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GPE
PETRO ENERGY CO.

Manufacturer of Truck & Train
Loading Arms, Stair Case, Platforms

Top & Bottom Loading Arms
Technology Bulletin

2024

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Introduction

GPE was founded in 2000 as a knowledge based company and now is a reputable brand in design and manufacturing of different solutions in marine/offshore loading/offloading and storage tanks industries.

In general, a Marine Loading Arm, also known as a mechanical loading arm, loading arm, or MLA is a mechanism consisting of articulated steel pipes that connect a tank ship such as an oil tanker or chemical tanker to a cargo terminal.

This is an alternative to direct hose hookup and is particularly useful for larger vessels and transfers at higher loading rates and pressures. Controlled manually or hydraulically, a loading arm employs swivel joints and can, to some extent, follow the movement of a moored vessel.

GPE marine loading arms are rotating Counterweight and Cable-sheave types. GPE marine loading arms can handle both liquids and gases, in a wide range of viscosities and temperatures and cover a wide range of application within industry. Available in wide range of sizes, applicable in loading/offloading of different products from small river barges to the largest supertankers, these all give GPE MLAs unique advantages as industry most effective solution.

Plus, options like hydraulic or manual quick connect couplers, position monitoring systems, emergency release systems, and piggyback vapor return lines etc are also availabe in GPE MLAs upon request.

To provide the exact compliance of final product with operational specifications, GPE MLAs are tailored for a given port based on considerations such as vessel size, cargo flow rate and cargo temperature. Environmental constraints such as the range of tide, wind conditions, and earthquake intensity are also considered in design and manufacturing of GPE MLAs.

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Design Base

The GPE MLAs are designed according to the Oil Companies International Marine Forum (OCIMF) standard which is the international reference to industry. Basic design depends on many factors like: jetty layout, environmental conditions like wind and earthquake, transferred product rate, design pressure, design temperature, vessel information and etc. which will be provided by the client.

Advantages of Persian GPE Marine Loading Arm

• Easy Operation & Easy Seal Change & Separate Support Structure.
• Features a separate support structure with its own generously sized mechanical bearings, which take up all major external loads and torques.
• The swivel joints and pipeline are only affected by the stress of internal pressure and weight.
• Pipeline is attached to support structure by flexible parts for compensating overstress.
• Counterweight balancing system makes the loading arm, inboard and outboard arms balanced in all positions by moving counterweight.
• Developed specially to meet the special requirements for loading arm flawless performance while yields the long reach capability.
• Equipped with three hydraulic driving assemblies for independent movements of the inboard arm, outboard arm and the slewing movements around its vertical axis. The driving assemblies are interchangeable. The three cylinders are operated by electro/hydraulic control console.
• Portable remote control system can also be considered as an option to control the arm movements from other points of the jetty or from tanker›s deck.
• Available with QC/DC; it is suitable for different manifold flange of the vessels.
• Available with vapor return line as per client's requests.
• Insulating flange is located vertically between triple swivel joint flanges and electrically isolates Tanker from MLA.
• Vacuum breaker is located at the top of outboard arm at apex; where vacuum occurs. It allows quick release of liquid and acts manually by rope or hydraulically.

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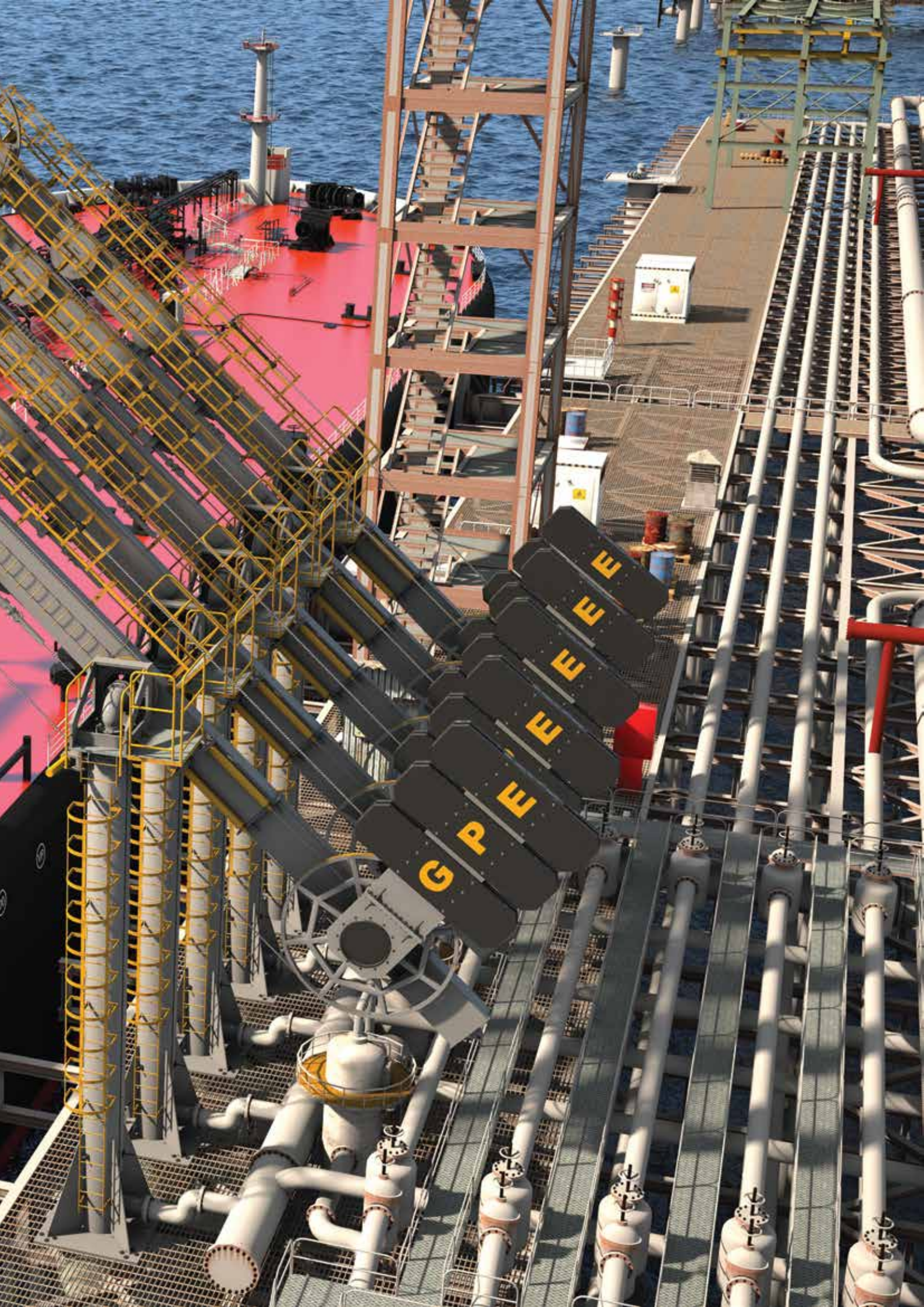
Marine Loading Arm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Marine Loading Arm Terminology

Marine Loading Arm Equipment

Base Plate & Main Riser

Base plate is bolted to foundation on deck. Main Riser holds all other equipment on MLA; and is welded to the base plate. Material for both of mentioned structures is carbon steel.

Slewing Structure

This structure locates on the top of “main riser” and rotates around vertical axis. Two swivel joints are located on slewing structure that causes rotation of loading pipes.

Inboard & Outboard Arm

Inboard arm connects inlet pipe to outboard arm. Swivel joints are located between them. Counterweights are located on inboard arm too.

Counterweights

GPE accurate balancing calculation and modeling assures balancing in empty or loaded conditions. Sometimes additional counterweight is required to adjust MLA.

Inboard Locking Device

When marine loading arm locates in the rest position, locking device locks inboard arm to main riser to protect arm movement against wind or other enviromental forces.

Slew Locking Device

When marine loading arm locates in the rest position, locking device locks Slewing Structure to main riser. When the arm is in overhaul, slewing movement is locked hydraulically.

Quick Connect / Disconnect (QC/DC)

QC/DC is located at the end of triple swivel joint, connects MLA to ship manifold. Manual or hydraulic QC/DC can be delivered, but hydraulic type is preferred. Number of grippers depends on design pressure and maximum design equivalent load according to OCIMF.

QCDC clamping mechanism shall be designed to compensate for up to 5 mm of unevenness of thickness of the nominal manifold flange.

QCDC shall not leak, deform or fail at twice the maximum design equivalent load plus internal design pressure, in both static load conditions and bending, assuming the failure of an agreed number of clamps.

QCDC shall be designed to prevent inadvertent release due to human error, pressure or vibration. If necessary, a mechanical or hydraulic locking device should be provided to prevent inadvertent release.

Activation of this device should be clearly visible by a method approved by the owner.

Connection and disconnection operations of hydraulically operated QCDC shall be possible both from the transfer arm control panel at the jetty platform and also at the local control station, which is typically a portable or pendant control panel.

QCDC shall be provided with a flange cover to contain any remaining product following disconnection.

The cover may have a tapped hole and be fitted with a plug or valve to enable the owner, if required, to fit a bleed valve or pressure relief port for depressurization before removal. The cover shall be rated at the same pressure as the transfer arm.

Swivel Joints

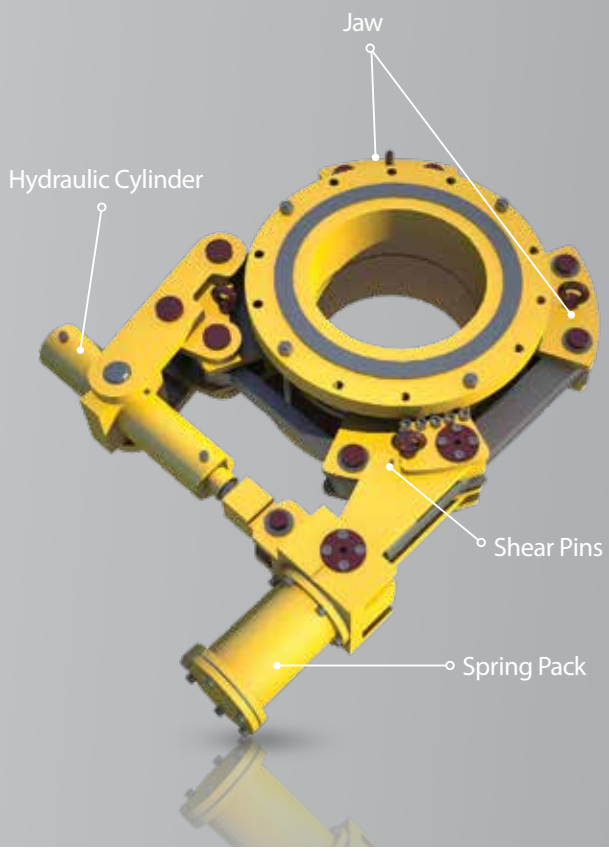
Swivel joints are used to make flexible connection between rigid pipes. 6 swivel joints are required for each loading arm for 6 degree of freedom. Swivels shall be hydrostatically tested at 1,5 times the design pressure, followed by a partial vacuum test at 0,5 bar absolute after which the hydrostatic test pressure is reapplied. The test pressure shall be maintained for a minimum period of 30 min at each stage. Leakage shall be measured at the primary seal and the secondary seal. The test shall be performed with the fully assembled product line under ambient temperature nitrogen gas at 3 bar gauge. The acceptance criteria are the same as for the prototype.

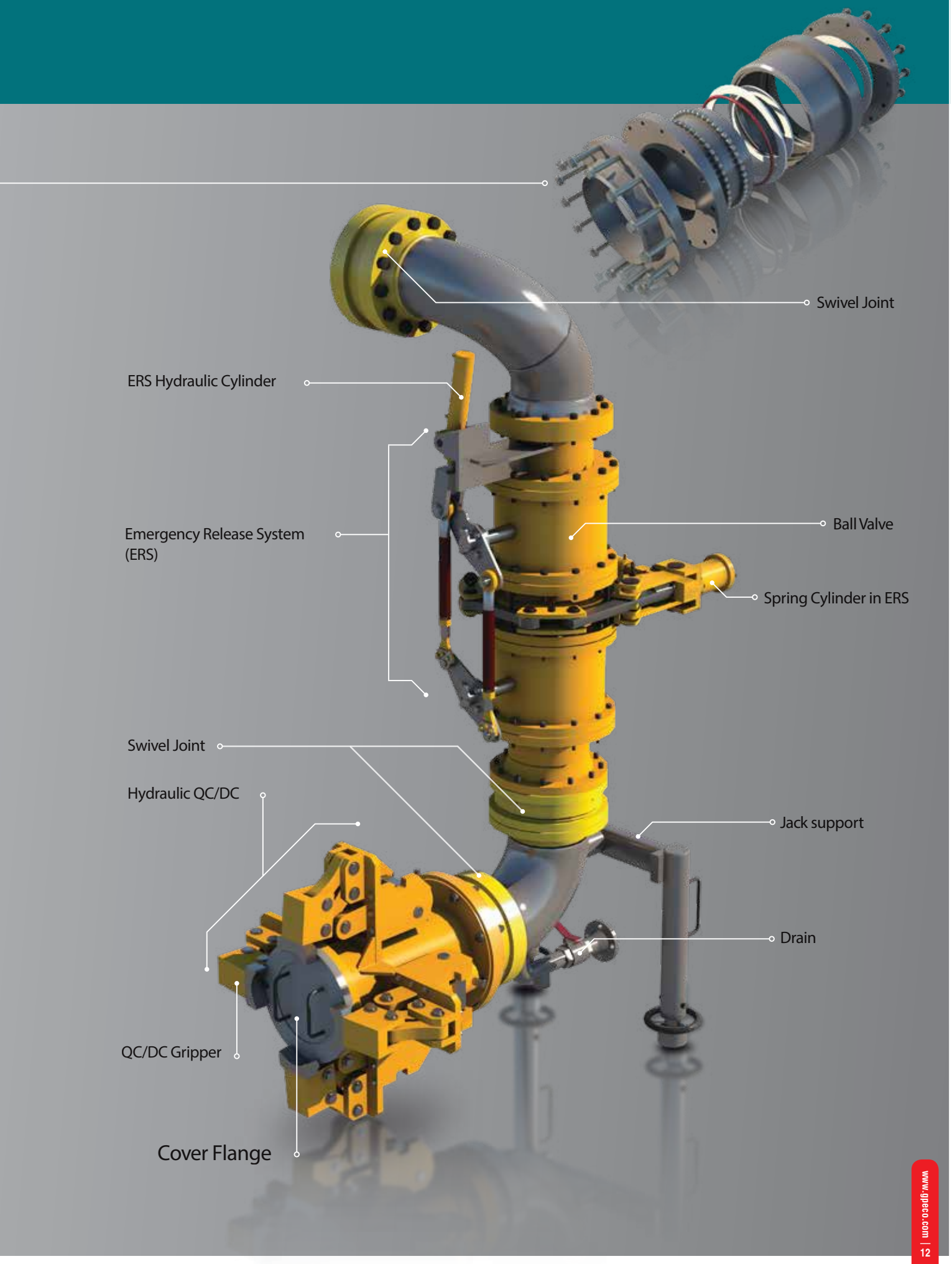
Emergency Release System (ERS)

ERS is a system that provides a positive means of quick release of transfer system and safe isolation of the oil tanker and transfer system. An ERS normally contains one or several ERC.
It consists of a double ball valve mechanism and ERC.
In emergency situation, hydraulic cylinder activates the ball valve to block product flow in the arm and then ERC causes the separation.
Available with double ball valve or double disk valve / emergency release coupling (DBV/ERC, DDV, ERC) which are automatically actuated when the tanker manifold flange to which the loading arm is connected moves outside of the working and safety envelope.

Emergency Release Coupler (ERC)

ERC is a device to provide a means of quick release of the transfer system when such action is required only as an emergency measure. Hydraulic ERC acts when shear pin Breaks by double acting cylinder. Spring pack pushes the linkage away and upper part of ERS and MLA arm move up.




Swivel Joint
ERS Hydraulic Cylinder
Emergency Release System (ERS)
Ball Valve
Spring Cylinder in ERS
Swivel Joint
Hydraulic QC/DC
Jack support
Drain
QC/DC Gripper
Cover Flange

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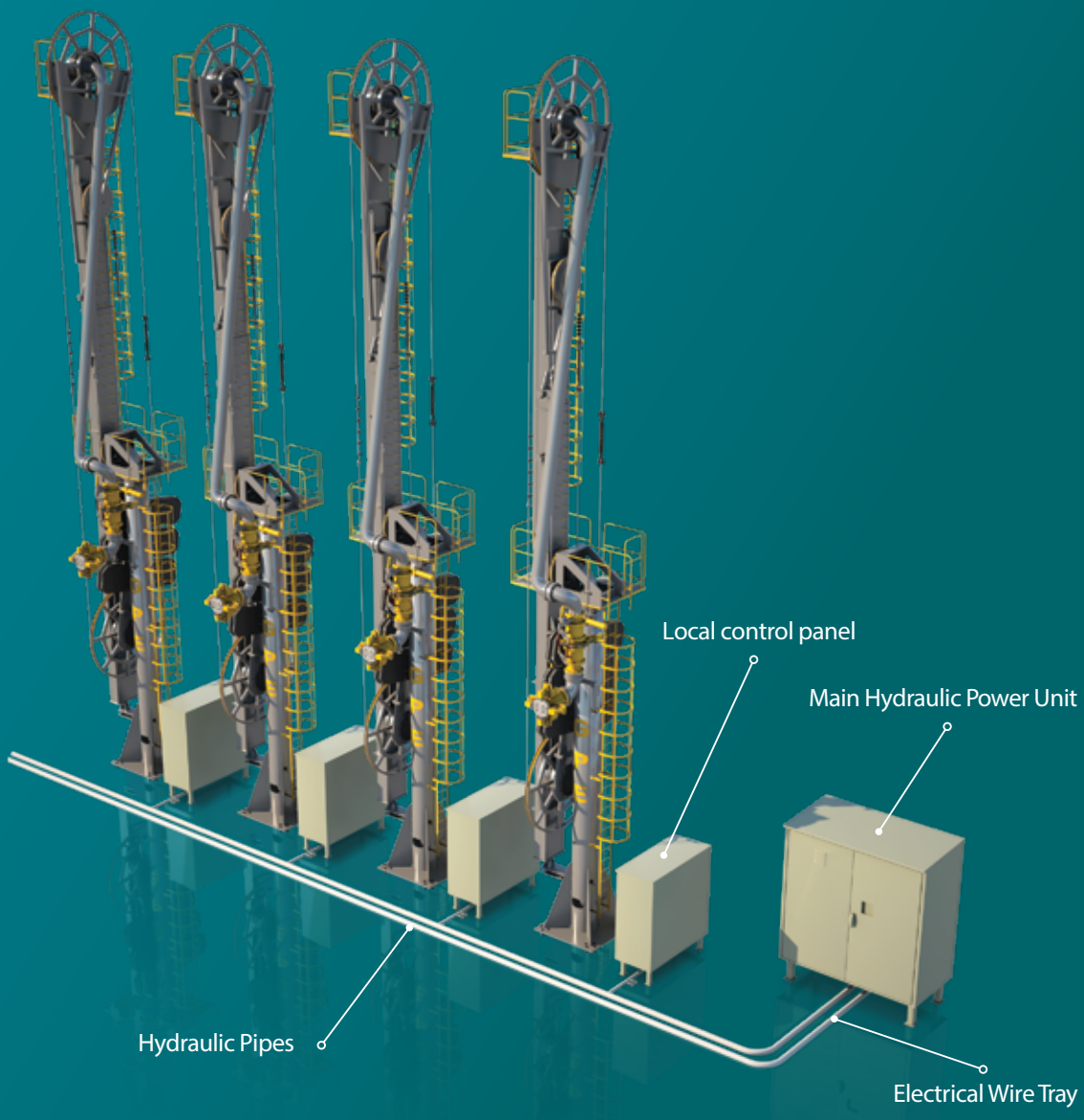
Hydraulic and Electric Control Systems

The operating and control system shall be designed as an electro-hydraulic system to ensure the normal operation of the arm, the emergency release sequence and retracting the arm empty or full of product after emergency release.
The arm control panel and the remote control shall not be operational simultaneously. Simultaneous movement of more than one arm should not be possible during normal operation.
Constant Position Monitoring System (CPMS)

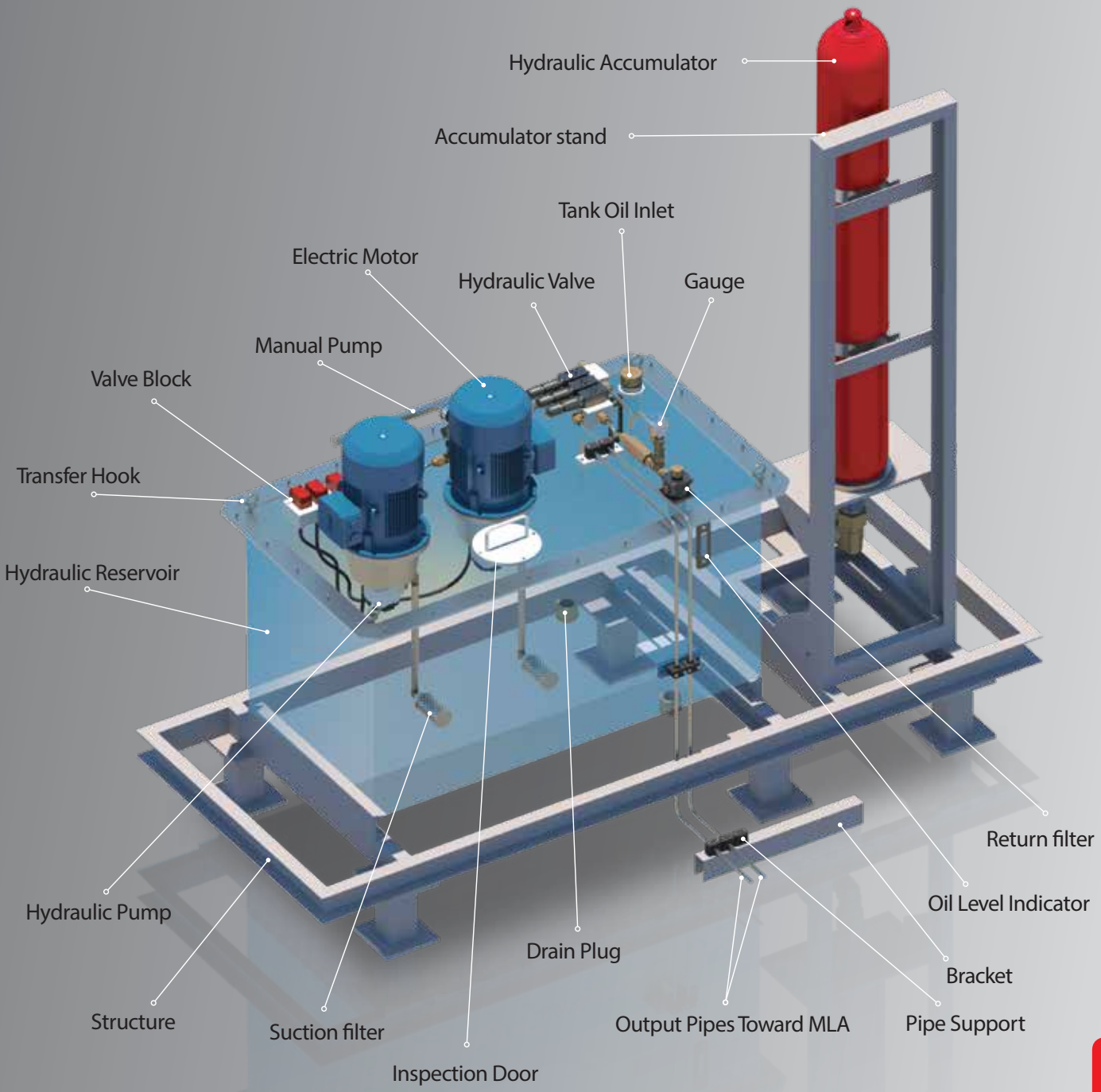
Constant Position Monitoring System (CPMS)

A typical Constant Position Monitoring System (CPMS) is based on sensor measurement of four angles and calculated co-ordinates. The system should give the position of the arm which has the most critical position within its working area (i.e. the one which is nearest to the alarm limits) between all the connected arms of the jetty.
Alarm limits are also computed by this system. These consist of a pre-alarm zone which is adjustable in dimension and monitored by the system to give an alarm when the ship moves out of it and a second alarm limit which should operate the ERC before reaching mechanical limits of the arm.



Hydraulic Power Unit (HPU)

HPU Generates hydraulic oil flow for hydraulic actuators. All hydraulic actuators are hydraulic cylinder. Hydraulic accumulator and hand pump ensure HPU function in emergency conditions. All hydraulic accessories are covered in a safety box at site.

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Safety Systems

The function of the ESD system (occasionally referred to as an “ESD I”) is to safely stop and isolate the transfer of liquid and vapor between ship and shore. Typically, this system may be activated by the following:
fire or gas detection, tank high level or abnormal pressure, ship’s drift or a manual signal. It shall result in the tripping of transfer pumps and vapor return compressors, both ship or shore as applicable, and the timed closure of ESD valves on the ship and shore to reduce hydraulic surge in the transfer lines to acceptable limits.
The function of the emergency release system (ERS) (occasionally generally referred to as an “ESD II”) is to protect the transfer arms by disconnecting them, should the ship drift out of their operating envelope. The ERS consists of an emergency release coupler (ERC), interlocked isolating valves to minimize loss of product when the ERC parts, and sensors to monitor transfer arm angle. The ERS may also be activated from the jetty by manual operation. Initiation of the ERS shall result in the simultaneous closing of interlocking ERS isolating valves, followed by the ERC separation and the transfer arms withdrawing clear of the ship’s structure and adjacent arms; thus preventing the arms being damaged or spillage of LNG. The disconnected arm(s) shall retract behind the berthing line and shall lock hydraulically. Activation of the ERS shall also initiate the functions of ESD if this has not already started.
The ship and shore monitoring and activation systems should be linked to ensure the coordinated operation
of both ESD and ERS functions on ship and shore.

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