

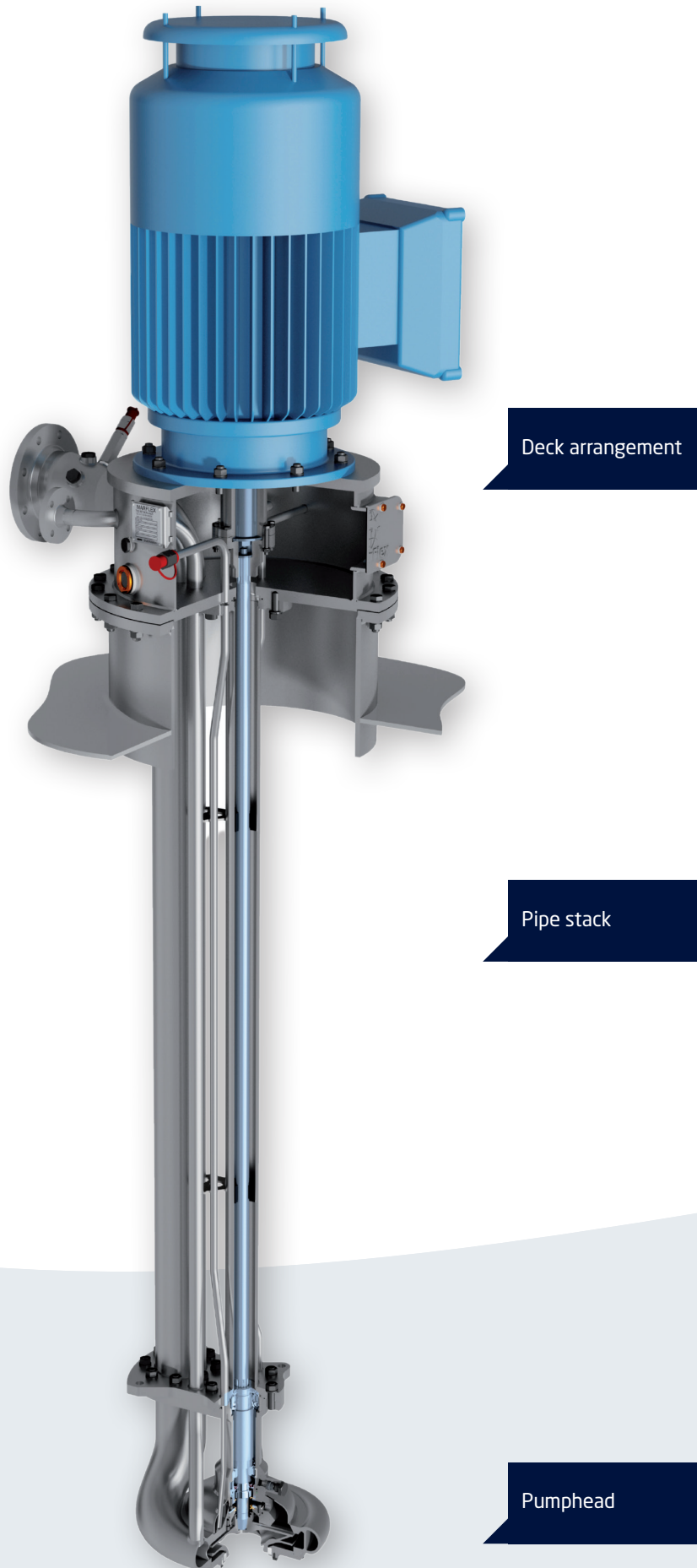


**MarFlex**

# The MarFlex Deepwell Pump



# Pumping Excellence



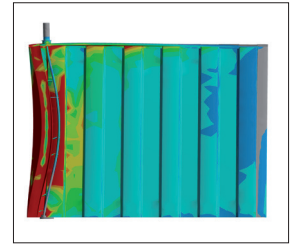
# The MarFlex Deepwell Pump

As MarFlex we developed the electric drive deep well pumping business. Many years of pumping experience brought us to complete solutions.

The MarFlex deepwell cargo pump is part of the most crucial operations on board and we have infinite motivation to fully understand our customers expectations to develop and optimize the mechanical requirements of our pumps. The MarFlex deepwell cargo pumps are engineered due to understanding the technical requirements of the vessel based on the types of cargoes, temperatures, capacities and to understand the operation requirements of the owner based on; efficiency, environment and the people that have to operate the system. This let us create a high-end product portfolio.

As the MarFlex deepwell cargo pump needed to be driven by an electric motor, we developed a 'non-cargo-lubricated' driveshaft. This resulted in a unique 'oil-lubricated' shaft running in a separate supporting pipe. The service life of an oil-lubricated shaft arrangement is more than 10,000 operating hours, based on the service life of the bearings in the electric motor. These 10,000 operating hours are normally sufficient to last the service life (20-25 years) of a sea-going vessel.

Our motive is optimum efficiency with the least maintenance interference, this can be achieved when eliminating or protecting the weak spots in the system. Mechanically the strength of



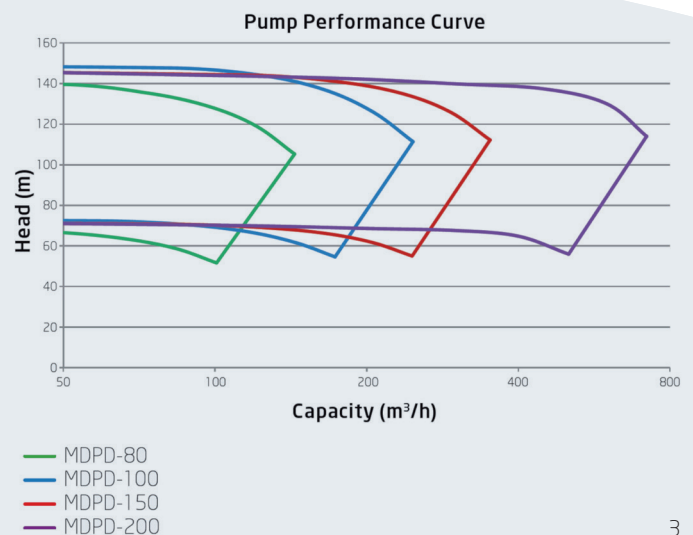
the pump head, pipe stack, shaft and spline connections are key. And last but not least, the people that operate the system from installation to discharge want to have a smooth experience. With dedicated in-house calculations for your project we advise on tank design and strength optimization. This results in a solid design that prevents from resonance during your discharge operation.

## Pump materials

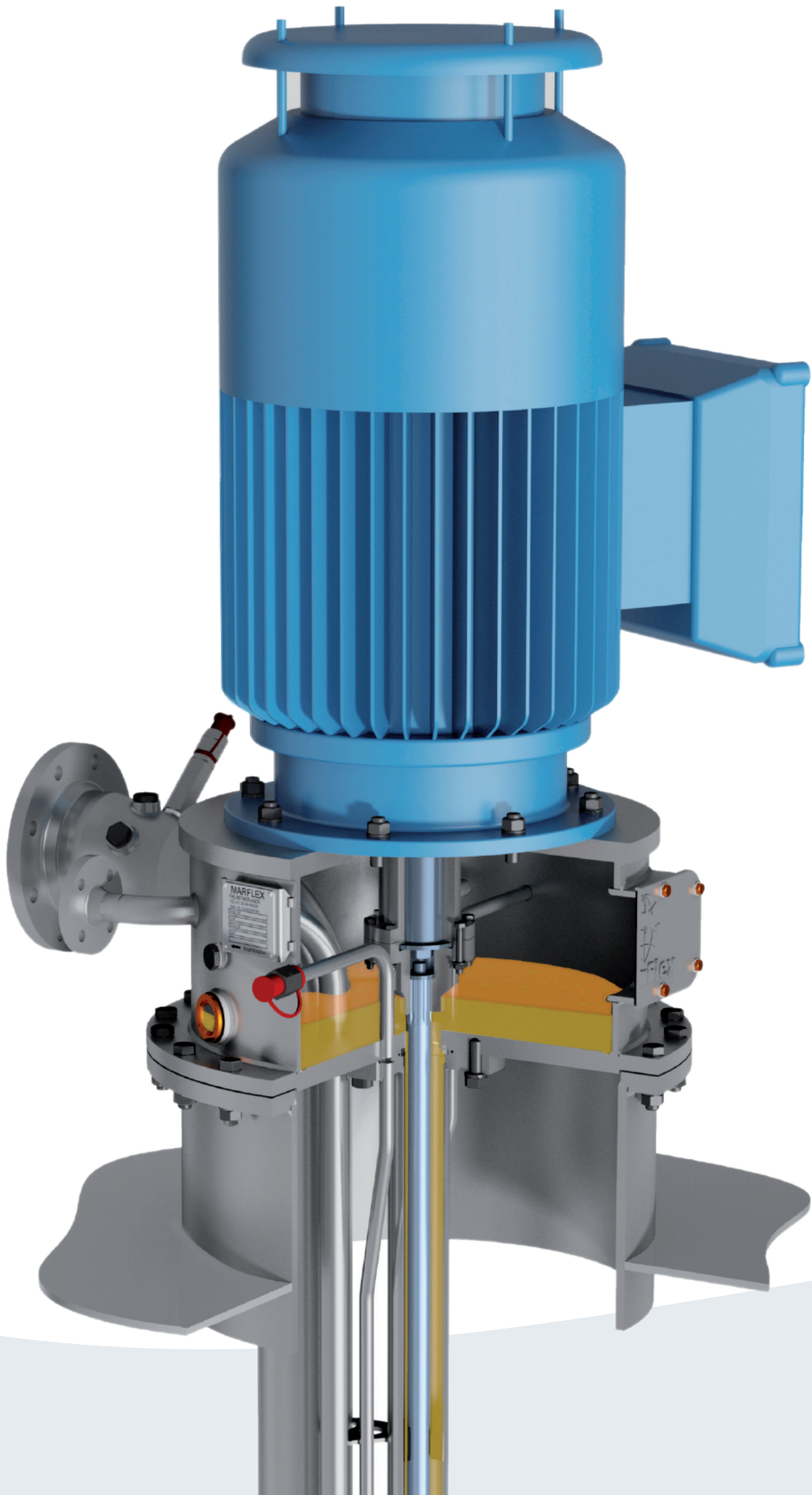
The MarFlex deepwell cargo pump is made entirely of stainless steel AISI 316L. On request, the MarFlex deepwell cargo pump can also be made from higher grade materials, such as 'duplex' or 'super duplex', to fulfill the customer's requirements. All seals and O-rings in contact with the cargo are made of PTFE or FFKM. Thanks to the materials used, the MarFlex deepwell cargo pump is highly chemical-resistant and suitable for handling cargoes with a temperature up to 100°C. Our pumps in cooperation with the drives and software are the optimum solution to reach maximum efficiency during discharge operations.

To explain the MarFlex deepwell pump in detail, we will divide the total pump into three sections:

- Deck arrangement
- Pipe stack
- Pump head



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## Deck arrangement

**The MarFlex deepwell pump can be driven by an explosion-proof, class-approved electric motor or a hydraulic motor. However, 99% of all the deepwell pumps installed by MarFlex since the introduction of the new design in 1987 are electrically driven, for the following reasons:**

Advantages of electric-drive deepwell pumps compared with hydraulic-drive deepwell or submerged pumps:

- Total system efficiency approximately 20% higher;
- Low noise level;
- Easy to install, thanks to the electrical wiring instead of a complicated hydraulic piping system (commissioning is reduced to a real minimum);
- Simple and robust AC motor;
- Clean system (no hydraulic oil leakages);
- Less maintenance.

The speed of the electric-drive MarFlex deepwell pumps can be controlled in several ways:

### **One-speed electric motor**

Suitable for tankers that carry products with a small specific gravity range, such as the so-called 'product tankers'.

Variable speed control by means of the electric shaft principle

This is mostly used for inland barges. The variable speed generator set that drives the bow thruster also drives the pumps during offloading.

### **Variable speed control by means of a frequency converter**

A frequency converter system has the following advantages:

#### **1. Power**

- High efficiency;
- Energy consumption according to actual need;
- E-motors and consequently generators do not need to be over-dimensioned for products with a high viscosity and/or specific gravity;
- Soft start (no inrush peaks); less frequent start-up of generators.

#### **2. Control**

Independent control of each deepwell pump;

- Accurate, variable control;
- Low mechanical wear;
- Low cavitation;
- Programmable for specific pumping requirements:
  - minimum discharging time;
  - minimum cavitation;
  - liquid level;
  - specific gravity;
- Connection to cargo monitoring or machinery automation system.

## Pipe stack

**The design of the MarFlex deepwell pump is based on a driveshaft that is separated from the cargo. The pipe stack consists of two pipes: one is the discharge pipe and the other is the enclosure for the intermediate driveshaft, the shaft bearings and the lubricating oil.**

The separation of the shaft from the cargo gives the following obvious advantages:

- The drive shaft is made of 42CrMo4V, which is a heat treatable steel. If the shaft were exposed to the cargo, it would be necessary to use AISI 316L steel, which is not the ideal material for a deepwell pump driveshaft.
- Because the shaft is oil-lubricated, the pump bearings never run 'dry' during stripping and tank cleaning operations.
  - No danger of explosion as a result of overheating of intermediate shaft bearings.
  - Longer service life of the shaft bearings.
- Because the drive shaft and bearings are oil lubricated, the pump can run at relatively high speeds. This results in a single stage deepwell pump.

The shaft bearings of the MarFlex deepwell pump are made of Composite, held within a FPM flexible member.

Advantages of the MarFlex intermediate shaft design:

- No shaft-alignment problems;
- Fixed coupling between the shaft of the drive motor on deck and the intermediate driveshaft;
- Because the intermediate shaft bearings are oil lubricated, they have a long service life.

The length of the pipe stack has no restrictions. However, an intermediate shaft support is fitted at 6-metre intervals.

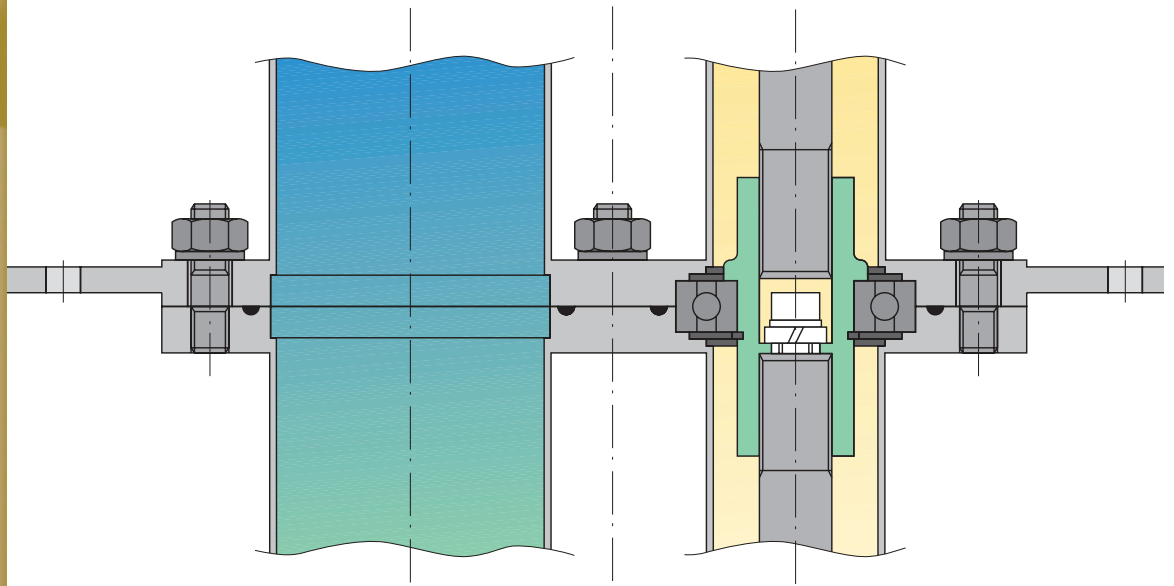
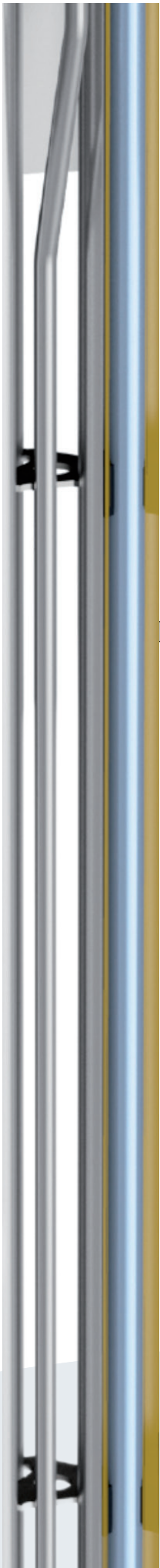
This support consists of a ball bearing, which takes only the axial load of each shaft length of 6 meters. Axial thrust / load from the impeller is taken only by the pump shaft bearings and is not transmitted to the intermediate shaft (bearings), thanks to the 'spline' connection between the pump shaft and the intermediate shaft.

### Teflon bushes

We use Teflon bushes to avoid any risk of cracks at the connection plates of the stripping / purging or sensor pipe. With this design a modified support strip connects the cargo and oil pipe by means of welding. This is needed to assure the required strength of the pump system. The other pipes are secured by means of the Teflon bushes. This results in less tension introduced by welding and furthermore the Teflon bushes will moderate vibrations caused by either the pumps or the vessel.



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## Pumphead

**The MarFlex deepwell pump is designed in such a way that the total pump head can be disconnected from the pipe stack, which makes maintenance very easy.**

A so-called 'spline' connection between the intermediate driveshaft and the pump shaft in the pump head makes it possible to disconnect the pump head from the pipe stack by lowering the pump head.

### 1. The pump shaft

This shaft is made of 32CrNiMo6V steel, a very high grade steel that is ideal for this purpose. Like the intermediate driveshaft, the pump shaft is not made of AISI 316L because it is oil-lubricated rather than being exposed to the cargo.

### 2. Seal arrangement

The MarFlex deepwell pump is supplied as standard with a special seal arrangement to separate the cargo from the lubricating oil and vice versa. This seal design has proven over many years to be a simple and reliable seal for all chemicals and mineral oil products.

The seal arrangement is built up as follows:

- Upper seal arrangement with oil seal.
- Lower seal arrangement with single cargo seal and double cargo seal.

Between the two cargo seals there is an atmospheric drainage chamber.

This chamber is called the 'cofferdam', and it acts as a safety barrier. Any leakage that might occur is collected in the cofferdam.

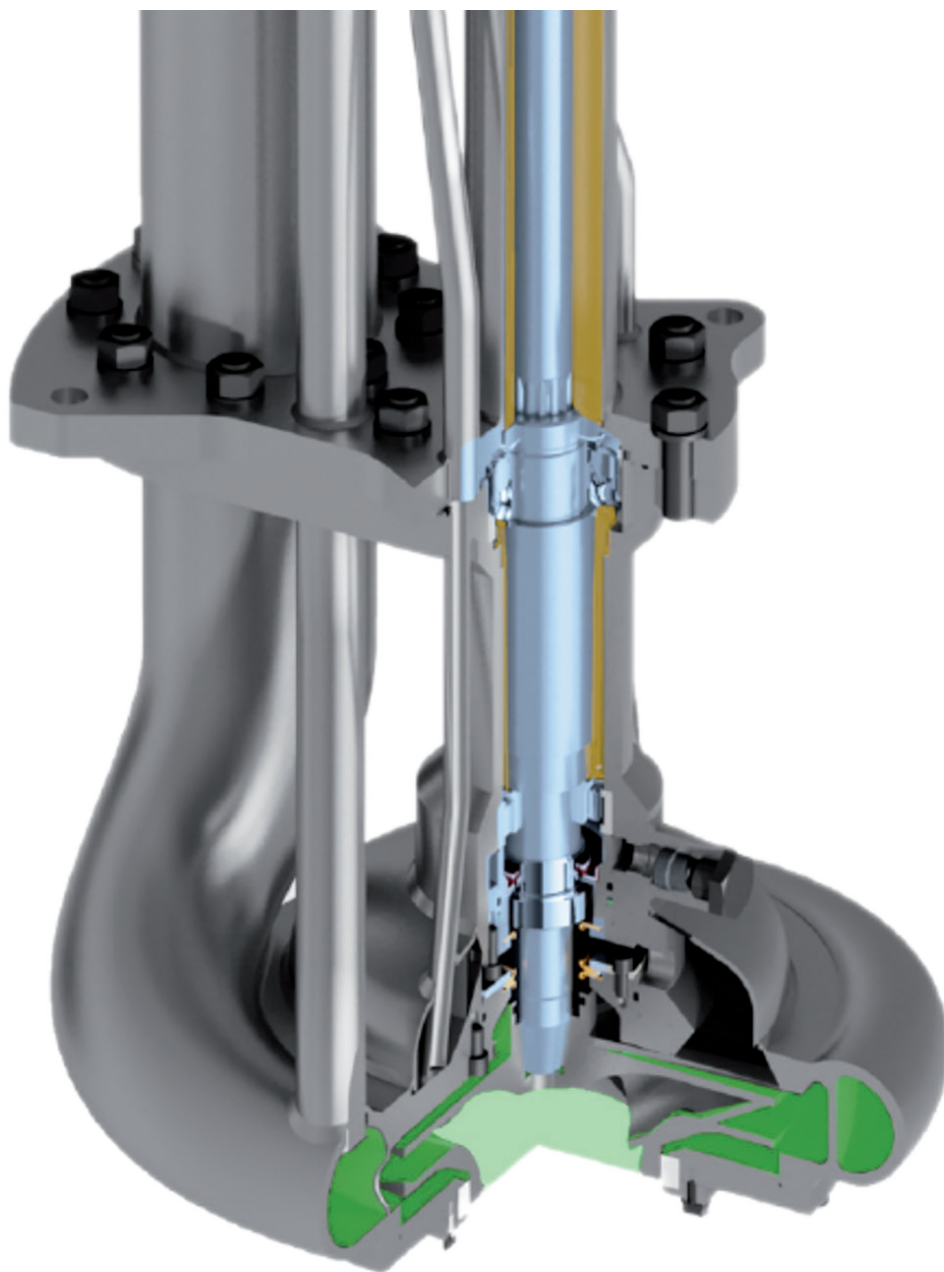
The cofferdam is connected to the main deck by means of two purge lines.

By purging the cofferdam with air or nitrogen, its contents can be blown out and collected on deck.

A regular purging routine enables the condition of the seals to be constantly monitored.

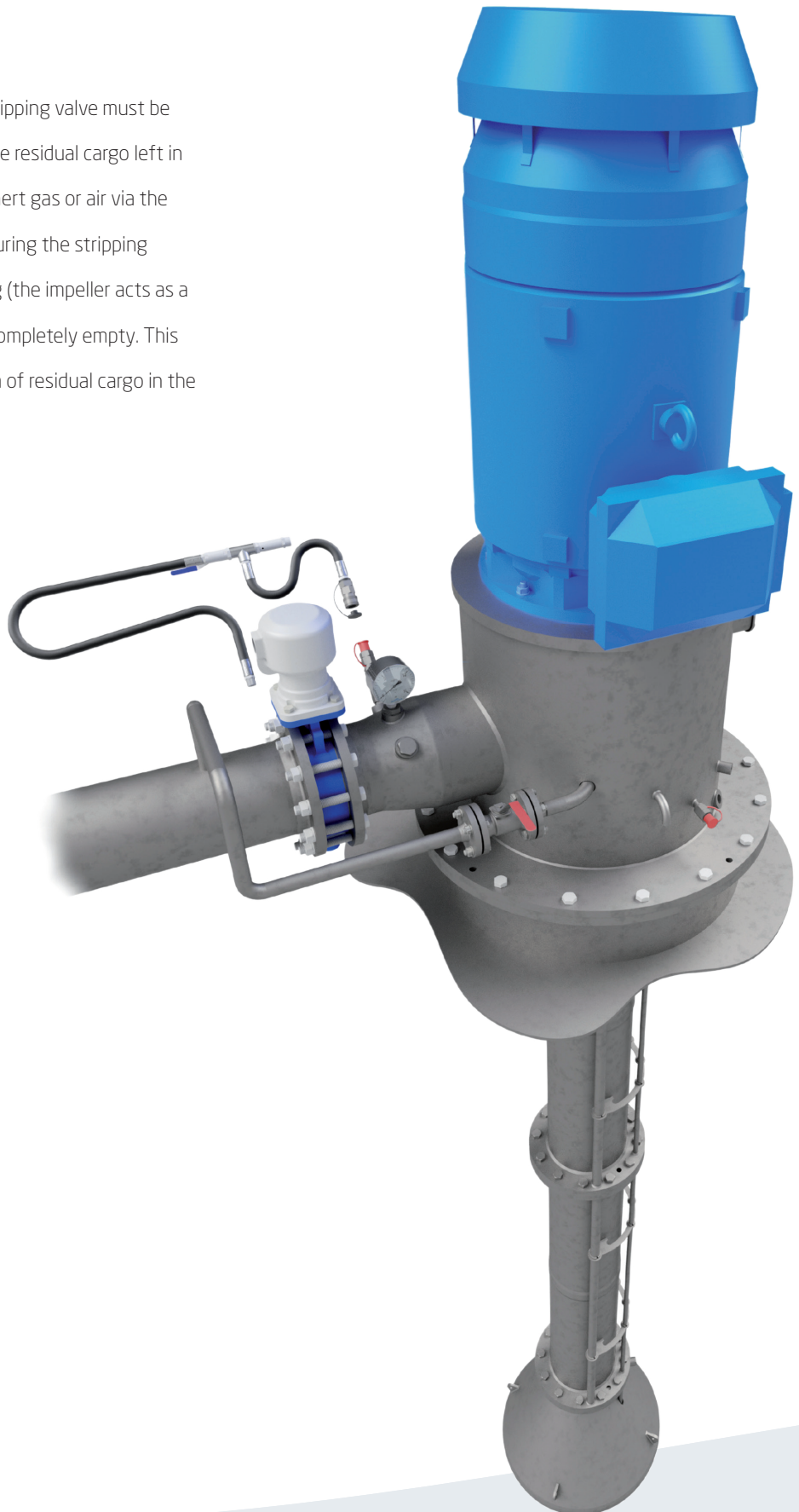
The advantages of this seal arrangement are:

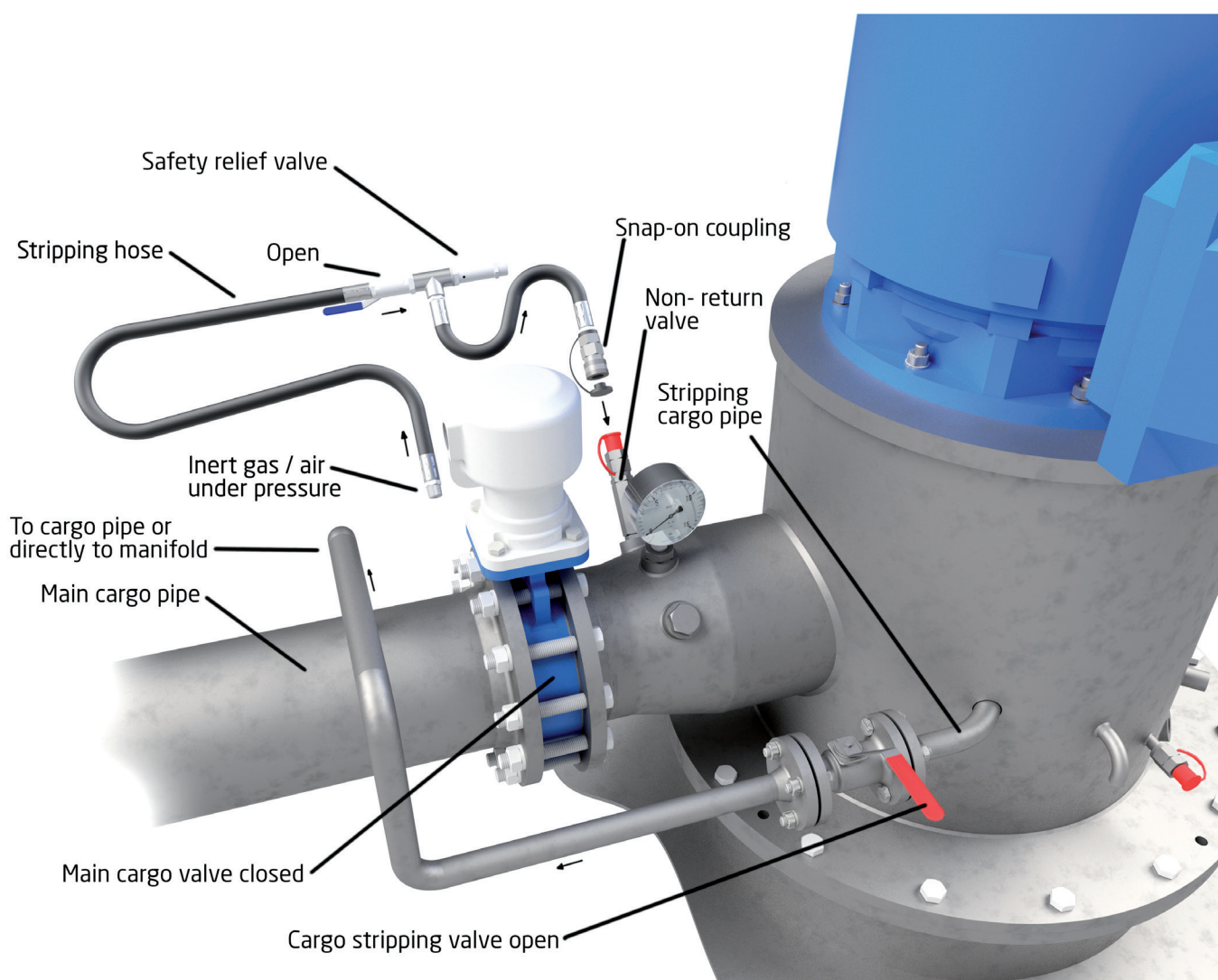
- Double protection with an atmospheric drainage chamber between the cargo side and the lubricating oil side.
- Proven to be simple and reliable.
- Easy replacement by the ship's crew (low cost).
- Seal condition can be monitored from the main deck side.



## Stripping procedure

When the cargo tank is empty, the cargo stripping valve must be opened and the main cargo valve closed. The residual cargo left in the main cargo pipe is removed by forcing inert gas or air via the stripping pipe into the cargo line on deck. During the stripping procedure, the pump should be kept running (the impeller acts as a dynamic foot valve) until the cargo pipe is completely empty. This procedure guarantees an absolute minimum of residual cargo in the pump well, and complies with all IMO rules.





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