Presentations in India

November 4th to 6th 2009

SAGE

Middle East to India
Deepwater Pipeline

The SAGE Project – Key team members

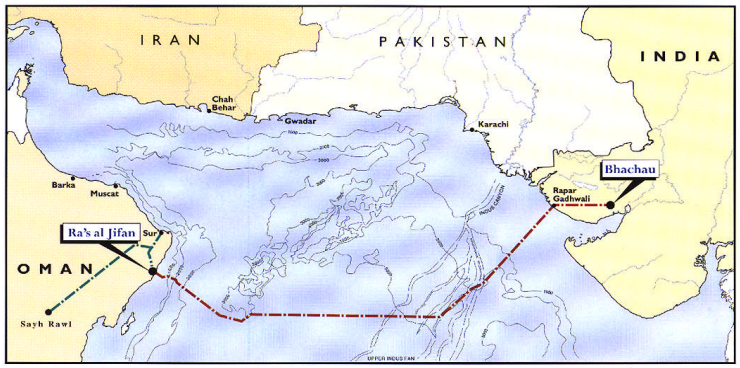
Mr. T.N.R. Rao	▪ Former Petroleum Secretary, Govt. of India and "Architect of the Oman-India Pipeline" ▪ Chairman of the SAGE Advisory Board ▪ Founder Chairman, Hydrocarbons Education & Research Society, Indian School of Petroleum ▪ Founder Chairman – University of Petroleum & Energy Studies
Subodh Jain	▪ 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. ▪ Chairman, Saipem India Projects Ltd., Chennai.
Ian Nash	▪ Managing Director, INTECSEA (UK) Ltd. ▪ Engineering Manager for MEDGAZ FEED. ▪ 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
Richard Freeman	▪ Manager, Business and Sales Development, Corus Tubes (Energy), UK.

History

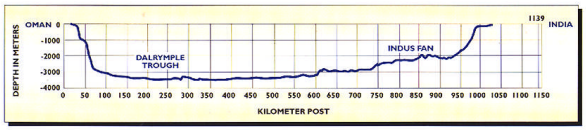
SAGE will build on the extensive study of the deepwater route from Oman during the mid 1990's. $65 million was spent developing the technology, performing detailed FEED and soliciting, receiving and evaluating competitive construction bids.

This work is now strengthened by studies undertaken since 2006 by SAGE and by the major body of industrial deepwater pipelay experience over the last decade. The route will reach down to around 3,300 meters and will be just over 1,100km in length.

A major study of a similar line to Gujarat from Iran was more recently undertaken by Saipem for GAIL and NIGEC.



Subsea Route and Sea Bottom Profile



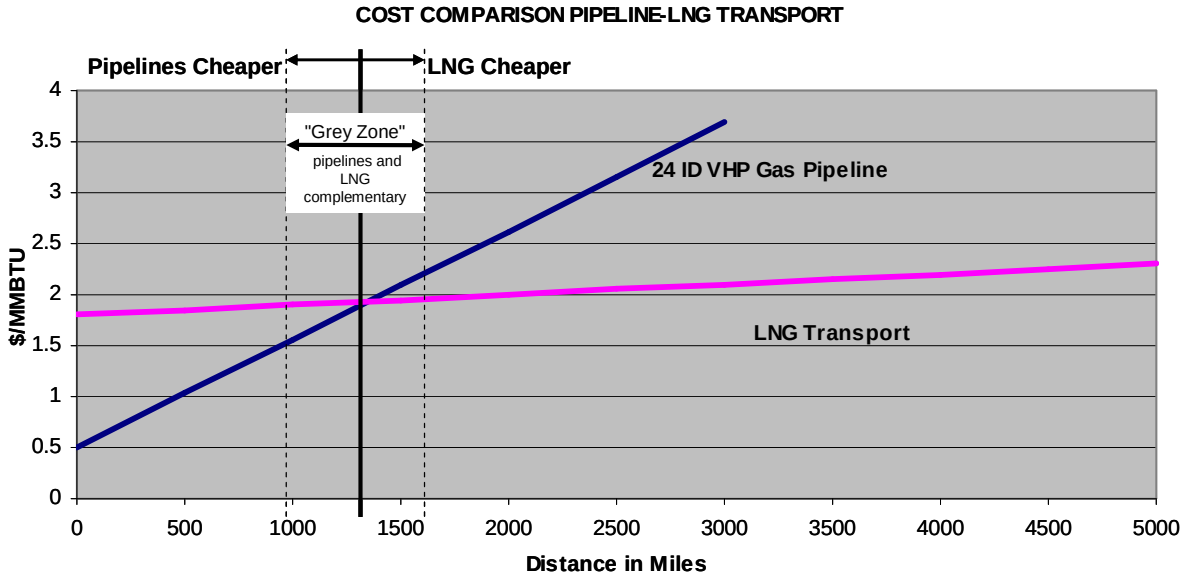
History

- Pipelines generally transport natural gas at a lower cost than LNG over distances up to around 2100Km.
- Transport of Iranian gas by offshore pipeline to anywhere in India lying to the South and West of Jaipur (approximately) can provide a shorter, more direct route than by overland pipeline.

SO why haven't numerous offshore gas pipelines from Iran to Western India been built over the last 30 years, either along the coast or across the deep water of the Arabian Sea, to complement Middle East LNG supplies?

ANSWER:

- A shallow conventional coastal route to India involves laying a pipeline across the Indus Canyon which is extremely challenging, technically, even today.
- Until recently, the geo-politically attractive Arabian Sea route was too deep but experience with new lay-barges now makes it practical.



History

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:

- 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.

Building on Previous Experience

What makes SAGE's Risk Profile lower now?

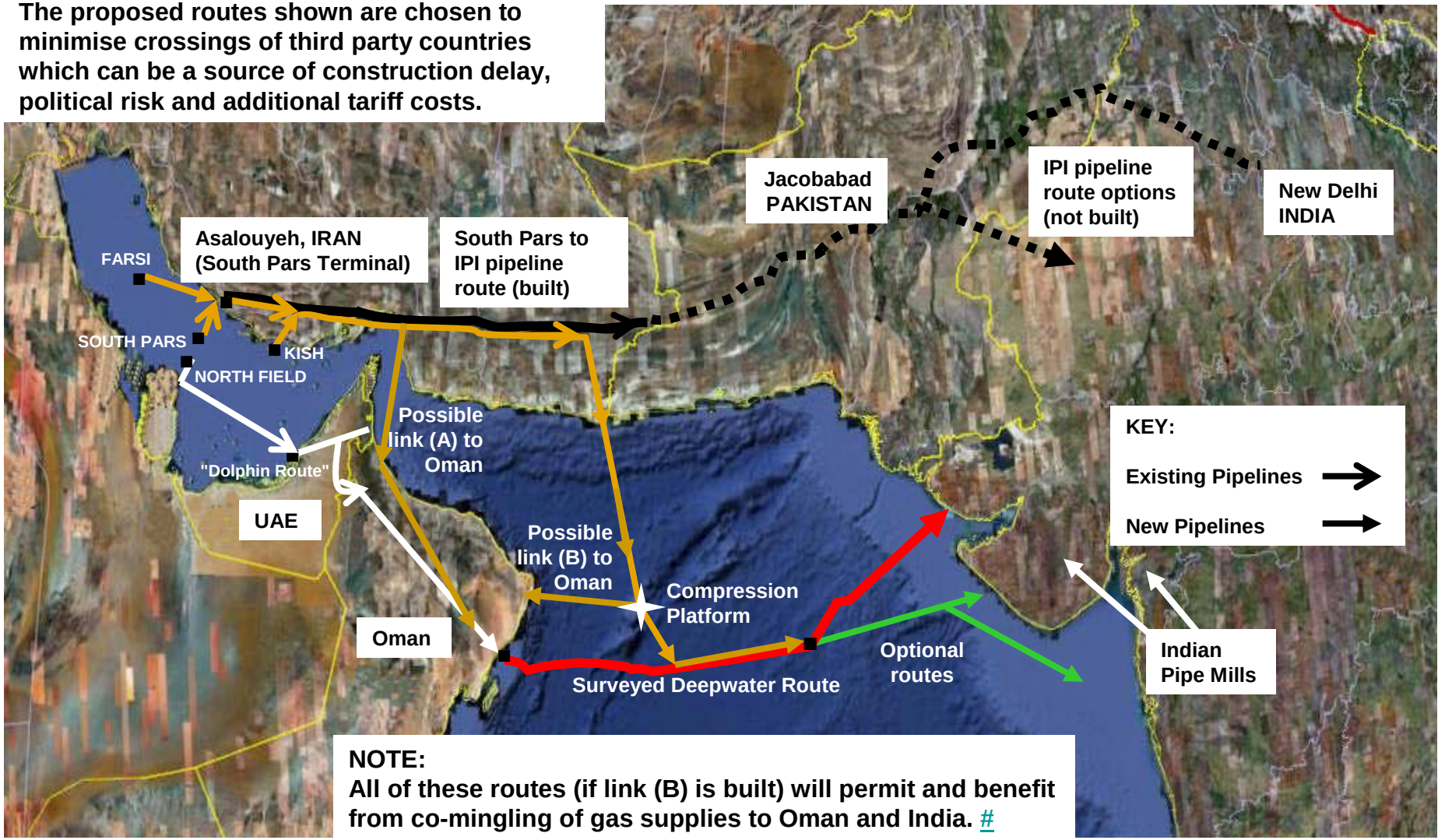
- New generation, large lay vessels ready to build.
- Several mills can manufacture pipe, particularly in India.
- Era of damaging cost escalation appears to be over.
- New and improved design methods for free-spanning and geo-hazards have been developed.
- Better positioning capabilities are now available 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 28-inch pipe.

Government Awareness

- Presentation to Mr S. Sundareshan, Additional Secretary Petroleum Ministry. Also to Power and Fertilizer Ministries in December 2007, 2008 and 2009.
- Indian Secy. of Foreign Affairs: Meetings and full support.
- At a meeting on 28th March 2009, H.E. Dr. Rumhy, Oman Oil & Gas Minister, agreed in principle to give "Right of Way" and other clearances to SAGE in presence of Indian Ambassador.
- Written confirmation from Qatar Energy Ministry that SAGE is on the "Waiting List" for gas.
- Principles of Cooperation signed with GAIL Summer 2009
- Invitation from NIGEC to present SAGE project and hold gas supply discussions in Tehran, 24th-25th May 2009.
- Signed MOU with NIGEC October 2009.

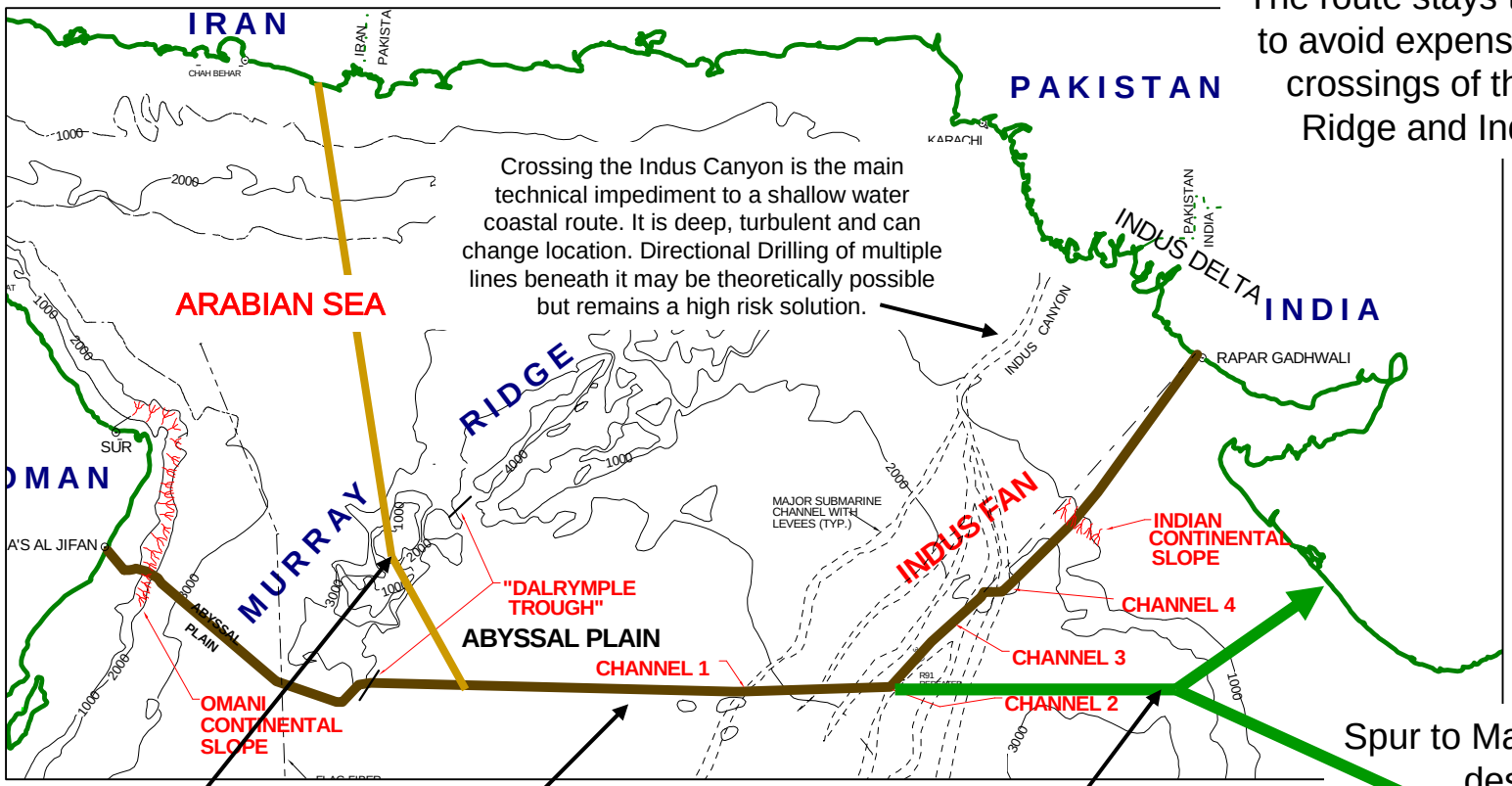
Summary of Possible Pipeline Routes to India

NOTE:
The proposed routes shown are chosen to minimise crossings of third party countries which can be a source of construction delay, political risk and additional tariff costs.



NOTE:
All of these routes (if link (B) is built) will permit and benefit from co-mingling of gas supplies to Oman and India. #

Possible Deepwater Routes for gas to India



Crossing the Indus Canyon is the main technical impediment to a shallow water coastal route. It is deep, turbulent and can change location. Directional Drilling of multiple lines beneath it may be theoretically possible but remains a high risk solution.

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

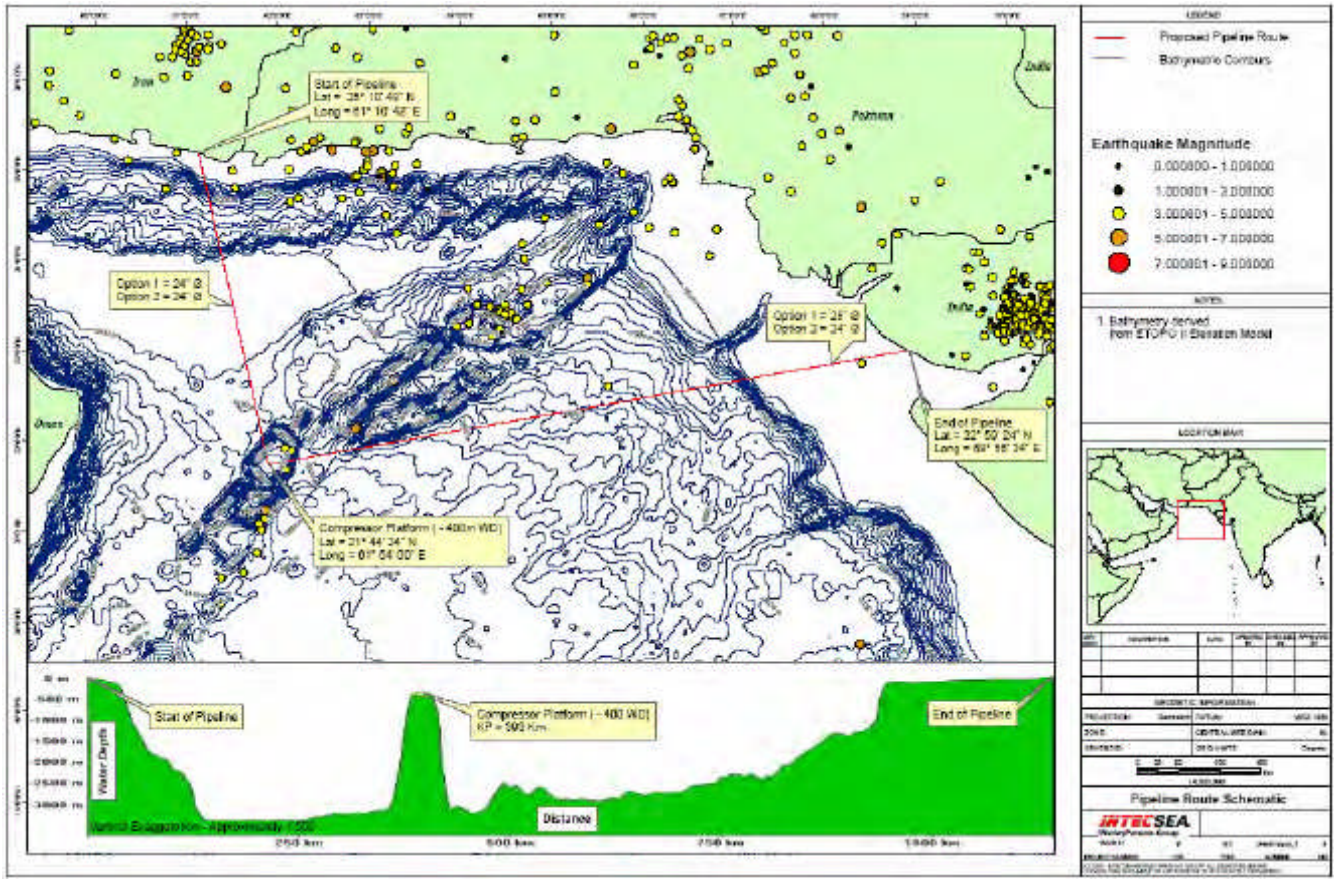
Spur to Maharashtra if desired

Original, surveyed, route

Possible route direct from gas export landfall via Compression Platform on Sea Mount. Two shorter, smaller lines laid by existing barges can be used on this route. Note there is no 3rd Party Jurisdiction crossing.

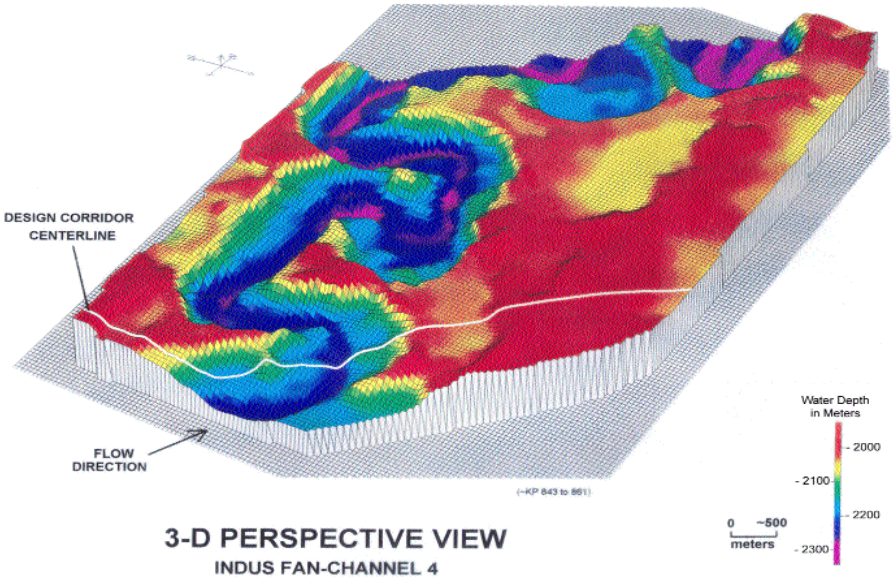
Possible re-route suggested by *INTECSEA* to minimize mud flow exposure in Channel 4; the revised route is also shorter

Seamount Location for In-line Compression

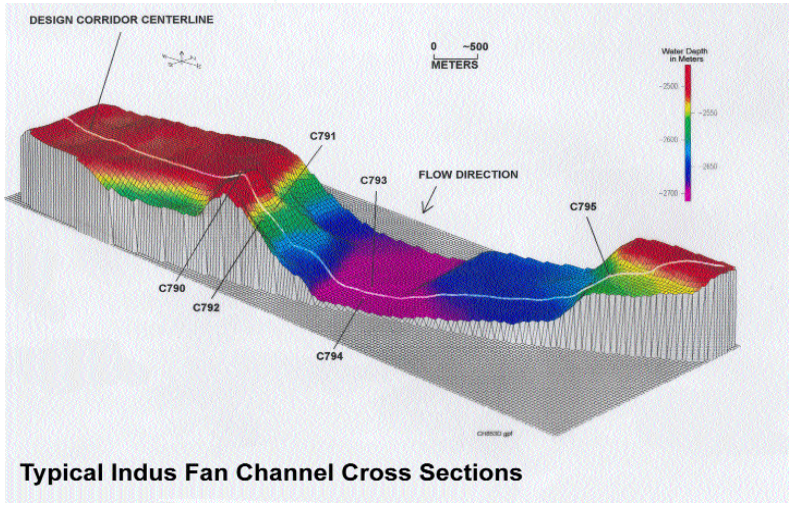


- The seamounts at the South-West end of the Murray Ridge present a near-ideal location for an in-line Compression Platform.
- These remarkable features reach to within a few hundred metres of Sea Level, as shown above.
- Several examples of platforms in this water depth exist.
- The slopes are exaggerated - they are quite suitable for pipelay up to the platform.
- The Compression Platform will be outside of all Territorial Waters but within helicopter supply range.

Indus Fan - crossing details on original route.

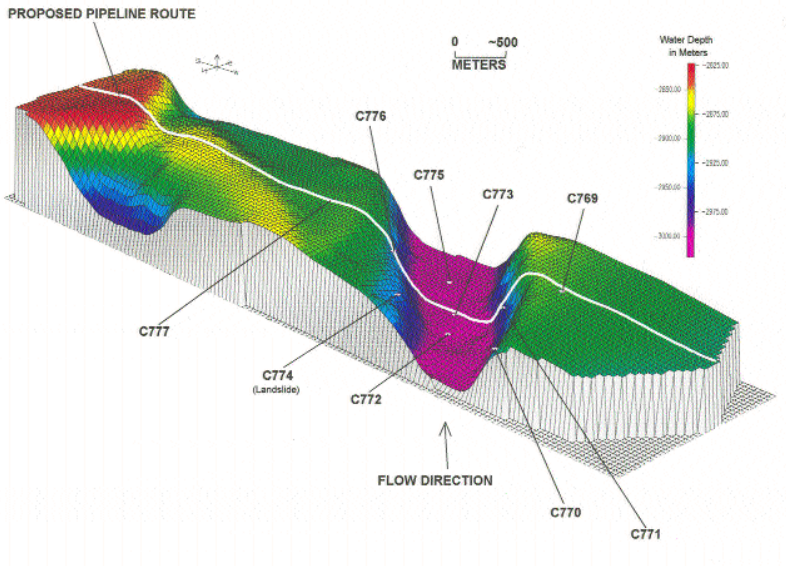


3-D PERSPECTIVE VIEW
INDUS FAN-CHANNEL 4
CHART PH1-107



Typical Indus Fan Channel Cross Sections

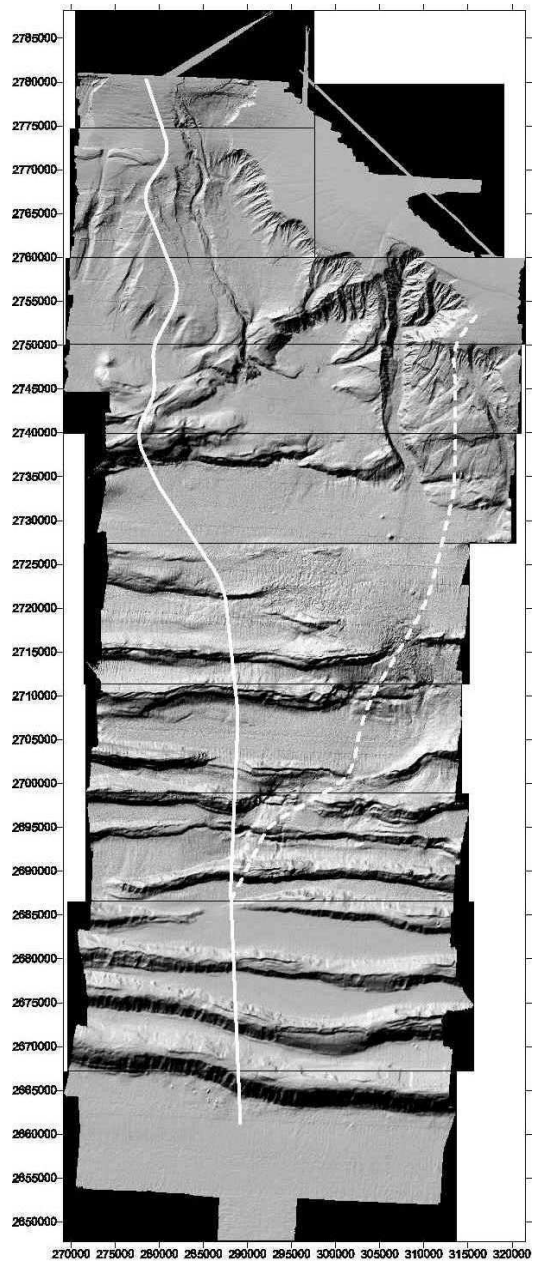
- The Indus Fan is formed in a 2500m thick pile of sediment covering the greater part of the Arabian sea.
- It was formed by the Indus river which drains the local topography from the western Himalayas and feeds the erosional outwash into the Arabian Sea
- The Indus is comparable in size and discharge to the Mississippi and is one of the major geological features of the Indian Ocean. Its development is proposed to have initiated the S.W. Monsoon.



INTECSEA
WorleyParsons Group

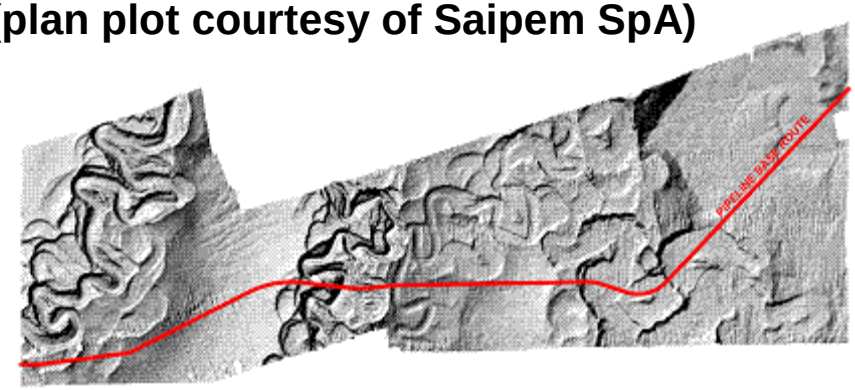
Iran Shelf Break - Possible Routes from Chabahar area.

(plan plot courtesy of Saipem SpA)

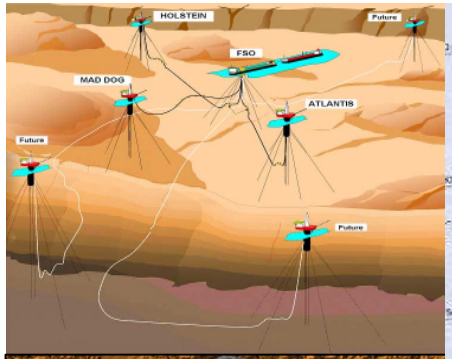


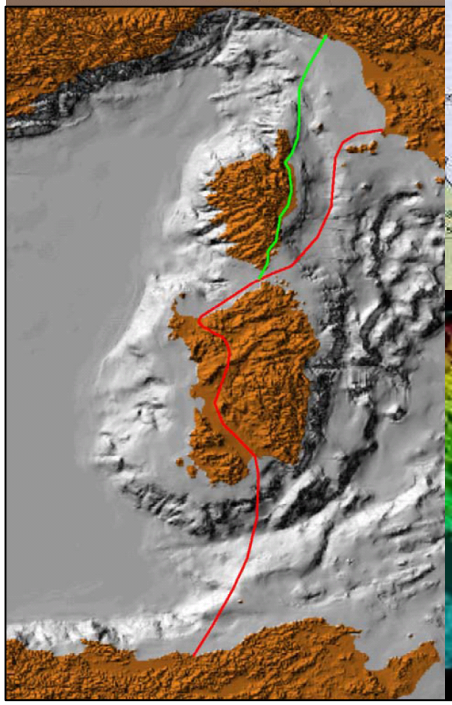
Indus Fan Channel 4.

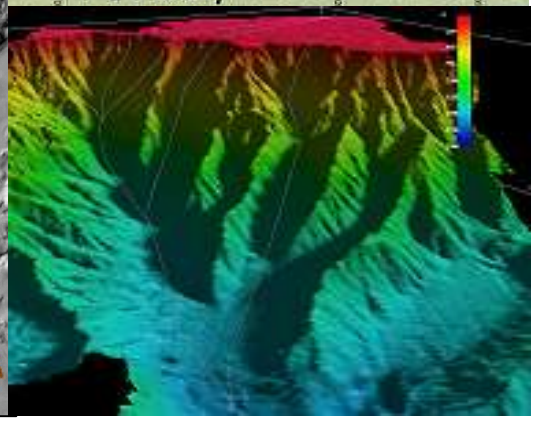
(plan plot courtesy of Saipem SpA)

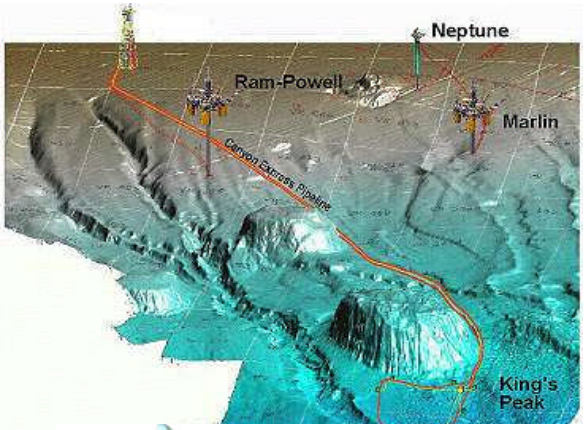


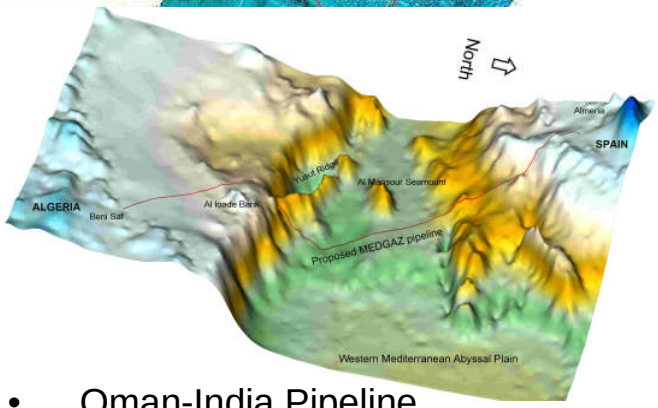
INTECSEA DEEPWATER Pipeline Examples







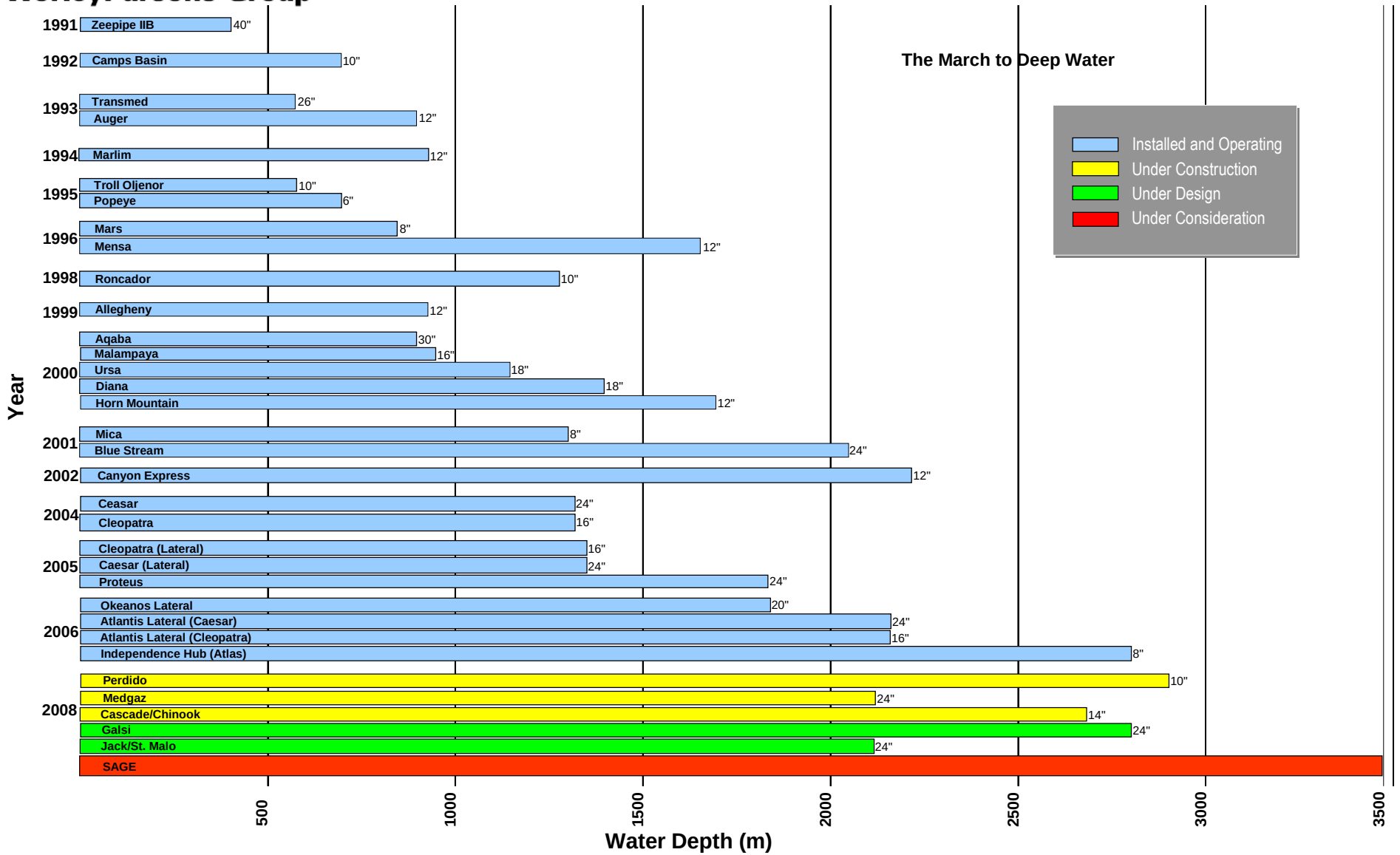




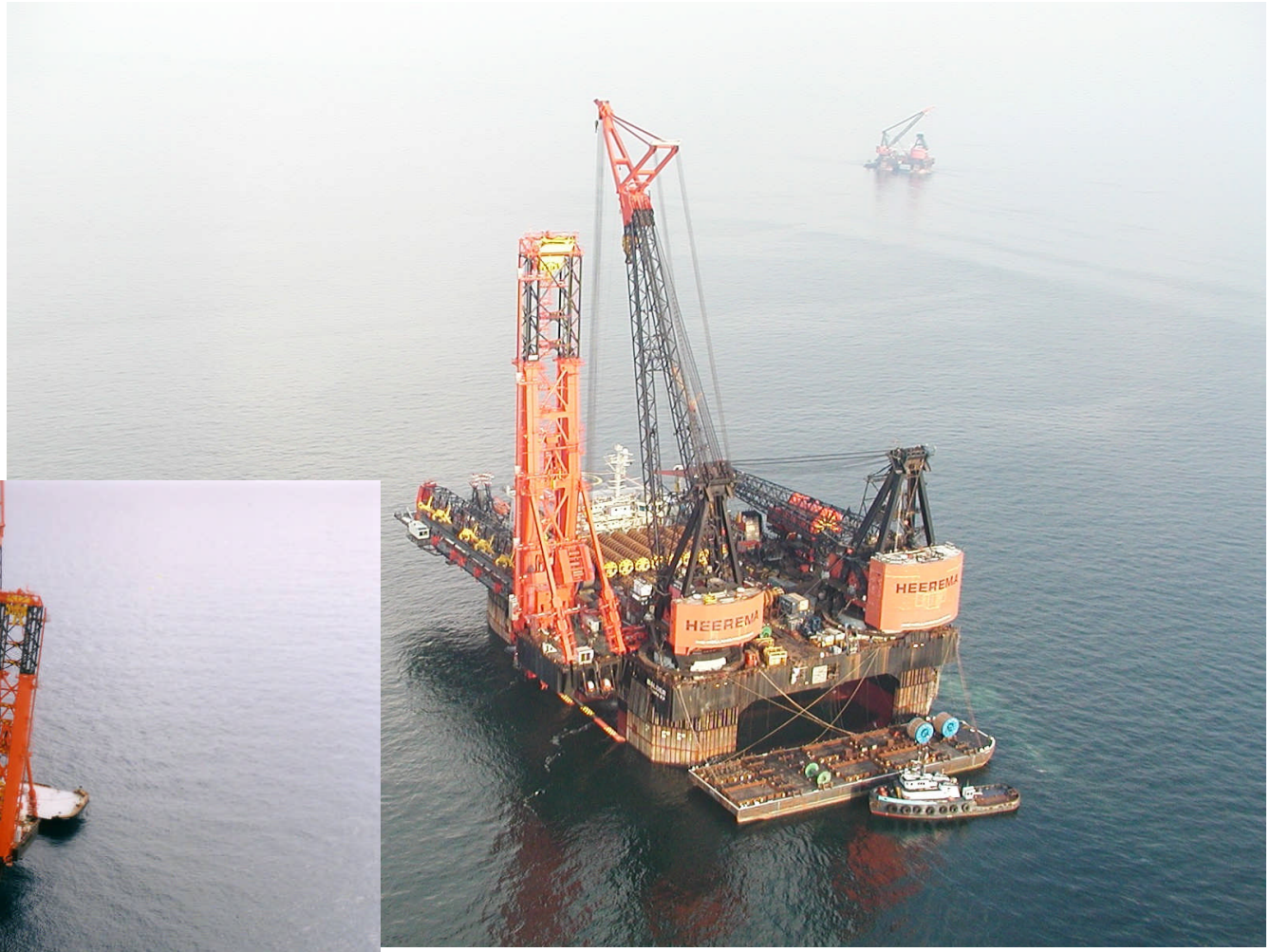
- Oman-India Pipeline
- Bluestream
- Canyon Express
- Mardi Gras
- MEDGAZ
- Galsi

INTECSEA
WorleyParsons Group

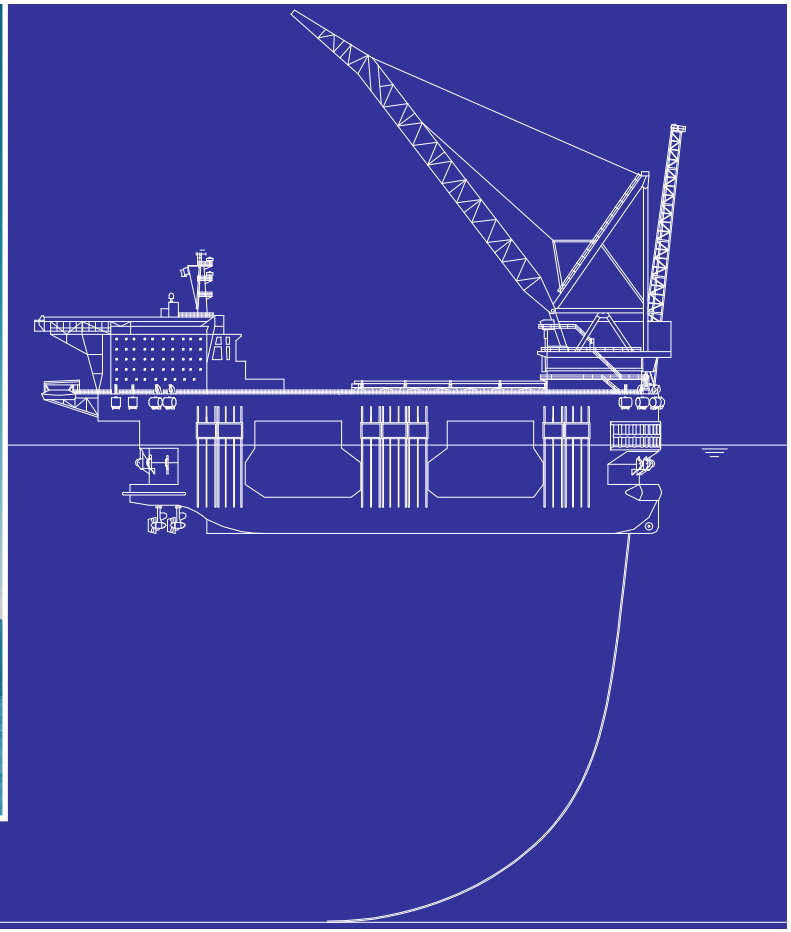
Deepwater Pipelay Progression



Current J-Lay vessel: DCV Balder



Current J-Lay vessel: Saipem 7000



INTECSEA
WorleyParsons Group

CastorONE

Saipem spa

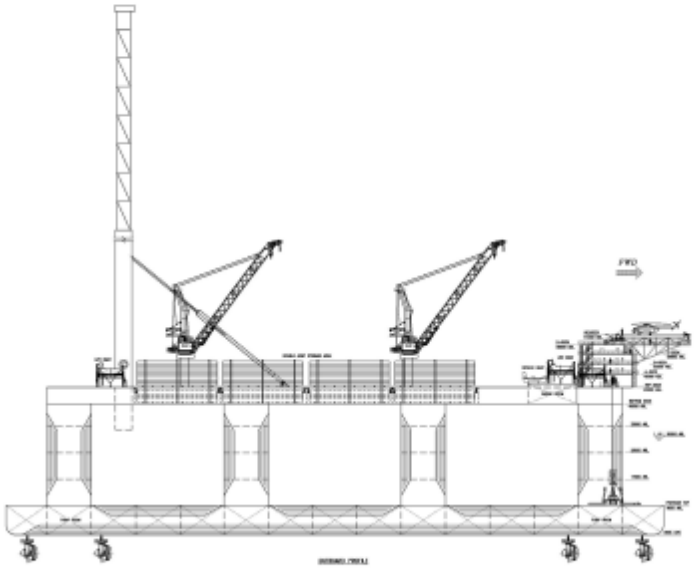
- Saipem spa has confirmed that the SAGE deepwater pipeline is feasible and can be installed into water 3500m deep using its new laybarge CastorONE, currently in construction.
- Saipem was a leading contributor to the line pipe Quality Management Workshop convened by DnV for SAGE.
- An MOU under which Saipem will join the SAGE Consortium has been signed.

CastorONE - under construction

- J-Lay and S-Lay.
- 2000t top tension capacity J-Lay gives ability to lay SAGE pipe to 3500m with 2 welding stations on triple joints.
- Weathervanes in J-Lay for all-year lay.
- DPS3 redundant dynamic positioning.
- Accommodation for over 700 persons.

SAGE-owned pipelay barge without heavy-lift cranes:

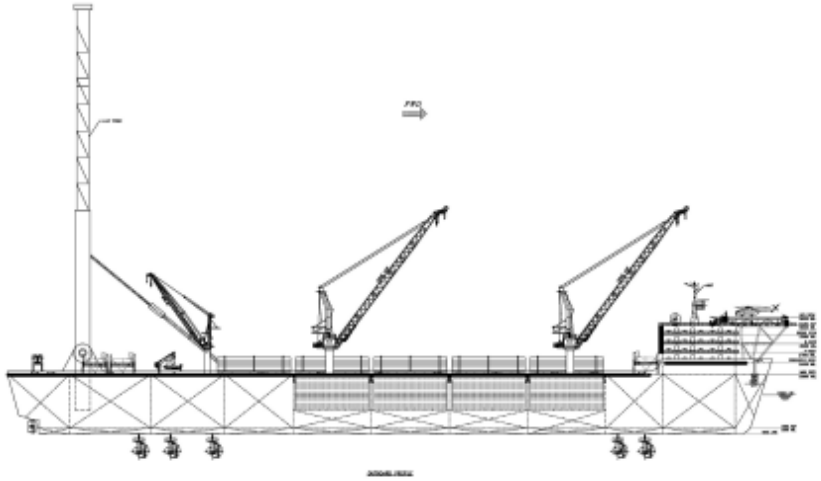
Dimensions & Displacements (Semi Hull)



DECK BOX

Length of main deck	175 m
Width of main deck	90 m
Depth of deck box	5 m

Dimensions & Displacements (Ship Shape)



Length Overall	254m
Breadth molded	44m
Breadth Extreme	46.5m
Depth	20m

CAPEX for any such barge is around $850,000. SAGE would need to set up full PMC team - but multiple lines possible.

November 2009

Line Pipe Feasibility - Summary

Heavy Wall Line Pipe manufacture:

- **DnV** has formally confirmed the SAGE pipe size and manufacturing Heat Treatment process to be safe.

  The work has shown that it is possible to document that a 28" OD pipeline with a 42mm nominal wall thickness made of DNV-SAWL-450 F (steel having a SMYS of 450MPa) exposed to light heat treatment to have sufficient safety level.

  MANAGING RISK DNV

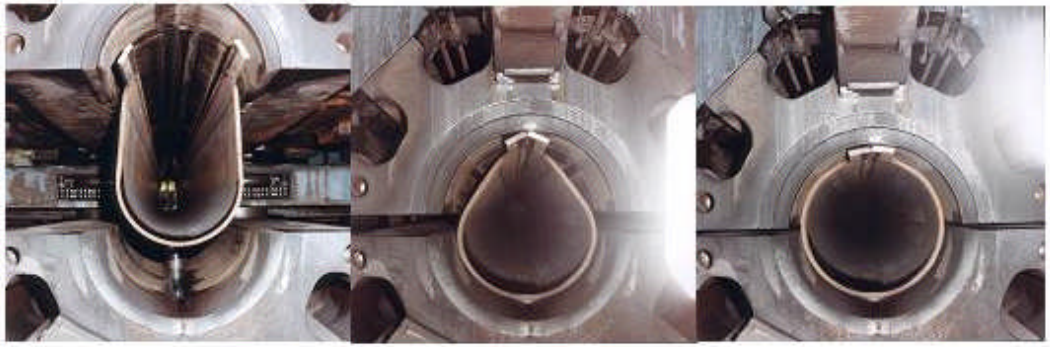
  Workshop: DNV Offices, Høvik, Oslo, **Date:** 16/17-1-08,

  - **DNV:** Kim Mork, Leif Collberg, Kristoffer Aronsen, Olav Aamlid
  - **CORUS:** Peter Tait, Technical Manager Energy,
    Mark Fryer Mgr–Develop. & Tech. Support
    Richard Freeman Manager – Business Development
  - **C-FER Technology:** Duane DeGeer Manager, Offshore Pipelines
  - **University of Texas:** Professor Stelios Kyriakides,
  - **Saipem Energy Services:** Enrico Torselletti, R&D Project Man.,
    Luigino Vitali, Mgr, Advanced Tech. Solutions
  - **SAGE:** Professor Alastair Walker F.R.S.

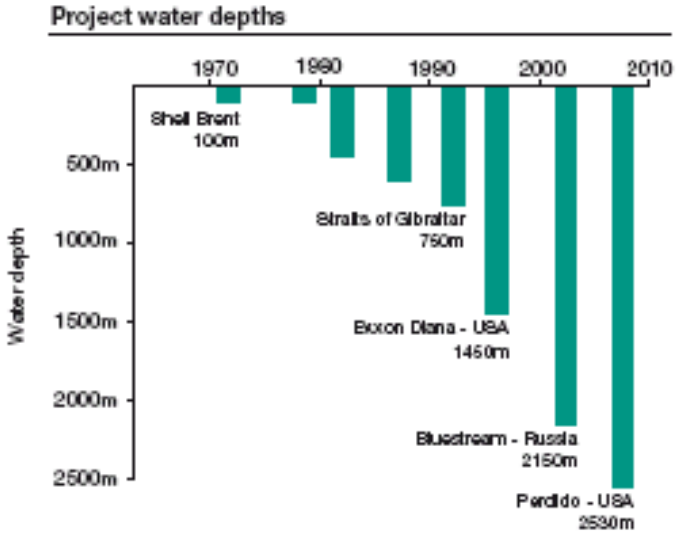
- **SAGE has established this pipe can be manufactured by Indian Pipe Mills.**

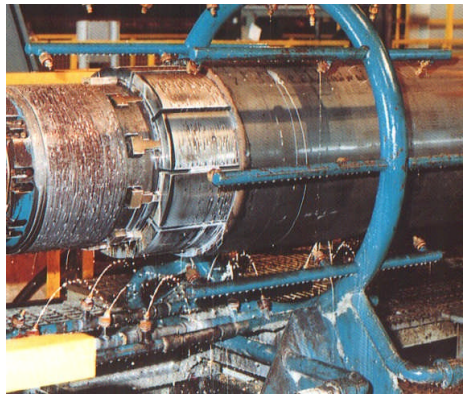
INTECSEA
WorleyParsons Group

Corus Tubes – Deepwater Track record



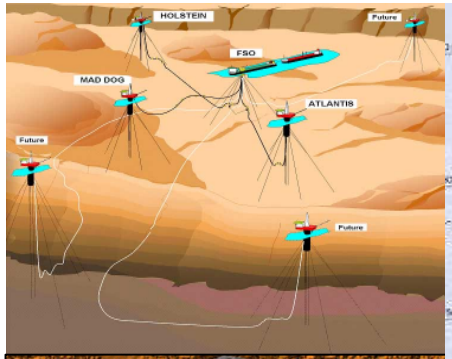
World Strongest : "O" Press
Max Pressure force : 50,000t

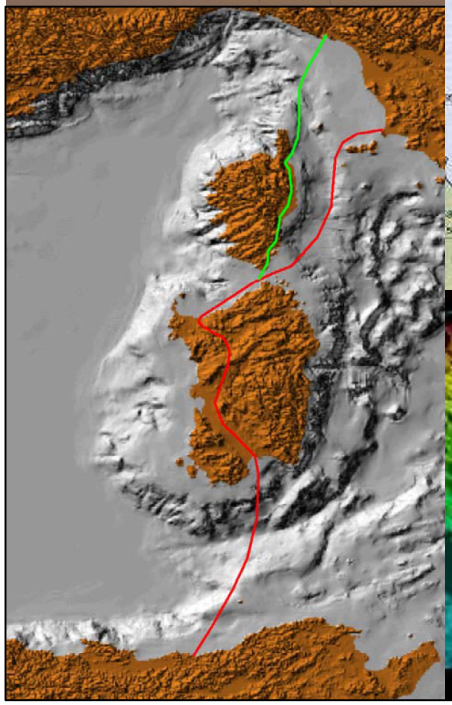


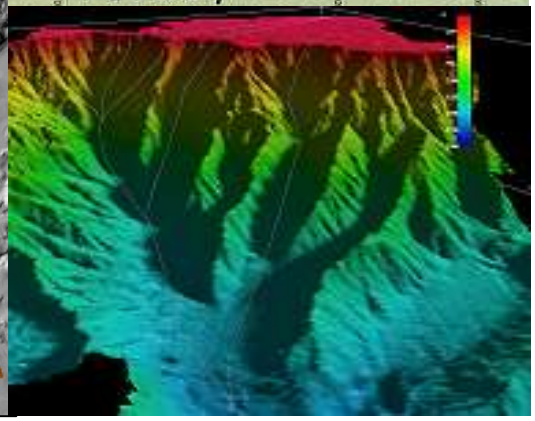


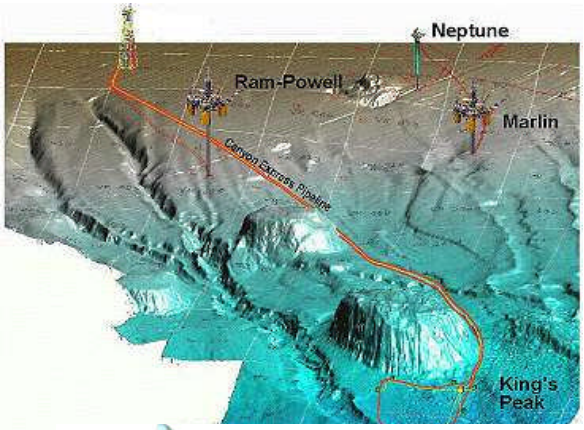
Corus Tubes UK UOE Mill has the strongest tooling in the world ensuring the required roundness and material compressive strength necessary for ultra-deepwater line-pipes

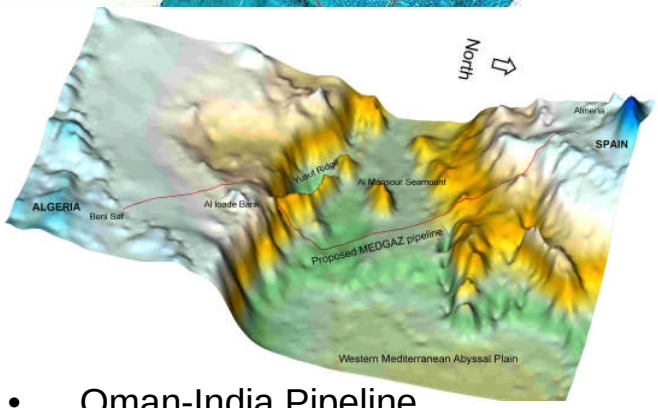
INTECSEA DEEPWATER Pipeline Examples









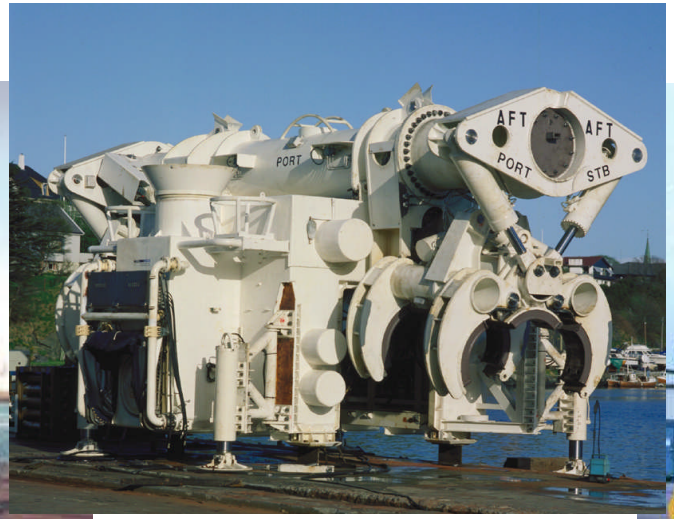


- Oman-India Pipeline
- Bluestream
- Canyon Express
- Mardi Gras
- MEDGAZ
- Galsi

INTECSEA
WorleyParsons Group

Deepwater Pipeline Repair

- No deepwater large diameter pipeline has ever required in-situ repair, nor is it statistically likely that a repair will be required during the lifetime of the pipeline
- However, within the last 5 years, deepwater pipeline repair systems have been designed, constructed, tested and commissioned for operational use for large diameter, high pressure gas pipelines
- Diameter range available today for large diameter is 16-inch to 28-inch OD
- Water depth rating available today is 3,050 m (10,000 ft)
- The use of advanced diverless remote equipment to repair a line takes time, and leads to consideration of redundancy such as multiple SAGE lines will provide.



Assessment of Risk Levels - under update.

Data from Oman India

Zone	Calculated Failure Probability	'Safety' Level
Oman Shelf	9.81×10^{-2}	0.04
Oman Shelf Break	2.87×10^{-4}	14.0
Upper Oman Slope	9.18×10^{-4}	4.4
Lower Oman Slope	1.44×10^{-3}	27.8
Abyssal Plain (Oman Side)	1.56×10^{-4}	25.6
Murray Ridge*	2.69×10^{-3}	14.9
Dalrymple Trough*	5.37×10^{-3}	7.4
Abyssal Plain (Indian Side)	6.60×10^{-4}	6.1
Indus Fan (Excl. Ch. 1, 2, 4)	4.27×10^{-4}	9.4
Indus Fan Channel 1	2.17×10^{-4}	18.4
Indus Fan Channel 2	3.09×10^{-4}	12.9
Indus Fan Channel 4	7.27×10^{-4}	5.5
Lower Indian Slope	1.96×10^{-4}	20.4
Upper Indian Slope	3.22×10^{-4}	12.4
Indian Shelf Break	1.15×10^{-3}	3.5
Indian Shelf	9.86×10^{-2}	0.04

Note:
"Safety" Level means "how much safer than acceptable is it?"

What does this tell us?

- The deepwater environment is an outstandingly safe, protective and benign location for a gas pipeline.
- The only areas requiring mitigation are the conventional shallow sections near the beach at each end, similar to any other pipeline, where trenching and rock-dumping are conventionally applied. This protects the pipeline against anchors and fishing activity.
- The risk from Sabotage is insignificant.

The SAGE Project – Current Activity

- Saipem preparing Construction Risk input to update Risk Analysis model.
- DnV input - SAGE Economic Upgrade by introducing Heat Treatment into pipe mill Quality Control techniques. DnV is preparing to show All-Risk Insurance is available at normal rates when risk Model updated.
- SAGE Technology being shared with Indian & UK Pipe Mills. Mills are implementing test programs under guidance from Prof. A Walker FRS.
- ***INTECSEA*** Inc. (a WorleyParsons company) has completed cost/route study of onshore Gas Gathering system and is now appointed as the SAGE Project Development Consultant. Feasibility Study recently updated and Risk Assessment is under way.
- Study of SAGE-owned Lay Barge is recently complete.
- Program of gas acquisition discussions in Iran and Qatar. MOU with NIGEC signed.
- JAI-Associates International has prepared 30-year Gas Price Scenarios - to be built into the SAGE Economic Model.
- Ernst & Young undertaking Commercial and Financial Feasibility Study and will report by end 2009.
- SAGE updating Project Schedule with help of all Stakeholders.

SAGE CAPEX (from Chabahar) and Break-Even Tariff where SAGE acts as a Common Carrier.

Cost Case		CAPEX US$	Break-Even Tariff $/MMBTU
Steel Cost US$ per tonne	Lay Spread Day Rate US$		
1700	500,000	2,411,757,373	0.76
2200	500,000	2,762,797,748	0.84
1700	1,000,000	2,863,994,873	0.87
2200	1,000,000	3,215,035,248	0.96

Notes:

- Seamount route from Chabahar permits very significant line size reductions.
- In this example Debt to Equity ratio is 4.
- In this example cost of Debt is 5% and of Equity 10%.
- Full route survey and intervention works evaluation needed as part of detailed design which may impact these numbers.
- Break-Even Tariff from Qatar around double these figures. (SAGE model)
- Comparable LNG figures are US$1.90, $2.40 or $3.5 per MMBTU, depending on source.
- Five year project to first gas.