

Statement on Emission Control Systems in Large Scale Hydrogen Plants



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This document summarizes the conclusions of the Safe H2 Group after considering keynotes from Josue Melguizo-Gavilanes and Clemens Ambros, along with two surveys conducted within the group during spring and summer 2025.

The group acknowledges that the need for **reliable models to predict** detonation overpressures upon venting is of prime importance and currently lacking. More test data and research are necessary to develop definitive design guidelines for inclusion in engineering standards. Research efforts should focus on collecting large-scale data accounting for actual or planned designs in terms of vent source pressure and temperature, diameter, maximum allowable flow rates during blowdown, etc. Ultimately, the development of more applicable testing campaigns will facilitate the creation of more reliable detonation overpressure prediction models.

Heat and pressure effects from areas where ignition of escaping hydrogen cannot be ruled out must be considered in early design phases. When **determining the maximum permissible radiation intensity and explosion overpressures**, project developers must rely on national guidelines, as clear legal requirements or internationally accepted standards are generally lacking. The group members point out that project developers should be aware of this and that these limit values can have a major influence on vent stack designs, for example. While a radiation intensity of **1.6 kW/m²** and an explosion overpressure of **50 mbar** serve as good reference points in purely industrial areas, different acceptability thresholds may apply to other use-cases. Therefore, a specific risk assessment must be conducted for each location.

For project developers and EPCs, the consortium would like clarity from standardization committees and trade associations on how to deal with the **ignition hazard of venting operations**, especially those imposed by lightning strike and the corresponding explosion overpressure effects. Furthermore, the need for preventing lightning strike in a hazardous area classified as **Zone 1** above the vent must be aligned between European countries as national approaches are currently deviating from each other.

By implementing **flare systems**, a significant number of group members avoid addressing the issue of maximum explosion overpressure, despite the disadvantages associated to them, such as the need to ensure ignition and high investment costs. Many members protect vent systems against internal ignition through **permanent inerting**, which virtually eliminates the risk of deflagration transitioning into detonation within the vent pipes. However, maximum **length-to-diameter ratios** such as **100:1** from EIGA 211 (which specifically excludes inerted systems from its scope) are rarely used in systems of this size.

Although EIGA 211 and CGA G-5.5 are reference points for the design of hydrogen vents, some group members have decided to deviate from them. Following thorough project- and application-specific risk assessments, some group members have opted to use materials other than stainless steel for vent pipes.

Pipes for discharging oxygen during operation and hydrogen during start-up, shutdown, and emergency shutdown are either collected in a **header** or separated in **single vents**.

The configurations are evenly distributed across the group. Based on the outcomes of the risk assessments, prioritising the prevention of backflow between systems may take precedence over reducing the number of atmospheric release sources.

Where the **oxygen concentration** in the air is already considered in the design, initial measures such as alarms are already triggered at **23.5%**.

Unsurprisingly, the “European design” of the **λ-vent** (known from the ESPC; IChemE recommendations or from DVGW G 442) predominates in **vent design**. However, designs from CGH 5.5 are also used in isolated cases.

The **Safe H2 Group** is a platform established within the framework of the IPCEI industrial program Hy2Use to promote safe handling of hydrogen and prevent accidents. The group meets twice a year to exchange experiences, standardize safety methods, and conduct training sessions.

Goal of the Safe H2 Group is to increase the safety knowledge of IPCEI participants. Members of the group work on creating and disseminating best practices for the hydrogen industry. An important aspect of their work is sharing information about safety risks and near-misses to learn from these experiences and prevent future accidents. Additionally, they conduct joint safety training sessions to raise awareness of potential hazards and improve safety standards in the industry.