

Presentation of the SAGE Deepwater Pipeline to transport natural Gas by several optional routes from I.R. Iran to India.

May 23rd to 26th, 2009

Tehran



Middle East to India
Deepwater Pipeline

History



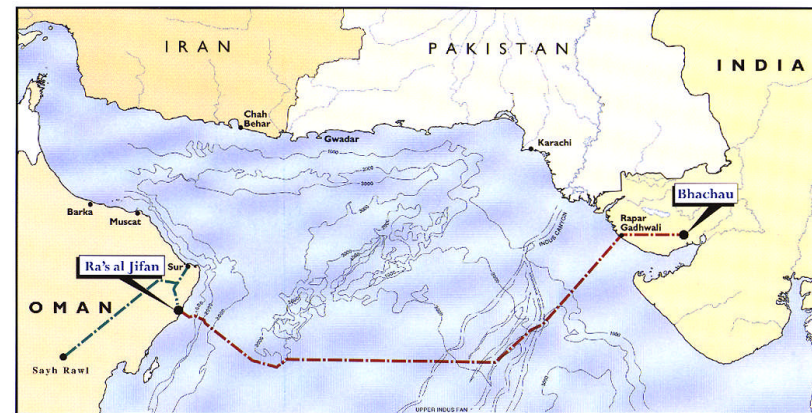
Strong cultural and business ties have developed historically between Iran and India over many centuries.

Iran and India are sufficiently close neighbours geographically that inter-connection of the two countries by natural gas pipelines is very typical of pipeline systems Worldwide.

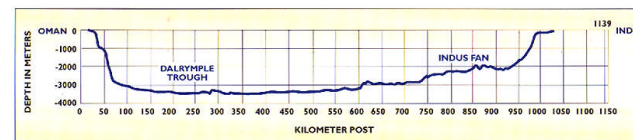
The establishment of such a gas pipeline inter-connection between Iran and India has been under discussion for over a decade.

SAGE will build on the extensive study of a deepwater route across the Arabian Sea started during the mid 1990's, strengthened by the development work now undertaken by SAGE, plus the major body of industrial deepwater pipelay experience over the last decade.

The deep water section will reach down to 3,500 meters and will be just over 1,000km in length.



Subsea Route and Sea Bottom Profile

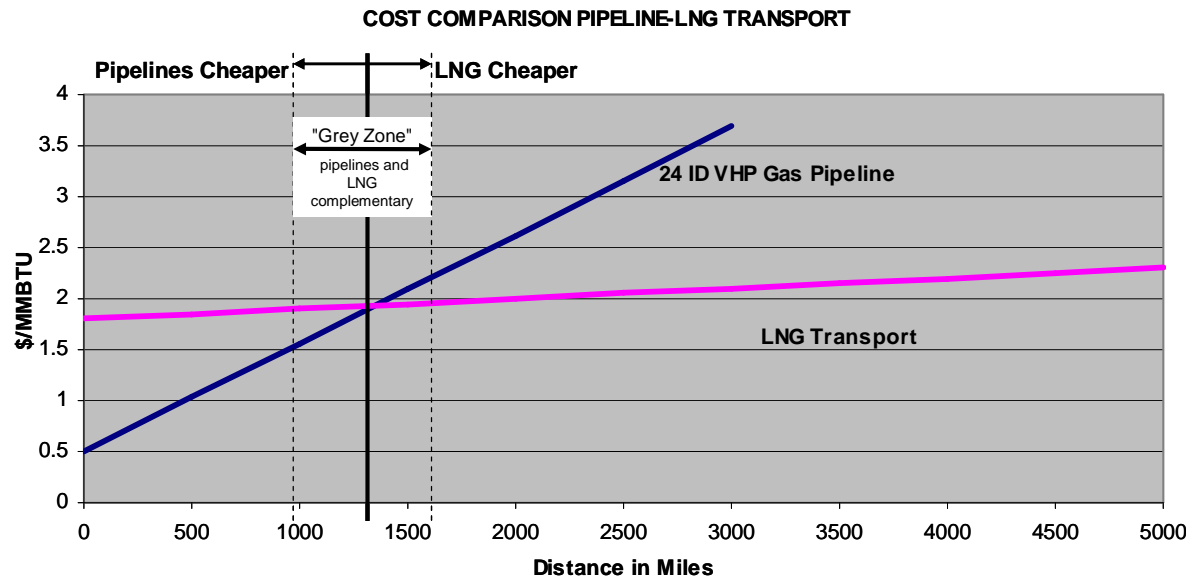


- Pipelines generally transport natural gas at a lower cost than LNG over distances up to around 2100Km.
- Transport of Iranian gas by offshore pipeline to anywhere in India lying to the South and West of Jaipur (approximately) can provide a shorter, more direct route than by overland pipeline.

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.



The SAGE Project – Key team members



Mr. T.N.R. Rao	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Director: South Asia Gas Enterprise PVT Ltd Director: VerdErg Ltd, London Former Project Director of original Oman-India Pipeline
Dr Herman Franssen	<ul style="list-style-type: none"> 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
Rob Narold	<ul style="list-style-type: none"> Heerema Marine Contractors Project Manager for new barge design and construction HMC Strategic Development Advisor Sr. Proposals Manager - Manager New Product Development HMC Deep Water Product Manager
to be nominated by Saipem	<ul style="list-style-type: none"> Representative of Saipem spa, (under discussion).
Ian Nash	<ul style="list-style-type: none"> UK Operations 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Manager, Business and Sales Development, Corus Tubes (Energy), UK.

Recent Milestones



- On 28th March 2009, 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 within recent months that SAGE is on the "Waiting List" for gas.
- Doha Gas Conference March 2009: evidence that the LNG price collapse makes diversification into gas pipeline export increasingly attractive to Gulf States.
- Presentation to Mr Pandey, Secretary, Petroleum & Gas Ministry in Delhi, April 2009. Mr Pandey offered his Ministry's help. Also presented to Power and Fertilizer Ministries.
- Gathering Support also received from Foreign Affairs Ministry in recent weeks aimed at adoption of SAGE Deepwater Gas Pipeline by Planning Commission.
- MOU with SAGE drafted by GAIL for signature in very near future.
- Increasing support from the Indian Ambassadors in Oman, Iran and Qatar in securing Natural Gas Supplies and necessary Permissions.
- 4th May 2009, met with Saipem which confirms SAGE is Feasible, in writing. An MOU between Saipem and SAGE is being finalised.
- Invitation from NIGEC to present SAGE project and hold gas supply discussions in Tehran, 24th-26th May 2009.

May 2009

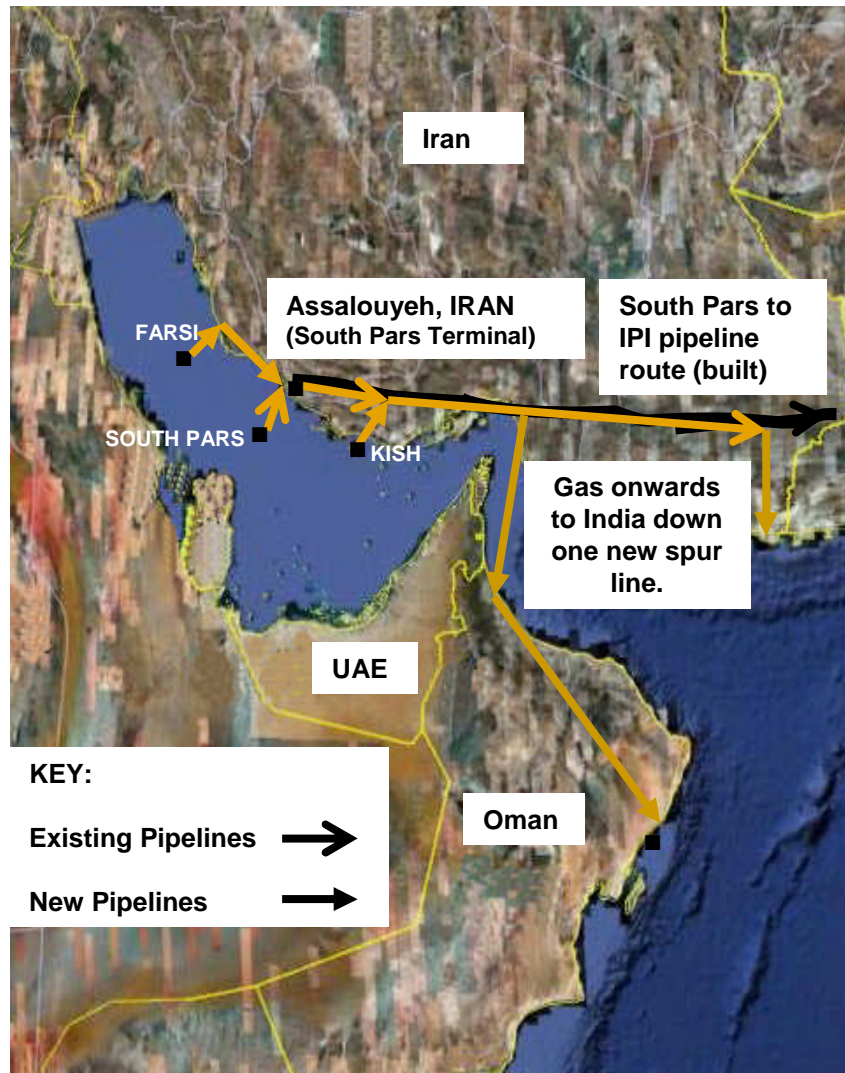
Proprietary to South Asia Gas
Enterprise PVT Ltd (SAGE)

Key success factors



- World class design and build consortium; **low project risk**.
- SAGE can provide non-volatile, long-term bi-partisan pricing, complementary to LNG “spot-market” volatility leading to a **superior financial risk** profile.
- Replaces **wasteful** use of Naphtha for fertiliser production
- SAGE brings “**Green Energy**” and **carbon reduction** benefits.
- SAGE will create **convergence** of regional economic interests.
- A huge unsatisfied gas market exists in India. Each SAGE line requires **8TCF** of the **2000TCF** of gas in the Middle East.
- SAGE will evolve into an **Energy Corridor** with a regional gas-gathering "Hub" fed by multiple sources exporting natural gas through a multi-pipeline deepwater **Gas Highway** to India.
- SAGE permits Iran to sell gas in India at **Market Price**.

Possible Upstream Routes for gas to India

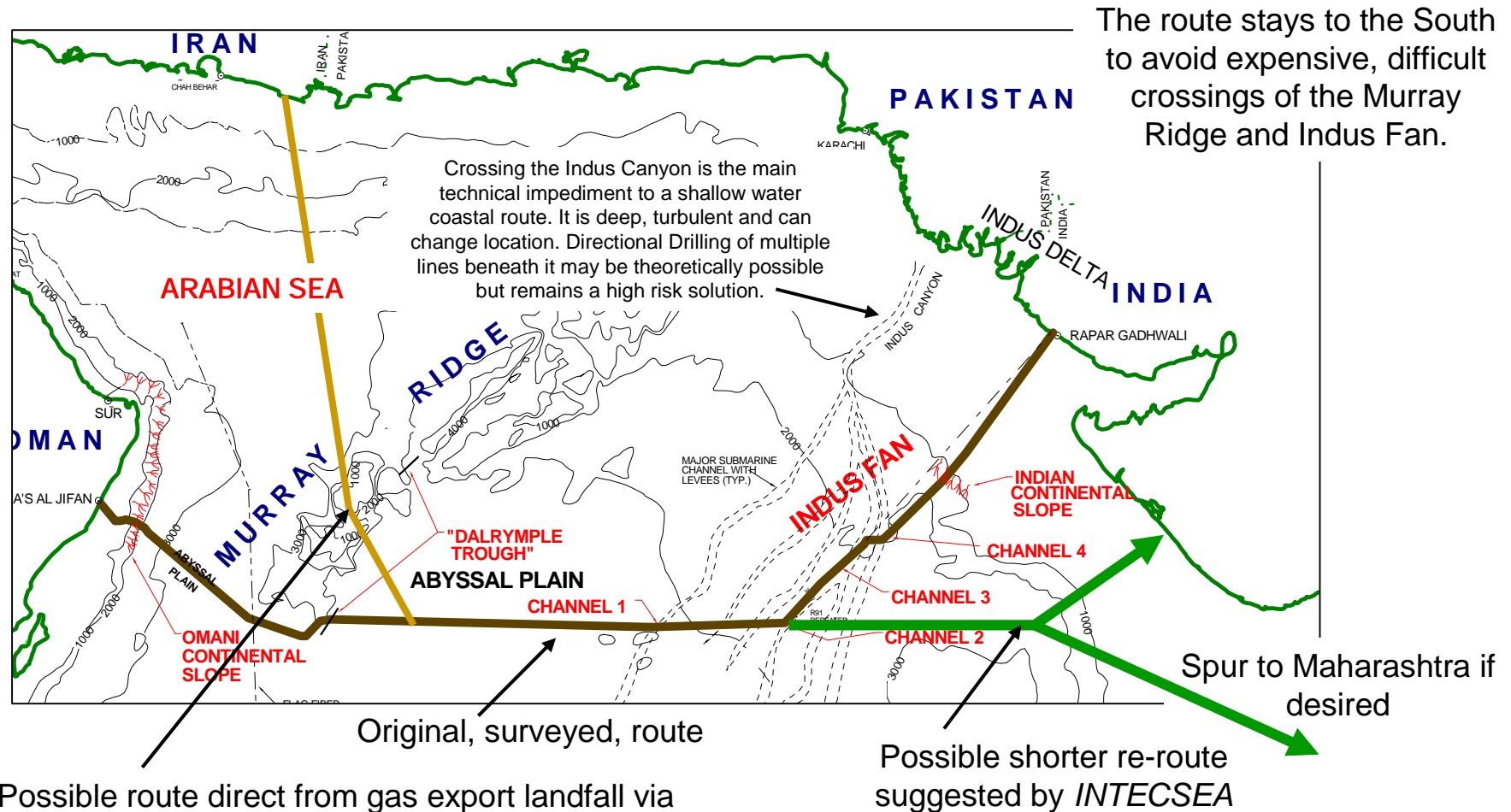


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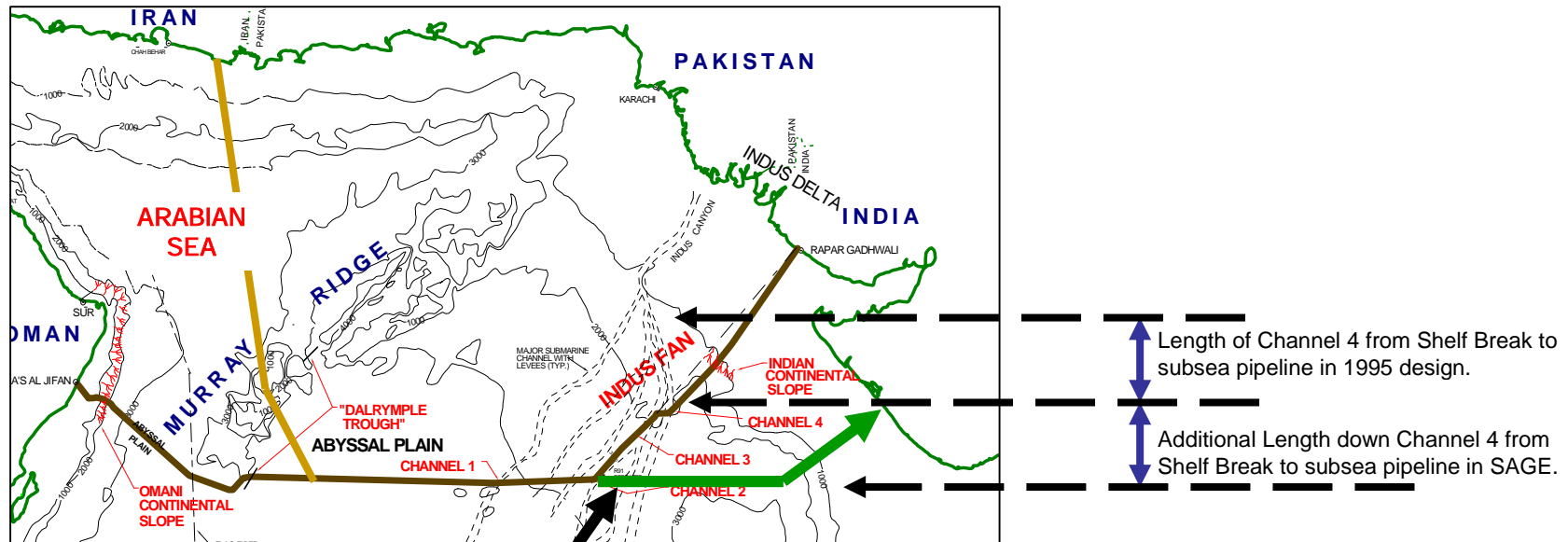
- South Pars gas allocated to India for the "IPI" line can equally well be transported to Gujarat via SAGE, because the distance is similar.
- The Gold coloured route for Iranian gas initially follows the Assalouyeh-Pakistan line, completed to Iranshahr. This is fed from the South Pars field, the source of the IPI gas. A new spur line down to the coast will complete the delivery system for gas on to India. Gas from FARSI and/or KISH can also feed into this system through short new lines as shown.
- Alternatively, a route to Northern Oman and then South to a deepwater compression terminal can be adopted.
- SAGE has discussed transport of FARSI gas to India with ONGC Videsh.
- SAGE has discussed combined transport of KISH gas to Oman and India with the Omani Authorities.

Possible Deepwater Routes for gas to India



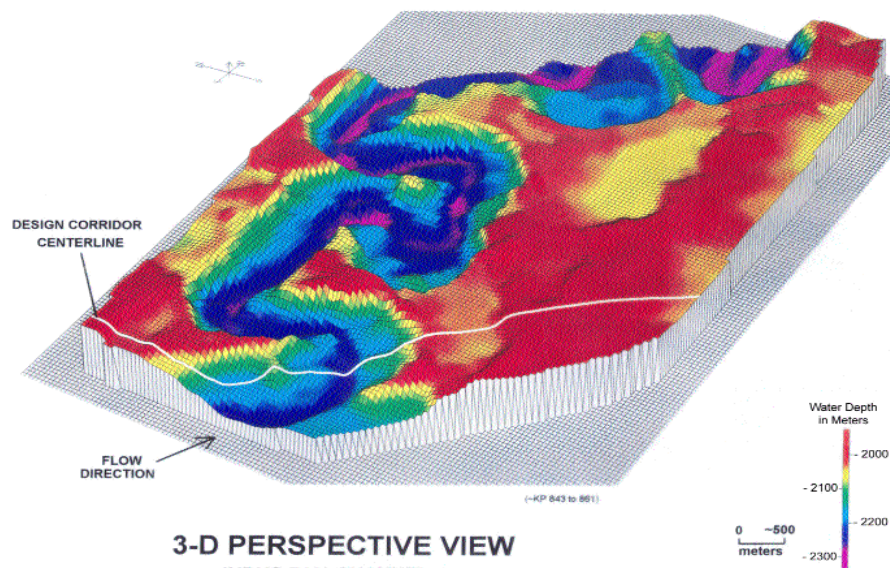
Possible route direct from gas export landfall via Compression Platform on Sea Mount. Two shorter, smaller lines laid by existing barges can be used on this route. Note there is no 3rd Party territorial crossing.

Indus Fan mudslide risk mitigation.

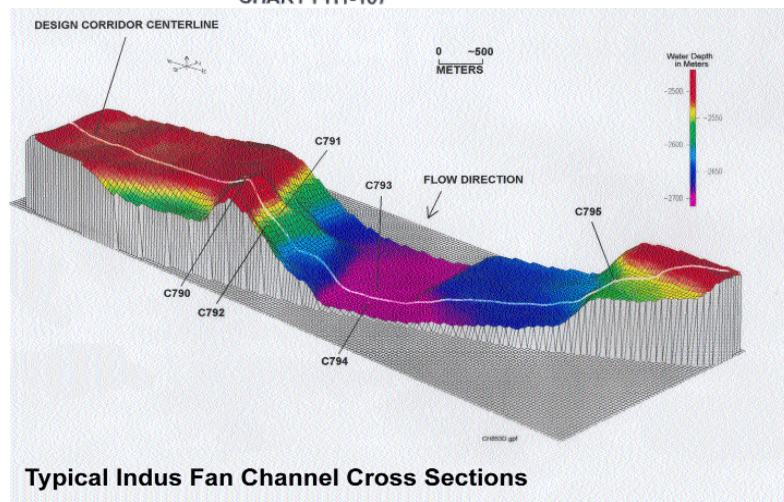


The re-route to the South suggested by *INTECSEA* will substantially minimize the energy in any mud flow to which the pipeline is exposed in Channel 4. This is because the distance which any such flow has to travel from the Continental Shelf Break before reaching the pipeline is doubled.

Indus Fan - crossing details on original route.

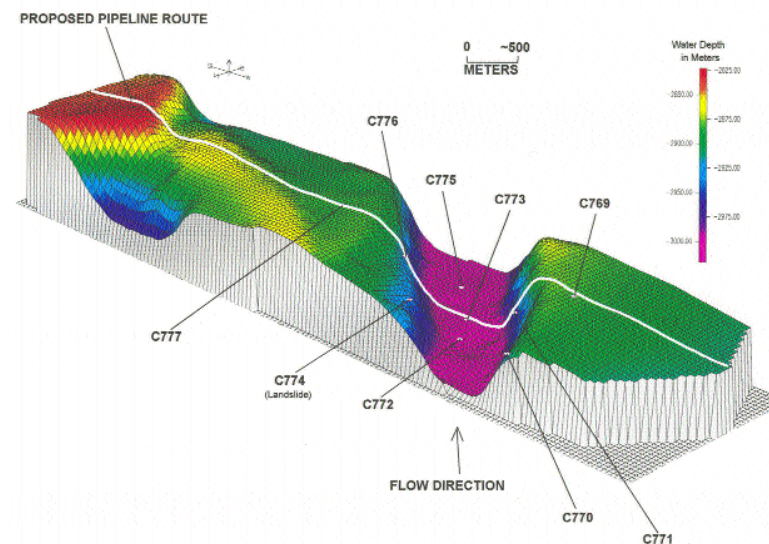


3-D PERSPECTIVE VIEW
INDUS FAN-CHANNEL 4
CHART PH1-107

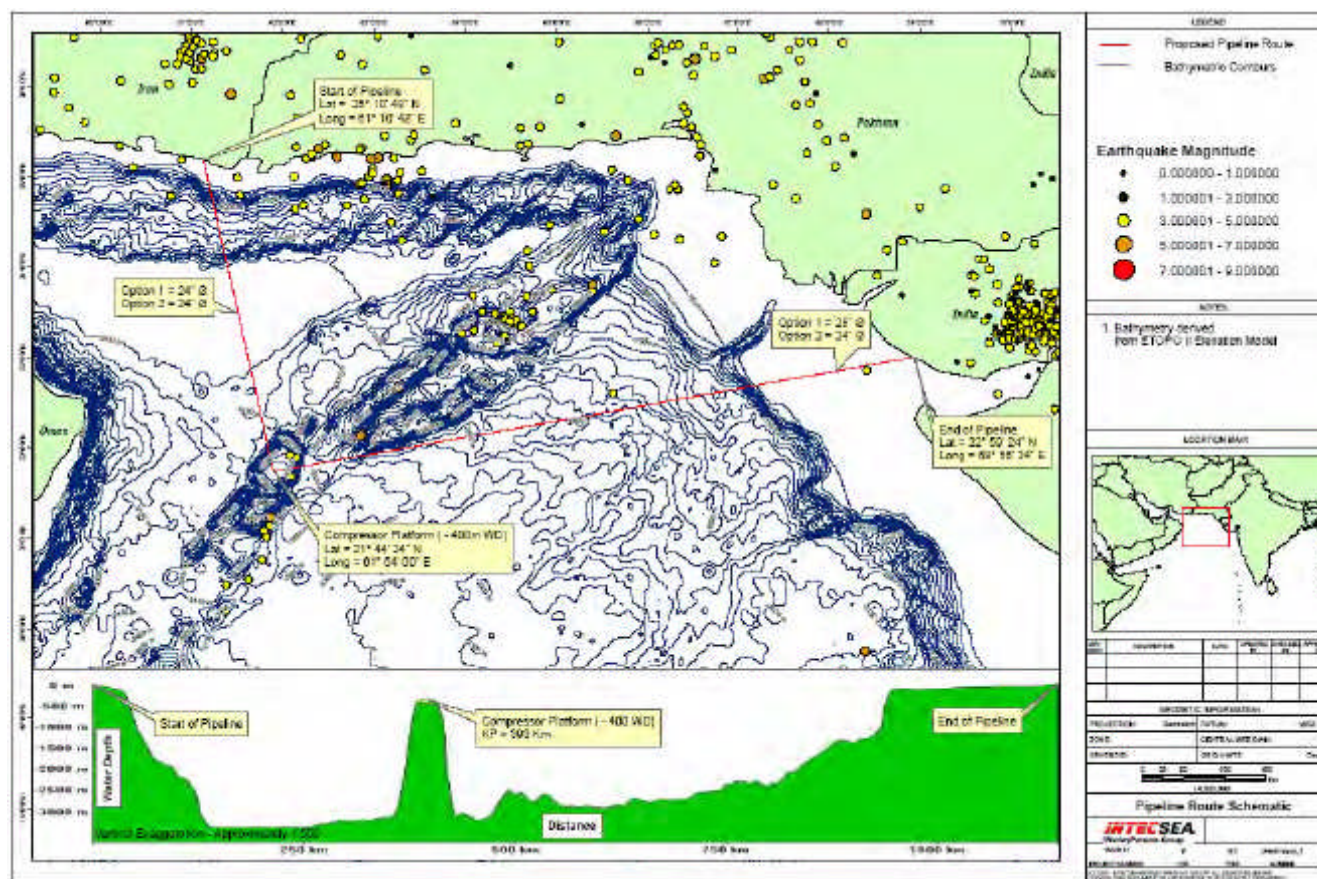


Typical Indus Fan Channel Cross Sections

- 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.



Seamount Location for In-line Compression

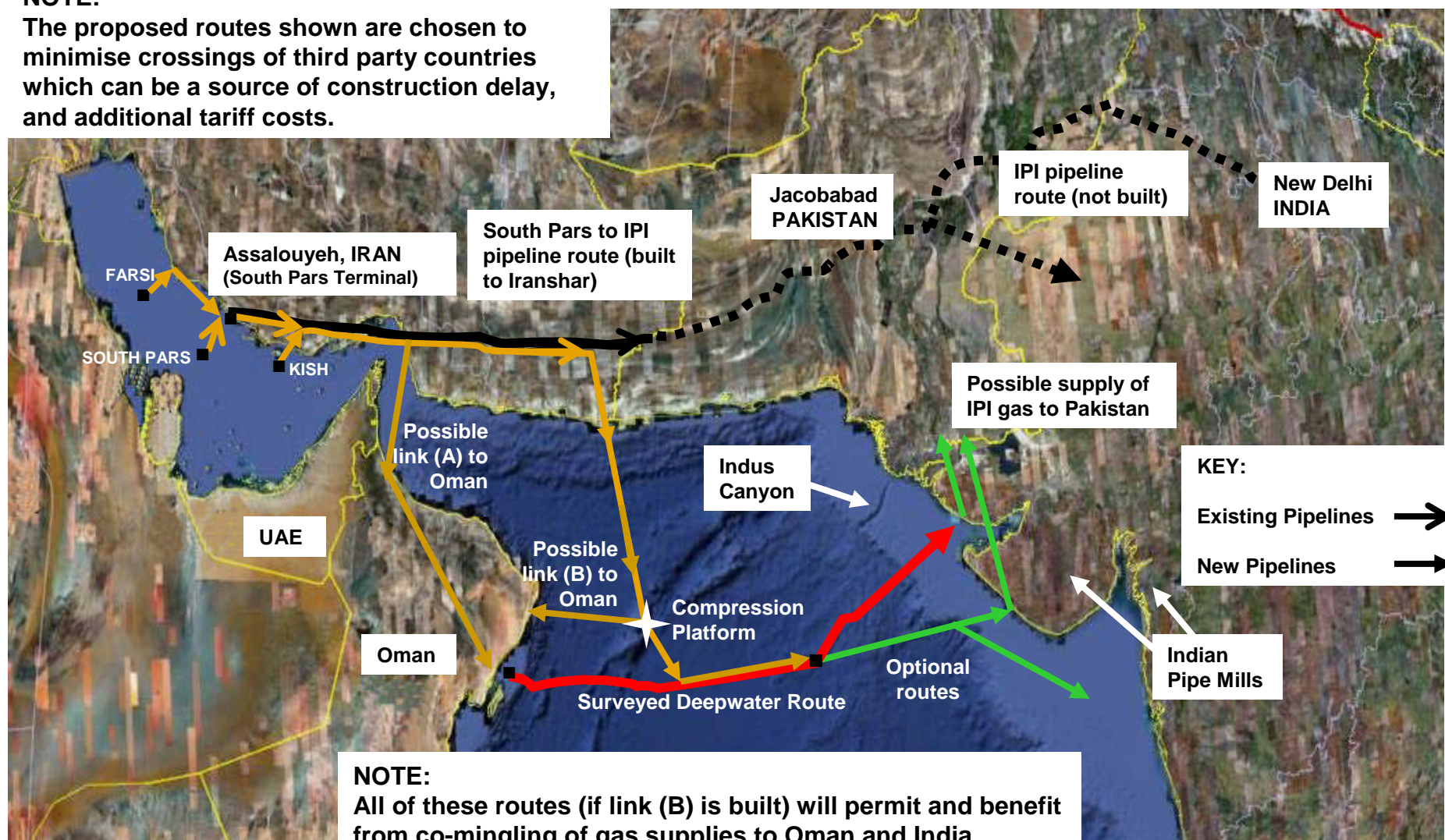


- The seamounts at the South-West end of the Murray Ridge present a near-ideal location for an in-line Compression Platform.
- These remarkable features reach to within a few hundred metres of Sea Level, as shown above.
- Several examples of platforms in this water depth exist.
- The slopes are exaggerated - 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.

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, and additional tariff costs.



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DEMAND:

- India will continue to need more gas by LNG and pipeline. The spot LNG price is now low but India was paying \$18-22 per MMBTU recently. Pipelines provide a complementary long-term supply option to price-volatile LNG to help India achieve a resilient, balanced, Energy Profile.

SUPPLY:

- Over 2000 TCF gas reserves are said to be available in the Middle East. Only 8 TCF is required for each SAGE line.

Independent feasibility study by Standard & Poors Indian company, **CRISIL** estimates that at target West Coast India price range of \$5-\$7 / MMBTU:

- Project cost of \$3.5 Billion for first line from Oman Coast to India requires a tariff of \$1.8 per MMBTU.
- Bringing the gas from, for example, Qatar to the Oman coast adds \$1.7/MMBTU for a total tariff of **\$3.5 per MMBTU**.
- Whereas Tariff direct from Iran via compression platform \approx **\$2.0/MMBTU**

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.
- SAGE Management Team participated on Client Side.

What makes SAGE's Risk Profile lower now?

- New generation lay vessels can lay SAGE into 3500m.
- Several Indian-owned mills can manufacture pipe.
- Era of damaging cost escalation appears to be over.
- New and improved design methods for free-spanning and geo-hazards have been developed. Lead INTECSEA role.
- 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 28-inch pipe delivering 31.1 Million Standard Cubic Meters per day (1.1BCFD) per line.

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

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.**

Design, Route Preparation, Pipelay and Repair:

- Heerema Marine Contractors has confirmed the deepwater pipeline installation to be technically feasible.
- Saipem has confirmed the deepwater pipeline installation to be technically feasible, using its new CastorOne Barge which can lay SAGE pipe into 3500m deep water.
- INTECSEA Engineering in Houston and London has confirmed the deepwater pipeline installation to be technically feasible.
- INTECSEA (UK) Ltd. is completing its Feasibility Study and updated Quantified Risk Assessment for SAGE.

Assessment of Risk Levels during Operation

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

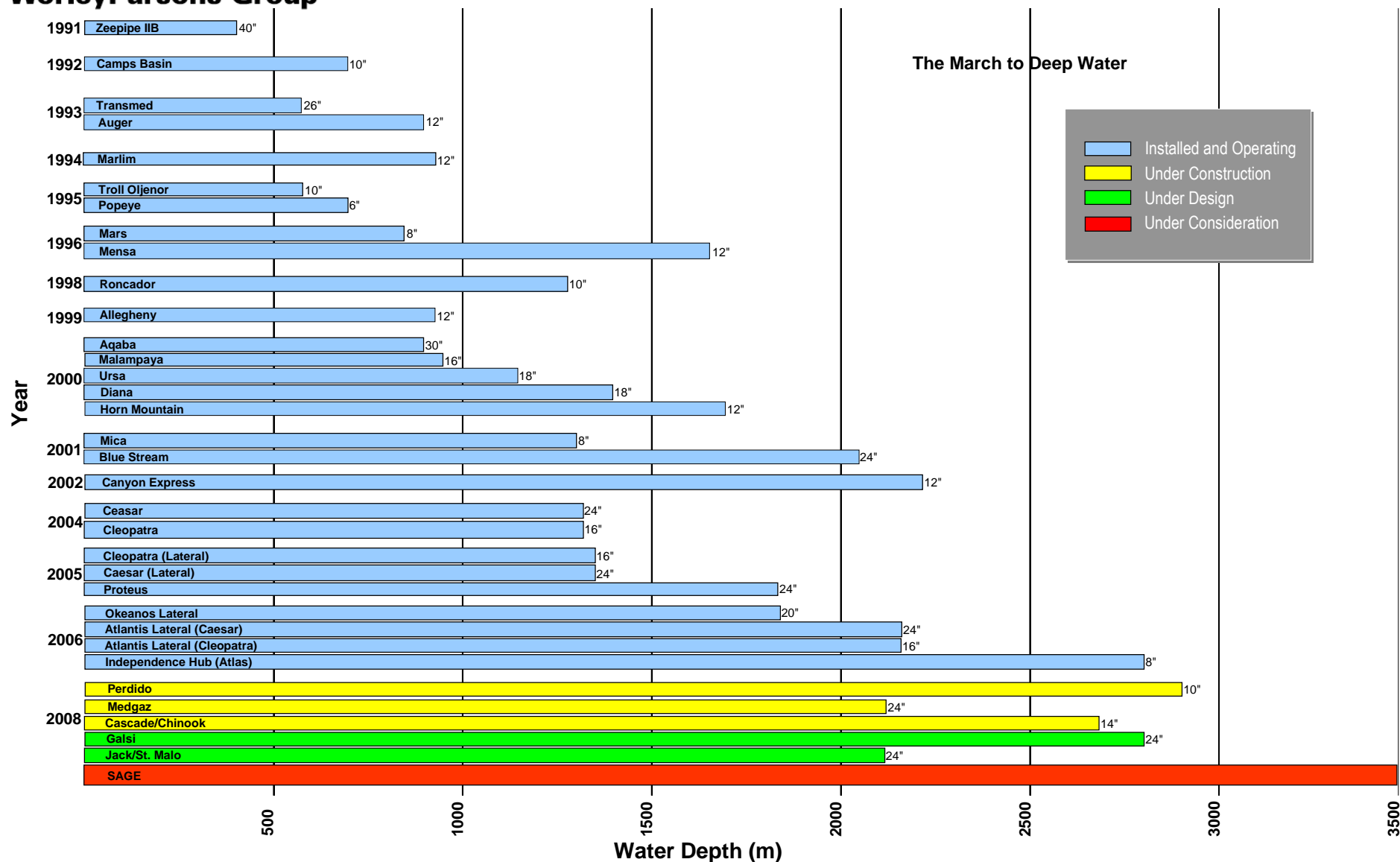
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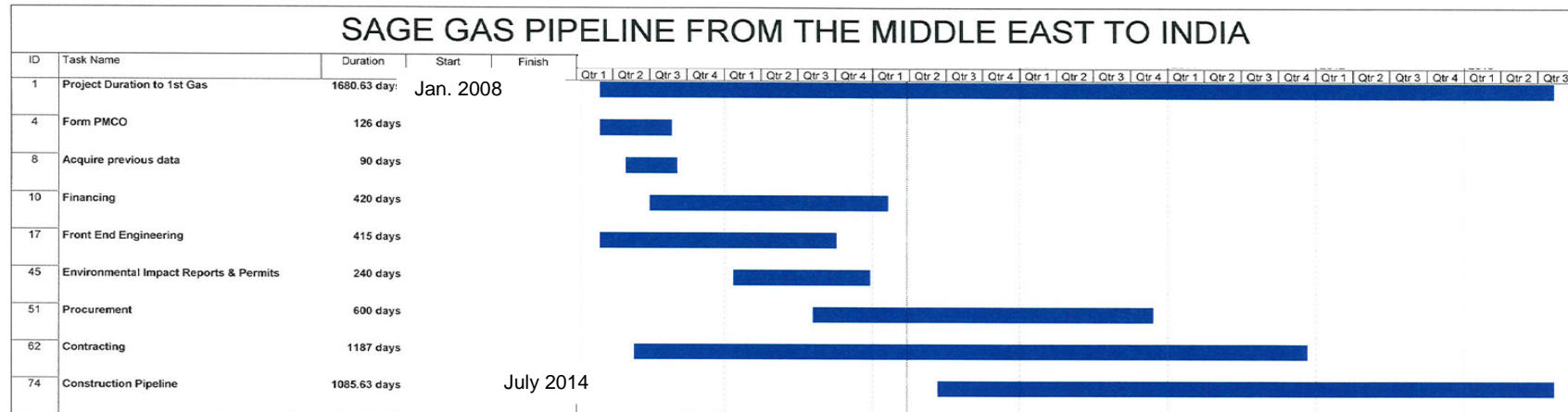
"Safety" Level means "how much safer than acceptable is it?"

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.

Deepwater Pipelay Progression





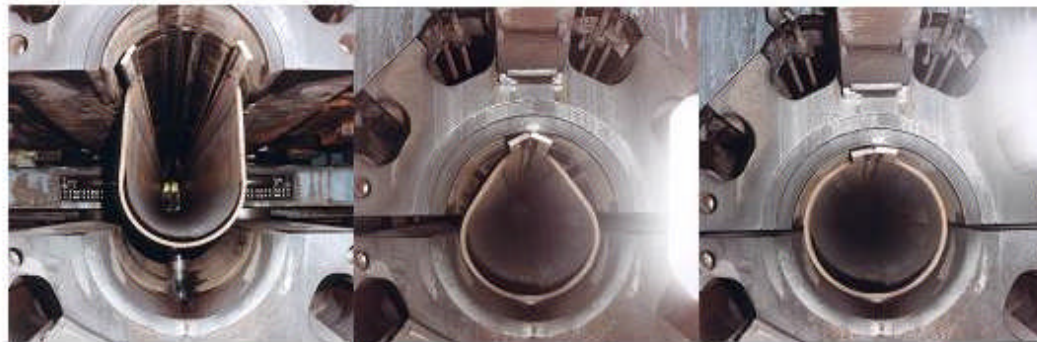
- Design development work started January 2008
- The project schedule leads to first gas in 2014
- Current glut of LNG is expected to be over by then and LNG spot-market prices will have been driven upwards again by US market demand.

- DnV input - SAGE **economic upgrade** by introducing **heat treatment** into pipe mill Quality Control techniques. DnV is preparing to show All-Risk Insurance at normal rates applies.
- **INTECSEA** Inc. (a WorleyParsons company) has completed **cost/route study** of onshore Gas Gathering system and is now appointed as the SAGE Development Phase Project Managers. Feasibility Study and Risk Assessment are under way.
- Study of **SAGE-owned Lay Barge** is being commissioned.
- SAGE **technology being shared** with Indian & UK Pipe Mills. Mills are enthusiastically implementing test programs.
- Middle Eastern **Pipeline and Upstream Companies** are being encouraged to join SAGE Consortium.
- Ongoing contact with **Indian entities** (GAIL/ONGC/IOC/NTPC). MOUs with GAIL and Saipem are being concluded.
- Program of **gas acquisition discussions** started: NIGEC's views requested.

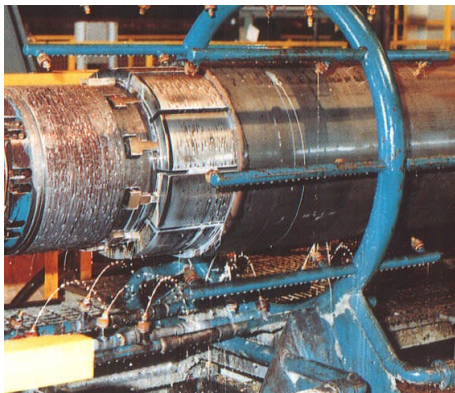
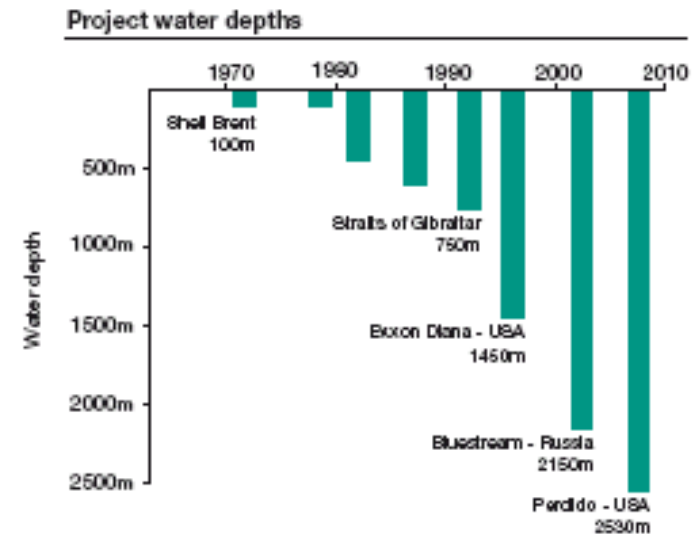
This Appendix summarises:

- the deepwater pipeline experience of SAGE Consortium Members:
 - CORUS,
 - Heerema Marine Contractors, Saipem spa and
 - INTECSEA, a member of the WorleyParsons Group, which is under contract to SAGE as its Development Phase Project Manager.
- The relevant experience in I.R. Iran of both INTECSEA and WorleyParsons.

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**



Current J-Lay vessel: DCV Balder

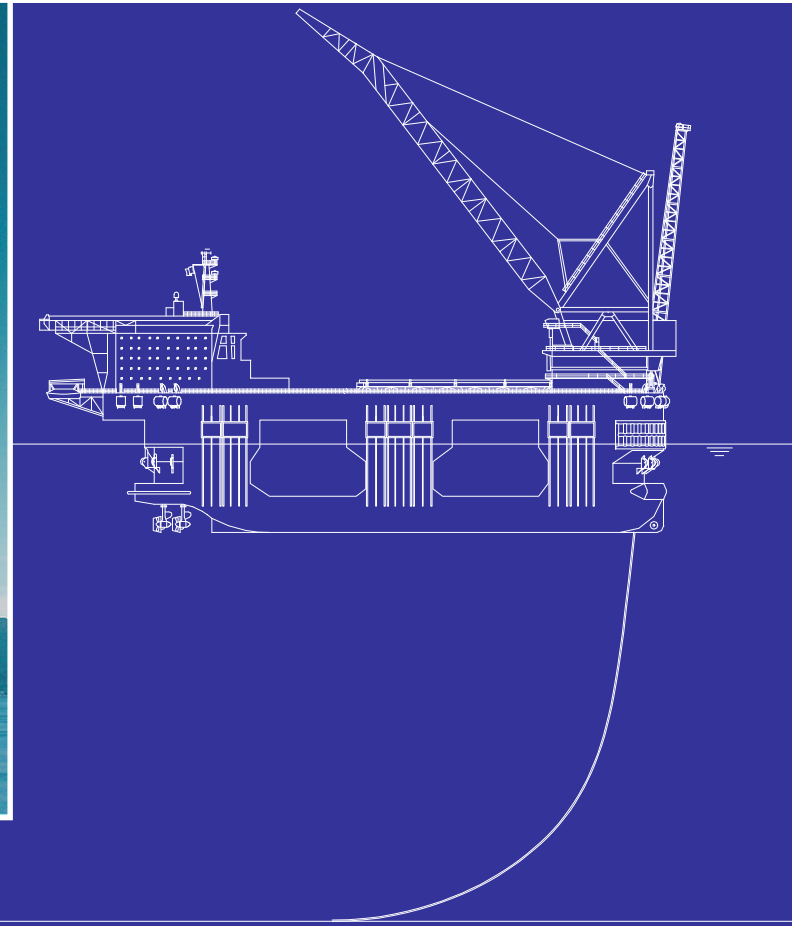


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Current J-Lay vessel: Saipem 7000



HMC's planned new J-lay vessel



- 2 x 5,500mT cranes.
- 2000mT J-lay system
- Pipe sizes up to 32" OD
- Accommodates 450 pax



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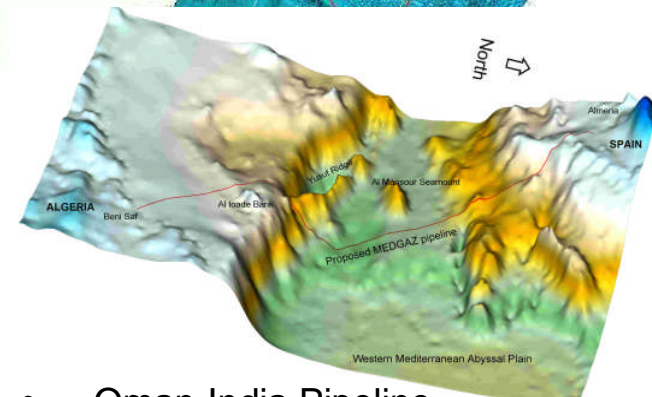
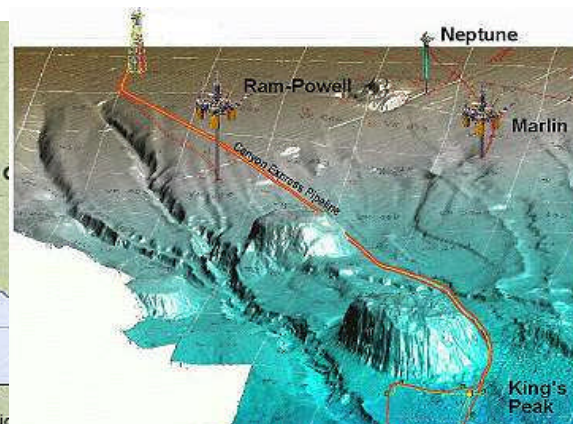
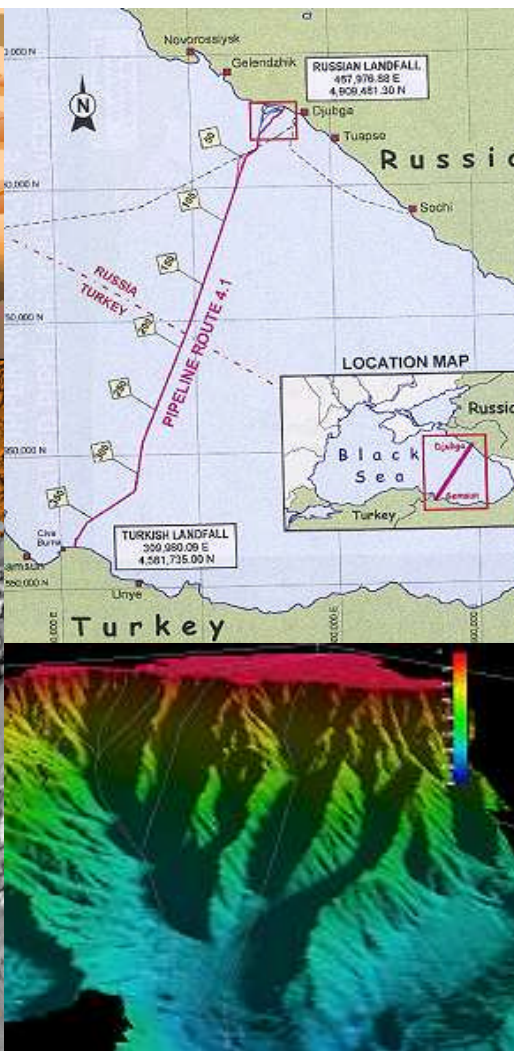
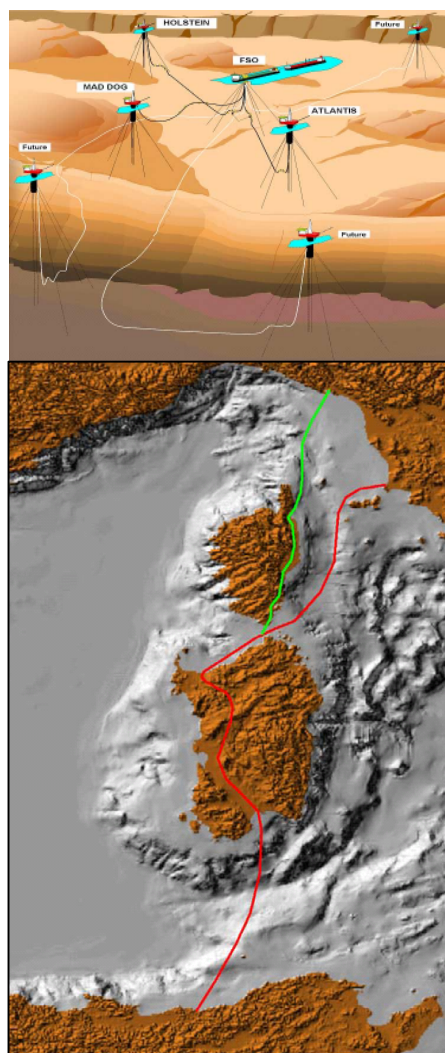
Saipem spa

- 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 agreed and is expected to be signed shortly.

CastorONE - under construction

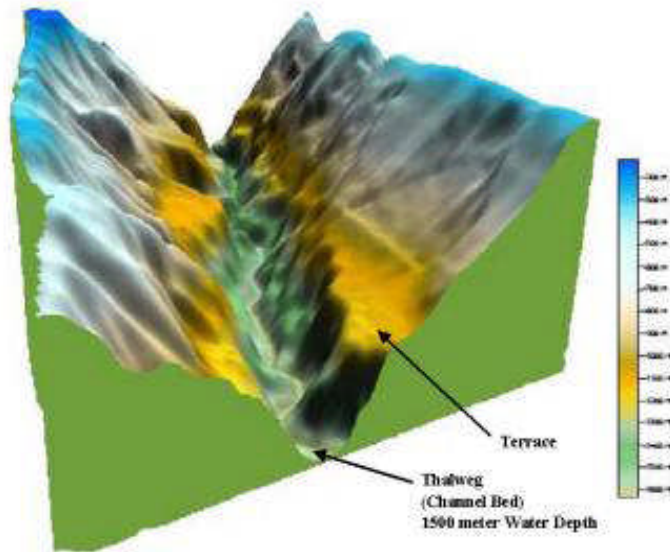


- J-Lay and S-Lay.
- 2000t top tension capacity J-Lay gives ability to lay SAGE pipe to 3500m with 2 welding stations on triple joints.
- Weathervanes in J-Lay for all-year lay.
- DPS3 redundant dynamic positioning.
- Accommodation up to 702 persons.



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

Indus Fan mudslide risk mitigation.



Texaco Angola Natural Gas Inc. is planning an LNG plant on the coastline south of the Congo River estuary, West Africa. The gas will come from various fields south of the Congo River, but fields north of the river could also contribute very significantly. The availability of this gas could greatly enhance the throughput of the LNG plant on the south side.

The Congo River forms a natural barrier to the construction of a gas pipeline. Over geological time, its discharge has incised a deep submarine canyon extending over 1,000 km to the Abyssal Plain. In places, this canyon reaches 1,250 meters relief and has local sidewall slopes up to 27 degrees. Sudden releases of accumulated sediment can flow down the canyon at high speeds, eroding the sidewalls and thalweg (channel bed). Further downstream, they deposit sediment on the bed and even high up on canyon terraces. Although gas pipelines have been installed on broadly similar terrain, there is no close precedent for crossing a deep submarine canyon such as this.

In 2002 INTECSEA participated in workshops to explore the feasibility of a crossing. The positive outcome resulted in Client awarding INTECSEA this Conceptual Study to develop some of the retained options.

SCOPE OF SERVICES:

INTECSEA was responsible for defining design envelopes, installation costs and schedules for the following crossing options:

- Catenary: suspend pipeline above turbidity flows
- Pile-supported pipeline: cross on canyon bed, using piles to stabilize the pipeline against turbidity flows
- Deepwater by-pass: cross far offshore, beyond the reach of harmful flows

The scope included an extensive data-gathering search and a screening study to assess the frequency and severity of turbidity currents. INTEC also made recommendations for carrying the project forward.

The project began in October 2002 and is still ongoing.

Congo River Pipeline Crossing Conceptual Study

Texaco Angola Natural Gas Inc.

Congo River estuary, West Africa

INTECSEA was responsible for defining design envelopes, installation costs and schedules.

October 2002—Ongoing

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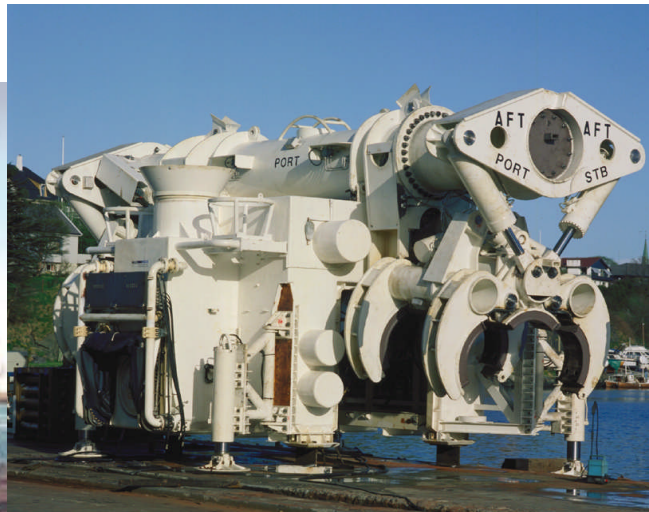
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Deepwater Pipeline Repair

- 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.



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INTECSEA (Delft) Projects in Iran

April 2009



South Pars Phases 1 thru 6: SWIP

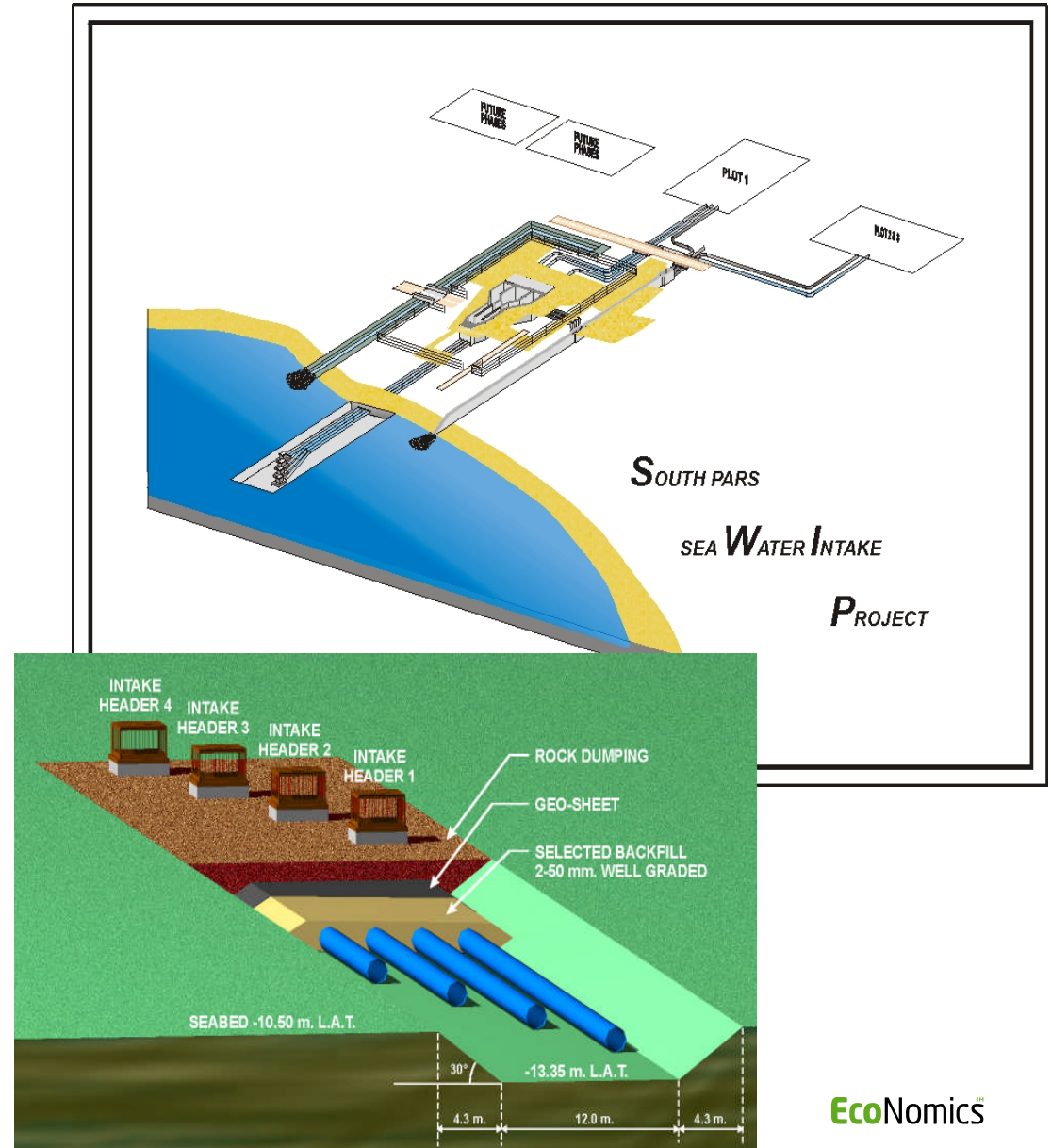
► Project Scope:

- four pipelines (56in diameter & 750m long),
- four suction headers and
- 3km onshore pipeline.

► **INTECSEA Scope:**

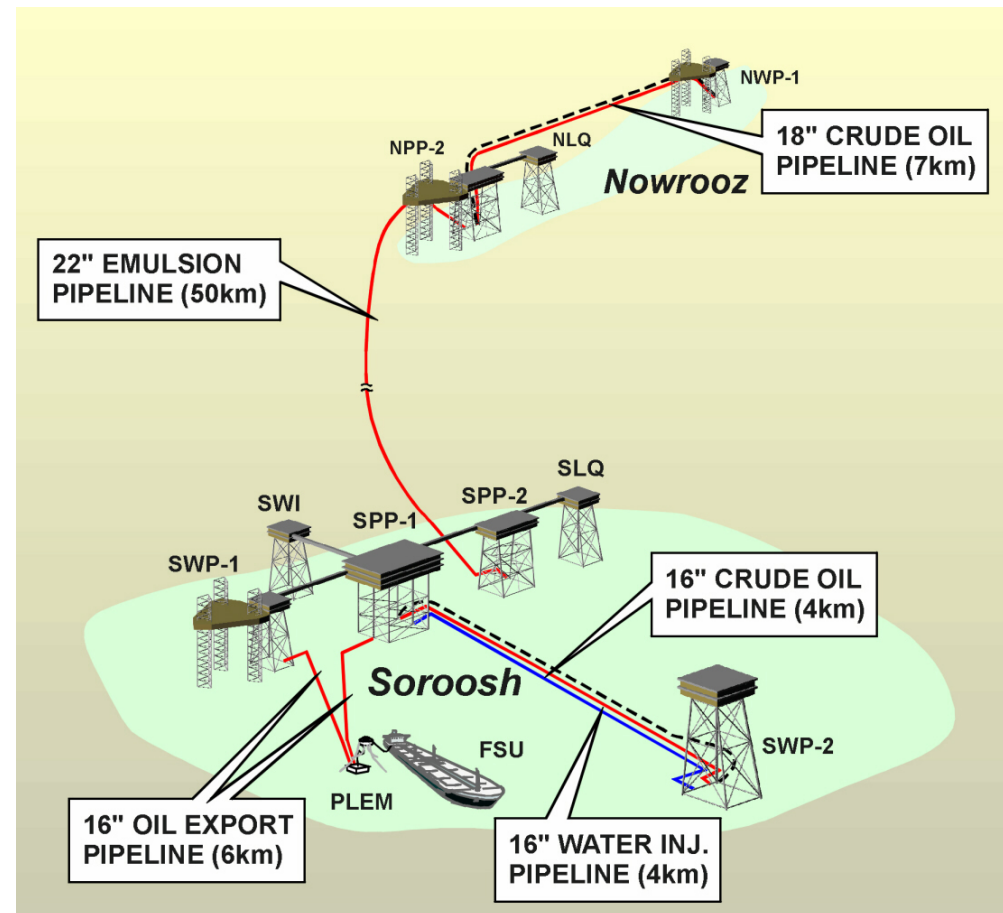
- Basic & Detailed Design of **Sea Water Intake Plant** at Assaluyeh for South Pars Development
- Procurement and construction support

► **Client:** POGC as sub-contractor to Ghorb Khatam



Shell – Soroosh & Nowrooz

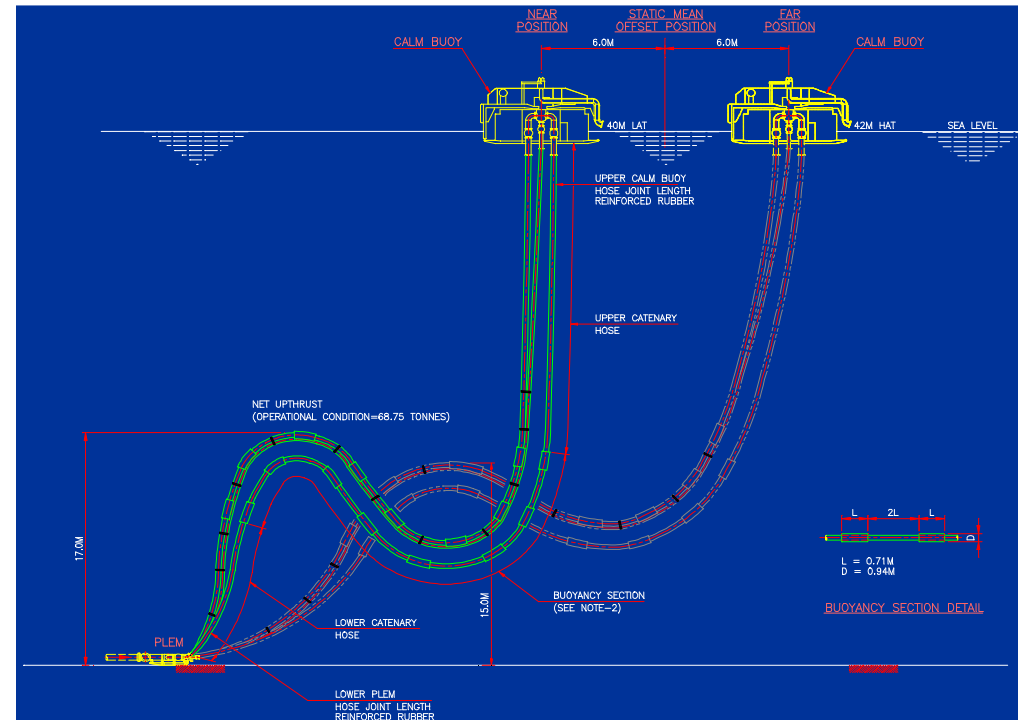
- ▶ Shell Soroosh & Nowrooz development comprises:
 - 9 Platforms
 - 1 FSU
 - 6 Pipelines
 - 2 Umbilicals
- ▶ INTECSEA scope:
 - Pipeline Mechanical Design
 - Stability
 - Expansion Spools
 - Riser & J-tubes
 - Hydraulic Analysis
 - Material Selection
 - Installation Method and Analysis
 - PLEM – Preliminary Design
 - Commissioning and Operation Philosophy
- ▶ Client: Shell as sub-contractor to ABB



INTECSEA Scope:

► Pipelines:

- Detailed Design Verification
- Cathodic Protection Design
- Stability & Wall Thickness
- Bottom Roughness / Span analysis
- Survey Support



► Single Point Mooring Condensate Export Terminal

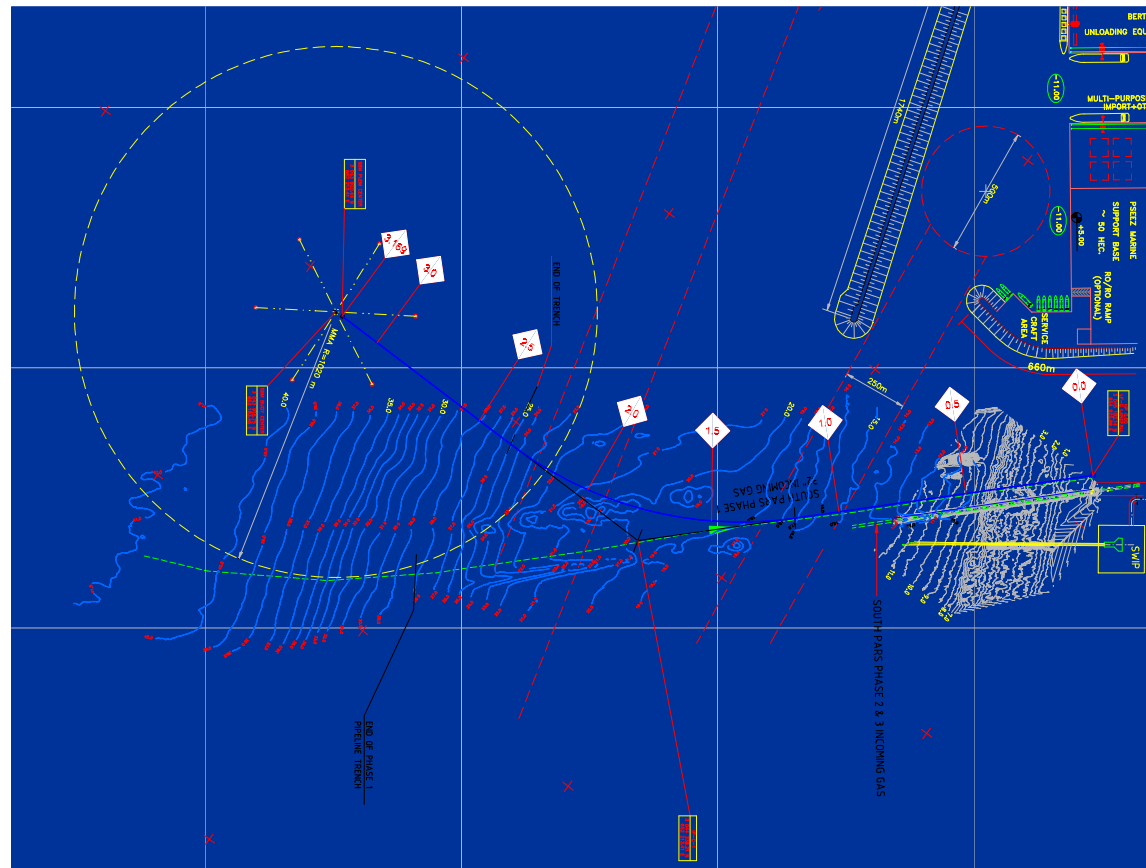
- Detailed Design Modification of SPM
- Detailed Mooring Analysis and Design

► Client: IOEC / CCC

► **INTECSEA Scope:**

- Evaluation of various alternative SPM locations and pipeline routings
- Marine operations
- Safety
- Pipeline routing
- Schedule
- Cost

► Client: IOEC



- ▶ 32in + 4in pipelines from South Pars Field (Phase 9&10) to shore
- ▶ INTECSEA Scope:
 - Detailed Design offshore pipelines
 - System Hydraulic Analysis
 - Detailed design onshore pipeline section & facilities
 - Procurement Assistance
 - Installation Engineering Verification
- ▶ Client: POGC / IOEC



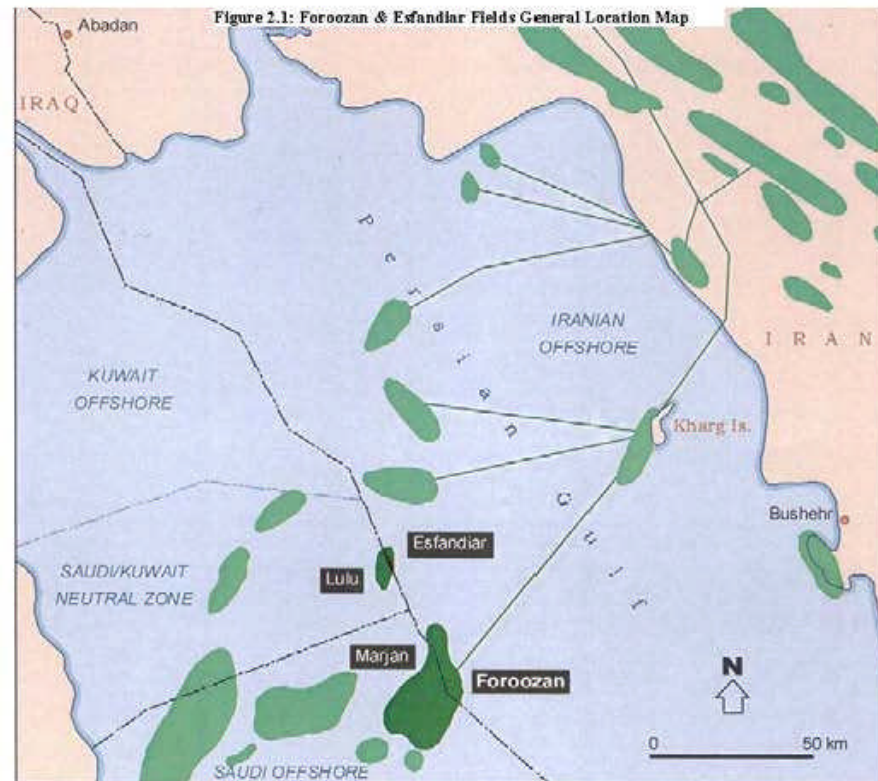
► **PROJECT:**

- Foroozan / Esfandiar Field Development
- Pipelines:
 - Export line to Kharg Island (88 km x 20-inch)
 - 17x Infield lines Esfandiar to Foroozan (Var. OD)

► **INTECSEA Scope:**

- Conceptual engineering for pipeline systems
- Front End Design of infield pipelines and export pipeline
- Preparation of ITB package for EPC contract

► **Client:** sub-contractor to ABB



- ▶ Project Scope:
 - Gas Export Pipeline from Foroozan / Esfandiar Field to Kharg Island
 - Infield: 10 flow lines and 1 umbilical
- ▶ INTECSEA Scope:
 - Hydraulics (static/transient)
 - Detailed design of export pipeline system
 - Detailed design of infield flowline systems Pipeline mechanical design
 - Shore approach design
 - Design of Risers, riser clamps and spoolpieces
- ▶ Client: PEDCO/IOEC



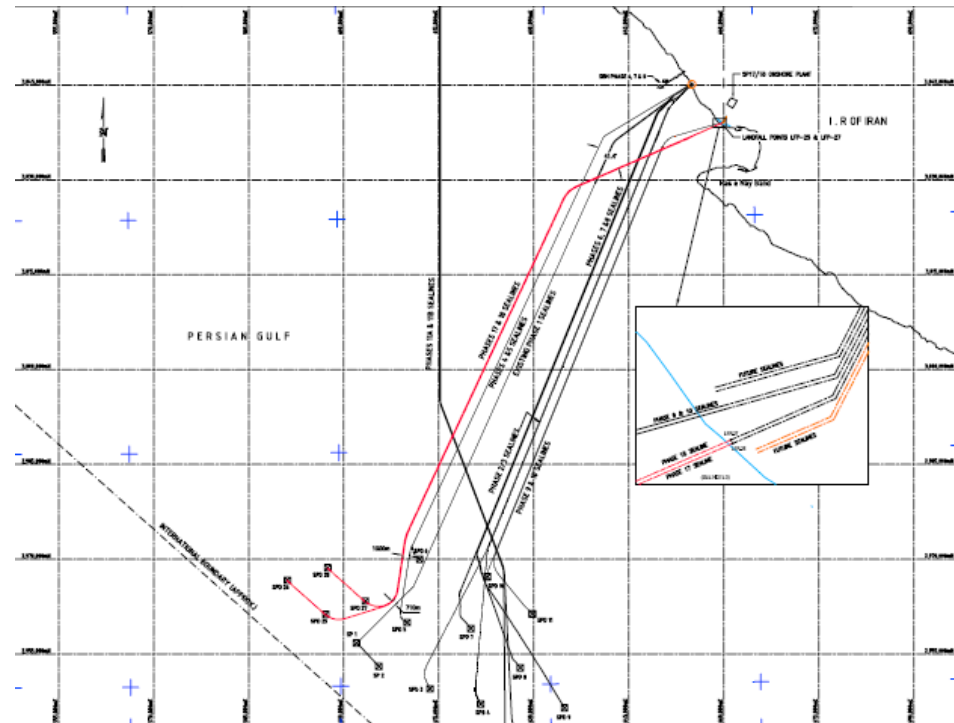
► **Project Scope:**

- Two 32-inch gas export pipelines with 4.5-inch piggy-back lines
- Two infield pipelines (20-inch and 18-inch)

► **INTECSEA Scope:**

- Detailed design of onshore pipeline sections
- Detailed design of the offshore pipeline systems

► **Client: POGC/IOEC**



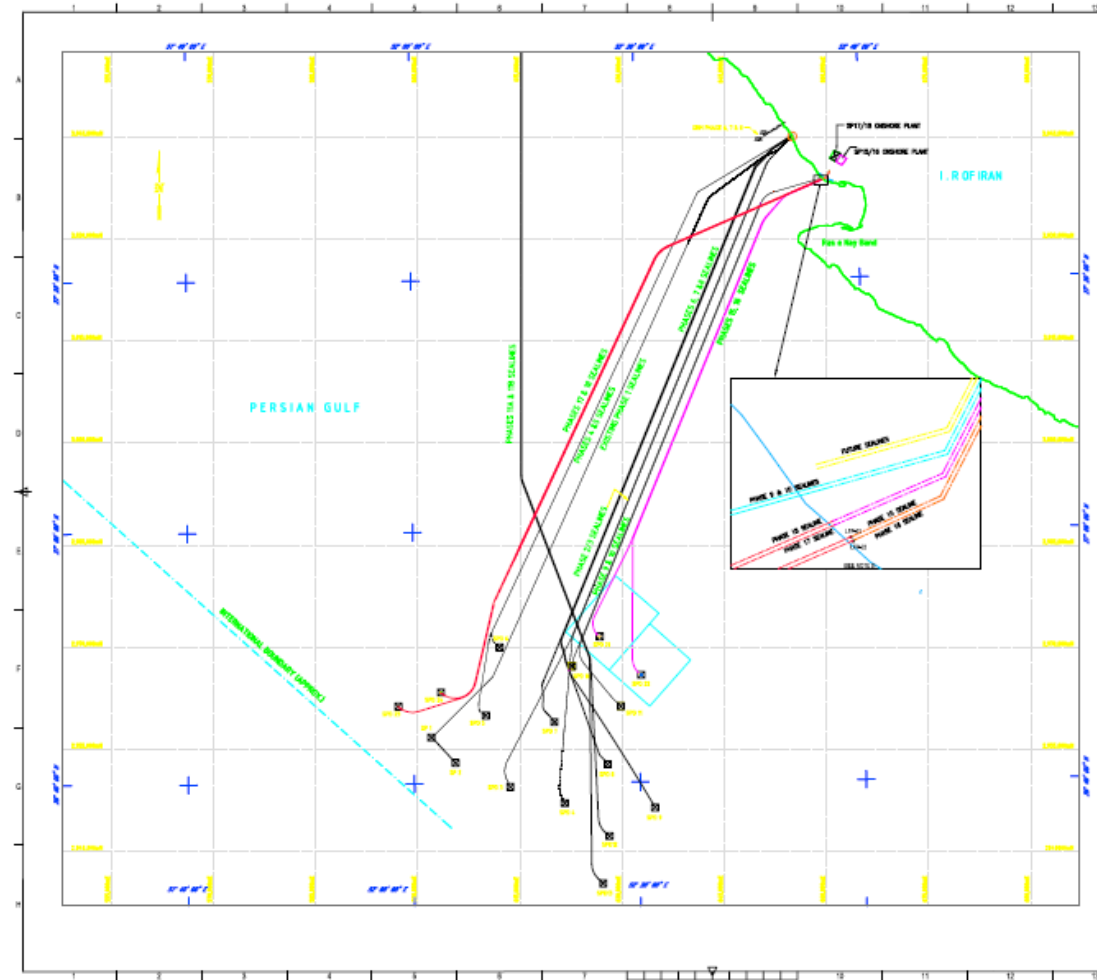
► **PROJECT:**

- Two 32-inch gas export pipelines with 4.5-inch piggy-back lines

► **INTECSEA SCOPE:**

- Detailed design of onshore and offshore pipelines

► Client: POGC / IOEC



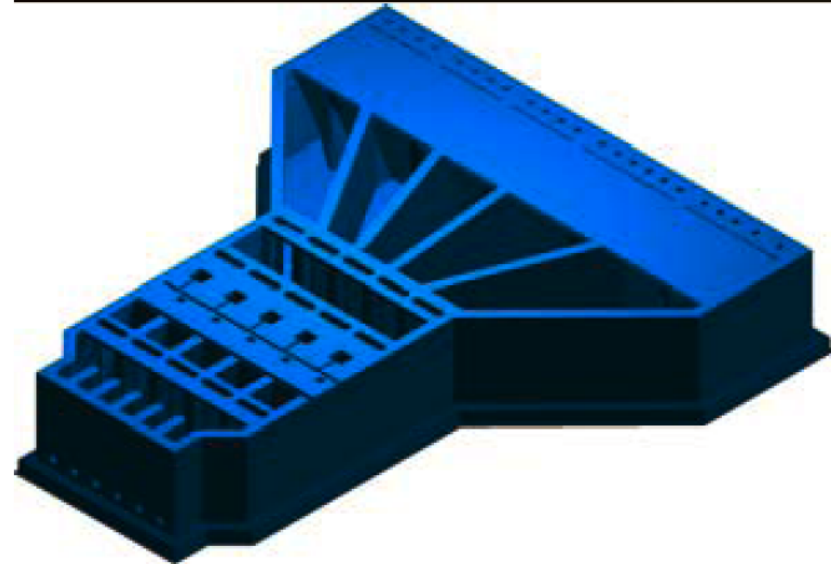
► **PROJECT:**

- Five HDPE seawater intake pipeline systems of 2.5km each
- Associated onshore facilities

► **INTECSEA SCOPE:**

- Design consultancy for:
 - offshore pipeline design
 - onshore civil and structural design
 - Electrical and instrumentation systems specifications
 - Construction methodologies
 - HSE & HAZOP studies

- Client: SAHEL Consultant Engineers on behalf of SEPANIER



South Pars Phase 12 Detailed Design

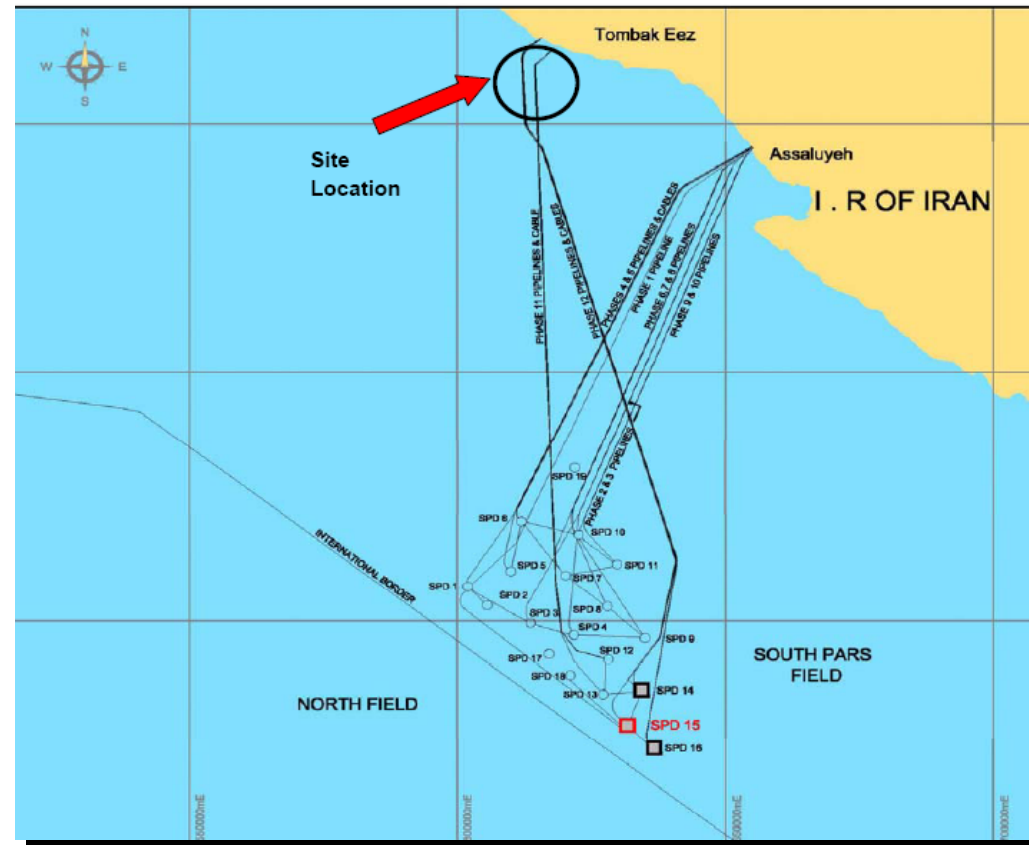
► PROJECT:

- Three 32-inch gas export pipelines with 4.5-inch piggy-back lines (150km)
- 30-inch condensate export pipeline from shore to SPM

► INTECSEA SCOPE:

- Detailed design of offshore pipelines
- Shore approach design
- Tendering support for SPM system

► Client: PetroPars / IOEC



Examples of Corporate experience in I.R. Iran:

WorleyParsons Group

WorleyParsons is currently performing these projects in I.R. Iran:

- the FEED Review and Detail Engineering and Procurement Services of the Iran LNG Liquefaction Units.
- The Onshore FEED and Basic Engineering for South Pars Phases 17 & 18.
- Offshore FEED, Basic Engineering and Detail Design for South Pars Phases 17 & 18,
- and recently completed the Onshore and Offshore FEED for South Pars Phase 12,
- Development and Detail Design for Offshore Jackets and Topsides on South Pars 12.

WorleyParsons has designed many projects in I.R. Iran, including:

- the Kangan Gas Plant,
- Karanj Gas Injection Project,
- Razi Petrochemical Company Gas Treating and Sulphur Recovery Plants,
- Bandar Mah Shahr Gas Refinery,
- eight NGL recovery plants in the South of Iran and
- topsides for Sirri and Salman offshore fields.