Shtokman Brief history

Gas & condensate field in the Russian Barents sea
- Discovered in 1988
- IGIP: 3800 GSM3
- Water depth: 340m,
- Offshore at 550km from Kola peninsula

Too large to be developed ay once, Full field development phases in 3 phases of 23,7 GSM3/year each.
- Phase 1: 7,5 MT/y LNG & 11 GSM3/y pipe gas
- Onshore plant at Teriberka
Shtokman
A frontier project in the Arctic Russian offshore zone
The Shtokman Phase 1 Project Partners

Gazprom 51%

SEVMORNEFTEGAZ

Total 25%

StatoilHydro 24%

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Such a partnership and the strong support from Gazprom represent a powerful asset for the project
An innovative contractual Framework for the phase 1 of the Shtokman development

Scope

- Organize, design, finance, construct and operate during 25 years the “Shtokman phase 1 development”
- Production plateau of 23.7 Gm3/year - 7,5 MTA LNG - 5 % gas for local market, the rest piped to the North Stream
- SDAG and its Shareholders support the technical & economical risks of the Phase 1 development

A single integrated dedicated Project Team; Gazprom / Total / StatoilHydro
A first class Russian project to satisfy LNG long term consumption growth and Tie-in to the North Stream to supply gas to Europe
Shtokman phase 1
Some of the main technical Challenges
Main Technical Challenges: size of the project

- Floater to process 70 MSm3/d of gas
  - one of the biggest floater worldwide
  - Ice resistant & disconnect able?
  - Topsides > 40,000 t
  - Emergency Evacuation & Rescue
  - Flare size
  - Turret size & number of risers

- Shtokman Trunk Line is unique compared to all other two-phase and multiphase flow pipelines: Distance + rough seabed topography + diameter

- LNG plant of 7,5 Mtpy ➔ a Mega LNG plant in a very remote area

Arctic Frontiers Presentation
Main Technical Challenges: Logistics

- Offshore field 350 NM from Murmansk
- POB: 200/350 max, crew change by helicopter
- Ice, Iceberg Management
Main technical Challenge - Ice & Icebergs

- **Sea Ice (with presence of ridges)**
  - Level ice up to 2 meters (100 year return period)
  - Ice ridge (first year) up to 170m length with 75m keel and 3 m consolidated layer.

- **Ice berg in open water and embedded in Sea Ice**
  - 220 icebergs observed around Shtokman area over 48 years.

In 2003, more than 15 icebergs have been observed close to Shtokman, 2 of them weighting more than 3 millions tons.

**Probability of ice (%) in April**

month were the ice extent is the maximum in Barents Sea
Main technical Challenge – Sea Ice

- Extreme ice thickness 3 m

Shtokman platform will be the first floating platform able to produce in pack ice condition

Pictures from Arctic Coring Expeditions at North Pole
From Concept to Technical options selection
Project concept

Sub-sea system

1. Sub-sea system
2. Gas to treatment plant
3. Slug Catcher
4. Gas to LNG plant
5. LNG offloading

Condensate to be stabilized

Volkov gas
Shtokman Project Onshore concept

- Located at Teriberka, 120 km Est of Murmansk.

- Main onshore facilities
  - Gas pre-treatment
  - Liquefaction plant: 7.5 MTA
  - Pipe gas treatment
  - LNG tanks
  - Export port for LNG & condensate
  - Utilities: Power plant, Living base, support vessels & tugs, etc…
Ice, icebergs and glaciers monitoring expeditions were performed every year since 2001 to observe:

- Ice morphometry and ridges
- Ice drift and mechanical characteristics
- Icebergs locations and drift
- Glaciers observations

Meteorological, oceanographic and bathymetric survey undergoing

- Observations of wave, wind and currents from the field to the LNG plant
Numerical simulation of Ice load in Moored configuration
Floater – Dis connectability studies

- Chutes fitted to the riser buoys
- Bell mouth
- Arctic Frontiers Presentation
Winterization: design specificity

- All structural materials able to resist -45°C
- All major process and utilities areas of equipment shall be covered against snow, icing and wind. Most sensible ones heated and ventilated.

Temperatures considered for design:
- Absolute minimum – 45°C
- Operating minimum ambient temperature – 35°C
- Emergency evacuation, safety systems – 45°C
- Accommodation, Control room + 21°C normal operation, +5°C in emergency
Shtokman phase 1- Selected Options
Sub-Sea

- 3 Subsea templates – 16/20 wells with large bore completion (9”5/8)
- 4/8 slot templates
- 16” flow-lines & 14” flexible risers
Shtokman Project description

Offshore - Floater

- Select the concept

- Dis-connectable

*Disconnectability can’t be avoided even if it is thought that probability to disconnect under iceberg threat is very low*
Phase 1 Onshore plant summary

- Located at Teriberka, 120 km Est of Murmansk.

- Main onshore facilities
  - Gas pre-treatment
  - Liquefaction plant: 7.5 MTA
    - APCI C3MR process
    - Electric driven compressors
  - Pipe gas treatment
  - 2 x 160,000 m³ LNG tanks
  - Export port for LNG & condensate
  - Utilities, Living base, support vessels & tugs, etc…
Harbour location
Environmental Challenges

Shtokman Development’s mandate is to respect the sensitive arctic environment.

- Project area is huge: covers nearly 600 km in one of most hostile and isolated environments on earth.
- Environment is very sensitive and relatively untouched by man. Onshore Land area is pristine. Important fisheries area offshore.
Environmental Challenges - Continued

- SDag environmental policy is to prioritise environmental protection throughout all levels of the organisation and to minimise environmental impacts (zero harmful discharge policy).

- Company policy is to comply with environmental requirements of the Russian Federation and World Bank requirements for best industry practice.
Environmental Survey Program - Offshore

Work Program consisted of:

- Understanding the level of vulnerability of the ecosystem to the impacts of the project and their capability for regeneration
- Anthropogenic impact on Barents sea bio resources – fisheries
- Sampling and analysis of Phytoplankton - with a focus on summer sampling to capture spring bloom and Zooplankton
- Sampling of sediments and benthos for contamination
- Ichtyological survey
- Marine mammal observation
- Pockmarks – Pockmarks are first being identified through the bathymetric survey. If pockmarks are found, a sampling program will take place in summer 09 to further understand the biology of the pockmarks.
Coastal Surveys

Surveys were conducted in Spring/summer and fall.

- Work program included: Hydrological survey and hydrochemical analysis indicators and contaminated areas.
- Sampling of sediments on coast for evaluation of physical and chemical characteristics
- Microbiological survey
- Fisheries survey (including habitats in the bay of Kamchatka crabs and molluscs)
Onshore surveys

Conducted throughout summer and fall 2008 in the area

- Key sensitivities included: location and type of rare plants
- Complex hydrology and hydrogeology
- Bird colonies and migratory bird routes
- Archaeological survey in Teriberka area
- Teriberka socio-economic survey of population
Environment and Communication

Survey program is nearing completion. Additional surveys to be launched in 2009 when necessary. Results and conclusions are used for:

- Environmental baseline section of OVOS and ESIA
- Design team: Data being transferred to design teams who will take into consideration environmental sensitivities for design.
- ESIA and OVOS starting in January 09

In a very sensitive eco-system, Highest environmental standard shall be adhered to since the early stage of the design

*Communication with Stakeholders already started*
Russian content

Russian content to be maximized providing that a fair competition prevails at all stages

- No negative impact on the project costs and No planning delay

A data base of Russian potential contractor is being established and will be available to international bidders

Challenges to be prepared with

- Human challenges, language (oral communication, reports) at all the level of the yard Hierarchy
- Specifications and Norms (International, RF norms, GP Norms, CTY, drawings, symbols….)
- Outstanding complexity (i.e. steel grade, wall thickness of equipment, specific welding procedures, quality control, qualified/certified work force, modular construction, accuracy required, module weights..)
- Security – Free site / yard access by authorized foreigners
- Required International HSE standards to be implemented
- Sub-contractors control (Russian, International)
- Interfaces with International contractors
- Contract Management, SDAG control on the work progress.
One of the top world class project with exciting challenges balanced by robust asset

A Russian project with a world class partnership to:

- Increase gas delivery and Improve the energy security to the world market
- Pave the way for an efficient development of the Arctic Shelf with the highest standards in terms of Safety Heath and Environment.