

GESTAMP

Special

Modern Equipment for Pressurized Hot-Water and Steam Plants

- *From mechanical to bus-capable
level controllers/limiters*
- *From the Steam Boiler Ordinance (DampfKV)
to the Pressure Equipment Directive (PED)
and Plant Safety Ordinance (BetrSichV)*
- *TÜV or EC type approval*

SPECTOR – one system for all requirements!

With the bus-capable level controllers and limiters of the SPECTOR family, GESTRA AG is already offering the fourth generation of components for safety equipment.

In the following, the spotlight will mainly be on equipment components according to boiler category IV of the Steam Boiler Ordinance (DampfKV) or diagram 5 of the PED. At certain points, we will also take a look at the boiler plants of categories II and III.

Only boiler plants with rapidly controllable firing equipment are considered here – i.e. the boiler plant type encountered most frequently today.

History of the Development:

Although float-operated level controllers/limiters were used as a rule until the early 70s, they have declined into almost complete insignificance in today's market.

Since the beginning of the 70s, the float systems lost relevance as the electrode-based limiters gained continuously in importance.

What factors were responsible for this development?

A Float-operated level limiters (see Fig. 1)

Float-operated low-level limiters function according to the principle of a float ball to which a permanent magnet is attached through a float lever. The terminal box of the float contains magnetic switches that are actuated through the magnetic force of the permanent magnets when they pass the switches.

The output contacts of the magnetic switches were included in the safety chain to interrupt and lock out the fuel supply. In an attempt to enhance these simple devices for unmanned operation, a hand-held magnet or, in the course of development, electromagnets were used to press the float ball under the water level at specified intervals – usually once a day or every 6 hours. In this way, a low water level was simulated to test the safety chain. Owing to the physical measurement principle and the experience obtained in practice, which is also reflected in the TÜV damage data files, additional requirements for the operation were issued in the later development of the technical rules; these included a reduction of the maximum permissible boiler-water conductivity from 8,000 to

300 $\mu\text{S}/\text{cm}$, regular replacement of the magnetic switches etc. – measures which were intended to prevent boiler damage but at the same time increased the operating costs.

B Electrode-based level limiters of “conventional design” (see Fig. 2)

In order to compensate for the disadvantage of the float systems as far as possible, electrode-type low-level limiters were used from the end of the 60s, with the benefit that they dispensed with the need for mechanical moving parts. These systems utilized the electrical conductivity of the boiler water and, associated with that, the change in resistance as a function of the medium's physical state at the electrode tip. Between the electrode rod and the counter-electrode (antifoaming protection tube or measuring pot) the distances are several times larger, i.e. corrosion on the inner surfaces of the counter-electrodes has no negative effects on the functional reliability of these systems.

Here too, the technology was improved for unmanned operation by implementing the insulation monitoring through a forced test daily or at 6-hour intervals. For example, this was done by blowing nitrogen into the protection tube; this made the water level drop until the electrode tip lost contact with the water and therefore signalled low water, switching off the fuel supply and locking it out.

Between the test intervals, i.e. over a period of at least 6 hours, there is no reliable monitoring of the insulation for units of “conventional design”, even with the solutions mentioned above. Accordingly, the system degrades into an unsafe operating condition in the event of unwanted secondary currents over the insulator (fouling), defects in the electrode entry point, or faults in the supply cable.

Nowadays, low-level alarms of “conventional design” are only used in boiler plants of category II and III, since these plants are graded as having a lower hazard potential than the boiler plants of category VI.

With the compact systems NRGs 11-2 (PN 6) – category II – and NRGs 16-2 (PN 40) – category III – of the SPECTORcompact family, GESTRA also set new standards in this area, by designing the alarms of “conventional design” to be redundant right up to the electrode tip for the first time ever, i.e. at least two faults must now occur simultaneously before these advanced systems are degraded to unsafe operation.

Fig. 1

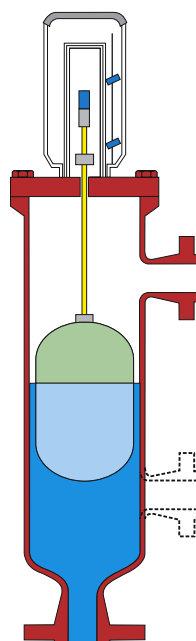


Fig. 2

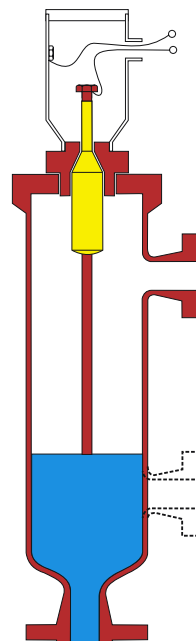
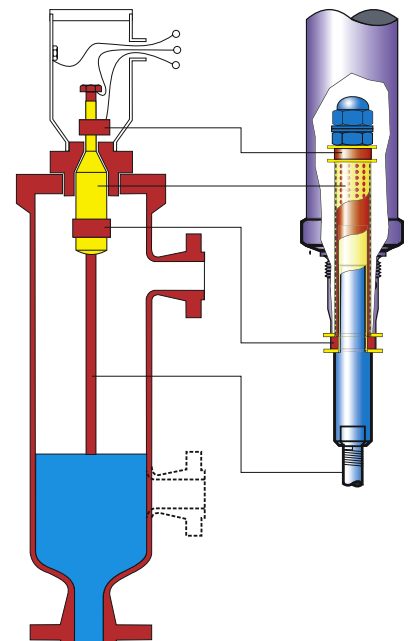


Fig. 3



C Low-level limiters of “high-integrity design” (see Fig. 3)

Starting from the safety technology viewpoint that two independent systems are not likely to fail or exhibit faults simultaneously, the systems of “high-integrity design” emerged early in the 70s. For these units, the insulation of the electrode, the electrode entry point as well as the cable connection to the level controller are included in the constant monitoring. However, the electronic evaluation unit was not subject to automatic monitoring.

Equipment of this design had to be, and still must be, examined every 6 months by qualified staff or, if used in 72-hour unmanned operation, by an external expert.

The test is conducted by reducing the actual water level in the boiler under the LW mark. Through the series-connected output contacts of the dual-channel level controller, the burner is shut down and locked out.

D Low-level limiters of “high-integrity design” with periodic self-test for loss of redundancy in the evaluation unit as per EN 50156 (formerly VDE 0116)

The primary advance with these systems, which are based on the TÜV bulletin “Water Level 100” (issue date 4.90) and were approved at the beginning of the 90s is, in comparison to the components named under **C**, the periodic self-test in the evaluation unit.

Every 40 seconds, the electronics (including the timers for the delay) is automatically tested for the proper functioning of all evaluation channels and the energizing circuitry of the output relay contacts is checked. In parallel to this, an automatic check routine is executed to perform the periodic self-test. Tests of this kind are conducted in the background mode of the electronics and are not noticeable from the outside. For such units, the inspection by an external expert is only required once a year for 72-hour unmanned operation.

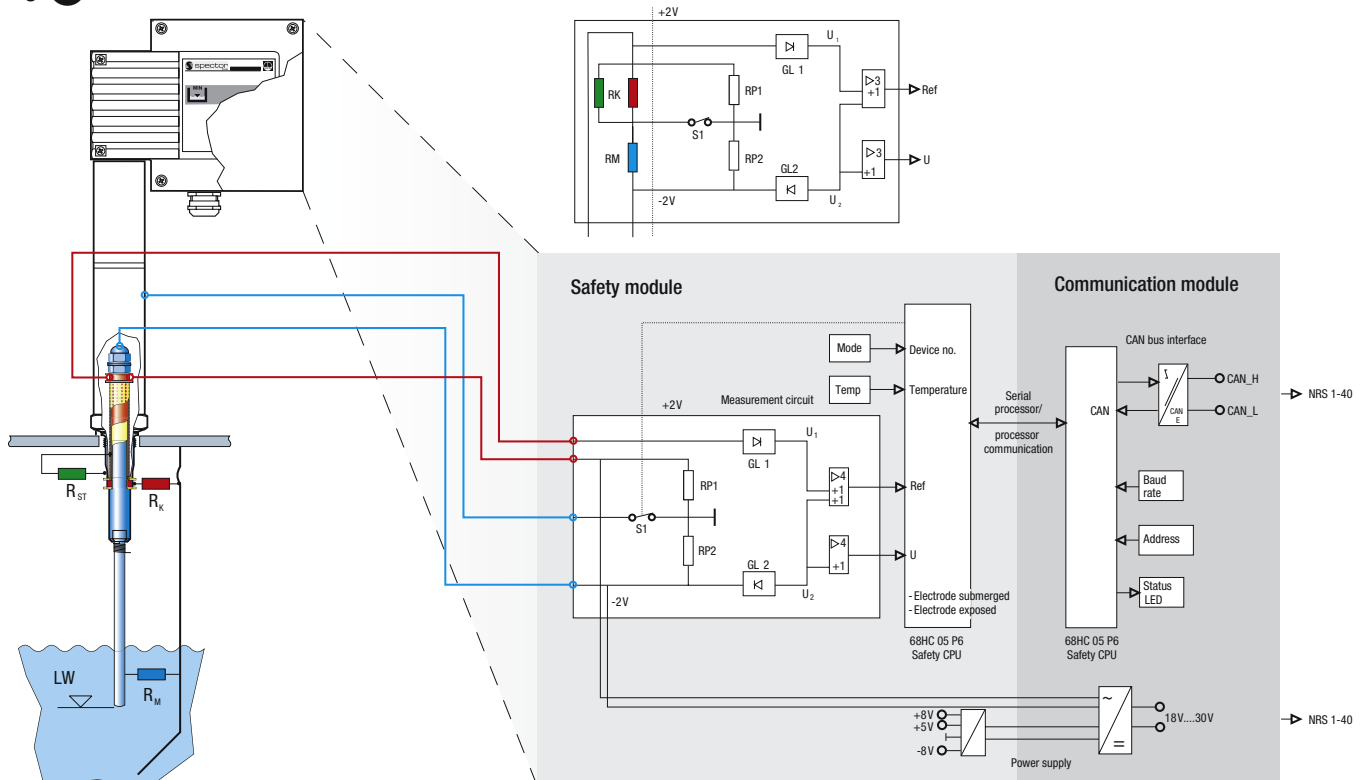
E SPECTOR – the future has already begun (see Fig. 4)

With the latest product family, GESTRA AG is again blazing a new trail in boiler equipment, strengthening its position as a market leader. In addition to the properties of the preceding systems described above, these systems for the new century are characterized by further innovative solutions for increasing the level of plant and reducing costs.

The new systems offer:

- Active autonomous monitoring of the cable connection between sensor and evaluation unit through the bus interface
- Active monitoring of the relay output contacts
- In the previous systems, the monitoring ended with the energizing circuits of the output relays. With this new solution, GESTRA has redefined the state of the art for safety circuits, since this test also detects fused relay contacts.
- Improved information convenience, thanks to separate display of the stati “electrode exposed” or “cut-out of the safety chain” and other sources of interference
- Separate signalling contact for the undelayed low-water level reporting during the functional test and for alarms
- Sensitivity beginning at 0.5 µS/cm, i.e. also suitable for “salt-free” feedwater, so that the stock-keeping and ordering of different units is no longer necessary.

Fig. 4



What is more, one can speak of low-level limiters and limiter systems for the first time, since this innovative technology safeguards the required independence through time-multiplexed querying of two sensors by a single electronic control unit. Furthermore, this system duplicates the periodic self-test of the level switch required for safety reasons, as was usual until now with type **D** systems, in the electrodes themselves. This is indeed a minor revolution in the area of safety technology and reflects the high safety standard of this technology. However, it does not represent the end of the road in our development planning as far as the benefit for the client is concerned.

All these systems can be installed either internally in a protection tube as per "Water Level 100" or externally in a measuring pot. In the case of external installation, suitable measures must be taken to ensure that negative influences, such as deposits or increasing constriction of the connecting lines to the boiler, are reliably prevented. We meet this requirement by employing approved logic units for monitoring (SRL 6), which force a purging of the measuring pot every 24 or 72 hours.

As a logical advancement of the previous low-level limiter system NRG 16-40 / NRS 1-40, the GESTRA boiler safety system was developed and introduced to the market.

The GESTRA boiler safety system provides the possibility of being able to connect as many as four limiter functions to one NRS 1-40.1 control device. For example, the constellations 2x NW, 1x HW and 1x STB for steam boilers with superheater, or 4x STB for cascaded superheaters, are feasible.

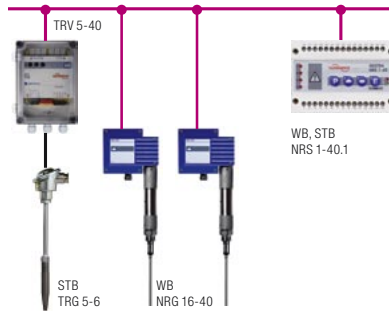


Fig. 5 GESTRA boiler safety system

You too can benefit from the possibilities of modern and reliable boiler safety technology. Why settle for anything less?

The new technology is rounded off with the TÜV and EC type approved systems for conductivity limitation/continuous blowdown and intermittent blowdown, as well as the new safety temperature limiters with integrated temperature indicators (actual/cut-off value) and the additional integration of two further Pt100 resistance thermometers not relevant to safety. What is more, the intelligent functionality of the systems cuts costs. In a 72-hour plant, only 4 electronic control units are needed to do the work of 7. Equipment that is not required does not have to be installed, wired up etc.

Conclusion

Owing to the need for operation almost entirely without supervision, the float-operated low-level alarms have been superseded by electrode-based level limiters in modern boiler plants. In Germany and other European countries, such as England, France, Hungary, Poland, Czechia, the Netherlands etc., more than 100,000 pressurized hot-water and steam plants have been fitted with self-monitoring low-level limiters of "high-integrity design" on an electrode basis. Through the introduction of units with periodic self-testing in 1991, the number of plants equipped in this way probably exceeds 40,000.

If one considers the types of boiler damage that may be ascribed to the failure of low-level alarms, the development shows that there has been a decline to almost zero since introduction of the self-monitoring electrode-based limiters of "high-integrity design".

With the SPECTOR family, the cable connections and the output relay contacts are now monitored actively. Moreover, the data exchange is conducted through the modern, cost-effective and forward-looking bus technology. In conjunction with the bus technology, a whole vista of new possibilities has opened up for the visualization of process data, as has long been state of the art in automation technology.

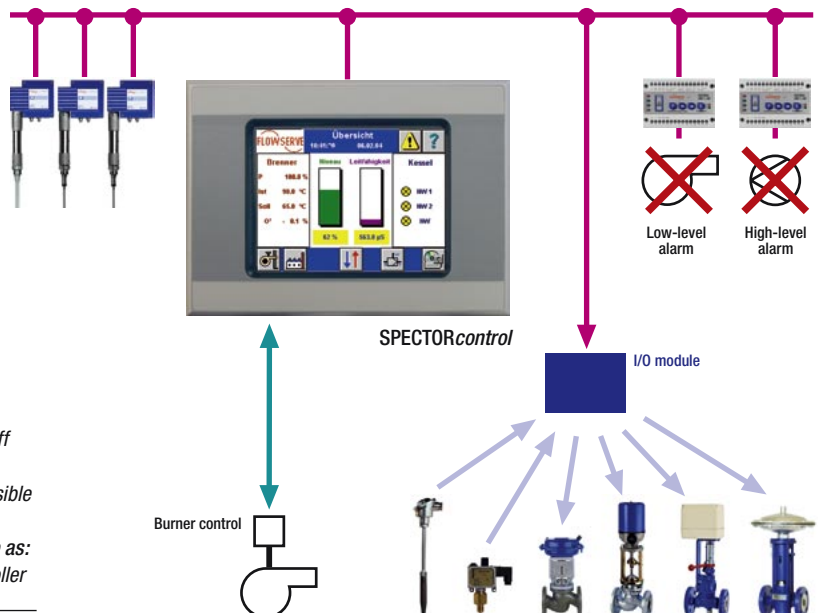


Fig. 6

5 controllers, selectable as:

- Continuous, or 2- or 3-position on/off controllers
- 2-position on/off controller also possible for multiple pump operation
- 1 three-element controller, selectable as:
- Continuous or 3-position step controller

Conclusion – continued

Over above the advantages of process data visualization, this system is ideal for the development of intelligent boiler management systems (BMS), since it permits the high-level logical combination of individual parameters of bus-transported information from diverse systems. In this way, the optimization of plant-specific operations is no longer left to chance.

If the safety-related deactivation is performed by means of approved systems, the control functions can be implemented by the BMS.

With the SPECTORcontrol system, GESTRA AG offers solutions that put you at the cutting edge of automation technology.

SPECTORcontrol performs tasks of control and regulation, i.e. the system permits a further reduction in the number of separate electronic control units as well as economical process display via Intranet or Internet on office PCs or laptops. With this technology, we are not only limited to the visualization, but can also optimize the control parameters using the same interfaces. With that, the concept of telediagnosics is no longer a vision of the future; it is already part of effective plant operation today. This is of particular benefit for the service area, since rapid assistance or a targeted deployment of technical staff can be effected in the event of malfunctions without any need for an immediate call-out of engineers to the plant.

This technology is further augmented by the possibility of integrating diverse burner controls – such as those by Siemens, HIMA, LAMTEC or Hamworthy – via the Modbus RTU interface.

Why settle for less?

Besides TÜV and other national approvals, GESTRA limiter systems for level, conductivity and temperature have of course also been subjected to EC type approval and are given CE marking, as units with safety functions according to the PED.

GESTRA – with Energy into the Future

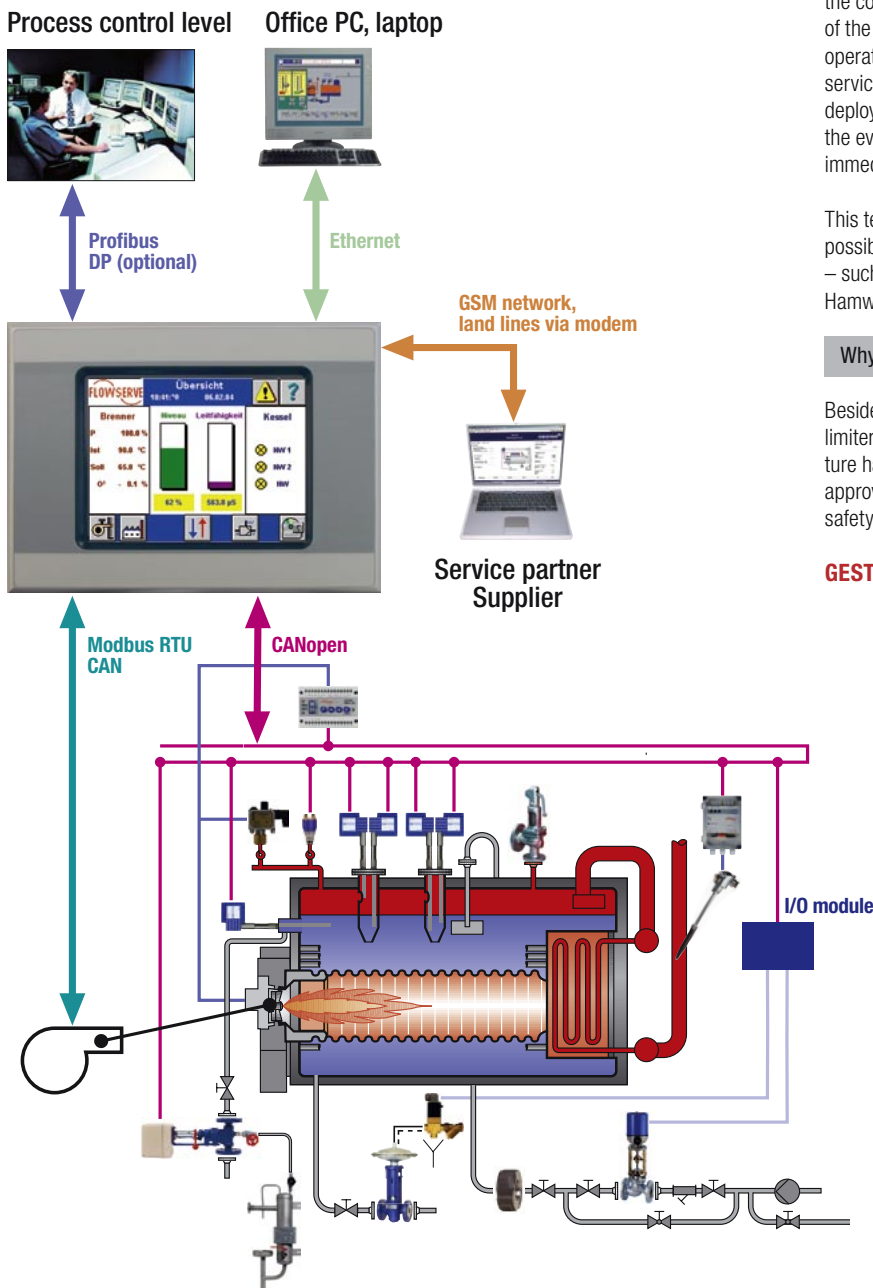


Fig. 7
GESTRA process data acquisition
in the boiler house



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