Schedule A

Executive Summary

In 2006 PTAC undertook a study to quantify and validate the REMVue AFR system on large (over 800 HP) natural gas engines used in the upstream natural industry with respect to fuel savings, emission reductions, reliability and return on investment (ROI). . The positive results of this PTAC project enabled industry to understand the benefits of implementing the REMVue AFR technology. In the last 5 years, industry has installed a large number of lower horsepower, (LHP), (100 to 800 HP) engines in the upstream sector. New regulations and financial penalties associated with facility emissions are forcing industry to take a closer look at its greenhouse gas (GHG) and energy foot prints for all of their operations. Through PTAC, industry is undertaking the demonstration and validation of a series of projects that will quantify and evaluate the REMVue AFR system on low horsepower (LHP) engines. Theses projects will look at fuel savings, engine reliability improvements, maintenance cost improvements, GHG and regulated emissions reductions and return on investment (ROI).

This project is proposing multiple LHP engine models within this study: The largest population of LHP engines installed in the field consists of Waukesha H24 and F18 lean burn models, as well as Caterpillar 3300 and 3400 rich burn models. The project is divided into two phases. Phase I will install and validate the operational performance and benefits of the REMVue LHP systems. Phase 2 will evaluate each engine post LHP system install for fuel consumption, load map testing, dynamic operation, and GHG (e).

$188K Technology Application - to purchase, provide and install 4 REMVue LHP systems, at the cost of operating company installing REMVue LHP for validation. Installation is estimated at $32K/unit. RTI will contribute $60K in one SlipStream® Technology installation and services . The SlipStream system will be installed on the ConocoPhillips unit.
$50,000 – for post-optimization audit and Final Report.
$6,000 - PTAC Facilitation Fee

REM Technology (RTI) as part of their in-kind contribution has agreed to evaluate and test a version of their SlipStream technology that would be suitable on one of the LHP test engines to evaluate the additional fuel savings and GHG reductions possible.

To speak to the anticipated benefits of the REMVue LHP system, the following is a list of expected benefits:

- fuel savings
- GHG(e) reductions
- Reliability improvements
- Engine performance improvements
- Maintenance cost reductions
- Reduced manpower for unit monitoring
- Built-in trending, data log, communications and SCADA functions

Background

REM Technology has for several years successfully delivered their engine management systems for **Air-Fuel-Ratio (AFR)** control for large engines (> 800 HP) for the purpose of reliability improvement and economic efficiency gains in "converting rich burn engines to lean burn" as well as enabling new lean burn engines to handle "hot fuels". REM Technology has recently developed a new system referred to as "**REMVue LHP**" that leverages existing REMVue AFR and SlipStream technologies and incorporates newly

developed technology for low horsepower engines. It is estimated that over 5,000 low horsepower engines have been installed as field booster units in the past 10 years in Western Canada in the upstream oil and gas sector. Since more than 90% of these engines do not have modern fuel management and also use instrument gas pneumatic systems there is a substantial opportunity for **reductions** in fuel consumption , GHG emissions, maintenance costs and **increases** in reliability and performance in these LHP units. Although we do not have accurate numbers for fuel gas usage for these small engines, in 2006 a PTAC report entitled "**Emissions and Efficiency Enhancements with REM AFR Systems**" identified that in Western Canada, Waukesha and Superior engines >600 HP alone consumed $1 B/yr in fuel (@$6/GJ).

Project Scope

The overall purpose of this project is to verify and summarize the results of the REMVue LHP system across multiple engine models at various sites. Converting two of each model number with the LHP system improves data accuracy and validation results. The REMVue LHP system offers unique opportunities for economic and environmental benefit a well as maintenance and reliability improvements for the operating companies.

This project is proposing to move forward with the validation of four field pilot installations and the summarization of these results in a final report. Three operating companies installed the LHP system on the target engines models to spread out the cost and to provide a variety of operating conditions under which the system can be evaluated.

The system performance will be assessed against an engine load map with at least three operating points per test. Along with the observed primary fuel gas offset achieved by the LHP system, exhaust gas analysis will be conducted for each operating point and well as gas samples to evaluate the GHG (e) reduction. The system will also be evaluated to test the capability of the REMVue LHP to dynamically manage the operation of the engine over a variety of typical operating conditions. In order to evaluate the reliability and maintenance cost improvements, it is proposed that:

1. Phase 1 will evaluate each engine prior to the LHP system install for:
    a. Fuel consumption
    b. Load map tests
    c. Dynamic operation
    d. GHG (e)
    e. Reliability history
    f. Maintenance history including frequency and cost of head swings, oil changes spark plugs etc.
2. Phase 2 will evaluate each engine post LHP system install for (a thru d) above and a report will be generated by RTI.

Typically, the capital cost to purchase, provide and operate the system is at the burden of the operating company and the cost of validation is shared amongst the project sponsors as a collaborative effort to share in the learning's of the validation. The learning's are typically held back for a period of 1 year within PTAC and the sponsors to enable them to take advantage of early action. The operating company participating in the installation of the project is said to be a participant with their in-kind contributions of capital expenditure.

It is anticipated that following the execution of the four demonstration projects, industry will see the value in the technology and more readily execute further installations.

Pilot Validation Work and Industry Impact Assessment

The pre-qualification to this proposal expects that as each pilot project is commissioned that REM Technology Inc. as the system vendor will be conducting their own system performance validation within the scope of each system delivered for the respective operating company. As each system is considered to have been fine tuned and ready for turn-over, phase 2 work will commence

Deliverables

- Validate field data results to substantiate system performance.
- Validate exhaust gas evaluation to ensure adequate excess oxygen is present to deliver clean combustion.
- Ensure load mapping of the engine and system is conducted as part of the system performance validation. Depending on the operating parameters of the system at least 3 points should be included in the load mapping, one at the maximum load available to be put on the engine and a second at minimum load.
- Perform load map test points at lowest NOx in addition to the three load map test points at lowest fuel consumption.
- Data dissemination (pre-REMVue vs lowest fuel + pre-REMVue vs lowest NOx) at test point per site
- Collect data and present findings on each pilot as it is commissioned and delivered.
- Roll-up a final report on all systems commissioned to date.
- Conduct and deliver a comparative analysis of the results post installation of the technology on all of the test engines in this study.
- Project deliverables are comparison, discussion and summary of the technology as it was applied to all engines in the study plus that required for the final report presentation.

It is anticipated that as each pilot is commissioned that the project performer will require no more than 2 days at site.