

Statement on Explosion Protection in CHP Operating Rooms

At carrying out periodic inspections of biogas plants, we often see that the protection of CHP operating rooms against explosion hazards don't correspond to the safety engineering state of the art. In many cases, only a manually operated shut-off device is installed in the gas supply tube right outside the operating room, but this does not comply with the applicable rules and regulations.

Due to the high prevalence of neglecting these regulations, we would like to present a brief overview of the legal situation below:

The relevant and legally binding basis for the operation of an installation subjected to licensing and inspection – as is the case for every biogas plant – in Germany is the BetrSichV (Industrial Safety Ordinance, in German Betriebssicherheitsverordnung).

The **§4 BetrSichV** states the following **basic obligations**¹⁾ for the employer.

(1) Work equipment²⁾ and tools may be used only if the employer:

1. has carried out a risk assessment,
2. has established the identified protective measures according to the state of the art, and
3. has determined that the use of the equipment is safe according to the state of the art.

But what is state of the art?

The state of the art is an indeterminate term, which refers to the latest level of development in science and technology. It is legally established in the BImSchG (German Federal Emission Act) as a model for other areas and aligned with European legal requirements.

“State of the art is the state of development of advanced processes, facilities, equipment and modes of operation which is deemed to indicate the practical suitability of a particular technique for restricting emission levels to air, water and soil, to ensure plant safety, to ensure environmentally proper waste management or otherwise to prevent or reduce impacts to the environment and to achieve a generally high level of protection of the environment as a whole.

When determining the state of the art, special consideration shall be given to comparable processes, facilities or modes of operation that have been successfully proven in practical operation.”

There are particular criteria (listed in the Annex of the respective legal standard) which need to be taken into account when determining the state of the art.

In the so called “Kalkar-Decision” from the Federal Constitutional Court, the state of the art is classified as more highly valued than the “generally recognized rules of technology”.

If we take a closer look at the topic of explosion safety, above all else is the European Directive 1999/92/EC with the subsequent standards (such as DIN EN 1127-1) and (national) technical rules like TRBS (Technical Rules for Operating Safety), TRGS (Technical Rules for Hazardous Substances), TR (Technical Rules), and additionally rules of the trade associations (BGR) and accident prevention regulations like DGUV (German Social Accident Insurance) Rule 113-001, resp. 104.

There are two basic rules to avoid explosion hazards.

1. Areas in which a hazardous explosive atmosphere may arise are defined as Ex-protection zones and potential sources of ignition must be prevented in these zones. Means only devices that have the appropriate Ex-protection class (secondary explosion protection) may be used.
2. If potential ignition sources cannot be excluded from these areas, as primary explosion protection the formation of a hazardous explosive atmosphere must be prevented or excluded.

A CHP is naturally, by its possible hot surfaces, a potential source of ignition. Therefore, in a CHP installation room, the formation of a hazardous explosive atmosphere must be prevented.

The usual constructive way to solve that is that only technically leak-proof system components are used and these components are regularly checked for leaks and, in addition, the room is controlled with a gas warning device which have automatically triggering of safety functions. Additionally, the operating rooms must be equipped with adequately dimensioned technical ventilation.

The formerly practiced method of a constant room ventilation of 35 m³/h per kW electrical power, with flow monitoring, is no longer considered as state of the art today (see DGUV example collection BGR 104, section 4.8.17)

The functions of a gas warning device and the subsequent actions, which must be triggered when the permissible threshold values are exceeded, are analogously specified in various technical rules such as: TRBS 2152-2 (2.5.4 ff.), TRGS 599 (Point 4. ff.), KAS³ reports and leaflets (e.g. KAS-12), the Safety Regulations for Biogas Plants **TI 4**, and the bulletin "biogas plants" from the Rhineland-Palatinate Structural and Approval Directorate.

These requirements for operating room monitoring are thus clearly to be regarded as state of the art and must be used (!)

The **TI 4** is a summary of the most important ordinances and regulations. The requirements for CHP installation (operation) rooms are clearly formulated under point 3.6.

Point 3.6.1.4 Disconnection of the gas supply

It must be possible to shut off the gas supply to the combined heating and power unit, in the open, outside of the installation room, as close as possible to the CHP unit room. The open and closed positions must be marked.

The same requirements apply to electrically operated shut-off valves.... *end of quote*

Of course, the shut-off valve must be freely accessible. At first glance, the point 3.6.1.4 gives no indication as to whether the gas supply must be shut off manually or automatically. The statement is merely that a shutoff must be mandatory and the open and closed positions must be marked.

It becomes clearer how must be designed the gas shut-off in connection with a room air control system when reading the next point.

Point 3.6.1.5 Room air control

The possible gas leakage of CH₄ mixtures in the engine room is controlled by a room air monitoring safety technology (gas warning device) with the following safety-related functions and interlocking.

At alarm threshold 20% of the LEL (0.9 vol% CH₄) in the room air with the follow-up safety actions:

- switch on visual and audible warning and
- run ventilation to 100%

At alarm threshold 40% of the LEL (1.8 vol% CH₄), the following would occur:

- switch on visual and audible warning and
- run ventilation to 100% power and
- automatically shut down the engine and automatically closing of the gas supply outside the installation room.

The gas warning device must be continues operated even when the 2nd alarm threshold is exceeded, means not switched off.... *end of quote*

This safety rule is clear and leaves no room for interpretation. Keeping in mind the principle of primary and secondary explosion protection. Either no ignition source may exist in the range of possible hazardous explosive atmosphere or a hazardous explosive atmosphere must be avoided or limited if there are possible ignition sources in the area.

The GefStoffV (German Ordinance on Hazardous Substances) also demands in §11 and Annex I, Number 1, Section 1.2 (3), that hazardous substance flows (in this case, biogas) must automatically be limited or interrupted

Two further comments on safety and state of the art from our side:

The shut-off valve must also close automatically, even if the auxiliary power like compressed air or electricity fails. A spring-closing drive must be placed on the valve or flap, which could easily be mounted on the commonly used butterfly valves and cost of a few hundred euros.

The triggered alarm must be set as a default message on the system control and also on the cell phone of the plant operator.

The gas warning device must work, even if the general power supply failed, as long as a safe operating state is reached. This means that the gas warning device shall be supplied by a grid-independent power source (emergency power).

We strongly recommend that you use state-of-the-art safety in accordance with legally binding regulations. The BetrSichV, as the most important legal basis for the operation of biogas plants, is very definite and inexorable in this point:

The § 22 BetrSichV Regulatory Offence (Ordnungswidrigkeiten) states inter alia:

(1) An offence in the sense of § 25, Clause 1, Number 1 of the Occupational Health and Safety Act, is committed who, by intent or through negligence

....

7. Is, against § 4 Clause (1), using a working equipment (which is not on the state of the art level of safety technology).

....

The § 23 BetrSichV Offences (Straftaten) is even harder:

(1) Any person who endangers the life or health of an employee by an intentional act as defined in § 22 (1) shall be punishable under § 26 (2) of the Occupational Health and Safety Act.

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Remarks

¹⁾ according to § 2 (3) 1. BetrSichV is also an employer, "whoever is not an employer, operates a facility subject to supervision for commercial or commercial purposes ..."

²⁾ according to § 2 (1) Work equipment means tools, devices, machines or systems that are used for the work, as well as installations requiring monitoring.

³⁾ KAS Commission for Plant Safety at the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

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