



JNW CleaningSolutions GmbH

Fully-Automatic Cleaning Robots for ACC Cleaning and Cooling with Low Water Use

ACC User Group Meeting, Stamford, Sept. 13th, 2022
presented by: Arndt Krebs CEO / Managing Director



JNW – Company Overview

Experience Pays – fully automated even more

Founded: 1932

Headquarter: Bochum, Germany

Business Divisions:

- **Machinery Building:** Since 1991 we delivered worldwide 420 complete cleaning systems including more than 3.000 chassis for the cleaning of air-cooled heat exchangers.
- **Cleaning Service:** With our patented mobile cleaning system we are cleaning air cooled heat exchangers in Germany, Europe and South Africa since 1995 and in USA with our partner Conco since 2001.



The JNW-Group

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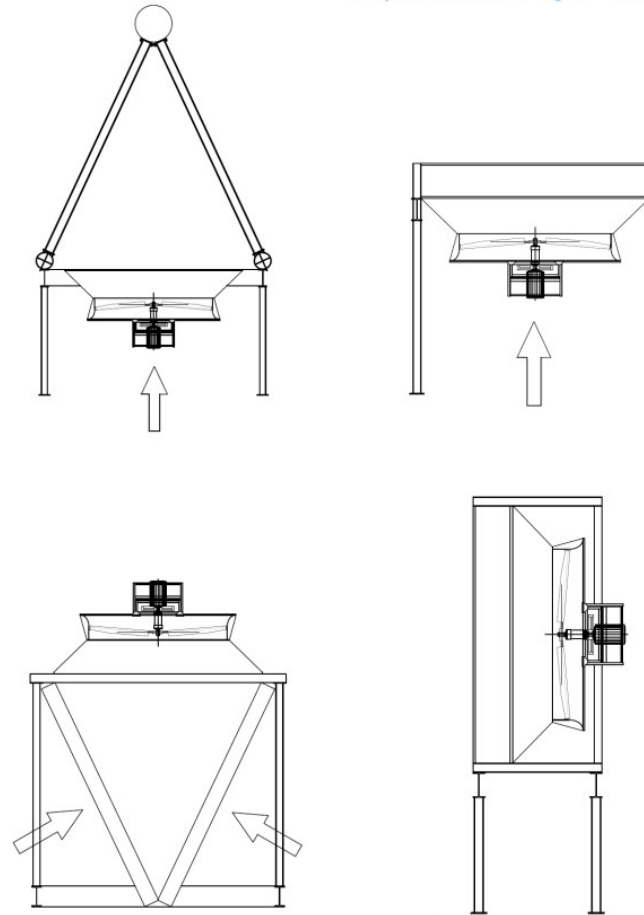
Cleaning Equipment Design

Our heart beats for engineering and clean air cooled heat exchanger!

That's why we design cleaning equipment that fits perfectly to each kind of air cooled heat exchanger:

- Air Cooled Condenser / ACC
- Flat Bed Cooler
- V-Design
- Hybrids

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Cleaning Equipment Range

Complete range from manual to fully automated

- Manual Cleaning Chassis since 1991
- Semi-Automatic Cleaning Systems since 1991
- Fully-Automatic Cleaning Robots since 2012
- Special cleaning equipment designed to customer requirements since 1991

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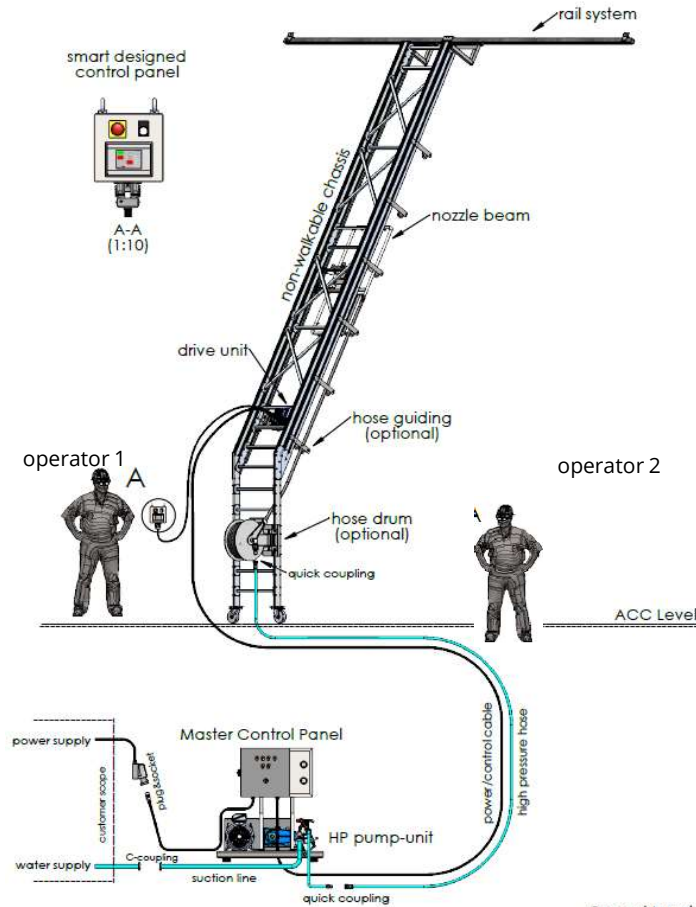


Fully-Automatic Cleaning Robots

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Fully-automatic vs. semi-automatic cleaning systems

- Semi-automatic cleaning system:
 - require 2 operators for:
 - horizontal movement of the chassis
 - to route and guide cables and hoses
 - equipment change (nozzle beam, drive unit) from one roof side to the next



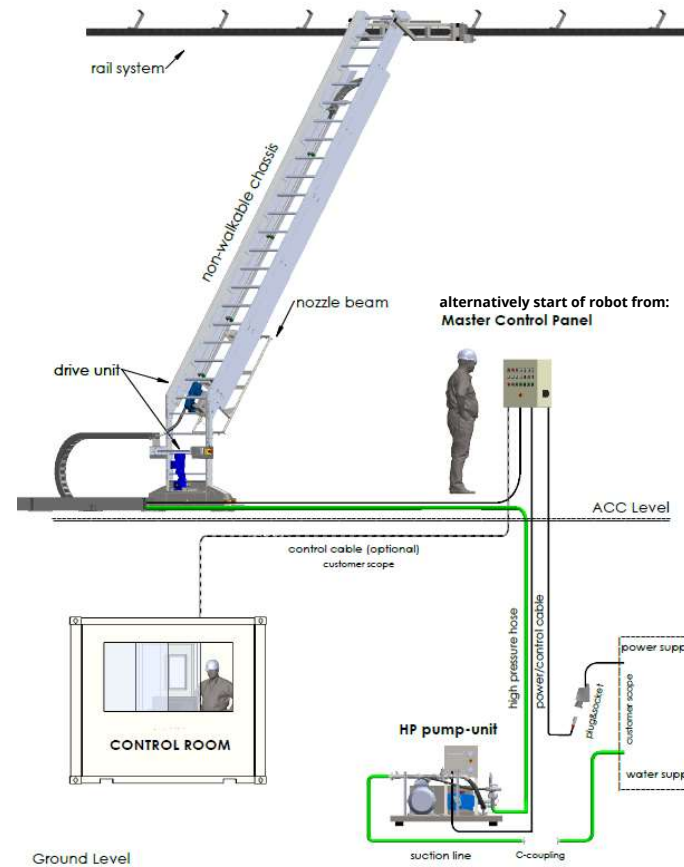
Ground Level

Fully-Automatic Cleaning Robots

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Fully-automatic vs. semi-automatic cleaning systems

- Fully-automatic cleaning robot:
 - controlled from the central control room or alternatively
 - from the Master Control Panel (MCP) on the ACC

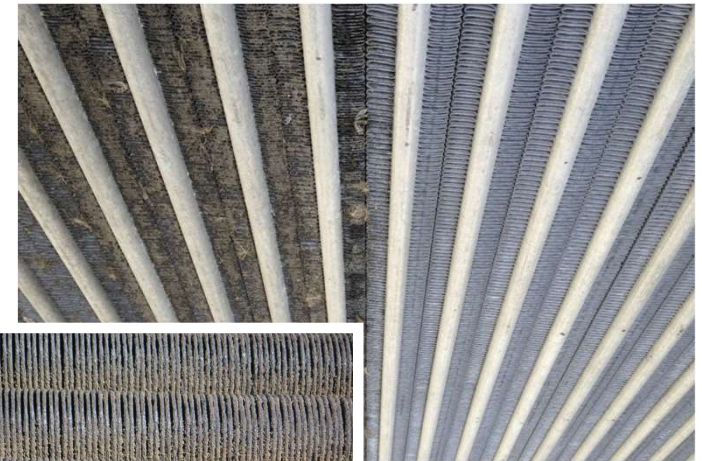


Fully-Automatic Cleaning Robots

Up to now - semi-automatic cleaning systems have been used for cleaning

- ACCs usually get dirty by pollen which has a negative effect on air circulation and thus on the cooling performance of the ACC.
- Therefore ACC cleaning is mainly done during or at the end of blooming period.
- A cleaning of the ACC once or twice a year is therefore usually enough to clean the ACC from pollen and to have it ready when it is getting hot in summer.
- A clean ACC significantly increases performance over a fouled ACC.

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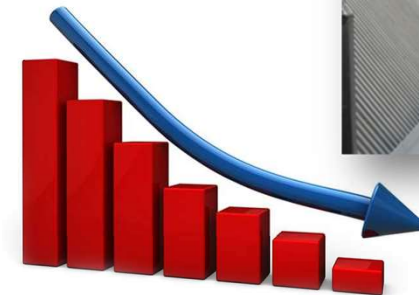
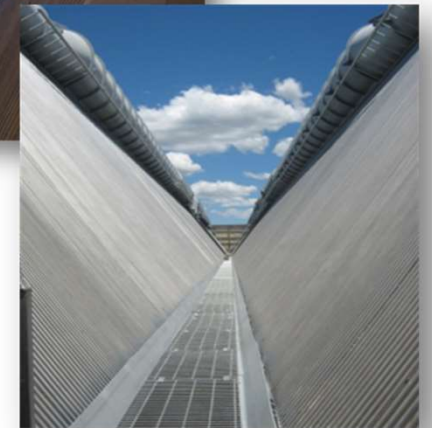


Fully-Automatic Cleaning Robot

You all know this scenario

- As soon as temperatures get up, especially when they rise well above the ACC's design temperature the cooling performance goes down and consequently:
 - turbine backpressure increases
 - degree of efficiency of turbine decrease
 - in worth case, the increase of backpressure leads to a throttling of the turbine
- Such a loss of ACC performance means a loss of:
 - efficiency
 - output
 - profit

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Fully-Automatic Cleaning Robots

...you manage this scenario but you don't solve it!

- Refineries with own fire department used it to spray water for cooling on the ACC or the semi-automatic cleaning system was used.
- But for multiple cleanings this is not flexible enough.
- Especially quick changing weather conditions require great organizational efforts and costs by using your own staff (if available) or by hiring external companies.
- Cleaning during summer is for safety reasons in some regions simply even not possible as temperatures on the ACC reaches 80-90°C/176-194°F

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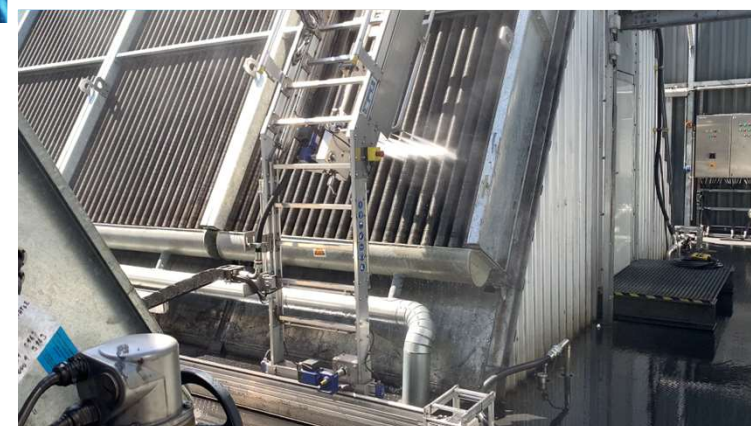


Fully-Automatic Cleaning Robots

Now we have a solution from this scenario!

- The solution is a fully-automatic cleaning robot that:
 - do not require any operator (own staff or from third party)
 - offers highest flexibility as it gets started from the central control room at any time even at temperatures of 80-90°C/176-194°F
 - is designed for a continuous operation
 - allows to spray constantly water for cooling on the ACC
- The JNW robot turns the cleaning system into a cooling system ensuring that:
 - the cooling performance of the ACC remains high
 - the increase of backpressure will be significantly reduced
 - degree of efficiency of turbine remain in an optimized range
 - a throttle of the turbine can be avoided

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Evidence - Our Strongest Argument

Evidence is given by a German biomass plant

- Technical Data of Biomass Plant, Germany:
 - wood fired approx. 100,000 t/a
 - steam boiler system with grate firing
 - turbine generator set for generating electricity and extracting heat
- ACC:
 - built 2006
 - single row
 - design temperature: 25°C / 77°F
 - roof: 1
 - bundle height 11m
 - length: 40m
- Turbine:
 - 14 MW
 - highest efficiency at steam exhaust pressure of ~ 60mbar
 - throttle of power at steam exhaust pressure > 150mbar

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Our Strongest Argument

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Let's talk about numbers and money

- Our customer reports that the output increase **with** use of the cleaning system for ACC cooling is **40 MWh/day!**

- That means the payback time of the total investment for a JNW fully automatic cleaning robot is calculated in days!

increase of output in MWh/day:	40
sales price in Euro for 1 MWh on power exchange, Leipzig/Germany on August 26 th , 2022:	699,44 €
additional sales due to output increase in EURO per day!	27.977,60 €
days with temperatures >25°C/77F per year (Ø-4years)	49
total additional profit due to output increase in Euro per year!	1.370.902,40 €
water consumption HP-Pump in l/min:	100
operation of HP-Pump per day in h	10
water consumption HP-Pump in l/day:	60.000
water consumption HP-Pump in m ³ /day:	60
purchase price water per m ³	1,64 €
cost for water per day in Euro	98,40 €
total additional profit due to output increase in Euro per day!	27.879,20 €
days with temperatures >25°C/77F per year (Ø-4years)	49
total additional profit due to output increase in Euro per year!	1.366.080,80 €

Fully-Automatic Cleaning Robots

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Cleaning philosophy changed by fully-automatic cleaning robots

- From a pure economic point of view, an increase in output is certainly beneficial, especially now as sales prices for energy are on all time high.
- Improving the efficiency of the plant and increasing the output by using the cleaning robot for ACC cooling is on the other hand causing an increase of water consumption (in the presented case 2.940 m³/year) without water recycling.
- Form an environmental point of view each plant operator has finally to decide whether the increase in efficiency of the plant together with higher water consumption is preferable or a lower efficiency of the plant with a lower water consumption.
- Whereby legal requirements must certainly also be taken into account depending on the location of the plant.



 **JNW**
CLEANING SOLUTIONS

Fully-Automatic Cleaning Robots

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Cleaning philosophy changed by fully-automatic cleaning robots

- What can we do to save water?
 - The plant operator can install a system for collection and recycling of the water used for ACC cooling.
- What JNW did to save water is:
 - the development of a special cooling program for our cleaning robot that saves up to 50% of water compared to the different programs for cleaning
 - the development of a new setup of our HP-pump that reduces the water consumption up to 60%

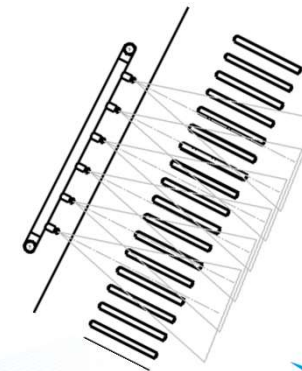


HP-Pump Optimization

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We used the Corona period for testing

- In our workshop we use our two test stands for an intensive test of different HP-pump setups with different HP-pumps, nozzle beams, nozzles etc. in order to find the best configuration for cleaning and cooling for single layer and...



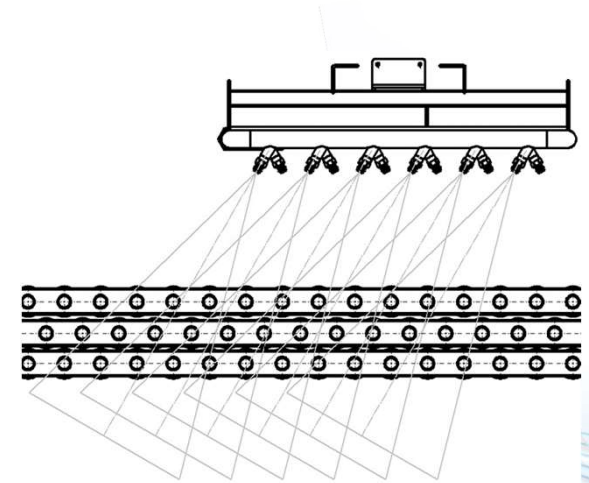
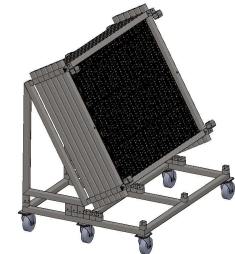
HP-Pump Optimization

and testing!

- and multilayer air cooled heat exchangers as well.



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HP-Pump Innovation

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HP-Pump Model	80 bar 170l/min	Improvement 2018	50 bar 100l/min	Further Improvement 2022	60 bar 60l/min
Technical Data / HP-Pump					
Pressure	80 bar		50 bar		60 bar
Flow	170 lpm	-41%	100 lpm	-40%	60 lpm
Technical Data / Drive Motor					
Output	30 kW (40 HP)	-50%	15 kW (20 HP)	-50%	7.5 kW (10 HP)
Noise Level (motor)	90.0 dB	-32%	61.0 dB	-7%	57.0 dB
Weight (in total)	400 kg	-13%	350 kg	-20%	280 kg



water consumption
cooling operation
10h/day



102 m³



60 m³



36 m³ !



Fully-Automatic Cleaning Robots

Your advantages!

- significant decrease of costs
- strong increase of safety at work
- massive increase of efficiency, output and profit

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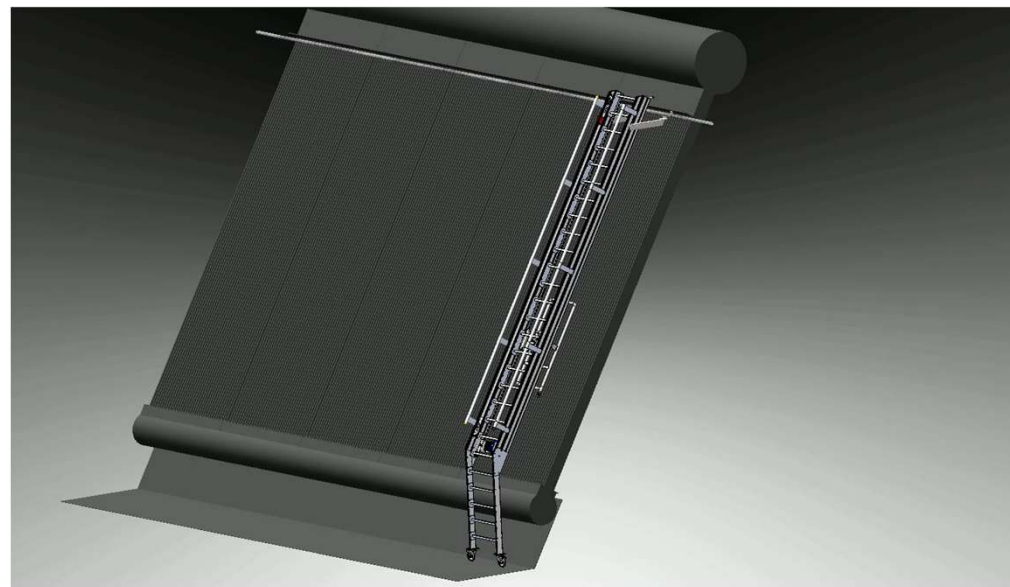


Fully-Automatic Cleaning Robots

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Make a change to fully-automatic cleaning robots

- New significant cost saving advantage for operators of a JNW semi-automatic cleaning system.
- A change of the entire cleaning system like this is **not** necessary anymore!

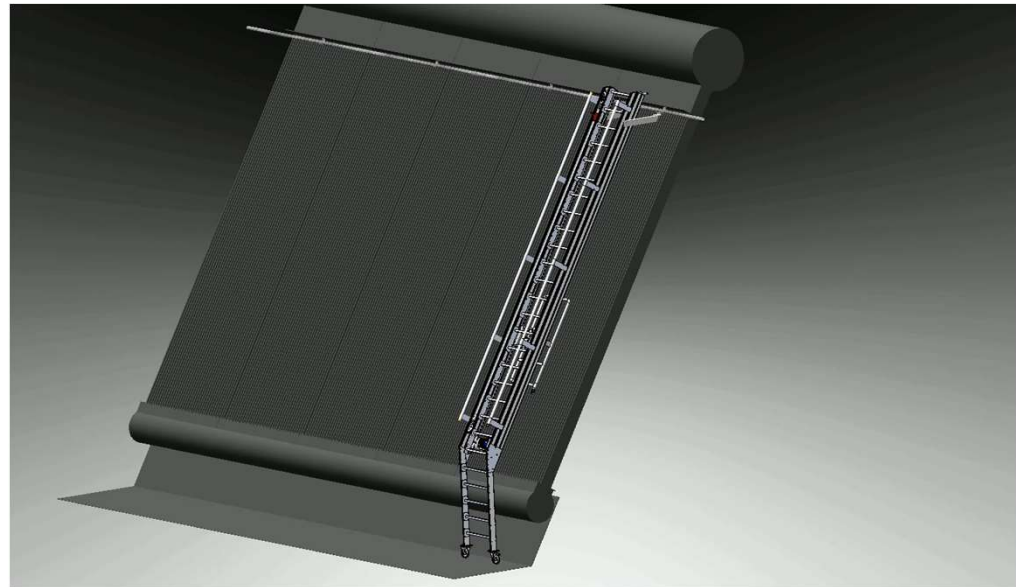


Fully-Automatic Cleaning Robots

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Make a change to fully-automatic cleaning robots

- Your existing semi-automatic cleaning system can now easily be upgraded to a fully automatic cleaning robot.
- Main parts of the existing semi-automatic cleaning system remain and can be reused!

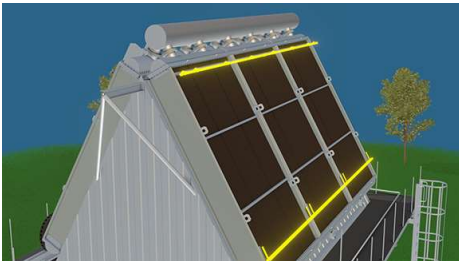


Fully-Automatic Cleaning Robots

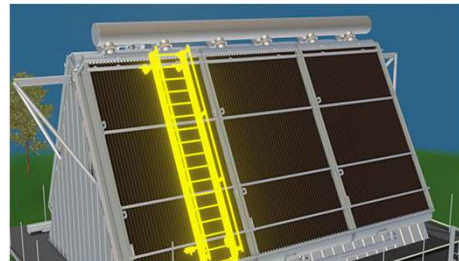
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Get fully-automatic and start now
if not at once than step by step

Your individual way of realizing a fully-automatic cleaning system step by step.



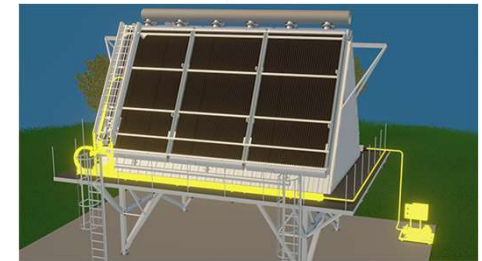
Step 1
Rail system



Step 2
Chassis



Step 3
Semi-Automatic



Step 4
Fully-Automatic



JNW – Your Partner

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- We not only offer to our clients tailor made technical concepts. We are also offer interesting and flexible commercial solutions like financing.
- It will be our pleasure to develop together with you an optimized technical and commercial solution for your company.
- We are looking forward to a successful cooperation.

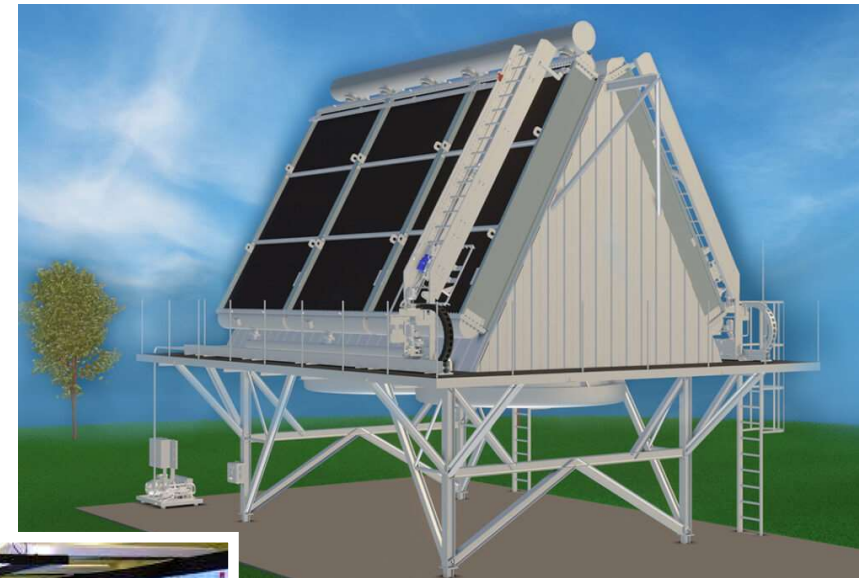


Fully-Automatic Cleaning Robots

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Fully-automated robots are now, combined with artificial intelligence is the future

- In future artificial intelligence will start the cleaning automatically based on an algorithm that considers lots of different parameters such as:
 - production plan
 - maintenance plan
 - outside temperature and weather forecasts
 - degree of foulingin order to calculate the optimum moment for ACC cleaning and cooling.
- JNW is ready to already deliver such intelligent systems for a future which is now and that has already started.



References

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