Louisiana Power & Light Company's Mobile Testing Program

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Overview

In December 1985, Louisiana Power & Light Company began initial development and implementation of the Middle South Utilities System Power Plant Productivity Improvement Program (PPPIP).

One of the key areas targeted for improvement was unit efficiency. As a result of a detailed conceptual study an upgraded unit testing program utilizing a mobile testing facility was recommended. Initial operation of the Mobile Testing Facility (MTF) began early 1987.

Initial MTF Development

In January 1986, the General Office Plant Performance and Results Department of Louisiana Power & Light Company in coordination with the generating station began the preliminary specification for the MTF. The project scope included:

1. Determine management information needs
2. Survey ASME test codes and other applicable material
3. Survey the latest technology and industry practices
4. Evaluate alternatives
5. Develop final MTF specification.

After completing these tasks we concluded the best approach would be centered on an upgrade of the turbine enthalpy-drop test. The specified system would be a small PC-based data acquisition system for data collection.

The MTF

The MTF consists of:

1. Data Acquisition System
2. Field Instrumentation
3. Calibration Equipment
4. Trailer and Auxiliaries

The data acquisition consists of a PC compatible computer linked to remotely located data acquisition units (Remote Data Collectors). The PC used is a Compaq Portable II (equivalent to an IBM PC AT). The Remote Data Collectors (RDCs), manufactured by Azonix Corp., are weatherproof enclosures which contain precision 18 bit A/D conversion of the instrument signals, engineering units conversions and math capabilities, built in modems for communications with the trailer-based PC, power supplies for the pressure transmitters, and mil-spec connectors for instrument hookup.

Field instrumentation includes pressure transmitters and four wire RTDs for temperature measurement.

The pressure transmitters used are Honeywell Smart transmitters. These devices are mounted within custom enclosures. The enclosures include mil-spec connectors, needle valves, and tubing connectors for instrument hookup and line blowdown. The Honeywell pressure transmitters were selected for their excellent performance characteristics, communications capabilities, and the ability to easily re-range the span.

The field RTDs are four wire with an alpha of .003916 (Japanese Industrial Standard). These RTDs were selected due to the superior performance characteristics of the four wire over RTDs with fewer leads and the higher alpha giving better stability and accuracy.

Calibration or metrology equipment comprises two systems. The pressure measurement standard is a D. H. Instrument Model 5300 hydraulic deadweight tester with .01% of indicated pressure accuracy.

The temperature measurement system consists of a Rosemount 160CE precision standard platinum resistance thermometer, an ice point bath, a Techne FB-08 fluidized bath, and 18 bit A/D measurement of the ohmic value for temperature.

Special computer software is used for the calibrations. For pressure, the transmitter is connected to the desired RDC channel, the desired pressure for the 4 and 20 MA output signals are generated by the deadweight tester (two points) and the counts of the A/D converter are measured. These two points are used to calculate a linear factor used for the engineering units conversion in the RDCs. These factors are downloaded into the RDCs such that the channels display "calibrated" psi units.

Calibrations for the temperature measurements are similar. The Rosemount SPRT is connected to a precision 18 bit A/D channel on the RDC. The field RTD is connected to the RDC channel to be calibrated. Two points, 0°C and 200°C are measured and the $y = mx+b$ factors calculated. This process is repeated for each RTD and these results are downloaded to the RDCs so that each channel is calibrated and displays degrees F.

Once the RDCs are calibrated, each specific channel with its specific RTD or pressure transmitter, the calibrations for temperature and pressure are cross-checked at several points to ensure the proper calibration factors have been applied.

Calibrations are performed pre-test. Cross-checks are performed pre and post-test.

The trailer has been designed for quick and easy hookup to the plants for power, computer, and auxiliary equipment. The trailer features a 480 volt single phase to 240/120 VAC transformer for power from the plant welding outlets, instrument air connection for the fluidized bath, a panel for connection of the PC computer to the field located RDCs, and a halon fire protection system.

Preliminary Test Results

The first series of tests for the MTF were completed late May 1987. Tests were conducted on a 560 MW supercritical 3500 psi/1000°F/1000°F G.E. tandem compound four flow (G2) machine. Preliminary results are tabulated below. Table No. 1 shows a typical cross-check of a calibrated RTD. RTDs are cross-checked for a ±50°F span of the estimated test measurement.

Table No. 1

Observed Points	Standard Pre-Test Ohms	Standard Pre-Test °F	Standard Post-Test Ohms	Standard Post-Test °F	Field RTD Pre-Test °F	Field RTD Post-Test °F
920°F	72.4593	926.30	72.1389	919.68	926.17	919.69
945°F	73.7197	952.46	73.3578	944.94	952.48	944.75
970°F	74.8049	975.09	74.6325	971.49	974.92	971.01
995°F	75.9491	999.06	75.8043	996.02	998.54	995.32
1020°F	77.0690	1022.63	76.9723	1020.59	1022.06	1020.18

Worst case error pre-test -.57°F
Worst case error post-test -.70°F

It should be noted these errors do not include those of the standard and its measurement system. Worst case accuracy of this system is better than .05°F.

Table No. 2 is a comparison of MTF data to plant instrumentation.

Table No. 2

	Calibrated RTD	Plant Thermocouple
Main Steam °F	991.1	997
HP Exhaust °F	588.6	587
14th Stg Ext °F	507.7	503

	Calibrated Transmitter	Plant Transmitter
Main Steam PSIA	3497.3	3509.7
1st Stg PSIA	2435.2	2408.7
Cold Reheat PSIA	671.7	691.4

Though the differences may not appear great their impact on the test results can now be realized. Table No. 3 illustrates the differences when the H.P. turbine efficiency results are calculated.

Table No. 3

	Plant Data	MTF Data
HP Turb eff	82.0	77.9
Uncertainty*	±5%	.5%
HP Turb eff range	77% to 87%	77.4% to 78%

*From ASME

As can be seen from the table the uncertainty for the MTF data is much lower. Also the MTF data allows us to examine plant instrumentation uncertainties for ourselves instead of relying on dated ASME codes.

Conclusions

The MTF has become an integral part of Louisiana Power & Light Company's testing programs. Preliminary results indicate the system; instrumentation, computer calibration and equipment, and procedures, enable highly accurate turbine enthalpy drop testing.