



## Cruise & Ferry steam boiler systems and services







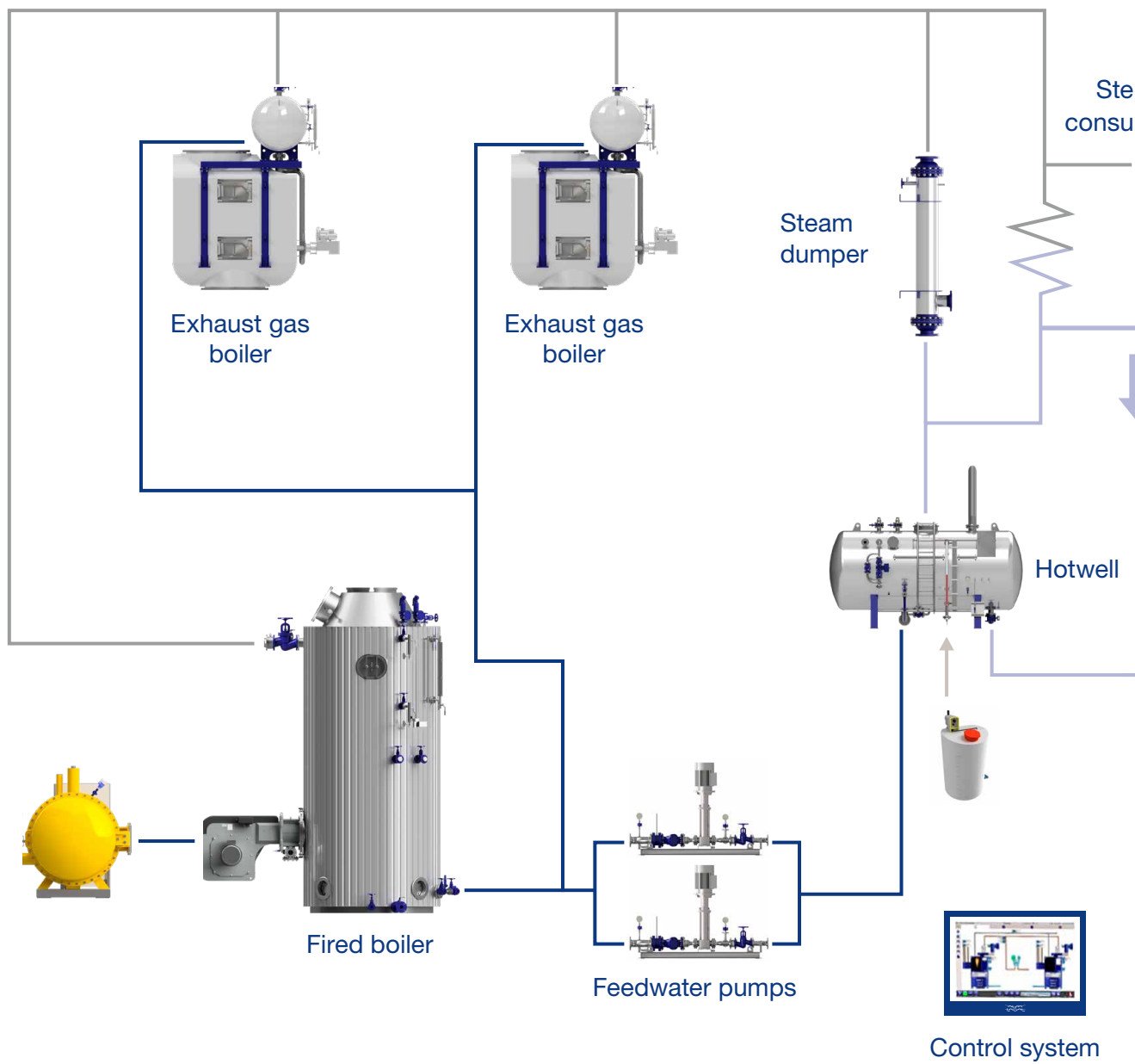
# The steam boiler system concept

To function properly, all parts of a ship's steam system must fit and work together seamlessly. To achieve this goal, we've created the Alfa Laval Aalborg Cruise & Ferry steam boiler system concept using a full-system delivery approach.

Our boiler systems are tailored to your demands, while remaining compliant with all passenger ship requirements and regulations. The steam system layout and control system design meet all IMO Safe Return to Port (SRtP) requirements, and they support the use of all established fuel types for fired boilers.

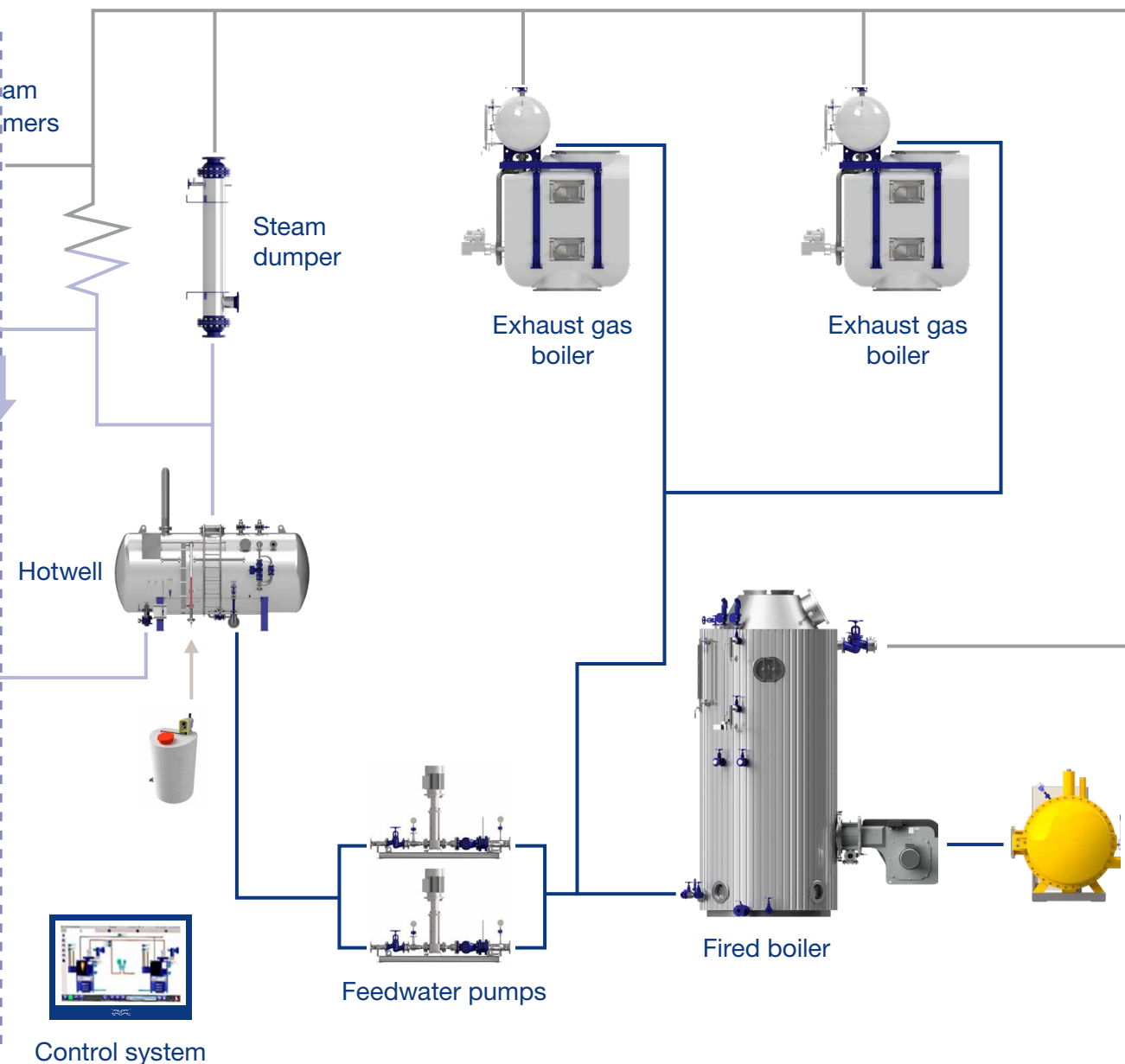
A typical delivery scope includes

- Waste heat recovery system (exhaust gas boilers)
  - Heating applications
  - Steam turbine applications
- Fired boilers with burners
- Complete steam system controls
- Complete feed water and condensate water systems
  - Hotwell tank
  - Feed water pumps
  - Control valves
  - Steam dumping condensers
- Fuel system
  - Gas valve units
  - Fuel oil pump units



# Cruise & Ferry steam boiler system

Typical layout for passenger ships



## Cruise control systems

Smart control makes modern steam boiler systems efficient and easy to operate. A system-tailored control system based on programmable logic controllers (PLC) supports a wide range of features, including intelligent boiler load sharing, automatic water quality control and efficient burner load control with flue-gas oxygen feedback. In addition, it provides highly effective troubleshooting tools.



With more than a century of boiler expertise and a deep understanding of passenger ship needs, we take a holistic approach to steam production on board.

### **Fired boilers, burners and fuel systems**

A reliable fired boiler is the heart of any ship's steam boiler system. Our proven boiler designs combine reliability and robustness with the highest efficiency on the market. All of our fired boiler models support a wide range of burners, so you can use the fuel of your choice: HFO, MGO, gas or any of these in combination.

A complete fuel delivery system is included in our scope. For liquid fuels, we supply a fuel pump unit that includes the temperature control for fuel heating or cooling. For gas, we have developed a gas valve unit that incorporates the whole fuel train in a single compact unit.

### **Waste heat recovery**

No modern marine steam system is complete without a safe, reliable and effective waste heat recovery system to improve fuel efficiency and reduce the ship's carbon footprint.

As well as providing traditional systems with forced circulation, we use a waste heat recovery concept based on natural circulation. Natural circulation uses changes in fluid density to drive water through the

boiler unit, which eliminates the issue of circulation pump cavitation. In addition, it vastly improves safety by minimizing the risk of soot fires.

At the same time, natural circulation simplifies the overall system design and maximizes the energy savings. No electric pumps are needed to drive the water circulation, and no heat energy is transferred out when the engine is shut down. Unlike systems with forced circulation, which constantly route saturated boiler water through the exhaust gas boiler, a system with natural circulation loses no heat energy to the draught in the funnel.

### **Control system**

Our Cruise & Ferry steam boiler control system concept features touchscreen panels with an intuitive graphical user interface. It incorporates all burner- and boiler-specific controls, as well as controls for all other devices in our delivery scope.

Based on programmable logic controllers (PLC), the control system is fully redundant and complies with all SRtP requirements. Combined with the internal process automation network, this lets us include smart features as standard, such as intelligent load sharing and blackout recovery.

# From fired boilers to waste heat recovery





Alfa Laval Aalborg CHB



Alfa Laval Aalborg OM-TCi

### Alfa Laval Aalborg CHB

The Alfa Laval Aalborg CHB is a vertical, high-efficiency marine boiler that features an advanced convection section. It can be used with gas, marine gas oil and heavy fuel oils with viscosities up to 700 cSt/50°C, as well as with waste oil and sludge. It can also be used as a steam drum for exhaust gas economizers.

Thanks to an upgraded thermal design that optimizes flue-gas oxygen content, the Aalborg CHB is far more efficient than typical boilers with a similar capacity range. This ensures lower operating costs and reduced environmental impact.

- Reduced fuel consumption and operating costs
- Good combustion due to proper furnace dimensioning
- Decreased CO<sub>2</sub> and NO<sub>x</sub> emissions
- Moderate loading and low material stresses
- Minimal refractory with water-cooled furnace bottom

### Alfa Laval Aalborg OM-TCi

The Alfa Laval Aalborg OM-TCi is a vertical boiler with a large furnace and an enhanced convection section, combining the best features of the Aalborg CHB and the well-known Aalborg OM. This standard boiler can be fired with a variety of fuels and has a capacity range of 8000–20,000 kg/h.

Like the Aalborg CHB, the OM-TCi has a thermal design that optimizes flue-gas oxygen content. This ensures lower operating cost and reduced environmental impact compared to typical boilers with a similar capacity range.

- Reduced fuel consumption and operating costs
- Decreased CO<sub>2</sub> and NO<sub>x</sub> emissions
- Traditional, proven design – easy to operate, very reliable
- Easily customizable to fit each layout/system
- Easy cleaning

### Steam balance

On a typical cruise ship, the heat energy needed for heating traditional heavy fuel oils comprises only a fraction of the total steam balance. The majority of the heat energy is consumed by the hotel consumers, e.g. heating of potable water, swimming pools and spas.

### Waste heat recovery

Effective waste heat recovery can improve the fuel efficiency of a typical cruise ship's heating system by 50%. Waste heat is recovered directly from the engine exhaust gas and transformed into steam, rather than being lost to the atmosphere.



Alfa Laval Aalborg OH



Alfa Laval Aalborg XWi

### Alfa Laval Aalborg OH

The Alfa Laval Aalborg OH is a two-pass boiler with smoke tubes, used to produce steam or hot water. Made with a crack-resistant, low-alloy plate material that extends its lifetime, it has a horizontal layout that provides a solution when vertical space is limited.

The Aalborg OH can be fired with gas, marine gas oil, diesel oil, heavy fuel oil or a combination of these. In addition, it can be used as a steam drum for exhaust gas economizers. If the economizer has a high capacity, the boiler size may need to be increased.

- Compatible with a wide range of fuels up to 700 cSt/50°C
- Traditional, proven design – easy to operate, very reliable
- Easily customizable to fit each layout/system
- High efficiency and fuel savings

### Alfa Laval Aalborg XWi

The Alfa Laval Aalborg XWi is an exhaust gas boiler with an integrated natural circulation system, which uses changes in fluid density to drive water through the boiler unit. This eliminates the problems associated with forced circulation, such as cavitation, water hammering and soot fire risk.

Because the Aalborg XWi circulates water only when the engine is running, no heat is lost to the cold draught when the engine is stopped. This means the oil-fired boiler is used less, with lower fuel costs and emissions as a result. When the circulation is stopped, water fills the boiler tubes, minimizing the risk of soot fires.

- Simple, reliable natural circulation – no pumps or rotating components
- Maximized safety, minimized risk of soot fires
- Reduced electricity consumption and maintenance costs
- Reduced total installation and material costs
- Reduced heat loss that may save hundreds of thousands of euros in systems comprised of multiple four-stroke engines
- Increased system redundancy

### Waste heat recovery with conventional forced circulation

Waste heat recovery systems can be designed with conventional forced circulation. In this case, pumps circulate saturated water from the fired boiler through the exhaust gas boiler, where a portion of it evaporates. The water is then returned to the fired boiler along with the steam. In such a configuration, the fired boiler acts as a steam drum for the exhaust gas boilers and is designed with an enlarged steam space.



Alfa Laval Aalborg hotwell tank



Alfa Laval Aalborg water chemistry solution

### Hotwell tank

Quality feed water safeguards the operation and service life of any marine steam system. Water quality control begins with clean source water, which is de-gassed and temperature-controlled in the hotwell to produce feed water. By detecting and removing oil and other impurities before they reach the feedwater system and steam boilers, the hotwell also plays an important role in controlling the quality of returning condensate water.

Atmospheric tanks are available. However, for the best possible results, we recommend a pressurized hotwell, which has a deaerator capable of de-gassing without chemicals.

- Thermal de-gassing of feed water with a deaerator
- Temperature control of feed water
- Oil detection for condensate water
- Oil skimming section for condensate water

### Water chemistry solution

In addition to de-gassing, chemical treatment is necessary to manage key parameters of feed water. Our automatic water chemistry solution monitors the water quality in all parts of the steam boiler system, and doses chemicals as needed. In addition to chemical dosing, the water chemistry solution performs the final crucial step of the fully automated water treatment solution, by controlling the automatic blow-down valves for each boiler and tank according to the results of the water analysis.

- Automatic water sampling
- Automatic dosing of chemicals
- Automatic saving of water records
- Automatic blow-down according to water quality
- Integrated control system

### Safe Return To Port

Safe Return to Port (SRtP) refers to the SOLAS regulation adopted by IMO resolution MSC.216(82), which came into force on 1 July 2010. The SRtP regulation requires passenger vessels to be designed for improved survivability if they are longer than 120 metres or have three or more main vertical zones. In the event of a flood or fire, it must be possible for passengers and crew to remain safely on board as the ship proceeds to port under its own power.



Alfa Laval Aalborg gas valve unit



Alfa Laval Aalborg fuel pump unit

### Gas valve unit

Our gas valve unit has a design and functions that are tailor-made for passenger ship installations. It incorporates the entire burner fuel train in one compact unit, which has a small footprint and opens to expose the fuel train for easy service. Modular and easily scalable, it can accommodate a wide range of power ratings.

The gas valve unit also features an inline methane analyser, which accommodates variable gas compositions and enables more flexible burner control. Combined with our Cruise & Ferry steam boiler control system, the unit can be used for different modes and load profiles, including boil-off burn mode and normal modulation mode. It can also be operated with various fuel line setups and pressure levels.

- Compact, integrated fuel train with a small footprint
- Easy service access
- Methane analyser for flexible burner control and variable gas compositions
- Multiple operating modes, including boil-off and normal modulation
- Support for various pressure levels and fuel line setups

### Fuel pump unit

Our fuel units for traditional liquid fuels include supply pumps, ignition oil pumps, heaters and coolers. All equipment is incorporated in a single modular unit. Fuel temperature can be adjusted with steam and electric heaters for heavy fuel oils, and with water coolers for light fuel oils.

### Steam turbine

The amount of energy that can be recovered from the ship's engine exhaust typically exceeds the consumption of heat energy on board. Excess recovered energy can be used to drive a steam turbine generator, improving the ship's fuel efficiency while reducing its carbon footprint.



Feed water pumps



Heat exchangers for steam condensing, heating and cooling

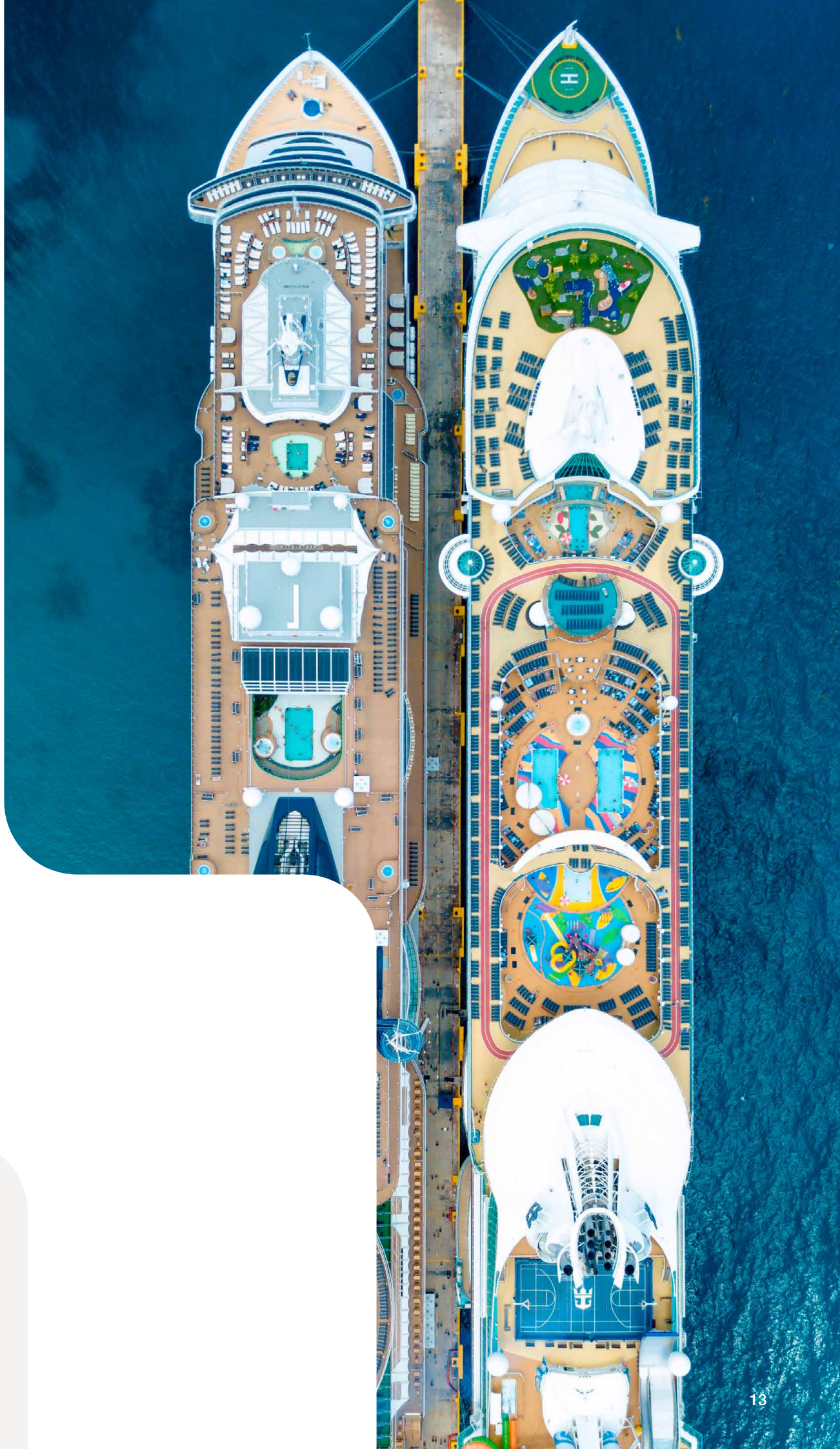
### Feed water pumps

Feed water system design is key to the steady, accurate control of boiler water levels. Depending on the installation, the feed water flow can be controlled with either continuously modulating control valves or variable-frequency pumps. Variable-frequency drive pumps offer improved energy efficiency and reduced wear on the pumps themselves.

### Heat exchangers for steam condensing, heating and cooling

Our full-system deliveries include steam-dumping heat exchangers with steam and condensate control valves. Designed to match the full amount of steam produced through waste heat recovery, they handle the extra load when the produced steam exceeds onboard consumption. Steam-dumping condensers eliminate the need for directional exhaust gas valves or bypass arrangements, which may take up too much space in the funnel.

- Minimal space requirement
- Full control of pressure in the steam system
- Simply designed exhaust gas ducts



# Applications for improved efficiency

There are possibilities to get even more from your steam boiler system. We can help you achieve additional savings and further enhance your green profile.





### **Steam turbine**

Our most energy-conscious customers may benefit from a steam turbine solution, which turns engine waste heat into electricity by using a steam turbine to drive a generator. We can provide a complete steam turbine generator set, designed for either superheated or saturated steam. The solution is controlled by the steam boiler control system.

### **Superheated steam**

Our use of natural circulation in waste heat recovery enables the production of superheated steam. Also known as dry steam, superheated steam contains no moisture and is the preferred choice for driving steam turbines. Because superheating increases the steam's energy content without increasing pressure in the system, it allows more heat to be recovered from the exhaust gas, increasing overall energy efficiency.

### **Integrated electric heating**

Waste heat recovery systems can be equipped with integrated electric heating. An electric heater can be installed on the steam drum(s) to facilitate steam production while in port, reducing or eliminating the need to run the fired boiler. When shore power is available, local emissions can be significantly reduced by burning less fuel to produce steam.

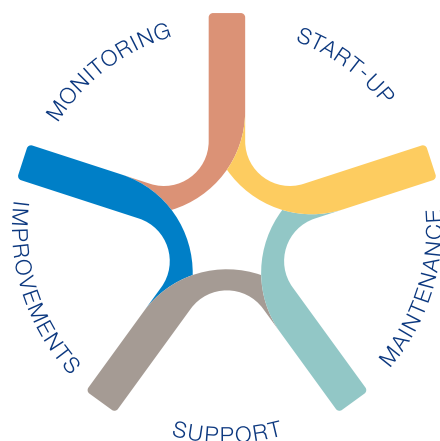
We provide full support for our Cruise & Ferry steam boiler systems. Our support covers their entire life cycle, from design, installation and commissioning, past warranty and throughout the entire service life.

### Service Agreements

We can't predict the future, but Alfa Laval Service Agreements can make it less uncertain. A fixed-period Service Agreement makes operation planning and cost projections more secure.

A well-crafted maintenance strategy offers transparent cost control and safeguards performance, lengthening your equipment's lifespan and reducing your total operating costs. Expert maintenance not only improves the performance of your Alfa Laval equipment, but also helps you get more from the equipment surrounding it.

### Extending performance in 360°



# Service



## Maintenance services

Preventive maintenance is the key to reliable performance. Our Preventive Maintenance Programme comprises annual and 30-month services that comply with regulatory inspection schedules for marine steam boiler systems. We issue an original equipment manufacturer's service certificate after each completed service.

Because we take a full-system approach, we address every part of the steam boiler system in our services, for example by checking water quality throughout.

## Condition inspections for steam boiler systems

Alfa Laval condition inspections let you know the current condition of your equipment, which is critical to making informed decisions about future operations and maintenance. Our specialists in Cruise & Ferry steam boiler systems can perform condition inspections with different scopes, but their efforts always go beyond inspecting individual components. In each audit, they take the entire steam boiler system into account.

## Remote connectivity services

Adding a connectivity gateway to the boiler control system enables a number of remote services, including secure remote monitoring, online technical support and remote software updates, as well as collection and storage of process data.

## Restart and lay-up services

Without the right precautions and system checks, returning to normal operation after prolonged downtime or a period of low-load operation may not be easy. Alfa Laval's restart inspection service includes all the inspections and tests necessary to ensure a smooth return to normal operation.

If you are planning an extended pause in boiler operations, proper steps will be needed to prevent the deterioration of your system. Our boiler lay-up service makes sure the correct steps are taken to protect your boiler until it's brought back into service.

## Spare parts

Using Alfa Laval original spare parts is key to maintaining the superior quality of your steam boiler system – and ensuring it will work as intended throughout its life. Based on our extensive experience, we've created tailored spare part packages with preventive maintenance in mind. A variety of spare part packages are available to meet your specific needs, so that you can always have the correct parts on hand.





### **This is Alfa Laval**

Alfa Laval is active in the areas of Energy, Marine, and Food & Water, offering its expertise, products, and service to a wide range of industries in some 100 countries. The company is committed to optimizing processes, creating responsible growth, and driving progress – always going the extra mile to support customers in achieving their business goals and sustainability targets.

Alfa Laval's innovative technologies are dedicated to purifying, refining, and reusing materials, promoting more responsible use of natural resources. They contribute to improved energy efficiency and heat recovery, better water treatment, and reduced emissions. Thereby, Alfa Laval is not only accelerating success for its customers, but also for people and the planet. Making the world better, every day. It's all about Advancing better™.

### **How to contact Alfa Laval**

Contact details for all countries are continually updated on our web site. Please visit [www.alfalaval.com](http://www.alfalaval.com) to access the information.

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