

Texas Commission on Environmental Quality
New Technology Implementation Grant (NTIG) Program

TIP Project

Final Implementation Report for:

New Technology Implementation Grant (NTIG) Program

582-21-23792-NG

Submitted by:

Enstor Katy Storage and Transportation, L.P.

Project Representative:

Pablo Rodriguez

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Introduction/Background

Enstor Katy Storage and Transportation, L.P. (Enstor KST) is a Texas-based high-deliverability, multicycle natural gas storage facility that consists of a depleted gas production reservoir, redeveloped as a natural gas storage reservoir, and a dual pipeline header system interconnecting with 15 natural gas pipelines. The facility is at an intersection of production from the Gulf of Mexico, South Texas, and the Permian Basin that serves the storage needs of natural gas producers, energy marketers, electric power generators, and utilities, and industrial users.

The project consisted of replacing eight (8) lean burn natural gas engine drivers (Waukesha 7042GL) used in natural gas storage compression service by eight (8) remanufactured, more efficient and lower emissions, rich burn natural gas engines (Waukesha 7044GSI S5). More specifically this reduced NOx emissions from 2.0 g/bhp-hr to 0.15 g/bhp-hr, VOC emissions from 0.767 g/bhp-hr to 0.003 g/bhp-hr. and PM emissions from 0.033 g/bhp-hr to 0.01 g/bhp-hr. The importance of this project is that it reduces emissions in a non-attainment area and increases the reliability of Enstor Katy Storage and Transportation facilities.

Project Objectives/Technical Approach

The NTIG program aims to help maintain the quality of air in Texas in order to meet standards established under the Federal Clean Air Act. The execution of the TIP Project by Enstor KST has resulted in the reduction of NOx emissions by 91.6%, VOC emissions by 99.6%, and PM emissions by 65.9%. This significant reduction in emissions represents a meaningful contribution towards achieving the goals of the NTIG Program.

Enstor Katy Storage and Transportation, L.P. set out to accomplish the following objectives during the project:

- Lower NOx, VOC and PM emissions at the facility
- Increase facility reliability and profitability
- Minimize impact to day-to-day operations while executing the work

The tasks for the Grant Scope of Work included the following:

- Task 1 Secure Rights to location
- Task 2 Secure all necessary permits to install and operate the project
- Task 3 Execution of contracts and purchase and installation of equipment
- Task 4 Testing and final design
- Task 5 Implementation reporting
- Task 6 Operational reporting period

Task 1 Secure Rights to location

Enstor KST owns the property (82.7 Acres) where the facilities are located. The documentation (deeds) demonstrating ownership of the property were submitted to finalize this task included in the scope of work. A copy of the deed for the property was submitted to complete this task of the grant Scope of Work.

Task 2 Secure all necessary permits to install and operate the project

Enstor KST secured the permits to install and operate the units. A copy of the amendment to Permit 20907 issued by TCEQ on November 3, 2021, including the Maximum Allowable Emission Rate by source, along with proof of insurance coverage were submitted to complete this task of the grant Scope of Work.

Task 3 Execution of contracts and purchase and installation of equipment

Contracts for long lead equipment acquisition and installation were issued on December 15, 2021. The procurement strategy was centered on ordering long lead items first and taking deliveries of equipment as they were being fabricated. The installation followed the delivery schedule of the long lead items. Field work commenced on February 01, 2022, to prepare for the installation of the first unit (C-208). The first engine was set on February 11, 2022. The last unit was commissioned on August 10, 2022. Installation of the catalyst units followed attaining the recommended engine run in period by the manufacturer. Between August 10, 2022, and October 14, 2022, updates to the unit control system and preparation for emissions testing were carried out. All eight (8) units were ready for emissions testing on October 14, 2022.

Task 4 Testing and final design

The tests to measure emissions, record gas composition, measure and record fuel flow, measure and record engine load, measure and record exhaust gas inlet and outlet temperature at catalytic convertor, obtain and analyze gas inlet and outlet composition at the catalytic convertor, and calculate the performance values were conducted between October 24-31, 2022. All tests were successfully completed, in fact the emissions of NOx, CO and NMHC are below the permit and NSPS JJJJ limits. Table 4.1 summarizes the emissions results:

Table 4.1 Emissions testing summary units C-201 to C-208 @ 1,200 RPM (Reference 1)

Parameter	Units	201	202	203	204	205	206	207	208	Permit limits	NSPS JJJ LIMITS
NOx	ppmvd @ 15% O2	0	0	0	0	0	0	0	0		82
NOx	g/hp-hr	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.15	1
CO	ppmvd @ 15% O2	7	4	4	2	10	6	4	7		270
CO	g/hp-hr	0.0482	0.0315	0.0344	0.0162	0.0835	0.0454	0.0345	0.0564	0.3608	2.0
NMHC	ppmvd @ 15% O2	0	0	0	0	0	0	0	0		60
NMHC	g/hp-hr	0.001	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.003	0.7

The tests to measure emissions rates of particulate matter (PM) were conducted between March 1-9, 2023. All tests were successfully completed, in fact the emissions of PM are below the permit. Table 4.2 summarizes the results:

Table 4.2 PM Emissions testing summary units C-201 to C-208 @ 1,200 RPM (Reference 2)

Parameter	Units	201	202	203	204	205	206	207	208	Permit limits	NSPS JJJ LIMITS
PM	g/hp-hr	0.007	0.007	0.006	0.001	0.005	0.003	0.005	0.007	0.01	None

Task 5 Implementation reporting

Enstor KST met the quarterly reporting requirements throughout the implementation period from Q4 2021 through Q3 2022.

Task 6 Operational reporting period

Units C-201, C-202, C-203, C-204, C-205, C-206, C-207 and C-208 will continue to operate for the coming years. Enstor KST will continue to post annual operating reports on the emissions testing for five years and submit a final operations report at the end of the five-year period.

Discussion/Observations

Objectives and Results

The primary objectives of this project were met, i.e., all eight units were installed, commissioned and tested successfully in a timely and safe manner. The emissions results, summarized in Table 3.1 above clearly demonstrate that the emissions objectives were met.

Enstor KST was able to meet the project objectives through a combination of the following factors

1. Interface identification: This phase consisted of a detailed review of all engine interfaces such as: piping connections, electrical connections, supports, coupling, air inlet and exhaust ducting and controls, among others; to clearly define the scope of supply and installation. This preliminary work done by Enstor KST personnel, was instrumental to minimize scope creep and identifying long lead items that may have delayed the execution of the work.
2. Planning: The work demanded simultaneous removal of existing equipment, installation of new equipment while maintaining the other units operational, and meeting service demand. This work required detailed planning and coordination between the contractors performing the work, plant operations personnel and business personnel to ensure that all these activities were performed safely, on time and with minimal or no impact to client requirements.
3. Coordination and supervision: Enstor KST employed a 3rd party engineering contractor to provide coordination and technical supervision services for day-to-day activities. This enabled Enstor KST to maintain the overall project schedule and effectively address issues arising during the installation and testing process without compromising execution schedule and cost.
4. Construction: The installation of the units was performed by a company specializing, among other things, in the fabrication and installation of compression skids, and TCEQ0855 (V.21.01)

recognized by, Waukesha, the OEM (Original Equipment Manufacturer) to carry out this type of work. The contractor had a dedicated construction manager dedicated to coordinating all the work and liaise with Enstor KST on all aspects of the work.

5. Procurement: Perhaps one of the most important aspects of the work was the timely procurement, and continuous expediting of equipment and materials to avoid and minimize negative impact on schedule and costs. This task required weekly and sometimes daily follow-up on the status of equipment and materials. It should be noted that the effort spent on identifying the interfaces mentioned in point 1 above was fundamental in avoiding delays due to the possibility of not receiving and/or not issuing the PO (Purchase Orders) for equipment and materials on a timely basis.

Critical issues/Technical goals and barriers

In addition to the Interface Identification and Procurement factors mentioned in Point 1 and 5 of the preceding section, the following factors were crucial to the success of the project

1. Communication: In addition to weekly meetings to assess the construction and procurement activities, a clear line of communication was established between the various contractors involved in the construction activities, plant operations personnel and project management personnel.
2. HMI (Human Machine Interface) Management: The new engine controls included direct access to real-time engine data, and protections handled by the engine's control module (ESM2). Unlike the original engines where the additional instrumentation was routed directly from the instrument to the PLC (Programmable Logic Controller), the engine data was captured directly and incorporated into the Start/Stop sequence.
3. Operation of New Units: Although the engine block for the original L7042GL and new 7044GSI-S5 engines are the same, there are significant differences in the operation of the units; namely, with respect to emissions, efficiency, and controls. Several training sessions with operations personnel were carried out to point out the differences between the original and the new engines. As operations personnel became more familiar with the units, their feedback was incorporated into the control parameters and operational mode of the units.

Scope for future work

The lessons learned from this project are very valuable and will be an integral part of new projects developed by Enstor KST.

Summary/Conclusions

Enstor KST considers that the project was a complete success. The project objectives were met on time and on budget without any safety incidents, while maintaining the rest of the operations in place.

Rather than limit the scope of this project to an engine swap, Enstor KST evaluated the project as part of an overall initiative to achieve Carbon-Neutrality. The significant reduction in emissions, coupled with other steps taken by Enstor KST, enabled this facility to be certified as Carbon-Neutral.

Acknowledgments

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Texas Commission on Environmental Quality Grants team for support during the execution of the project.

Contractors, equipment vendors, equipment manufacturers, and material suppliers for striving to maintain the schedule despite recent supply chain issues.

References

1. Source Performance Test Report Katy Hub and Storage Plant. TRC Environmental Corporation Report 505712.KATY.COM, November 28, 2022. This report was submitted to the Texas Commission on Environmental Quality on November 30, 2022.
2. Emission Test Report Katy Hub and Storage Plant. TRC Environmental Corporation Report 512415.KATY.PM, April 04, 2023.

Appendices

Appendix A: Before & After Project Execution Photos



Before



After

