**INTERNATIONAL ELECTROTECHNICAL COMMISSION SYSTEM FOR CERTIFICATION TO STANDARDS RELATING TO EQUIPMENT FOR USE IN EXPLOSIVE ATMOSPHERES (IECEx SYSTEM)**

**Title: Proposal to include ISO Standards associated with Hydrogen applications into the IECEx System.**

**To: Members of the IECEx Management Committee, ExMC**

**INTRODUCTION**

The IECEx System has from its inception covered the assessment and certification associated with applications involving Hydrogen.

During the March 2021 meeting of the IECEx Executive, a proposal was considered for the inclusion of International ISO Standards that address applications of Hydrogen as part of the developing Hydrogen economy, with the Executive agreeing to prepare a discussion paper for the 2021 ExMC Meeting.

This document provides a paper for discussion during the ExMC meeting and is to be supplemented by a brief presentation from Dr Thorsten Arnhold (Member of CAB and IECEx immediate past Chair) of Germany.

The meeting will be asked to support the coverage of the said ISO Standards within the IECEx Schemes.

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**IECEx Secretariat**

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**Background**

H2 Safety – Need for IECEx to include ISO Standards related to Hydrogen areas

The operation of plants in the hydrogen economy must be carried out in such a way that the protection goals of the applicable legal requirements are achieved. The necessary protective measures must be determined and specified by the operator. For this purpose, systematic safety considerations are required which include the following

- Protection concepts for the safe operation of hydrogen plants along the entire hydrogen value chain, and

- Plant safety concepts for multi-megawatt hydrogen economy plants to prevent incidents that ensure a high level of protection for human health and the environment.

The production, compression, storage, transport and final use of hydrogen as an energy source, based as far as possible on the use of renewable energies for its production, represents one of the cornerstones for a future climate-neutral sustainable energy economy. As a prerequisite for the development of a complex networked national hydrogen infrastructure, a large-scale production and processing base must be created that exceeds the currently existing plant dimensions by orders of magnitude.

Protection concepts for the use of hydrogen as a carrier and storage medium for energy within a sustainable and cross-sector energy economy already exist and used by IECEx, via TC 31which are well established.

ISO TC 197 created a brand new set of standards dealing with the whole supply chain of green Hydrogen like ISO 22734: 2019: Hydrogen generators using water electrolysis – Industrial, commercial and residential applications or ISO 19880-1:2020: Gaseous hydrogen – Fuelling stations – general requirements

The technology for using hydrogen as a secondary energy carrier is currently still at an advanced stage of development. The so-called up-scaling - i.e. the transfer of findings from laboratory to industrial scale - has begun. The first large-scale hydrogen generation plants in the megawatt range are being operated as test plants, but not as part of the more strictly regulated industrial use.

The special safety requirements result from the nature of hydrogen, which will be characterized here by only a few critical properties:

- Hydrogen forms explosive mixtures together with oxygen in a wide concentration range.

- The minimum ignition energy required to ignite explosive mixtures is minimal. Electrical and mechanical sparks as well as numerous other ignition sources can thus trigger explosions.

- Hydrogen has one of the highest flame preparation speeds. Triggered explosions are therefore particularly violent.

- Because of its extremely small molecular size and the associated large diffusion coefficient, hydrogen can escape relatively easily from closed systems. There are therefore special requirements for the tightness of the systems.

- Hydrogen has a negative Joule-Thompson coefficient under normal ambient temperatures. This means that compressed gas heats up during expansion. Under certain pressure conditions, this can lead to spontaneous ignition of a hydrogen-oxygen mixture.

Even though there are already a variety of operationally proven solutions to safely contain hydrogen in plant components, especially for large-scale use as well as for a decentral organized infrastructure (P2G plants, filling stations, fuel cells in mobile and stationary applications, etc.), cannot be completely ruled out that there may be temporary releases and thus the formation of hazardous explosive atmospheres. In order to minimize these and other hazards (e.g. from cryogenic liquid or highly compressed hydrogen), systematic conformity assessment procedures shall be carried out along the entire value chain.

Inherent with the risks relating to explosion hazards associated with production, storage, transport and use of Hydrogen, special attention is required for the Equipment and Installations along with servicing of such and the competence of persons working on such.

Due to the fact that the hazards of explosions are by far the biggest safety concern in conjunction with the hydrogen economy, and noting that assessment and certification of Equipment, Services and Competence of Persons dealing with explosion protection are already covered by the IECEx Conformity Assessment System, it is proposed that IECEx apply its established Schemes to ensure coverage of the conformity assessment elements of the hydrogen value chain, by including the ISO TC 197 Standards, noting that the Basic rules of IEC CA 01 and IECEx 01-S already provide for use of International Standards in this area. It is further noted that Equipment for use in Hydrogen areas has already long been covered by IEC TC 31 Standards as well as the IECEx System. Standards that would fall under this area would include:

**ISO 22734:** 2019: Hydrogen generators using water electrolysis – Industrial, commercial and residential applications; and

**ISO 19880-1**:2020: Gaseous hydrogen – Fuelling stations – general requirements

**Proposal**

The following course of action is proposed

ExMC to form a WG to consider the business case for including the ISO Standards within the IECEx, using the newly developed CAB Document IEC CAB-G01 “*Guideline for IEC Market Impact Analysis/Business Case for New and Existing IEC Conformity Assessment Services*”, with the result of this analysis to be considered by the IECEx Chair. If considered positive, work to commence on the development of an IECEx Operational Document, OD(s), to address how these standards are to be included within the IECEx System, in similar manner to OD 0280 which was developed to integrate the ISO 80079 series of non-electrical standards into the IECEx system.