

# FEV Signature Solutions

## Turnkey Hydrogen Safety Engineering

### – Concept-to-Release Package



**Accelerate certification and reduce program risk with a safety-by-design architecture – for mobile and stationary H<sub>2</sub> systems.**

#### FEV offers

- **End-to-end hydrogen safety concepts**, scalable from first demonstrator builds to series
- **Proven, repeatable safety process**: from concept to validation, using established methods to derive complete, traceable requirements.
- **Faster approvals, lower program risk**: we translate hazards into clear, actionable safety requirements that support certification and stakeholder confidence.
- Definition, implementation, and validation of **safety measures**: your system will be designed safely, tested and ready for operation.



#### Why FEV

- **Proven expertise**: 45+ years of automotive & process engineering excellence, trusted by global OEMs and Tier-X suppliers to deliver innovative, production-ready solutions with deep domain expertise.
- **Hydrogen-specific expertise with practical solutions**: robust detection, isolation, pressure protection and control logic designed to avoid unnecessary shutdowns and increase reliability.
- **Certification & customer-oriented delivery**: Transparent and customizable, with strong standards alignment and customer-ready project deliverables.

# Reference project FEV energy + resources

## H<sub>2</sub> Safety Concept

Background: Implemented H<sub>2</sub> safety measures for electrolyzer system – Top-event-driven architecture

### FEV involvement

- Defined the H<sub>2</sub> safety concept and top-event-driven safety architecture for an H<sub>2</sub> application .
- Proven process: HAZID, HAZOP, HARA + qualitative FTA (depth ≥ 4) and system-FMEA from concept through to validation.
- Specified safety mechanisms incl. H<sub>2</sub> dual sensor leak detection and M-of-N shutdown voting across pressure/temperature/leak channels to avoid false trips.
- Supported standards (e.g., UNECE R134, ISO 19881/19884, ISO 17268) and certification alignment and compiled audit-ready deliverables (SOPs, FAT/SAT plans & reports, training, inspection/test plans).



#### Certification

Delivered a certification-oriented safety package that accelerated approval readiness and reduced program risk.



#### Field-practical

Implemented robust, field-practical safety measures: early leak detection with defined actions and reliable emergency isolation without nuisance shutdowns.



# Our Safety-by-Design Approach for Hydrogen Systems

FROM HAZARD ASSESSMENT TO VALIDATION — PRACTICAL SAFETY SOLUTIONS FOR VEHICLES AND INDUSTRIAL APPLICATIONS



**01**

## Program setup & system definition

Define use cases, interfaces, and boundaries for mobile or stationary H<sub>2</sub> applications



**02**

## Hazard & risk assessment

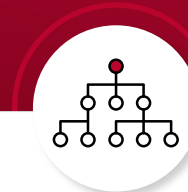
Perform HAZID / HAZOP and HARA where applicable to define safety goals



**03**

## Safety requirements engineering

Derive functional / technical safety requirements using qualitative FTA and validate completeness via system-FMEA



**04**

## Safety concept & architecture

Define safety functions, e.g., detection, isolation, ventilation / relief, electrical protection



**05**

## Integration & implementation

Integrate safety measures into hardware / software incl. diagnostics and robust shutdown decision logic



**06**

## Verification, validation, and compliance

Define and perform test strategy (e.g., fault injection) and create documentation

# What's Inside the Hydrogen Safety Package

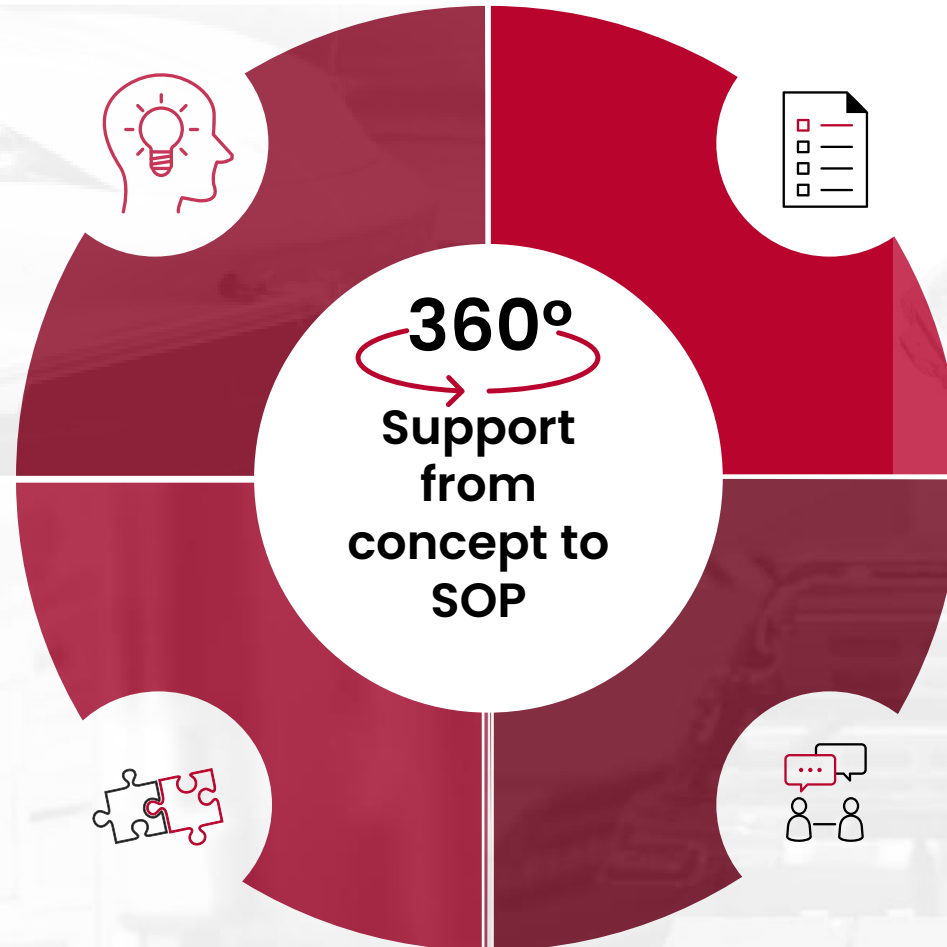
TANGIBLE OUTPUTS FOR SAFE OPERATION AND CERTIFICATION READINESS ACROSS MOBILE & STATIONARY H<sub>2</sub> SYSTEMS

## Safety Concept & Architecture

- Top-event-driven H<sub>2</sub> safety concept and system safety architecture derived from your use case
- Defined safety functions (detection, isolation, ventilation / relief, electrical protection)
- H<sub>2</sub> thresholds / actions concept (incl. warning / shutdown strategy as applicable)

## Implemented Safety Measures

- Detection strategy (e.g., dual sensor concept) and robust emergency isolation logic (e.g., M-of-N voting)
- Pressure protection concept (redundant relief, safe vent routing)
- Electrical safety measures and hazard-area compliant component guidance where applicable



## Requirements & Evidence

- Safety goals and traceable functional / technical safety requirements
- Traceable safety requirements + evidence pack
- Targets for safety functions where applicable (e.g., SIL targets for detection / actuation / cut-outs)

## Test, Handover & Operations

- Test & acceptance package (FAT / SAT plans & reports) and inspection / test plans
- Operating procedures (SOPs) and training package for commissioning and operations
- Continuous-improvement loop to incorporate test & field learnings into the safety concept

# Get in touch with us for further information



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