

MAY 2002

Framo Supplies Subsea Multiphase Booster Pumps for Amerada Hess' Ceiba Field

Triton Equatorial Guinea, Inc. (a subsidiary of Amerada Hess Corporation) has awarded a contract to Framo Engineering AS for the supply of subsea multiphase pump systems for installation in Hess' Ceiba Field offshore Equatorial Guinea, West Africa. The scope of supply includes two totally independent freestanding pump systems interfaced to the subsea production system via flow line connectors.

The pump systems, each of which utilizes one 1-MW Framo electrically driven pump (ELSMUBS) will boost the production from two individual production wells to the Floating Production Storage and Offloading vessel "Sendje Ceiba", located approximately 7 km from the booster station and production wells. Installation of the pumps is planned for Autumn 2002.

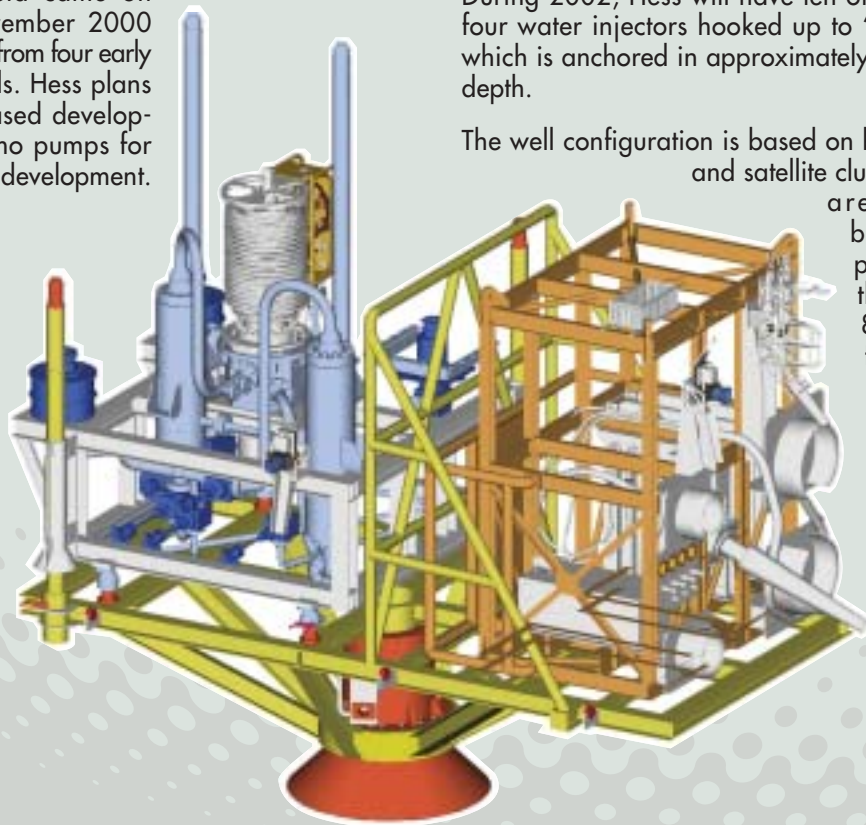
The Ceiba Field came on stream in November 2000 with production from four early production wells. Hess plans to apply a phased development with Framo pumps for Ceiba full field development.

Field Characteristics

The Ceiba Field, located in the Rio Munin Basin in Block G offshore Equatorial Guinea, is characterized by a relative shallow low-pressure reservoir with good permeability producing oil in approximately 700 meter water depth and 7 – 9 km from the host. Water injection is used for pressure maintenance.

During 2002, Hess will have ten oil producers and four water injectors hooked up to "Sendje Ceiba", which is anchored in approximately 90 meter water depth.

The well configuration is based on both single wells and satellite cluster wells, which are manifolded before being produced back to the FPSO. Dual 8" or 10" flowlines are used from each well location to accommodate round pigging.





System Description

Each pump system comprises one 100% capacity 1-MW electrically driven multiphase pump integrated in a step-out booster station that will be positioned between the X-mas tree and the production manifold.

Rigid M-styled 6" OD jumpers with vertical connectors will be used between the X-mas tree and pump station suction end and pump station discharge end and the manifold.

The pumps will be installed in approximately 750 meter (2500 ft) water depth up to 7 km (4.2 miles) from the FPSO.

Electric power to the pumps will be supplied through a dedicated cable/umbilical laid from the FPSO, one to each booster station location.

One common pump control building, which will contain the variable speed drives, transformers, control and auxiliary systems will be located on the FPSO deck. Each system will use a subsea transformer to supply the required voltage to the electric motor. Electric/hydraulic and signal jumpers will be used between the subsea transformer, subsea control unit and the pumps for power and control functions of the booster station.

The complete booster station structure with pumps and subsea transformer will be supported on a single pile, which includes a 30" conductor housing profile. The booster station has been designed to accommodate installation as one unit (first time installation) or separate installation of individual components being the pump/driver cartridge, the pump support structure and the subsea transformer module. The latter can be installed by layaway from the booster station to the FPSO. ROV is used during the installation and commissioning phase of the system.

Boosting Objectives

The actual reservoir and field characteristics and the high probability for high water production make the use of subsea booster pumps very attractive to maintain the required production rates from the wells.

The objectives are to accelerate the production and to increase the recoverable reserves from the Ceiba Field. Hence, the booster pumps represent both an "upside generator" as well as a "downside protector".

The two first pump systems will boost the production from wells C3 and C4, which are two of the four early producers.



Scope of Supply

The two subsea pump systems designed and manufactured by Framo Engineering AS include the following scope of supply:

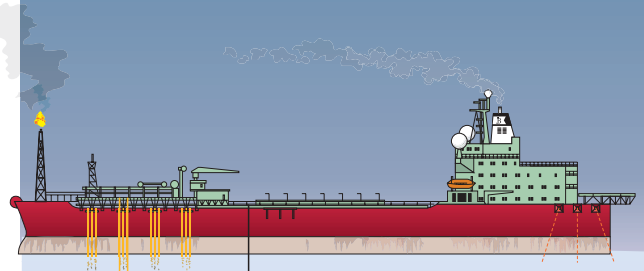
- Two plus one spare 1 MW Framo ELSMUBS pump/driver cartridges
- Two subsea pump support structures complete with pump barrel, pumps, valves and structure elements
- Signal and hydraulic control jumpers
- Two subsea transformer modules
- Two subsea power/hydraulic/signal cables/umbilicals
- One topside pump control building
- Pump/cartridge intervention system including pump running tool

Pump Specification

Motor rating	900 kW
Differential pressure	45 bar (660 psi)
Gas Volume Fraction	50-90%
Total Flow Rate at suction condition	250 am ³ /h (38.000 bbl/d)

Light Intervention

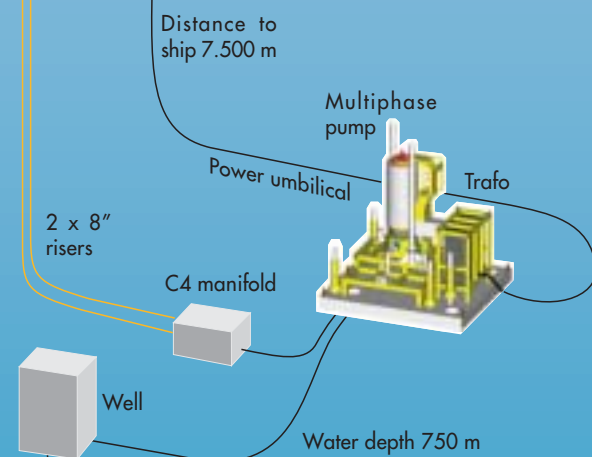
A simple and remotely operated running tool is used that allows pump/cartridge installation to be carried out from a light intervention vessel. The environmental lip seal system is hydraulically pressure tested through the remotely operated running tool (installation), or permanent hydraulically set through the subsea umbilical (operation).



Design Philosophy

The basic design philosophy of Framo ELSMUBS is simplicity in subsea integration, handling and operation:

- Incorporates the flexible and self-regulating helico-axial pump principle (Poseidon) as proven through several field installations
- All components susceptible to wear and tear are located in a single, easily retrievable cartridge
- High degree of operational flexibility provided by variable speed drive control system
- Cooling and overpressure functions provided by an integrated barrier fluid system
- Direct drive, high-speed oil filled electric motor
- A stiff motor/pump shaft arrangement specified to provide optimum running conditions, even in pure gas
- Simple control functions and operating procedures
- Diverless maintenance (ROV assisted)
- All intervention carried out by a light vessel and remotely operated running tool
- Power supplied by a subsea wet mateable high power connector



Main Components and Features

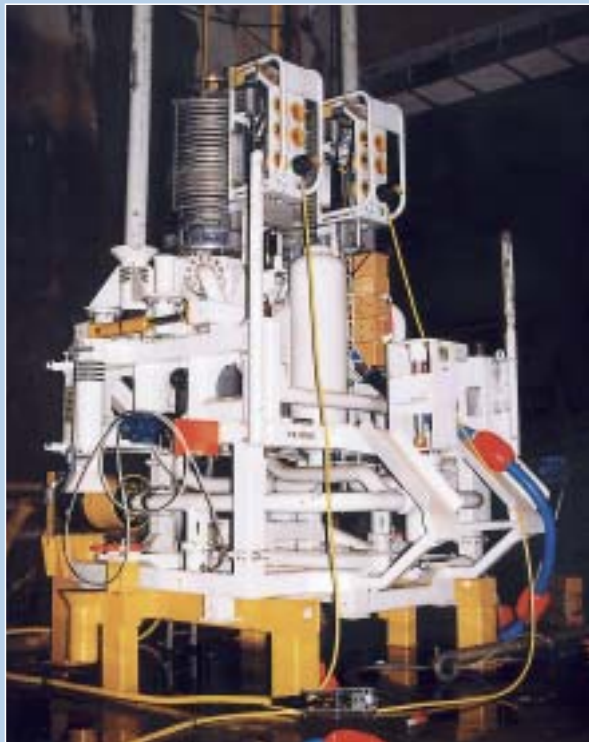
Pump/Driver Cartridge

The retrievable pump/driver cartridge is partially encapsulated in a receiver barrel, which typically is flanged directly to the X-mas tree or integrated in the manifold arrangement. The major components are:

- The flow mixer for inlet flow conditioning
- The helico-axial multiphase pump
- The high-speed electric motor
- The high power electric connector
- The environmental lip seal system
- The handling/running tool interface

Pump Module

- Flexible and retrievable design
- Installation on a suction pile
- Fully self-contained design
- Simple interfaces



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Jumper Systems

- Individual oil-filled signal jumpers for pump control and booster station valve operation
- Oil-filled high power jumpers complete with wet mateable connectors and barrier and lip seal lines
- Jumper installation by ROV

Subsea Umbilical

- Incorporates electric power conductors, hydraulic control lines and signal lines



Subsea Transformers

- Oil filled design integrated in a support structure
- Simple pressure compensation system
- System cooled by the sea environments
- No moving parts
- System installed on the pump structure end by layaway installation of umbilical



Topside Pump Control Building

All functions in one module – single lift design

- Transformers for HV – subsea transmission
- Variable speed drive systems
- Hydraulic power unit for the barrier fluid system
- Pump control system
- Cooling unit
- Fire and gas system + fire rating of module



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