Safety issues of the hydrogen economy

Every two months, Prof. Dr. Thorsten Arnhold, IECEx Chairman 2014-2019, provides an update on developments within the organisation.

A couple of months ago I wrote about the megatrend that is the hydrogen economy. This simple-structured chemical element will have huge significance as a carrier of energy in the future. Since my article, some important events have taken place which underline this statement.

More and more countries are publishing their national strategies to develop appropriate hydrogen infrastructures within the next 10 to 20 years. For instance, Germany published the national programme in autumn 2020, South Korea published a national hydrogen law at the beginning of 2021, and the UK's publication of the national hydrogen strategy is expected at the end of Q1.

All these papers show that there are not only great expectations for the opportunities presented by hydrogen, but there is also now an appropriate awareness of the safety risks that need to be overcome as the hydrogen economy develops. As an example, the following quote was featured in an article about South Korea's hydrogen law in *The Korea Herald*: "Most importantly, the hydrogen law tackles the safety issues that had long remained in a regulatory blind spot. Previously, hydrogen equipment – electrolysers, portable fuel cells and hydrogen extractors – and fuel cell facilities that directly used hydrogen weren't subject to periodic government safety checks. Now, safety assurance will be carried out in three steps – technology safety at the design stage, an on-site examination upon completion of a facility, and annual safety checks…"

The hydrogen story is a good example to demonstrate how well the international cooperation between the standardisation organisations ISO and IEC is functioning and how the conformity assessment of IEC can support the establishment of a safe and reliable infrastructure.

Considering the typical value stream of the green hydrogen economy, it consists of several main elements: electrolysis, the transport and storage of hydrogen, the distribution to the end users and the final step of transformation of the hydrogen chemical energy into electrical energy by fuel cells.

IEC Technical Committee TC 105 covers the fuel cell technology. There is a set of brand new standards dealing with safety of portable fuel cell systems IEC 62282-5-100 (May 2019), and the safety of stationary fuel cell systems IEC 62282-3-100 (September 2020). The new standard dealing with the safety of fuel cell modules is approaching the final stage (CDV) and will soon replace the current edition of the 62282-2 Ed. 2(2012). ISO TC 197 mostly covers the rest of the elements of the value chain mentioned before.

To get a comprehensive overview about all safety related aspects of the hydrogen generation, transformation, transport and distribution process, the Technical Report ISO/TR 15916 (2015): "Basic considerations for the safety of hydrogen systems" is highly recommended. A new version is currently being prepared at ISO TC 197. The international standard ISO 22734 (September 2019) deals with "Hydrogen generators using water electrolysis – industrial, commercial, and residential applications". Another standard, ISO 19880-1 (March 2020) is about Gaseous hydrogen – fuelling stations – Part 1: General requirements. Both standards require a comprehensive risk analysis at the very beginning of a facility's design. All detected dangers shall be removed by means of appropriate safety measures.

One of the most important dangers of hydrogen is caused by its flammability and its tendency to explode. Therefore, explosion protection is a particular focus in the safety standard. In both standards, all requirements for explosion protection are directly referenced to the respective IEC TC 31 standards. There shall be zone classification according to IEC 60079-10-1, the installation shall follow IEC 60079-14 and there has to be regular inspection and maintenance according to IEC 60079-17. If the installed electrical and other equipment must be explosion protected, the realisation shall be according to the respective standards for protection methods IEC 60079 – 0 ff. and IEC 80079 – 36 f.

With such a perfect consistency between the standards of two different organisations, it is possible to integrate elements of the hydrogen value chain in the existing conformity assessment systems of the IEC. Since the IECEx system has been testing and certifying equipment for use in potential hazardous hydrogen atmospheres for many years, it should not be too complicated to integrate the green hydrogen processes if regulators require this.

For me this is another example illustrating the ability of modern global standard organisations to support technical progress by maintaining a high level of safety. ■