

bluewater

CALM Buoy

for the The Western Libyan Gas Project Wafa Plant



Power by People



WLGP Wafa Plant – Agip Gas B.V. Libyan Branch

Project Overview

The Western Libyan Gas Project (WLGP) is a \$5.5 billion dollar integrated development of upstream, processing and export facilities that will pipe natural gas to customers in Italy.

The initiative, being developed by NOC and Agip – a subsidiary of Italian energy group ENI – includes the production of gas from two fields: Wafa, which lies close to the Algerian border, and offshore NC-41, in the Gulf of Gabes, about 110 km from the coast.

Bluewater Energy Services B.V. designed and fabricated a Single Point Mooring (SPM) System for the WLGP Wafa Plant, Libya. The SPM System is scheduled for installation in the 2nd Quarter of 2004. It will be moored about 2 km off the coast of Libya in a water depth of 28 m. This new facility will service the loading of tankers up to 84,000 dwt, handling condensate, at a rate of about 5600 m³/hour.

The Bluewater turret buoy solution was chosen for its attractive initial price, inherently safe concept and for its capability to operate without dry-docking during the total life of the buoy (low cost of ownership).

Buoy Concept and Design

The CALM (Catenary Anchor Leg Mooring) buoy concept was chosen as a cost-effective and fast solution. Bluewater's turret buoy design offers increased loading efficiency for tankers; maximum throughput can be achieved safely, while maintenance and down time are significantly reduced.

- The concept incorporates:
 - A round turret CALM Buoy
 - A Pipeline End Manifold (PLEM)
 - Dual submarine and floating hoses
 - 26 inch onshore-offshore pipeline (not Bluewater supply)

Pipeline, PLEM and Hoses

From the manifold in the tank area of the Terminal, a 26-inch pipeline will run over a jetty from which end it will be trenched into the seabed to the buoy location where it terminates at the PLEM.

Special features includes:

- Single product transfer – stabilised oil and stabilised condensate
- Direct oil export from the CALM Buoy to the tanker via two floating hose strings
- Hawser Load Monitoring System



Key Elements: Buoy Arrangement

The Bluewater turret buoy consists of a steel turret suspended from a bearing. This is attached to the buoy body and connected at the lower end to the anchor legs with ratchet-type chainstoppers, located in the spider structure.

Arrangement Details:

- The buoy body will be allowed to weathervane freely through 360° around the turret
- Six anchor legs, equally spaced, will ensure the buoy holds its mooring position
- Three chain hawse pipes will extend from the bottom plating of the buoy body to the deck. During offshore installation, the pipes will be aligned with the spider's chainstopper assemblies
- The deckhouse wall will form an extension of the hawse pipes, up to the deckhouse roof level
- An air winch will be fitted in the deckhouse. During installation, the winch can be rigged to pull in the anchor legs through the hawse pipes, submarine/floating hose strings and mooring hawser
- Open hawse pipes, at deck level, will allow the chains to be checked and cut after being locked in the chainstoppers
- A riser pull-in pipe extends from the turret bottom plating to the turret deck level, to allow connection of the submarine hose to the turret piping, using the winch
- The two submarine hose strings will be maintained in "Chinese Lantern" configuration, with flotation collars. It will be connected to the 20 inch turret piping by means of a lap joint





Single Product Swivel and Buoy Body

This configuration will allow stabilised oil and stabilised condensate to flow through the submarine hose to the 20-inch product piping in the turret. It will then be transferred to the rotating buoy body by means of 20 inch piping, via a pipe-type single product swivel. Overboard pipe spools will connect the buoy body piping to the floating hose strings.

Within the product swivel, a sealing system will prevent leakage; a leak detection system can provide monitoring of the pressure between the seals – providing an important safety feature.



The buoy body will be connected to the turret via a three-race roller bearing and fitted with a closed deckhouse. The design protects critical equipment including the bearing, valves and product swivel. It also reduces maintenance requirements. Such work can be undertaken safely inside the deckhouse. The interior of the buoy body will consist of watertight compartments, each of which can be checked or sounded for water ingress. Draught marks on the hull exterior will also allow the floating condition of the buoy to be monitored.

Access to the buoy:

- A boat landing platform and a ladder will provide access to the main deck
- Overboard work platforms will be provided, to assist with hose and mooring hawser handling
- The hull will be fitted with fendering

Tanker Interface and Mooring Arrangement

The tanker will be moored to the buoy by a single hawser arrangement, shackled to a mooring uni-joint on the buoy deck. The uni-joint is integrated with the buoy via mooring lugs, fitted with bushes to prevent excessive wear. At the tanker end of the hawser, chafe chains will be provided to prevent damage from the tanker fairlead. Hawser guides and hardwood protection on the buoy deck will minimise the risk of damage. A load monitoring system will be installed in the mooring uni-joint, interfaced to provide audible and visual alarms to prevent hawser overloading.



Batteries and solar panels on the deckhouse roof will provide the buoy's electrical power. Electrical power will be provided for the navigation aids and instrumentation.

Safety

Appropriate safety systems and alarms have been incorporated into the buoy's design. Deck and overboard platform will be provided, with railing and grating.

Navigation Aids include:

- A foghorn
- A marine flashing lanterns
- A radar reflector

In addition to providing normal marine signals, the foghorn will provide an audible alarm for the mooring hawser load monitoring system. An additional flashing beacon will also provide a visual alarm for hawser loads. Hand-operated safety items will include fire extinguisher and personal life-saving equipment.

The integrity of the two floating hose strings has been carefully considered. When operational, the strings will be equipped with appropriate lighting and breakaway couplings to avoid spillage in the event of uncontrolled tanker disconnection.

Additional Equipment

The CALM buoy system will also include:

- A bilge pump
- A rotation stopper system
- Rigging equipment
- Ballast and trim facilities
- Sacrificial anodes
- Lifting and towing padeyes
- Pick-up arrangements for the floating hose and mooring hawser



Western Libyan Gas Project Wafa Plant

On completion of the CALM Buoy system for the WLGP Wafa Plant, Libya will have an offshore terminal ranking among the best in the world



Buoy Dimensions

Buoy body diameter (including skirt)	13.5 m
Buoy body diameter (excluding skirt)	10.2 m
Hull height	5 m
Projection of spider below hull	1.8 m
Total height (including fog horn)	12.5 m
Weight	210 MT
Centre of gravity above keel	3.3 m
Installed draft	4.5 m

Certification

The system has been designed and built as an OI 100 AT Single Point Mooring and Loading Terminal with Lloyd's Register of Shipping.

Anchor System

Anchor legs	6
Pattern	6 x 1
Length	295 m
Chain size (studless links)	81 mm
Anchor points	6 piles
Pretension angle	40°

Submarine Hose System

Strings	2
Size	20"
Hose length	35 ft or 40 ft
No. of hoses	3
Pressure rating	19 bar

Location

2 km offshore Wafa Coastal Plant, Libya	
Water depth	28 m

Design Criteria

Design life	25 years
Discharge capability	5600 m ³ /hr

Mooring Equipment

Hawser length	45 m
No. of hawsers	1
Circumference	12"
Hawser type	single
OCIMF Chafe Chain	Type B + C

Buoy Piping System

Design pressure	19 bar
Turret piping	2 x 20"
Turret product valves	2 x 20"
Swivel	1 x 36"
Buoy body piping	2 x 20"
Buoy body product valves	2 x 20"

Floating Hose System

Strings	2
Size	20" / 16"
Hose length	30 ft or 35 ft
Pressure rating	19 bar