

Turbine I&C for Nuclear Power Plants

For more than two decades Framatome has provided nuclear power plants with turbine control and protection based on Framatome's own TELEPERM XS digital platform while conforming to the highest safety standards of the industry.

Challenge

In this time of growing safety requirements old analog and even digital solutions for turbine control and protection are becoming obsolete. Plant operators seek new solutions, based on I&C platforms that satisfy the highest safety norms and standards of nuclear business.

Customers are looking for proven references for turbine control, bypass control, turbine protection and condenser protection that can confirm quality, functionality, safety and availability of the product.

Solution

The Framatome turbine controller consists of two identical channels, which makes it single failure tolerant. The same redundancy structure is used also for the bypass controller and seal steam controller. Turbine controller and bypass controller use independent hardware. Failures are automatically recognized by TELEPERM XS self-monitoring. In the event of failure, change-over to the slave channel is instantaneous and has no impact on plant operation. Protection systems consist of three identical channels, condenser protection on bypass is independent from the turbine protection. Actuation of the protection functions is carried out by two out of three hydraulic actuators.

The probability of an outage of the turbine controller function due to a hardware failure is less than one percent over a period of 20 years. The use of digital technology throughout, and especially the use of patented control algorithms, enables it to respond much faster and more precisely to load changes of all kinds.

The turbine controller can handle short-circuits, load rejection to island load, house load, or zero load. It also provides primary and secondary frequency control. In these operation modes, the plant's output directly tracks the demand of the grid.

A power plant equipped with the Framatome turbine controller can feed power both into the grid system and to the load island. In the event of a load rejection to island load or house load, the output generated is adapted much more quickly to the island or house load than with any other known controller.

An optional built-in plant simulator can be activated during outages. It enables any desirable dynamic tests in single mode, as well as in interaction with other plant and I&C components such as true valves, control room, process computer, etc., and can also be used for staff training.



Dual channel turbine controller based on TELEPERM XS

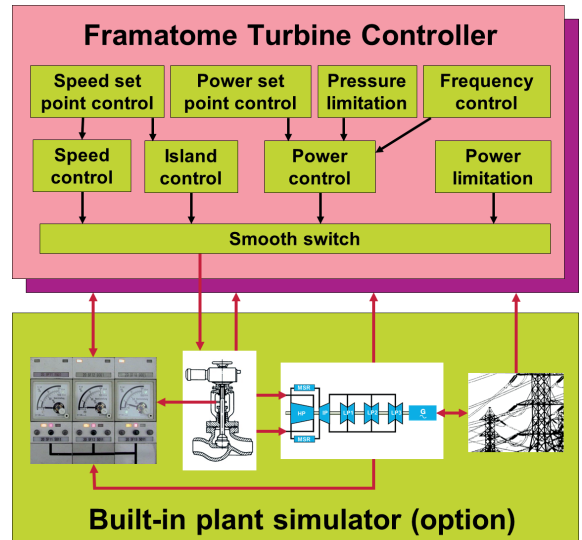
Customer benefits

- Improved operational safety and reliability with this controller solution that conforms to the highest safety norms and standards of nuclear business
- Lower maintenance costs and easier maintenance due to fewer parts – the uniform I&C platform TELEPERM XS is used for turbine control, bypass control, turbine protection and condenser protection
- Very high safety and availability level due to redundant structure and deep self-monitoring of TELEPERM XS confirmed by numerous references
- Simple and clear solutions for I&C functions through patented digital algorithms
- Easy dynamic tests and simplified staff training with the optional built-in plant simulator

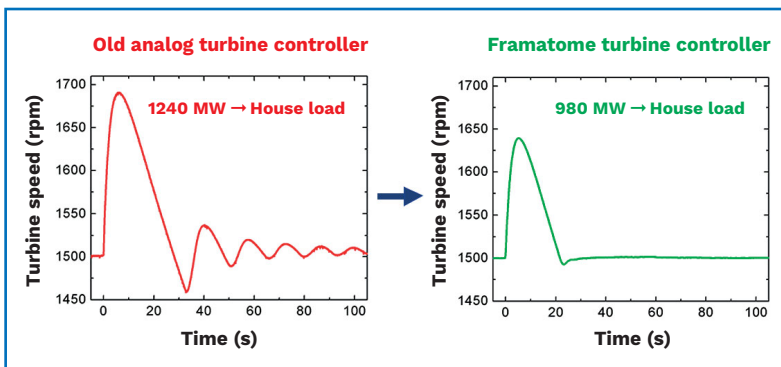
Your performance
is **our** everyday **commitment**

Experience

Framatome has global experience in the field of turbine I&C since 2000. I&C functions are implemented using the Framatome TELEPERM XS I&C platform that conforms to the highest safety requirements. Special patented digital algorithms ensure the many unique features of the control functions. The total operation time of 14 years in both units of one customer plant made it possible to gain necessary experience, and to maintain and further develop the I&C functions. Plant experiments and decades of operational experience have demonstrated the ability of the Framatome controller to master load rejection to house load or zero load, its absolute island capability, its precise load following, and its capability to perform fast and precise load rejections on possible failures in the energy production chain.



The optional built-in plant simulator enables any desirable dynamic tests as well as staff training.



Governing of load rejection to house load: Framatome turbine controller in comparison with old analog solution as result of plant experiments

Key Features

- High level of safety and availability
- Simple and compact structure
- Simple and approved digital algorithms
- Dual/Triple channel solutions
- Cycle time of 10 to 15 ms
- Single failure tolerance
- High level of device qualification
- Built-in plant simulator (option)
- Numerous references

References

- Turbine controller – 3 systems (Germany, Switzerland)
- Individual control of turbine valves (Germany)
- Speed measuring unit – 2 systems (Germany, Switzerland)
- Primary frequency controller – 4 systems (Germany, Switzerland)
- Secondary frequency controller (Germany)
- Turbine stress evaluator – 3 systems (Germany, Switzerland)
- Bypass controller – 2 systems (Germany, Switzerland)
- Seal steam controller – 2 systems (Germany, Switzerland)
- Reheater warming up controller – 3 systems (Germany, Switzerland)
- Turbine protection (Germany)
- Condenser protection on bypass (Germany)

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