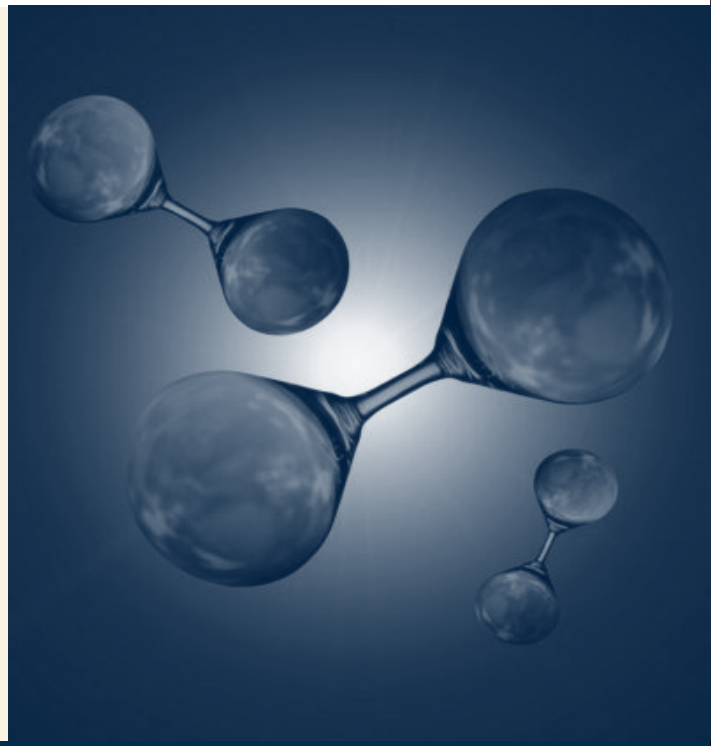
Enabling safe (green) hydrogen production by water electrolysis

Results ISPT / NTA8221



Karen van Tol & Dimitri Quist
17 december 2025

Enabling safe (green) hydrogen production by water electrolysis

Karen van Tol

- Chemical Engineer – TU Delft
- Senior consultant Seveso
- Over 30 years of experience in process safety, environmental safety, and policy formulation
- Identification of needs for standardisation enabling green hydrogen production
- Member of NTA8221 committee

Haskoning

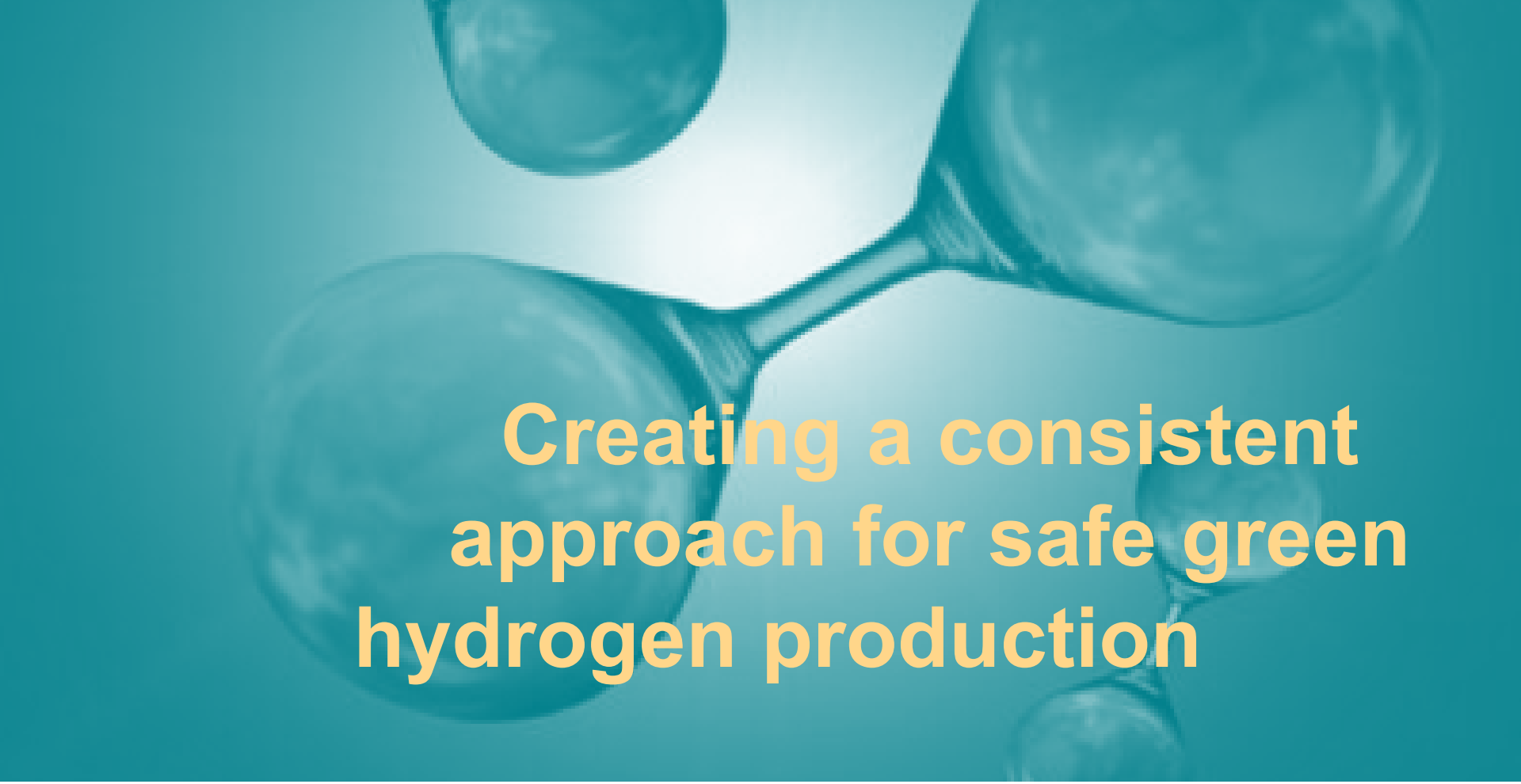
Enhancing Society Together

Results ISPT / NTA-8221

17 December 2025

Dimitri Quist

- HSSE leader in CAPEX – Open University & INHolland University
- Expert in heavy Industries & Complex CAPEX/OPEX projects
- Over 25 years of experience in industrial safety and compliance
- Skilled in HAZOP, PSSR leadership, incident investigations, and operational excellence



Creating a consistent approach for safe green hydrogen production

Challenges of (green) hydrogen

Paris Climate Agreement: Hydrogen has to be produced by green electricity on a large scale

Target

- ✓ NL: 4 GW 2030; 8 GW 2032
- ✓ Europe: 40 to 60 GW

Status:
2026–2028 700 MW expected (NL)

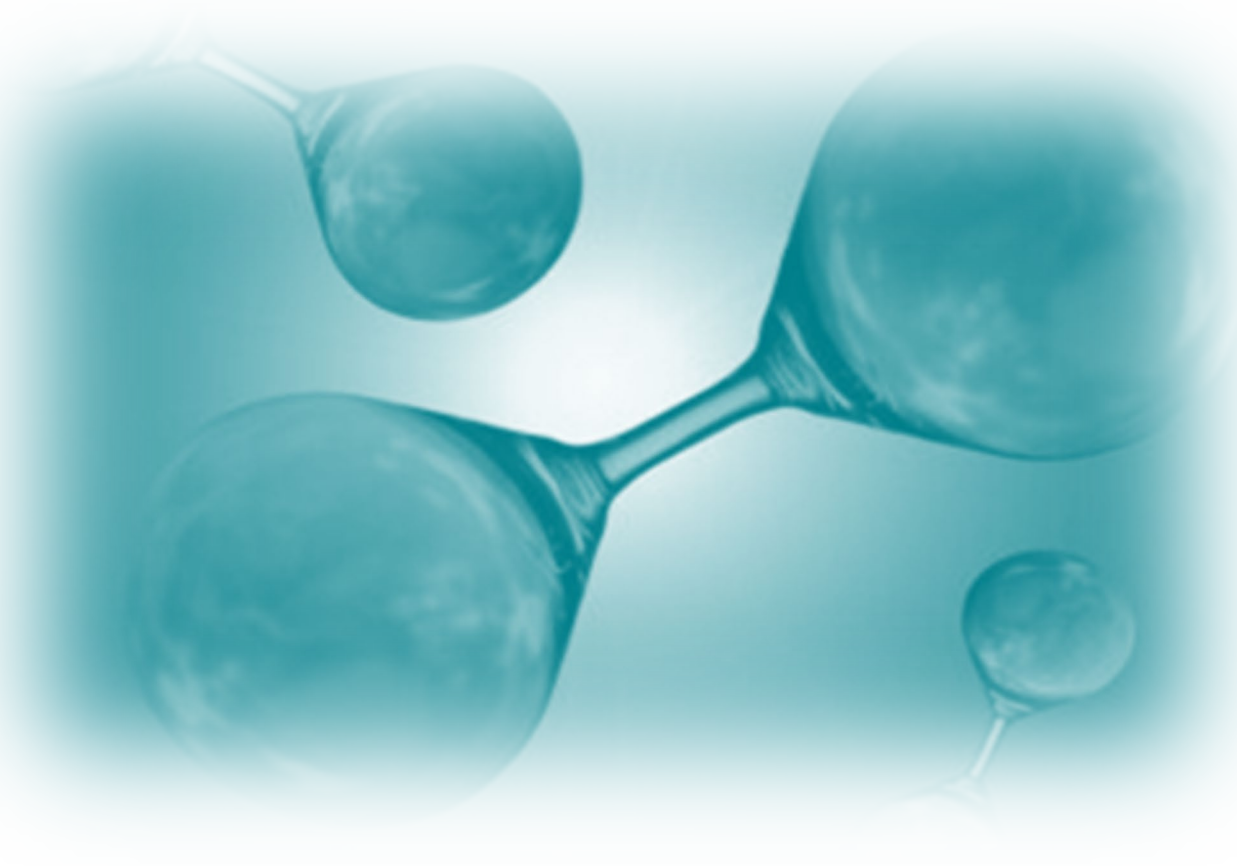
https://energietransitiestrategie.nl/

Challenges

- Availability of renewable energy
- Costs of the technology for production, storage and transport

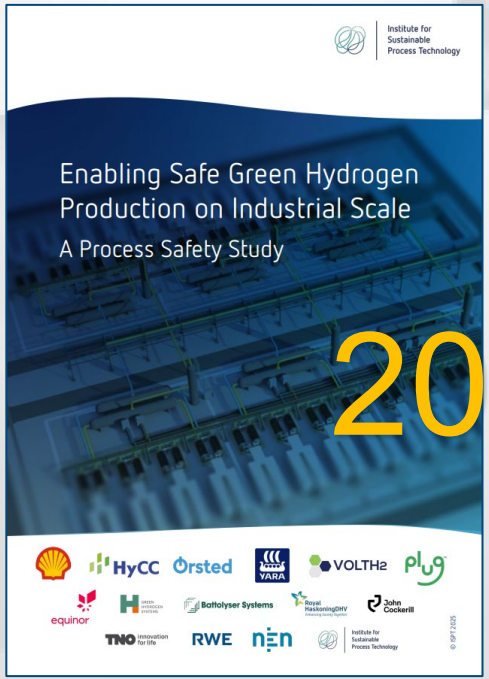
Last but not least:

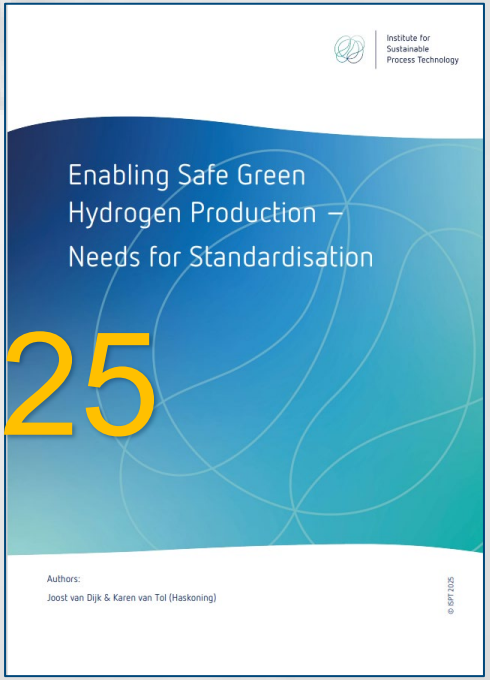
- Technical challenges associated with scaling up, including safety aspects



Addressing the challenges

Institute of Sustainable Process Technology (ISPT):



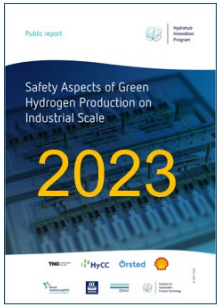


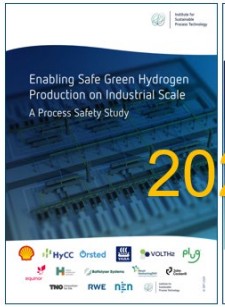
Free download at https://ISPT.EU

Addressing the challenges

Initiator:

Institute of Sustainable Process Technology (ISPT):





Additional input:

Dutch Hydrogen Safety Innovation Program (WVIP)

Specific expertise and projects

Publication date: 7th oct 2025
Available at https://www.nen.nl

Nederlandse technische afspraak

NTA 8221
(nl)

Procesveiligheid voor de productie van waterstof door elektrolyse voor industrieel gebruik

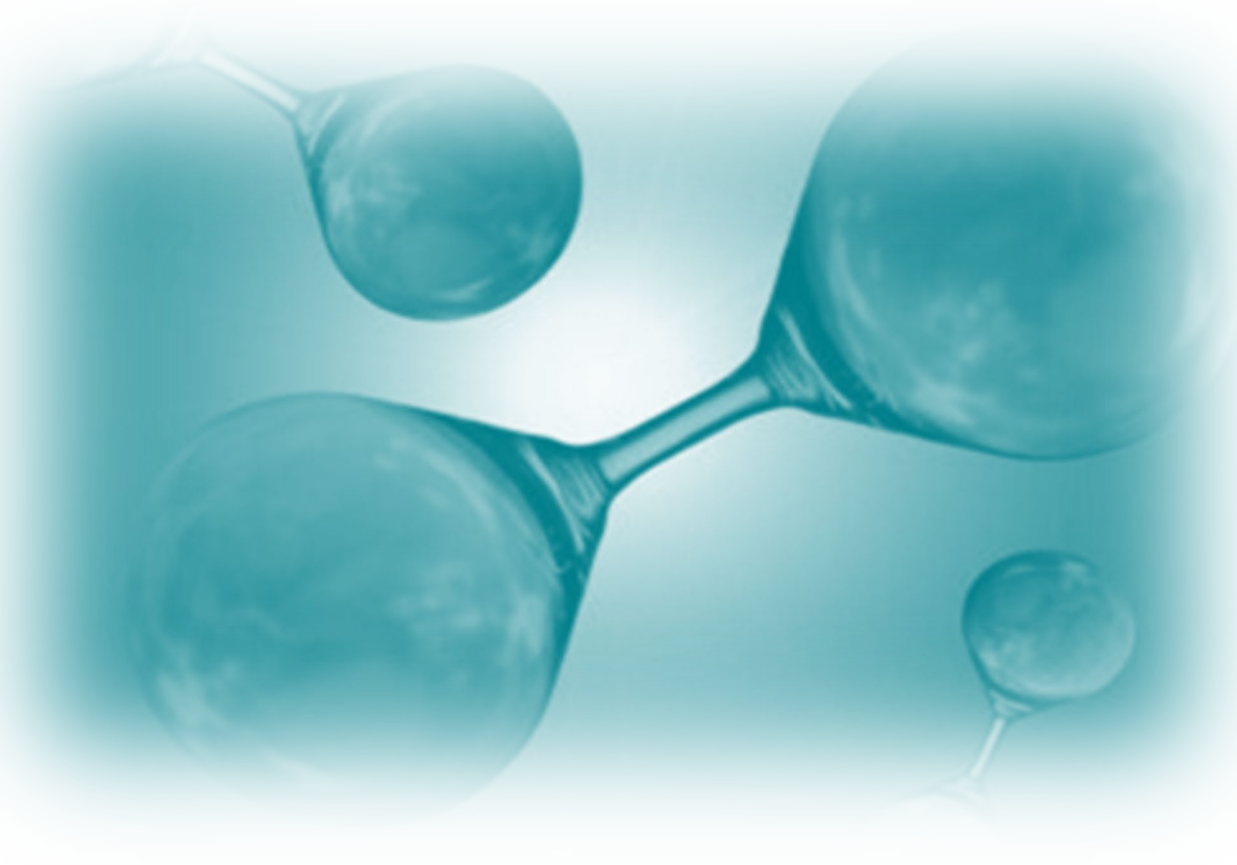
Process safety for the production of hydrogen by electrolysis for industrial use

Future European standard ?

PUBLICATIEREEKS GEVAARLIJKE STOFFEN

40 Installaties voor de productie van waterstof door elektrolyse

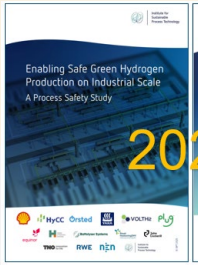
Draft version (Dutch)
Final version Part of Dutch Law



Playing field

Design Phase	Operational Phase
OEM	Operator / Owner
Component CE, Equipment CE, Assembly CE	Installation
International	***Local, Regional, European***
Design standards 	License to Operate 
HAZARD IDENTIFICATION & RISK ASSESSMENTS	
Control and inspections by accredited bodies	Control and inspections by governmental inspection

Scope and target audience



Nederlandse technische afspraak

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(nl)

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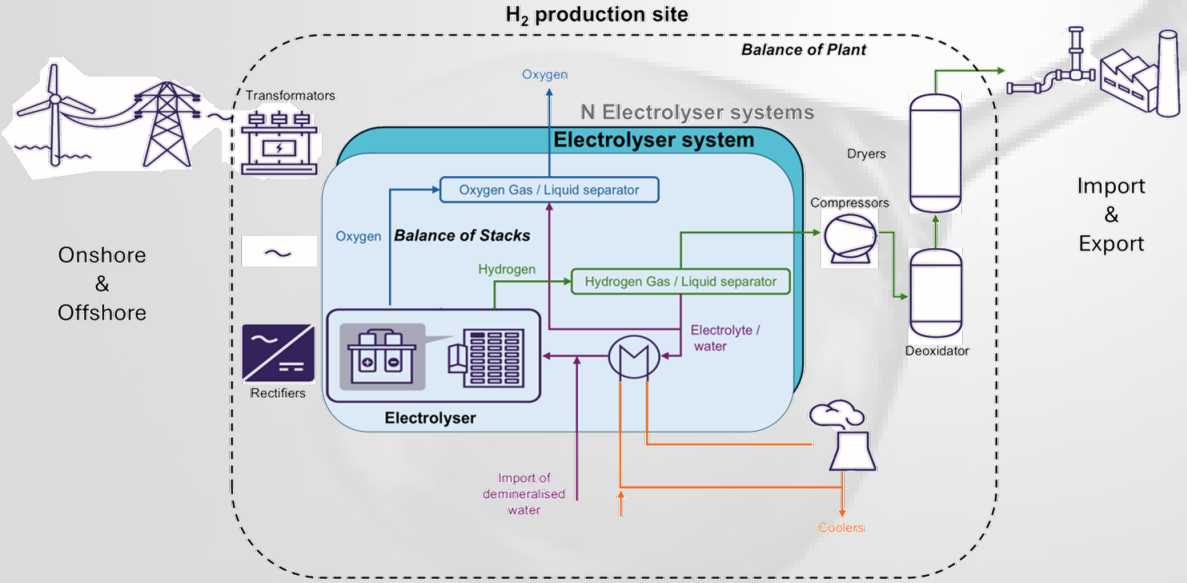
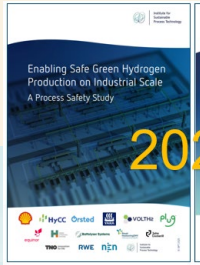


AWE and PEM; industrial scale

- Designers;
- Manufacturers/suppliers and assemblers;
- Operators/ Owners;
- Licensing authorities and inspectors
- Accredited bodies

Philosophies



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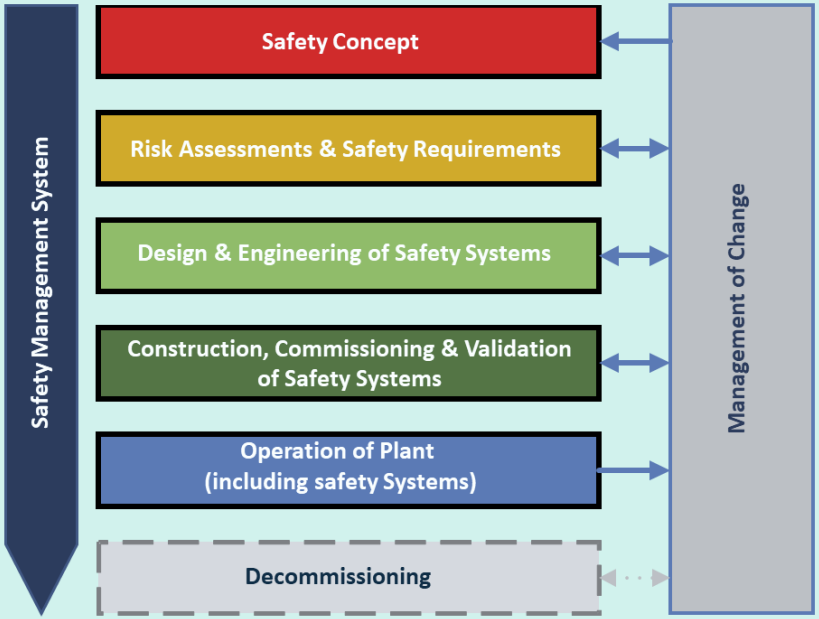
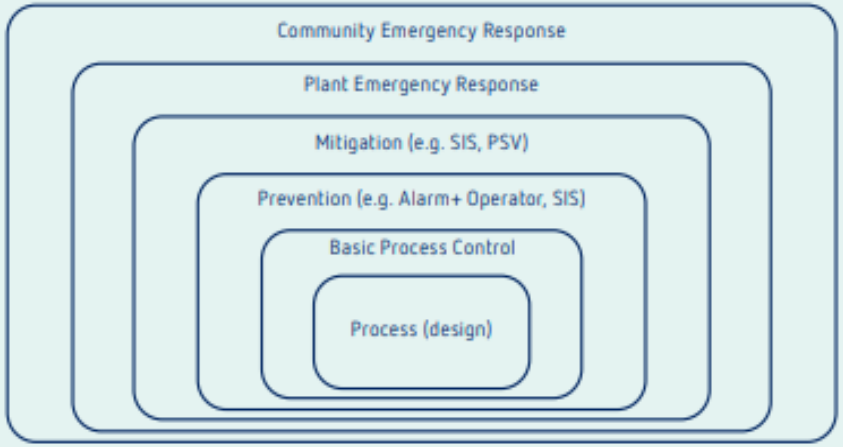
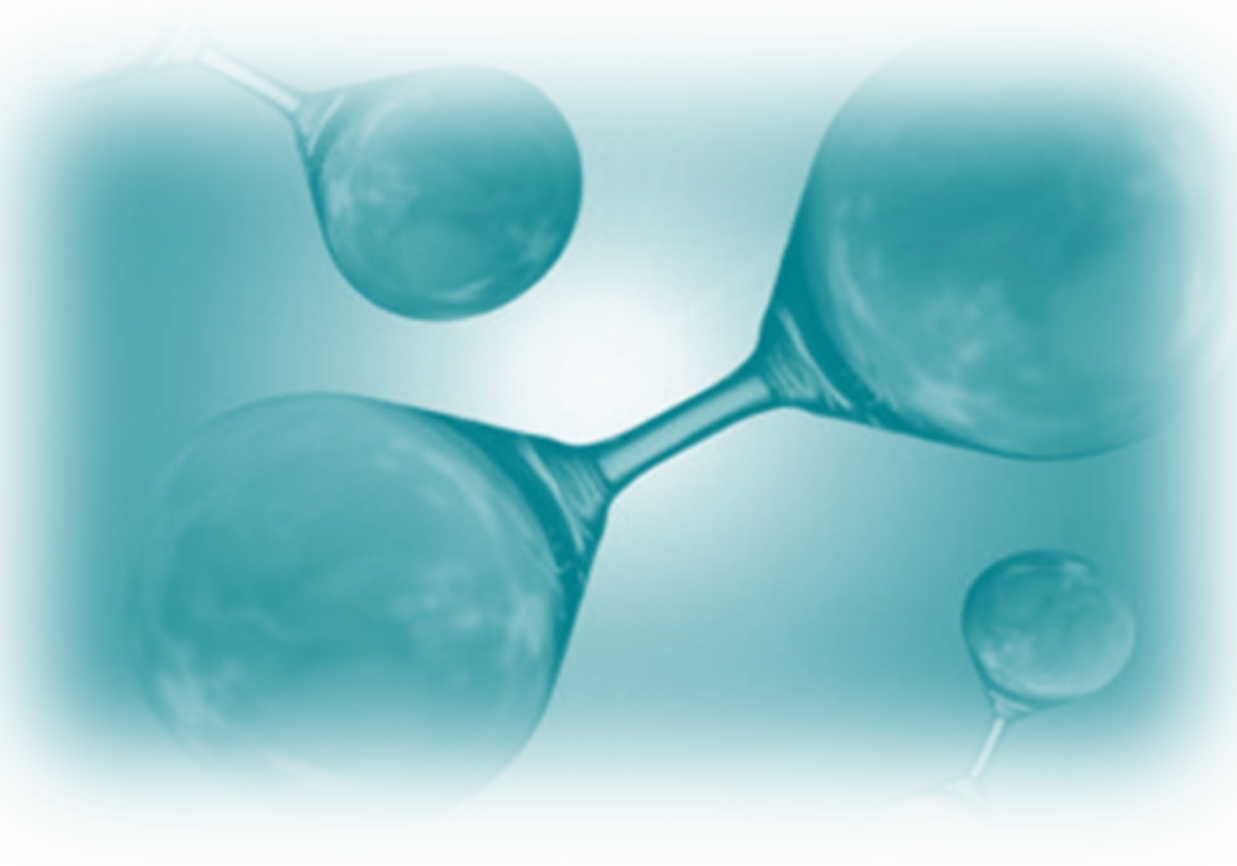
Safety Aspects in Asset Life Cycle

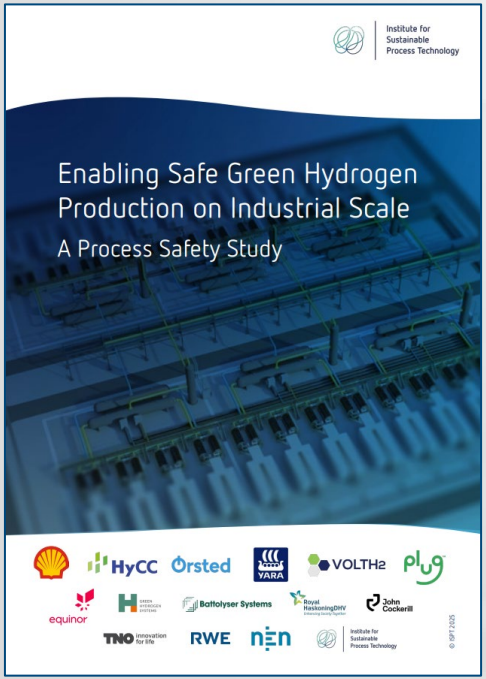


Independent protection layers





ISPT (2025) - A process safety study

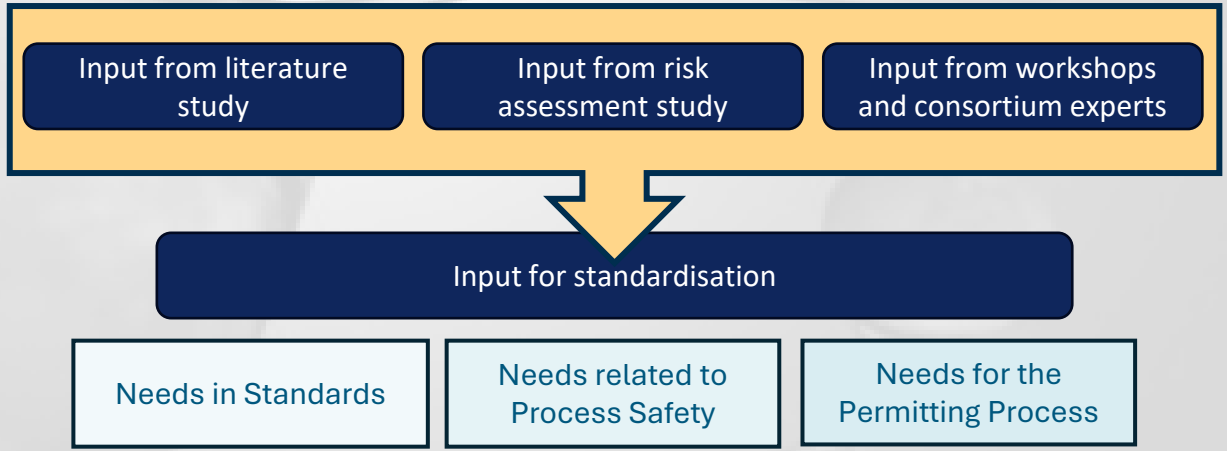


A deep dive into the technical safety risks, scenarios and design implications for electrolysis using **Alkaline Water Electrolysis (AWE)** and **Proton Exchange Membrane (PEM)** technologies.

- Generic **hazard scenarios** and risk assessments
- **Process safety management** for electrolysers
- Effects of **intermittent power supply** on system degradation and safety
- Explosion and fire hazards specific to **hydrogen and oxygen**
- **Operational safeguards** tailored to large-scale electrolysers

ISPT (2025) – Needs for standardisation

Mapping the **needs** relevant to safety standardisation **during the multiple project phases of the design and operation** of green hydrogen production facilities and the related permitting process



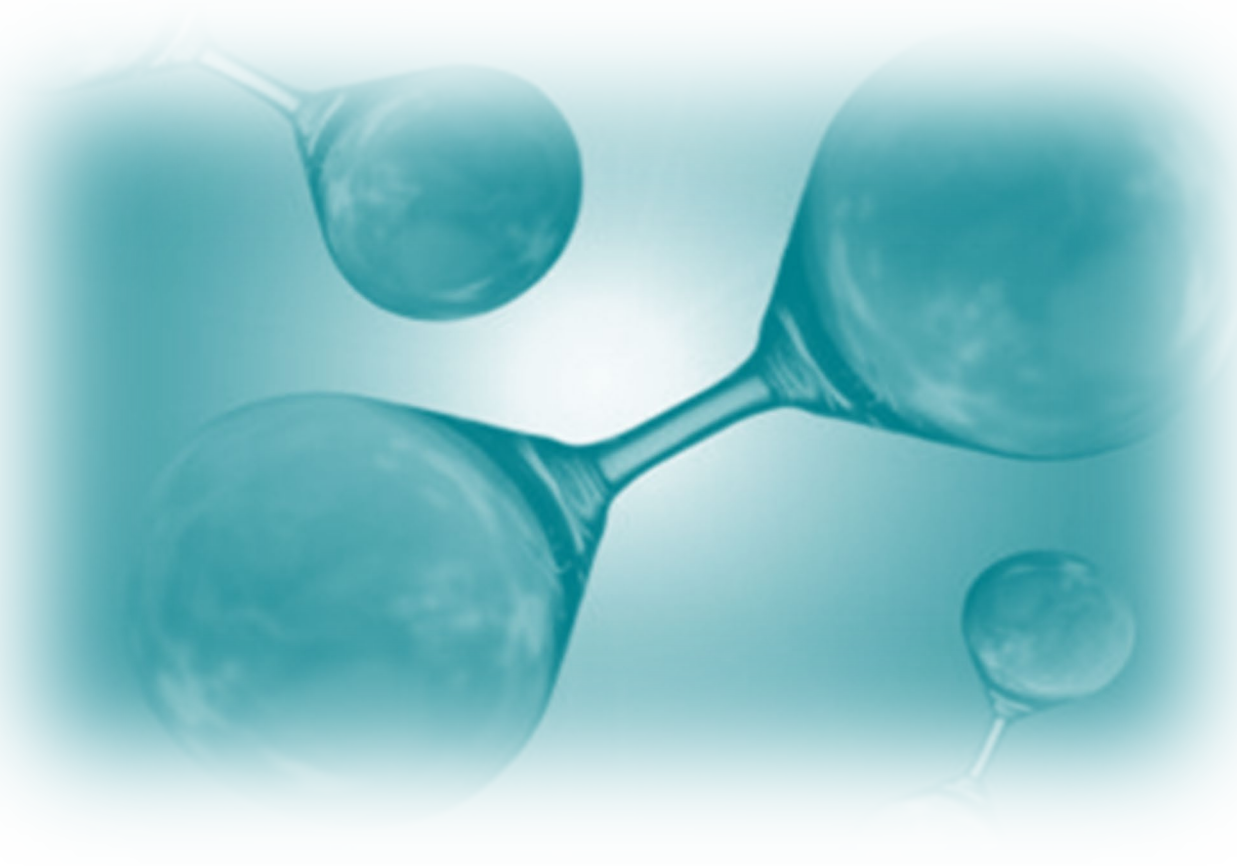
Key findings of ISPT: Needs for standardisation

- Needs in Standards
- Needs based on Process Studies
- Needs for the Permitting Process

Finding 1: Industry can design, build and operate water electrolysers safely.

Finding 2: Operators/owners need a sufficiently detailed framework .

Finding 3: Permitting process is often time consuming because of missing laws, regulations, and standards.



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Finding 2: Operators/owners need a sufficiently detailed framework .

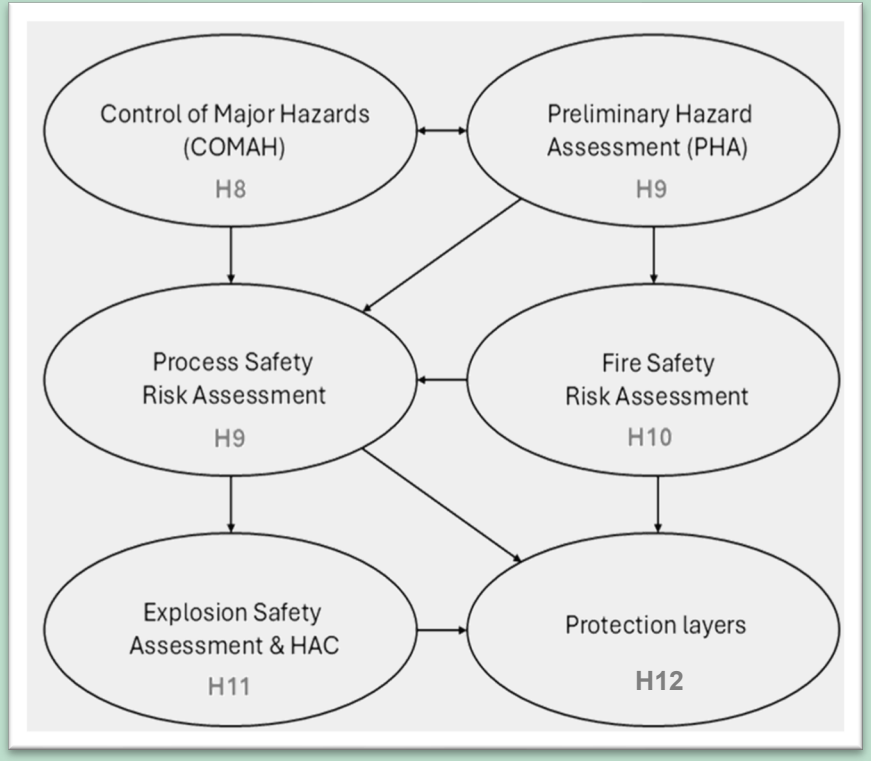
Finding 3: Permitting process is often time consuming because of missing laws, regulations, and standards.

Finding 4: A large number of applicable standards are generic and do not specifically concern hydrogen or even water electrolysis.

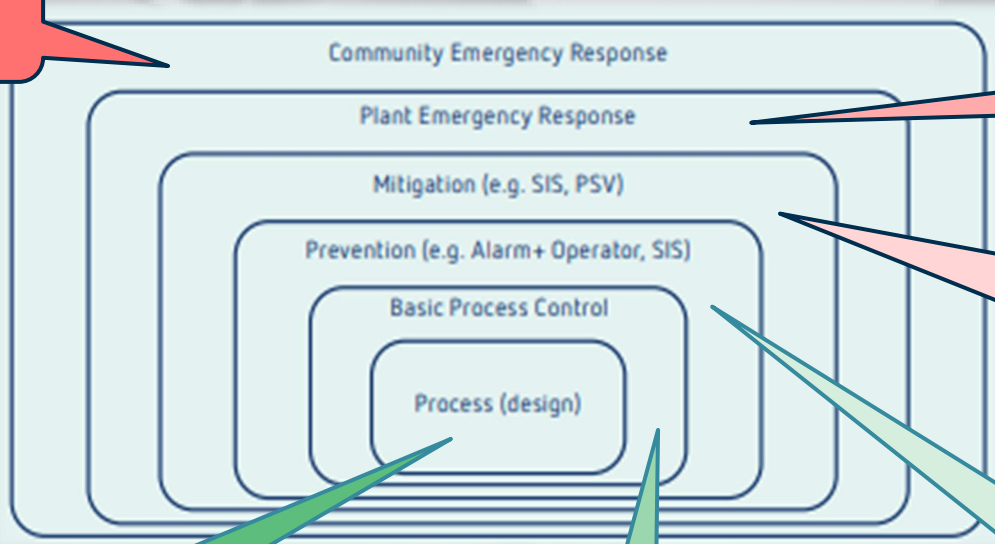
Finding 5: More specific technical topics need to be filled in to have a complete and consistent knowledge base.

NTA 8221: Contents

H1-H4	*Subject and Scope, Normative References, Terms and Definitions, Abbreviations*
H5-H7	*Basic Concepts of Process Safety for Hydrogen Production, Safety Management, Safety Strategy*
H8	*Control of Major Hazards*
H9	*Process Safety Risk Assessments*
H10	*Fire Safety: Risk assessment en strategies*
H11	*Explosion safety: Explosion zoning and strategies*
H12	*Design and Construction Requirements for Electrolyser Systems (Engineering Aspects, Validation, Operation and Maintenance)*



Agreements with authorities regarding suppression



Safeguarding of electrolyser system(s)

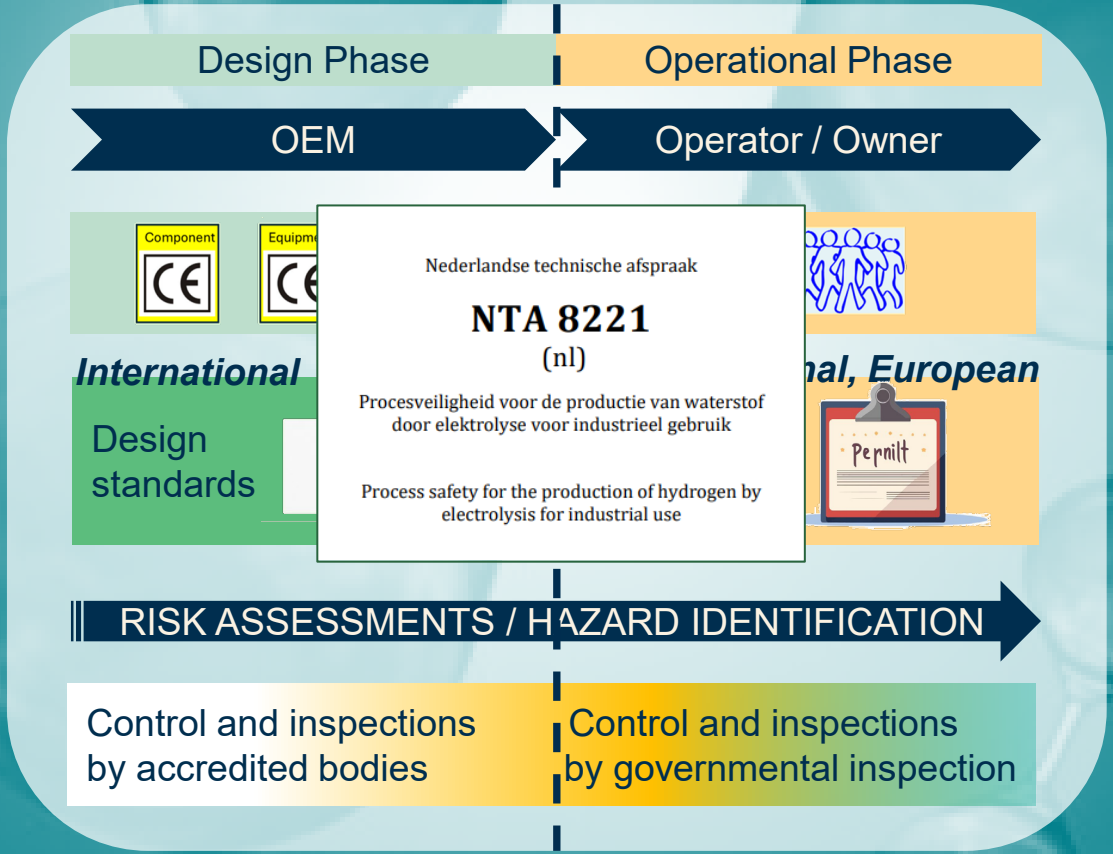
- PSV and hydrogen specific properties
- prevention of deflagration -> detonation

e.g. Design Requirements for:
- venting systems
- electrical systems
- start-up and shutdown

Membrane monitoring

Safety Instrumented Functions based on results of risk analysis and LOPA-studies

Playing field



2025

Needs in Standards:
- ✓ Hydrogen in general
- ✓ Hydrogen in water electrolysers
- ✓ Green water electrolysers

Needs based on Process Studies:
- ✓ In equipment mixing
- ✓ Loss of Containment H_2
- ✓ ATEX

Needs for the Permitting Process:
- ✓ Availability of documented best practises
- ✓ Base for law and regulations

NEN

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Enhancing Society Together

Dimitri Quist
Strategic HSSE Leader in CAPEX
Dimitri.Quist@Haskoning.com

Karen van Tol
Strategic Consultant Industrial safety
Karen.van.Tol@Haskoning.com

Nico Mulder
Sr. consultant process safety management
nico.mulder@haskoning.com

Joost van Dijk
Process safety consultant
joost.van.Dijk@haskoning.com

linkedin.com/company/haskoning

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