PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Design, manufacturing and testing of the single tower CNG dryer for the compressed natural gas station.

2. The work includes mechanical and electrical fabrication work and programming required in the shop fabrication of the CNG drying equipment.

B. Related Sections:

1. Section 18000 - All

1.02 QUALITY ASSURANCE

A. Manufacturer Qualifications: Equipment manufacturers shall have at least 5 years experience in manufacturing products and accessories similar to those specified for this Project, with a record of successful in-service performance.

1. Provide list of projects with Owner contact information.

1.03 SUBMITTALS

A. Submit in accordance with applicable provisions of Section 18000, General:

1. Manufacturer's qualifications: Project list.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with the following:

1. Ship dryer to site only when its foundation pad is completed and ready for permanent installation.

1.05 PROJECT SITE AND DESIGN CONDITIONS

A. Design Conditions:

1. Number of dryers 1

2. Minimum Inlet Gas Flowrate The greater of 1200 Scfm at 60 psig inlet or 110 percent of the flow of 2 compressors at 60 psig inlet pressure

3. Minimum Process Flow Pipe Size As required to meet pressure drop specification

4. Minimum throughput between regenerations 20 MMSCF

5.	Regeneration Time (maximum)	8 hours
6.	Maximum Outlet Gas Pressure Dew Point	-50 F
7.	Outlet Gas Moisture Content	<0.25 lbs/MMScf
8.	Minimum design pressure	150 PSIG
9.	Max. Pressure Drop Across Dryer Assembly	3 PSID

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS AND SYSTEM DESCRIPTION FOR CNG DRYER

A. General:

1. The design, fabrication, testing, delivery, installation, startup, testing, commissioning and training for a compressed natural gas purification system complete with a coalescing prefilter, captive blower purge, desiccant gas dryer system integral with the regeneration package, particulate afterfilter and relevant controls and instrumentation, factory pre-piped, wired and tested on a common skid.

2. Weatherproofing: Dryer system shall be suitable for operation outdoors without the concern of undue corrosion or degradation of any components from the elements. Electrical components shall be rated as weatherproof and for use in a Class I, Division 2, Group D hazardous area. Valves, actuators or other moving components shall be shielded from accumulation of debris which could hamper their operation. External cooling coils shall be protected from accumulation of debris or fouling by use of shields, screens, and positioning. Insulation shall be fully weatherproofed with an external metal skin and sealing.

3. Design Pressure:

   a. The minimum design pressure shall be the greatest of a minimum of 1.5 times the maximum station inlet design pressure, the minimum design pressure indicated in Section 1.05 above, or higher if required due to expansion of gas during the heating cycle of regeneration.

B. Pre-filter and After-filter:

1. The pre-filter shall be a coalescing, high efficiency, sub-micron oil removal type, designed to remove aerosols, liquids and solids down to 0.1 microns absolute size and 0.0014 ppmw oil concentration.

2. The after-filter shall be a high efficiency, particulate filter, designed to remove solids down to 1.0 microns absolute size.

3. Filters shall consist of an ASME section VIII designed and U or UM-stamped pressure vessel (if required by vessel size), stainless steel or carbon steel

housing rated for the design pressure as specified in Section 18510, Para. 1.05. Filters shall contain the element and the captured liquids and replaceable filter cartridges to remove the contaminants, with both parts combined to form a complete assembly. The filter cartridge shall be positively sealed to the housing by means of elastomeric O-ring seals suitable for natural gas service.

4. The filter housing shall be designed so as to allow servicing of the cartridges without removing the filter assembly from the system piping.

5. The filter assembly shall be equipped with a manual drain valve for the periodic removal of the collected liquid(s) and for depressurization of the chamber for service.

6. A locally-mounted differential pressure gauge shall be provided to indicate the filter element condition.

7. An isolation ball or butterfly valve shall be provided between the filter and the tower to allow the filter to be serviced without venting down the entire dryer.

C. Drying and Regeneration System:

1. The dryer shall be a single tower externally heated regeneration type using 3A molecular sieve as the adsorbing media. Process gas shall not be exhausted to the atmosphere and regeneration shall be accomplished by recirculation of a captive volume of the gas. The regeneration cycle shall include a heating and cooling cycle to ensure proper regeneration of the desiccant and a constant outlet dewpoint at all times.

2. The drying flow shall be downward to minimize fluidization of the desiccant bed in the event of upset conditions.

3. Desiccant chambers shall be of carbon steel construction and ASME Section VIII designed and U-stamped, manufactured and stamped for design pressure at minimum 400 deg F with a 1/16-inch corrosion allowance.

4. The gas piping shall include necessary interconnecting piping from the inlet of the prefilter to the outlet of the after-filter. Included in the piping shall be a prefilter, dryer, after-filter, and other fittings and supports as required.

5. Desiccant chamber shall be fitted with desiccant fill and drain ports to facilitate filling and draining of desiccant without the need to disassemble manifold piping.

6. Desiccant chamber shall be designed and constructed to ensure that wet gas is evenly distributed across the bed to maximize the life of the desiccant bed.

7. Desiccant chamber shall be fitted with a relief valve set at the design pressure of the dryer.

8. All relief valves shall be complete with isolating ball valve with lockable handle and shall have outlets that are piped to a single accumulation pipe header at site for remote venting.

9. Desiccant chamber (tan to tan), heater housing and heated gas piping shall be insulated with two inch fiberglass and aluminum jacket for personnel protection and to minimize heat loss.

10. Desiccant chamber inlet and outlet switching valves shall be high performance, non-lubricated, low pressure drop valves, suitable for high temperature operation. Regular port ball valves or butterfly valves are acceptable as long as the overall system pressure drop requirements are met. Dryer block and bypass valves shall be lockable ball or butterfly valves.

11. Valves shall be non-proprietary and manufactured through a third party.

12. Dryer desiccant shall be high capacity, non-corrosive, rugged and low pressure drop molecular sieve and a sieve size so selected as not to absorb or desorb a measurable amount of odorant from the main gas stream. The odorant is a mixture of tertiary butyl mercaptan (75 percent weight), isopropyl mercaptan (15 percent weight), and n-propyl mercaptan (10 percent weight).

13. Dryer regeneration at lower than line pressure is permitted. If venting of gas prior to regeneration is required, blow down valves and tubing to the vent stack shall be provided.

14. If it is necessary to regenerate at higher than inlet pressures, lockable ball valves, multi-turn gauge valve, regulator and tubing from a high pressure source shall be provided and configured to ensure the safe pressurization of the regeneration loop.

15. The heating cycle shall continue until the desiccant bed is completely dry and the cooling cycle shall continue until the desiccant bed temperature is within 20 deg F of the ambient temperature, and until all condensate is removed from the regeneration loop (exception: condensate collection tank). A thermocouple shall be provided immediately downstream of the bed to confirm the end of the heating cycle.

16. The cooling cycle shall ensure adequate cooling of the desiccant bed to provide a constant outlet dewpoint at all times.

17. Recirculation of the regeneration gas shall be closed-loop with a blower and motor housed inside a U-stamped ASME Section VIII coded pressure vessel. It shall have the same or higher pressure rating as the dryer vessels. The blower and motor assembly shall be supported on the blind flange of the housing. The housing shall be installed in a manner to provide and allow for ease of access to the blower and motor assembly. The horizontal housing shall be designed to permit sliding it away from the blind flange with minimal effort and by one person. Suitable anchoring of the blower housing shall be provided to support the blower housing (i.e. leveling bolts) once installed. This vessel must be flooded with gas at all times when power is connected to

the system. The blower motor is to be certified by the manufacturer for use in a 100 percent natural gas environment.

18. Relief valves shall be installed to protect all ASME vessels. This will include heater chambers, blower vessel, and filters and separators if they are defined as vessels. Relief valves shall be complete with isolating ball valve(s) with lockable handle and shall have outlets that are piped to a single accumulation vent stack. One relief valve may serve more than one vessel if there is no possibility of any vessel becoming isolated from that relief valve other than by a service technician closing a locked-open valve.

19. Bleed valves shall be installed in all sections as required to depressurize the dryer for regeneration or for service or repair. These valves shall be tubed to the vent header.

20. A fin and tube type air-cooled regeneration loop gas cooler shall be utilized to cool and condense water vapor from the regeneration gas. It shall have the same pressure and temperature rating as the dryer vessels. The Maximum Allowable Working Pressure (MAWP) for the unit shall account for any pressure increase due to the temperature increase during the dryer regeneration cycle. The cooler shall be complete with a Division 2 rated and weatherproof fan motor, non-sparking fan.

21. A centrifugal type or coalescing, high efficiency separator shall be located downstream of the regeneration gas cooler to remove liquid water. The separator shall be complete with an integral condensate reservoir to accumulate the condensed liquids. The reservoir shall have a liquid capacity equivalent to at least two regeneration cycles.

22. The dryer manufacturer shall specify and supply an appropriate storage and disposal container (minimum five US gallon capacity) to receive odorized water which will be automatically drained from the dryer regeneration loop.

23. A single, electric, external regeneration gas heater shall be used for each dryer. The heater shall utilize “Incoloy” (alloy) sheathed low watt density heater elements located inside an insulated heater housing. The heater shall be complete with a sheath and a chamber, and a chamber downstream piping mounted thermocouple to monitor heater skin, heater chamber and heater outlet regeneration gas temperatures, (adjustable in the controls) to control the regeneration gas temperature and provide heater over-temperature shutdown and alarm.

24. Dryer shall be equipped with a PLC to perform the following:

    a. Assure full utilization of the moisture holding capacity of the desiccant bed before indicating a need to regenerate.

    b. Monitor the regeneration process and indicate switching points within the regeneration cycle.

c. Communicate with the MCP PLC and the monitoring computer via Ethernet Network.

25. The dryer controller shall be comprised of reliable and durable components not susceptible to shorting and corrosion. Control components including controllers and displays shall be third party/non-proprietary manufacture.

26. A hygrometer complete with a moisture sensor installed at the dryer outlet to monitor the actual dryer outlet dewpoint shall be provided. The dewpoint shall be indicated in degrees Fahrenheit through a display and transmitted to the MCP PLC.

27. The moisture sensor shall be installed such that it may be serviced without removing desiccant from the dryer and while the dryer is on service.

28. Dryer regeneration shall be initiated manually upon receipt of a signal from the hygrometer that regeneration is required. The controller shall contain built-in diagnostics to check each operation as it is initiated and provide fault shutdown and annunciation.

29. The dryer system shall be equipped with the following standard instrumentation and alarms. All gauges are to be equipped with isolation valves to permit service without depressurizing connected piping and vessels.

    a. Locally mounted inlet and outlet gas pressure gauges.

    b. Locally mounted chamber pressure gauge.

    c. Locally mounted regeneration blower gas differential pressure gauge.

    d. Locally mounted inlet and outlet filter gas differential pressure gauges.

    e. Panel mounted warning lights to indicate locally and to be communicated to the station master PLC:

        1) High regeneration temperature.

        2) Dryer outlet high humidity alarm.

        3) Blower and cooler motor overload alarm with shutdown.

        4) Heat detector.

30. Panel mounted ESD button tied into the station ESD system. Any station ESD is to terminate dryer operation. Dryer operation shall be automatically restarted upon restoration of power on the ESD system.

31. Dryer shall include a fixed temperature heat detector and collection pan mounted above the dryer. This detector shall be wired as an input to the dryer PLC and to the station Master PLC. A fire signal shall cause the station to ESD and activate annunciation devices.

32. A block and bypass assembly shall be factory piped with two or three 3-piece, carbon steel, butt weld or flanged, ball or butterfly valves with stainless steel trim and handles that can be locked in either the open or closed position.

2.02 MANUFACTURERS

A. Dryer assembly shall be designed and manufactured by:

1. PSB Industries Inc. "General Air Division"

2. SPX.

2.03 MATERIALS

A. Guards over moving parts shall be non-sparking aluminum construction meeting all OSHA requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 18000, General, for general commissioning requirements.

3.02 QUALITY CONTROL

A. Shop Testing:

1. Dryer functions test (no flow) of minimum four hour duration (accelerated cycle).

2. Function test to check operation of control systems, safety alarms and shutdowns.

3. Calibration of instruments.

4. Performance tests to check motor voltage, current draw and power.

B. Field Testing During Startup and Testing:

1. Dryer functions test of minimum one regeneration cycle and 30 days of normal operation.

2. Function test to check operation of control systems, safety alarms and shutdowns.

3. Calibration of instruments.

4. Performance tests to check motor voltages, current draws and power distribution to other components. Verify all circuits are operational.

5. Verify shutdown alarms and sequences are working.

6. Verify the dew point immediately prior to regeneration and after at least one regeneration.

End of Section