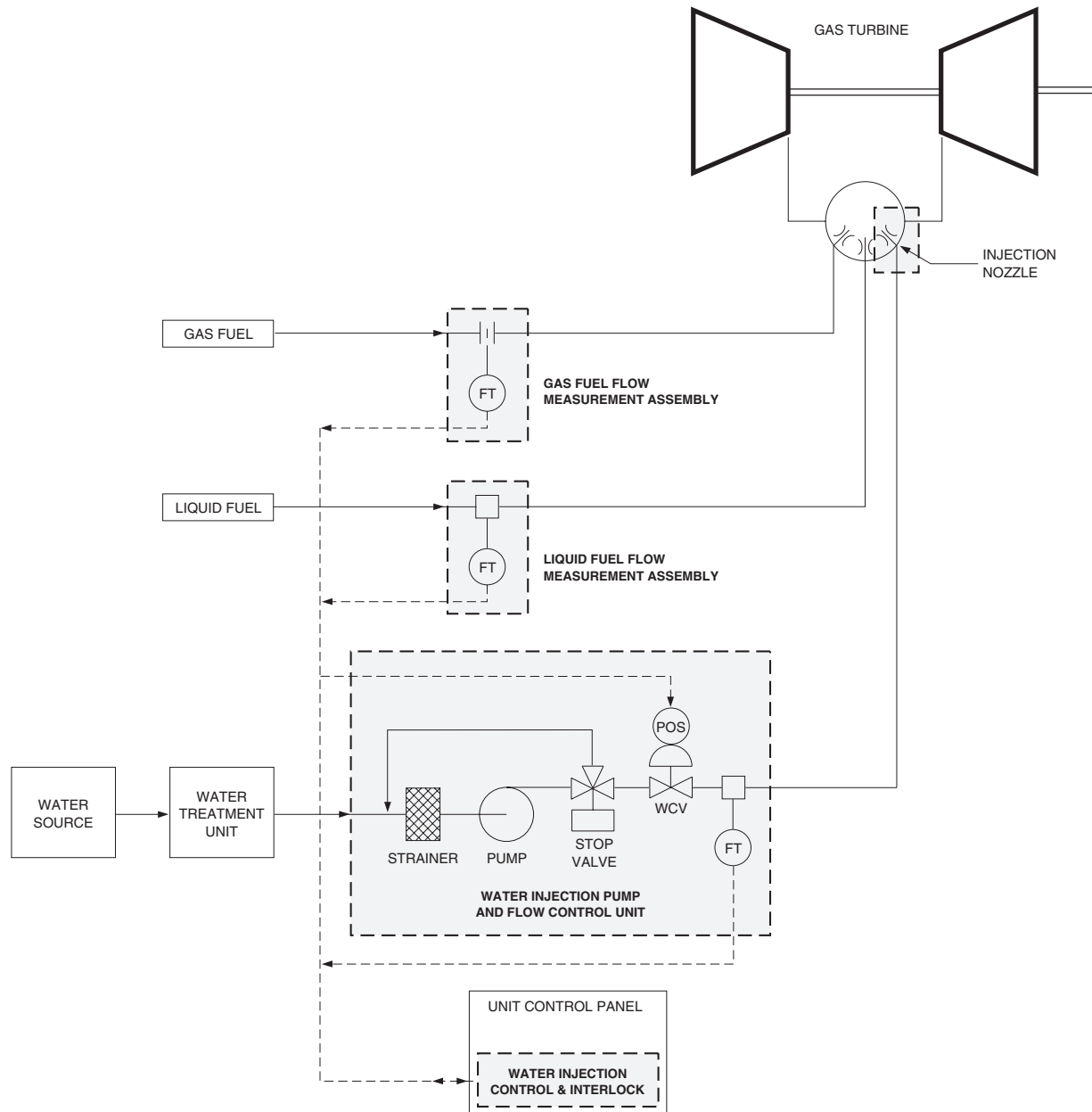


HEAVY-DUTY GAS TURBINE WATER INJECTION SYSTEM



MAY 2012



Simplified schematic showing principal parts of the series GTW water injection system for NOx reduction and power augmentation.



APPLICATION

Injection of water into the combustor of a heavy-duty gas turbine lowers peak combustion temperature for a given power output. This effect can be utilized exclusively to reduce NOx at a given power output, or to increase peak power at the same peak combustion temperature, or to simultaneously reduce NOx and increase power, each to a lesser extent.



Installation of a water injection pump and flow control skid for a Frame 7 gas turbine gen set in utility service.

ADVANTAGES

For Power Augmentation (exclusively):

Typical increase in peak power is 6% to 10%.

For NOx Reduction (exclusively):

Typical NOx value (for a typical Frame 5 in good condition) is 30-35 ppm.

Values are for a gas turbine within factory specifications, burning methane fuel at standard conditions. Increasing the water flow rate can usually compensate for gas turbine performance not within factory "as shipped" specifications.

FEATURES

System Components

Typical water injection systems include:

- Water source.

Water treatment unit.

- Depending on the available water characteristics and the specific application, this can be a reverse osmosis unit; a deionizing unit; or merely a filter unit. If the gas turbine is located at a steam power plant, a source of suitable treated water is usually available on site.

Water nozzles.

Two types are available:

- Water/fuel mixing upstream of the common nozzle tip.
- Separate water and fuel nozzles.

Gas fuel flow measurement assembly.

- Necessary for gas or dual fuel gas turbines where the objective is NOx reduction.
- Desirable (but not necessary) for gas or dual fuel gas turbines where the objective is power augmentation.

Liquid fuel measurement assembly.

- Necessary for liquid or dual fuel gas turbines where the objective is NOx reduction.
- Desirable (but not necessary) for liquid or dual fuel gas turbines where the objective is power augmentation.
- Not required if the fuel pump or flow divider provides flow measurement output.

Water injection pump and flow control unit.

A complete skid-mounted assembly.

Water injection controller.

A complete panel or application software package for existing control panel.

- Installation piping, labor.
- Installation wiring and motor controller/protection.
- Commissioning.
- Training.

Petrotech is prepared to supply all system components, except the water source, on a turnkey basis.

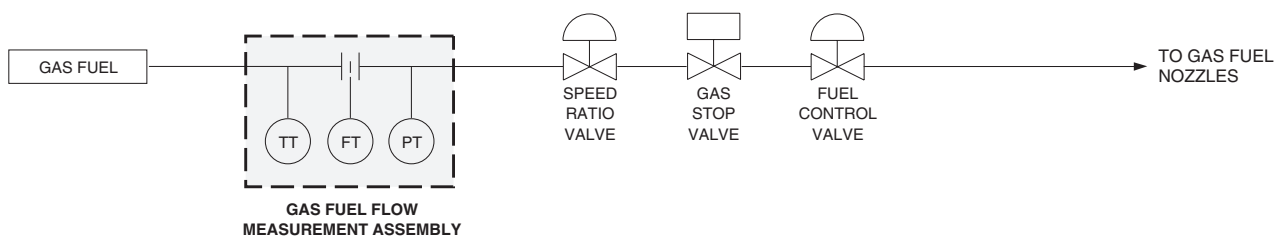
GAS FUEL MEASUREMENT ASSEMBLY SCOPE OF SUPPLY

The gas fuel measurement assembly, includes the following items:

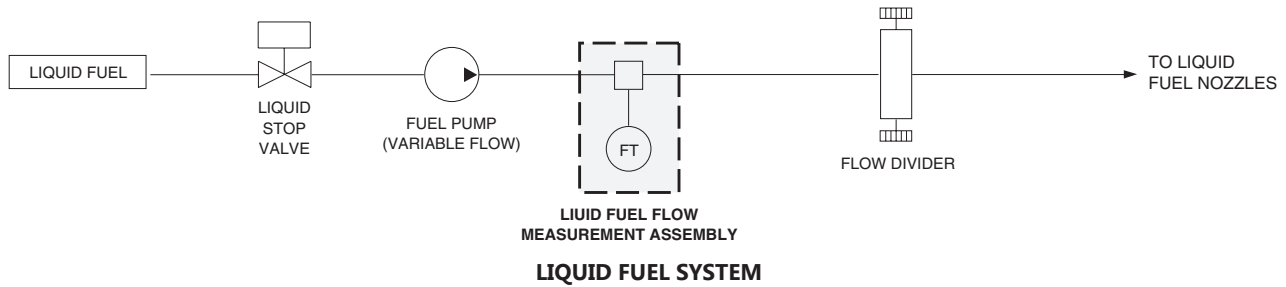
- One (1) flow transmitter, SS wetted parts and process valves, complete with 3-valve manifold.
- One (1) pressure transmitter, SS wetted parts, complete with process valve.
- One (1) temperature transmitter, SS wetted parts, complete with thermowell.
- One (1) flow orifice flange union set, SS flange and plate.

Items not included:

- Pipe spool, installation materials or labor.



GAS FUEL SYSTEM



**LIQUID FUEL MEASUREMENT ASSEMBLY
SCOPE OF SUPPLY**

The liquid fuel measurement assembly, includes the following items:

- One (1) liquid flow meter, turbine type, with pulse x mA.

Items not included:

- Pipe spool, installation materials or labor.

WATER INJECTION NOZZLE SCOPE OF SUPPLY

The water injection nozzle, includes the following items:

- Water/fuel mixing nozzle.

OR

- Water injection nozzle.

WATER INJECTION PUMP & FLOW CONTROL UNIT SCOPE OF SUPPLY

The water injection pump and flow control unit, includes the following:

- One (1) filter/strainer, SS, "Y" type.
- Three (3) pressure indicators, SS wetted parts.
- One (1) temperature indicator, SS wetted parts.
- One (1) pressure switch, pressure safety low, SS wetted parts.
- One (1) electric motor-driven water pump, centrifugal.
- One (1) 3-way stop valve, SS wetted parts, water or hydraulic actuator,
- One (1) liquid flowmeter, turbine type.
- Skid base and support, steel. Completed skid dimensions, approximate, 4 m L x 2 m W x 2.5 m H (12 ft. x 6 ft. x 8 ft.)
- Piping to skid edge, type 304 SS, with studs and nuts.
- Gage indicator local plate, SS fronts, skid mounted.

Items not included:

- Piping beyond skid edge, companion flanges, gaskets, or studs.
- Cable to motor or pressure switch.
- Motor controller or protection devices.
- Installation.

**GAS TURBINE WATER INJECTION CONTROLLER
SCOPE OF SUPPLY**

- Available either as a complete, tested hardware plus application software control panel or as an application software package only.
- Application software package integrates seamlessly into all Petrotech series 9500 integrated gas turbine control panels.

Catalog item GTWC, gas turbine water injection controller, includes the following:

Discrete inputs:

- Pump suction low.

Discrete outputs:

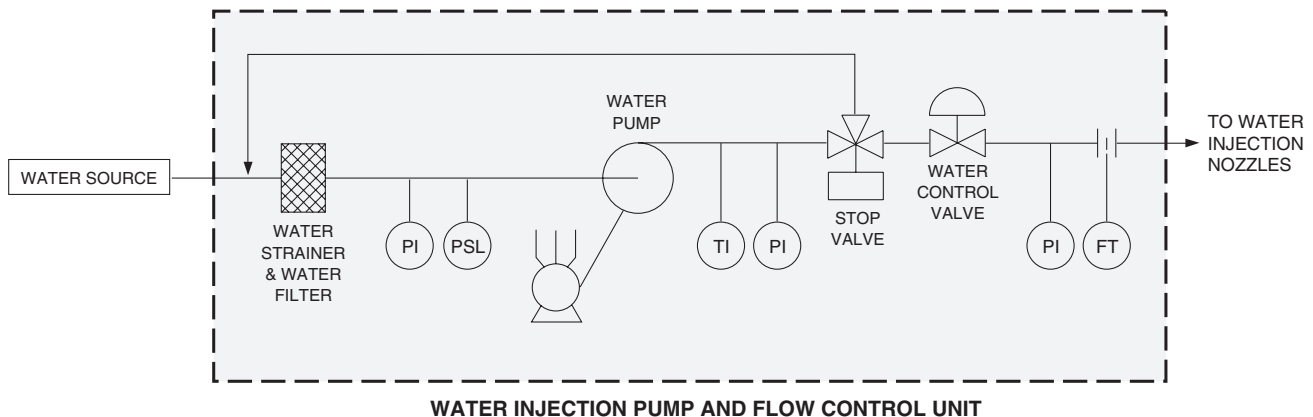
- Stop pump (momentary .5 sec).
- Start pump (momentary .5 sec).

Alerts:

- Pump low suction.
- Pump low suction trip.

Analog inputs:

- Gas fuel FT.
- Gas fuel PT.
- Gas fuel TT.
- Liquid fuel FT.
- Water FT.





Computed for control and display:

- Gas fuel mass flow.
- Gas fuel standard flow.
- Liquid fuel mass flow.
- Water/fuel ratio.

Display:

- All measurements.
- All analog outputs.
- All computed values.

Controller functions:

- Water/fuel ratio controller:
- Setpoint..
- Measurement.
- Output.

Interlock:

- As required.

REQUIRED TO SPECIFY A COMPLETE SYSTEM

- Technical details of the gas turbine.
- Technical details about available water.
- The objective.
- Components desired
- Technical details of the existing controls.

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