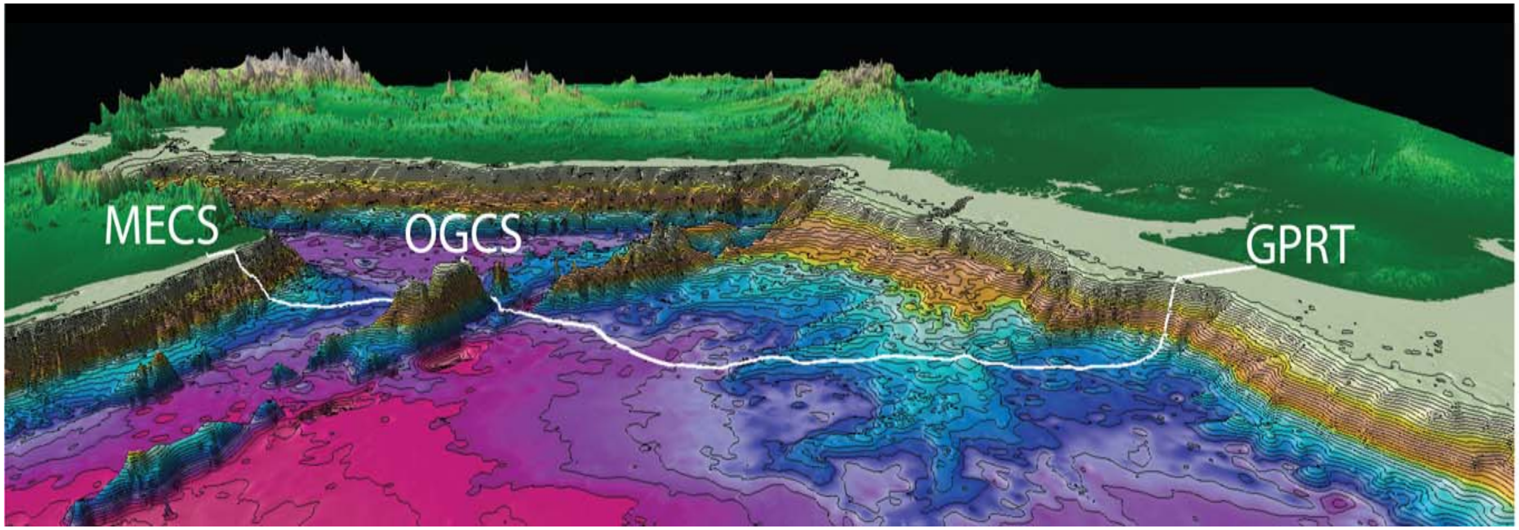
Middle East to India Deepwater Pipeline (MEIDP)



Presentation to

Kelkar Committee

(14 August 2013)

Project Summary

1. Project Overview and Participants
2. Supplying India's Gas Needs
3. Current long distance and deepwater pipelines
4. Design Challenges
5. Comparison with Oman-India Pipeline Project
6. SAGE developments and work to date
7. Schedule and Construction Considerations
8. MEIDP Financial Model
9. Summary and Conclusions

Introduction

- *SAGE*
  - South Asia Gas Enterprise Pvt Ltd (SAGE), a joint venture lead by the Indian Siddhomal group, is actively considering building a deepwater, transnational, natural gas pipeline system from the Middle East to India
- *India needs gas*
  - The deepwater route across the Arabian Sea is the shortest secure distance between huge reserves in Qatar and Iran and the rapidly developing industrial heartland of India in Gujarat, and is too short for LNG to be an economic transportation option
- *A pipeline across the Arabian Sea*
  - The current work builds on the extensive study of the deepwater route of the Oman to India Pipeline that was carried out in the early 1990's
  - The case for this route has been strengthened by recent development work undertaken by SAGE and by the major body of deepwater design and pipelay experience accumulated over the last decade

The Project

- MEIDP 1 will be the first in a series of pipelines supplying gas to the Gujarat coast of India, from the vast available resources in the Middle east, by the **safest, most economic** and **reliable** means
- The SAGE MEIDP Project is envisaged as an transmission pipeline **Infrastructure project** allowing transportation of multiple sources of Middle East Gas to the West Coast of India
- The pipeline will be laid as a "**Common Carrier**" pipeline whereby SAGE will be the Gas Transporter and will be paid a Tariff for pipeline use
- The Gas Buyers and the Gas seller will negotiate the Long Term Gas Supply Contract themselves [under the aegis of SAGE in a **Tri-partite Framework Agreement**]

The SAGE Project – Key team members

Mr. T.N.R. Rao	▪ Former Petroleum Secretary, Govt. of India and "Architect of the Oman-India Pipeline" ▪ Chairman of the SAGE Advisory Board ▪ Founder Chairman, Hydrocarbons Education & Research Society, Indian School of Petroleum ▪ Founder Chairman – University of Petroleum & Energy Studies
Subodh Jain	▪ Director: INOX-AIR PRODUCTS Ltd. ▪ Director: South Asia Gas Enterprise PVT Ltd ▪ Director: Siddho Mal & Sons, New Delhi ▪ Former Senior Advisor to original Oman-India Pipeline team
Peter M Roberts	▪ Director: South Asia Gas Enterprise PVT Ltd ▪ Director: VerdErg Ltd, London ▪ Former Project Director of original Oman-India Pipeline
Dr Herman Franssen	▪ Senior Consultant to SAGE ▪ Member of the SAGE Advisory Board. ▪ President, International Energy Associates, USA ▪ Former Economic Advisor to the Oman-India Pipeline project ▪ Former Economic Advisor to the Sultanate of Oman, Ministry of Petroleum
Stefano Bianchi Roberto Bruschi Milind Baride	▪ Senior Vice President, Saipem Energy Services, Milan. ▪ Sealine and Subsea Manager, Saipem Energy Services, Milan. ▪ ex-Chairman, Saipem India Projects Ltd., Chennai now in Saipem Milan.
Ian Nash	▪ Business Acquisition and Operations Director, Peritus International (UK) Ltd. ▪ Managing Director INTECSEA (UK) Ltd. ▪ Project Manager for Detailed Design of BP Block 31 Subsea flowlines and Structures ▪ Project Manager & Engineering Manager for MEDGAZ FEED. 24" Gas Trunkline in 2200m Water ▪ Engineering Manager (Saipem Inc) for Canyon Express design EPIC. ▪ Project Manager (SASP UK) for Europipe 2, 42-inch 650 Km Gas Trunkline detailed design.
Dr Alastair Walker FRS	▪ Leading International Expert on Marine Pipeline Engineering ▪ Senior Consultant to SAGE ▪ Member of the SAGE Advisory Board ▪ Professor Emeritus, University of Surrey UK ▪ Visiting Professor, University College London

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

SAGE

Pipe Mills

- Tata (CORUS) steel
- Welspun
- JindalSAW

Engineering & Consultancy:

- Peritus International Ltd.
- Engineers India Ltd.
- Intecsea (UK) Ltd.
- FUGRO GeoConsulting Ltd.

Installation Contractors

- Saipem SpA
- Heerema Marine Contractors

Suppliers and Takers

- Indian Oil Corporation
- GAIL
- GSPC
- Oman Ministry of Oil and Gas
- NIGEC

Certification Bodies:

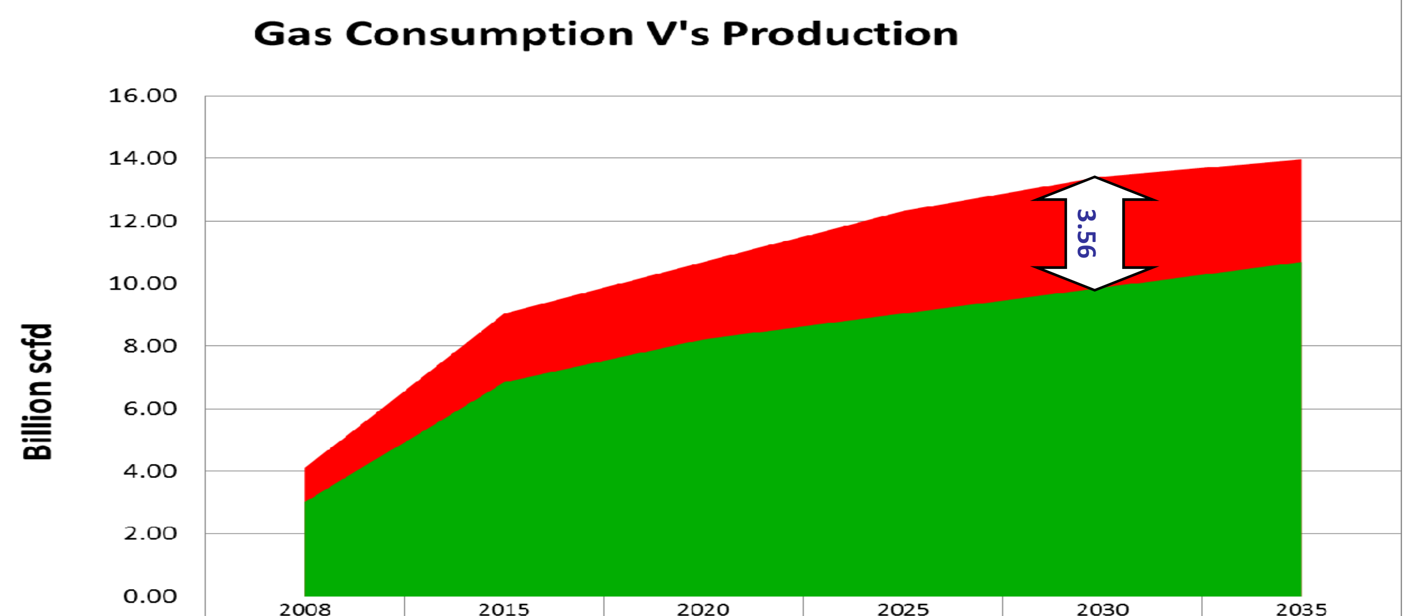
- .Det Norske Veritas

MEIDP Project Features

- Potential Start Points
  - Chabahar, Iran
  - Ras al Jafan, Oman
- End Point- South Gujarat
- Diameter 27.2”, 32.9-40.5mm WT (DNV OS-F101)
- Flowrate 1.1BSCFD (31.1mmscmd)
- Maximum Depth- 3,450 meters
- Length- 1,200- 1,300 kilometers
- Fast Track Project can be executed over 5 year period
- Pipeline Construction over 2 years

Indian Natural Gas Reserves

- US Department of Energy Predicts a shortfall of 3560MSCFD by 2030
- Indigenous KG-D6 reserves have not lived up to expectations



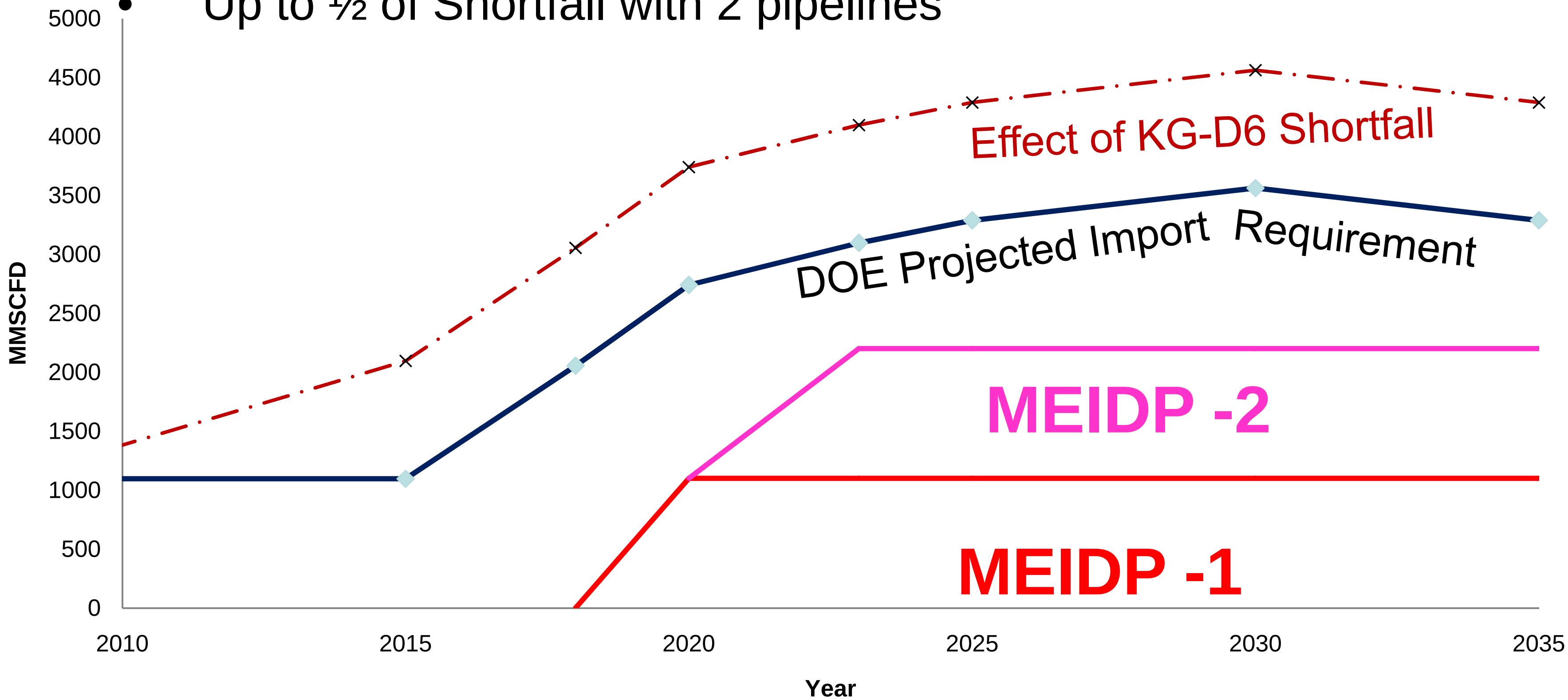
	2008	2015	2020	2025	2030	2035
India Gas Consumption	4.11	9.04	10.68	12.33	13.42	13.97
India Domestic Gas Production	3.01	6.85	8.22	9.04	9.86	10.68

U.S. Department of Energy, DOE/EIA-0484(2011)

Projected Gas Import Requirements (MMSCFD thru 2035)

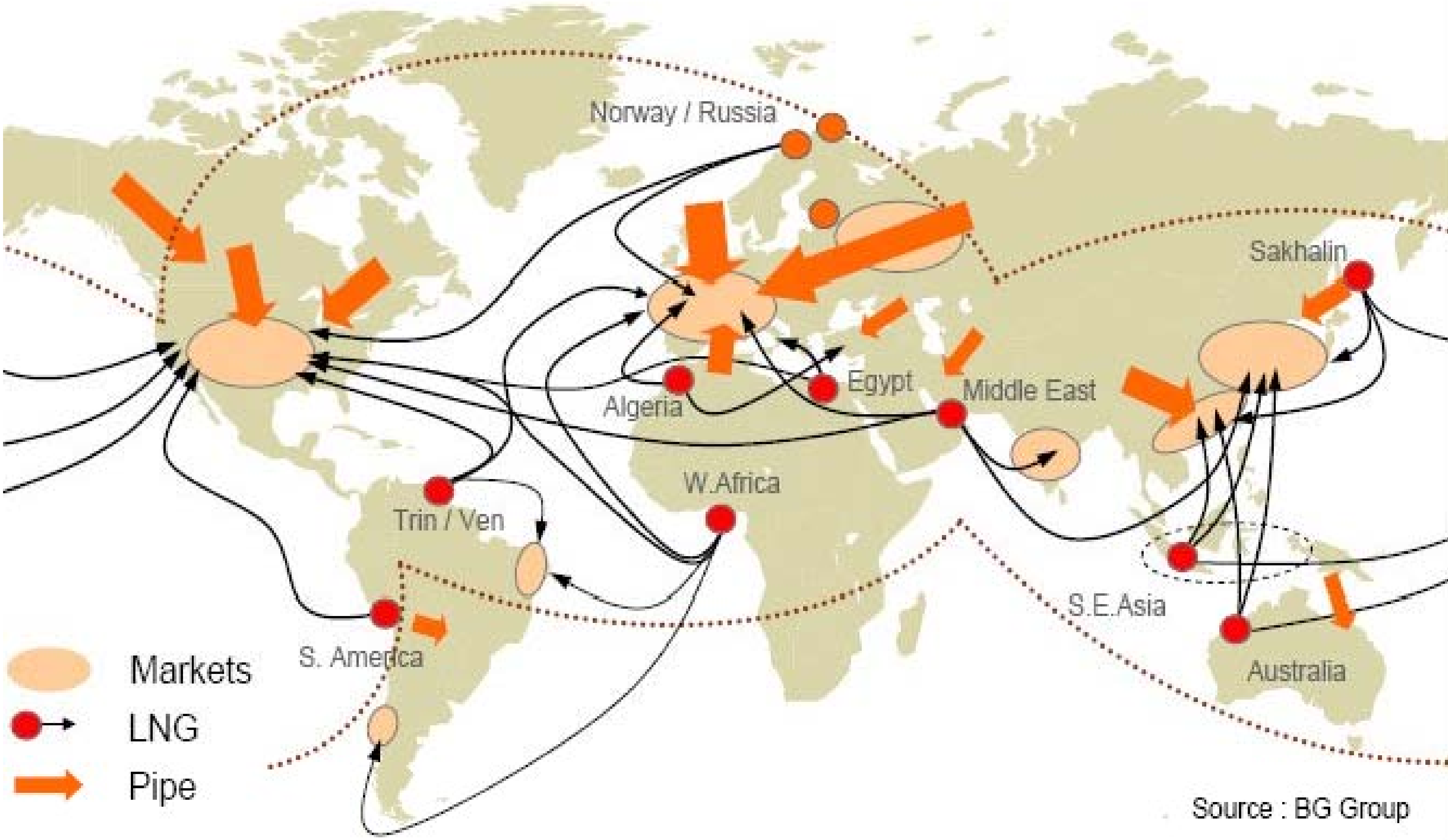
MEIDP Provides

- Up to ¼ of Shortfall in Indigenous Supply with 1 pipeline
- Up to ½ of Shortfall with 2 pipelines



U.S. Department of Energy, DOE/EIA-0484(2011)

World Natural Gas Market (Pre Shale)



LNG Landed Prices May 2013

Natural Gas Overview: World LNG Prices $/MMBtu

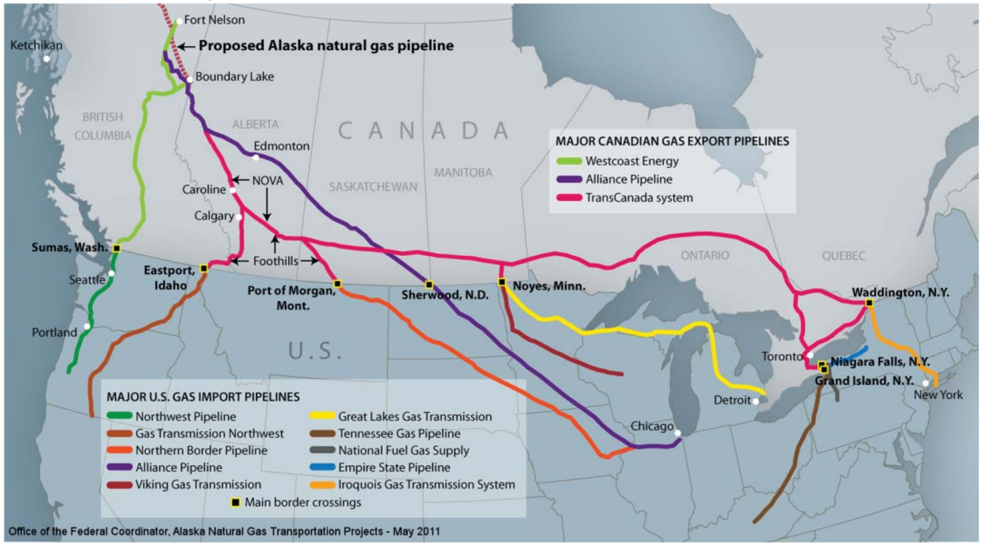
Federal Energy Regulatory Commission • Market Oversight • www.ferc.gov/oversight

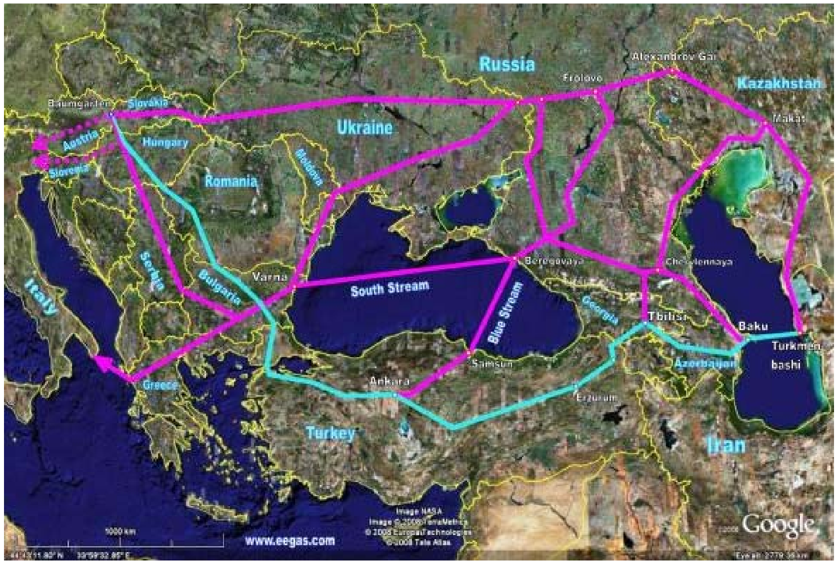
World LNG Estimated August 2013 Landed Prices

Transnational Gas Pipeline Regions

- Northern Europe
- China
- Russia to Europe
- USA to Canada
- West Africa

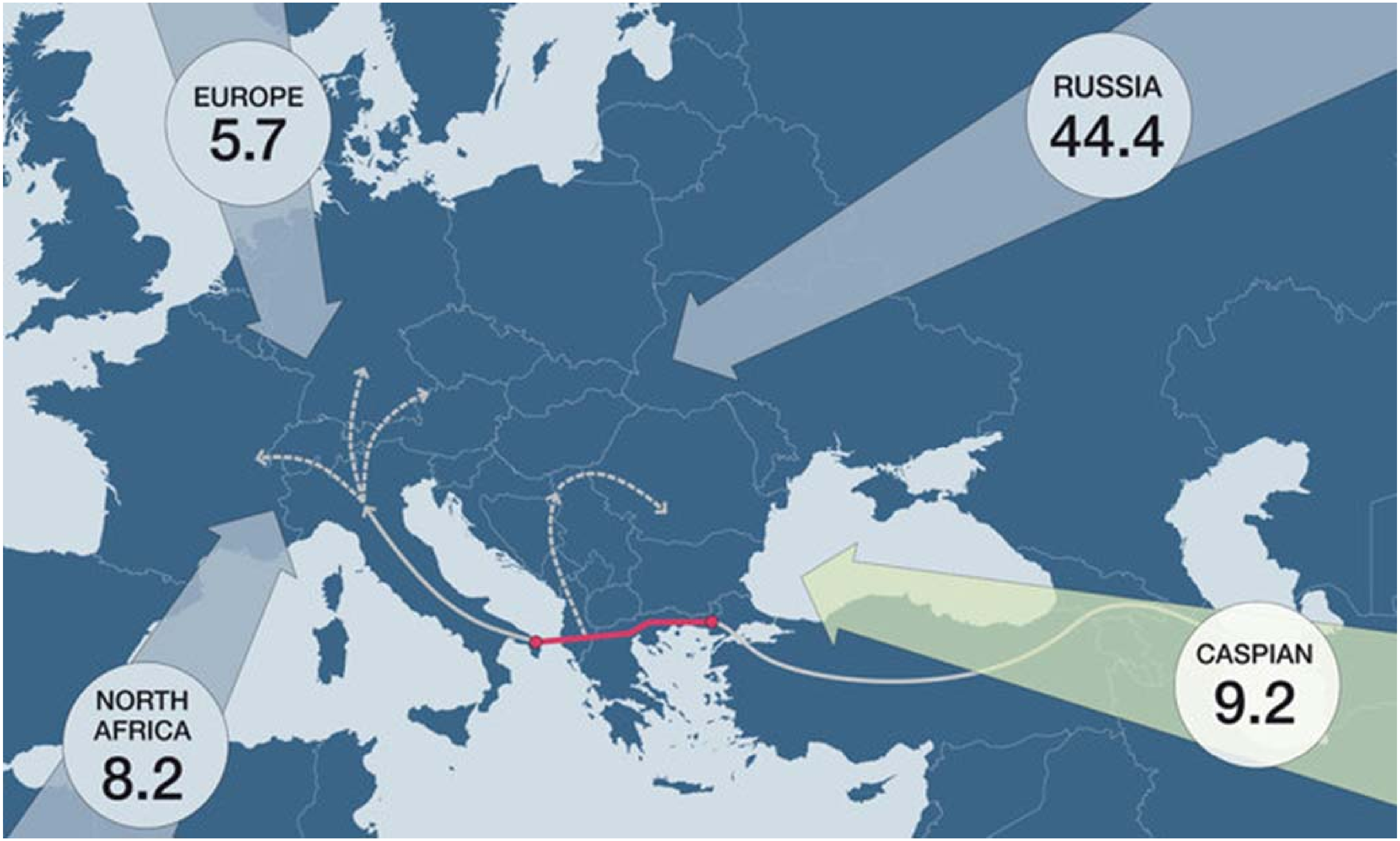
MAJOR CANADA, U.S. EXPORT-IMPORT GAS PIPELINES



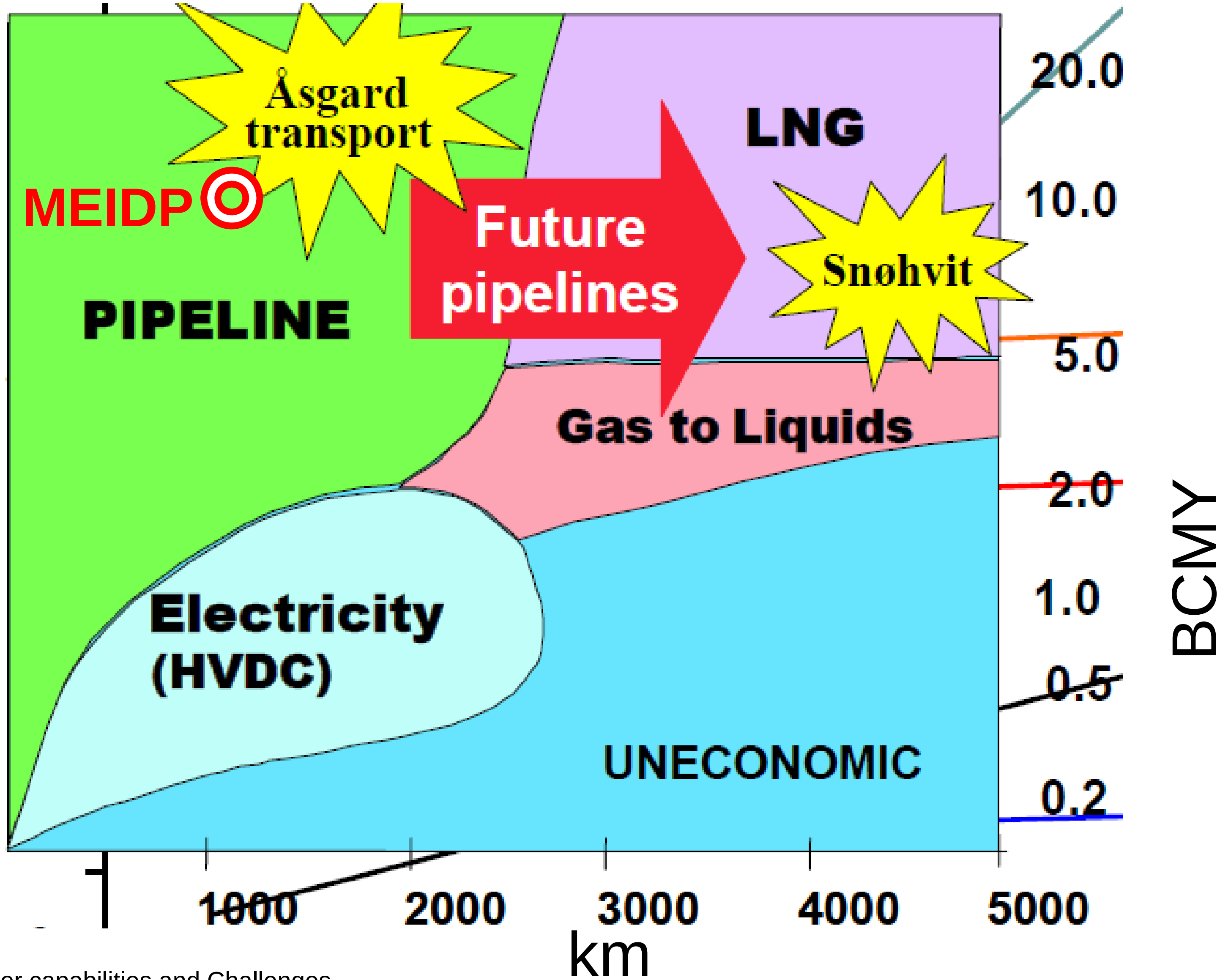


European Transnational

Volume in BSCFD



Competitiveness of Pipelines

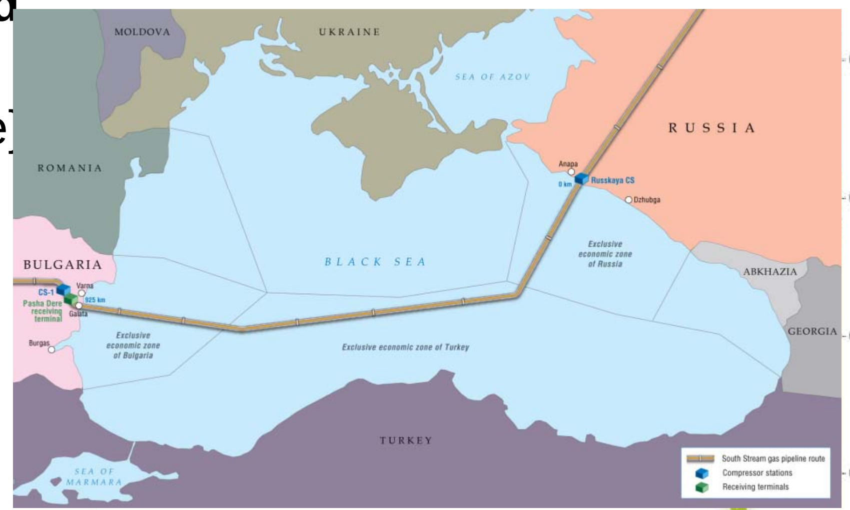


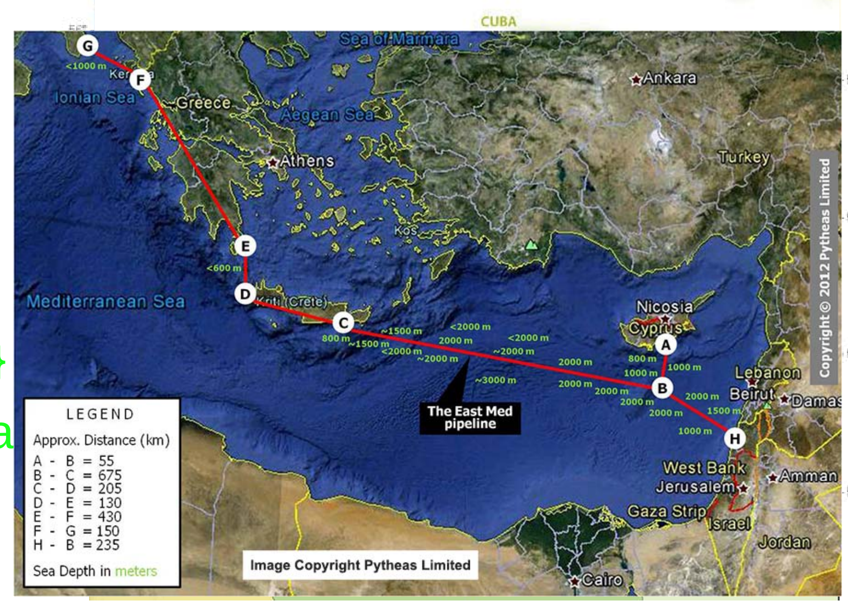
Ultradeepwater capabilities and Challenges
Statoil R&D

Current and Planned Long Distance

Long Distance Subsea Pipelines are Safe and Reliable Worldwide

- FranPipe 840km 42” {Norway → France}
- ZeePipe 1400km 42” {Norway → Belgium}
- Europipe 650km 42” {Norway → Germany}
- Langeled 1170km 42” {Norway → UK}
- Nordstream 1200km 48” 2 off {Russia → Germany} (2 further planned)
- Gulfstream 1200km 36” {Alabama → Florida, USA}
- West Africa Pipeline 569km 20” {Nigeria → Benin → Togo → Ghana}
- Malampaya 504km 24” {Philippines}
- Polarled 482km 36” {Artic Circle → Norway}
- Southstream 925km 32” {Russia → Bulgaria
- Galsi 550 km 28” {Algeria → Italy}
- East Med Pipeline 910km {Israel Greece}

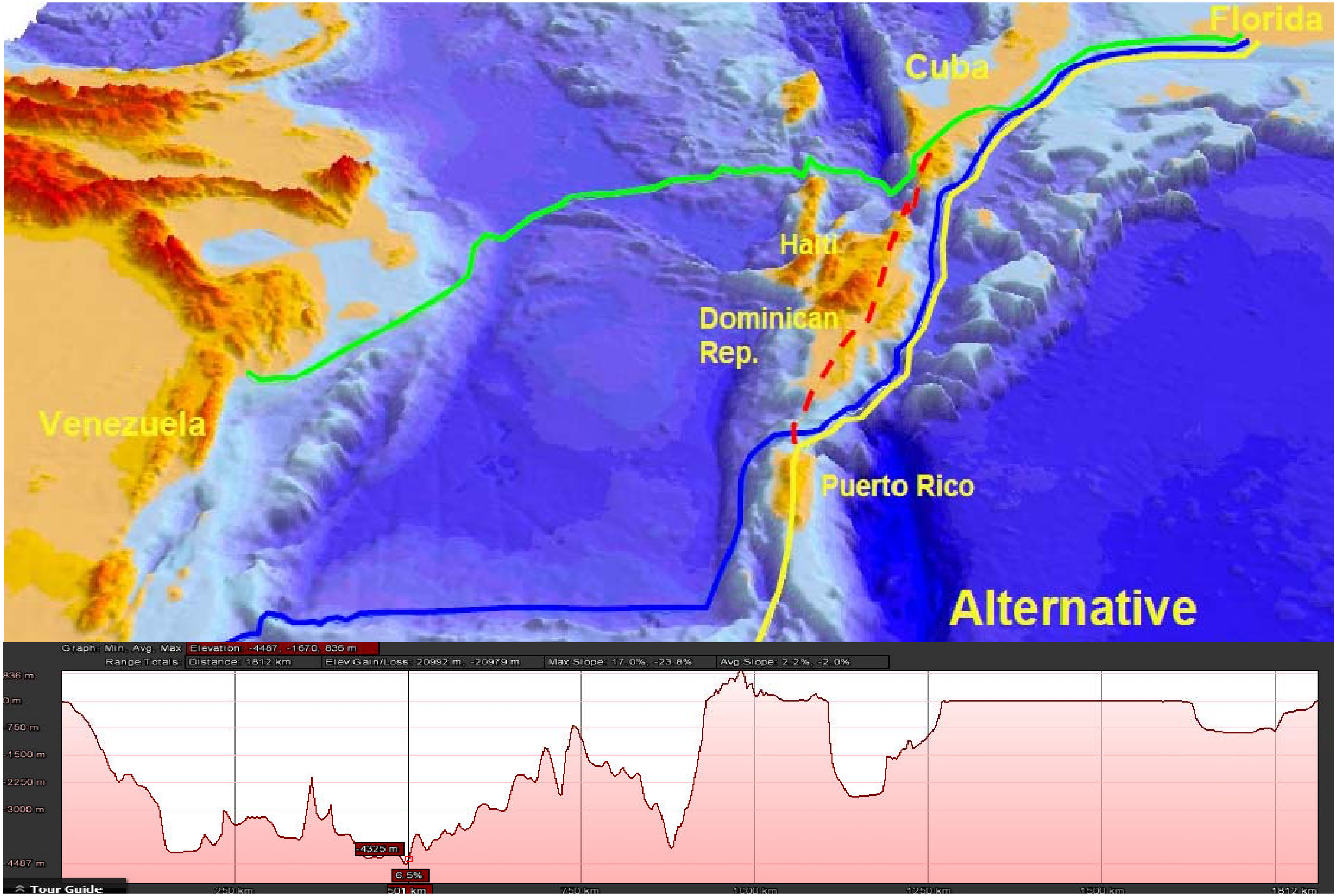




Recent & Planned Deepwater Projects

Project	Location	Year	Water depth (m)	Length (km)	Size	Product
Canyon Express	GOM	2002	2200	180	12”	Gas
Bluestream	Black Sea	2003	2150	385	24”	Gas
Mardi Gras	GOM	2006	2150		16”-30”	Gas
Medgaz	Med	2008	2155	210	24”	Gas
Cascade Chinook	GOM	2009	2680	19	9”	Oil
Perdido	GOM	2009	2961	10	10”	Oil
Jack St.Malo	GOM	-	2200	220	24”	Gas
South Stream	Black Sea	-	2100	925	32”	Gas
Galsi	Med	-	2800	565	26”	Gas
Venezuala Florida	GOM	-	4400	1880	24”-28”	Gas

Venezuala- Florida Pipeline



Gas Reserves & International Supply

International Supply of Gas to India

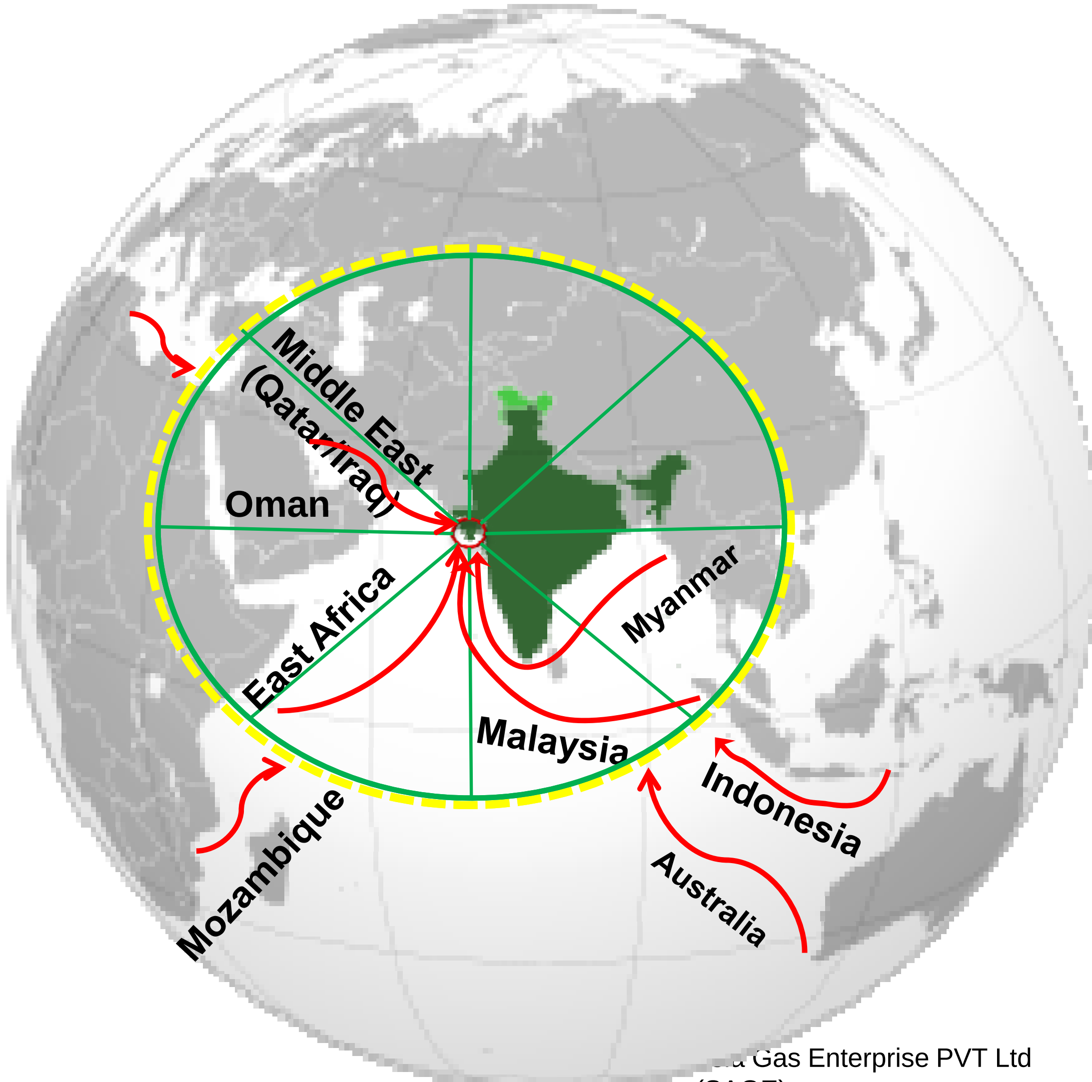
- Over 2,000 TCF of natural gas reserves are held by countries with which India has a traditional trading relationship, including Qatar, Iran and Turkmenistan
- Iran is looking for export solutions for its vast reserves of Natural Gas
- Qatar is looking for new export markets with the advent of Shale Gas explosion in USA
- Iraq is building its Gas development and looking for Export solutions
- Onshore Pipelines such as IPI and TAPI have significant security and supply issues

Table 7. World natural gas reserves by country as of January 1, 2011

Country	Reserves (trillion cubic feet)	Percent of world total
World	**6,675**	**100.0**
Top 20 countries	**6,067**	**90.9**
Russia	1,680	25.2
Iran	1,046	15.7
Qatar	896	13.4
Saudi Arabia	275	4.1
United States	273	4.1
Turkmenistan	265	4.0
United Arab Emirates	228	3.4
Nigeria	187	2.8
Venezuela	179	2.7
Algeria	159	2.4
Iraq	112	1.7
Australia	110	1.6
China	107	1.6
Indonesia	106	1.6
Kazakhstan	85	1.3
Malaysia	83	1.2
Egypt	77	1.2
Norway	72	1.1
Uzbekistan	65	1.0
Kuwait	63	0.9
Rest of world	**608**	**9.1**

2300tcf
34.8%

Optimal Transportation to India (WC)



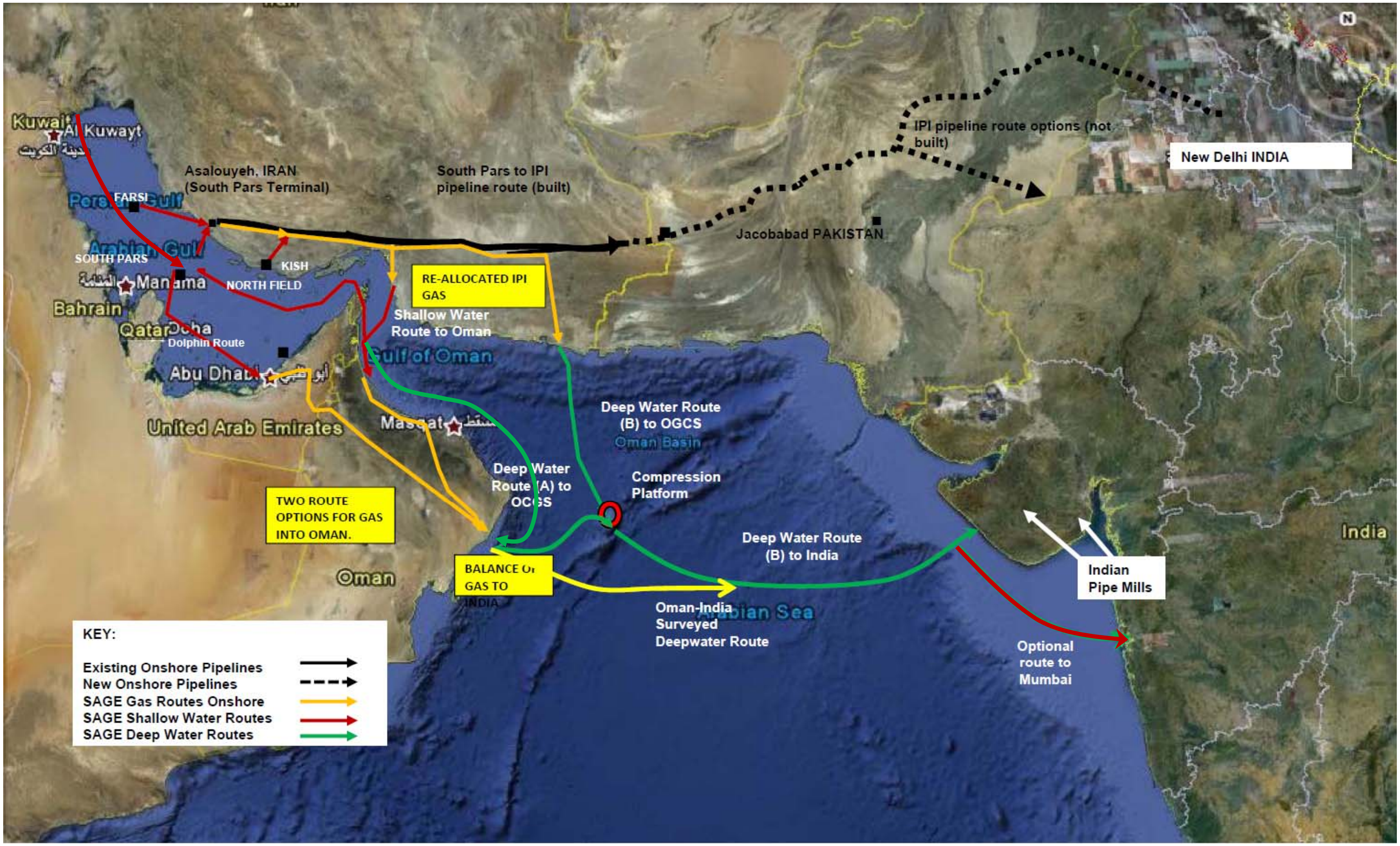
Offshore Pipeline

- Qatar
- Iraq
- Oman
- Iran
- Myanmar
- Malaysia
- East Africa (North)

LNG

- East Africa (South)
- Australia
- Indonesia
- North Africa
- Western Med

ME Gas Routes to India



Discussions with Gas Suppliers

SAGE continues to have discussions with potential Gas suppliers

I. Iran – Numerous discussions have been are having Gas supply discussions with National Iranian Gas Export Co. (NIGEC). Latest meeting held in Tehran in Feb 2013.

II. Qatar – MEIDP Project continues to be on their "Waiting List" considering their heavy commitments to LNG Projects.

III. Iraq - Preliminary discussions have been held to look at options for Iraqi gas

IV. Turkmenistan – Numerous discussions with Turkmen Oil Ministry. Oil Minister has advised that they are ready to Supply Gas Swap for MEIDP Project, when Iran gives NOC for the Gas Swap with Iran.

V. Oman - Now a net Gas Importer, SAGE has MOU with Oman Ministry of Oil & Gas for a Strategic Alliance for Gas Sourcing from 3rd countries e.g. Qatar / Iran / Turkmenistan / Iraq.

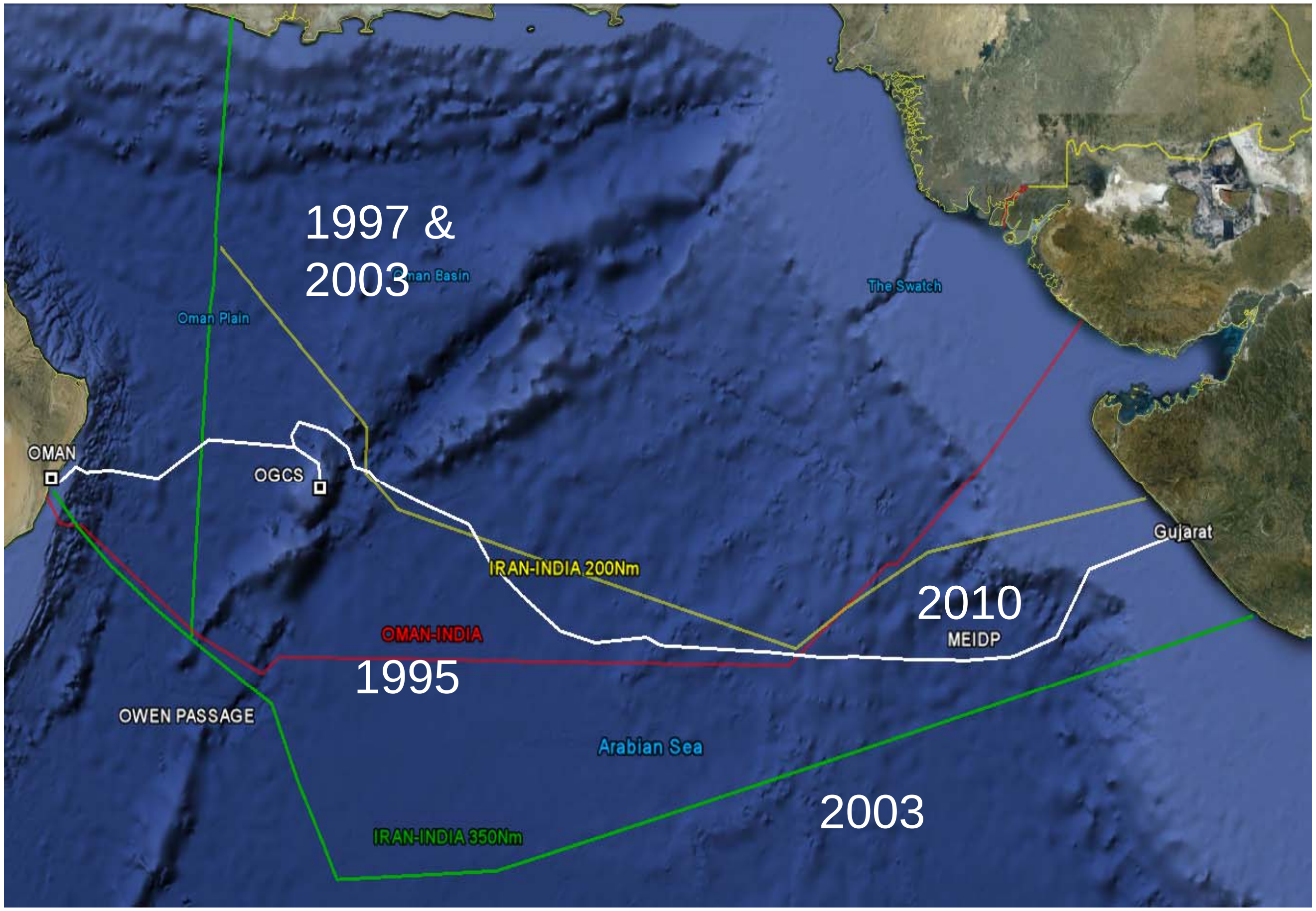
Indicative Overall Economics Today

	Costs $/mmBtu	
	Pipeline	LNG
Assumed FOB price of dry gas Arabia	7.0	7.0
Liquefaction Cost	-	3.0
Transportation cost	2.0	0.3- 0.6
Gasification	-	0.7
Total costs gas landed in India West Coast	9.0	11.0-11.3

1. ORF Policy Brief #13, Dash for Gas: Opportunities and Challenges (Jan 2012) Assumes a cost of landed LNG in India at $15/mmBtu as a reference case
2. Liquefaction, transportation and regasification costs from Jim Jensen Associates

Historical Route Options

- ❑ Historically many routes have been considered
  - ➢ Oman-India 1995
  - ➢ Iran-India 1997
  - ➢ Iran-India (200NM) 2003
  - ➢ Iran-India (350NM) 2003
  - ➢ MEIDP 2010
- ❑ All were considered to be Installable.



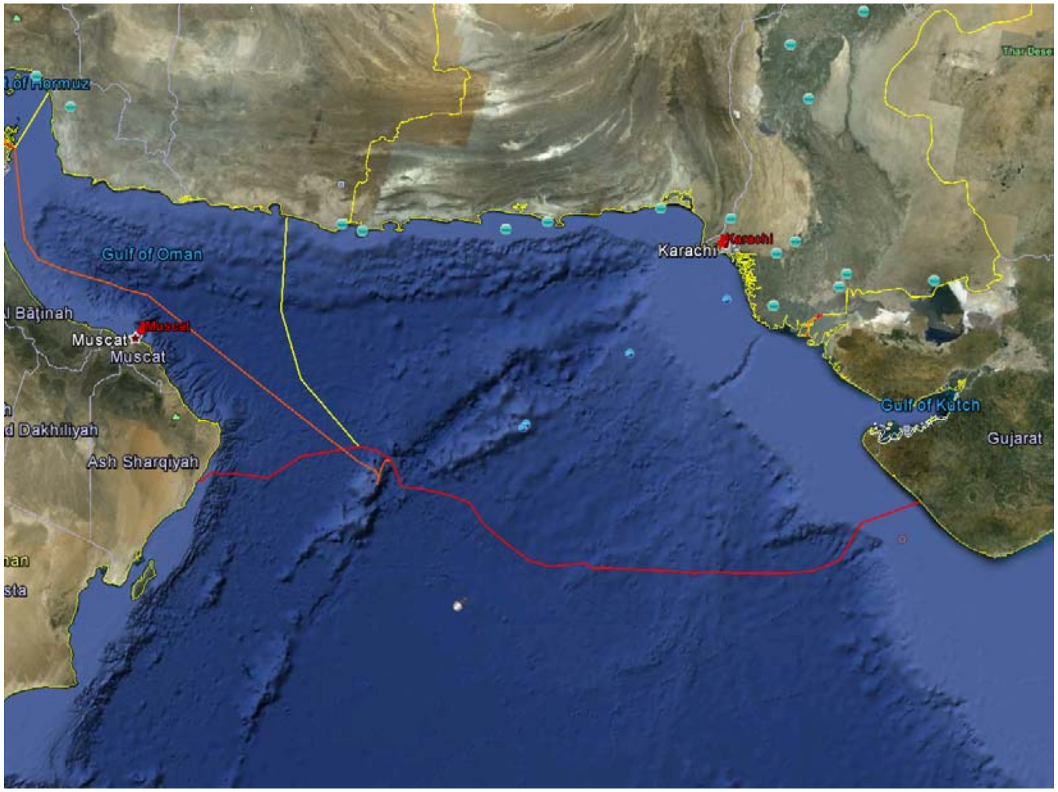
MEIDP Project Components

Feedler Pipelines from:

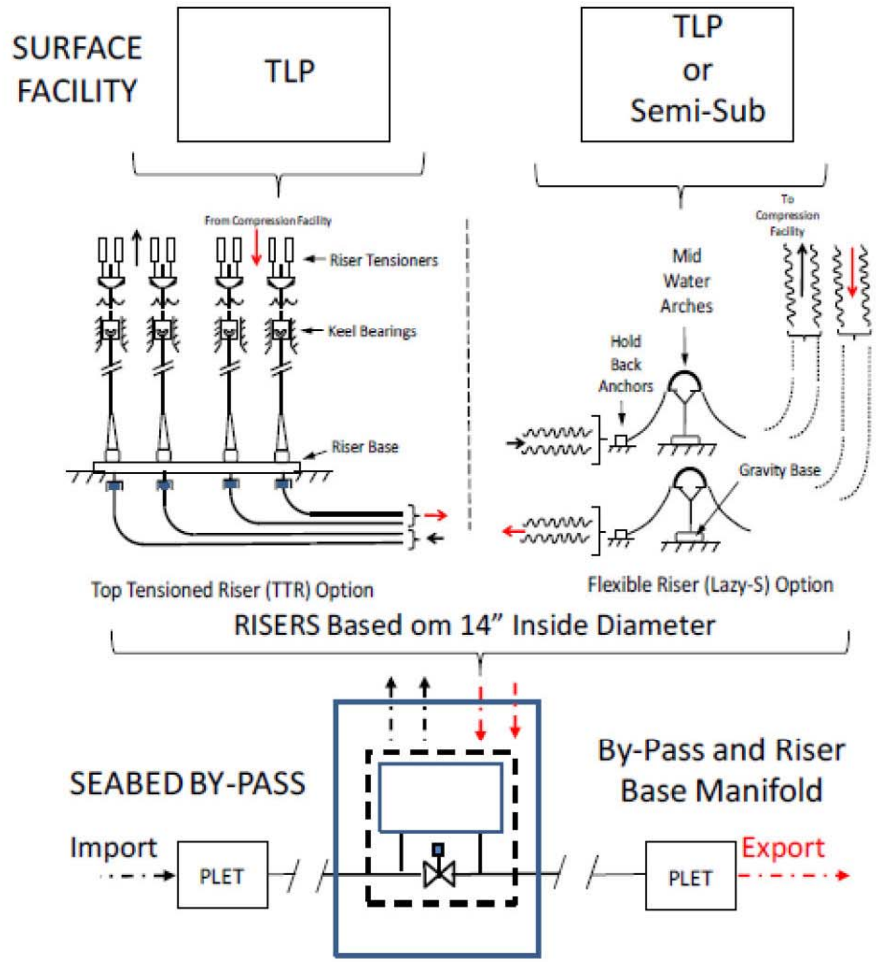
- Iran to Oman (Hormuz crossing)
- Qatar (via Musandam)
- Iraq (via Musandam)

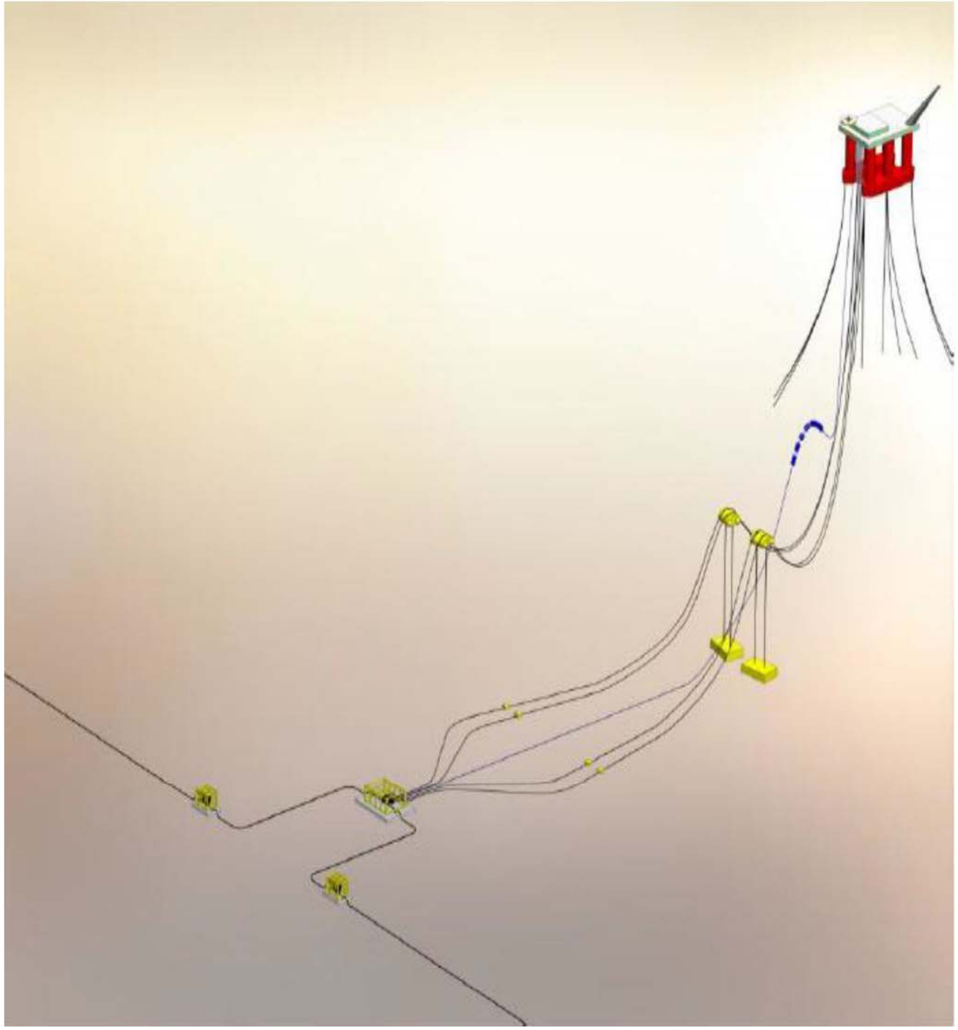
Deepwater Arabian Sea Crossing from

- Oman (Ras al Jafan)
- Iran (Chabahar)
- Additional Compression Facilities on Qalhat Seamount



Riser and Subsea By-Pass at Seamount





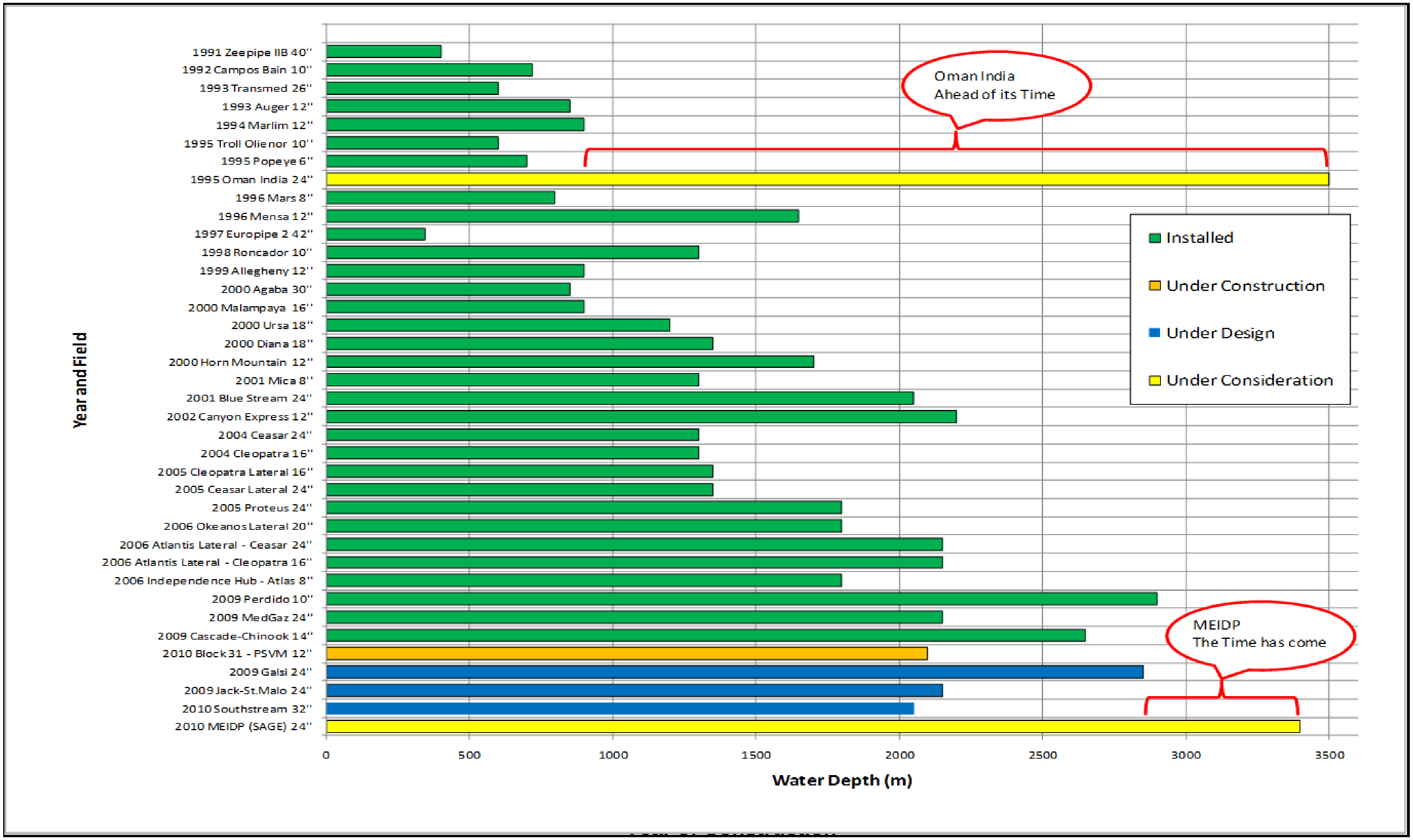
UltraDeepwater Challenges

The relevant technologies to design, install and operate UltraDeepwater pipelines are:

- Design Framework
- Geohazard Assessments
- Deepwater Pipelay Capabilities
- Accurate Seabed Mapping
- Freespan and Seabed Intervention
- Emergency Repair Technology
- Risk Assessment & Mitigation
- Project Organisation

Depth itself is not the most important

Deepwater Project Progression



Design Considerations for Ultradeepwater Pipelines

1) Pre-feasibility Study / Concept Development

- Pipeline system configuration (ND and number)
- Route selection vs. Environment and Geohazard Characterization
- Line-pipe material and wall thickness selection vs. fabrication technology and
- Installation Capability

2) Survey Campaign for Pipeline Route Corridor

- Intervention Work Minimization
- Geohazard Risk Reduction

3) Feasibility Study

- Route Optimisation
- Preliminary Geo-hazards Design
- Operability and Hydrate Formation
- Material Selection
- Installation
- Seabed Intervention Works

4) FEED Phase vs. overall pipeline system design and project schedule

- Route Optimisation
- Detailed Geo-hazards Study
- Seabed Intervention Works
- Pipeline Design for Operation and Installation
- Linepipe material & LLI Procurements
- System Pressure Testing Philosophy
- Maintenance & Repair etc.

5) Detailed Design pre-construction oriented

- Pipeline Configuration Optimization
- Detailed Material & Procurements
- Installation Analysis
- Seabed Intervention Works Optimisation
- Maintenance & Repair Strategy etc.

Deep Offshore Technology International, 30 November - 2 December 2010
L. Vitali, L. Marchionni, C. Crea, R. Bruschi

Comparison With OIP

Technical Risk Issues facing the project in 1995:

- Pipe mill upgrades needed to manufacture linepipe.
- Lack of lay vessel with enough tension capability. Conversion work needed to lay pipe to 3,500m water depth.
- Incomplete understanding of seismic activities and mitigation methods – mudflows, fault lines & slope failures.
- No qualified deepwater pipeline repair system was available.

However even in 1995, 15 years ago:

- These were not considered to be fatal impediments by the industry and three competitive bids were received and evaluated before the gas was re-assigned elsewhere.

What makes SAGE's Risk Profile lower now?

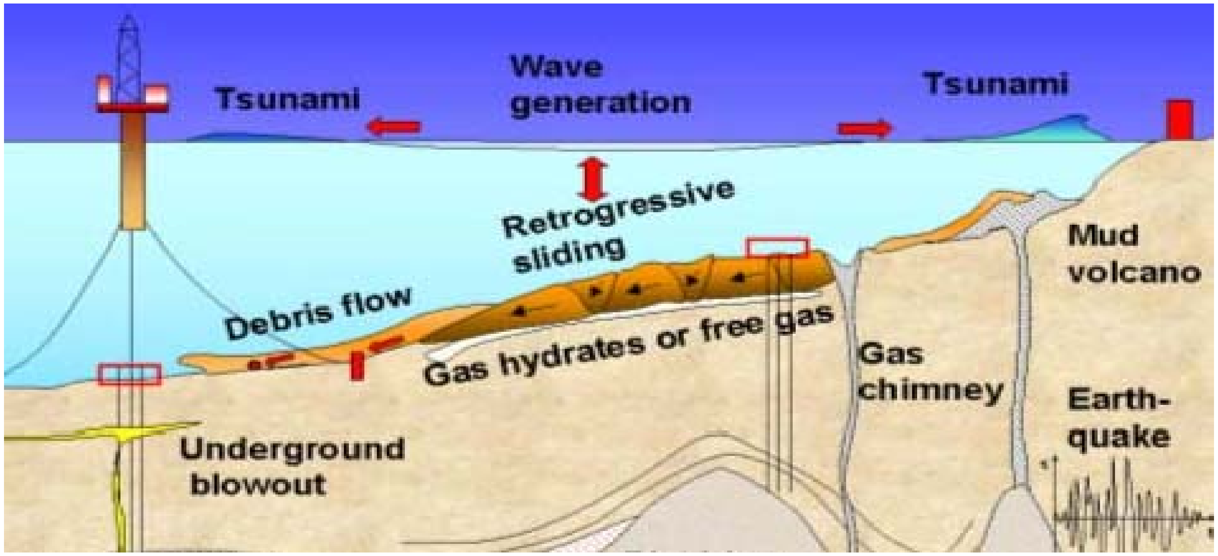
- New and improved design methods for free-spanning and geo-hazards have been developed.
- Several mills can manufacture pipe, particularly in India.
- New generation, large lay vessels available for the project.
- Era of damaging cost escalation appears to be over.
- Better positioning capabilities are now available during pipelay to avoid seabed hazards.
- Deepwater repair systems are now available.
- New testing and commissioning philosophies developed by SAGE with DnV permits use of 27-inch pipe.

Geohazard Risk and Mitigation

- Fault Movement
- Submarine landslides
- Liquefaction-induced lateral spreads
- Flow failures
- Debris flows
- Turbidity currents
- Seabed Erosion

.

- Geohazard design performed in accordance with PRCI Guidelines for the Seismic Design and Assessment of Natural Gas and Liquid Hydrocarbon Pipelines (PR-268-9823, 2004)



- Results of MEIDP Geohazard Risk Assessment (Fugro 2011)

Geohazard	Relevant Location	level	Effect on Pipeline/ facilities
Tsunami	Oman and Indian coastline	2	flooding of landfall facilities, scour and damage to shallow pipelines
Steep slopes	Oman and Indian continental slopes and the Qualhat Seamount	2	pipeline instability
Seismic activity	Northern Oman, Kathiawar Peninsula (Gujarat, India) and along the Owen Fracture Zone	2	damage or destruction of facilities and pipeline, environmental risk
Fault displacements	Faults of the Owen Fracture Zone and the Indian shelf and slope	2	pipeline spanning, unacceptable/critical stresses on pipeline, damage of pipeline, environmental risk
Liquefaction	Oman and Indian (inner) shelf	2	loss of support, burial, uneven sinking of pipeline
Slope failures	Oman and Indian Continental slope, Qualhat Seamount, channels of the Indus Fan	2	damage to pipeline, lateral displacement, burial
Turbidity currents	Indus Fan	2	burial, loading and scour of pipeline
Rock sub-/outcrops	Inner Oman Continental Shelf and outer Indian Continental Shelf	1	
Risk Level 2	Further investigation to refine assessment, and mitigate through relocation or consideration during design		

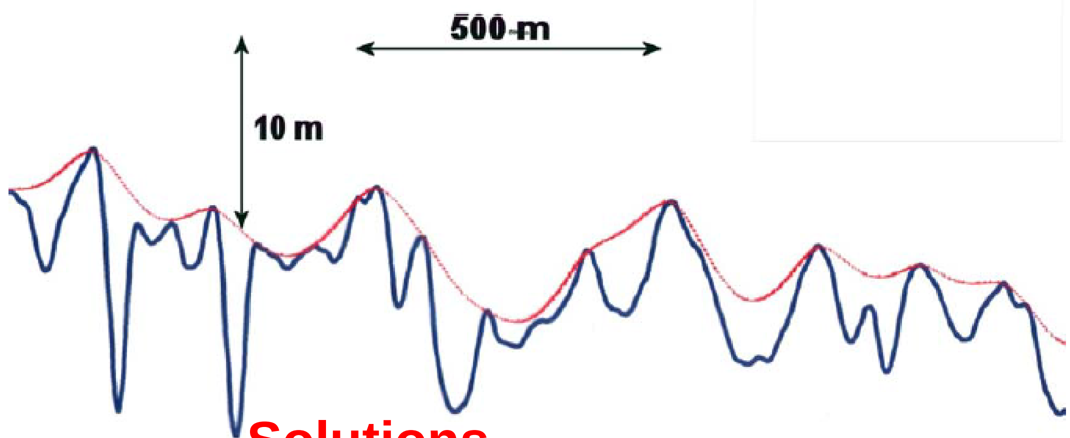
Mitigation measures to achieve acceptable design risk

- Pipeline routing along rather than across slope failure runout routes
- Trenching pipelines in run-out deposition areas
- Do not cross faults at oblique angles
- Add wall thickness to ensure additional strength capacity
- Unburied pipelines & routing gives pipeline flexibility at faults
- Add buoyancy to lighten pipe and lessen lateral restraint
- Ensure bend pull out does not occur at top of steep slopes – add pipeline anchors where required.
- Limit pipeline spans to ensure seismic dynamics are acceptable
- Perform risk base analysis where deterministic analysis fails

Design Methods - Freespans

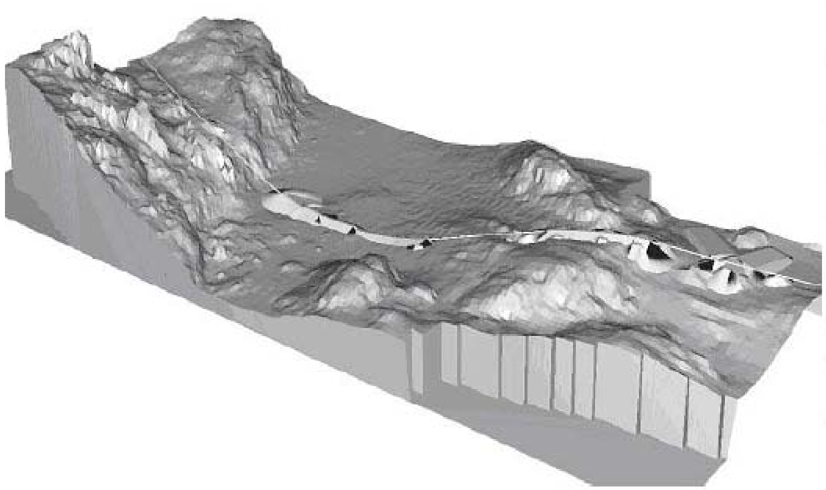
FREE SPANS

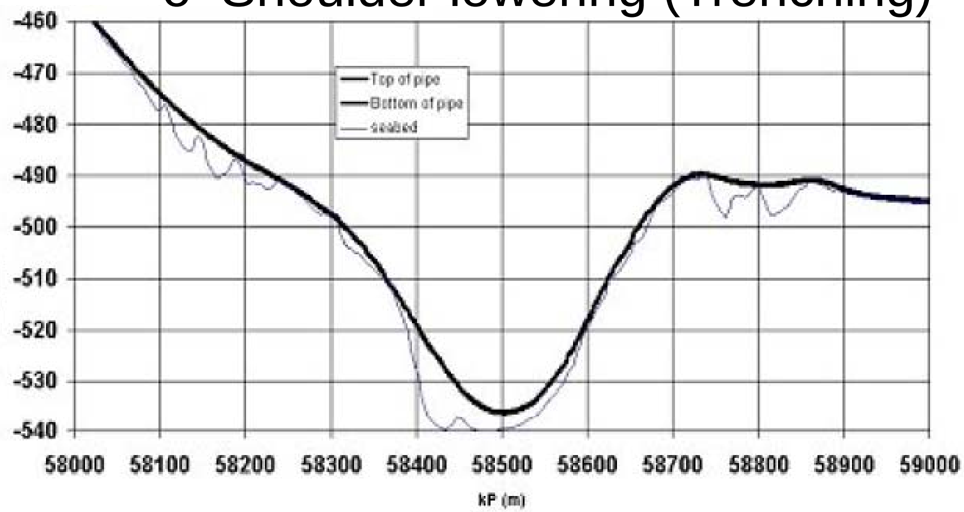
- ***SPANS MUST BE LIMITED DUE TO RISK OF***
  - ***OVERSTRESSING***
  - ***FATIGUE***
- ***SPAN ASSESMENT IS INTIMATELY DEPENDENT ON MAPPING***



Solutions

- Pre and Post lay rock dumping
- Mechanical Supports
- Shoulder lowering (Trenching)





MEIDP Pipe Manufacture

a) “J-ing” Stage b) “C-ing” Stage c) “O-ing” Stage

JCOE Pipe Forming at JindalSAW, India (2012)

MEIDP Capable Pipelay Vessels

CastorONE (Saipem SpA) 2013

Aegir (HMC) 2013

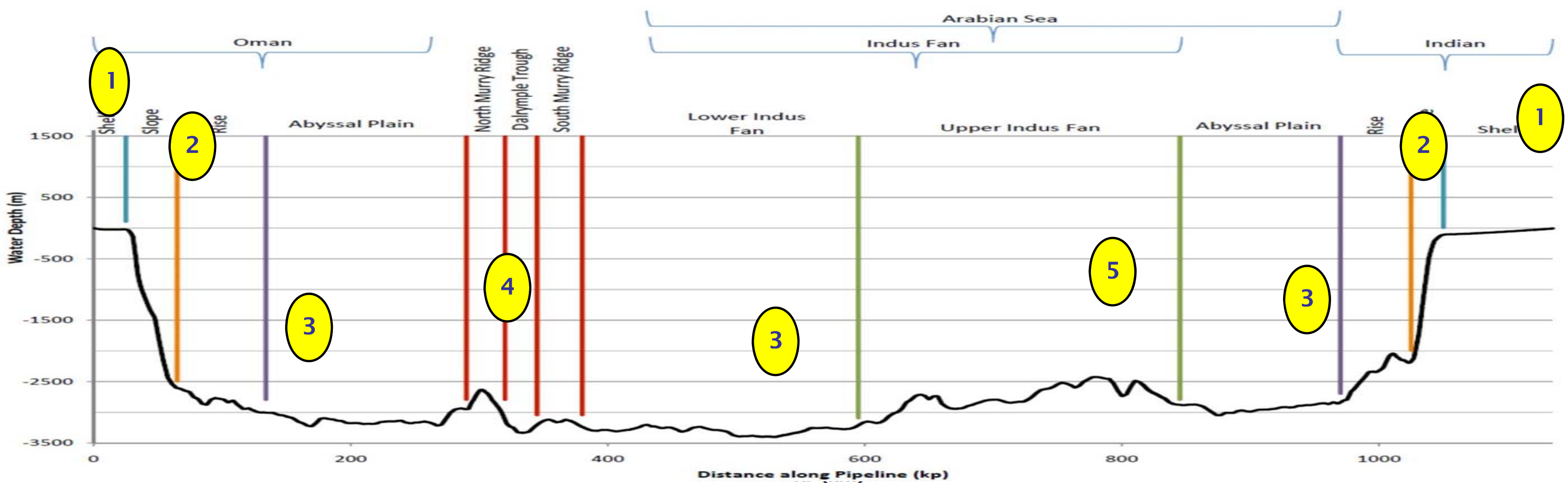
Pieter Schelte (Allseas) 2014

AC6000 (Petrofac) 2016

Intervention Zones

The route has been divided into five different intervention requirement zones.

1) Shallow Water Zone (0 to 150m WD)
2) Continental Slope Zone (150m to 2500m WD)
3) Deep Water Section (2500m to 3500m WD)
4) Seamount Section / Owen Fracture Zone (300m to 3000m WD)
5) Indus Fan Section (2500m to 3000m WD)



Intervention Zones Seabed Conditions

Zone	Location	Soil Properties Summary
1	Oman Continental Shelf	Sands, gravel, reefs and outcrops of limestone, igneous/metamorphic rocks, calcareous silts and well-sorted sands
	India Continental Shelf	Quartz and heavy mineral sands, dark yellowish brown to olive grey silt, clay with shell fragments, light olive grey carbonate sand (oolitic sand) and algal and oolite limestones (or calcarenites)
2	Oman Continental Slope	Olive brown to olive grey very soft to soft pelagic silt and clay
	India Continental Slope	Dark yellowish brown to olive grey fine grained cohesive soils, i.e. silts and clays with shell fragments
3a	Abyssal Plain and Lower Indus Fan	Pelagic sediment of greenish grey to olive grey very soft to soft clay and silt
3b	Owen Fracture	Dark yellowish brown to greenish grey to olive grey very soft to soft pelagic clay and silt
4	Remote Seamount	Dark yellowish brown to greenish grey to olive grey very soft to soft pelagic clay and silt
5	Indus Fan	Yellowish brown to olive grey very soft to soft clay and silt

Intervention Drivers

Intervention works, either pre or post lay may be required to mitigate against the following effects along the route:

- Geo-hazards
- Bottom roughness
- Free spans
- Slopes
- Stability
- Thermal/pressure buckling
- Crossings
- Fishing interaction

Candidate Techniques for intervention are :

- Dredging
- Trenching
- Rock Dumping
- Mattresses
- Mechanical intervention
- VIV Strakes
- Backfilling

Intervention Methods

Zone	Intervention Required For	PRE-lay Intervention						Post-lay Intervention				
		Dredging	Trenching	Rock Dumping	Mattresses	Mechanical intervention	VIV Strakes	Backfilling	Trenching	Rock Dumping	VIV Strakes	Pipeline Repair System
1	Stability at Landfall	X						X				
1	Pipeline Stability								X			
1,4	Thermal Buckling					X				X		
1	Ship Anchor Damage								X			
1,4	Fishing Gears Interaction								X			
1,2,3,4,5	Free Spans		X	X			X		X	X	X	
1,2,3,4,5	Pipe Leaks or Local Buckle											X
2,3,4,5	Geohazards		X						X			
2,3,4,5	Pressure Buckling					X				X		
2,3	Crossings			X	X	X						

Typical QRA for Deepwater Pipelines

MEIDP QRA Risk Contributors and % contribution

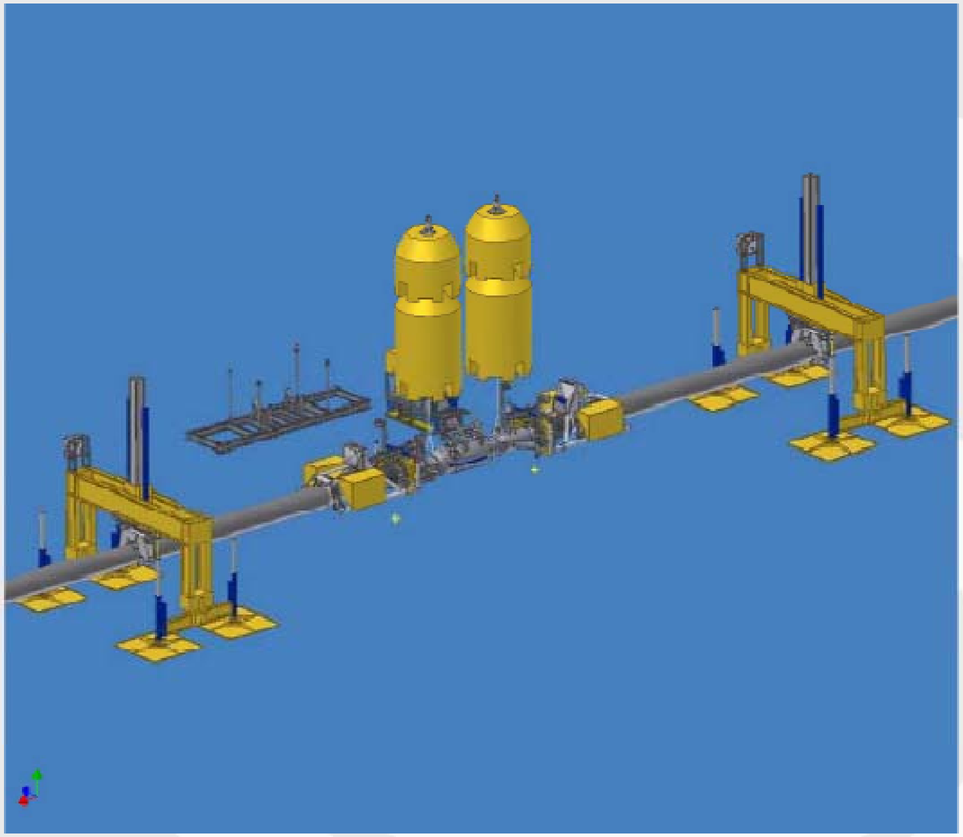
- Ship sinking (40.24%)
- Objects dropped from ships (19.91%)
- Ship grounding (14.07%)
- Material and construction defects (11.17%)
- External corrosion (10.62%)
- Anchoring (3.23%)
- Internal corrosion (0.63%)
- Trawling (0.12%)

These risks are similar to all (Shallow and Deep water pipelines)

Geohazard risks are assess based on 1in 500yr event incurring no damage to the pipeline

Diverless Sealine Repair System
SIRCOS

- SiRCoS is a pipeline repair system developed for deepwater application
- meeting requirements of TransMed (Tunisia – Sicily), Green Stream (Libya – Sicily), Blue Stream (across Black Sea)
- suited to pipeline size ranging from 20" to 32" in water depths up to 2200 m
- SiRCoS is available under a Service Contract Agreement



Saipem has stated that the system can be uprated to 3500m by change-out of buoyancy and control pod

Saipem currently has its Workclass ROV's rated to 4000m WD

MEIDP Completed Activities

- Design Basis definition
- Flow Assurance Studies
- Mechanical Design
- Onshore Compression Station
- Offshore Compression Station Definition & Review
- Receiving Terminal Definition
- Quantified Risk Assessment - OIP Update
- Geohazard and Fault Crossing Assessment
- Metocean data collection
- Emergency Repair Equipment
- GIS Data collection
- Riser and Subsea By-Pass definition
- Pipeline Intervention Review
- Vessel & Equipment Capabilities review
- Alternative Integrity Verification Phase 1 (Establish no hydrotest principle)
- Cost Estimate Update
- Reconnaissance Survey definition and scope of work
- Mill qualification and ring testing program
- Reconnaissance Survey Completed

Ongoing and planned 2013-2014 work

Ongoing Work

- Master Project Schedule Update
- Metocean Data Acquisition Scope definition and ITT Documentation

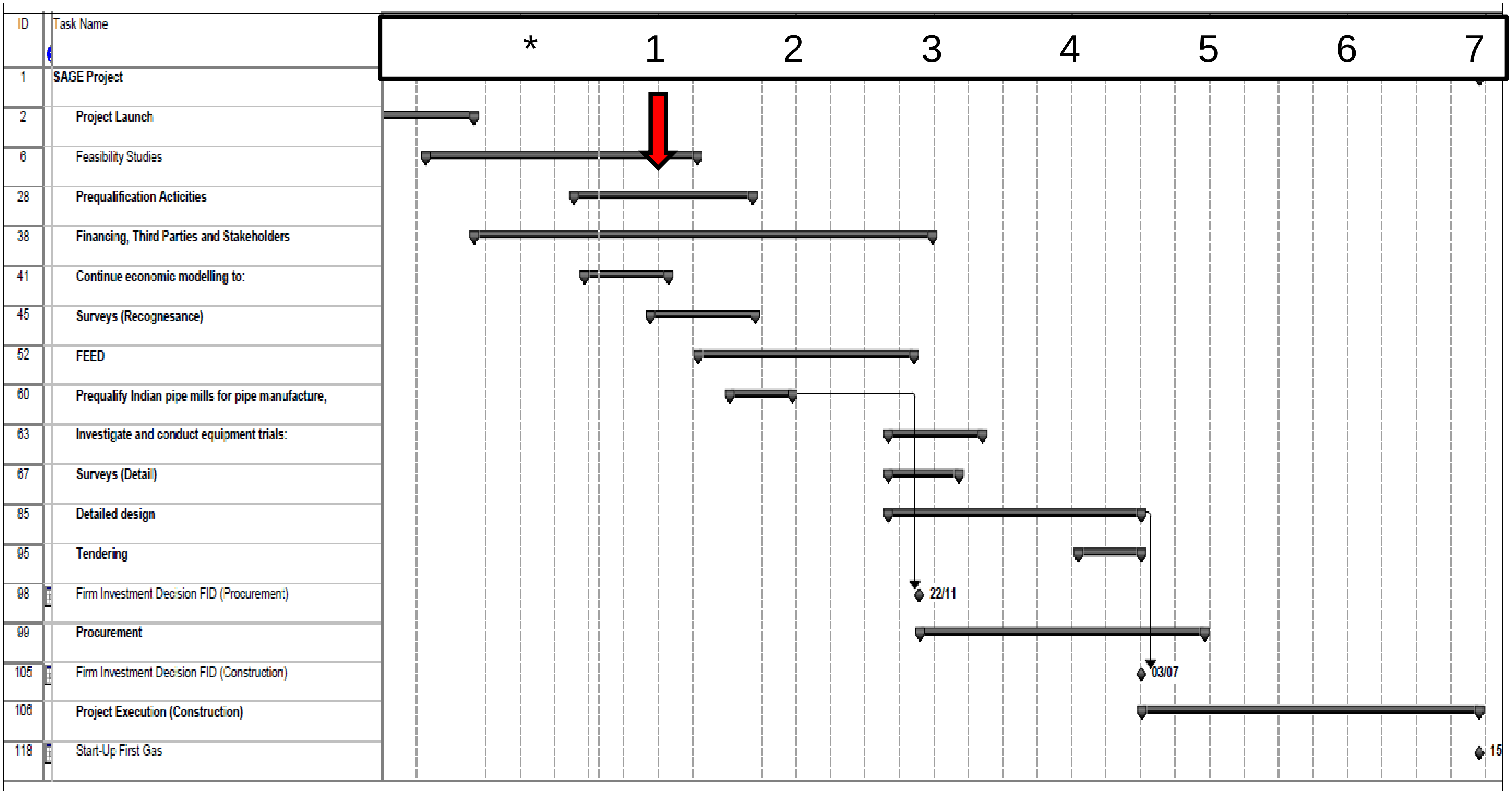
Planned Work

- Route Review and Refinement
- Intervention optimisation at the Continental Slopes, Owen Fracture Zone and Indus Fan
- Metocean Data Collection on Site
- Environmental Statement ITT and Scope Definition
- Onshore Facilities FEED ITT and Scope definition
- Offshore Pipeline FEED ITT and Scope Definition
- Environmental Survey Scope Definition and ITT Documentation.
- Preliminary design of Feeder pipeline to supply MEIDP system from Qatar/Iraq
- `

Technical Highlights

- During 2011-13, SAGE/Peritus International have conducted a series of Qualification trials in Indian Pipe Mills (Welspun and Jindal Saw) which will enable both these Indian Mills to supply the required thicknesses steel pipe along with other international pipe mills
- After detailed study, DNV Norway have also confirmed that the Pipeline can be laid at such depths using recommended pipe thickness from the latest Design Codes
- Indus Fan pipeline route has moved to the south to mitigate the worst of the deep channels and slopes and is now no more significant than continental slopes and Owen fracture zone

Project Development Schedule



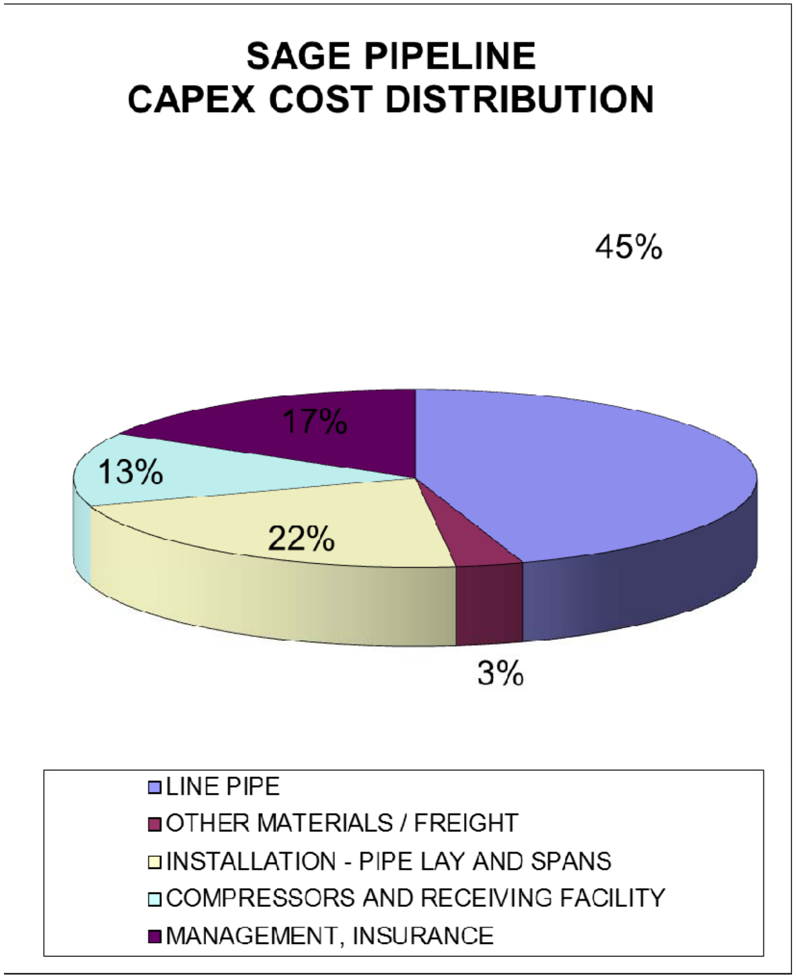
- Pre-FEED to 1st Gas is a 7yr undertaking
- On Fast Track FEED to 1st Gas can be 5yrs
- Offshore Construction Period 2 yrs

Schedule & Construction

- Project can be set up in a 5 year time span if bought on **fast track** with **active government support** as substantial preparatory work has already been done and continues
- Pipeline construction will occur over a 2 year period
- Pipe Lay Barges **AC6000, Castorone**, **Pieter Schelte** and **Aegir** are being build with the intention of laying Ultra Deepwater Pipelines (up to 4000m in water depth)
- Pipeline Repair systems are now available that can repair pipelines in such depths

Financial Highlights

- Project Cost: USD $3-4 Billion from Omani or Iranian coast to Indian Gujarat West Coast
- Pipeline tariff from will be in the range of $1.60- $1.85/mmbtu
- Project Internal Rate of Return (IRR) of 12-15%
- Ernst & Young, London and Crisil, Mumbai have reviews/ recommended various feasible financing options



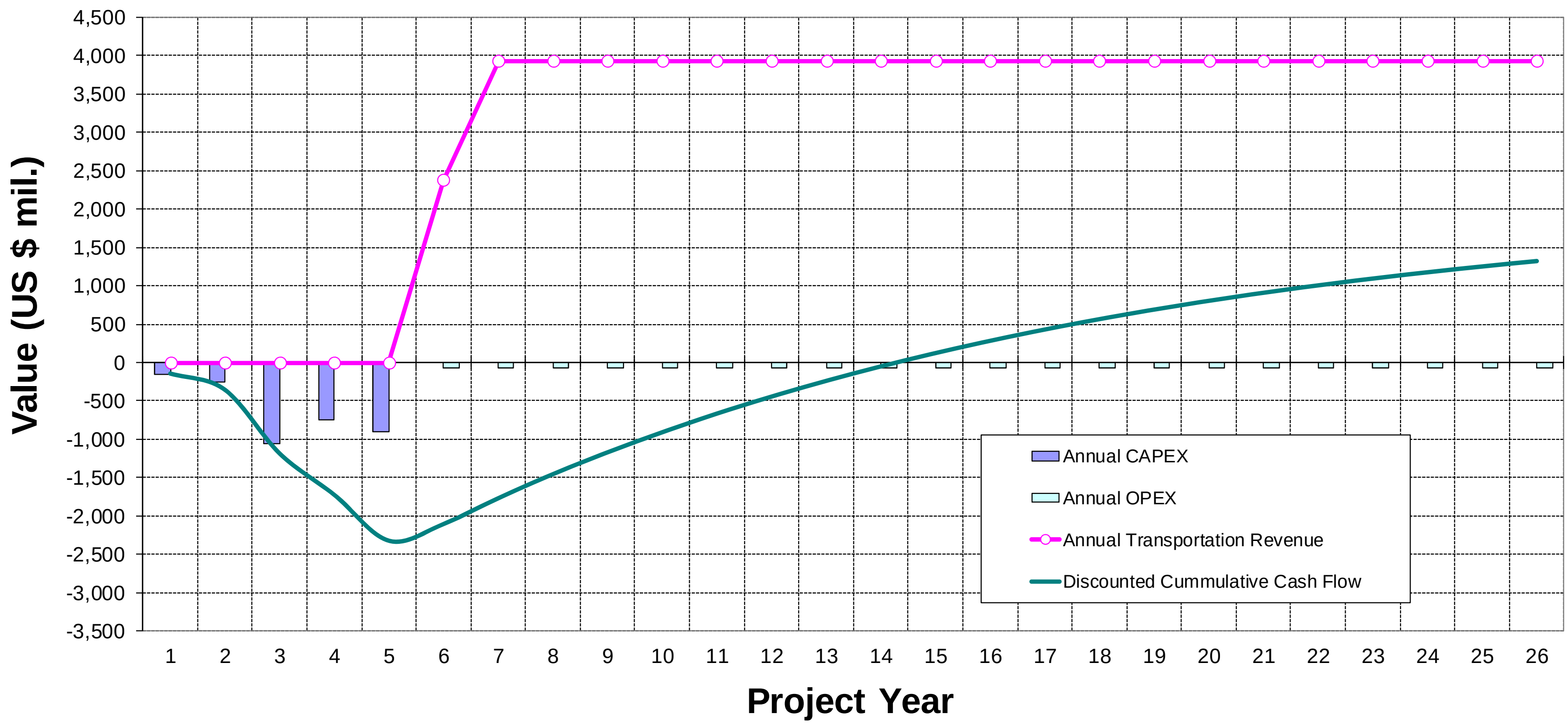
Project Financial Model

SAGE

Pipeline Design Factors:		Gas Factors		Economic Parameters	
Pipe OD (in.)	28	Gas Sales Price (US$/MMBTU)	8.85	Cost of Equity	10.0%
No. of Pipelines	1	Gas Purchase Price ($US/MMBTU)	7.00	Cost of Debt	8.0%
Wall Thick (mm)	40.5	Max Gas Transfer (MMMMBTU/yr)	444.5	D/E Ratio	2
Steel Cost ($/mT)	$1,800	Caloric Content (BTU/SCF)	1107	WACC	8.7%
Lay Speed (km/day)	2.00	Max Flow Rate (BSCFD/line)	1.100		
Day Rate ($/day)	$1,000,000	Max Allowed Flow Rate (BSCFD/line)	1.108		

Offshore Compression No

SAGE Project CashFlows & Discounted Cummulative Cash Flow



Recent Developments

- Iran has expressed its willingness to supply Natural Gas and a Framework Agreement has been discussed with NIGEC [National Iranian Gas Export Company] for Pipeline Construction and Gas Supply through the SAGE Pipeline
- NIGEC has confirmed to SAGE that they are currently in a position to provide gas for 2 pipelines from Iran to India
- In April 2013 Speaker of Iranian Parliament called for implementation of Iran's natural gas transfer project to Oman
- On 20th June 2013 SAGE presented the project to Member (Energy) Planning Commission. All agreed that project is technically feasible and needs to be pursued further
- On 21st June 2013, SAGE completed a multi-million $ Geophysical Survey of the Arabian Sea with Fugro's vessel to determine the most suitable pipeline route

The Middle East to India Deepwater Pipeline Reconnaissance Survey

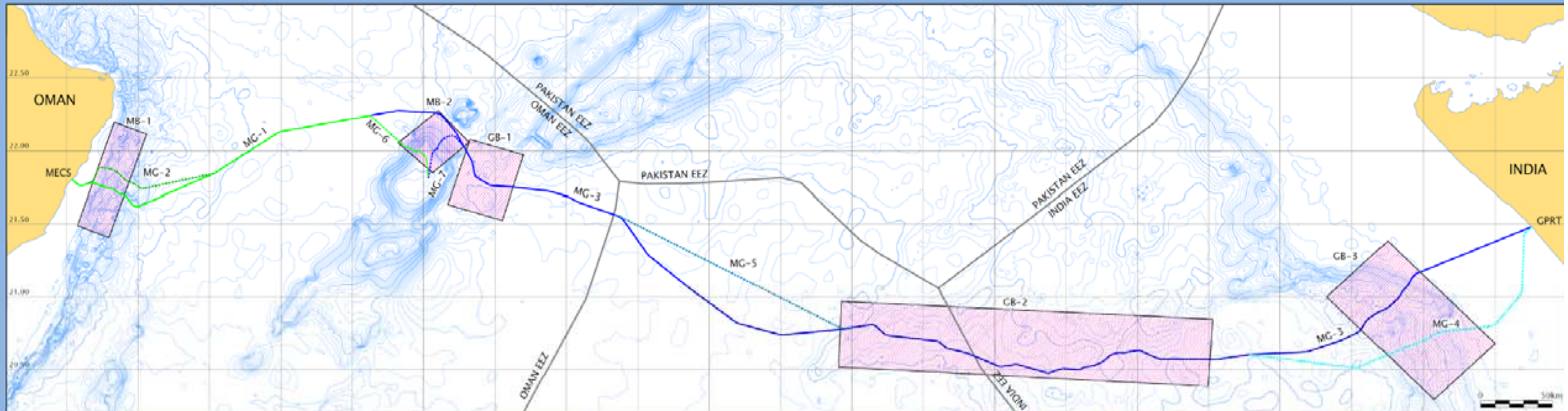
By Ian Nash

1 Objectives

The MEIDP Reconnaissance Survey combines Area/Block route corridor surveys of critical areas of the pipeline route including the Omani and Indian continental slopes, the Arabia-India plate boundary and associated features such as the Qalhat Seamount, Murray Ridge and Dalrymple Horsetail, Indus river abyssal fan.

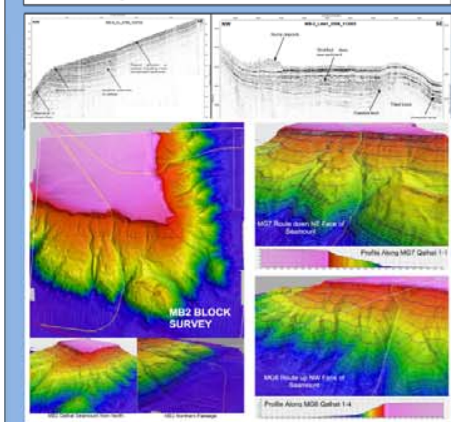
In May and June 2013 the MV Fugro Gauss performed the geophysical survey including:

- Multibeam echo sounder (12kHz - EM122 & 70kHz -EM710)
- Backscatter imagery
- 35kHz & 2-7kHz sub-bottom profiler (SES-2000 Deep)



2 Projection Parameters

Projection	Lambert Conformal Conic with 2 standard parallels (LCC2SP)
Hemisphere	North
Latitude of Origin	20° N
Longitude of Origin	66° E
Latitude of 1st Parallel	21° N
Latitude of 2nd Parallel	22° N
False Easting	800,000m
False Northing	0m

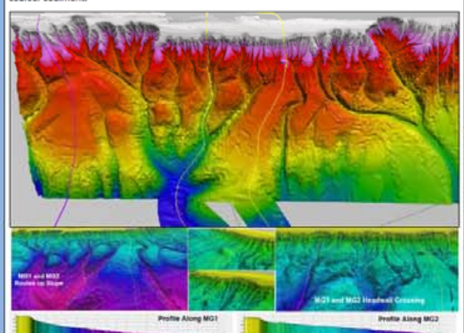


4 Qalhat Seamount – Block MB2

The high Qalhat Seamount located approximately 280km east of the Oman coast within the Omani EEZ and could potentially be used to locate floating compression facilities should a route direct from the Persian gulf be adopted. The seamount rises from a water depth of 3000m in the deep sea area to about 300m at the shallowest point on the plateau, a rise of 2700m. In order not to lose the opportunity of collecting geophysical data on the seamount, the survey included the most likely routes up the eastern slope and down the northern slopes, together with parts of the plateau area. The history of the Qalhat Seamount is not completely known however the presence of a strong magnetic anomaly in the vicinity of the seamount and a typical flat morphology. Evidence suggest that the Qalhat Seamount is a volcanic guyot. The general gradients of the eastern slope are around 20° with the upper slope area having gradients between 25° and 29°. Deep canyons and gullies dissect the slopes and there is frequent evidence of slumping and sliding along the slopes.

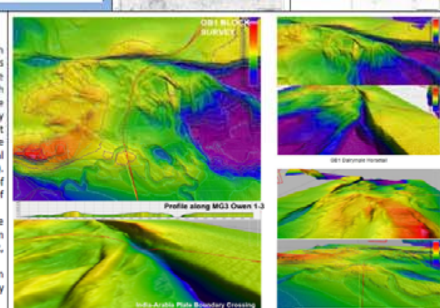
3 Omani Continental Slope – Block MB1

The seabed in Box MB-1 is dominated by large canyons and channels coming down the slope and extending seawards from the continental shelf. The water depth at the shelf break is aprox 100m. a large amount of small channels and gullies at the shelf break. As the channels continue down the slope, they merge into larger channels and canyons and at the foot of the slope, the majority of them have merged into four major canyons. One of the largest canyon complex is seen in the south. It comprises three large tributaries at the foot of the slope and is almost 6km wide. The water depth at the canyon mouth is 2900m. Along the slope there are several evidences of slumping and sliding, however slump scars are almost entirely found within the channel walls. No slump scars have been detected in the areas in between the canyons and channels. The shelf and slope show homogeneous sediments on the slope between the canyon complexes. On the shelf, there are outcropping / sub-cropping rock and hard ground. The soft seabed sediments are of varying thickness on the shelf but generally less than 2m. The canyons and channels on the slope appear to contain various amounts of coarser sediment.



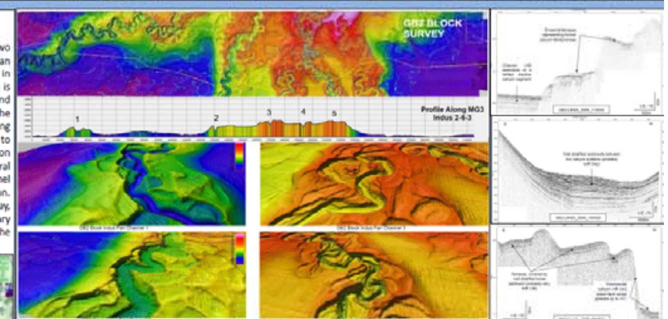
5 Owen Fracture Zone – Block GB1

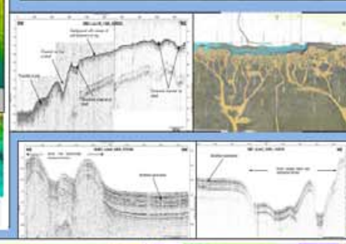
The GB-1 block is characterized by two main structures, a central part which comprises the westernmost extension of the Upper Indus Fan complex as well as the east flank of the Qalhat Seamount, and the deep basins of the Dalrymple Trough in the north. A distinct fault crosses the area in an almost north-south direction into the southernmost end of the pull apart basin of the Dalrymple trough at the Dalrymple Horsetai. This fault is the tectonic plate boundary between the Arabian and Indian plates that extends over 800km in 5 main fault segments of up to 220km length. At the MEIDP crossing point of the Dalrymple Horsetail the Owen Fracture Zone takes the form of a strike-slip right lateral fault. The best estimate for slip rate along this fault is 2mm/year (7mm/yr max). On entering the Dalrymple trough the fault line breaks up into a series of spreading normal faults. At the location of the pipeline crossing, the surface relief of the fault forms a 200m deep canyon, 1.3km wide and water depth of 3200m.
Another distinct feature in the area is a bathymetrical high in the south, at the top of the slope to the deep Arabian Abyssal Plain basin. The high is about 6km wide at its widest point and approximately 19km long. The shallowest part, 2630m, is found on the southern part of the high.
To the east of the bathymetric high, there is a 1km wide, approximately 40m deep meandering channel. Parts of the channel are almost entirely in filled by pelagic sedimentation and barely visible in the seafloor.



6 Indus Fan – Block GB2

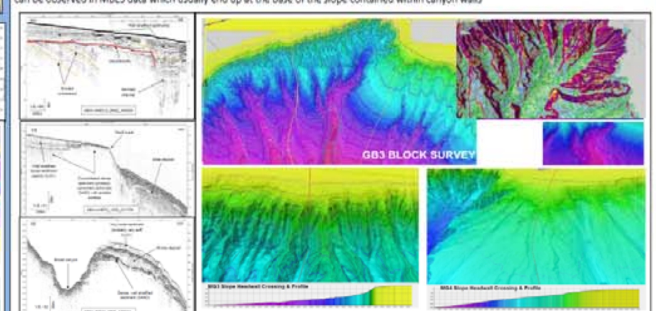
The seafloor in the survey area of Box GB-2 is characterized by two topographical main structures: The channel/levee systems of the Indus fan which dominate the central part of the box; and the deep sea basins in the easterly and westerly sections of GB-2. The channel/levee system is characterized by central channels with a series of adjacent terraces and numerous abandoned channel loops, which are partially refilled by the overspill sediments from active canyon areas. The pipeline route crossing the Indus River Abyssal Fan crosses five turbidity current channels up to 200m high, in water depths between 2100m - 3200m. With the exception of Channel 1 the channels follow a meandering flow pattern with general N-S direction. Channel side slopes up to 25° have been detected. Channel 1 on the western edge of the block follows a meandering E-W direction. Generally the seabed is covered by a fine grained soft to very soft clay, deposited by turbidity currents and mass wasting events. The sedimentary levees are a result of overspill sediments and deposits on both sides of the canyon/channels.





7 Indian Continental Slope – Block GB3

The seabed in the survey area of Box GB-3 consists of a narrow shelf section at the eastern edge of the box and a broad area covering the continental slope in the middle and western part of the survey area. The water depth ranges from 70m at the East to around 150m at the shelf break. The water depth ranges from 150m at the shelf break to around 2500m at the base of the slope. The upper slope area is dominated by numerous steep incised gullies with slopes of up to 30° observed near the shelf break (see slope map below). Down slope, most of the gullies join together to form smaller canyons, which then form major canyons. Between the canyons sediment ridges/mounts are developed. Slump deposits can be observed in MBES data which usually end up at the base of the slope contained within canyon walls



8 Conclusion

The survey must be seen to be a great success for all concerned. The next stage of the project is to finalise of the route. The data will allow the detailed assessment of the 5 critical route areas (Indian Slope, Indus Fan, Owen Fracture Zone, Qalhat Seamount and Omani Slope), which will in turn allow a full definition of the intervention works required to safely install the MEIDP. This assessment is very important in order to allow the project to move forward to remove any doubts that remain about its technical viability.

Technical summary

- MEIDP are no longer a giant leap forward, but rather **the logical next step**
- The development of 3 off deepwater **pipelay vessels capable of installing MEIDP** due by 2014
- Studies performed in 2009-2012 **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 summary

- **The MEIDP pipeline**
  - Provides an **economically competitive** method of gas supply to the Western coast of India
  - Enhances the **security and diversity of energy supply** for Indian subcontinent
  - **Promotes competition** in the Indian energy markets and will assist in determining **Market Prices**
  - Will contribute significantly towards the implementation of sustainable development strategies of an **integrated energy plan** for the Indian Subcontinent

Conclusions

- Indian has and will continue to have a demand for imported gas
- Available supplies from within the Middle East the region
- Importance of energy security by diversification (do not put everything in the LNG basket)
- The technology has advanced in the past decade (in 1990's at the very edge of technology but not yet proven; today proven technology).
- Economics works at significantly less that the cost of LNG (liquefaction, transportation and gasification).
- The project is financially sound and feasible
- Indian Strategic Planning needs to get behind the project
- Indian Government support is required

Government Support Requirement

- Heads of Agreement/MOU with Gas Supplier countries (Qatar/Iraq/Iran/Oman/Turkmenistan)
- MEIDP needs to be "Taken on Record" like IPI and TAPI
- Gas buyers such as GAIL/ IOC/ GSPC/ NTPC/ IFFCO should be advised to work closely with SAGE to negotiate Gas supply contracts
- Treat the MEIDP project as an Infrastructure project for funding

Additional Information

1. Indian Gas Consumption and Supply
2. Transportation Economics
3. Discussions with Gas Suppliers
4. Design Basis
5. Pipeline Routing
6. Flow Assurance and Mechanical Design
7. Metocean Investigations
8. Geohazard Features and Seismic Design
9. Onshore and Receiving Facilities
10. Pipeline Installation Intervention and Repair
11. Construction Vessel Progress
12. References