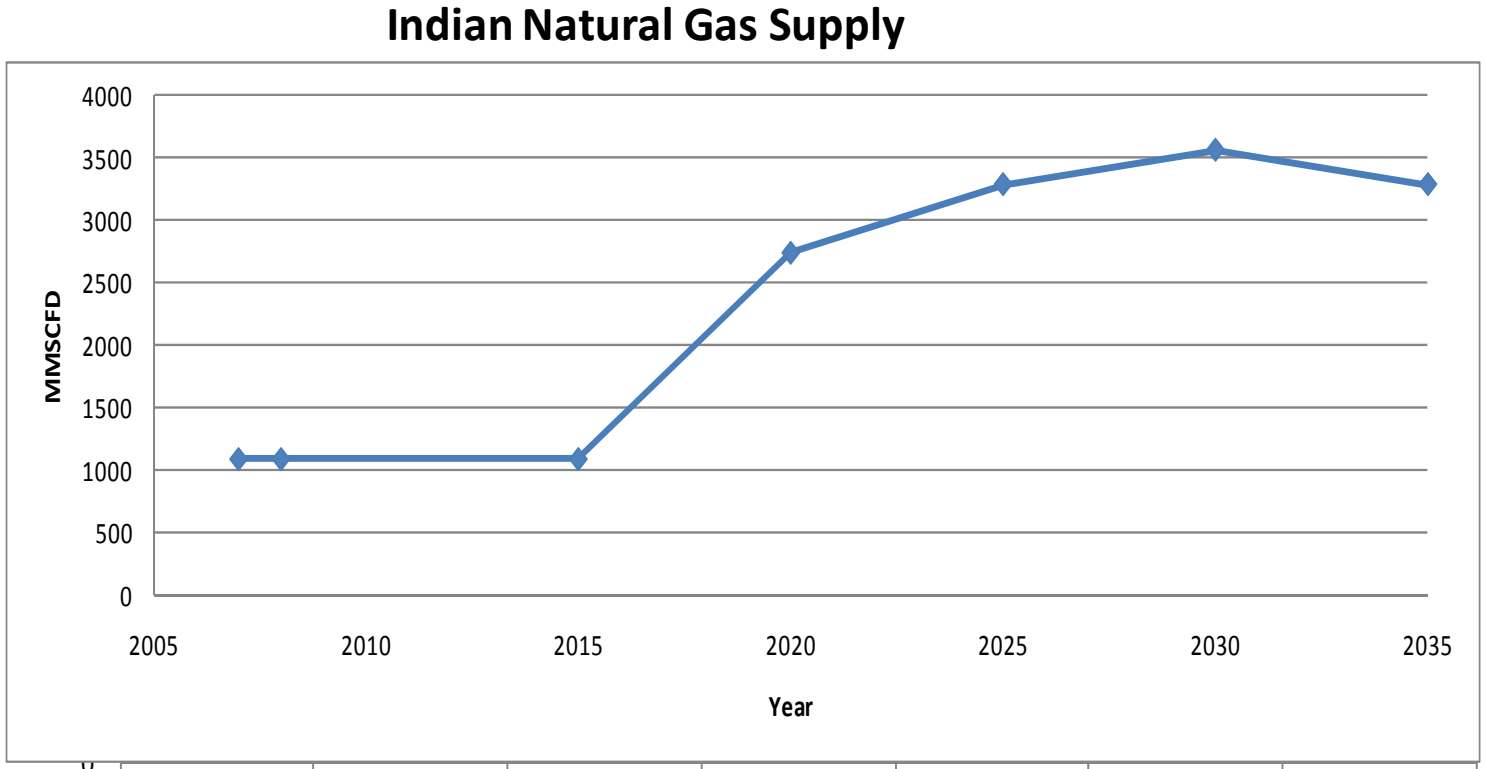
Introduction

- **Why?** *India needs gas*
  - Reserves over 2,000 TCF in India trading countries (including Qatar, Iran and Turkmenistan)
  - The deepwater route provides a short secure distance between huge reserves and industrial heartland of India
  - Route from Middle east is too short for LNG to be an economic transportation option

Introduction

- **How?** *A pipeline across the Arabian Sea*
  - Building on the extensive study Oman to India Pipeline in the Mid 1990's
  - Sage concept studies have strengthened technical Viability
  - Major body of deepwater design and pipelay experience has been accumulated over the last decade

Indian Natural Gas Supply



	2007	2008	2015	2020	2025	2030	2035
Import Requirement	1096	1096	1096	2740	3288	3562	3288
Indian domestic Supply	3014	3014	7397	8219	8767	9041	9041

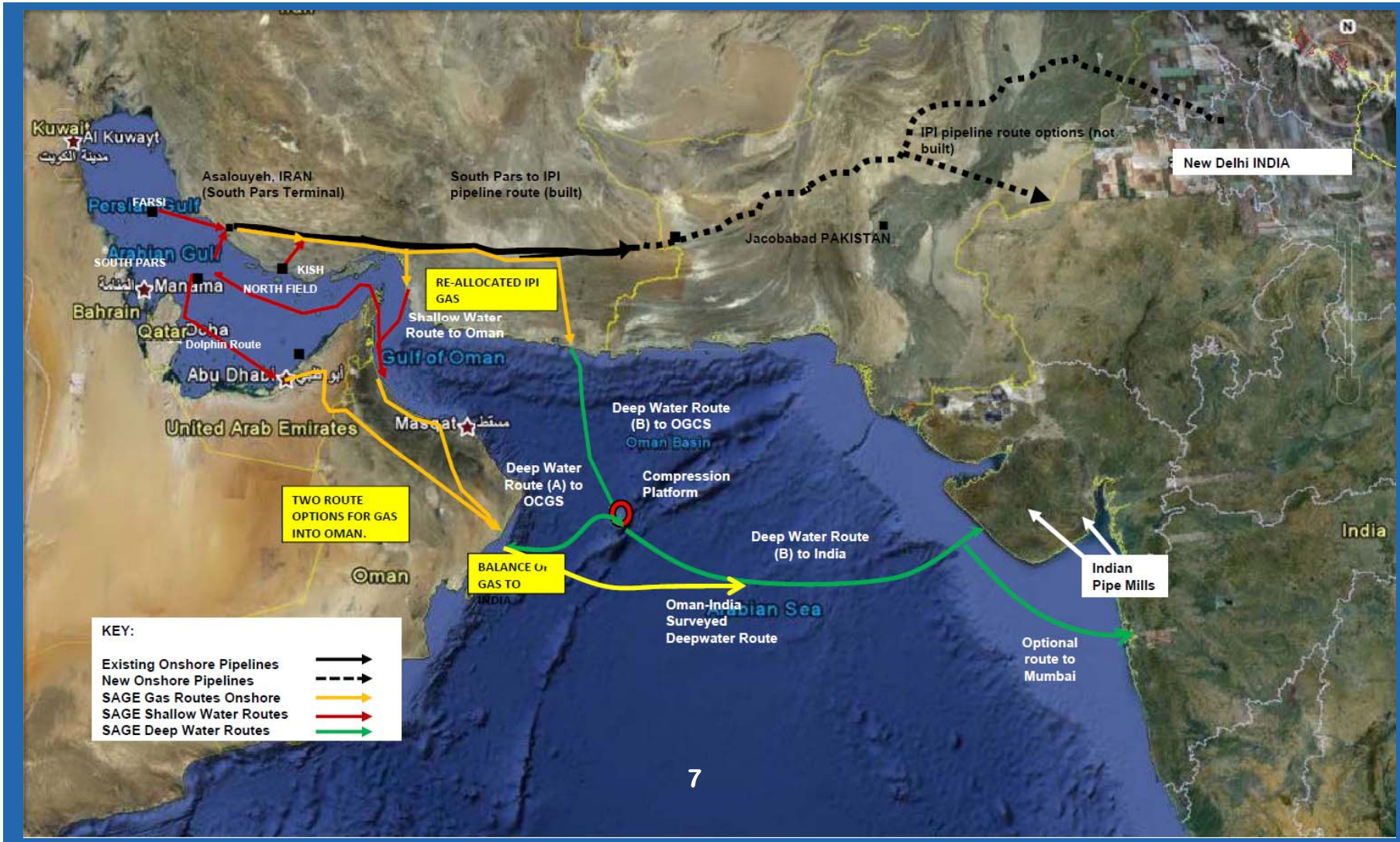
U.S. Department of Energy, DOE/EIA-0484(2010)

SAGE MOU's and Agreements

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

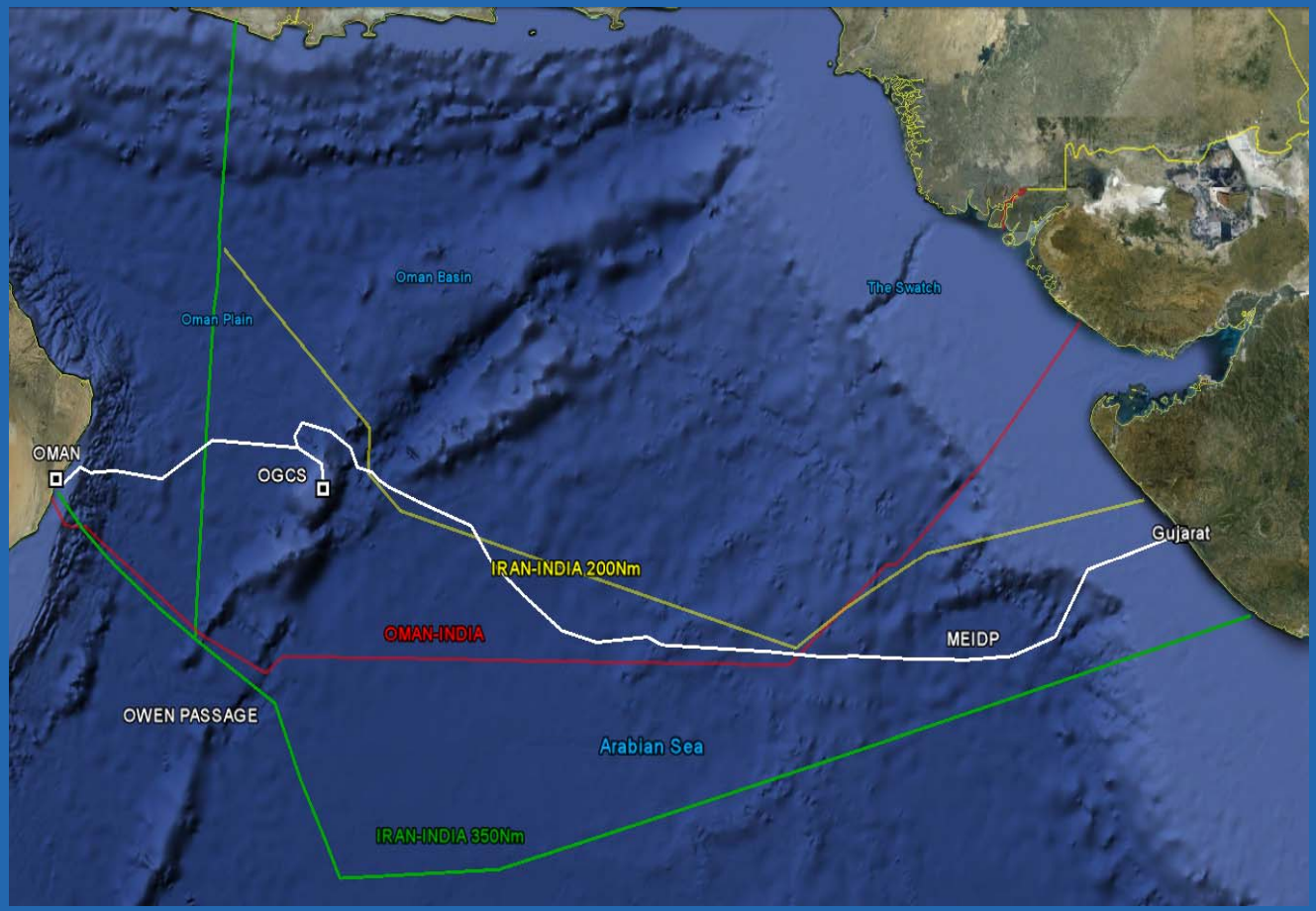
- Indian Oil Corporation
- Oman Ministry of Oil and Gas
- GAIL
- NIGEC
- Peritus International Ltd.
- Engineers India Ltd.
- Saipem spa
- Heerema Marine Contractors
- TATA-CORUS steel
- WELSPUN
- FUGRO GeoConsulting Ltd.
- INTECSEA (UK) Ltd.
- Det Norske Veritas

Gas Routes to India



Historical Route Options

- Oman–India 1995
- Iran–India 1997
- Iran–India (200NM) 2003
- Iran–India (350NM) 2003
- MEIDP 2010



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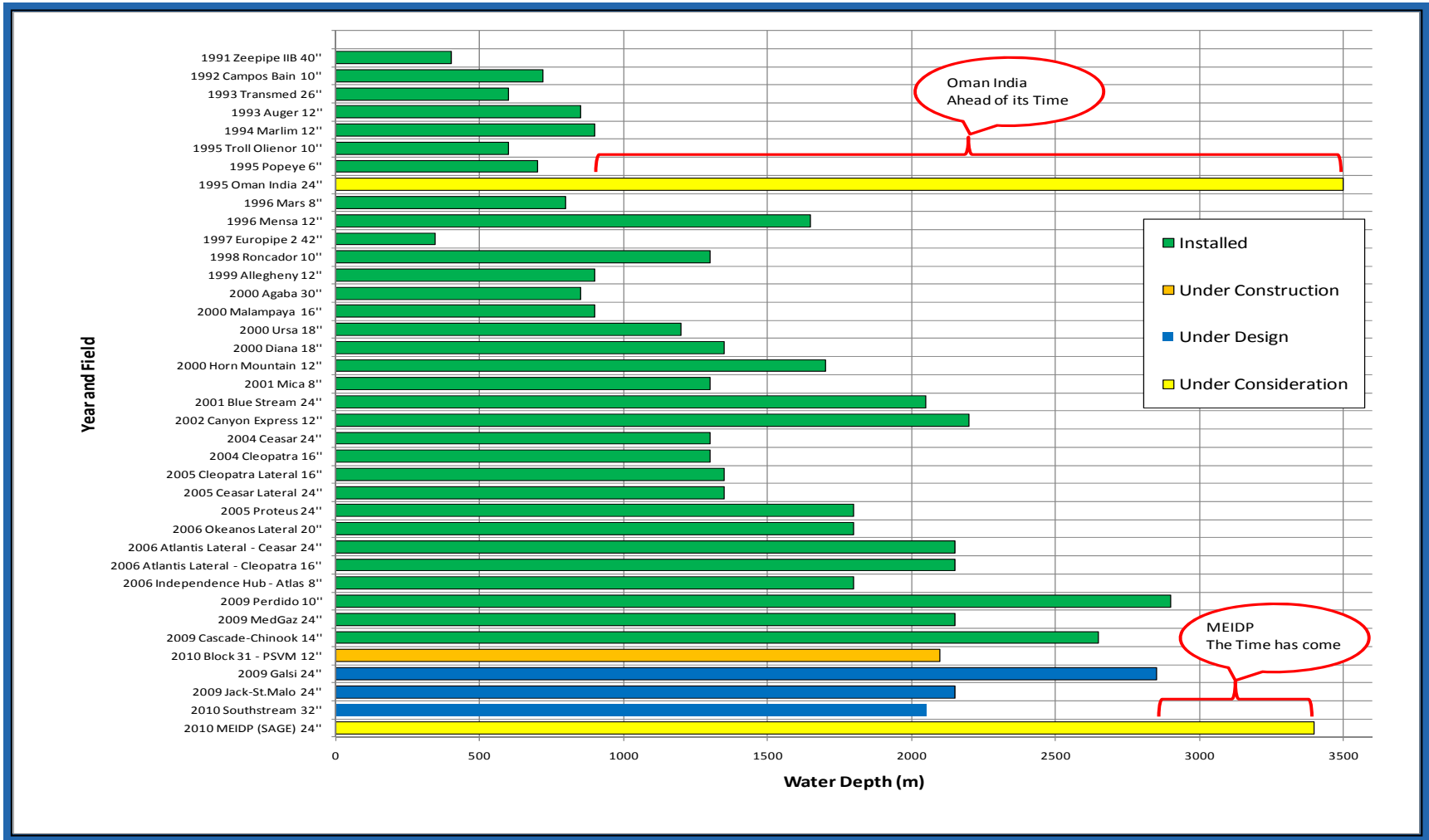
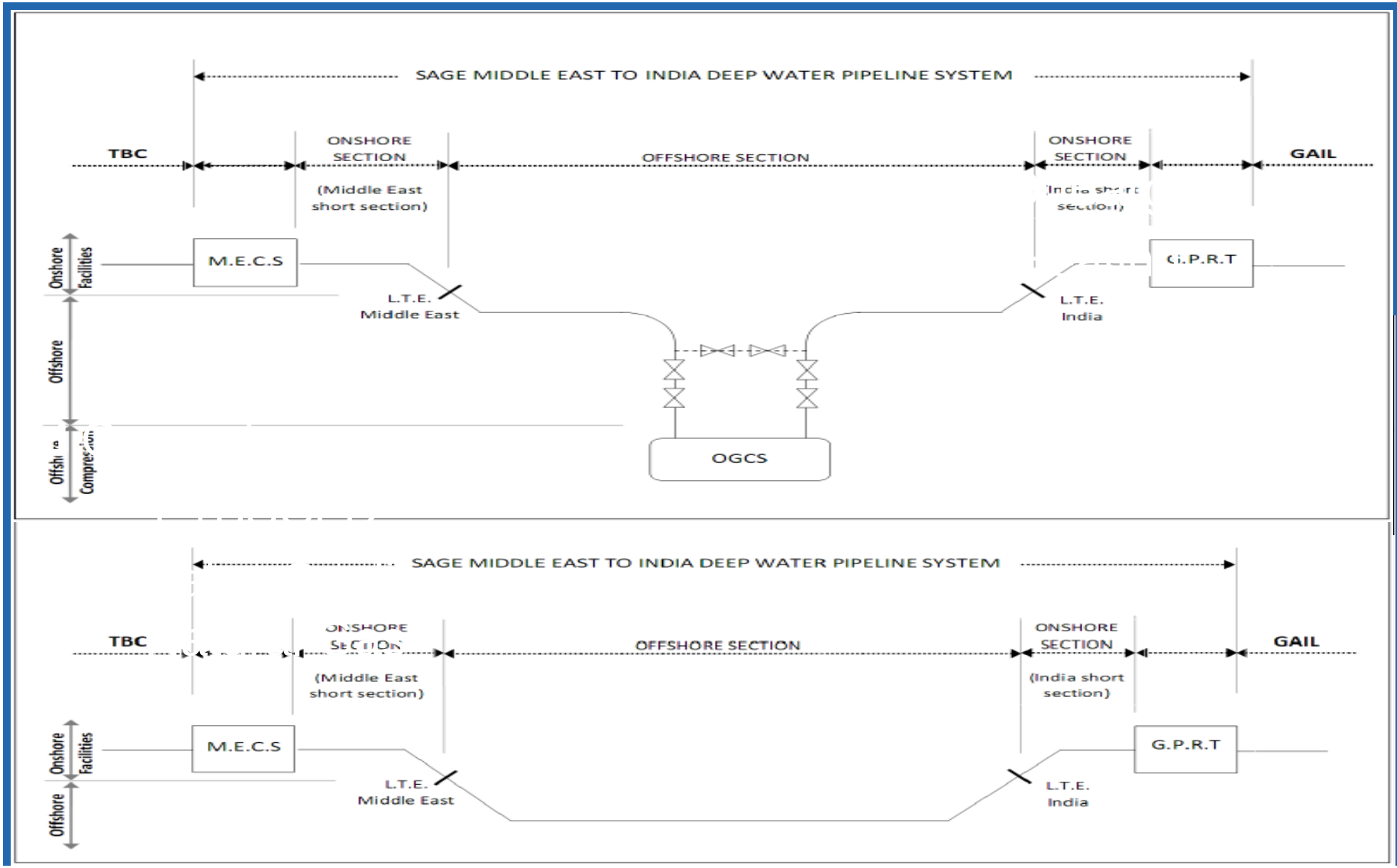
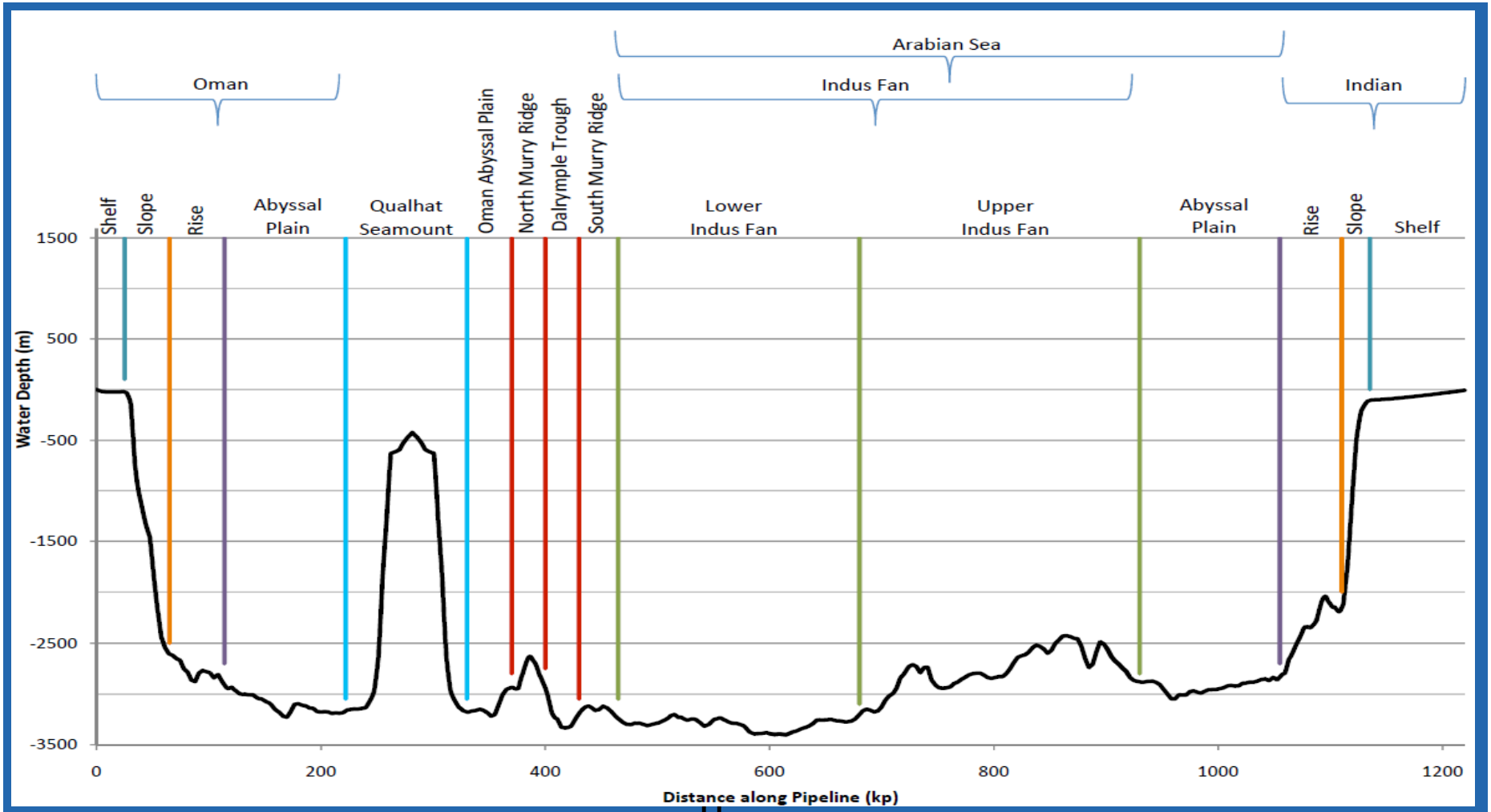
Difficulty of Deep Pipelay Projects



Design Basis



Pipeline route Profile
MECS => OGCS => GPRT



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Pipeline route Profile
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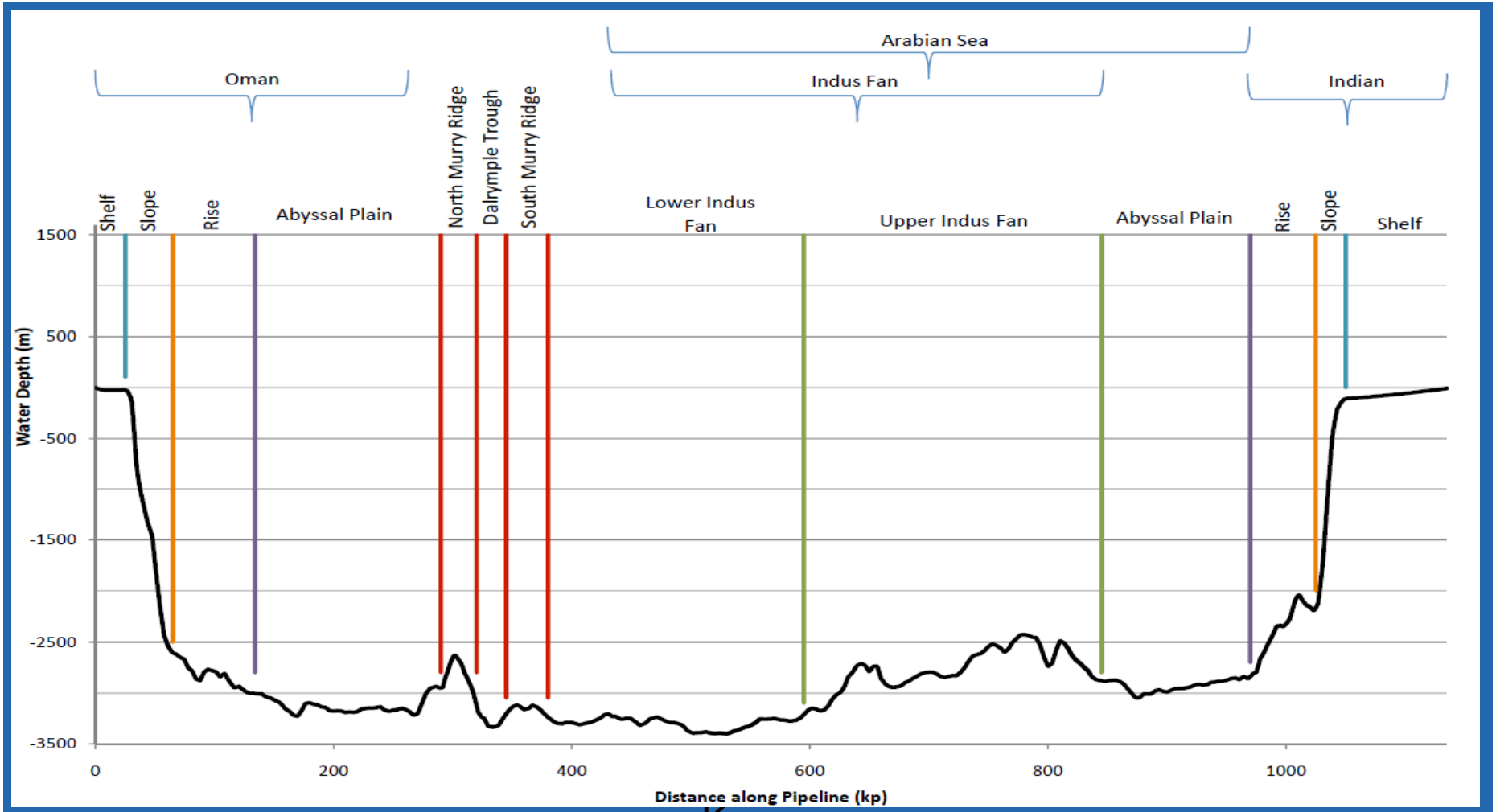

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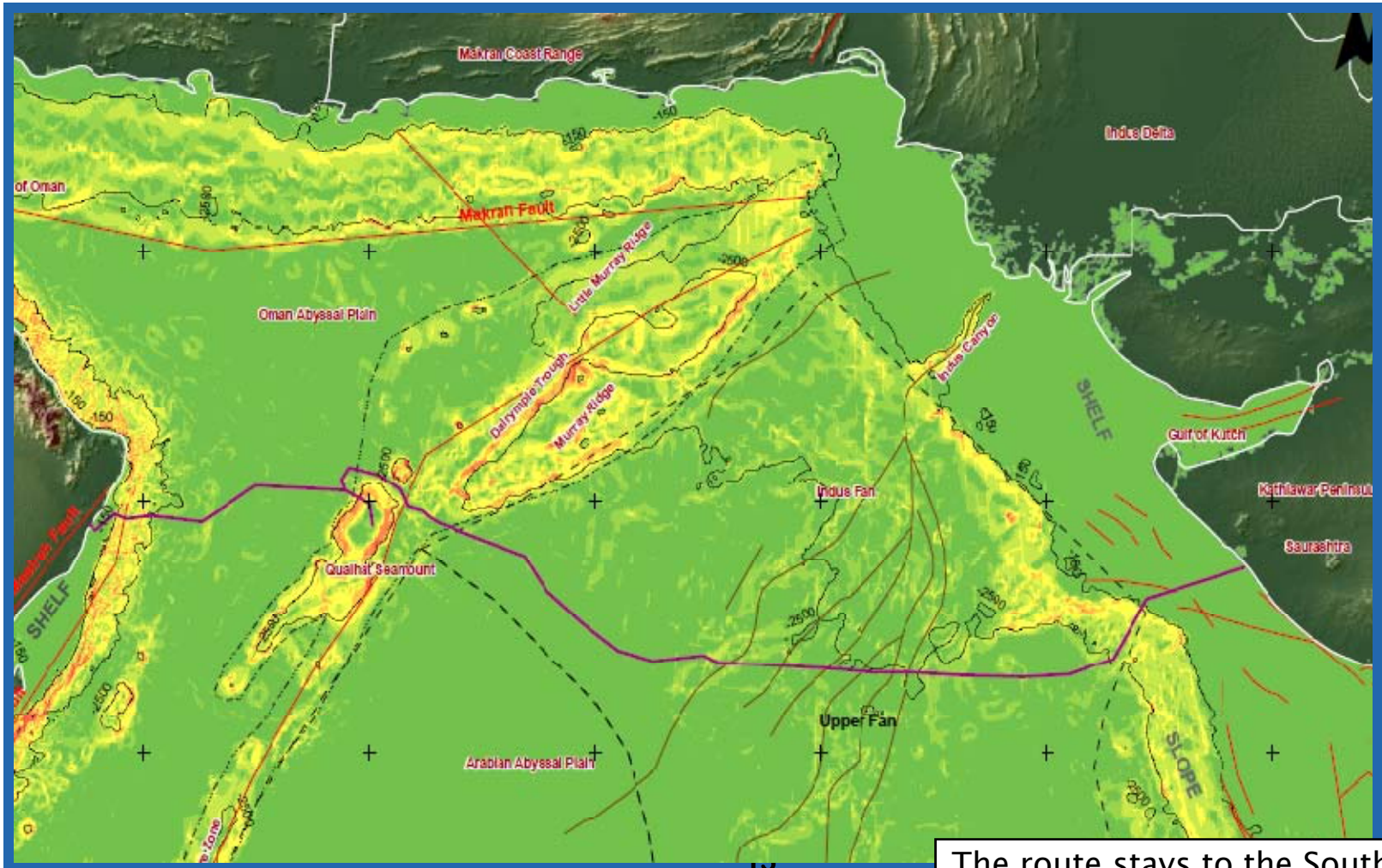
2010 Activities Completed

- Overall Project Management
- 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 Activities Completed

- Overall Project Management
- Vessel & equipment capabilities review
- Pipeline intervention review
- Geohazard and fault crossing assessment phase 2
- Metocean data phase 2
- GIS data collection
- Riser and subsea by-pass definition

Seabed Slope Map



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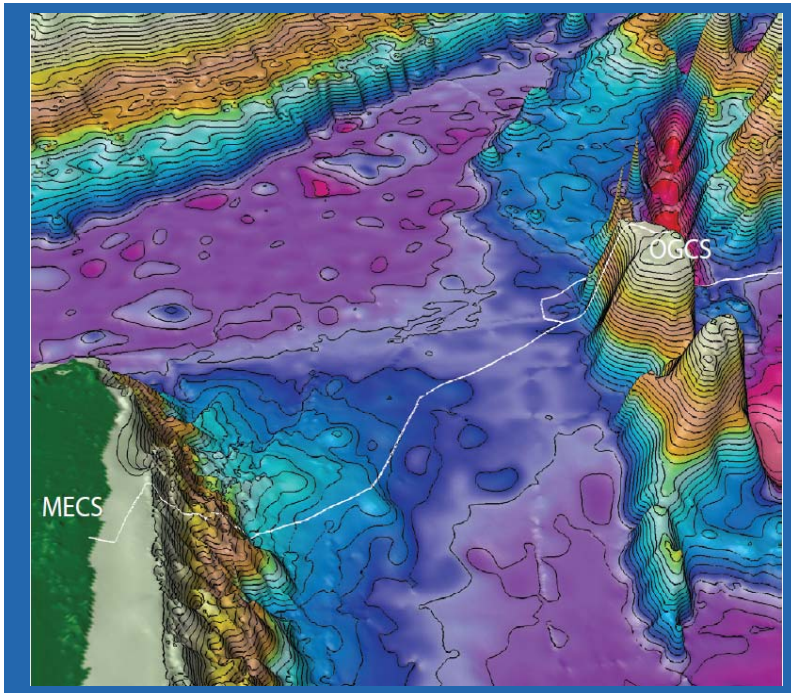
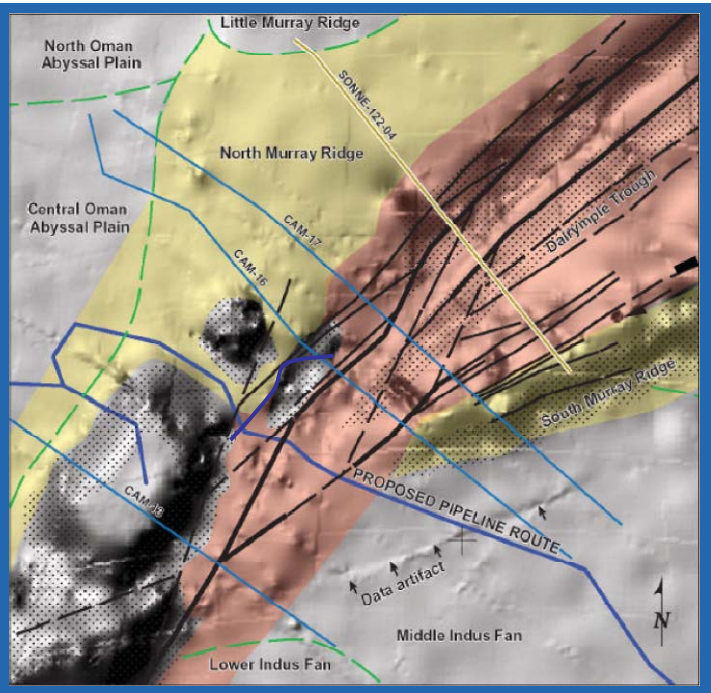
The route stays to the South of the Indus Fan to avoid expensive, difficult crossings.

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

Murray Ridge and Qualhat Seamount





- Qualhat Seamount location (Compression facility)
- Outside of all Territorial Waters
- Within helicopter supply range.
- Northern Slope 20deg similar to Landfalls.

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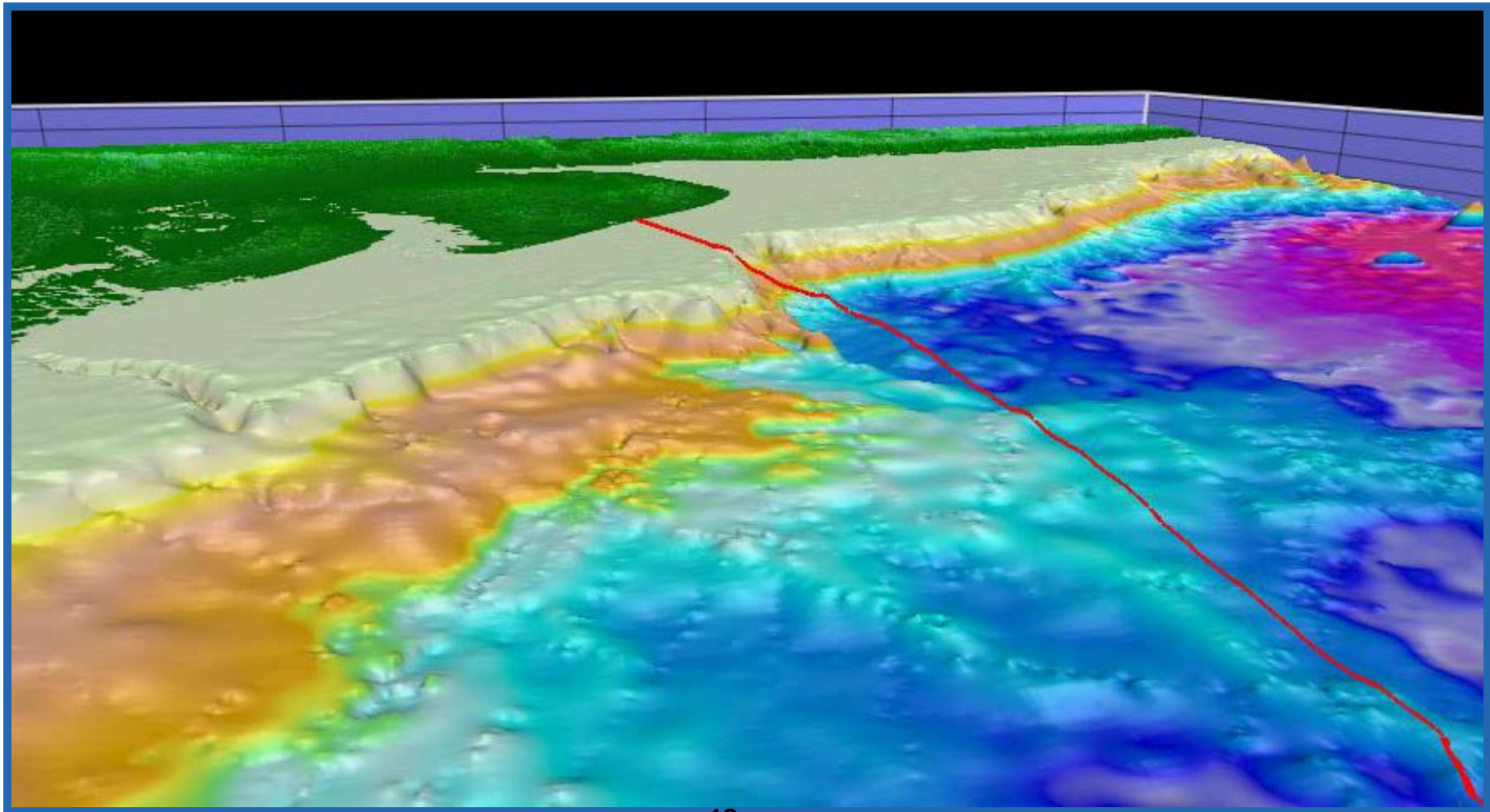
Indus Fan and Indian Slope



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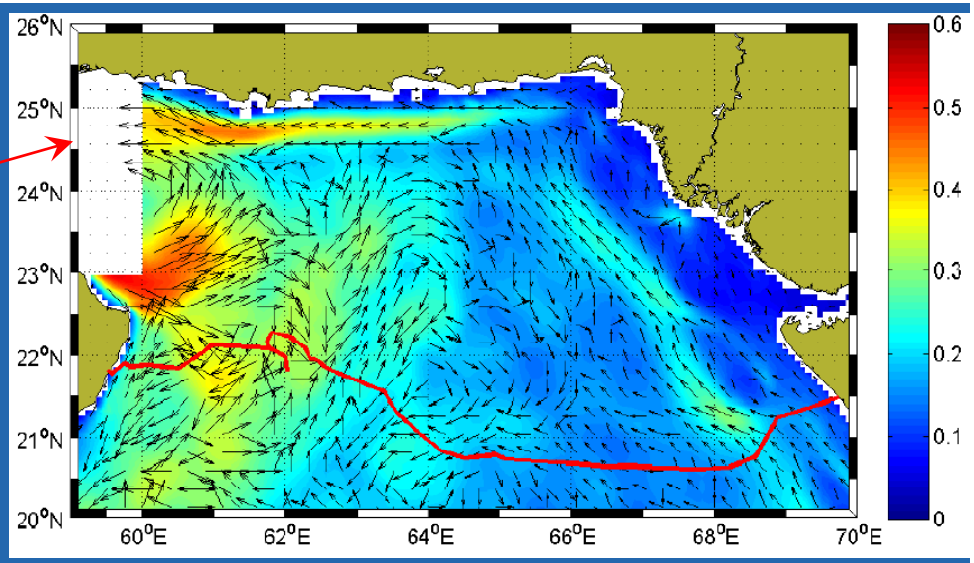
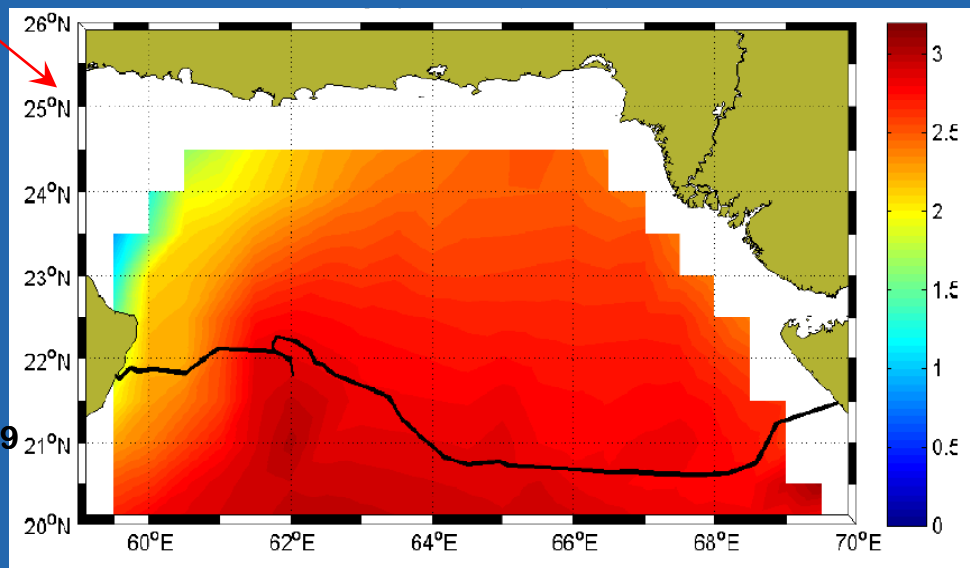
Completed Studies – Metocean Phase 1

North West Monsoon

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

South East Monsoon





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Completed Studies - Mechanical Design

- DNV-OS-F101 using DNV 485 DSAW linepipe
- Supplementary requirement U material strength factor
- DNV technical report => Fabrication factor α_{fab} = 1.0,
- Ovality = 0.5%

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

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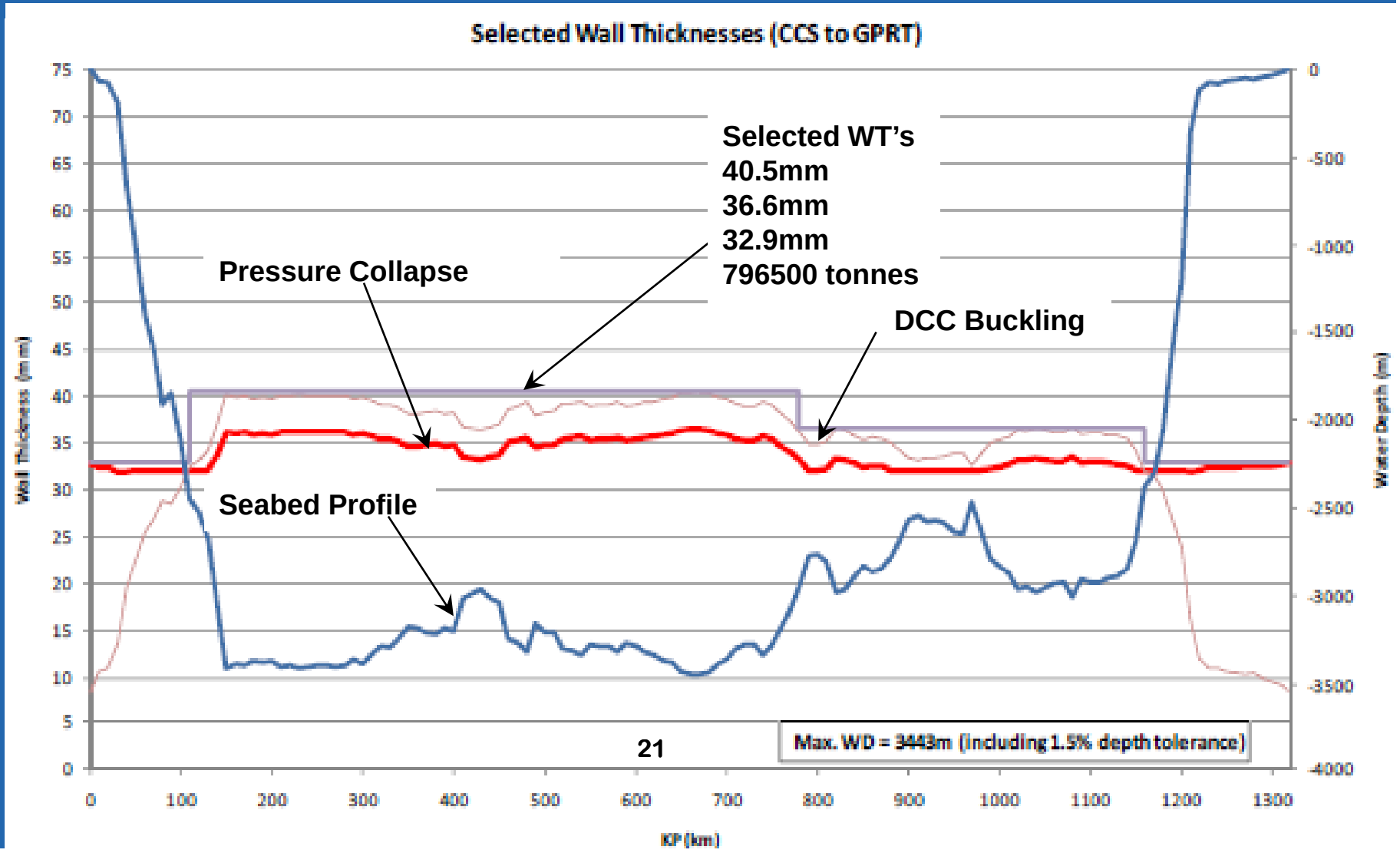
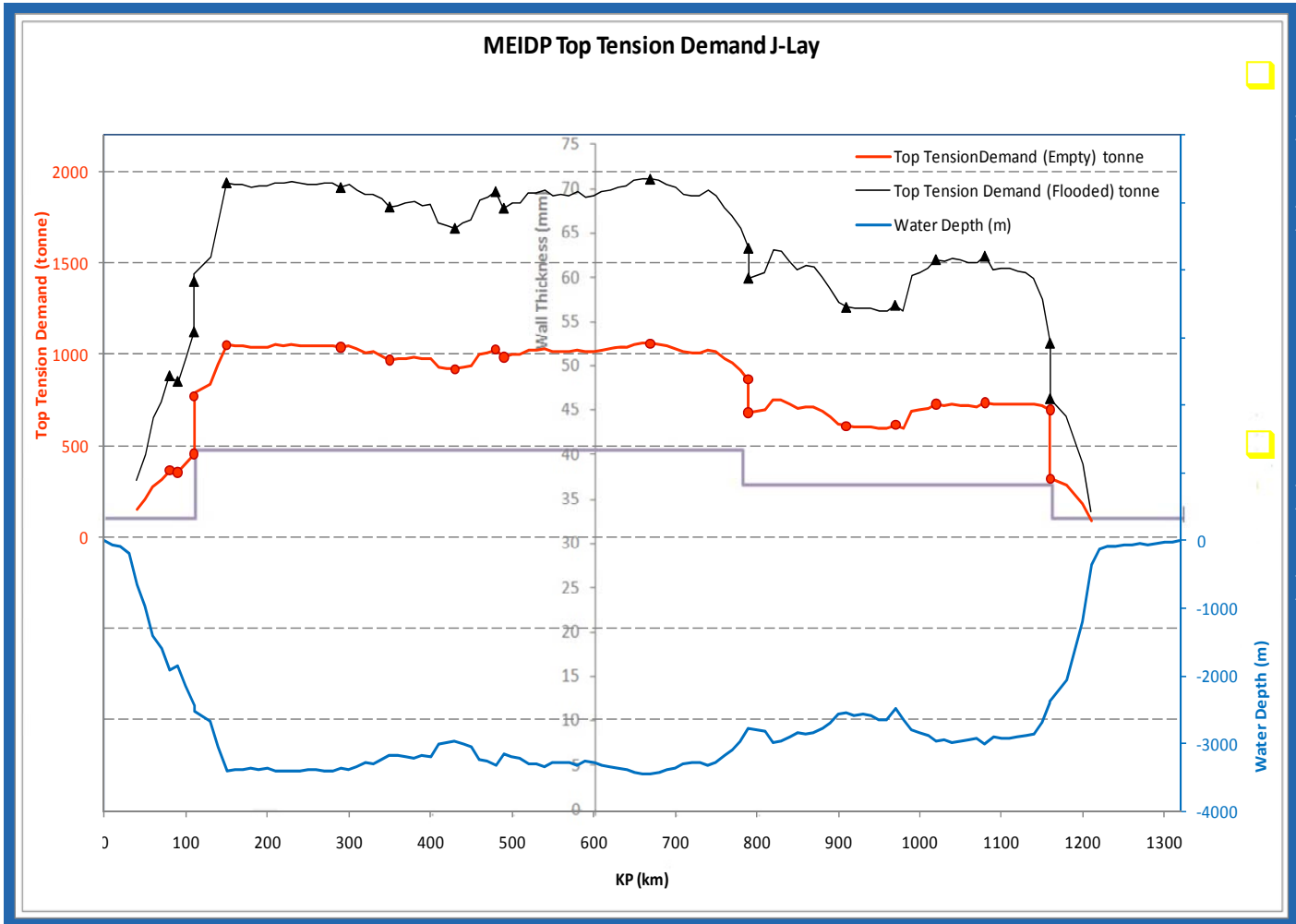
Completed Studies - Mechanical Design



Installation Vessel J-Lay Demand



- **J-Lay Demand**
  - 1060 tonne normal lay
  - >1950 tonne A&R
- **J-Lay Capacity**
  - 1600 tonne normal lay
  - >2000 tonne A&R

New Pipelay Vessels under Construction

- CastorONE (Saipem SpA)
- Operational early in 2012
- Rated for 3500m Pipelay
- J-Lay & S-Lay

- Aegir (HMC)
- Operational early in 2014
- Rated for 3500m Pipelay
- J-Lay

- Pieter Schelte (Allseas)
- Operational Mid 2014
- Rated for 3500m Pipelay
- S-Lay

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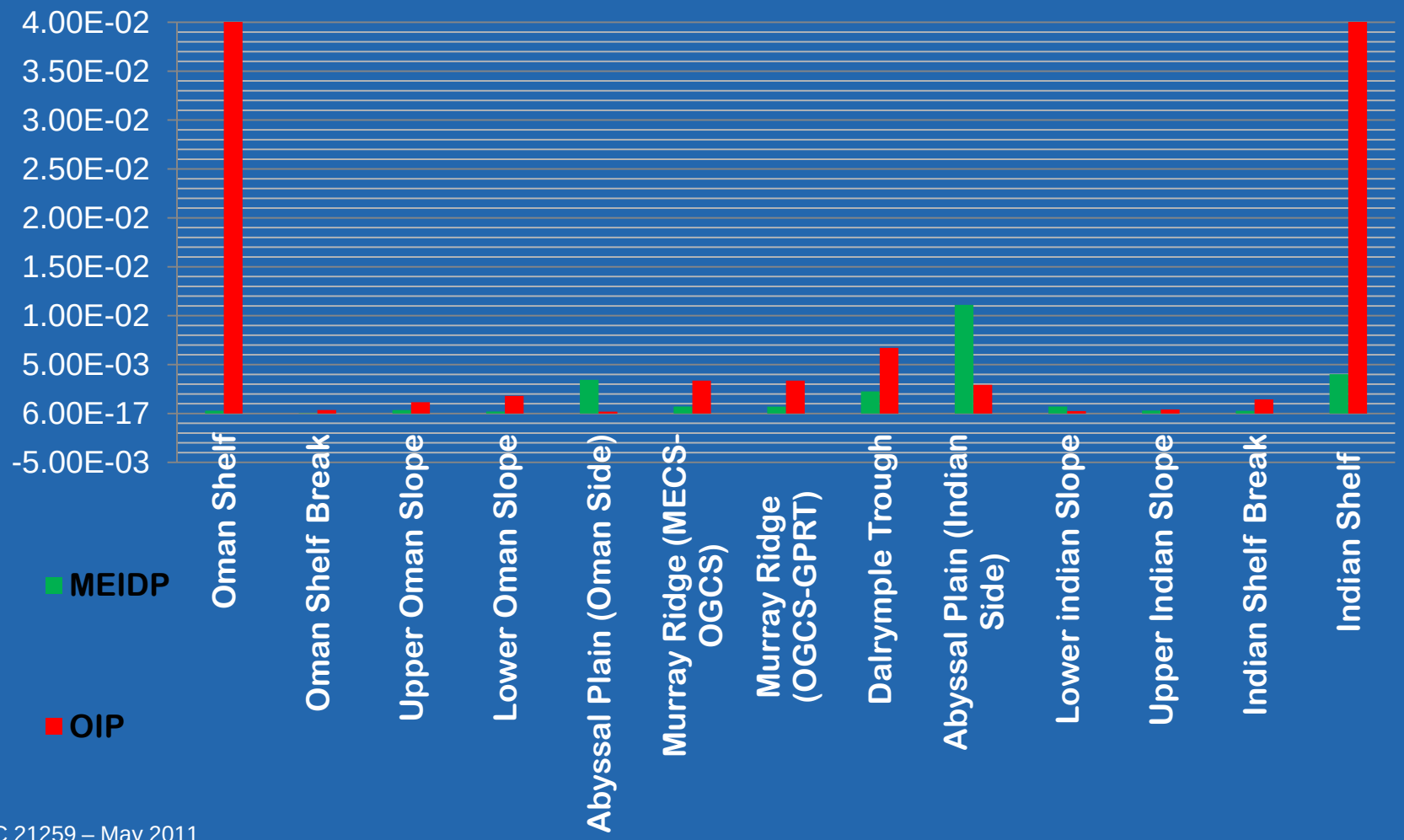
QRA Update

- 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



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Ongoing 2011 studies

- Establish no hydrotest principle
- Onshore compression station review
- Offshore layout optimisation
- Receiving terminal conceptual design
- Emergency repair equipment review

Planned 2011 studies

- Insurance risk review
- Survey definition and scope of work
- Define survey ITT and tender
- Environmental statement
- Mill Prequalification and Ring Test Collapse Programme
- Examine the effect of moderate heat treatment)

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

Technical summary

- MEIDP are no longer a giant leap forward, but rather **the logical next step**
- The development of deepwater **pipelay vessels capable of installing MEIDP** due by 2014
- Studies performed in 2009-2011 **prove feasibility of the MEIDP project**
- Fabrication technologies exist within **current mill capacities** for MEIDP size/wall
- Routes established to **avoid the worst features of the Indus Fan**, minimising project technical risks

Economic and commercial summary

- The MEIDP pipeline
  - Provides the **most economic** method of gas supply to the Western coast of India
  - Enhances the **security of energy supply** for Indian subcontinent
  - **Promotes competition** in the Indian energy markets
  - Will contribute significantly towards the implementation of sustainable development strategies of an **integrated energy plan** for the Indian Subcontinent

Acknowledgements

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- HMC Vessel Data Aegir http://hmc.heerema.com/tabid/1838/language/en-US/Default.aspx
- Allseas Vessel Data Pieter Schelte http://www.allseas.com/uk/19/equipment/pieter-schelte.html