Experion PKS for Digital Turbine Control

The Honeywell Turbine Control System is based on the Experion® Process Knowledge System (PKS) platform. Experion integrates process control with advanced solutions and services in an open system environment that increases safety, reliability, efficiency and security. High-speed Experion controllers along with high-speed servo valve positioner and speed sensor input modules meet the stringent requirement for fast response crucial for turbine control (turbine governor) and protection systems, as well as compressor anti-surge control. Redundancy is featured from the control processor, I/O modules, power supplies and communication levels, such as Honeywell's unique Fault Tolerant Ethernet (FTE) based network solution, enhance system reliability and availability. The system is modular so that different turbine configurations, from a simple auxiliary turbine to the most complex mainline steam turbine in large capacity power plants or refineries, are readily accommodated. A typical configuration has a single integrated control platform for turbine governor and compressor anti-surge control.

The control system can provide both full arc and partial arc (single valve and sequential valve mode) steam admissions under the appropriate conditions and include a valve management function to handle transfer from one mode to another. The valve management function also performs valve characterization to related valve position to steam flow so that the valve transfers can be performed without a change in load.

The Turbine Control System (TCS) or Turbine Governor (TG) regulates the appropriate steam valves through the servo valve positioner module to control the turbine speed during startup and shutdown, and to control the load when the generator breaker is closed. It also controls the turbine speed or load through lift control of these servo valves. Typically, these servo valves are provided with dual servo valve coils for valve actuation and dual Linear Variable Differential Transformers (LVDT) for valve position feedback. All these signals are interfaced to a dedicated servo valve positioner module.

Typical Experion Integrated Turbine Control Configuration

Three to four speed pickups (probes) measure turbine speed. These pickups are connected to dedicated speed measurement module (SPM) which convert pulse signals to actual speed.
Typically three probes are provided for speed regulation and three probes are provided for protection after performing two out of three voting logic on input signals. The system also receives generator megawatt output, turbine throttle pressure, turbine first stage pressure, condenser vacuum, turbine exhaust temperature, turbine supervisory system signals, signals pertaining to thermal stress monitoring of valves and turbine, and all other signals pertaining to turbine protection form.

The solution is complete with custom displays and faceplates for ease of monitoring and error-free operator actions. The operator screens are customized to the specific needs of each plant.

**Benefits**

Honeywell’s integrated control system is designed to optimize the reliability of major plant equipment including boilers, turbine and generator, boiler auxiliaries, feed water pumps, heaters, condensers, compressors and more.

Benefits include:

- Reduced total cost of ownership with common hardware and software platforms, common maintenance parts and common engineering, diagnostic and documentation console
- Ease of operation and training with common operator interface for the entire plant
- Effective and consolidated data reporting and archiving
- Increased reliability and availability through redundancy features of the Experion system
- Complete solution including hydraulic parts from one source.

**Turbine Control Features**

Honeywell’s turbine control solution addresses two broad functional categories: turbine regulation (turbine governor) and turbine protection. In addition to the standard requirement of steam and fuel valve lift control and electronic protection, the following functionalities are included:

- Speed, pressure and load control mode of operation
- Initial pressure and limit pressure control mode
- Automatic turbine startup and shutdown sequence
- Turbine stress evaluator
- Online testing of valves and trip devices
- Load shading and unit islanding operation
- Frequency correction for generated load
- Automatic synchronization

**Turbine Regulation Overview**

The system offers turbine speed control varying from barring speed to synchronization to prevent the turbine from over speeding. Three speed probes are provided for speed measurement and the median signal is used for control purposes. The SPM module is also equipped to monitor speed probe conditions and generate alarms. Once the turbine is synchronized, control is transferred to load/pressure control.

In the power industry, the unit can be operated in various modes such as Unit Coordinated Mode, Boiler Follow Mode or Turbine Follow Mode. Provisions are also made to accept unit load set points from automatic load dispatch centers. Normally the turbine is operated in sliding pressure mode with turbine governing valves wide open. In the case of turbine throttle pressure falling below preset pressure limits, the pressure controller cuts in to action and prevents further drop of pressure by throttling governing valves. The condition resets after improvement of steam pressure. Another feature that can be programmed in the system is frequency correction to the generated load in order to respond to an over/under frequency condition of the grid. Frequency, power production (megawatts), first stage pressure and throttle pressure are the factors to be considered during load control operation. These four control loops are available as trim control to the overall turbine inlet steam flow demand and may be placed in and out of service by the operator. The system is on load control after the generator breaker is closed (after synchronization), with initial load pickup set between 2% to 10%.

**Automatic Turbine Startup and Shutdown Sequences**

The automatic startup sequence is developed to roll the turbine from barring speed to synchronization with minimum or no operator intervention. The startup sequence takes care of minimum acceleration requirements to avoid critical speeds and other safety criteria during turbine rolling. Similarly the automatic shutdown sequence is developed for safe coasting down of the turbine after tripping/shutdown. These sequences can be run in either automatic, semiautomatic or operator guide mode. Customized graphics are provided to support proper operation and monitoring of these sequences.

**Turbo-Generator Synchronization**

The Turbine Control Solution provides for either manual or automatic synchronization of the unit.

**Manual Synchronization** - The operator increments or decrements the turbine speed and generator voltage from the operator work station or from hardwired backup controls and decides when to manually close the generator breaker.
Auto Synchronization - Optionally a separate auto synchronization can be provided, which monitors turbine speed, line frequency and line voltage, and adjusts turbine speed and generator exciter voltage and decides when to issue the signal to close the generator breaker.

Turbine Protection System
The turbine is protected from plant upsets or any auxiliary system or component failure. This is accomplished through over speed protection, vacuum protection, lube oil pressure protection, thrust bearing temperature and fire protection. These protections can be built in either two out of three selection criteria or dual redundant channels. Provision is also made for emergency manual trip pushbuttons and any other trip protections operating from the control system.

Protection
The TCS provides over speed protection functionality to avoid turbine over speed trips due to loss of load or other plant upsets. The system includes logic to detect and account for a speed channel failure. The system provides the operator the capability to override the electronic over speed protection function so that the mechanical trip system can be tested.

The Over speed Protection Control consists of three different control actions:

- Close Intercept Valves (CIV) - This action is taken on a partial loss of load. The reheat pressure and electrical power are compared. If they differ by an adjustable amount (default setting of 40%), the CIV action is initiated which consists of closing the intercept valves for an adjustable time period
- Load Drop Anticipation (LDA) - The generator breaker status is monitored and if the breaker opens, both the governor/control and intercept valves are closed
- Action - If turbine speed exceeds 103% (adjustable) of rated speed, the governor/control and intercept valves are closed.

Trip
The trip causes a complete turbine shutdown if the speed of the turbine exceeds the trip point of 110% of rated speed. This trip point is adjustable.

Trip Testing
The TCS includes provisions for testing the external (mechanical or electronic) over speed trip system. This feature allows the turbine to be ramped to the remote trip point to verify that the over speed trip operates properly.

Maintenance Functions
The turbine control system is provided with following maintenance functions that can be initiated from the operator/engineering console:

- Automatic valve characterization
- Manual valve characterization
- Valve coordination
- Valve sequence changes
- LVDT calibration
- Control limits and parameters configuration.

Optional Features
Turbine Stress Evaluator - Thermal stresses for various major components such as turbine casing, turbine rotor, stop valves and governing valves are continuously monitored through various temperature measurements done on these components. This information is used to decide safe operating margins during rolling or loading the turbine. Information received from OEM is used to calculate stress limits for various components.
Online Testing of Valves and Trip Devices - System provides facility for online testing of all valves one by one without affecting unit operation (maximum +/- 2% change in load). Similarly trip device operation can be tested online without actually tripping the unit.

Automatic Turbine Testing Screen

For More Information
To learn more about Honeywell Turbine Control System, visit our website www.honeywellprocess.com or contact your Honeywell account manager.

Honeywell Process Solutions
Honeywell
1250 West Sam Houston Parkway South
Houston, TX 77042

Honeywell House, Arlington Business Park
Bracknell, Berkshire, England RG12 1EB UK

Shanghai City Centre, 100 Zunyi Road
Shanghai, China 200051

www.honeywellprocess.com