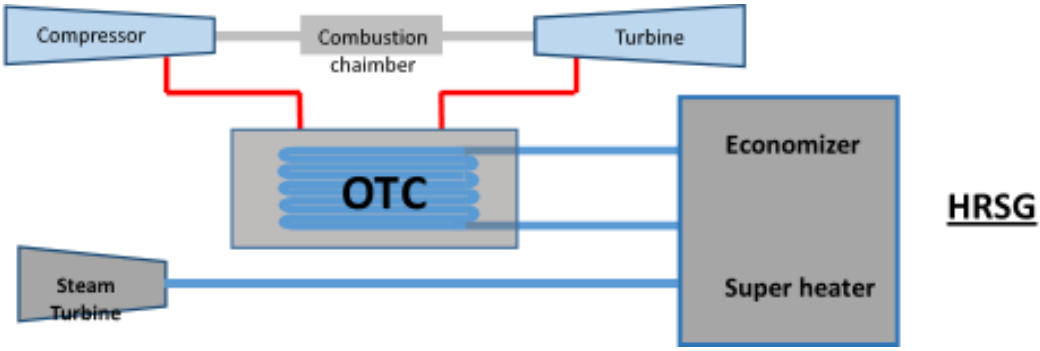
Once Through Cooler Valves For GT24/26 Turbines

Significantly Reduce Start Up Times and Stabilise Process

Save £1000's Per Start In Short Term Marginal Costs



What Is a Once Through Cooler

Many UK installed gas turbines require cooling of the turbine blades. To cool the turbine blades, cooling air is produced in a Once Through Cooler (OTC).

The OTC is a heat exchanger, with hot air on the shell side and water/ steam as refrigerant on the tube side. The hot air is compressed air extracted from the compressor of the gas turbine and cooled down in the OTC.

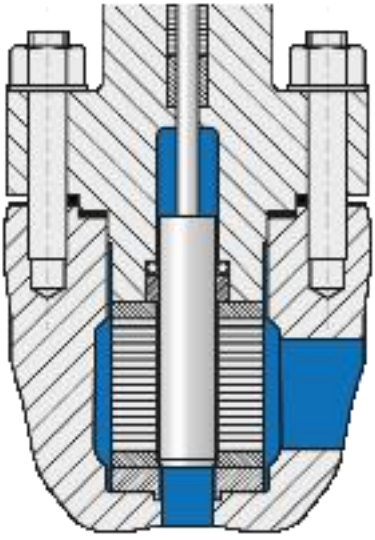
The feed water, which is taken from the economizer of the HRSG, flows through the OTC and cools down the hot (compressed) air. It is evaporated and superheated when leaving the cooler. This steam is fed back into the HRSG superheater.

The cooled air is used to cool down the blades of the turbine (film cooling) and to heat up the combustion chamber . As the cooling of the turbine blades is very crucial for the gas turbine it is of the highest importance that the outlet temperature of the air coming out of the OTC is controlled within a margin of only a few degrees.

Common Problems With OEM Supplied OTC Valves

- **Seat / trim wear**
- **Poor position control at low flow**
- **Speed of response**

Original supplied OTC valves are often valves with a staggered disc trim. This trim construction is based on a staggered pile of disks, all individually having channels (see picture) with a multi-stage pressure reduction, controlled by a plug moving up and down within the disk stag. Stroking of the plug is opening or closing individual discs giving more or less flow.



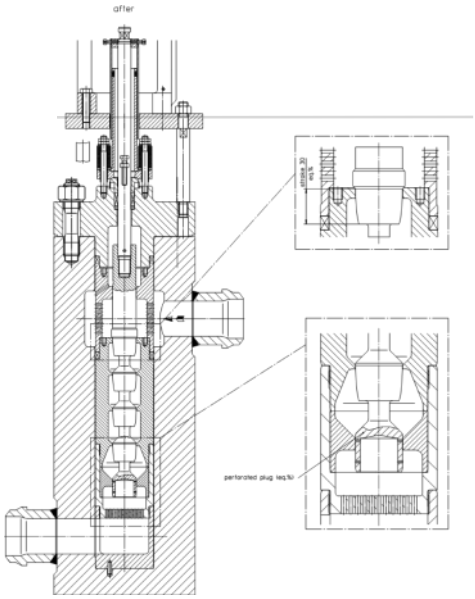
The Solution—Design a Specific Valve

A multi-stage cascade valve, 5+1 up to 7+1 stage pressure reduction (depending on max dp) with 3 mm dead stroke and flow direction on the plug. This first part of the stroke gives the valve the time to overcome hysteresis and to "activate" all the stages in the trim before the real control function begins.

The cascade trim is a proven design multi-stage pressure reduction, capable of continuously reducing an increasing or decreasing mass flow. With flow on the plug and Kv values per stage matching the flow demand, cavitation cannot occur and flashing is removed from the seat area to the outlet of the trim where wear is not affecting the function and leakage class of the trim. The plug design makes this trim less sensitive to magnetite and particles compared with a staggered disc trim.

FEATURES

- 5 to 7 controlled pressure reduction stages
- Full control over total stroke
- No seat hammering
- No cavitation
- Flashing away from the seat area
- Less sensitive to magnetite
- No stepping
- In some cases it is possible to reuse an



ADVANTAGES

- Stable start-up
- Reduction in start-up time (filling the OTC / flame on phase)
- Strong reduction in GT trips during start up (longer maintenance interval GT)

Cost Benefits

Cost savings are based on reduced time to start the GT (ignition phase). In current installations we have seen an improvement of about 15 to 20 minutes.

- Phase one: get the water level right in the OTC
- Phase two: constant air outlet temperature to the GT combustion chamber and first GT vane rows
- Phase three: transition to PID controller

Saving 15 to 20 minutes in start up time is a direct saving on gas and is a quicker delivery of energy/power to the grid.

Let's say an installation with one GT and one HRSG, total capacity 450 MW (typical for a GT26 installation)

15 minutes is: 0.25 x 450 = 112.5 MWh

In the UK the rate which is used for the Capacity Auction Market is around GBP 20 / MWh. However in case power is required by the grid, rates can vary between GBP 50 to 900 per MWh.

Based on GBP 20/MWh an installation can make 112.5 x 20 = GBP 2,250 more with each start (quicker on the grid)

Based on GBP 50 /MWh an installation can make 112.5 x 50= GBP 5,625 more with each start.

Maintenance.

Instead of replacing an expensive trim every year (some installation each half year) we have an maintenance interval of at least 3 years and most likely much longer.

Typical cost for a staggered disc trim from the GT26 OEM is GBP 30,000

Typical cost for a complete spare set for an OTC valve is GBP 18,000

So over a period of 4 year, what I expect based on the data we receive from installation where we have installed the specially designed OTC valve, we can save approx. GBP 102.000,= (parts only)

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