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BROOKHAVEN SCIENCE ASSOCIATES

Department of Applied Science

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Intellidyne, LLC
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Gentlemen:

This letter is to report the results of our laboratory performance testing of the IntelliCon-HW (previously named the ThermoMi$er-HW) fuel economizer control unit. These tests were performed by the staff of the Energy Efficiency and Conservation Division of the Dept. of Applied Sciences at Brookhaven National Laboratory, Upton NY.

Installation

The IntelliCon unit was installed on a Utica residential high efficiency, oil-fired hydronic boiler, located in our Combustion Research Laboratory. This boiler is an 87% efficient, three-section wet-base cast iron boiler. It was fired by a Beckett burner with an installed nozzle's fuel flow rate of.77 gal/hr., giving the burner a theoretical output of 107,800 BTU/hr.

The load to the boiler was supplied by a water-cooled plate heat exchanger. The coolant water was supplied at constant pressure and supply temperature and was discarded after leaving the heat exchanger. The heat exchanger coolant flow rate was controlled by a gate valve in the discharge line.

Instrumentation

The cooling water flow rate to the load heat exchanger was measured using a target type flow meter and further verified by accurately timing the collection of large volumes of water in the dump tank. Boiler flow rate was measured using a paddle-wheel flow meter and was found to be essentially constant at 4.6 gpm during all runs. Well and surface mounted thermocouples were used to measure the temperatures of the boiler inflow and outflow water as well as the heat exchanger coolant inflow and outflow temperatures. Data was recorded in 5-second intervals using a modular data acquisition system connected to a laptop computer.

In addition to the temperature and flow rate data, the date, elapsed time, cumulative burner firing time and IntelliCon control state changes were measured with a resolution of .01 seconds and were recorded at each time slice. The accumulated number of burner ignitions was also recorded.

Test Procedure

The tests were run by adjusting the load coolant flow rate to obtain an average temperature drop across the boiler of 15 – 20 deg. F. Once the heat exchanger cooling water flow rate was set, it was held constant for the duration of the tests and the boiler circulator was operated continuously. To eliminate the effect of normal cycle to cycle fluctuations, data was recorded for a minimum of 50 complete burner cycles.

Two tests were performed. In the first test, the boiler was run with the IntelliCon control deactivated. This provided the 'base' case for the boiler operation. In the second test, the IntelliCon control was activated and the test was re-run under the same conditions as the base case.

Data Reduction Procedure

After testing, the recorded data for each test was converted to engineering units using a post-processing program. This data was then analyzed to locate all burner On to Off and Off to On changes starting with the first recorded burner ignition and ending at the last recorded burner ignition. This then allowed the burner run time and total cycle time to be found for each cycle along with the total elapsed time and the total burner firing time for the entire test. The burner firing time per hour of boiler operation was computed for each test from the ratio of the burner run time in minutes to the total elapsed time in hours. The number of burner cycles per hour was computed for each test by dividing the number of burner ignitions by the total elapsed time in hours.

Test Results

The results of the test are summarized in the Table give below:

	IntelliCon OFF	IntelliCon ON	% Reduction
Burner Firing Time per Hour of Boiler Operation	28.9 min.	24.8 min.	14.2 %
Number of Burner Cycles per Hour	10.1	3.6	64.4 %
Burner Run Time per Cycle	2.85 min.	6.86 min.	-

The major results are as follows:

- With the IntelliCon control turned off, burner firing occurred 48.2% of the elapsed time. With the IntelliCon control activated, the burner fired only 41.4% of the time. Thus, the action of the IntelliCon control led to a 14.2% reduction in the burner run time, under the test conditions.

- Based on the average cycle duration, with the IntelliCon control turned off, the burner was cycling on and off at a rate of 10.1 cycles per hour. Under the same load, but with the IntelliCon control on, the burner was cycling on and off at a rate of only 3.6 cycles per hour. Therefore, the use of the IntelliCon control resulted in a 64.5% reduction in the burner cycling rate.

These results show that the IntelliCon control has a significant positive effect on the operation of the boiler. For oil-fired boilers such as the one tested, the 64.4% reduction in cycling rate should also result in a substantial reduction in cumulative soot emissions as well as 'wear and tear' on the boiler, due to the reduced number of burner starts.