

Urea-SCR Emission Control System for Stationary Applications

Task 1 Report

for:

New Technology Research and Development Program

582-11-13515-2019

Submitted by:

Nett Technologies Inc.

Principal Investigators:

John Popik

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Abstract/Executive Summary

This report describes the progress made on Task 1 where the main objective was to develop a United States Environmental Protection Agency's (EPA) Environmental Technology Verification Program (ETV) verification test plan. Nett Technologies Inc (Nett) encountered serious difficulties identifying the proper section group within the EPA's verification program dealing with NO_x control in stationary applications. Once however the proper section had been identified significant and fast progress has been made. Product Verification Application has been submitted and formal EPA approval of the test plan and authorization to proceed with system durability and consequent performance testing has been obtained.

Introduction/Background

Funding for the verification of Urea Selective Catalytic Reduction (SCR) Emissions Control System for stationary applications was awarded to Nett Technologies Inc. in the form of a grant by TCEQ. The project duration was estimated for 12 months. The Scope of Work (SOW) consists of five tasks with Task 1 (Development of ETV Verification Test Plan) requiring completion prior to release of funding for the remaining tasks.

The United States Environmental Protection Agency (EPA) has two offices that deal with diesel emissions. Mobile applications fall under the responsibility of the Office of Air and Transportation Quality (OTAQ) and stationary engines that are non-transportation related all under the responsibility of the Office of Air Quality and Planning Standards (OAQPS). As a result, different verification protocols for NO_x retrofit devices had to be followed. After lengthy discussions with both agencies it was agreed that OTAQ will take responsibility for verification test plan approval. The application was submitted on June 20, 2012, and formal approval from EPA was received on February 20, 2013.

Project Objectives/Technical Approach

The primary objective of the task was to identify and initiate discussion with the appropriate agency within EPA which will accept Verification Application for NO_x control system on stationary engines. Considering complexity of the regulation, Task 1 took most of resources and time of the original project timeline.

Tasks

Task 1

Development of ETV verification test plan

From the Grant Activities (Scope of Work):

“2.1. Task Statement: The PERFORMING PARTY will develop and receive EPA approval of a verification test plan for urea-SCR retrofit system in stationary applications.

2.1.1. The PERFORMING PARTY will develop a draft test plan and submit it to EPA for approval.

2.1.2. The PERFORMING PARTY will respond promptly to all requests for additional information or verification test plan changes from EPA, and will revise the draft verification test plan as necessary to address EPA’s concerns and requirements. The PERFORMING PARTY will submit the revised verification test plan to EPA for approval.”

Stationary engine verification protocols were reviewed in preparation for completing the first draft of the test verification plan. The EPA's Office of Air Quality & Planning Standards (OAQPS) was determined to be the point of contact and the NO_x Control Technologies for Stationary Combustion Sources was the applicable verification protocol. This protocol had strict requirements for quality assurance and control which affected the preparation of the test verification plan.

A preliminary design for the urea-SCR system was developed according to the requirements of the target market including customizations due to climate factors and the nature of stationary applications. Selection of a suitable generator-set for demonstration testing was started taking into account the requirements of the EPA and the target market. Initial communications with the EPA were time consuming and refinement of the test verification plan progressed at a slower rate than expected. The California Air Resources Board (ARB) was also investigated as an alternative for attaining urea-SCR verification.

Early 2012 saw the assignment of a dedicated point of contact with the EPA improving communications and progression of the test verification plan. The bulk of the discussions focused on rules and requirements of the durability process. Typical aging on an in-use application was not available so the in-house aging process was of special concern to the EPA. Many proposals for the engine loading cycle were discussed to mimic as closely as possible the real-world conditions for aging to ensure the urea-SCR system would be exposed to as much wear-and-tear as in any in-use application. An eight-hour 9-mode schedule was devised, providing an average loading of 47% which would be repeated in excess of 125 times to achieve the 1000 hour aging requirement.

Finalization of the design for the urea-SCR system including modifications for aging during winter conditions was completed after numerous performance tests. A generator-set and load-bank for durability testing were purchased and commissioned. Dynamometer-based verification testing services have been arranged along with securing a suitable test engine for stationary applications according to EPA requirements. Other EPA mandated changes, such as functional testing of the urea-SCR monitoring systems every 250 hours, have been incorporated into the plan. Satisfied with the inclusion of all required changes, the EPA has approved the test verification plan.

Schedule:

From the Grant Activities (Scope of Work):

“2.1.3. Schedule: The PERFORMING PARTY shall complete this task within 13 months of the signed Notice to Proceed Date as issued by TCEQ.”

Completion of this task took entire time for project deliverables. In addition to underestimated regulatory complexity of the project itself, the EPA being understaffed cause delays. After arranging a face to face meeting with assigned EPA personnel the significant progress has been made resulting in verification application submission and informal approval to proceed with system durability and emission testing.

Deliverables:

From the Grant Activities (Scope of Work):

“2.1.4. Deliverables: The PERFORMING PARTY shall submit a report to the TCEQ upon completion of this task. This report will include but is not limited to the final EPA approved verification test plan.”

Task 1 has been successfully completed where verification test plan approval (Appendix A) has been received via email from EPA on February 20, 2013. Confirmation of such approval can be provided by EPA Julie Hawkins at (202) 343-9072.

Discussion/Observations

Objectives vs. Results

The objective was to obtain EPA approval of a verification test plan within 13 months of NTP. This was only achieved within 21 months and is now considered complete.

Critical issues

Due to the shortened timeframe for the remaining tasks, much of the preparation work is already complete to ensure the grant work will be complete by the May 31, 2013 deadline. The urea-SCR system for aging has been built according to requirements of the test verification plan. The second urea-SCR for degreening is scheduled for production first week of March 2013 and will be completed well in advance of the end of the aging process on the first unit. Once the second unit has been built, Task 2 will be complete. Task 3, durability testing, will begin as early as March 1, 2013, and will progress on an accelerated twenty-four hour a day, seven days per week basis. This will result in the 1000 hour aging process completed in approximately 45-50 days allowing for functionality testing and engine maintenance every 250 hours. Degreening of the second system will be completed approximately three to four days later.

Task 4, Verification Testing, has already been arranged and confirmed with Environment Canada. The verification test engine is onsite and ready for testing. Testing and creation of the verification test report should be complete within XX weeks of the start of testing.

Table 1 – Remaining Tasks Timeline

Day #	Estimated Date	Completed Activity
50	April 19	Aging of First SCR system complete (Task 3)
53	April 22	Steady State Testing of Aged System Complete (Task 3)
54	April 23	Degreening of Second SCR system complete (Task 3)
55	April 24	Steady State Testing of Degreened System Complete (Task 3)
55	April 24	Both SCR systems shipped to Environment Canada (Task 3)

57	April 26	Both SCR systems received at Environment Canada for testing (Task 4)
??	May 10	Verification testing complete (Task 4)
??	May 17	Verification test report received from Environment Canada (Task 4)
??	May 24	Completion of Final Report (Task 5)

Technical and commercial viability of the proposed approach

Based on experience with previous urea-SCR systems and tested performance on transient engine applications, it is expected that SCR performance for stationary applications will be extremely good, reaching 85%+. Substrate sizing has been done so as to meet the warranty requirements of the industry so performance after aging should remain high.

Stationary diesel applications (generator and non-generator) in the US are estimated at 900,000 units with approximately 49% of those in the targeted engine power range of 149 – 1000 hp. At this time, no other systems have been verified by the EPA for NO_x control of diesel-powered stationary sources. The verification will cover a broad range of applications from stand-by to prime generators, mobile and stationary, pumps, and compressors. Technical system challenges have been successfully achieved. Modular design of the system allows for mass production meeting any market demand.

Scope for future work

Future work includes:

- Build the second urea-SCR system for degreening purposes;
- Complete the aging and degreening processes for both units and complete Steady State testing prior to shipping the SCR systems to Environment Canada; and
- Weekly communication with Environment Canada on our aging/degreening status as per request due to engine already being secured at their test cell.

Intellectual Properties/Publications/Presentations

None

Summary/Conclusions

Task 1 has been successfully completed where verification test plan approval has been received from EPA. It is imperative that TCEQ allow Nett to precede the next tasks leading to the project successful closing.

Contact Information

For further information about this project please contact:

Wayne Moffat
Nett Technologies Inc.
Phone: 905.672.5453
Email: wmoffat@nettinc.com

Appendices

Appendix A: EPA Approval of Test Plan

From: Hawkins, Julie [mailto:Hawkins.Julie@epa.gov]

Sent: Wednesday, February 20, 2013 9:34 AM

To: John Popik

Cc: Ivan Luke; Ted Tadrous; kate.williams@tceq.texas.gov; jwang34@gmail.com

Subject: Nett 300D Testing Plan

John and Team,

With regard to the Nett 300D Test Plan, which is attached, EPA has approved it for verification purposes. However, EPA reserves the right to request Nett for any modifications at any time, including the suspension of testing if needed.

Nett is required to communicate with the EPA as well as any third-party stakeholders regarding the progress of testing and durability. Nett may not make changes to the any part of the testing without EPA's approval. Lastly, Nett is fully responsible for all parts of the testing and results.

Thank you and feel free to contact me with any questions and/or comments.

Sincerely,

Julie Hawkins

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Office of Transportation and Air Quality
United States Environmental Protection Agency
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Appendix B: EPA Approved Test Plan