MEIDP The Deepwater Gas Route to India
Introduction

Who?  

SAGE  

- South Asia Gas Enterprise Pvt Ltd (SAGE),  

- Joint venture between the Indian Siddhomal group and UK based deepwater technology company  

- Considering building a deepwater, transnational, natural gas pipeline system from the Middle East to India
Why? *India needs gas*

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

- Building on the extensive study Oman to India Pipeline in the Mid 1990’s
- Sage concept studies have strengthened technical Viability
- Major body of deepwater design and pipelay experience has been accumulated over the last decade
Indian Natural Gas Supply

- **Import Requirement**: 1096, 1096, 1096, 2740, 3288, 3562, 3288
- **Indian domestic Supply**: 3014, 3014, 7397, 8219, 8767, 9041, 9041

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<td>Import Requirement</td>
<td>1096</td>
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<td>2740</td>
<td>3288</td>
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<td>Indian domestic Supply</td>
<td>3014</td>
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<td>7397</td>
<td>8219</td>
<td>8767</td>
<td>9041</td>
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</table>

**Indian Natural Gas Supply**

- MMSCFD

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

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

- Oman–India 1995
- Iran–India 1997
- Iran–India (200NM) 2003
- Iran–India (350NM) 2003
- MEIDP 2010
Difficulty of Deep Pipelay Projects

- 1991 Zeepipe II 40"
- 1992 Campos Bain 10"
- 1993 Transmed 26"
- 1993 Auger 12"
- 1994 Marlin 12"
- 1995 Troll Offenor 10"
- 1995 Popeye 6"
- 1995 Oman India 24"
- 1996 Mars 8"
- 1996 Menra 12"
- 1997 Europe 2 42"
- 1998 Roncador 10"
- 1999 Allegheny 12"
- 2000 Agaña 30"
- 2000 Malampaya 16"
- 2000 Ursa 18"
- 2000 Diana 18"
- 2000 Horn Mountain 12"
- 2001 Mica 8"
- 2001 Blue Stream 24"
- 2002 Canyon Express 12"
- 2004 Caesar 24"
- 2004 Cleopatra 16"
- 2005 Cleopatra Lateral 16"
- 2005 Caesar Lateral 24"
- 2005 Proteus 24"
- 2006 Okeanos Lateral 20"
- 2006 Atlantis Lateral - Caesar 24"
- 2006 Atlantis Lateral - Cleopatra 16"
- 2006 Independence Hub - Atlas 8"
- 2009 Perdido 10"
- 2009 MexGas 24"
- 2009 Cascade-Chinook 14"
- 2010 Block 31 - PSVM 12"
- 2005 Galo 24"
- 2009 Jack-St.Malo 24"
- 2010 Southstream 32"
- 2010 MEIDP (SAGE) 24"

Water Depth (m)

- Installed
- Under Construction
- Under Design
- Under Consideration

Oman India Ahead of its Time
MEIDP: The Time has come

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Design Basis
Pipeline route Profile
MECS => OGCS => GPRT

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Pipeline route Profile
MECS => GPRT

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2010 Activities Completed

- Overall Project Management
- Design Basis definition
- Flow Assurance Studies
- Mechanical Design
- Onshore Compression Station Definition
- Offshore Compression Station Definition
- Quantified Risk Assessment - OIP Update
- Geohazard and Fault Crossing Assessment Phase 1
- Metocean data Phase 1
- GIS Data collection Phase 1
- Assessment of the effects of moderate heat treatment
2011 Activities Completed

• Overall Project Management
• Vessel & equipment capabilities review
• Pipeline intervention review
• Geohazard and fault crossing assessment phase 2
• Metocean data phase 2
• GIS data collection
• Riser and subsea by-pass definition
The route stays to the South of the Indus Fan to avoid expensive, difficult crossings.
## Identified Risks

<table>
<thead>
<tr>
<th>Geohazard</th>
<th>Location</th>
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<tbody>
<tr>
<td>Tsunami</td>
<td>Oman and Indian coastline</td>
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<tr>
<td>Steep slopes</td>
<td>Oman and Indian continental slopes and the Qualhat Seamount</td>
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<tr>
<td>Seismic activity</td>
<td>Northern Oman, Kathiawar Peninsula (Gujarat, India) and along the Owen Fracture Zone</td>
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<tr>
<td>Fault displacements</td>
<td>Faults of the Owen Fracture Zone and the Indian shelf and slope</td>
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<tr>
<td>Liquefaction</td>
<td>Oman and Indian (inner) shelf</td>
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<tr>
<td>Slope failures</td>
<td>Oman and Indian Continental slope, Qualhat Seamount, channels of the Indus Fan</td>
</tr>
<tr>
<td>Turbidity currents</td>
<td>Indus Fan</td>
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</tbody>
</table>
Murray Ridge and Qualhat Seamount

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

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Completed Studies – Metocean Phase 1

North West Monsoon

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

South East Monsoon
Completed Studies - Mechanical Design

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

<table>
<thead>
<tr>
<th>KP Range (km)</th>
<th>WD Range (m)</th>
<th>Section Length (km)</th>
<th>Pipe ID (mm)</th>
<th>Selected Wall Thickness (mm)</th>
<th>Buckle Arrestor Required</th>
<th>Tonnage of Steel Required for Line Pipe (Tonne)</th>
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<td>0 - 6.8</td>
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<td>770 - 1150</td>
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<td>380</td>
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<td>60</td>
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<tr>
<td>1210 - 1317.5</td>
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<td>1317.5 - 1318</td>
<td>1.5 - 0</td>
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<td></td>
<td></td>
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<td><strong>796,537</strong></td>
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</table>
Completed Studies - Mechanical Design

Selected WT's
- 40.5mm
- 36.6mm
- 32.9mm
- 796500 tonnes

Pressure Collapse
DCC Buckling
Seabed Profile

Max. WD = 3443m (including 1.5% depth tolerance)
Installation Vessel J-Lay Demand

- J-Lay Demand
  - 1060 tonne normal lay
  - >1950 tonne A&R

- J-Lay Capacity
  - 1600 tonne normal lay
  - >2000 tonne A&R
New Pipelay Vessels under Construction

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

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

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

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The following hazards have been quantified:

- Trawling
- Anchoring
- Objects dropped from ships
- Ship sinking
- Ship grounding
- Internal corrosion
- External corrosion
- Material and construction defects
MEIDP v’s OIP Failure Frequency

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Ongoing 2011 studies

- Establish no hydrotest principle
- Onshore compression station review
- Offshore layout optimisation
- Receiving terminal conceptual design
- Emergency repair equipment review
Planned 2011 studies

- Insurance risk review
- Survey definition and scope of work
- Define survey ITT and tender
- Environmental statement
- Mill Prequalification and Ring Test Collapse Programme
- Examine the effect of moderate heat treatment
The project Goal => first Gas in 2017

- 2010-2011 Feasibility Studies
- 2011-2012 Reconnaissance Surveys
- 2012-2013 FEED Studies, Detailed surveys.
- 2013-2015 Detailed Design, Equipment Trials,
- 2013-2015 Procurement of long lead items
- 2015-2017 Installation
MEIDP are no longer a giant leap forward, but rather the logical next step. The development of deepwater pipelay vessels capable of installing MEIDP due by 2014. Studies performed in 2009-2011 prove feasibility of the MEIDP project. Fabrication technologies exist within current mill capacities for MEIDP size/wall. Routes established to avoid the worst features of the Indus Fan, minimising project technical risks.
Economic and commercial summary

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

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