

SIL-capable actuators protect against excessive temperatures

BASF Ludwigshafen, Germany



INDUSTRY

APPLICATION

Flue gas cleaning

AUMA SOLUTION

- > SA actuators with intelligent AC 01.2 actuator controls in SIL version
- > Safety functions Safe OPENING and Safe CLOSING
- > GS part-turn gear box

CUSTOMER BENEFITS

- > Overall safety system achieves SIL 3
- > Maximum safety and plant availability

AUMA actuators that are TÜV-certified for use in safety related systems up to SIL 3 have proved a perfect fit as part of a safety system for flue gas scrubbers on an incineration plant installed at BASF in Ludwigshafen, Germany.

At its headquarters in Ludwigshafen, Germany, BASF operates an incineration plant for the disposal of solid, pasty and liquid wastes created at BASF production sites. Flue gas from the incinerator is cleaned in a multi-step process that includes wet scrubbing.

The flue gas scrubbers contain glass fibre reinforced plastic (GRP) components which must not be subjected to excessive heat. For this reason, flue gases must be cooled to 85 °C to prevent damage to the scrubbing system.

BASF engineers used a risk assessment matrix to examine the probability that the scrubbers would be exposed to excessive temperatures, and the consequences if this were to happen. They concluded that they needed a protection scheme meeting at least safety integrity level 2 (SIL 2) according to IEC 61508.

Besides taking care to protect human health and the environment, BASF also wanted to minimise downtime for the incineration plant. The safety scheme was thus designed to ensure high levels of both safety and availability.

OVERALL SYSTEM MEETS SIL 3

The actual system devised by BASF to safeguard the flue gas scrubbers meets the even more stringent SIL 3 classification. Among other components, the overall system includes temperature measurement sensors, an emergency cooling water reservoir and three flue gas dampers fitted with AUMA electric actuators.

For temperature monitoring three temperature measurement sensors are installed in a 2oo3 (two out of three) redundant configuration that guarantees high levels of both safety and availability.

Project responsibility:
AUMA Riester, Germany

www.auma.com



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INITIATING THE SAFETY FUNCTION

The safety function is initiated if two of the three temperature sensors within the flue gas scrubbers signal inadmissibly high temperatures. A safety operation on demand triggers four emergency actions simultaneously:

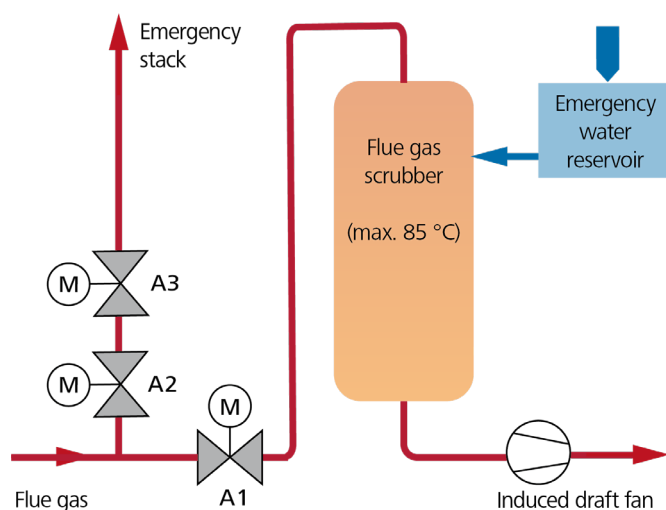
- > **Open valves to dump emergency cooling water.**
The reservoir is pressurised, so it does not rely on pumps.
- > **Switch off the downstream induced draft fan.**
- > **Close damper A1 upstream of the scrubber.**
- > **Open dampers A2 and A3 to divert flue gas to the emergency stack.**

For maximum safety, these dampers are arranged in series in a 2oo2 (two out of two) configuration. Both dampers must therefore open before the emergency bypass operates.

The emergency shutdown of the induced draft fan and the closing of damper A1 trigger a shutdown of the incineration plant. Meanwhile, the emergency cooling water system provides short-term protection for the scrubber system. This combination of diversified and redundant actions provides reliable protection for the flue gas scrubbers against excessive temperatures, while maintaining high levels of reliability for the incineration plant as a whole.

ELECTRIC ACTUATORS FOR SIL 2/SIL 3 REQUIREMENTS

Electric operation of the flue gas dampers is provided by AUMA actuators that have been specifically developed to fulfil prime safety requirements. They are TÜV-certified for use in safety-related systems up to SIL 2/SIL 3 (SIL 3 for redundant system architecture).



Schematic representation of the safety-related system: The flue gas dampers A1, A2 and A3 are equipped with AUMA actuators that are TÜV-certified for use in safety related systems up to SIL 2/SIL 3 (SIL 3 for redundant system architecture).

Since the dampers require high operating torques, AUMA SA actuators are used with GS gearboxes. They are equipped with intelligent AC 01.2 actuator controls in SIL version.

The actuators are controlled by a safety PLC that issues a signal to the ESD (emergency shutdown) input of each actuator whenever there is demand for a safety operation.

Damper A1 upstream of the scrubber has a type SA 14.6 multi-turn actuator paired with a GS 250.3 part-turn gearbox. This actuator operates with the safety function Safe CLOSING, so on demand the actuator moves the damper to the end position CLOSED.

Dampers A2 and A3, which isolate the emergency stack, are both equipped with combinations of SA 07.6 multi-turn actuators and GS 125.3 part-turn gearboxes. These actuators operate with the safety function Safe OPENING, so on demand they move their respective dampers to the end position OPEN.

PRIORITY OF THE SAFETY FUNCTION

A SIL module integral to the AC 01.2 SIL controls on each actuator ensures that the system meets its prime safety requirements. The SIL module is an additional board integrated within actuator controls AC 01.2 SIL to provide the emergency safety function on demand. Even if the actuator is operated manually, for example via local controls, or remotely from the control room, the safety function always has priority.

PARTIAL VALVE STROKE TEST AT REGULAR INTERVALS

Once a month, each actuator performs a partial valve stroke test (PVST) to ensure that all the actuators and dampers are working correctly. The PVST is carried out automatically by the distributed control system (DCS), but can also be triggered manually. The three actuators are tested in sequence to ensure complete system availability even while the tests are going on.

During a PVST each actuator travels a predefined path, first clockwise and then counterclockwise. This ensures that the actuators actually operate, allows the detection of safety-relevant errors, and reduces the probability that the actuator will fail on demand.

CONCLUSION

Thanks to a combination of protective actions, BASF managed to create a safety system that protects the incinerator scrubber system effectively against excessive temperatures. Standardised and certified AUMA actuators in their SIL versions are an important part of this system. The overall system achieves a risk reduction complying with SIL 3, which exceeds the safety performance that was originally requested.