Overspeed Protection for Turbines

CTo

A reliable overspeed protection system is indispensable for turbomachinery. For gas and steam turbines, this means reliable detection of over-speed and immediate closing of the trip valve in response.

The Voith CTo overspeed protection system provides both functions in a single device. An electronic monitoring unit detects overspeed and an electrohydraulic assembly actuates the trip valve immediately.
All the world’s our home

We are a reliable partner to manufacturers and operators of turbomachinery in all international markets. Voith control technology has proven its value in tens of thousands of applications in power plants around the world and ensures economical, reliable operation of gas turbines, steam turbines and compressors.
Benefits

- Compact design
- Direct mounting onto the actuating mechanism of the trip valve on the turbine
- No space required in the control cabinet
- Short signal paths; on-site detection, evaluation and actuation
- Device insensitive to malfunctions
- Especially well-suited for turbines operating in a lower power range (retrofits and new systems)
- Partial stroke test during operation
- Speed sensor optional, triply redundant
- Explosion-proof designs optional
Design and function

Design
The CTo consists of a 3/2-way hydraulic unit, a current-controlled electromagnet (solenoid) and the evaluation and control electronics.

Functionality
If no trip criteria are satisfied, the solenoid generates the force $F_{Mag}$. This magnetic force presses the control piston of the hydraulic unit against a restoring spring. In this position, the hydraulic unit connects the pressure supply to the actuator of the trip valve, causing it to open.

If a trip criterion is satisfied (e.g. overspeed), the solenoid exciter current is interrupted immediately. The restoring spring shifts the control piston back to its original position by means of the spring force $F_s$, draining the actuator of the trip valve and causing it to close.

Partial stroke test
The partial stroke test (“Trip-Sim”) permits testing of the trip valve during turbine operation. During a pulse with an adjustable length, the CTo drains the oil from the trip actuator. The trip valve moves briefly towards the closed position and re-opens immediately.

1. Voith CTo, attached directly to the actuator of the trip valve on a steam turbine
2. Controlled-extraction condensing turbine SST-110 (TWIN AFA 46)
   Manufacturer: Siemens Turbomachinery Equipment GmbH
   Power: 2 400 kW; speed: 14 953 rpm
   Trip speed: 15 850 rpm
3. Controlled-extraction condensing turbine SST-110 (TWIN CA 56)
   Manufacturer: Siemens Turbomachinery Equipment GmbH
   Power: 4 730 kW; speed: 14 786 rpm
   Trip speed: 15 820 rpm
4. Steam turbine KT 600-5(0) E2
   Manufacturer: M+M Turbinentechnik GmbH
   Power: 9 000 kW; speed: 7 673 rpm
   Trip speed: 8 426 rpm
**CTo technical data**

<table>
<thead>
<tr>
<th><strong>Hydraulic data</strong></th>
<th></th>
<th><strong>Electrical data</strong></th>
<th></th>
<th><strong>Ambient conditions</strong></th>
<th></th>
<th><strong>Mechanical data</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum input pressure</td>
<td>25 bar (362 psi)</td>
<td>Supply voltage</td>
<td>24 VDC</td>
<td>Ambient temperature</td>
<td>-20 °C to +80 °C (-4 °F to +176 °F)</td>
<td>Dimensions H x W x D</td>
</tr>
<tr>
<td>Flow rate</td>
<td>330 l/min at Δp = 4 bar</td>
<td>Current consumption</td>
<td>0.5 A, briefly 3 A</td>
<td>Protection class</td>
<td>IP 65 to EN 60529</td>
<td>265 x 105 x 155 mm</td>
</tr>
<tr>
<td>Operating medium</td>
<td>Hydraulic oil or turbine oil</td>
<td>Trip speed</td>
<td>4,000 to 10,000 Hz, adjustable</td>
<td>Expansion protection</td>
<td>Optional EEx d IIC T4, others upon request</td>
<td>Weight</td>
</tr>
<tr>
<td>Temperature of the operating medium</td>
<td>+10 °C to +70 °C (+50 °F to +158 °F)</td>
<td>Remote display of actual speed</td>
<td>4 – 20 mA</td>
<td><strong>Electrical data</strong></td>
<td></td>
<td>Approx. 14 kg (31 lbs)</td>
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</tbody>
</table>

**Example of incorporating the Voith CTo into a turbine control system**

Illustration: turbine in operation