Improved ACC performance

How to enhance the performance
with an acceptable price level

A client in The Netherland needed an ACC replacement

Next to the basic design as per specification the following was requested.

- Improved performance in summer
- Limited performance loss due to air leakage
- No pits for pumps
- Limited steam duct-flow resistance.
- Indoor location for pumps and valving
- Freeze protection during low steam steam flows.
- Vibration monitorring gearboxes in stead of vibration switches

Original situation

The location for the new ACC was behing the exisitng ACC. The steam duct had to be routed around the old ACC.

All equipment around the new ACC was operational during the entire project.

During winter the air inlet of the ACC was almost completely closed to reduce the air flow as now fan control was present.

Fan Drives

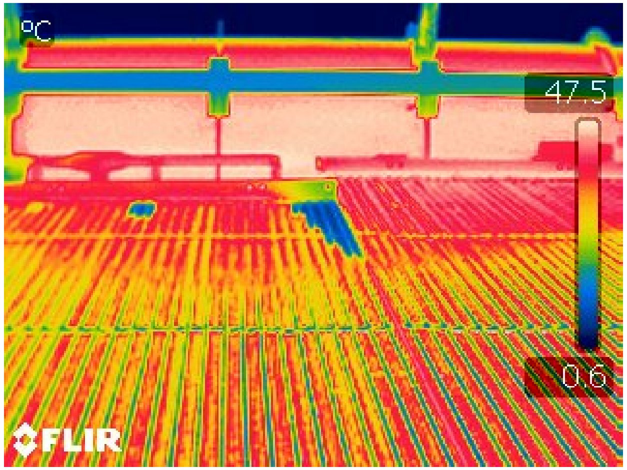
Design of fan motor and gear box was based on the specified capacity.
For an amount of $3500.- per cell the gearboxes and motors were upgraded from 45 kW to 95 kW
The inverters were provided by the client and had a capacity of 150 kW.

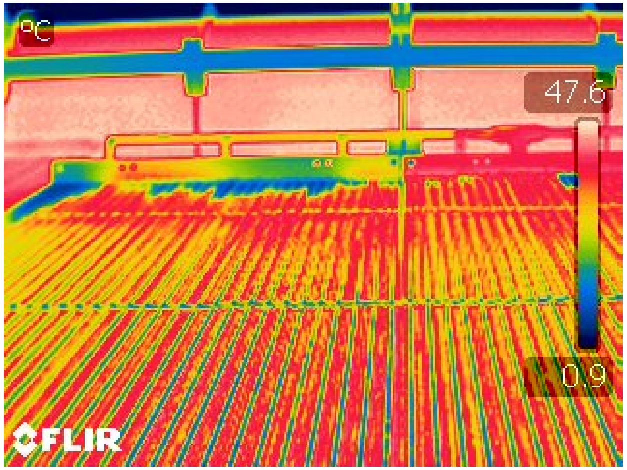
The fan was installed in a way that with 50 Hz
The specified performance was guaranteed.
By increasing the frequency to 60 Hz motor power became 90 kW with 61% more air flow.

Air leakage

As the turbine was existing and in operation for many years, air leaks were to be expected.
From the thermal calculations the air to be extracted was 5 kg/h
The steam ejector system was designed for 20 kg/h.

During commissioning we found an air leak of 44 mbar per minute.
This was the equivalent of 44/1000 x 100 m3 x 0.075 Bara x 60 min = 16.5 kg air





The extraction could maintain the vacuum in an acceptable way. Leaving a few black spots near the extraction points.

Calculation example

ACC data

- Volume 200 m3
- Ambient temp. 15 C
- Pressure 100 MbarA
- Extraction 5 kg/h (HEI)

Leak rate 100% duty

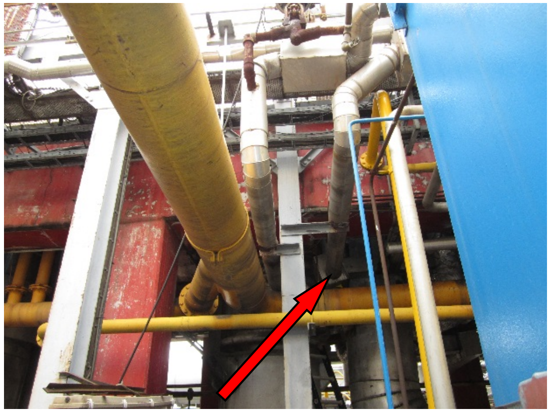
$$\frac{1000\text{mBar} \times 5\text{kg/h}}{200\text{m3} \times 1.22\ \text{kg/m3} \times 60} = 0.34\ \text{mBar/min}$$

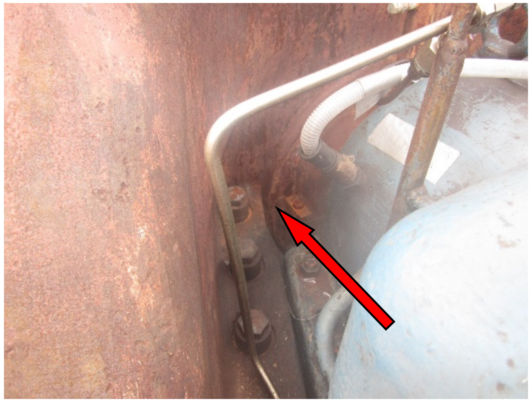
This is an ideal situation

A small amount of additional leakage and the extraction duty is not sufficient

Leak detection

During commisioning the client has to be convinced that the leaks were from the old turbine and not the ACC.
This was cleared by using a helium detection test





All welds on the ducting were tested with helium.
The leaks found were in the turbine casing and gland steam condenser
ACC was completely tight.

Location on site

The location was completely surroundd with process equipment.
Many piping and ground cables were found.
For this reason the construction of pits was not allowed.

Due to all operational process equipment, 250 bar storage tanks, lifting of steam ducts were a special exercise

Lifting of ACC

Solution was found in the following;

- Lifting the complete ACC 2 meters
- Using the difference in pressure of the condensate tank and ejector surface condenser to suck the condensate

From the surface condensers to the tank while condenser and tank were installed at the same height.
For drain pump a low NPSH (0.17 m) was used,

The result was a simple layout, maintenance friendly and reliable

Steam duct design

Due to the presence of the old ACC the steam duct was longer than normally installed.
The solution was th increase the diameter of the duct, which meant more plate material.

The increase in diameter was from 48 to 56 inch.
Additional plate 1.2 ton, price $ 2500.-
Pressure drop difference 2 mBar

Indoor location for pumps and valving, and freeze protection

To protect the steam ejectors, pumps and valving against the element and freezing in winter, a room was build around the equipment.
Calculations on the air flow to the fans showed that the additional air flow resistance was minimal.
All piping to this space was self draining and needed no heat tracing

Vibration monitoring fan and drive.

As a special request from the client the vibration swiches were replace by vibration sensors, contenuous monitoring vibrations.
Make was Benley Nevada.
The DCS analysis was used to stop the fan during heavy vibrations.

The location of the sensor was very critical and was fixed together with the gearbox supplier.
Mouting on the base plate or Gear-box casing, gave
4 times heavier vibrations

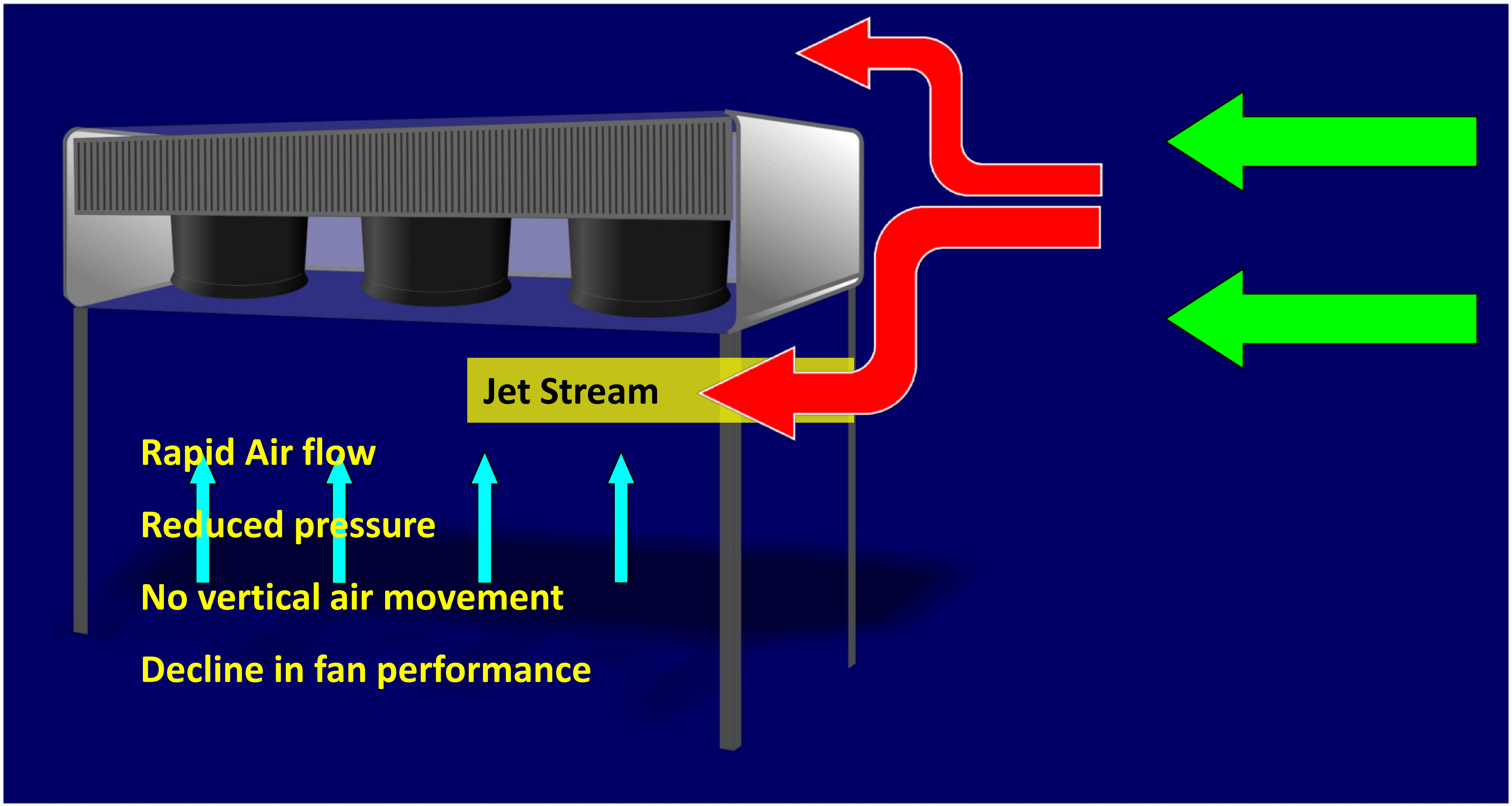
Contruction procedures

An expensive activity during construction was the welding of the steam duct on top of the bundles.
This was due to safety procedures for working on the inside of the duct.
It was decided to weld the steam duct from the outside. Eliminating the safety crew and faster welding.

The Effect Of Crosswinds

ACC TEAM

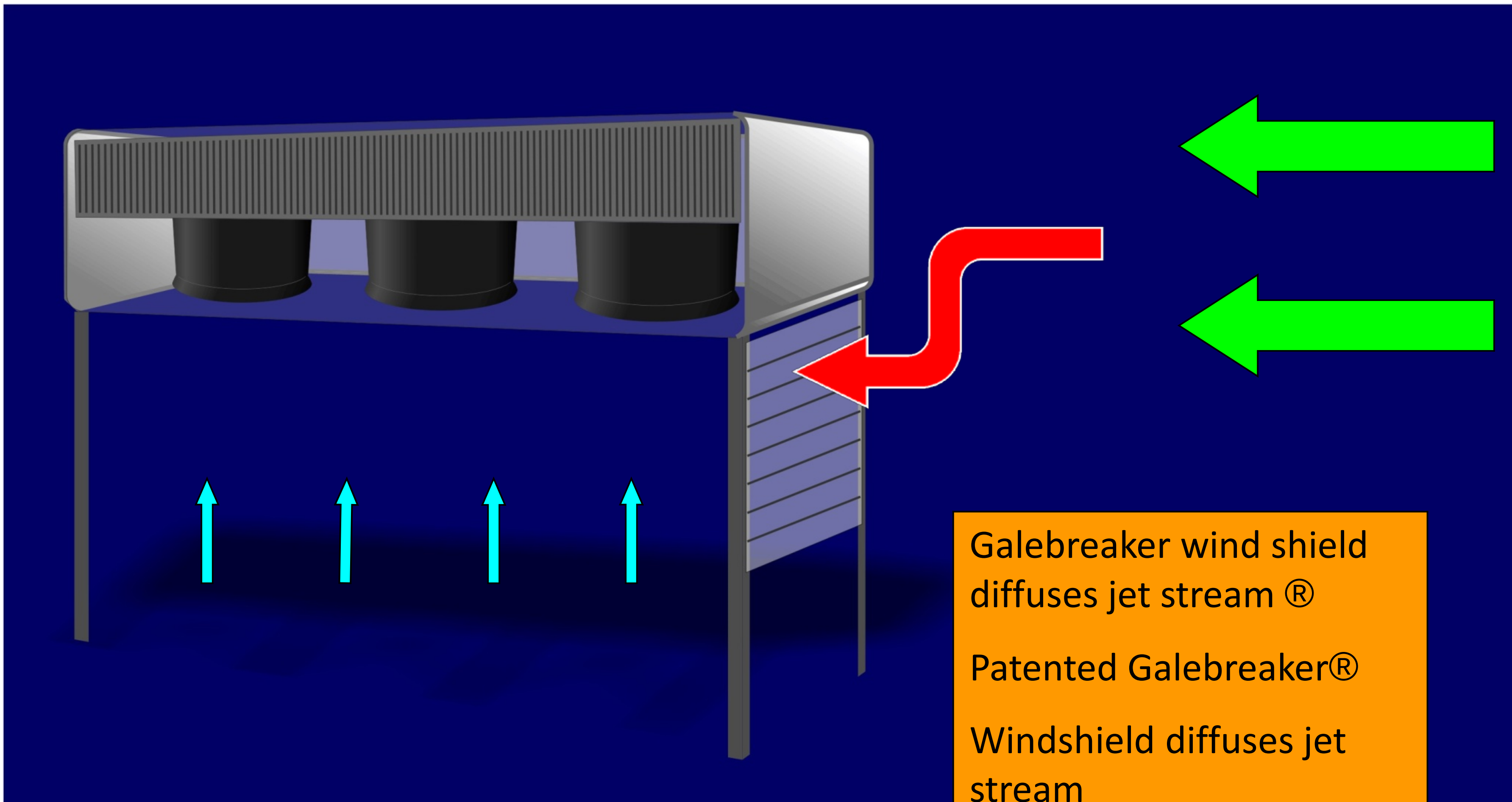
Fan Induced Winds — Prevailing Winds — Deflected Winds



ACC TEAM

Wind force is reduced

Fan Induced Winds | Prevailing Winds | Deflected Winds



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