

# HAZOP UPDATE, SIL VERIFICATION FOR COMPRESSOR STATION LEGACY SYSTEMS

**PROJECT OWNER:** Confidential

**TIMEFRAME:** 2017 – 2018

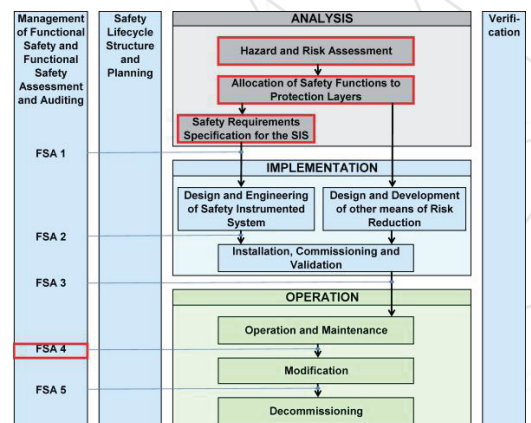
**KEY PROJECT DATA:** Existing gas transport compressor station, commissioned in 2007, comprising:

- 8.5 MW electric-motor-driven (EM) gas compressor
- 11 MW gas-turbine-driven (GT) gas compressor
- Gas transport capacity up to 2,150,000 m<sup>3</sup>/h
- Six pipeline interconnections, including three metering stations
- Tie-in of new DN 1200, PN100 pipeline and over-pressure protection systems (under construction 2018)
- Existing station auxiliary and utility systems, including three independent legacy safety systems (Station, EM-compressor, GT-compressor)



- SCOPE OF SERVICES:**
- Update of HRA (re-HAZOP) and SIL-analysis (Risk Graph method acc. VDI/VDE 2180)
  - Gap analysis of existing FSM-documentation
  - Preparation of Cause & Effect Chart for safety and process trip logic
  - Investigations on site to confirm as-built status of safety-related loops
  - SIL-Verification using ExSILentia and preparation of compliance report (equivalent to FSA-4) according to DIN EN 61511:2012
  - Preparation of recommendations and priorities for corrective actions

All services were carried out in accordance with PSC's FSM-Plan as per DIN EN 61511 and CFSE-certified.



# HAZOP-AKTUALISIERUNG, SIL-VERIFIKATION FÜR EINE BESTEHENDE VERDICHTERANLAGE

## EXTENDED DESCRIPTION

The following gives a detailed description of PSC's services.

### a) HRA Update (Re-HAZOP)

Existing safety review from 2007 was updated on basis of as-built status 2017. The update was carried out via several workshops covering following nodes:

- Station main process systems
- Station auxiliary systems (vent, fuel gas, fire & gas system)
- Flow path variations (ca. 50 station operating modes investigated)
- Compressor-driver units, including auxiliaries
- Tie-in of new pipeline and over-pressure protections

### b) SIL Analysis

SIL / Risk reduction analysis carried out as per calibrated Risk Graph methodology (VDI/VDE 2180). 70 safety loops investigated, resulting in definition of SIL/RRF for 34 SIFs.

### c) FSM-documentation gap analysis

Review of legacy documentation established that some critical documents should be prepared / updated, e.g.

- Cause & Effect Chart
- Safety Requirements Specification
- Missing sensor / actor failure data/ certification

### d) SIL Verification

Modelling of SIFs using ExSILentia software

- Review of available E&I, safety system logic and vendor documentation and confirmation of 'as-built' status via site inspections
- Database research / contact to manufacturers to establish failure data for legacy equipment with missing certification
- Evaluation of 'proven-in-use' capability where published failure data was not available
- Review of site proof-test procedures in order to define CPT for all SIFs
- Modelling of loops in ExSILentia and preparation of compliance documentation
- Recommendations based on identification of FSM-compliance issues:
  - SIL-degradation
  - End of equipment useful life
  - Proof test coverage
  - Management of non-SIL functions implemented in safety systems

