



Department of Public Works
Infrastructure Services Division

Ghassan Korban
Commissioner of Public Works

Preston D. Cole
Director of Operations

Jeffrey S. Polenske
City Engineer

February 17, 2015

Subject: Official Notice No. 22-1-2015

Northwest Garage - Compressed Natural Gas Fueling Program
3025 West Ruby Avenue
City of Milwaukee, Milwaukee County, Wisconsin

For which bid will be received on
Wednesday, February 19, 2015

Addendum No. 2

- A. In regard to our advertisement for the Northwest Garage - Compressed Natural Gas Fueling Program, 3025 West Ruby Avenue, City of Milwaukee, Milwaukee County, Wisconsin this attached Addendum No. 2 is issued to modify the original documents and is hereby made part of the proposal.
- B. Each bidder shall read the entire addendum. Proposals shall include all items included in this Addendum No. 2.

Very truly yours,

Paul R. Fredrich, Facilities Operations Manager
Bridges and Buildings



Official Notice No. 22-1-2015

Northwest Garage – Compressed Natural Gas Fueling Program
3025 West Ruby Avenue
City of Milwaukee, Milwaukee County, Wisconsin

Addendum No. 2

IMMEDIATELY UPON RECEIPT OF THE ADDENDUM, PLEASE SIGN THIS RECEIPT AND FAX BACK TO DPW-BRIDGES AND BUILDINGS SECTION AT (414) 286-5907 OR EMAIL (Thomas.tarkowski@Milwaukee.gov).

Company Name

Name

Date



ADDENDUM No. 2
February 17, 2015

Official Notice No. 22-1-2015
NW Garage Compressed Natural Gas Fueling Program
NW Garage
3026 West Ruby Avenue
Milwaukee, Wisconsin

Responses to bidder questions:

1. On page 184 of the spec, you call for 8% of our aggregate workforce is to be a goal for minority participation. Does the aggregate workforce include all employees of our company or just the people working on the job.
 - a. Response: DBE commitment is for entire contract bid.
2. Section 083324/1.4-c
Are these doors to be fire rated? According to the description it sounds like it but is not specify fire rated
 - a. Response: No, fire rated doors are not required.
3. Section 083324/1.1-2
Is the electrician bringing the power to the operators or are we to run the power from the panel? It would be best that the electrician runs power.
 - a. Response: Work assignments are the responsibility of the General Contractor.
4. Section 083324/2.4-A
There are three powder coated standard colors, grey, white and tan. They also have about 200 standard powder coated colors that you can get with an up charge. For quoting would they three standard colors be OK?
 - a. Response: Yes standard colors are acceptable.

Additional Revisions:

5. See attached revised Section 400100:
 - a. Deleted all reference to ANGI equipment purchased by owner. All ANGI equipment except for AssetWorks Fuel Management System is to be provided by contractor.
 - b. Provided new ANGI contact information. Previous information is obsolete.
 - c. Revised CNG fueling system equipment list in Part 1.1.C to match drawings.
 - d. Revised fast fill dispenser in Part 2.3.A.1 to match drawings.
 - e. Eliminated all reference to time fill dispensing equipment. There is no time fill system in this project.

End of Addendum

SECTION 400100 CNG FUELING SYSTEM EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This specification covers the furnish and installation of compressed natural gas (CNG) fueling system equipment for the City of Milwaukee Northwest Garage at 3025 West Ruby Avenue, Milwaukee, Wisconsin, 53209.
- B. All references to equipment, materials and services either furnished by or provided by ANGI is to be interpreted as being the basis of design and not sole source specified. Engineer and Owner preapproved equivalent products and services will be accepted, see Section 016210 for substitute requests. Basis of design for all equipment in this Section is the following:
1. ANGI Energy Systems, Inc. (ANGI), 305 W. Delavan Drive, Janesville, WI 53546, 608-563-2856, Tony Bauer, abauer@angienergy.com, www.angienergy.com
 2. AssetWorks, 998 Old Eagle School Road, Wayne, PA 19087, Joseph A. Basile, VP Fueling Technologies, Joseph.basile@assetworks.com, 610-228-0120, and Jill Coffin, Jill.Coffin@assetworks.com, 610-228-0126.
- C. CNG fueling system equipment furnished by ANGI shall consist of the following components and services:
1. Tag Nos. 02-CMP-02 Gas Compressor in enclosure
 2. Tag Nos. 02-TK-04 thru -06 CNG storage Vessels
 3. Tag Nos. 02-FD-03 CNG Fast-Fill Dispensers
 4. Tag No. 01-PVP-01 & 03 Valve Panels for CNG fill systems
 5. Tag No. 01-FMS-02 & 03 Fuel Management Systems
 6. Factory acceptance testing by ANGI in Milton, WI.
 7. Delivery of equipment to site.
 8. Field testing support services.
 9. Operation and maintenance manuals and record drawings.
 10. Operation and maintenance training in field.
- D. Equipment information to be issued as Attachment 1 to Section 400100 at Pre-Bid Meeting will include:
1. General arrangement drawings with equipment weights.
 2. Product Data
 3. Shop drawings (as available).
 4. Equipment delivery schedules.

1.2 PROJECT CONDITIONS

- A. Natural Gas: Pipeline quality from WE Energies:
1. Specific gravity: 0.59 (assumed)
 2. Temperature: 70 degrees F (assumed)
 3. Heating value: Varies – assume 1050 Btu/SCF
 4. Moisture content: <7 lb./MM SCF
 5. Gas pressure at station inlet: 65 psig (nominal)
Minimum "float" of compressor suction shall be from 40 psig to 80 psig
- B. Electrical Service (see Drawings and Division 26 Specifications):
1. Electrical power supplied to compressor's motor starter panel shall be 480VAC \pm 10%, 3-phase, 60 hertz.
 2. Electrical power supplied to dispensers shall be 120VAC, single-phase, 60 hertz.
 3. Electrical power supplied at other voltages shall be furnished as shown on drawings.
- C. Design Conditions:
1. Compressor System
 - a. Compressor suction gas pressure 40 psig (min)

- | | |
|---------------------------------------|----------------------------|
| | 60 psig (design flow rate) |
| | 80 psig (max) |
| b. Discharge pressure from compressor | 4,500 psig. |
| c. Design flow rate | 500 scfm per compressor |
| d. Max gas discharge temperature | 20 deg F above ambient |
| 2. Site: | |
| a. Ambient temperature | -20 deg F to 95 deg F |
| b. Elevation above MSL | 649 ft. |

1.3 REFERENCES

- A. All equipment and entire packaged fueling system shall comply with latest revisions of applicable codes and standards and Wisconsin Department of Commerce Chapter Comm. 40. All materials shall be new and unused. As a minimum, equipment shall comply with the following codes and standards:
1. American Gas Association (AGA):
 - a. 2-93: Requirements for Manually Operated Valves for High Pressure Natural Gas.
 2. American Petroleum Institute (API):
 - a. 520: Sizing, Selection, and Installation of Pressure-relieving Devices.
 3. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel (B&PV) Code:
 - 1) Section VIII, Division I – Pressure Vessels.
 - 2) Section IX – Welding and Brazing Qualifications.
 4. American Welding Society (AWS):
 - a. D1.1 – Structural Welding Code.
 5. National Fire Protection Association (NFPA):
 - a. 52 – Vehicular Gaseous Systems Code – 2002 (per WI Comm. 40).
 - b. 52 – Vehicular Gaseous Systems Code – 2010 (for future).
 - c. 54 – National Fuel Gas Code – 2009.
 - d. 70 – National Electrical Code (NEC) – 2008.
 6. Underwriters Laboratories Inc. (UL):
 - a. 508 – Industrial Control Equipment.
 - b. 508A – Industrial Control Panels.
 7. American National Standards Institute (ANSI):
 - a. B31.3 – Process Piping (ASME Code for Pressure Piping).
 8. Occupational Safety and Health Act (OSHA):
 - a. 29 CFR1910.95 – Occupational Noise Exposure.

1.4 QUALITY ASSURANCE

- A. Paint, coatings and priming products shall be lead, chromium and cadmium free. In addition, products and all other materials used shall comply with local, regional, state and federal air quality rules and regulations.
- B. Materials and surfaces exposed to exterior, unless pre-finished or otherwise treated with a corrosion-resistant finish, shall receive a minimum of a two-coat, shop-applied, epoxy coating system with surface preparation in accordance with SSPC standards and coating manufacturer recommendations.

PART 2 PRODUCTS

2.1 CNG COMPRESSOR SYSTEM PACKAGE (02-CMP-02)

- A. Natural Gas Compressor System (furnished by ANGI):
1. CNG Compressor Manufacturer:
 - a. Ariel Model JGQ.
 2. Each compressor system has been sized to handle quoted capacity with gas analysis and conditions specified in Article 1.02, Paragraphs A and C.

3. System will be a self-contained electric-driver package, consisting of an electric motor-driven compressor, control panel with PLC controls, auxiliary systems, and safety devices. Each compressor will be designed specifically to compress natural gas.
4. Compressor will be of multi-stage, reciprocating design. Compressor will be air-cooled trunk piston or cross head design.
5. Compressor cylinders will be splash or pressure lubricated with pressure lubricated crankcase running gear. Compressor lubrication shall be ISO150 grade synthetic oil, or as approved by compressor manufacturer.
6. CNG compressor system enclosure by ANGI:
 - a. Totally enclosed weatherproof and sound attenuating enclosure (75 dBA at 10 ft. outside of enclosure) shall be provided for compressor skid.
 - b. Enclosure will be of welded steel construction.
 - c. One (1) 150W minimum light fixture suitable for Class 1, Division 2, Group D location will be provided complete with explosion-proof wall-mounted manual switch.
 - d. Exterior surface will be weatherproof, rain-tight, and factory-coated with manufacturer's recommended coating system.
 - e. All doors will be either swing out; shall be lockable; and shall have hold-open devices with means to open at least one door from inside.
 - f. ESD Push-button will be located inside system enclosure near primary access door and outside skid enclosure.
7. Each compressor system will be furnished by ANGI with the following items skid-mounted inside enclosure (except for Item A, which shall be installed by Contractor):
 - a. Inlet line assembly, including a particulate filter, check valve, fail-closed actuated valve, isolation valve, flexible hose, and relief valve for field installation by Contractor as shown on drawings.
 - b. Direct compressor drive.
 - c. Interstage gas coolers, gauges, separators, and relief valves.
 - d. Piston rings shall have a guaranteed minimum life of 4,000 hours. Supplier shall provide manufacturer's written guarantee of compliance.
 - e. Compressor valves shall have a minimum life of 3,000 hours.
 - f. Compressor shall have a guaranteed maximum oil carryover after final discharge filtration system of no more than 0.5 lb/MMscf of natural gas.
 - g. Fan belts, if required, shall be V-belt, cogged type.
 - h. Guards for drive belts and hot surfaces that provide protection in conformance with OSHA and other safety regulations.
 - i. Automatic condensate drain system.
 - j. Discharge line assembly including pre-coalescing and coalescing filters, relief valve, check valve, and isolation valve.
 - k. Parker-type zero tolerance o-ring face seal fittings for tubing sized 1/2-inch to 1-1/2-inch.
 - l. Service vent valves to depressurize line for servicing.
8. Equipment vibrations shall not exceed following displacement measured with a three-component measuring system (see Paragraph 2.2.D):

<u>Frequency (cycles per second)</u>	<u>Displacement (inches)</u>
0 – 10	0.0020
10 – 20	0.0010
20 – 30	0.0006
30 – 40	0.0004
40 – 50	0.0003
50+	0.0001

9. Electric Motors:
 - a. Manufacturers:
 - 1) A. O. Smith.
 - 2) Baldor.
 - 3) GE.
 - 4) Regal Beloit (Leeson, Lincoln or Marathon).
 - 5) WEG Electric Motors.

- b. Constant speed, NEMA Premium®, TEFC motor.
 - c. 250 HP/ 480 VAC / 3-phase / 60 Hz / 1800 rpm.
 - d. Rated for continuous duty with minimum 1.15 service factor.
 - e. Rated for Class 1 Division 2 Group D location.
- B. CNG Cooling System (provided by ANGI on compressor skid):
- 1. Gas coolers suitable for service in ambient temperatures of between -20°F and 120°F, and designed to deliver gas at a maximum temperature of ambient plus 20°F.
 - 2. Forced draft air circulation will be used to cool CNG from effects of compression. Fan drive may be either derived from prime mover or separate electric motor.
 - 3. Tube material will be seamless Type 316SS, manufactured and labeled according to ASTM A213.
 - 4. Cooler intake and exhaust sections will be oriented so as to minimize introduction of exhaust air into enclosure. Coolers will include sound attenuating louvers at intake and exhaust sections.
- C. Gas Recovery System (provided by ANGI on compressor skid):
- 1. Gas recovery system will recover any gas that is vented during compressor shutdown.
 - 2. Upon compressor shutdown, gas within compressor system will be routed to recovery system to allow unloaded compressor starting.
 - 3. All oil separators will drain to a single manual drain piped to edge of enclosure (Contractor shall provide elbow discharge off skid for open vessel collection by Owner – NOT hard-piped to drain).
 - 4. Gas recovery vessel will be ASME-rated and have necessary capacity and pressure rating to accumulate blowdown gas without relieving gas to atmosphere or to station inlet line.
 - 5. Gas recovery vessel will have a relief valve and manual service vent valve.
- D. Vibration Monitoring System (provided by ANGI):
- 1. Manufacturer:
 - a. Wilcoxon Research.
 - 2. Vibration monitoring system (sensor/transmitter, monitor, software) with output to station control PLC and SCADA system for following applications on each compressor:
 - a. Cross-head vibration (cross-head looseness for each compressor).
 - b. Compressor frame vibration (shaft imbalance) for each compressor.
 - 3. Factory prewired to PLC installed in CNG station PLC control system.
 - 4. Tested during factory acceptance test and log data.
- E. Filters (provided by ANGI):
- 1. Acceptable manufacturers:
 - a. Parker / Finite.
 - b. Nowata.
 - 2. Inlet Gas Suction Filter:
 - a. Sized to filter particulate of 50 micron diameter or greater at maximum compressor flow rate.
 - b. Manual drain valve with differential pressure gauge.
 - 3. Interstage Coalescing Filters:
 - a. Coalescer downstream of each cylinder between interstage cooler and next-stage compressor inlet.
 - b. Sized to eliminate 95% entrained liquids and liquid accumulation from up to 8 hours of continuous operation.
 - 4. Discharge Coalescing Filters:
 - a. Two filters (pre-coalescer and coalescer) for each compressor.
 - b. Coalescing filters (in-series) as far as possible downstream of final stage aftercooler, but before priority-direct fill valve panel.
 - c. Filters sized for discharge not to exceed 50 ppm liquid hydrocarbon or oil.
 - d. Pressure drop shall not exceed 2% at compressor's maximum flow rate over gas pressures ranging from 2,000 to 4,500 psig.
 - 5. Automatic Condensate Drain System:
 - a. Actuated drain valve for each coalescing filter piped to system blowdown tank and controlled by programmable controller adjustable at controller user interface.

- b. ASME-rated condensate blowdown tank(s) with sufficient volume for maximum system condensate flow, tank relief valve, and tank drain piped to edge of skid with manual isolation ball valve.

2.2 CNG-STORAGE VESSELS (02-TK-04,-05,-06 – Furnished by ANGI)

- A. Manufacturer: CP Industries or FIBA
 1. One (1) 3-pack storage assemblies with ASME-rated CNG storage vessels will be provided (nominal 36,000 scf at 5,000 psig). Each vessel shall be 20 inches diameter x 23 feet long, with capacity of 11,500 scf at 4,500 psig, and MAWP of 5,500 psig, and shall include framing and bracing.
 2. Each 3-pack Vessel Assembly weighs approximately 21,000 lbs.
- B. Arrangement:
 1. Tube-type vessel shall be bolted to its foundation by Contractor, by structural steel rack per drawings.
 2. Vent Risers shall be provided by Contractor per drawings.
- C. Valves and Drains:
 1. Each vessel will include a full-port 3/4-inch pressure relief valve (PRV) set at vessel MAWP with a full-port 3/4-inch ball valve locked open between PRV and vessel.
 2. Each vessel will include a 3/4-inch service ball valve, and a drain port at its low point with a needle type drain valve.

2.3 FAST-FILL DISPENSERS (02-FD-0-03 – furnished by ANGI)

- A. Manufacturer: ANGI Energy Systems:
 1. One (1) dual-hose medium duty 3,000/3,000 psig CNG dispenser with internal fill-control logic for DPW fast-fill system and display on both sides of dispenser (both hoses at 3,000 psig.)
- B. Specifications:
 1. Dispensers will be capable of delivering fills of specified CNG temperature compensated to 70°F, based on control logic housed in dispenser.
 2. Dispensers will include two MicroMotion CNG-050 meters, mechanical vehicle pressure gauge for each hose inside cabinet, and shall have a backlit data display.
 3. All CNG tubing and fittings will be 1/2 inch x .065 inch, grade 304/316 SS.
 4. Vent tubing will be 3/8-inch x .049 inch, grade 304/316 SS.
 5. A means of preventing escape of CNG from fast-fill system, in case dispenser is knocked off its base, shall be provided.
 6. Dispenser-control valves will use actuated ball valves.
- C. Filters:
 1. Dispensers will include one inline oil-coalescing filter for each of three sequence-bank feed lines and a block and bleed valve arrangement to facilitate servicing of filters. Three total filters will be housed in Parker-Hannifin J2 housings and will include a Grade-4 coalescer element. Filters will be located upstream of meter and control valves in dispenser cabinet.
- D. Hose and Nozzle:
 1. Hoses will be 3/8-inch x 12 feet long with 5,000 psig MAWP.
 2. Inline breakaways mechanisms with check valves, which will be electrically conductive.
 3. Nozzle will be NGV-1 Type-2.
 4. Hose will not contact ground when nozzle is in its keeper.
- E. Operation:
 1. Dispenser will be controller by internal logic controller.
 2. Dispenser will include internal 3-bank sequencing with 3/8-inch tubing connections to storage array.
- F. Interface with Fuel-Management Terminal:

1. Dispensers shall be configured for connection to CNG industry standard fuel-management terminal, so that terminal must authorize dispensing of fuel, and so that CNG fuel consumption mass is recorded by terminal, along with User ID, time of day, and Vehicle ID.
2. Pulse-Count Output:
 - a. Dispenser will generate 100 pulse-count per mass of CNG dispensed (i.e., 100 pulses per gasoline-gallon equivalent of CNG).
 - b. Actual mass-calibration rate shall be diesel gallon equivalent for DPW Fast Fill and Gasoline Gallon Equivalent for Public Access Dispenser.
3. Contractor shall install connections between each dispenser and fuel management terminal for the following signals:
 - a. Handle switch.
 - b. Low-voltage meter pulser.
 - c. "Authorize" signal.
 - d. Conductors of different voltages shall be routed in separate conduits.

2.4 CNG STATION PLC CONTROL PANEL IN ENCLOSURE (furnished by ANGI)

A. PLC:

1. Programmable logic controller(s) (PLC) will be provided to control compressor operation, priority/time-fill valve panels, and an emergency shutdown system.
2. PLC Manufacturer: Horner.
3. Local Display:
 - a. Touch-type LCD display.
 - b. Fault annunciation.
 - c. Operating conditions.
 - d. Interface for modifying setpoints by authorized operator.
4. Programmability:
 - a. Owner will have unimpeded access to modify setpoints and operating parameters upon completion of work.
 - b. Supplier will provide PC-host software (or similar) as required to modify controller program, including any specialized PC interface connector.

B. Control Panel:

1. NEMA 3R type (outdoor use) enclosure.
2. Located on compressor skid.
3. Compressor keyed on/off switch.
4. Exterior indicating lights will include "Compressor Running" and "Compressor Fault."
5. Emergency shutdown push-button and keyed alarm reset accessible from exterior of panel.
6. All 120-VAC wiring shall be terminated at a single, clearly labeled terminal strip ready for field termination by Contractor.
7. Additional termination points for remote emergency shutdown push-button stations. (Remote push-button stations shall be provided by Contractor, except for push-button at compressor, which shall be provided by Supplier.)
8. Incorporate with SCADA system.

C. Performance Specification

1. Compressor Starting:
 - a. Logic in base controller shall prohibit a second compressor from starting within 10 seconds of primary starting compressor, but shall allow both compressors to operate concurrently based on demand from time-fill/fast-fill dispensers and storage pressure, which shall be adjustable.
 - b. Controller shall facilitate incremental compressor startup based on threshold storage pressure.
 - c. Incremental compressor start sequence shall be associated with storage-bank pressure; i.e., first compressor starts when bank falls to 3,600 psig, and second compressor starts when mid-bank falls to 3,300 psig. Both setpoints shall be adjustable.
 - d. Second compressor shall be prohibited from starting based on field programmable time of day.
2. Storage Bypass:

- a. Controller shall control and prioritize compressor discharge to time-fill header, priority storage banks, fast-fill direct supply to DPW fast-fill dispensers, or supply to public area storage banks.
- D. Shutdowns, Alarms and Annunciations:
- 1. Compressors (minimum requirement):
 - a. High/low suction gas pressure: shutdown
 - b. High interstage pressure (all stages): shutdown
 - c. High discharge pressure: shutdown
 - d. Low lube oil pressure: shutdown
 - e. High interstage temperature (each stage): shutdown
 - f. High discharge temperature: shutdown
 - g. High compressor/cooler vibration: shutdown
 - h. High oil temperature: shutdown
 - i. Lubricator failure: shutdown
 - j. Excessive motor starts: shutdown
 - 2. System:
 - a. High storage pressure, each bank: shutdown
 - b. High blowdown pressure (95% MAWP): shutdown
- E. Emergency Shutdown System:
- 1. An emergency shutdown (ESD) system shall be provided. When ESD system is activated:
 - a. Power to PLC outputs, gas supply to compressors, and dispenser(s) are shut off.
 - b. Signal shall be available to activate optional visual warning devices.
 - 2. ESD System shall be activated by:
 - a. CNG station shutdown push-buttons (various locations).
 - b. Loss of station electrical power.
 - 3. System shall not allow station to resume operation without a manual reset and station returning to normal.

2.5 SCADA (SUPERVISORY CONTROL AND DATA ACQUISITION) SYSTEM (Furnished by ANGI)

- A. Summary:
- 1. SCADA System will provide centralized monitoring and recording of programmable controllers for compressors, dryers, priority panels, storage, and dispensers.
 - 2. SCADA System will include computer and program software.
 - 3. SCADA will monitor devices and display natural gas process.
 - 4. Motors, pumps, valves, pressures, temperatures, switches, vibration monitors, etc., shall have a graphical representation.
 - 5. SCADA will manage and monitor CNG processes and facilities management.
 - 6. Graphics, controls, configuration data, and programming associated with SCADA installation will be configured and implemented base on representation of infrastructure equipment deployed at CNG site, allowing entire system to be monitored and controller in real-time.
- B. Screens:
- 1. Screens shall properly display CNG equipment as process piping schematic.
 - 2. Main menu screen shall include a general arrangement representing CNG site.
 - 3. Sub menu screens shall display specific CNG equipment.
- C. Ethernet:
- 1. CNG equipment PLC will include a built-in Ethernet port with standard TCP/IP.
 - 2. Each controller will have a unique IP address and be configured to site specifications.
 - 3. Ethernet port will support 10/100BaseT.
 - 4. Ethernet protocol to be finalized by Owner with ANGI.
- D. Alarms:
- 1. Alarm functions shall display alarms (and related alarm help pages), and acknowledge, disable, and enable alarms.
 - 2. SCADA will provide information about alarms and allow operators to add comments to alarm records.
 - 3. Alarms will be logged with a time and date stamp.

- E. Mapping:
 1. SCADA program will have a tag configurable database that polls CNG stations and tells software which parameters within station are to be accessed.
 2. Database will schedule frequency at which parameters of station are accessed.
 3. Parameters will include measure values, data points, and alarm setpoints.
- F. Logging and Trending Data:
 1. Trend graphs.
 2. Trending will provide dynamic visual analysis (trend and graphs), production records and status of equipment, efficiency and preventive maintenance.
- G. Messages:
 1. SCADA PC software shall provide messaging for SMS or emails that report status and alarm condition reported to external personnel.
- H. Web Browser:
 1. To be finalized by ANGI in submittals.

2.6 MAIN PRIORITY VALVE PANEL (02-PVP-01) (furnished by ANGI)

- A. Manufacturer: ANGI Energy Systems:
 1. Priority valve panel will direct flow of CNG from DPW CNG fueling station.
 2. Storage will be accessed first in event of a demand for vehicle fast-filling. If storage pressure drops to set point, station control system will start compressor and shall run until fast-filling demands have been met. If there are not further fast-fill demands, compressor shall replenish storage.
 3. Main priority valve panel control system will direct compressor discharge gas to dispensers or to storage. Control logic for priority for compressor flow is summarized as follows:
 - a. First priority: Direct flow to DPW fast-fill dispenser.
 - b. Second priority: Direct flow to "Public" priority system fast-fill dispenser.
 - c. Third priority: Direct flow to DPW time-fill system.
 - d. Fourth priority: Replenish DPW fast-fill storage high to mid to low bank.
 4. In addition to I/O signals required for CNG Station Control, PLC shall interface with following I/O signals:
 - a. ESD push-buttons (provided by Contactor as shown on drawings).
 - b. Storage pressure.
 - c. Actuated valves in valve panel.
 5. ESD valves shall fail closed.

2.7 PRIORITY VALVE PANEL (02-PVP-02) (PUBLIC FAST FILL AREA – furnished by ANGI)

- A. Manufacturer: ANGI Energy Systems:
 1. Priority valve panel will direct flow of CNG from DPW CNG fueling station to public fueling dispenser (02-FD-03).
 2. Storage will be accessed first in event of a demand for vehicle fast-filling. If storage pressure drops to set point, station control system will start compressor and shall run until fast-filling demands have been met. If there are no further fast-fill demands, compressor shall replenish storage.
 3. Priority valve panel control system will direct compressor discharge gas to dispensers or to storage. Control logic is from system PLC priority for compressor flow summarized as follows:
 - a. First priority: Direct flow to DPW fast-fill dispenser.
 - b. Second priority: Direct flow to "Public" priority system fast-fill dispenser.
 - c. Third priority: Direct flow to DPW time-fill system
 - d. Fourth priority: Replenish DPW fast-fill storage high to mid to low bank.
 4. In addition to I/O signals required for CNG Station Control, PLC shall interface with the following I/O signals from this Priority Valve Panel:
 - a. ESD push-buttons (provided by Contactor as shown on drawings).
 - b. Storage pressure.
 - c. Actuated valves in valve panel.
 5. ESD valves shall fail closed.

2.8 INSTRUMENTATION AND CONTROLS (Provided by ANGI on Pre-wired Skids)

- A. All pressure gauges shall conform to following requirements:
 - 1. All gauges will read at least 1.2 times system design pressure (NFPA 52).
 - 2. Accuracy, including hysteresis, will be +0.5% of full-scale or better.
 - 3. Rear blowout protection will be provided.
 - 4. All gauges will be waterproof and liquid-filled.
 - 5. Dial will have a minimum diameter of 2-1/2 inches.
- B. Instrument components interfacing with natural gas will be made of material compatible with odorized natural gas. No copper metal or alloys containing more than 70% copper shall be used in natural gas service.
- C. Gauges and manually operated valves shall be located no higher than five (5) feet above grade.
- D. Pressure gauges will be installed at following locations as a minimum:
 - 1. Suction pressure downstream of suction filter.
 - 2. Interstage pressures at filters and cooler.
 - 3. Oil pressure on compressor frame oil filter.
 - 4. Final discharge pressure at discharge filters.
 - 5. Blowdown vessel pressure.
 - 6. Control gas pressure (if installed) downstream of regulator.

2.9 FUEL MANAGEMENT SYSTEM (02-FMS-02,-03) (Furnished by Owner)

- A. Manufacturer: AssetWorks.
- B. Equipment details to be provided with Attachment 1 to this section at Pre-Bid Meeting.

2.10 PIPING / TUBING ON SKIDS (Furnished by ANGI)

- A. Piping and tubing systems will be rated for maximum pressure and temperature to which they will be subjected under normal operating conditions, and be properly supported and protected to prevent damage from vibration during shipment, operation, and maintenance. Piping and tubing systems shall be installed in a neat and orderly arrangement, adapting to contours of skid package. Piping and tubing systems shall not obstruct access openings. Supports shall not be welded directly to piping or tubing.
- B. Piping design, inspection and testing shall be in accordance with ANSI/ASME B31.3. Piping shall be seamless, minimum Schedule 40 (standard weight), and conforming to ASTM A53 or A106 Grade B. Cast iron or semi-steel piping will not be used. Testing shall be pneumatic.
- C. Gas tubing on compressor skid will be seamless stainless steel ASTM A269, Type 316. Hardness of stainless steel tubing shall be no more than Rockwell hardness of 80. All tubing fittings used throughout station system (compressor skids, dispensers, storage, and inter-skid connections), will be Parker Seal-lok® o-ring face seal for 1/2-inch and larger diameter and Gyrolok® 316 stainless steel for smaller than 1/2-inch diameters.
- D. Piping will be prepared and painted in accordance with manufacturer's standards.
- E. ANGI will provide drain lines brought to skid edge and allow draining into a container placed on ground next to skid.

2.11 EQUIPMENT TAGS (Furnished by ANGI)

- A. All equipment, including storage vessels, tanks, heat exchangers, instrumentation (gages, transducers, etc.), all valving (isolation, bleed check, regulation, solenoid and relief), and panels will be provided with an equipment tag and unique tag number matching equipment ID number on D. Tags will be laminated plastic with black letters on white background, or approved equal. They will be attached to flat surfaces of equipment using an epoxy adhesive or wired to equipment with stainless steel wire.

PART 3 EXECUTION

3.1 FACTORY ACCEPTANCE TESTING BY ANGI

- A. Prior to shipment, CNG compressor shall be operated for a minimum of four (4) continuous hours and functionally tested. Test shall include, but not be limited to the following:
 - 1. Operation of compressor control.
 - 2. ESD system test.
 - 3. Load testing.
 - 4. Auto start/stop testing.
 - 5. Safety shutdown testing.
 - 6. Alarm testing.
 - 7. Noise and Vibration analysis.
 - 8. Motor testing.
 - 9. Lube oil system testing (pressure and temperature).
 - 10. Fan testing.
 - 11. Compressor interstage pressure and temperature testing.
- B. Factory acceptance test parameter data shall be logged with readings, time and date and signed by authorized supplier representative.
- C. Acceptance by Owner of witnessed test shall not release Supplier from any of its warranty obligations, or any other obligation, under this Specification.

3.2 DELIVERY

- A. Supplier shall ship CNG compressor, dispensers, storage tanks, and all accessories to corresponding CNG vehicle fueling station site.

3.3 FIELD INSTALLATION

- A. System equipment shall be received, unloaded, set in place, wired and piped to operate all gas drying, compression, storage, dispensing, control, and fuel management in accordance with manufacturer's shop drawings and installation instructions.
- B. Installation shall be completed in accordance and in compliance with all applicable local and national Codes and Standards.
- C. All components shall be tested in accordance with NFPA 52, NFPA 54, or other applicable CNG industry standards.
- D. Pre-start Pipe Cleaning: All piping sections between packaged components that include piping or tubing shall be blown clean prior to connection to equipment. Blow-out shall be achieved by closing the downstream end of pipeline with a 5000 PSI-rated ball valve, connecting a minimum 1650 PSI-source pressure vessel to the upstream end of the pipeline, opening supply valve at source so that minimum 750 PSI accumulates in pipeline, then opening outlet ball valve to atmosphere. Procedure shall be repeated until no solid or particulate matter is discharged from the pipeline.
 - 1. Personnel opening and closing ball valve at downstream end shall take care to keep clear of the discharge path of the blowout, and shall wear eye and ear protection during procedure.
 - 2. Direction of blowout flow shall be performed in both directions, if possible.
 - 3. Contractor shall take care to clear area at pipeline discharge to prevent property damage or injury during procedure.
- E. Startup Filtration: "Witch's hat," or similar strainer device, shall be installed where practical at termination of such piping sections prior to system startup and shall be checked, cleaned and replaced by the Contractor as required, until all residual pipe debris has been removed.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services By ANGI:
 - 1. Supplier's or manufacturer's technician for equipment specified herein shall be present at jobsite for minimum man-days included (travel time excluded) for assistance during plant construction and plant startup:

- a. Two (2) man-days for Installation Support Services to Contractor.
 - b. Five (5) man-days to support Field Testing by Contractor and conduct Field Training.
 - c. Two (2) man-days for Post-Startup Services.
- B. Acceptance by Owner of CNG fueling system under this specification shall occur only after the following requirements have been met:
1. Demonstrate to satisfaction of Owner that CNG fueling station as a whole meets and conforms to requirements of specification and drawings.
 2. Testing required by this specification has been successfully completed and has been accepted by Owner.
 3. Date of acceptance of fueling station shall be date of written notice of its acceptance by Owner to Supplier. All warranties and/or guarantees referred to or implied in this specification shall commence on that acceptance date.
 4. Acceptance by Owner of witnessed test shall not release Supplier from any warranty obligations, or any other obligation, under this specification.

3.5 FIELD ADJUSTING, BALANCING AND TESTING BY CONTRACTOR

- A. After completion of the installation, start, regulate, calibrate, adjust and test all equipment and devices.
- B. Leak and pressure testing in accordance with Section 400500, Process Mechanical Piping and Tubing System.
- C. Functional Tests:
1. Test ESD/Emergency shutdown at all button-station locations, including required valve closures.
 2. Test low suction pressure, each skid; close skid-supply ball valves.
 3. Test temperature-compensated dispenser fill for each dispenser, including correct dispenser start on button, auto-stop on fill completion, and verify 'settled' fill pressure vs. ambient temperature two (2) hours following fills. Pressure shall be within 4% of design-fill pressure temperature compensated to 70°F.
 4. Test for correct operation of fuel-management system at each fast-fill dispenser, and time hose post hose, including: authorization of transaction, energizing of dispenser, and recording of transaction data (fill volume, time/date stamp, event ID, and pump number).
 5. Test dryer regeneration based alarm on dew point – general false positive at hygrometer.
 6. Test for correct annunciation on controller/PLC shall be required for all test events, as appropriate.
 7. Observe compressor operation, including stage pressures and temperatures, and verifying function of controller, including triggering selected faults, such as high interstage temperature.
- D. Reliability Test:
1. Reliability test shall consist of fueling under normal-use conditions for five (5) consecutive work days.
 2. System shall have no failures of compressor operation, dryer operation, normal dispenser operation, or operation of the fuel-management system during the test period. If any failure occurs, the test shall be repeated in its entirety.
 3. Final acceptance of the facility shall only be declared upon successful completion of the test.
 4. Contractor shall be responsible for all onsite coordination of troubleshooting and coordination of suppliers and trades during test.
 5. Failure shall be defined as the occurrence of any of the following:
 - a. Inability of the CNG system to dispense CNG at the pressures and rate specified, including accounting for temperature compensation at settled conditions.
 - b. Failure of the dryer to provide dried gas and/or not be able to auto-switch or regenerate.
 - c. Failure of a compressor to start and run within factory-listed operating pressures and temperatures.
 - d. Failure of the controller/PLC, valve panel, fuel-management system, and/or dispensers to operate as specified.
 - e. Presence of an audible or visible gas of CNG leak.

- f. Occurrence of an auto-fault shutdown of either or both CNG compressors, except those caused by ESD-button activation, gas-detection system outside of skids, variations in gas supply pressure, or damage to facility beyond the Contractor's control.
- 6. Contractor may take equipment offline for scheduled maintenance during the test period, provided maintenance is consistent with manufacturer's recommendations and does not impinge on Owner's ability to fuel vehicles during the normal daily fueling window between 7:00 a.m. and 11:00 p.m.
- 7. Contractor shall be responsible for maintenance through successful completion of test, including provision of consumables.
- 8. Corrective work conducted by the Contractor and all subcontractors and suppliers preceding and during performance test shall be documented at time of repair by technician performing repair. If technician suspects a cause of fault that is beyond scope of his respective firm or responsibility, technician shall notify Owner immediately and shall not implement repairs until condition of failure has been documented and other firm(s) have been notified and been provided documentation of condition.
- 9. Owner shall not pay Contractor for any work or repair that is implemented during testing above contract amount, unless work or condition is beyond control of Contractor, Contractor's subcontractors, or Contractor's suppliers.
- 10. Contractor shall notify Owner in writing of intent to perform any work that Contractor deems to be outside of contract scope, prior to performance of any such work.
- 11. Any discrepancies in Contractor's materials or workmanship found as a result of these inspections and test shall be corrected by Contractor at no cost to Owner, including cost for making all corrections and repeating test within two (2) weeks.

3.6 CNG FUELING OPERATION AND MAINTENANCE TRAINING By ANGI

A. On-site Training:

- 1. General:
 - a. At least 60 days prior to scheduled date for commencement of training, submit training syllabus with time allotments per topic and instructional materials to Owner for review and approval. Upon review of syllabus, Owner may require additional time be allotted to certain training topics.
 - b. Develop and conduct a program to train ten (10) Owner-personnel in the safe operating procedures, and maintenance of equipment and systems furnished, during hours required by Owner. Also include in training program key hazards and their protectors, and corrective actions for violation of safety rules.
 - c. Furnish instructors, instructional materials, and audio-visual aids and equipment.
 - d. Owner shall furnish physical facilities and equipment.
 - e. Begin instruction upon successful completion of field testing.
- 2. Program Content: At a minimum, instruction will include material covered in operation and maintenance manuals, as well as the following:
 - a. Theory of operation of CNG system.
 - b. Practical aspects of operation.
 - c. Description of system, equipment and components.
 - d. Functional characteristics of system, equipment and components.
 - e. Emergency operating procedures.
 - f. Maintenance procedures.
 - g. Servicing intervals and schedules.

B. Duration:

- 1. Training for maintenance, facility operation, and troubleshooting shall be eight (8) total hours (minimum).

END OF SECTION