

ATTACHMENT A
TECHNICAL SPECIFICATION

Technical Specifications

for

Primary Hydrogen Sulfide Treatment System

Dane County Renewable Natural Gas Plant

Revision #	Initials	Date	Comments
0	MW	9/1/22	First draft
1	MW	9/7/22	Significant progress and updates
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1 Introduction

1.1 Summary

Dane County is inviting Proposals for the fabrication and delivery of a new primary hydrogen sulfide treatment system (hereafter referred to as the “**Equipment**”) at the Dane County Renewable Natural Gas Plant (hereafter referred to as “**RNG Plant**”). The new Equipment includes but is not limited to process piping, mechanical systems, electrical systems, controls, and supporting structures. The new Equipment will replace an existing biological treatment system and will be owned and operated by Dane County RNG Plant staff.

The word “**Vendor**” in this specification shall mean the designer and the manufacturer of the Equipment. If the Vendor purchases any components from other suppliers or has any fabrication work performed by others, then it is the Vendor’s responsibility to ensure compliance of those components with the requirements of this specification.

The word “**Engineer**” in this specification shall mean Dane County project team member or authorized representative of Dane County.

2 Vendor Scope of Work

2.1 General Requirements

2.1.1 Description of Work

This specification establishes the minimum requirements for the engineering, design, materials, fabrication, testing, quality assurance, packaging, preparation for shipment, and performance guarantee of Equipment and shall include, but not limited to, major equipment and auxiliary equipment / accessories described as follows:

1. Gas process piping, tubing, valves, and pressure vessels
2. Liquid process piping, tubing, and pumps
3. All required instrumentations and controls
4. All required pneumatic tubing and wiring on skid, with connections to bulkheads or terminal strips at skid edge
5. Control panels
6. Structural skid and all required structural steel
7. Any special tools required for maintenance
8. All piping and vessel insulation and cladding where required. Insulation cladding, where required, shall be smooth.
9. Training and startup commissioning services
10. Storage and delivery services
11. Vendor will be required to provide associated documentation for Equipment, including, but not limited to:
 - a. O&M manuals
 - b. As-built drawings
 - c. Startup and testing procedures
 - d. Weld inspection and testing records

All work and materials not expressly listed in this specification, but necessary for the complete and proper installation, maintenance, and operation of the equipment, other than the work specifically listed under Section 2.1.2 shall be supplied by the Vendor.

Vendor shall be responsible for the supply of new, safe, reliable equipment designed to meet the anticipated service conditions, in accordance with what is normally defined as good engineering practice, conforming to all applicable codes, regulations and requirements set forth in this specification.

All equipment shall be new and recent manufactured in accordance with the latest applicable codes / manufacturer's association standards and the best present-day design and trade practices.

The vendor shall provide an itemized list of clarifications and exceptions with reasons with proposal submission.

2.1.2 Furnished by Dane County

Dane County shall furnish the following associated items and work:

1. Unloading at the jobsite
2. Foundation pads or piles
3. Traffic protection bollards

4. Field installation labor, materials, and supplies
5. Supply and installation of interconnecting piping external to the equipment boundaries
6. Pipe racks external to the skid boundaries
7. Electrical power supply and wiring external to the equipment skid boundaries
8. Grating and walkways not mounted directly to equipment skid
9. Connections and anchors between equipment skid and foundation
10. Equipment makeup water supply (as required)
11. Sanitary sewer connection (as required)
12. Instrument quality air supply (as required)
13. Fuel gas (as required)
14. Demolition and removal of existing treatment system
15. Permits required for installation and operation of Equipment

2.2 Technical Requirements

2.2.1 General

2.2.1.1 Conditions of Service

The Equipment shall be designed, sized, and manufactured for full load duty on a continuous basis. All Equipment shall be installed outdoors and shall be suitable for ambient conditions described in Section 3. Vendor to determine any requirements for insulation, heat tracing, or enclosures based on ambient conditions.

Equipment shall be utilized under varied process conditions and shall be adaptable to conditions with minimal changes to equipment and controls. Equipment shall provide continuous operation without manual adjustment through range of process conditions as specified in Section 3.

All equipment, components, and devices shall be new and unused condition. They shall be selected and installed within range of the manufacturer's specifications.

2.2.1.2 Safety Features

Instrumentation and devices used in process and emergency shutdowns must be testable in the field for function and calibration; including automated isolation valves and process gas instrumentation. Where specific Equipment procedures or devices are required for testing, those shall be documented and supplied with Equipment.

The shall be capable of interconnecting with two externally mounted ESD device such as a button, fire detector, or gas detector providing circuit opening switch action.

2.2.1.3 Noise Levels

Equipment shall operate at noise level less than or equal to 85 dba at a distance 15 feet throughout full range of operating conditions. Noise level shall be less than or equal to 85 dba at a distance of 15 feet during factory acceptance test.

2.2.1.4 Accessibility

Accessibility shall be considered in design and construction in order to maximize safe, reliable human performance by treating the human (operator, maintainer, or other supporter of the facility) as integral and central to the system. Important objectives shall include:

- Ensure that human-machine and other human-system interactions are properly considered and addressed in design
- Ensure that all operable components, including valves, instruments, controls and displays can be viewed, understood, reached, and operated effectively and safely by personnel.
- Ensure that equipment and layout allow for safe and efficient routine and non-routine maintenance tasks, with due consideration for human capabilities, health, and safety.
- Ensure that all areas of the facilities can be accessed and evacuated safely and efficiently under normal, adverse, and emergency conditions. Ensure layout allows logical and efficient access for routine operator rounds and field personnel.
- Ensure safe design and construction of platforms, walkways, stairs, ramps, ladders, and other mechanisms used for translation. Ensure that access to work areas and equipment is based on task analysis of required operations, maintenance, and inspection activities.
- Ensure that requirements for lifting and lowering, in addition to holding and moving equipment, goods, and materials both manually and mechanically have been put in place to minimize risk to workers.

The following general requirements shall apply:

1. All work areas shall provide safe and efficient access and egress for operations, maintenance, and inspection activities over the range of normal, adverse, and emergency conditions.
2. Critical and frequently accessed equipment, including valves and instrumentation, should be accessed from walkways or access platforms wherever possible.
3. Stairs are preferred over ladders for safety and ease. Access to elevated platforms and equipment should be via stairs where possible. Ladders shall only be selected where stairs are impractical. Task and risk analyses must support the use of ladders instead of stairs.
4. Stairs shall be provided where task analysis indicates that stairs are essential for safe execution of operational or maintenance tasks. This requirement applies to any task and platform where manual sampling and handling is required monthly or more frequently.
5. Stairs shall be provided where access is required for routine operational checks and where personnel are required to gain access monthly or more frequently.
6. Manual lifting of any load up or down ladders shall be minimized, and shall not be permitted without specific Dane County approval. Where manual lifting is deemed inappropriate, means for mechanical lifting aids shall be considered, such as A-frame hoists, forklifts, or overhead gantry cranes.
7. Work platforms shall be provided wherever personnel are required to use two hands to perform at a task. Exceptions to this rule shall require specific approval, and if accepted, shall include provision of the appropriate fall arrest harness attachment points.
8. Effective fall protection shall be provided on stairs and ladders, and on permanent platforms higher than 4 feet.
9. Piping and cabling traversing walkways and access routes shall be routed either below or above the walkway. Commercially available, listed, and installed cover systems are allowable to place items below walkway.

10. All walkways, access ways and work areas shall be self-draining and designed to eliminate potential for standing water and snow accumulation, and they shall be slip resistant.
11. Abrupt elevation changes in walkways and access ways, regardless of dimension, which may pose trip hazards shall be avoided.

2.2.2 Mechanical Systems

2.2.2.1 *General*

1. All supplied piping systems shall be designed, tested, and fabricated in accordance ASME B31.3 and applicable standards listed in Section 6. Where conflicting, the more stringent requirement shall be required.
2. All valves, filters, gauges, sensors, and other end devices shall be identified on drawings and have corresponding identification on securely attached stainless steel markers or tags.
3. The Vendor shall furnish all on-skid piping and valves associated with the Equipment and the specified auxiliaries. All instruments except those directly mounted in the line (i.e. thermometers in thermowells) shall be provided with individual shutoff valves.
4. All filter, drains, and manual vents shall include a multi-turn valve.
5. Gas pipe and tube shall be designed according API RP 14E for velocities for specified process conditions. This requirement shall not apply to valves, meters, and components other than pipe and tube.
6. All gas process, liquid, and instrument air tubing shall be at least 0.375 inches in diameter. Tubing lines within continuous enclosed protection shall be exempt from this requirement.
7. Insulation for personnel protection shall be included on piping operating with surface temperatures over 140°F. Bulkheads, panels, or other surfaces challenging to insulate shall include conspicuous “Caution Hot Surface” labelling.
8. Electrically actuated solenoid valves shall be ASCO or preapproved alternative. Solenoids shall be rated for continuous duty for ambient design conditions.
9. Sintered metal vent plugs are not acceptable on actuators exposed to external weather. Where exposes, vents shall be plumbed with screens to protect from external icing.
10. All piping and tubing shall be rated or approved for the material, pressure, and temperature they may be exposed to during normal and abnormal operation. This includes process deviations within independent safety layer operation (i.e. pressures up to PSV setting, temperatures up to thermal safety switch).
11. Butterfly valves used in both gas and liquid service shall be installed according to manufacturer’s recommendations or industry best practices including for stem orientation.

2.2.2.2 *Gas Piping and Tubing*

1. Existing process gas connections in the anticipated install locations shall be 12 inch or 18 inches ASME B16.5 class 150 raised face flanges. Equipment shall match existing process line class and size at equipment boundary.
2. All gas pipe, tubing, and fittings shall be stainless steel.
3. Fittings in seamless stainless steel tubing service shall be Swagelok compression type, or approved equivalent. Both fittings and ferrules shall be stainless steel. Stainless steel tubing shall be fully annealed and care taken to ensure that tubing is fully bottomed and fittings correctly tightened.
4. Steel pipe flanges, flanged valves, and fittings shall be in accordance with ANSI B16.5.

5. Minimum test pressure for pressure piping shall be at least 110% of the design pressure. Test pressure of systems shall not exceed 50% of the specified minimum yield strength.
6. All piping prior to shipment shall be pressure tested at manufacturer's facility at for a minimum of one hour. Testing records including but not limited to test log, charts, and calibration records shall be provided in document package and approved before shipment.
7. Suitable means shall be provided for simplified on site hydrostatic testing. This shall include at a minimum:
 - a. Blinds, spacer, slip blinds, or other means to isolate ASME vessels and pressure control valves
 - b. Low point drains and high point vents of adequate number and location to facilitate testing
 - c. Jumper tubing, spools, or other components to allow testing Equipment once installed
8. Non Destructive Examination (NDE) for process gas pressure system shall be in accordance with ASME B31.3. And additionally:
 - a. Butt-welds and socket-welds shall be 10% radiographic tested (RT)
 - b. Welds too small for RTO shall be dye penetrant or magnetic particle tested
 - c. After any radiographic testing failure, only a single attempt may be made at the repair; if the repair fails NDE second time a full cut out is required
9. Low point six o'clock positioned connections should be avoided in horizontal pipe runs. Where required for fabrication, such connections shall be plugged and include accessible and usable valve.

2.2.2.3 *Liquid Piping and Tubing*

1. Liquid piping and tubing shall be selected and appropriate for full range of possible process conditions including known failure modes of equipment, instrumentation, and operator control.
2. Pumps shall have visual analog gauge or transmitter display locally for both suction and discharge pressure. And shall include snubber valves for dampening and isolation.
3. Stainless Steel and CPVC are preferred materials. Use of PVC shall require Dane County approval.
4. Protections against chemical spray shall be included to protect equipment and personnel. Protections may include but are not limited to:
 - a. Spiral wound gaskets with compression centering ring should be used with raised face flange connections
 - b. Drip pans installed under flanges and valves over walkways, platforms, and work areas to contain leaks and channel to a safe location
 - c. Chemical spray covers installed around pressurized valves, flanges, stuffing boxes to contain potential leaks and sprays
 - d. Equipment controls should be located that any employee operating them is not be exposed to, or contacted by, the hazardous substance(s), and if doing so is not feasible, then adequate shielding shall be provided to prevent exposure
 - e. The design and installation of sample stations should prevent exposure to temperature, pressure, corrosive substances and other hazards
5. Pumps shall include adequate break flanges to facilitate maintenance and hoisting activities.
6. For horizontal pumps where process, safety and layout constraints allow, pumps should be oriented with motor end towards the access way for ease of maintenance and hoisting access and to reduce risks associated with leaks.

7. Pumps manual start/stop or disconnect shall be located such that they have a direct, unambiguous, and obvious spatial relationship to the controlled pump.
8. Vertical filters requiring regular element change out shall be easily accessible and shall preferably be located toward the periphery of skids or equipment packages.
9. Filters and other pressure vessels containing filter elements that have to be removed and replaced shall provide a minimum horizontal clearance of 30 in. (.75 m) from the required filter change out access location(s).
10. For large filters, access shall be required at various points around the filter body for access to flange bolts and to allow safe and comfortable working postures during filter change-out activities.
11. The top of the filter body which the filter element must clear should be between 36 in. and 43 in. above the standing surface, where practicable.
12. Elevated work platforms may be provided to meet accessibility requirements.
13. Access platforms shall not impede access to valves or to adjacent equipment items.
14. For covers weighing 35 lbs. (16 kg) or less, handles shall be provided.

2.2.3 Electrical Systems

2.2.3.1 *Electrical Panels and Related Equipment*

All panels which can exceed the design condition of the wiring or internal components shall be equipped with heaters and/or coolers as required to meet the service conditions. All panels shall open horizontally. Panels shall not have top penetrations. Bottom penetrations are preferred. All conduit penetrations shall be installed using weatherproof hubs. Penetrations through sheet metal enclosures shall be made using a knockout tool.

Any special requirements for the installation of the electrical equipment shall be identified in the proposal. Electrical assemblies, configurations, and equipment shall be provided as submittals for review and approval during design review process.

2.2.3.2 *Cable, Conduit, and Grounding Systems*

Electrical packages shall be electrically continuous for the purpose of grounding. A minimum of two grounding lugs shall be provided on each package or skid at opposite ends. All metallic components supplied shall be securely bonded to the frame by mechanical means or bonded by using insulated (green), stranded, copper cable of AWG 2/0 or larger. All wiring shall be routed in UL approved rigid metallic conduit. Seal-offs are required on all conduit runs into the control boxes and shall not be poured until after commissioning.

The Vendor is responsible for installing all conduit, conduit fittings, junction boxes and associated supports to complete the conduit runs in accordance with NFPA-70 (NEC).

Conduit shall not be routed in a manner such that it interferes with walkways, hatchways or access to equipment requiring maintenance.

All wiring shall be installed in compliance with National Electric Code, hot-dipped galvanized conduits or utilizing overhead cable tray are preferred. Conduit shall be restricted to trade sizes of ¾", 1", 1-1/2", 2", or 4". Individual devices may be fed by ½".

Conduits shall be supported at distances not exceeding the maximum specified in the applicable codes. Conduits shall not be supported from piping or equipment. Accessories or other structures used for conduit support in outdoor locations shall be constructed of either stainless steel or hot dipped galvanized steel per ASTM A123. Steels which are pre-galvanized zinc ASTM A525 or electro-plated zinc ASTM B633 shall not be used outdoors.

Raceways shall not be relied upon as a grounding conductor. Circuits used for power utilization shall include a separate grounding conductor. Vendor shall comply with special bonding requirements for hazardous areas as listed in NEC Article 250.98. Liquid tight flexible conduit with metallic core may be used sparingly subject to the limitations of this raceway in hazardous locations as listed in the NEC Article 501.30. It shall not be relied upon as a grounding conductor and shall not be used in lengths exceeding 5 feet.

Conduit seals shall be installed in an accessible location for pouring and inspections by Engineer after equipment commissioning. Conduit seals shall be installed in hazardous areas within 18 inches of solenoids, transmitters, I/P's, or junction boxes containing arcing equipment. Seals shall also be installed at all conduit entries to purged enclosures. Alternate means of sealing may be proposed by the Vendor and used if acceptable to Engineer.

Each conductor shall be identified with a destination label where it lands at a terminal strip at the other end. The destination label shall include a device-terminal strip-number sequence and shall be consistent with the wiring Drawings. Identification label shall be in the form of a pre-printed adhesive marker. Color coded wire shall not be used as the sole conductor identifier.

2.2.4 Instrumentation, Controls, and Safety Systems

Terminal strips shall be labeled consistent with the design drawings. In addition, every terminal block shall receive a unique designation and marked accordingly using marking assemblies supplied by the terminal strip manufacturer. Terminal strips shall be secured using TS35 Din rail. Separate terminal strips shall be used for 120 VAC and DC circuits. Wiring of different types or voltage levels shall not be run in the same conduits.

Grounding for shields etc. shall be accomplished using 10x3mm copper tinned busbar with support blocks or ground blocks.

2.2.4.1 Unit Control

The equipment shall include Allen Bradley CompactLogix 5370 L3 controllers and 1769 series modules for process control. Control system shall include UPS system providing a minimum of 20 minutes of continued operation of PLC controls and instrumentation after power outage. HMI and control system shall provide the following at a minimum:

1. User authentication required to modify operational settings
2. Display operational data, status, and control of operating modes
3. Alarm log view and acknowledgment
4. Remote monitoring and control functions via customer supplied Ethernet connection to internal local area network
5. Lead-lag, start-stop controls for all duplicated parallel motors, blowers, compressors, or process trains
6. Remote and local operating mode control

HMIs exposed to environment shall include a UV resistant, sunlight light readable touchscreen; and include a collapsible screen cover.

Each PLC processor or point I/O rack shall provide the greater of 2 points or 10% sparing for each I/O type.

PLC program shall be backed up locally to SD card. Program shall be made accessible to Dane County after time of commissioning with separate liability release and agreement.

2.2.4.2 Instrumentation

1. Each Pressure Instrument or Gauge shall include a root valve and bleed valve to facilitate field calibrations and adjustments.
2. Instruments shall have field displays, and a means to field calibrate, either through the glass or pushbutton.
3. Thermowells shall be stepped / fast response type.
4. Pressure gauges shall be Stainless Steel, bottom mounted, blowout proof, and minimum 4" Diameter
5. Control valves shall be fail-safe, spring closed and installed so each valve can be easily removed for service.
6. Valves shall offer bubble tight shutoff at both high and low differential.
7. Valves in primary gas and liquid process line shall be installed via mechanical means, readily removable for service and rebuild.

2.2.4.3 Safety Systems

Pressure Reliefs

1. Relief devices shall protect all ASME vessels and piping. They shall be Mercer or preapproved alternative and rated for the maximum working pressure of protected equipment or lower.
2. Relief valves shall be new and certified within 6 months of install date.
3. Relief devices shall be sized and installed as per API RP 520, as applicable above 15 psig. Sizing calculations shall be submitted with documentation package deliverable.
4. Relief devices shall be ASME certified with permanently stainless steel labels or tags.
5. Relief devices on ASME vessels shall be sized for external fire exposure.
6. Relief devices shall be installed with unobstructed identification labels and directly removable for service.
7. Rupture discs shall not be used on any gas or lubrication systems.
8. Any installed rupture disk shall be metallic type, with external data tag, and removable for replacement.
9. Process gas relief vents shall terminate at least 15' from grade and include supports if required.
10. Liquid service relief vents shall terminate in such a manner to prevent injury or inhibit functioning of equipment.

Flammable, Toxic, and Fire Detection

1. Fixed gas detectors shall be Honeywell Sensepoint XCD for both methane and hydrogen sulfide detection.
2. Gas detectors for both constituents shall be located inside enclosed non-hazardous control area and within any enclosed hazardous classified area.

3. Gas detectors located over gas process pipe area shall include integral switching relay triggering ESD during trip alarm trip.
4. Detection equipment shall be centrally located at roof. If location prevents ready access for
5. Gas detectors shall warn at 20% LEL and Alarm Trip at 40% LEL.
6. Rate of rise heat detector shall be installed in non-hazardous control areas and shall trigger ESD during trip.

Emergency Shutdown (ESD) Systems

1. ESD systems shall be hardwire loop type and be able to function independently of process control system.
2. ESD systems, once tripped, shall remain off until manually reset by operator.
3. ESD system shall shutdown all blowers, pumps, compressors, motors, and related equipment. Ventilation fans are exempt from this requirement
4. ESD buttons, gas detectors, and rate of rise detectors shall trip ESD.
5. ESD triggering devices shall be individually addressed to control system and uniquely identified in local alarm banner. ESD buttons may use a common address and identification.

2.2.4.4 Facility Balance of Plant Integration

Equipment shall be integrated into existing Balance of Plant facility control and network scheme. IP address ranges used for Equipment shall be harmonized with existing facility to avoid conflicts. VNC or other remote access shall be provided for site operator to use from existing facility HMI.

2.2.5 Structural Requirements

1. A heavy-duty structural steel skid shall be provided. Skid shall be of sufficient strength for transportation and installation, and to transmit equipment-generated forces and couples to foundation.
2. Equipment shall be designed for vertical loading with crane without additional bracing or structural support.
3. Load bearing components shall be full depth members and of sufficient strength to prevent excess deflection that would damage installed equipment when the skid is moved or installed.
4. Equipment shall be mounted on load bearing components and shall be capable of being secured by bolting, grouting or sole plate rail mounting.
5. Provisions for shims shall be made where alignment is critical.
6. Provisions for installation of anchor bolts shall be integral to the skid.
7. Skid shall be of sufficient width and length for installation of equipment.
8. Supports and braces shall not be attached to unsupported floor plate.
9. Skids shall have ceiling mounted lighting and light switch to operate in accordance with Area Hazard Classification. Light level in enclosed areas shall be not less than 20 FC.
10. Enclosure openings shall utilize louvers and be screened to prevent animal and insect intrusion.
11. Roof penetrations shall be minimized and boots or covers shall be provided for each penetration.
12. Enclosure and roofs shall shed rain and support snow loads appropriate for local climate.

3 Process Design Parameters

Table 1 provides Equipment inlet gas design conditions as a range of each individual values and not a minimum or maximum loading condition (i.e. boundary condition for H₂S removal capacity). Vendor shall utilize best judgment to adequately design and size Equipment for range of H₂S loading as described

in Table 2 utilizing worst case conditions within ranges below as appropriate. Equipment shall be designed and capable to operate continuously at Minimum and Maximum edge cases and within expected ambient temperatures range of -15°F – 100°F.

	Units	Minimum	Nominal	Maximum
Landfill Gas Conditions				
Methane	mol %	45	50	55
Carbon Dioxide	mol %	35	40	45
Oxygen	mol %	0	0.25	1
Water	rh	Saturated		
Nitrogen	mol %	4	8	12
Hydrogen Sulfide	ppmv	1,000	5,000	10,000
Flow	SCFM	1,200	2,000	3,000
Pressure	PSIG	2.0	2.5	4.0
Temperature	°F	50	75	110

Table 1 - Equipment Inlet Gas Condition Ranges

Nominal conditions listed in Table 1 shall be used to answer detailed questionnaire presented in Appendix B for the purposes of estimated operating inputs, outputs, and costs.

Table 2 provides the minimum requirements for H2S loading conditions Equipment must meet or exceed. The proposed Equipment shall be capable of continuous online operation within the ‘Continuous Turndown Range’ condition envelop without degradation to removal performance, physical modification, manual operating actions.

	Units	Minimum Loading	Continuous Turndown Range	Maximum Loading
Landfill Gas Conditions				
Flow	mol %	1,000	1,400-2,500	3,000
Hydrogen Sulfide Inlet	ppmv	1,000	2,000-6,000	8,000
Hydrogen Sulfide Outlet	ppmv	<10	<10	<20

Table 2 - Inlet H2S Loading Conditions for Sizing Removal Capacity

3.1 Alternate Treatment Conditions

The process design parameter presented below are alternate process pressures existing in RNG Plant before and after existing treatment system. Vendors should evaluate suitability, summarize key Equipment changes, detail relative benefits or drawbacks, and provide lump sum net price (addition or subtraction) for each case below as an option. The alternate pressures available are intended to allow Vendors to provide best value solution and allow Dane County to evaluate impacts to site operations. Proposing systems to multiple Treatment conditions is not required.

Alternate 1 – Landfill Vacuum Collection

Alternate would place Equipment on the vacuum side of gas collection system to provide additional placement options.

	Units	Minimum	Nominal	Maximum
Landfill Gas Conditions				
Pressure	Inches WC	-50	-39	-20
	All other conditions the same			

Table 3 - Alternate Treatment Condition 1

Alternate 2 – Intermediate Compression

Alternate would place Equipment after intermediate booster blower compression

	Units	Minimum	Nominal	Maximum
Landfill Gas Conditions				
Pressure	PSIG	6	12	18
	All other conditions the same			

Table 4 - Alternate Treatment Condition 2

Alternate 3 – Treatment Compression

Alternate would place Equipment after compression to treatment pressure within RNG plant. Treatment pressure compression includes additional volume flows of recirculated sweetened gas that do not add additional H2S loading.

	Units	Minimum	Nominal	Maximum
Landfill Gas Conditions				
Pressure	PSIG	120	145	160
Hydrogen Sulfide	ppmv	1,000	3,500	8,000
Flow	SCFM	1,200	2,800	5,000
	All other conditions the same			

Table 5 - Alternate Treatment Condition 3

4 Alarm and Interlock, Sequence of Operation Requirements

A Cause and Effect Diagram, Control System description shall be provided by the Vendor for the Equipment identifying the control of the landfill gas, material inputs, and outputs. All interlocks, alarms, and shutdowns shall be identified on the Cause and Effect Diagram. The Vendor shall also include a detailed Sequence of Operation for the Equipment. These deliverables shall be reviewed and approved by Engineer before shipment.

5 Available Utility Service

Available utilities at RNG Plant are shown in Table 6. Additional utilities required by Equipment for regular operation or maintenance shall be listed and described in proposal response.

Electrical Power	60 Hz, 480V AC, 3 Phase, Delta-Wye Grounded
Instrument Air/Nitrogen	80 to 120 psig with a dew point of -40°F
Water	Municipal piped water
Wastewater	Municipal piped sewer

Table 6 - Available Utility Conditions

6 Applicable Codes and Standards

The latest edition and amendments of applicable codes, standards, and the latest regulatory requirements of where the equipment is to be installed shall be followed. Material and equipment labeled or listed by the Underwriter's Laboratories, Inc. (UL) or Factory Mutual (FM) shall be furnished where available. Table 7 is provided for guidance and is not exhaustive of all applicable codes and standards.

Codes / Standards	Description
ANSI B1.1	Unified Inch Screw Threads
ANSI B1.20.1	Pipe Threads, General Purpose
ANSI B16.5	Steel Pipe Flanges and Flanged Fittings
ANSI B16.11	Forged Steel Fittings, Socket-Welding, and Threaded
ANSI B16.25	Butt Weld Ends
ANSI B31.3	Process Piping Code
ANSI C2	National Electrical Safety Code
ASME BPVC VIII Div. 1	ASME Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels
ASME BPVC IV	ASME Boiler and Pressure Vessel Code, Section IX, Boiler & Pressure Vessel Code for Welding & Brazing
API RP 14E	Erosion Velocity in Piping Systems
API RP 520	Sizing, Selection, and Installation of Pressure-Relieving Devices
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NFPA Code 70-Article 500	Hazardous Locations
NFPA Code 70-Article 501	Hazardous Location (Class I Locations)

Table 7 - List of Applicable Codes and Standards

7 Quality Assurance

7.1 Quality Assurance Program Requirements

The Vendor shall always have a QA Program in effect which clearly establishes the authority and responsibility of those responsible for the QA Program. Persons performing quality functions shall have sufficient and well-defined responsibility and authority to enforce quality requirements; to identify, initiate, recommend, and provide solutions to quality problems; and to verify the effectiveness of the solutions. Submittal of this QA Program before executing purchase agreement is required.

Engineer shall designate a QA inspector. They shall be responsible be allowed to inspect, witness, and audit the work and documentation to ensure compliance with Dane County and regulatory requirements.

7.1.1 Vendor's Responsibility for Suppliers

The Vendor shall identify, in purchase documents to his suppliers, all applicable quality and QA requirements imposed by the specification on the Vendor and shall ensure compliance thereto.

7.1.2 Notification and Hold Points

Engineer shall have the right to establish notification points for which the Vendor shall give prior notification. In addition, Engineer may establish temporary notification points to ensure resolution of temporary quality problems. Notification points require receipt of notification at least 5 working days in advance of the scheduled time of performance. Engineer may require that activities performed without proper notification be repeated for Engineer's observation at the Vendor's expense. Engineer will witness the event or will authorize the Vendor to proceed without Engineer witnessing of the event. Expected Hold points include

- 30%, 60%, 90%, 100% design completion
- Factory Acceptance Test
- Shipment

7.2 Examination and Test

All necessary examinations and tests shall be as required by code, manufacturer, or this specification.

Vendor shall provide an Engineer witnessed Factory Acceptance Test of the Equipment prior to shipment to verify the integrity of all piping systems and the functionality of the control/instrumentation system where possible. During the shop run test, instrumentation will be loop checked back to Vendor supplied termination points. All instrumentation shall be loop tested and documented at or before FAT. Vendor will provide assistance during testing. The Engineer shall be notified of this test at least four weeks prior of the anticipated run times.

7.3 Inspection

The specific duties required but not limited to Vendor's and Dane County's QC inspector(s) are shown in Table 8.

Task	Description
Visual Welding Inspection	perform random visual inspection to assure that the welding meets the requirements as specified
Pressure Testing	witness pressure testing and verify from Vendor's records pressure testing has been performed as specified
Marking	verify that the devices are correctly labeled according to drawing Verify that pressure vessels are code stamped
Painting	verify that painting has been performed on properly prepared surfaces in accordance with the requirements as specified
Preparing for Shipment	verify requirements for shipment have been met before shipment
Manufacturer's Report	verify that the manufacturer's data reports for code stamped vessels have been completed by the Vendor and signed by the authorized code inspector
Documentation Audit	perform an audit of documentation as itemized to ensure documentation has been submitted in accordance with requirements
Shipping Release	issue Shipping Release Tag confirming all requirements of this specification have been met

Table 8 - QA/QC Inspection Requirements

7.4 Documentation

The documentation requirements are as follows:

1. Records System
 - a. A records system shall be established and maintained that provides for the identification and correlation of test and inspection records and certificates.
2. Document Submittals
 - a. This specification requires specific documents to be formally submitted to the Engineer for information, approval, or approval with subsequent certification. When required by this specification, those documents generated by the Vendor's suppliers shall also be submitted. Prior to submittal, the Vendor shall review them for conformance to requirements and note approval from the Vendor on the face of the documents. Revisions to documents after Engineer's approval of same shall require that the revised documents be resubmitted for approval.
3. Vendor's Documentation
 - a. QA documents are a deliverable item. The Vendor's QC representative shall approve them, then present them to the Engineer.
4. Final Inspection and Check of Records
 - a. The Vendor shall be responsible for inspecting the item(s) and checking the applicable records, prior to shipment, to verify that all specification requirements have been complied with. Two complete sets of all documents required to comply with this specification shall be submitted to the Engineer. At least one set shall be printed and bound. Acceptance of the completed sets of records does not relieve the Vendor of responsibility for compliance with specification requirements.
 - b. After completion but prior to submittal of these records, the Vendor shall complete and submit a Certificate of Compliance. The Certificate of Compliance supplied as part of

the specification is a document which certifies that the inspections and tests, required by the specification, have been satisfactorily completed and the Vendor's documentation for that shipment conforms to the procurement document requirements, this specification, and applicable codes and standards. The Certificate of Compliance shall be completed and signed by the Vendor's quality representative and submitted to the Engineer together with the other documentation applicable to that shipment

5. Shipping Release
 - a. Release shall be in writing by Engineer.

8 Preparation for Shipment

8.1 Packaging

1. Packaging shall be adequate to prevent contamination, mechanical damage, or deterioration of the item supplied, as defined in the requirements listed below. These requirements are applicable immediately after manufacture.
2. All expendable materials such as tapes, barriers, plugs, desiccants and desiccant bags, caps, inhibitors, etc., to be in contact with austenitic stainless steel or nickel alloys shall not contribute to corrosion during the storage period by, for example, rain or condensate leaching deleterious chemicals contained in the expendable material. Objectionable chemicals are lead, mercury, chloride, fluoride, sulfur, copper, and zinc. To assure that such corrosion does not occur, it is expected that the Vendor shall select expendable materials which contain objectionable chemicals in trace concentrations only.
3. Items not immediately packaged after manufacture shall be protected from contamination.
4. Items shall be inspected for cleanness immediately before packaging. Cleaning acceptance criteria are invoked as defined in this specification. Any entrapped water shall be removed.
5. All openings into items shall be sealed or plugged. Weld end preparations shall be protected against corrosion and physical damage.
6. Items shall be packaged in suitable containers, crates, or on skids.
7. Where special blocking, anchoring, or cushioning is deemed necessary by the Vendor, the essential details shall be submitted to the Engineer for review.
8. The center of gravity and lifting points for large and heavy equipment shall also be identified.
9. All exposed machinery surfaces (threads, flange faces, gasket seating surfaces, etc.) shall be coated with an easily removable protective coating.
10. All flange openings in equipment or packaged unit shall be protected and made waterproof. Flanges shall be furnished with one bolt for every either hole but with at least four bolts.
11. Threaded openings shall be plugged with threaded plugs of the same material or plastic plugs as the connected part and sealed with Teflon tape thread sealant.
12. The Vendor shall exercise good judgment and provide workmanship consistent with good preparation and packing practices. No portion of this section of these requirements or referenced specifications listed herein is to be construed as limiting or relieving the Vendor from their responsibility. If there is any problem or apparent conflict, the Vendor shall contact the Engineer for resolution before packing the item for shipment.

8.2 Marking

1. Where nameplate for an equipment is required by the specifications, it shall be of corrosion resistant material inscribed as required by the specifications or drawings and attached to the

equipment in a manner that preclude the possibility of atmospheric corrosion of the equipment beneath the nameplate.

2. All items assigned tag numbers shall be provided with suitably inscribed corrosion-resistant metal tags attached to the items with corrosion-resistant wire.

8.3 Shipping

1. The weight, lifting points, or center of gravity indicated on the Equipment, shall be utilized for all handling procedures.
2. All items shall be prepared and packed to prevent physical damage and corrosion during transit, handling, and storage. The type, design, and material used for preparation and packing shall be the Vendor standard.
3. Baseplate mounted equipment shall be shipped with all auxiliary components completely assembled and properly supported. If removable components affixed to baseplate mounted equipment are considered by the Vendor to be too heavy or cumbersome for safe transport when completely assembled, they may be shipped disassembled as required, but suitably tagged for reassembly.
4. All components of equipment shall be shipped at one time, if practicable, with the Vendor consolidating subcontracted items for proper marking and shipping. Direct subcontract shipments are subject to Engineer's prior written approval. One shipment is preferred, however, if more than one shipment is required due to equipment size, then a copy of each instruction manual and all drawings required for assembly or erection shall be included per shipment, preferably attached into or onto the largest shipping unit in the shipment.
5. Special tools shall be separately packed and identified as special tools. Spare gaskets shall not be bolted in place between flanges and cover plates but shall be separately packed. Loose clips and similar small structural items shall be separately packed and attached to larger pieces

8.4 Rejection

1. Equipment or materials, or any parts or materials used to fabricate or manufacture the equipment, or materials which contain injurious defects or excessive repairs, indicate improper fabrication, cleaning, or preparation for shipment, or that are not in accordance with the agreed upon specifications shall be subjected to rejection at the jobsite if such conditions are discovered after acceptance of the equipment or materials at the Vendor's works or if they are damaged during shipment because of improper packaging.
2. Packing methods which are not in accordance with the listed specifications and containers, or any parts or materials used for such containers, which have injurious defects or excessive repairs, indicate improper fabrication, or that are not in accordance with the specifications, shall be subject to rejection.

Equipment shall be Delivered-at-Place, Dane County RNG Plant or another designated facility within 10 miles of RNG Plant. Vendor shall be responsible for all shipping costs, insurance, and risk in delivery to RNG Plant. Cost for shipment and insurance shall be included in response subject to change order before shipment for changes in actual incurred cost.

9 Purchasing and Fabrication

9.1 Release for Material Purchase for Fabrication

Written approval to the Vendor to start material purchase or fabrication of the equipment covered by this specification will be provided by the Engineer.

9.2 Tools

Special Tools (Special Tools shall be defined as anything not normally and usually available in industrial gas facility or readily available thereto), fixtures, or appurtenances used only during erection shall be furnished by the Vendor. One complete set of all special tools, fixtures, and appurtenances required for maintenance and operation shall be furnished. Each proposal shall include an itemized list of the Special Tools that will be furnished. This requirement shall not include Vendor or supplier specific software.

10 Deliverables and Services Provided by Vendor

10.1 Deliverables with Proposal

The following information shall be provided by Vendor with proposal submittal and further detailed in Attachment B – Response Questionnaire

1. Preliminary equipment P&IDs or process flow diagram
2. Projected performance data
3. Preliminary major item Bill of Materials
4. Summary Operation and Maintenance plan or schedule for first 3 years of operation
5. Description and quantification of required utility and consumable material inputs
6. Description and quantification of byproduct or waste output description including SDS if available
7. Detailed description of waste handling practices, safety precautions
8. Estimated operating expenses at 1 year and 3 year horizons including all expected inputs and maintenance events

10.2 Engineering Deliverables

Engineering deliverables provided by Vendor shall include:

1. 30%, 60%, 90%, and 100% design sets for review and comment by Dane County.
2. Complete set of engineered drawings in both paper and digital form.
3. Equipment and device documentation including manufacturer's part numbers.
4. Operational procedures for equipment startup, shutdown, and general maintenance.
5. Engineering documentation as specified and required to complete project permitting, construction, and commissioning.
6. Documents and personnel to complete a Hazard and Operability Analysis, to be scheduled and led by Dane County before 100% design .
7. Two (2) bound, hard-copy operation and maintenance manuals that include all systems, materials, products, equipment, mechanical and electrical equipment and systems supplied and installed in the Equipment. Provide electronic version of operation and maintenance manual also.

10.3 Installation and Commissioning

1. Dane County or authorized agent shall be responsible for scheduling commissioning after site construction and installation is complete. Vendor shall be responsible for all operation and actions performed on supplied Equipment to meet requirements as agreed to.
2. Commissioning plan and tests to be reviewed and preapproved by company before operating Equipment.

3. Engineer shall witness and approve operation and shutdown functions of Equipment during site commissioning. Acceptance of operation and shutdown functions in factory does not preclude testing of same after final installation.

11 Guarantee

The Vendor shall warrant the equipment to be free of defects in materials and workmanship and is adequate in capacity and size to meet the design and operating conditions specified. Warranty shall be for a period of 12 months following date of Final Acceptance or 18 months from date of shipment, whichever occurs first.