FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

H2FUTURE
Hazards Identification / Risk Assessment Approach

Workshop on Safety of Electrolysis

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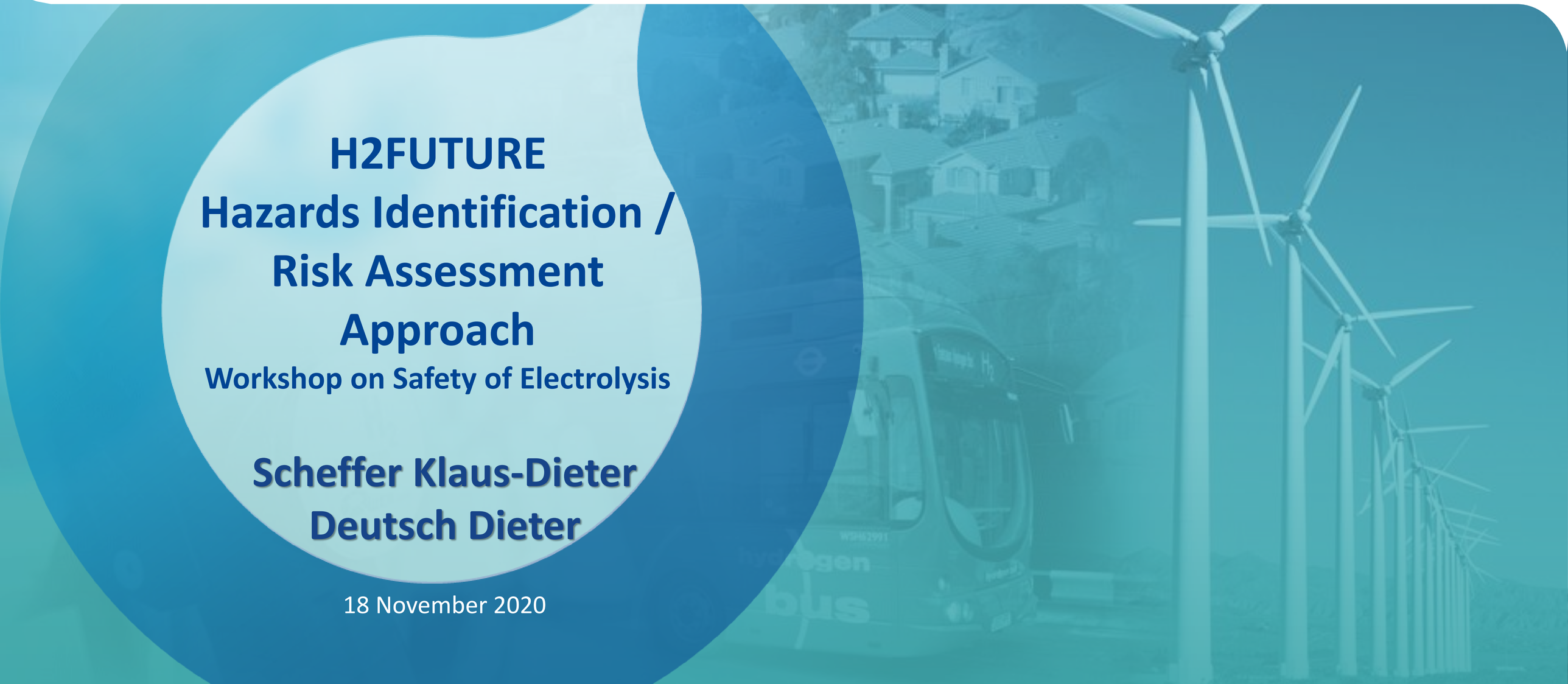

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Workshop on Safety of Electrolysis

Project Brief

Consortium

Verbund – **voestalpine - Siemens –** APG –K1met – ECN

Safety Responsibility

electrolysis: Siemens

infrastructure : voestalpine

Key data

6MW PEM electrolyseur

Start of pilot plant operation in 2019

Pilot tests and demonstration until 2021

Location

Located at steel production site of voestalpine Linz, Austria

Regulations, Codes and Standards

Main regulations and standards

ISO 22734:2008 („one failure safe“)

ÖNORM EN ISO 12100
ÖNORM EN ISO 60204
ÖNORM EN 61511 (EN ISO 13849-2)
ÖNORM EN ISO 13850

Cenelec Guide 32

Low voltage directive [2014/35/EU]
ATEX [1999/92/EG]
EMF [2014/35/EU]

Identification of Safety Vulnerabilities ISV / Risk Assessments

Methodology used during product and system development

- Risk analysis based on ISO 12100 and Cenelec Guide 32, resulting in
  - Internal rules and regulations for manufacturing, handling (packing, transport), installation and commissioning of Siemens SILYZER 300 electrolyzer systems
  - Safety hints published in the operation and maintenance manual of SILYZER 300
  - CE compliance of PEM Stack (2014/35/EU)

Methodology used during the system and plant engineering

- Multi-phase HAZOP workshops, leading to safeguard definitions wherever required, e.g. organizational measures or requirements for implementation of functional safety

It was generally considered useful to have a neutral (external) moderator who guides through the workshops and takes care of systematic documentation.

Prevention and mitigation

Analysis

- Process safety via HAZOPS
- Personal safety via risc analysis
- Explosion protection according to the definitions of ATEX [1999/92/EG]

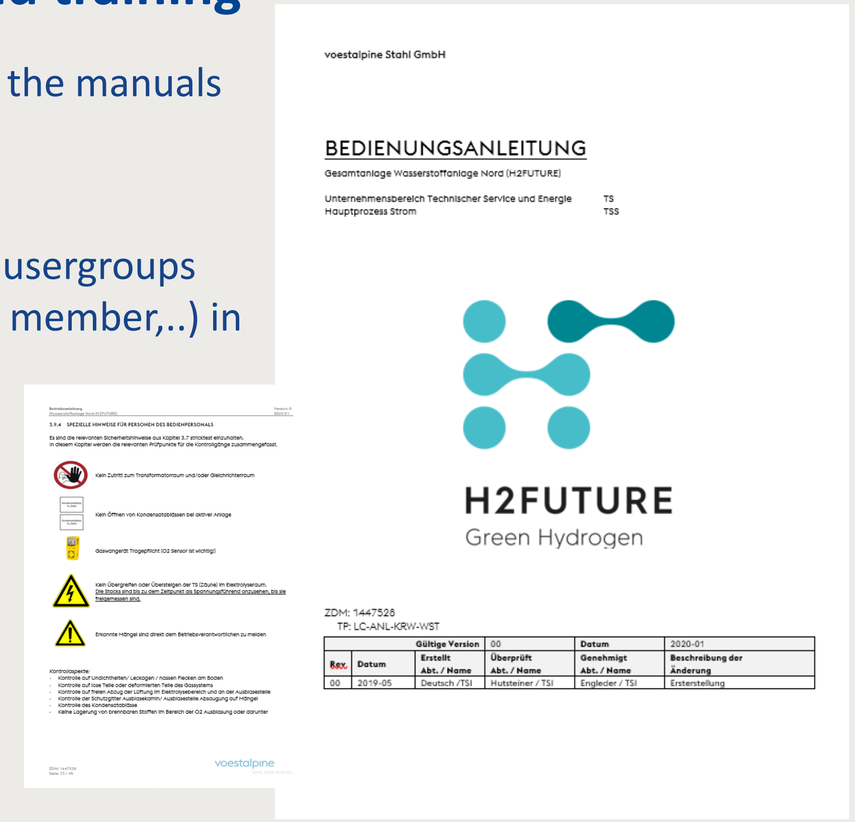
- Design matching at limit of supply between Siemens and voestalpine

Validation

- Analysis of basic concept for the complete system with TÜV Austria
- Validiation according to technical standards EN 61511 (ISO 13849-2)
- Check of the validiation steps and results with TÜV Austria

Operational concepts, education and training

- Operational steps and residual risks are part of the manuals (risks are visualized by signs)
- The informations are summarized for different usergroups (guide, electrician, mechanics, fire department member,..) in these documents.
- training on the job


voestalpine Stahl GmbH

BEDIENUNGSANLEITUNG

Gesamtanlage Wasserstoffanlage Nord (H2FUTURE)

Unternehmensbereich Technischer Service und Energie TS
Hauptprozess Strom TSS

H2FUTURE
Green Hydrogen

ZDM: 1447528
TP: LC-ANL-KRW-WST

		Gültige Version	00	Datum	2020-01
Rev.	Datum	Erstellt Abt. / Name	Überprüft Abt. / Name	Genehmigt Abt. / Name	Beschreibung der Änderung
00	2019-05	Deutsch /TSI	Hutsteiner / TSI	Engleder / TSI	Ersterstellung

5.9.x SPEZIELLE HINWEISE FÜR PERSONEN DES BEDIENPERSONALS

Es sind die relevanten Sicherheitshinweise aus Kapitel 3.7 strickest einzuhalten.
In diesem Kapitel werden die relevanten Prüfpunkte für die Kontrollgänge zusammengefasst.

Kein Zutritt zum Transformatorraum und/oder Gleichrichterraum

Kein Öffnen von Kondensatabläufen bei aktiver Anlage

Gaswarngerät Tragepflicht (O2 Sensor ist wichtig)

Kein Übergreifen oder Übersteigen der TS (Zäune) im Elektrolyseraum.
Die Stocks sind bis zu dem Zeitpunkt als Spannungsführend anzusehen, bis sie freigemessen sind.

Erkannte Hänge sind direkt dem Betriebsverantwortlichen zu melden

Kontrollaspekte:
- Kontrolle auf Undichtheiten/ Leckagen / nassen Flecken am Boden
- Kontrolle auf lose Teile oder deformierten Teile des Gassystems
- Kontrolle auf freien Abzug der Lüftung im Elektrolysebereich und an der Ausblasestelle
- Kontrolle der Schutzgitter Ausblasekamin/ Ausblasestelle Absaugung auf Hänger
- Kontrolle des Kondensatablass
- Keine Lagerung von brennbaren Stoffen im Bereich der O2 Ausblasung oder darunter

voestalpine

Safety issues observed so far

accidents: none

unexpected hazards: none

off-normal events: sensor, valve defects

lessons learnt

ATEX in austria has small differences to ATEX in germany (lower limit to define a explosion zone)

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Safety concept electrolysis

The SILYZER 300 electrolyzer has a conceptually safe system design

- Low operating pressure minimizes the risk of internal and external leakages
- PEM cells completely flooded with water
  (Cycling process water on oxygen and hydrogen cell side)
- Water trap (siphon) secures safe separation of oxygen and hydrogen gas
- Fast responding full-pole disconnection of power supply using
  DC circuit breakers and isolators
- Grounded process equipment / DC supply with integrated earth fault detection
- Plant control system with a comprehensive set of sensors incl. safety-related level and pressure monitoring acc. to IEC 61511
- Multi-channel gas quality monitoring on oxygen and hydrogen side
- Pressure relief valves

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Safety concept infrastructure

The infrastructure has a conceptually safe system design

- H2 valves fail safe closed
- N2 valves fail safe open
- H2 components are inertized with N2 before and after use
- Exhaust line is during H2 production always flushed with N2
- System pressure > ambient pressure
- Large distance between O2 and H2 exhaust line
- Electrolysis-room is well ventilated

- Access restrictions to the electolyzer hall and to electrical rooms
- Regular inspections
- Large distance between visitor/access area and stacks
- No maintenance close to the stacks while H2 production is running

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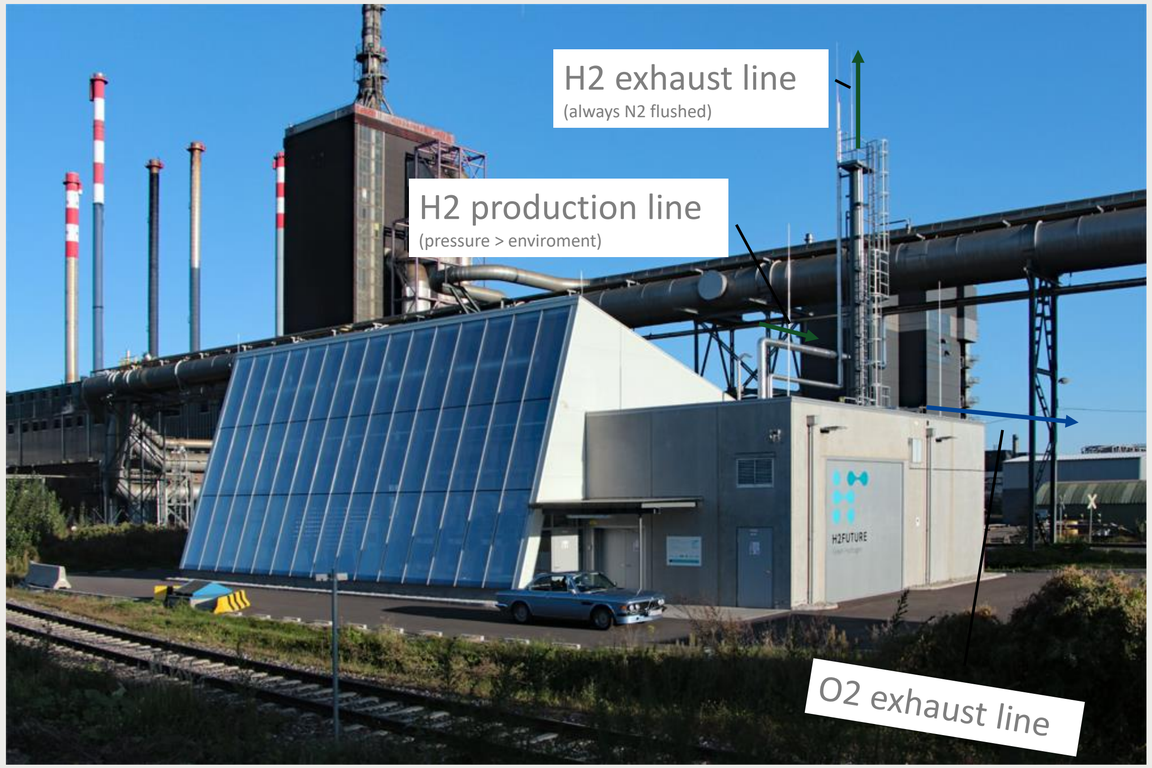
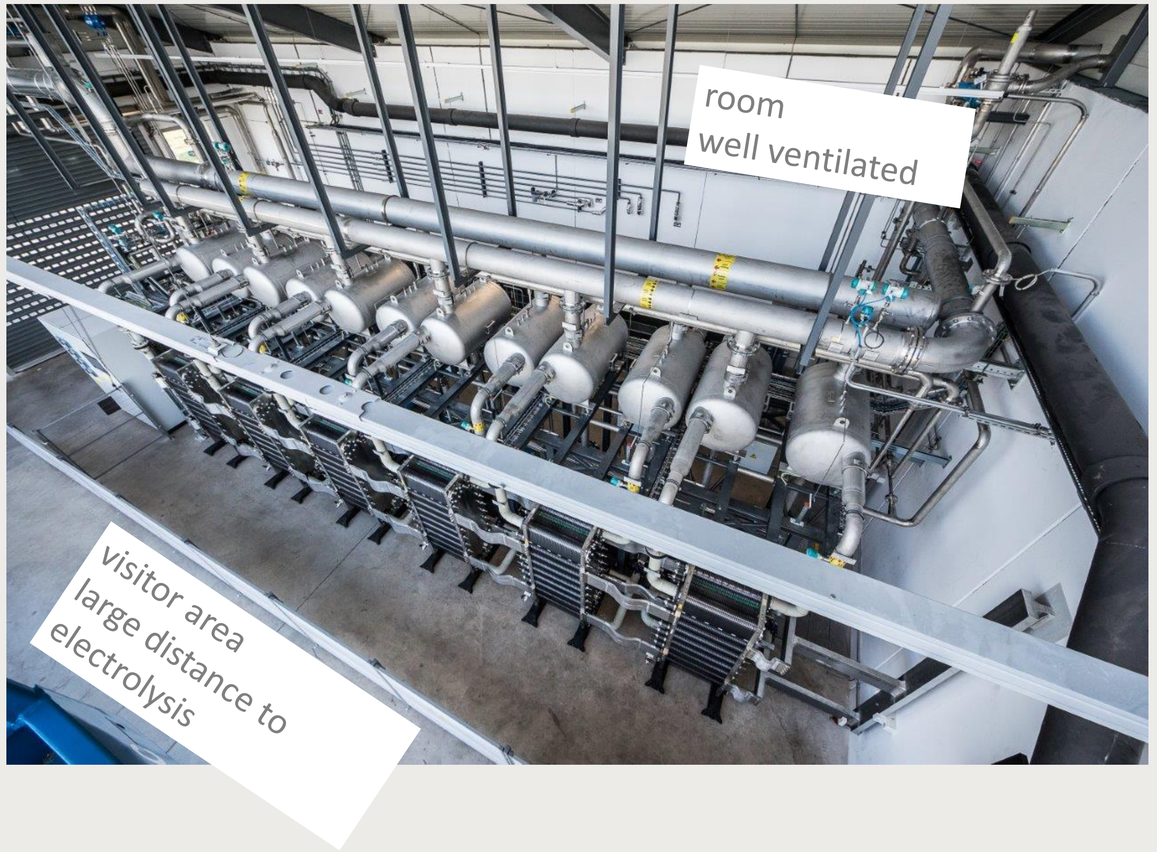
Safety concept infrastructure





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