



Hydro ECI inc.



PLC-TG SPEED GOVERNOR

**HYDRAULIC TURBINE
PLC BASED SPEED GOVERNOR**

*1200 Arthur-Danis
Granby, QC, Canada
J2J 0T3
T: 1-450-777-0808
F: 1-450-777-5858
www.hydro-eci.com*

Hydro ECI Inc. is a company specialized in the design and implementation of control and protection systems for hydroelectric power plants. Its engineers and technicians cumulate many years of specialized experience on the small, medium size and large hydro generation fields.

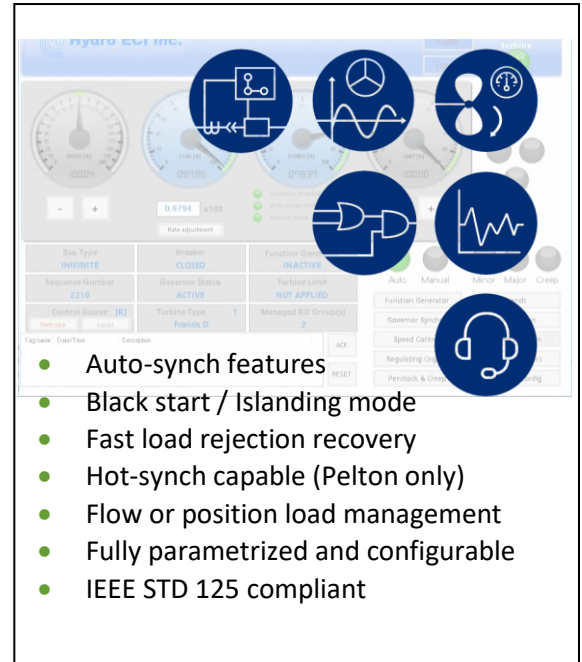
Using this experience in solid protection and site control programming for more than 50 sites and 100 running turbines, Hydro ECI vision of competitive, compatible and reliable products helped to develop a flexible PLC based governor applicable to new and modernization projects.

HIGH PERFORMANCE & AFFORDABLE PLC BASED GOVERNOR

The PLC-TG speed governor is an extremely flexible, safe and highly competitive solution for all types of turbines that exceed the needs and requirements of small and medium hydro sites.

A solution from HECI used by major turbine makers, contractors and owners for their water to wire projects because of its competitive price, scalable parametrization and extensive configurable options turned one of the best alternatives for turbine speed governing.

- *Hardwired and network communication management,*
- *Scalable CPU power and flexible I/O configuration,*
- *Controller redundancy only possible through a PLC design,*
- *Standard - off the shelf / ready available replacements parts,*
- *Integrate and manage other components from its base:*
 - *Hydraulic power unit components and valves*
 - *Turbine inlet valves*
 - *Deviation and bypass valves*



The screenshot displays a complex control interface with multiple circular icons representing different functions like speed control, load management, and protection. Below the icons is a data table and a list of features.

Bus Type	Breaker	Function Status	Control Mode
INFINITE	CLOSED	INACTIVE	Auto
Sequence Number	Governor Status	Turbine Limit	Manual
2219	ACTIVE	NOT APPLIED	Minor
Manual Source	Turbine Type	Managed I/O Groups	Major
IB1	Francis S	2	Creep

- Auto-synch features
- Black start / Islanding mode
- Fast load rejection recovery
- Hot-synch capable (Pelton only)
- Flow or position load management
- Fully parametrized and configurable
- IEEE STD 125 compliant

THE COMPLETE GOVERNOR SOLUTION: PLC-TG + FSC MODULE + VISUAL-65

Generator and bus frequency measurement are a critical part of any speed governor. Reliability over those signals is the core for every task the governor is intended to perform. With such concept in mind, Hydro ECI developed its own frequency to signal converter (FSC-P) that couples in the most reliable way generator and bus frequency from PTs. These signals are then isolated and conditioned to connect them to PLC high speed counters.

When both generator and bus signals are connected to the FSC module, the phasing offset between the two frequencies is calculated for the governor algorithm to process it for contact closure.

The governor package also includes its own control, configuration and management tool. Visual 65 (V65) is a windows compatible program that allows for intuitive monitoring and management of the governor activities and provides granular protected access to the more than 1000 configuration and tuning parameters.

V65 provides high speed logging and trending capabilities independent of the type of HMI or platform, allowing for a non-license dependant, firewalled secure IT environment.

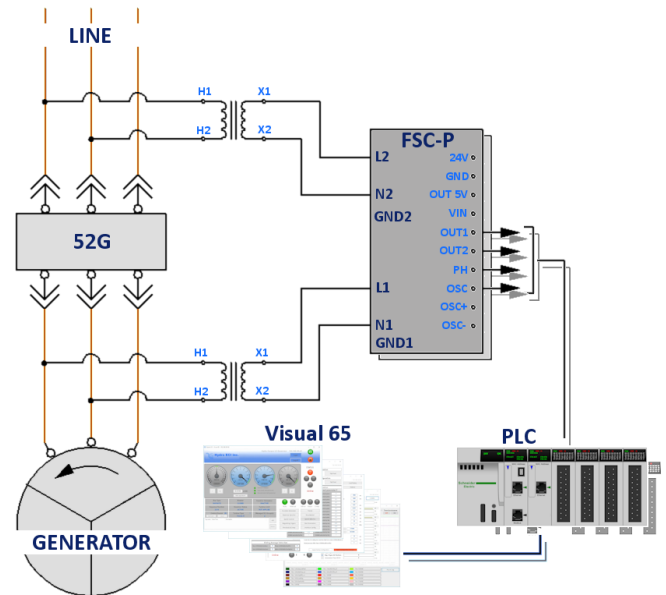
ROBUST AND REDUNDANT DESIGN

The FSC-P acts as the interface between the voltage transformer and the high-speed counter (HSC) modules of the governor PLC. The PLC uses the FSC-P output to measure the two frequencies and the phase difference between the generator and the power utility.

Additionally, the PLC-TG governor may use conventional tooth-gear speed pick-up which can be configured as redundant source as well as for islanding mode.

A unique benefit from a PLC based design is the CPU and card redundancy where controllers can seamlessly switch upon faults. Such scenario can even be more robust using a redundant FSC-P module and failover TCP networking.

V65 can be used for purpose specific operations while SCADA communications are also available.



SIMPLIFIED CONNECTION SCHEMA WITH REDUNDANT OPTIONS

PLC-TG SPECIFICATIONS

CORE GOVERNOR FEATURES

- Flexible generator speed measurement
- Fully configurable speed switches
- Phasing offset measurement
- Islanding mode
- Auto/Manual synchronization feature + On-Synch contact/breaker closure
- Regulating component opening and output limitations
- Load sharing, distribution and transfer: Individual and grouped (sequential / parallel)
- Speed loop with permanent and transient speed droops
- Load rejection recovery sequence
- Rotor creep detection and response
- Individual component (jet/gate/blade) manual operation
- Flow calculation and flow-based operation
- Penstock monitoring
- Flexible I/O configuration, scalable CPU power and redundancy.
- Hardwired and networked configurable remote management
- SCADA ready (added to Visual 65 control and logging)
- IEEE STD 125 compliant

SPEED AND BUS

Bus frequency measurement	PT Signal
Generator speed measurement	PT Signal / Teeth proximity switch / 4-20mA

TURBINE TYPE FEATURES

Francis	Simple and double regulating units + load sharing
Kaplan	Wicket Gate + Blade with 3D characterization CAM
Pelton	Up to 6 jets + 6 deflectors
	Configurable individually, in groups (pairs or thirds)
	Speed control by nozzle or deflector

TURBINE REGULATION FEATURES

Wicket gate positioning servo	Analog output or ON/OFF positioning
Blade positioning servo	Analog output or ON/OFF positioning

FSC-P MODULE SPECIFICATIONS

SINE-WAVE INPUT

Rated voltage	120 V RMS
Continuous maximum voltage	300 V RMS
Minimum measurable voltage	200 mV A.C.
Measurable frequency	0 to 120 Hz
Filter	Low pass at 180 Hz
Overload protection	Yes

SUPPLY

Rated voltage	24 VDC (-15% to +10%)
Overload protection	Yes

OUTPUT (5V)

Rated voltage	5 V (±5%)
Maximum current	Up to 3 HSC inputs

OUTPUT (OUT1 / OUT2 / PH)

Output type	0-24V / 0-5V jumper set
Maximal current	Up to 3 HSC inputs
Activation frequency	0-120 Hz
Maximum phase difference	0.2 °
(between two zero crossing cards at 60Hz 100V RMS)	
Frequency variation at 0.5 VAC (from 6- to 70Hz)	±0.05 Hz
Frequency variation at 100VAC (from 50 to 70 Hz)	±0.05 Hz

OSCILLATOR TRANSISTOR OUTPUT

Output type	0-24V / 0-5v jumper set
Maximal current	Up to 3 HSC inputs

OSC OUTPUTS

Output type	RS422 differential (line driver)
Rated voltage	5 Volts
Maximal current	Up to 3 HSC inputs
Activation frequency	16 different rotary switch selectable frequencies
	A 120Ω resistor must be installed if output is not used.



VISUAL 65 SPECIFICATIONS

FEATURES

Comprehensive monitoring of all governor activities, functions, operations and status.
 Granular password protected access to 1000 parametrization tags (10 password levels)
 Can be executed on demand at any SCADA or HMI station or on a dedicated PC.
 Event logging
 High speed event logging of turbine/excitation/generator response tests.
 Alarm logging
 Full governor configuration backup saving and restoration capabilities.
 Multiple simultaneous trending capabilities:

- Main Trend window with up to 18 different selectable pens.
- Speed control window: PID parameters (SP/PV/CV)
- Positioning control window: PID parameters (SP/PV/CV)
- Adjustable trend frequency update.
- Trend auto-save per screen.

Minimal CPU and memory requirements: i3 dual core (or compatible) 4GB (or higher).
 Minimal display size: 1024x768 (minimal suggested)
 Storage requirements: internal or network based on customer logging requirements.
 Compatible with Windows versions: 10, 7, Vista, XP, 32 and 64bit,
 Embedded or Pro. Requires .NET 4.5 or higher
 Bandwidth / Network: Optimized for very low usage Modbus TCP link.
 (<3 kbps average / 5.4 kbps on high speed logging)

Simultaneous SCADA connection to PLC-TG does not affect V65 nor governor performance.

FSC-P MODULE SPECIFICATIONS (continued)

OPERATING RANGE

Operating temperature -5°C/70°C (23°/158°F)
 Operating humidity 5%/90% w/o condensation

ENCLOSURE AND DIAGNOSTICS

Electromagnetic interference shielded aluminum protection on the inner side.
 As diagnostic aids one red led indicates power, and two greens indicate positive edges for each PT incoming signal.

DESIGN STANDARDS

Impact	Operating: IEC 60068-2-27 (Test Ea, unpackaged shock): 30g Non-oper: IEC 60068-2-27 (Test Ea, unpackaged shock): 50g
Vibration	IEC 60068-2-6 (Test Fc, operating): 2g @ 10-500Hz
ESD immunity	IEC 61000-4-2: 6kV contact discharge, 8kV air discharge
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1kHz sine-wave 80% AM from 150kHz to 2000 MHz, 10V/m with 200Hz 50% pulse 100% AM to 900MHz
Fast transient immunity	IEC 61000-4-5: ± 2kV Line-earth (CM) on shielded ports
Conducted RF immunity	IEC 61000-4-6: 10Vrms with 1 kHz sine-wave 80% AM from 150 kHz to 80 MHz
EMI	C37.90.2 Electromagnetic interference at 150 MHz and 450 MHz, 10 V/m
Dielectric strength	2.0 kV for 1 minute to ground

New projects and modernization made easy!

Interested in more details, contact **Hydro ECI**.

PLC-TG Governor Software meets or exceeds IEEE STD125

The *HECI Smart/Soft control system* is in conformity with the IEEE Std. 1010-1987 Guide for Control of Hydroelectric Power Plants and IEEE Std. 1046-1991 Application Guides for Distributed DIGITAL Control and Monitoring for Power Plant standards.

Rev 4.1
2021-12