Water Injection Skid for NOx Reduction

A Petrotech, Inc. White Paper

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COMPANY OVERVIEW

Petrotech has over 50 years of experience in the turbomachinery controls business and have retrofitted every type of gas turbine in both power generation and mechanical drive. We started with pneumatic controls, later developed our own microprocessor-based turbine controls, and in the early 1990's moved our core technology to modern platforms such as PLC, DCS and others. Since then, we have delivered gas turbine control systems for virtually all brands and models of gas turbines on all major PLC platforms such as Allen Bradley, GE, TI, Siemens, Modicon, etc. We have successfully delivered over 3000 systems accounting for over 9 million of running hours making us the trusted experts in this field including hundreds of GE Frame 5 Control System. For some GE Frame 5s, we provided water injection skids that were used for NOx Reduction and Power Augmentation as well. The control portion of those skids was done as follows:

- Stand-Alone System PLC Platform (Allen Bradley) to interface with the existing Turbine Control system through some hardwire signals.
- Control Portion integrated into the existing Unit Control System (or new control system) by adding a remote I/O Drop to handle all the new I/Os for the NOx Reduction Skid.

ABSTRACT

This white paper discusses the advancements and applications of Petrotech's water injection skid for NOx reduction and power augmentation in GE Frame 5 and Frame 7 units. Highlighting a recent project with a New York State power utility provider, the paper details the simulation, design, installation, and successful commissioning of the system, which significantly reduced NOx emissions and increased power output.

CASE STUDY: POWER UTILITY PROVIDER

Recently we provided a Water Injection Skid used for NOX reduction on a dual fuel GE Frame 5 to one of the New York States Power utility providers. This Power utility provider contacted Petrotech after New York passed a law that by May 1, 2025, the limit is 25 ppm of NOx for gaseous fuels and 42 ppm of NOx for distillate oil or other liquid fuel. Thus, Petrotech developed simulation software to show this Power provider the level that we can get to with our control system/ Skid package. Petrotech then designed, built, delivered, and installed a test Skid for the GE Frame 5 and GE Frame 7 units. Below is a picture of the Water Injection Skid while at Petrotech's manufacturing facility before delivery.

CONTROL SYSTEM DETAILS AND RESULTS

Water Injection Skid Control: Implemented on an Allen Bradley ControlLogix PLC Platform with an HMI, interfacing with the existing GE Mark II SpeedTronic control through hardwired signals. Below is an image of the skid after installation.

NOx Reduction and Power Augmentation: On the Turbine side, Petrotech modified one (1) Set of 10 fuel nozzles/ combustor end caps and to fit new water injection nozzles. Then we installed new WI header and SS water injection manifolds tubing around the combustors where we connected them to the new water nozzles. Also, the manifolds were connected to the main WI header back to the water skid.

Simulation and Testing: Developed simulation software to predict emission reductions, followed by successful real-world testing on GE Frame 5 units. The testing was done on a GE Frame 5 first where we were able to lower the emissions from 64.5 to 20.3 ppm of

NOx on Gas and from 105.5 to 35 ppm of NOx on Liquid. In addition, the customer was able to get more power (MW) as well. Due to the accurate numbers and results achieved on frame 5, which matched the results provided by our simulation software our customer decided to permanently install the skid on the GE Frame 5 and not test the GE Frame 7.

CONCLUSION

Petrotech's innovative solutions and extensive experience in turbomachinery controls have positioned it as a leader in the industry. The success of the water injection skid project demonstrates Petrotech's ability to meet stringent regulatory requirements while enhancing turbine performance.

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