




FlexSILon TMC

---

# A Holistic Approach for Turbine and Compressor Safety: The All-In-One System for TMC Applications

---

 By Uwe Bruckhoff, Turbomachinery Application Manager at HIMA  
Brühl, October 2019

The safe operation of rotating machines, including steam turbines, is currently under extensive review throughout the petrochemical industry. The increase in catastrophic failures in turbine control and protection systems has resulted in significant downtime, high repair costs, and increased danger to human life. Consequently, many companies have begun detailed investigations of safety-critical components and associated software. International standards for functional safety are being increasingly implemented and followed to reduce the risk of these system failures. →

With reference to the current safety standards, turbine manufacturers and turbine operators continue to discuss the question of whether turbine control should be integrated into the turbine safety system. With regard to safety standards, turbine control functions are considered as functions that are not safety related. All critical functions that can result in catastrophic turbine failure, however, are monitored by the turbine safety system.

To lessen the confusion in the petrochemical market, the American Petroleum Institute has extended the “Machinery Protection Standard API670”, 5th edition, with requirements imposed on integration of turbine control and Safety Instrumented Systems, or SIS. Hereby all functions are combined in a single SIL 3 safety system. Thus, functional safety is becoming a topic for operation of turbomachinery.

With FlexSILon TMC (Turbo Machinery Control), HIMA offers a completely new approach for safe and economical operation of turbomachinery. The solution includes operation, control, and protection – including overspeed protection – in a single safety system of multiple architectures. Function-specific, dedicated solutions from different manufacturers become irrelevant, while operation and maintenance become considerably easier and more clearly organized.





# Safe and Economical: Protection and Control of Turbomachinery with FlexSILon TMC

For several years, HIMA has been offering a solution package with FlexSILon TMC that ensures safe and profitable operation of turbomachinery and satisfies safety requirements. FlexSILon TMC integrates turbomachinery automation into a safety system. This enables functional safety for the overall system of a turbomachine train instead of automation for only dedicated components. This approach has been validated through the increasing number of sample SIL classifications of individual functions. Consequently, with the holistic system, companies can today prepare their turbomachines for the functional safety standards that, in the near future, will be binding for these machines.

The complete solution for fully automating turbines and compressors combines all individual components into one system. Depending on the availability requirement of the system, solutions from HIMatrix (single channel) or HIMax (redundant) are available.

With standardized function blocks for operation (start-up, operation, manual functions, etc.), control (speed control, steam distribution, anti-surge, etc.), protection (bearing, temperature, pressure, etc.), and the ability to implement overspeed protection, a cost-effective alternative to dedicated individual components from different manufacturers is available. The multitasking capability of FlexSILon TMC ensures a non-reactive separation of safety functions and control functions. This ensures that safety functions will always be executed independently of each other.

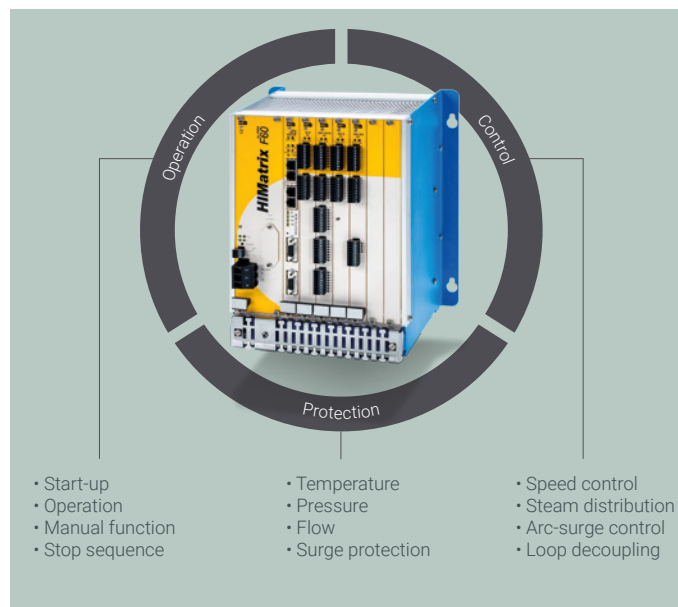


Fig. 1: Turbo-machine solution with HIMatrix, SIL3, single-channel.

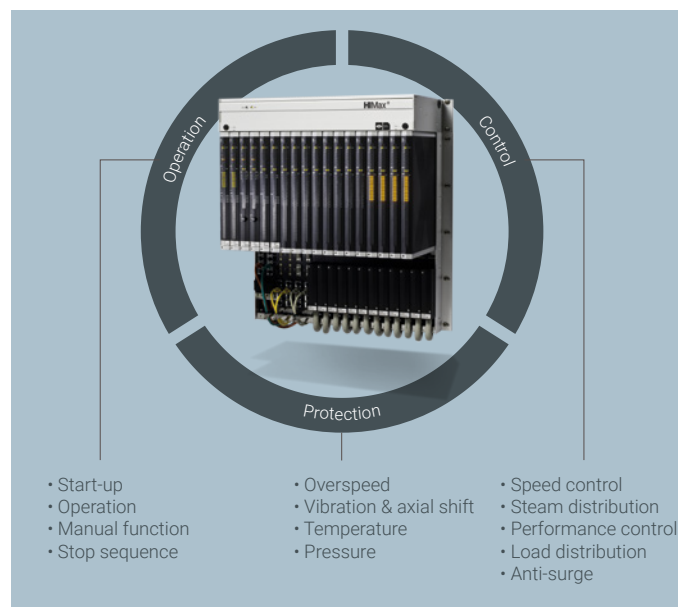


Fig. 2: Turbo-machine solution with HIMax, SIL3, mono, redundant or triple-redundancy.

## An All-In-One Solution

With previous solutions, a turbomachine train is often controlled by many dedicated logic-solvers, from multiple manufacturers in a complex architecture. This results in increased engineering and wiring effort. It also requires more space in the control cabinet and a larger inventory of spare parts. Moreover, such a fragmented system architecture is more susceptible to faults and makes troubleshooting more difficult. Lastly, the use of different components and systems demands extensive knowledge and experience on the part of operators and maintenance staff.

With FlexSILon TMC, on the other hand, different individual solutions from different manufacturers are done away with. This enables easier and more clearly organized operation. The communication of the HIMA systems and the external connection based on open, manufacturer-independent standards replace the various proprietary communication paths. This makes it possible to integrate the FlexSILon TMC system into an existing automation environment. The result is a simplified communication system that is significantly less susceptible to failure.

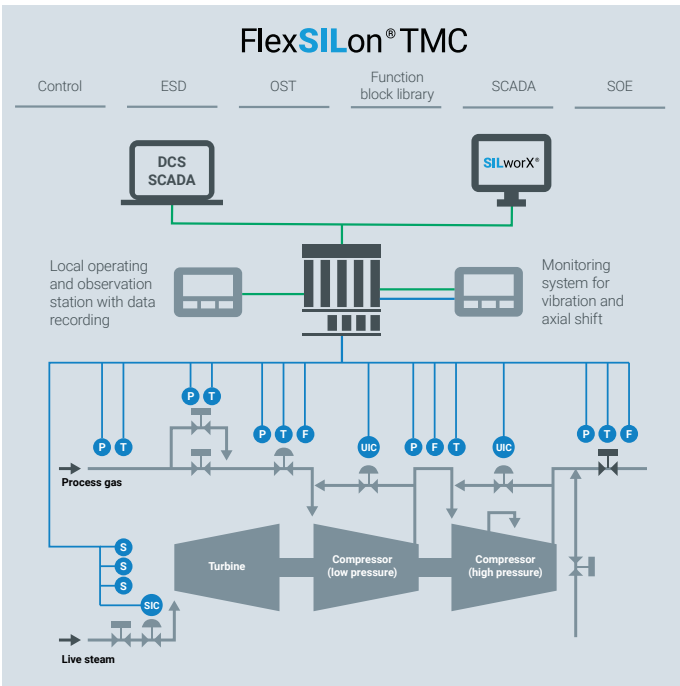


Fig. 3: Sample complete solution package.

## Systems and Software from a Single Source

HIMax and HIMatrix safety systems – as well as the SILworX configuration, programming, and diagnostics tool – are the core of every FlexSILon TMC solution. This core is supplemented with solutions for local visualization, on-site operation, and sequence-of-event recording. FlexSILon TMC solutions include standardized,

tested function blocks that can be flexibly adapted and integrated into any automation environment via open interfaces. All safety solutions and standard automation solutions come from HIMA and are approved up to SIL 3.

Electronic overspeed protection is crucial for protecting a turbine, and it is a key component of the HIMax system. This module works independently and does not interact with the safety system's CPU. Connector boards enable flexible availability requirements. An overspeed protection solution also exists for the HIMatrix system.

## Function Blocks Facilitate Commissioning

Standardized, tested, and highly adaptable turbine and compressor function blocks shorten and facilitate commissioning of the plant. They have been specifically developed for the operation, control, and protection of axial and radial compressors and turbines. Based on the HIMax safety system, the 14 standard TMC function blocks can be used by an operator to automate a turbine without the operator having to develop the respective functions himself. Complete operation of the compressor and the turbine can be realized through adaptation of a few parameters. Thus, project planning and system start are facilitated and require less programming effort. This means that complete operation of both compressor and turbine can be enabled in the interaction with the compressor function block and other function blocks from the standard function block library from SILworX.

HIMA Safety Lifecycle Services are another important feature of FlexSILon TMC. It covers all phases of the safety lifecycle of a turbo-train, from basic engineering to implementation to decommissioning. It also includes all services from safety consulting, engineering, procurement, and system integration, including on-site services.



Fig. 4: HIMA Safety Lifecycle Services.

## The Concept Has Been Proven Worldwide

FlexSILon TMC is already being used in the global processing industry by enterprises like ExxonMobil, BASF, and OMV. OEMs like MAN Energy Solutions, Mitsubishi, and Nuovo Pignone also use it.

Daqing Petrochemical Company, a regional branch of China National Petroleum Corporation (CNPC), is a good example. Below is a brief description of how a FlexSILon TMC solution enables the complete, safe operation of turbines and compressors in a Daqing gasoline desulfurization plant. The integrated system is based on the fully redundant HIMax platform. Daqing Petrochemical chose HIMA because they had already had a good experience with solutions from the Brühl-based safety

experts. Moreover, the expertise demonstrated in the implementation of TMC solutions, and HIMA's service offerings over the entire lifecycle, were convincing.

"We have installed several HIMA systems as a safety instrumented system (SIS) in our refinery plant," says Mr. Sun Qiang, E&I Manager. "This is the first time we have used HIMax, and our experience shows that the HIMax system is fast, stable, safe, and reliable." Compliance with the SIL3 safety standards in accordance with IEC 61508 and IEC 61511, and in accordance with API 670, were also important for Daqing Petrochemical. Additional key factors were the company's desire to implement a safety system that increases the availability of the plant while permitting extensions and modifications without interrupting operation.

### Benefits of FlexSILon TMC

- All TMC functions (operation, control, protection functions, etc.) in one system
- 100% independent and non-reactive overspeed trip module
- Maximum transparency and diagnostic functions for overspeed trip module. Diagnostic coverage > 99.9 %.
- Investment security thanks to compatibility with current and future standards and a delivery guarantee for systems from HIMA for several decades
- Compliance with all safety requirements imposed on turbomachines
- Compliance with all requirements imposed on critical control functionalities
- Nonstop operation over the lifecycle of the plant
- Simplified engineering, service, and maintenance
- Customer-specific package solution with hardware, software, and services (lifecycle service)
- Function block library for turbines and compressors
- Standardized HMI with fast data logging



**Uwe Bruckhoff**

Turbomachinery Application Manager at HIMA

Since 2006, Uwe Bruckhoff has been Turbomachinery Application Manager at HIMA Paul Hildebrandt GmbH. He has worked in the automation industry for 28 years, in the areas of control technology, project planning, and project management.

## WHITE PAPER

# SAFEGUARDING TURBINES AND COMPRESSORS

---

For further information please contact:

**HIMA Paul Hildebrandt GmbH**

E-mail: [applications@hima.com](mailto:applications@hima.com)

Or visit us online:

 [www.hima.com/TMC](http://www.hima.com/TMC)

Images © HIMA Paul Hildebrandt GmbH

The content provided in this document is intended solely for general information purposes, and is provided with the understanding that the authors and publishers are not herein engaged in rendering engineering or other professional advice or services. Given the complexity of circumstances of each specific case and the site-specific circumstances unique to each project any use of information contained in this document should be done only in consultation with a qualified professional who can take into account all relevant factors and desired outcomes. This document has been prepared with reasonable care and attention. However, it is possible that some information in this document is incomplete, incorrect, or inapplicable to particular circumstances or conditions. Neither HIMA nor any of its affiliates, directors, officers or employees nor any other person accepts any liability whatsoever for any loss howsoever resulting from using, relying or acting upon information in this document or otherwise arising in connection with this document. Any modification of the content, duplication or reprinting of this document, as well as any distribution to third parties – even in parts – shall require the express written approval of HIMA.



[www.hima.com](http://www.hima.com)