**Specification for the Selective Catalytic Reduction (SCR) System for NOx Reduction on Natural Gas Engine(s)**

1. Supplier to provide an SCR system to reduce the NOx exhaust emissions of each engine to meet a minimum of 0.3 g/bhp-h (or other limit as per local regulation) at steady state when the engine, a (engine OEM & model #) is at full load.
2. The SCR reactor shall include an oxidation catalyst to achieve the following NMHC and CO engine emissions:
   1. CO (Carbon Monoxide) to 2.6 g/bhp-hr
   2. NMHC (Non Methane HydroCarbons) to 0.14 g/bhp-hr
3. The catalyst shall be guaranteed for a minimum of 16,000 run hours and shall be capable of long term extended operation from the 60%-100% engine load points.
4. SCR system to include an optional method/means of silencing exhaust to the equivalent of a hospital grade silencer – to be specific there shall be a minimum noise attenuation of 35 dBA. The silencing method/means must be contained within the same physical housing as the SCR to minimize space and installation.
5. Under no circumstances should the SCR system be placed downstream of a silencer with absorptive acoustical material. Any additional silencers should be placed downstream of the SCR.
6. Additional Spaces: The SCR housing will be manufactured with room to add one additional row of NO(x) reduction catalyst elements
7. Access: The interior of the SCR shall be accessible by removing a side panel, and the panel shall be supported by installed crane or hinged doors, without needing hoisting equipment.
8. Housing integrity: The housing shall be reinforced to withstand all normal conditions of pressure and temperature with reasonable allowance for excursions of pressure and temperature.
9. The SCR system shall utilize Closed Loop control with solid state NOx sensors both upstream and downstream of the SCR catalyst to provide NOx reduction performance throughout varying engine loads while minimizing ammonia slip. Solid state sensors shall be used to ensure fast response times and durability. In addition, the downstream NOx sensor shall be situated in a way that allows the sensor to analyze several sample points (minimum of 5) at different locations in the same plane normal to the exhaust flow.
10. All SCR electronic controls and urea injection equipment shall be housed in a single NEMA 12 panel no larger than 30” H by 30” W by 8.5” D. The control and urea injection panel will be equipped with an industrial grade urea injection pump system for maximum reliability and precise control. The control system shall provide a Modbus TCP/IP interface so that emissions data can be transferred to the customer’s Building Automation System (BAS).
11. The system shall have the capability to provide remote monitoring and diagnostic capabilities through a built in Ethernet port and GSM modem. The remote monitoring capability shall provide the Vendor or facility owner with access to the system so that any alarms and associated trouble shooting can be done from a central location. The remote monitoring system will provide real time data, and access to historical emissions data. It shall be possible to view the data as trend charts using a normal internet browser.
12. The system controller shall be industrial hardened and capable of operating from 0oF - 140oF. In addition, it shall have at least 256 MB of RAM and 1 GB of solid state storage available for historical logging. The controller also requires at least 1 GFLOPS of computational power/performance so that catalyst reaction kinetics can be accurately modeled in real time.
13. All sensors will be pre-terminated to a single junction box located on the SCR reactor for the purpose of easy wiring. Communication Cables shall be used to transfer all sensor signals between this junction box and the SCR control panel.
14. The SCR shall be designed to operate with commercially available Diesel Emissions Fluid “DEF” as reagent and shall not exceed the Vendor warranted DEF flow rate by more than 20% at 100% load. The dosing panel, tanks and lines with urea must be protected from freezing
15. For container mounted SCR reactors, for worker safety while maintaining instruments or other components, the Supplier shall provide an integrated Work Restraint System that allows up to two (2) workers to attach Fall Restraint harnesses to the reactor. This Work Restraint System shall be capable of supporting a force of up to 4kN.
16. The SCR reactor shall be constructed from Stainless Steel. In addition, the SCR reactor should include a minimum of three (3) inches of mineral wool insulation and aluminum cladding to reduce thermal losses in the engine room. If installed outdoors the SCR shall minimize water intrusion in the insulation.
17. The reactor shall be compliant with seismic Zone 2 standards. The reactor shall be manufactured with no less than 10 gauge, 409 stainless steel material.
18. SCR system components for each engine shall be fabricated so that the SCR system can be mounted from the ceiling or can be floor mounted to minimize space and reduce construction costs. It shall be possible to configure the system for bottom entry, top exit or end entry with top exit. The unit shall be structured in a cube shape so that the mixing duct and reactor are packaged within the cube.
19. As an option the Supplier shall supply a urea storage system to be sized based on a minimum of 14 days of full load engine operation. The Urea storage system shall be provided complete with:
    * A pre-engineered external wall mounted fill station to allow a bulk truck to fill the urea storage tank(s). Fill station to be stainless steel, lockable and include high level alarm light and operator instructions in lamacoid signage.
    * If required, a pre-engineered urea booster pump system to transfer urea from the storage tank to the Urea Injection system associated with each SCR shall be provided. Where a shared booster pump is used to supply more than 1 engine it shall be a full-duplex type, such that the failure of a single urea booster pump does not affect more than one (1) Urea Injection System
    * Main urea storage tank to be equipped with level measurement, leak detection and alarm
    * If required, heat tracing and insulation will be provided for the urea tank to prevent urea from freezing.
20. The services to be provided by the supplier under this section to include but to not be limited to the following for a complete and satisfactory operating system including the SCR system.
    1. Shop drawings, fabrication and assembly as per "reviewed" shop drawings.
    2. Interface control wiring diagrams, schedules and wire running lists between all components
    3. Witness testing procedure to be submitted as a shop drawing for review by the Engineer. Witness testing shall include test equipment and testing to verify performance of the system.
    4. Delivery schedule
    5. Provide technical staff for supervision of site assembly, installation of power and control cable connections, installation and connections, and all other work normal to the M & E trades.
    6. Include site testing, calibration and commissioning, site testing and supplementary witness testing using permanent load bank. Witness testing procedure to be submitted as a shop drawing for review by the Engineer. Handling, installation, to be by the Installation Contractor.
    7. Providing technical staff and manuals for field training of Owner's staff in the complete operation of the system.
    8. Warranties to guarantee the reduction of emissions to the specified levels
    9. Services of a technical representative as required by the Owners to review production schedule, delivery dates, shop drawing changes, shop and field testing and training programs.
21. Unloading, hoisting and setting into place, and work normal to the electrical, mechanical and millwright trades such as providing interface power and control wiring to terminals within the equipment components, piping & ductwork, and installation of major components to be done by the Installation Contractor.
22. Materials and parts comprising the system to be new, of current manufacture, of a high grade and free from all defects and imperfections.
23. Tests shall be conducted, one engine at a time at varying loads up to full load on a third party supplied load bank.
24. Verified test results shall be provided to the Engineer for submission to the environmental authority having jurisdiction for final acceptance.
25. The SCR system for each engine shall include for all the components, engineering services, field assembly drawings, on-site technical services as long as required by the eventual contractor in assembling the system and initial testing, commissioning, training, operating and maintenance manuals (part of base bid).
26. Include for one (1) year full warranty and verification of SCR performance prior to the expiry of the warranty, and a 2-year prorata warranty of the SCR catalyst in the reactors.
27. **Reference Supplier**

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