Report 9: Cost-Effective Reciprocating Engine Emissions Control and Monitoring for E&P Field and Gathering Engines

Technical Progress Report
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Abstract

During the eighth reporting period, high-impact monitoring and control technologies were identified during a series of meetings at Ajax/Cooper in Oklahoma City. Many of the technologies that were identified will be tested on the Ajax DP-115 engine and are capable of being widely utilized by the E&P industry. Two major areas were engine controls and ignition systems but still included other alternatives to reduce emissions.

Another major advance was the completion of setting the Ajax DP-115 engine. This includes anchoring and leveling the engine. Shortly after the engine was prepared, all the necessary utilities were installed. Once the utilities were installed the engine was successfully operated over its normal operating range at the end of the reporting period.

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Introduction

The objective of this project is to identify, develop, test, and commercialize emissions control and monitoring technologies that can be implemented by exploration and production (E&P) operators to significantly lower their cost of environmental compliance and expedite project permitting. The project team will take considerable advantage of the emissions control research and development efforts and practices that have been underway in the gas pipeline industry for the last 12 years. These efforts and practices are expected to closely interface with the E&P industry to develop cost-effective options that apply to widely-used field and gathering engines, and which can be readily commercialized.

The project is separated into two phases. Phase 1 work establishes an E&P industry liaison group, develops a frequency distribution of installed E&P field engines, and identifies and assesses commercially available and emerging engine emissions control and monitoring technologies. Current and expected E&P engine emissions and monitoring requirements will be reviewed, and priority technologies will be identified for further development. The identified promising technologies will be tested on a laboratory engine to confirm their generic viability. In addition, during Phase 2 a full-scale field test of prototype emissions controls will be conducted on at least ten representative field engine models with challenging emissions profiles. Emissions monitoring systems that are integrated with existing controls packages will be developed. Technology transfer/commercialization is expected to be implemented through compressor fleet leasing operators, engine component suppliers, the industry liaison group, and the Petroleum Technology Transfer Council.

Research Progress

The progress during the last quarter has been remarkable. Figures A and B show how much the test cell has advanced since the last reporting period. The progress included, but is not limited to, the installation of the exhaust system, dynamometer cooler piping, and engine flywheel. The muffler can be seen standing up on the left hand side of Figure B. The other most noticeable difference in the figures is that the flywheel is attached to the engine.

Figure A: Ajax Test Cell as of 1-1-05 Figure B: Ajax Test Cell as of 3-31-05

The main focus has been to complete the test cell as soon as possible. At the time of this report, the test cell is approximately 90% complete. After the delivery of the engine in December the first objective was to install sufficient auxiliaries and controls to start the engine. This required the manufacturing of clamps to hold down the engine as well as the installation of the air and gas lines. Once the hold down clamps where installed and the air line was complete, the engine was motored using compressed air. After successful motoring all the hold down clamps were rechecked for the proper torque. Some of the hold down clamps needed to be retightened, which indicated the engine may have settled and may not be sitting square. For this reason the clearance in the crosshead were rechecked.

The second objective was to install the muffler and gas piping. The exhaust system involved designing and building a muffler stand as well as fabricating the correct length of pipe to meet the manufacturer's recommended length of 16 feet. Once the gas piping and muffler were in place the engine was started and operated in an unloaded condition. The engine was then operated at different speeds, followed by a recheck to make sure the crosshead clearances remained within acceptable tolerances to avoid any mechanical failures.

While the primary effort during this reporting period was on establishing an operating engine, significant effort was also focused on the instrumentation that would be used to monitor engine performance, control the engine, and measure engine emissions. . At the present time the instrumentation is 80% done, and a significant portion of the instrumentation system is operable and can be used to collect and process engine data.

Finally, the coupling between the dynamometer and engine was installed. After the coupling was in place, the engine was loaded to 100% load at 100% speed. This marks the first time the engine has been run and loaded at the NGML.

Future Work

In the next quarter, our next objective is to finish installing the instrumentation and begin the baseline tests. The baseline test is expected to be completed during the first part of June, followed then by a battery of tests that include pre-combustion chambers, ion sense, and in-cylinder peak pressure measurements.