

Wandlung von  
Überschusswärme der  
Haupt- und Hilfsdiesel in  
elektrische Energie  
mit Hilfe des ORC Verfahren.



**KARBERG&SCHMITZ**





## Alfa Laval E-PowerPack



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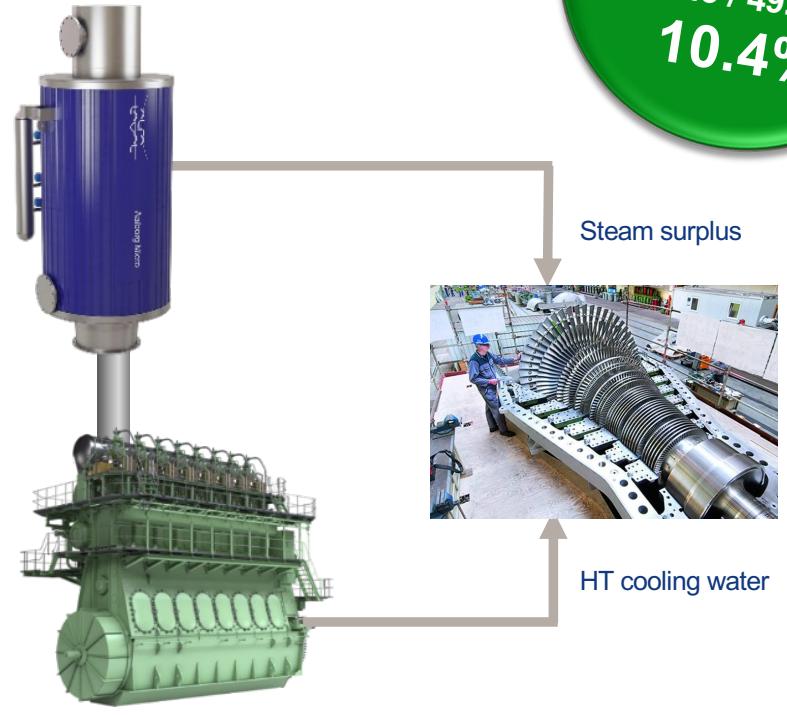
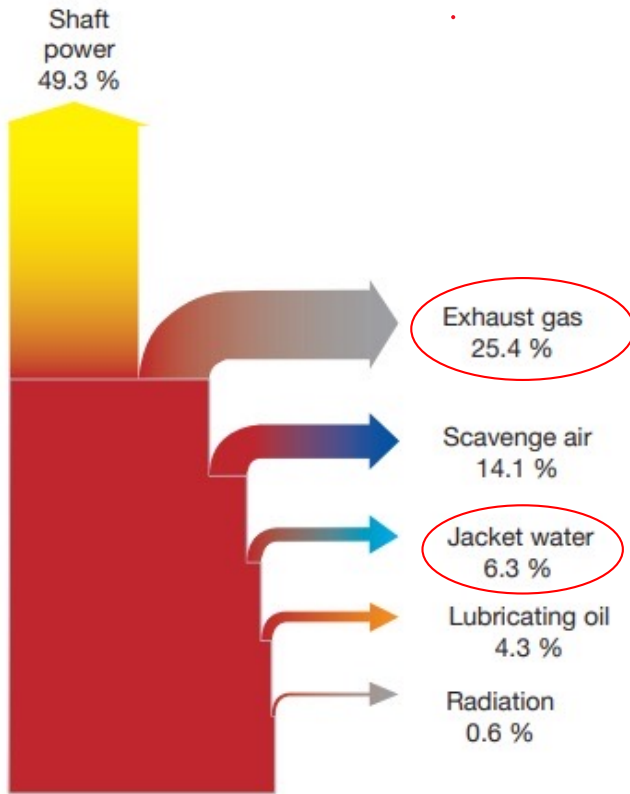


# Alfa Laval E-PowerPack

Introduction



Engine efficiency improvement with heat recovery:  
 $54.3 / 49.1 = 10.4\%$



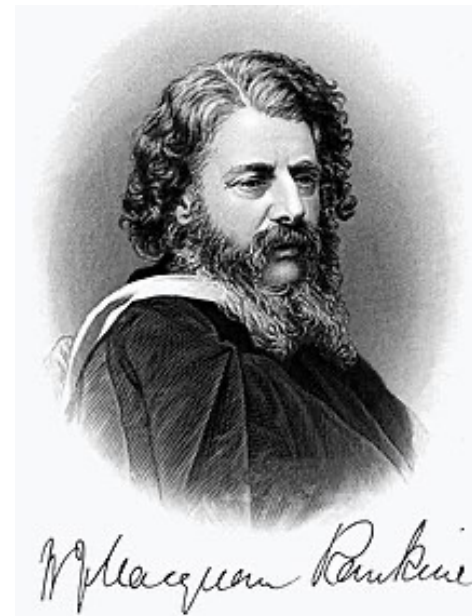
# Organic Rankine Cycle

Turning waste heat into electrical power



Der **Organic Rankine Cycle** ist ein Verfahren des Betriebs von Dampfturbinen mit einem anderen Arbeitsmedium als Wasserdampf.

Der Name des Verfahrens geht auf William John Macquorn Rankine zurück, einen schottisch-britischen Physiker und Ingenieur im 19. Jahrhundert.



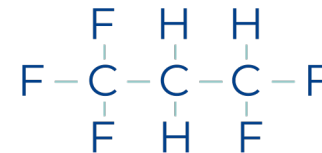
# Working medium

R245fa



- In the E-Powerpack the medium is **R245fa** (HFC-245fa)
- R245fa commonly used in refrigeration and cooling applications
- R245fa is **non-toxic**, non-flammable and has no ozone-depletion-potential (ODP=0)
- It is a material that will **conform** with the relevant regulations and classification requirements (GWP 1030)
- No significant **safety considerations** for positioning

## Pentafluoropropane



### Names

**IUPAC name** 1, 1, 1, 3, 3 - pentafluoropropane

**Other names** R-245fa; HFC-245fa; Enovate 3000; Genetron 245fa; AC1Q4KND; UNIITA9UOF49CY

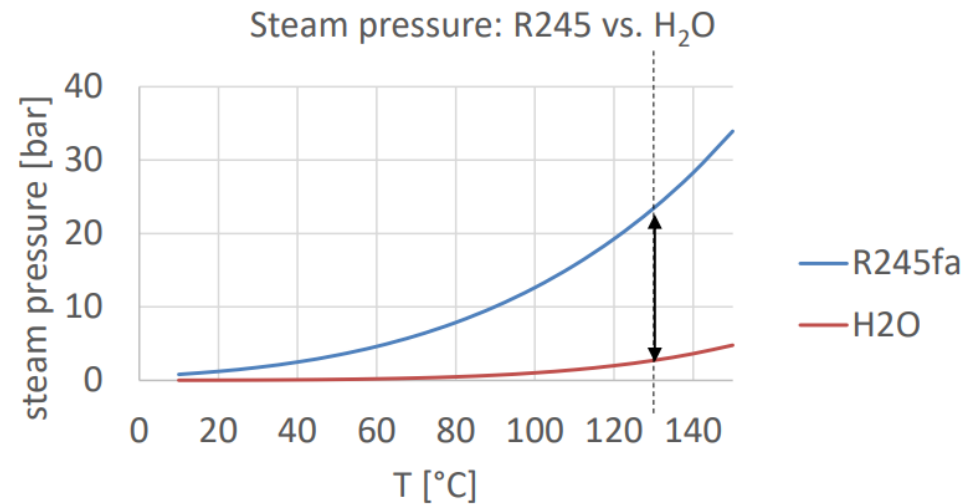


# Organic Rankine Cycle

- Relevance



- Ability to create a **high pressure** at relatively low evaporation temperatures to run the expansion machine.
- **High vapor density** allows us to build a relatively compact, light and small in terms of footprint, system.



Efficient use of low temperature heat sources

# Waste energy management

Turning waste heat into electrical power

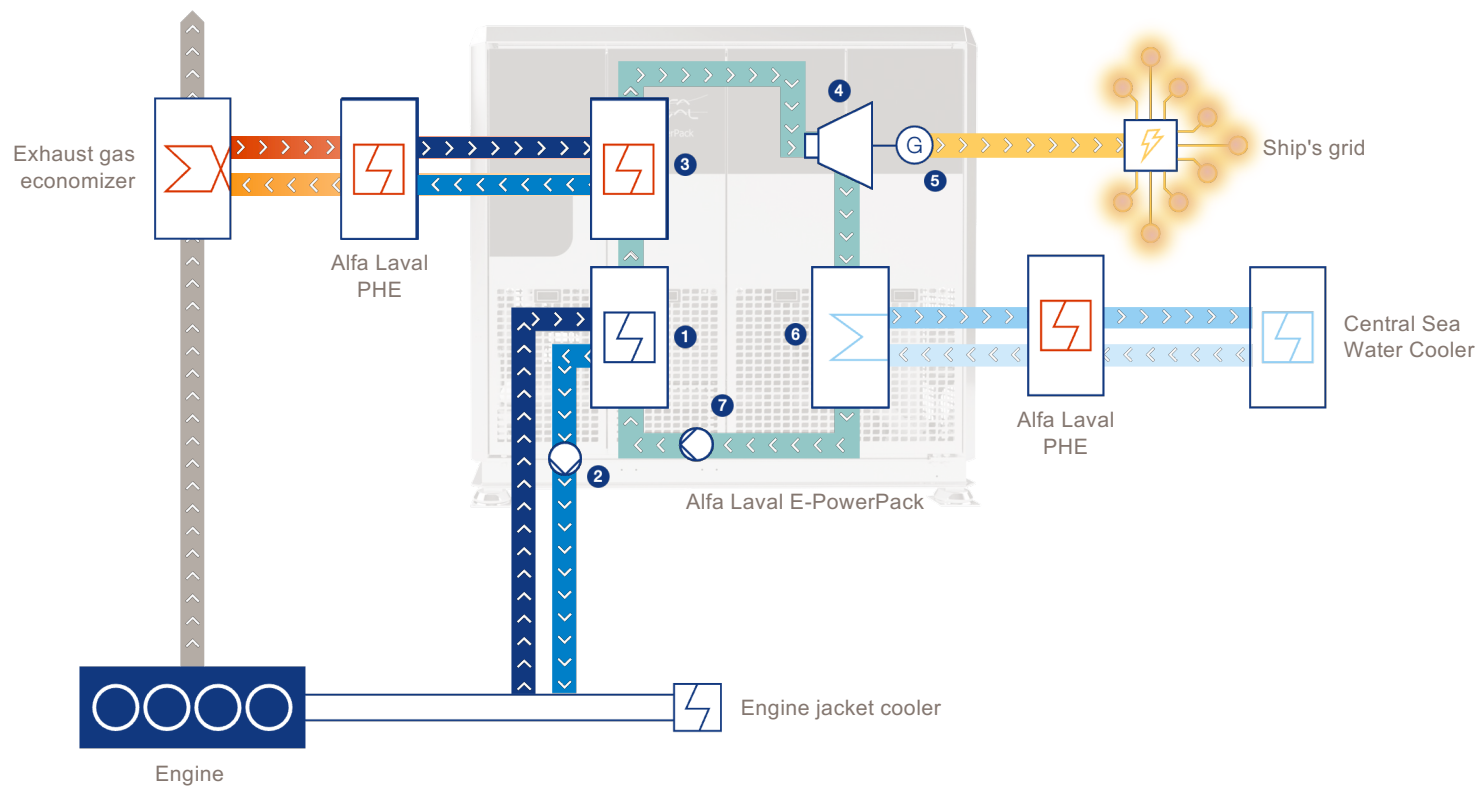


- Recovering waste heat is one of the simplest ways of improving a vessel's overall energy efficiency
- The Alfa Laval E-PowerPack turns excess onboard heat into electrical power
- A new, sustainable source of electricity reduces demand on a vessel's auxiliary engines
- This, in turn, lowers overall fuel consumption and GHG emissions



# How it works

## Organic Rankine Cycle



- 1. Preheater
- 2. Jacket cooling water pump
- 3. Evaporator
- 4. Expansion machine
- 5. Generator
- 6. Condenser
- 7. Feed pump



# Sizes

– Nominal Power Output



## Alfa Laval E-PowerPack 100kW



**Dimensions:**

1180 x 1400 x 1982 mm

Footprint: 1.5 m<sup>2</sup>

Weight: 2300 kg (incl. refrigerant)

## Alfa Laval E-PowerPack 200kW



**Dimensions:**

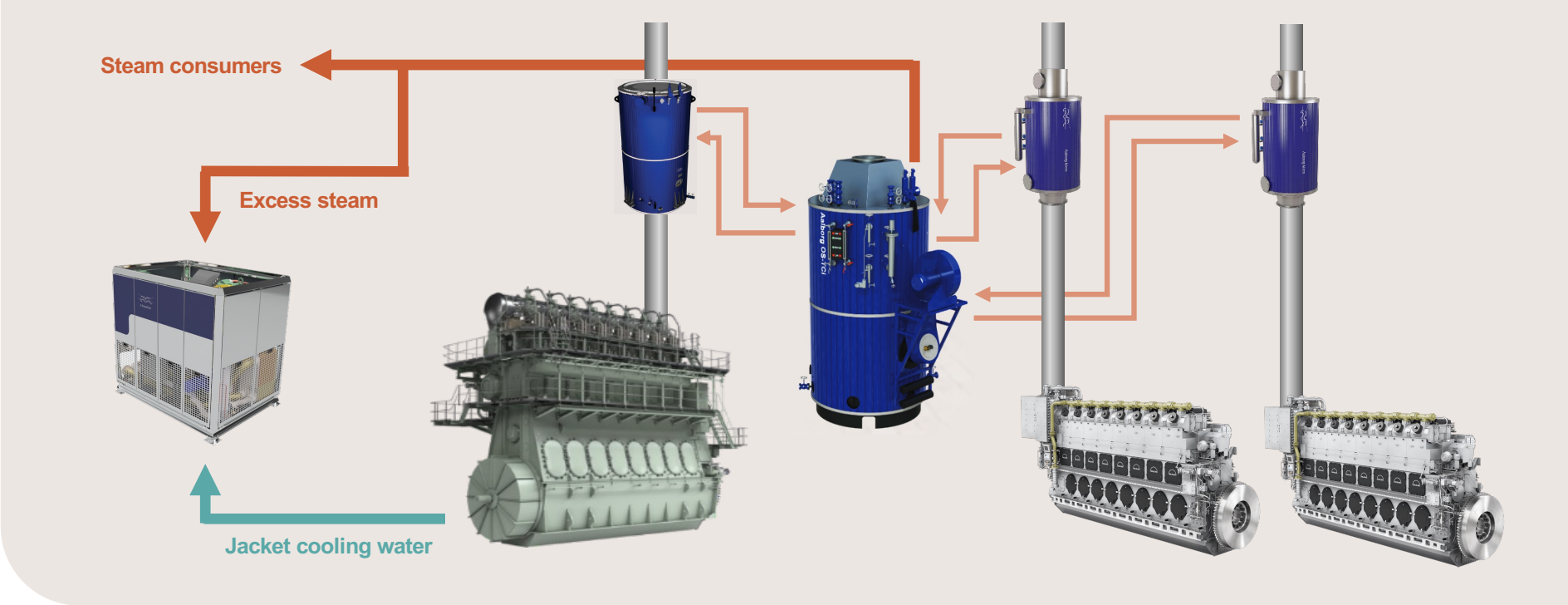
2300 x 1700 x 2100mm

Footprint: 4 m<sup>2</sup>

Weight: 4600 kg (incl. refrigerant)

# Alfa Laval E-PowerPack

Example of steam application



# For engines of many types and sizes

Small engine compatibility



## 500kW

## 5000kW



<b>Weight</b> (incl. insulation)	400–3900 kg
<b>Diameter</b> (incl. insulation)	950–1870 mm
<b>Height</b> (incl. insulation)	1700–2800 mm

The **Aalborg Micro** can be used with engines as small as 500 kW, and up to 5000 kW.

It works with both auxiliary and smaller main engines.

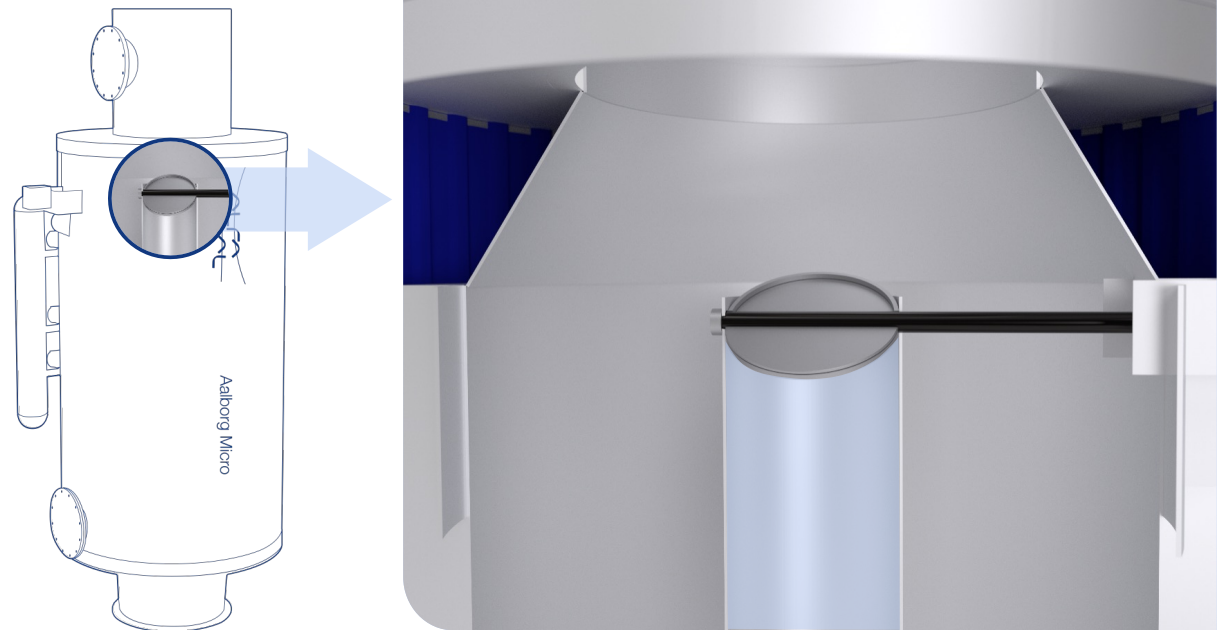
# No need to oversize

By-pass handles back pressure



Exhaust gas boilers normally need to be oversized to handle back pressure.

Not the Aalborg Micro. It comes with a **by-pass** (including an electric actuator) – a straight tube with a damper that controls both the steam production and the back pressure. This is capable to by-pass up to 80%.



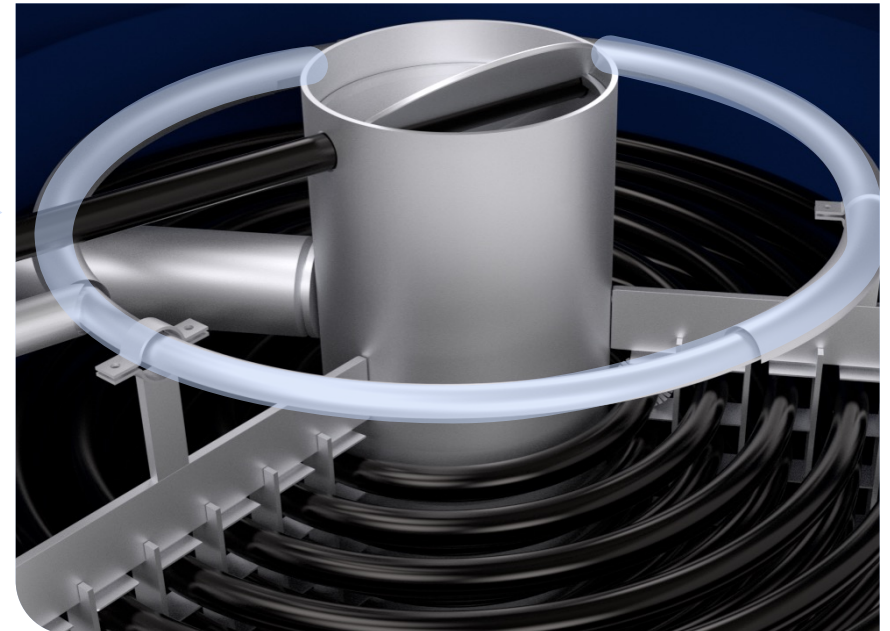
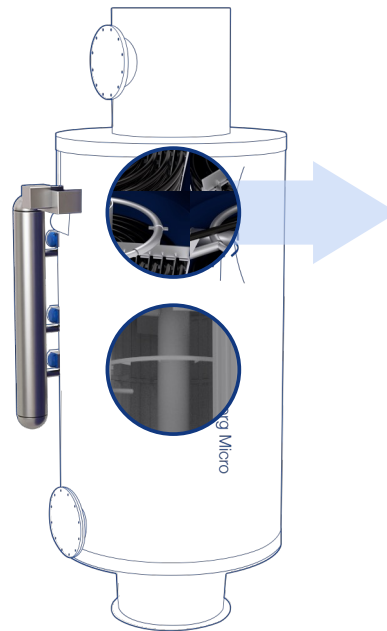
# Efficient, no-hassle cleaning

Soot blower reliability



## Soot blower

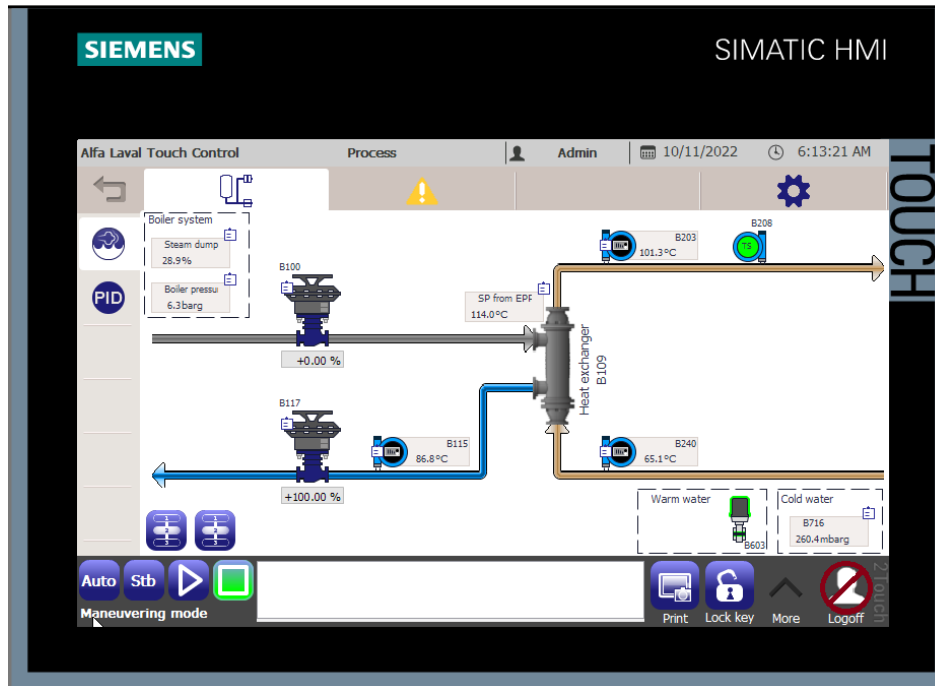
The soot blower guarantees an easy, well-proven and efficient cleaning process.



SIMPLICITY

# Operation

Control system and HMI interface



Interface panel (L49) HMI layout

- Fully independent operating unit
- **Sufficient waste heat** → Automatic switch on and synchronization to a live grid
- Heat disappears → Automatic switch off
- **No human interference is required.**

# Alfa Laval Test and Training Centre

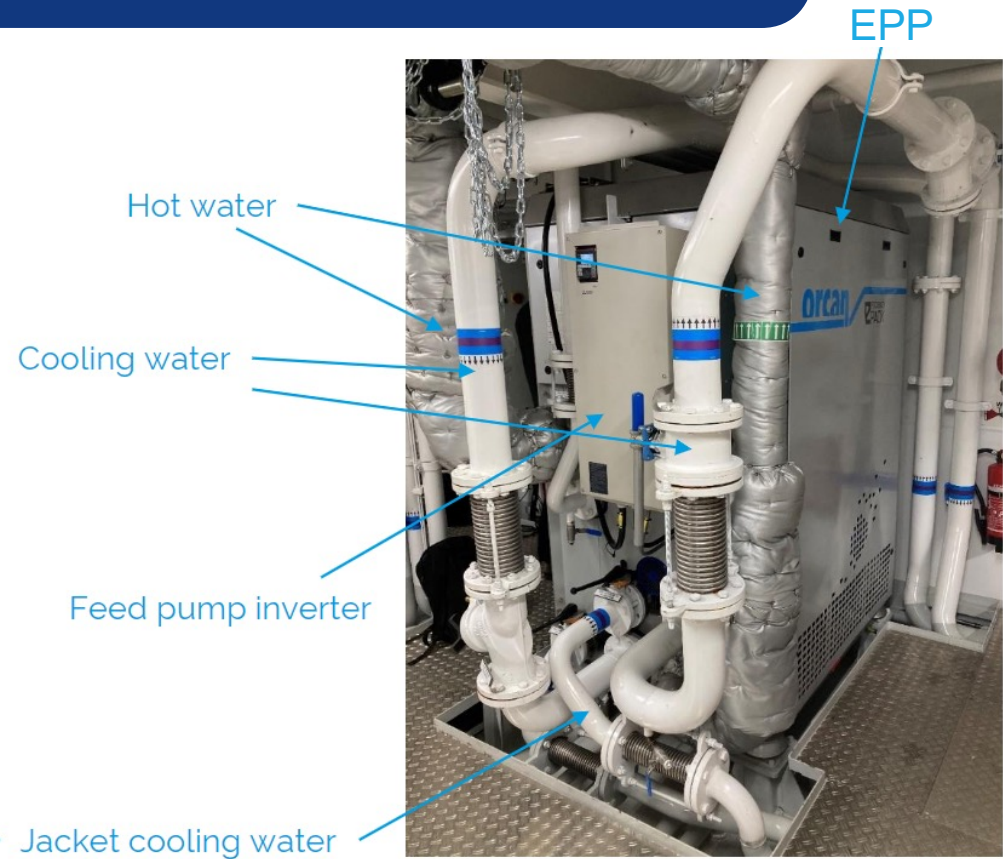


# Alfa Laval Test and Training Centre





# Ship integration



# Benefits



Reduced **fuel consumption** from the auxiliary engines

Reduced **emissions** and carbon footprint

Improved Energy Efficiency Design Index (**EEDI**) and vessel's **CII** rating

Reduced **CO2 tax** (EU, worldwide scale?)

# Key takeaways



## E-PowerPack

- It is a compact system for generating power from waste heat
- Uses the **Organic Rankine Cycle** technology
- The medium used is **R245fa** (non-toxic, non-flammable and has no ozone-depletion-potential) common refrigerant
- The system can use waste heat from **hot water, saturated steam and thermal oil**
- Comes in 2 sizes, **100kW and 200kW** of nominal capacity
- It is a low maintenance, highly reliable system
- It is fully automatic with minimum human interference required
- Vessel's operating profile (sailing conditions, winter, tropical, etc.) will affect power output

