

CITY OF TOPEKA

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LIQUID OXYGEN STORAGE AND VAPORIZATION SYSTEM 291139.01

PART 1 GENERAL

The City of Topeka Water Pollution Control Division is soliciting bids from qualified firms for the lease, maintenance, compliance testing, furnishing, installing, start up, test, and commissioning of a packaged Liquid Oxygen Storage and Vaporization System (LOSVS), with associated piping and valves, sensors, monitoring, control and alarm systems, and other appurtenances required for a complete operating system as shown on the Drawings and as specified herein to be installed and operating no later than 11/2/2026.

1.01 SCOPE OF WORK

- A. The Awarded Bidder (Provider) shall provide an Integrated LOX Storage Tank and Vaporizer monitoring and control system from a single supplier that will be solely responsible for the operation of the entire system. Purchase of storage tanks and vaporizers from different suppliers and use of System Integrate to provide monitoring and control system shall not be acceptable as an alternate to meet the specified requirements of this contract document. Third-party suppliers acting as intermediary between LOSVS manufacturer and the installation contractor are strictly prohibited. The General Contractor is required to deal directly with the LOSVS manufacturer and Provider to ensure proper coordination and timely completion of the work.

The equipment to be furnished shall be designed and constructed in accordance with the best practices, methods and codes of the industry. The installed equipment shall operate satisfactorily per the manufacturer's guarantees and the specification contained herein.

- B. The LOSVS manufacturer shall provide a factory-trained startup representative to coordinate with the Provider for proper installation, testing, and commissioning of the system once installed, to insure proper operation. Startup shall include all other adjustments required to properly operate the system.
- C. Startup services and site visit made by the LOSVS manufacturer shall be included in this bid. The LOSVS manufacturer shall coordinate startup and training with the Provider and the City during startup and commissioning activities.
- D. The LOSVS shall meet the operation and service requirements specified herein. Equipment items, devices or design features not specified in these documents but necessary to provide a complete, workable and safe LOX storage and vaporization system shall be furnished.
- E. The above package shall include but not be limited to the following items:
1. One (1) 3,000 gallons vertical LOX vessels/storage tanks;
 2. Local Vaporizer Switching Panel
 3. Two (2) ambient vaporizers with switching manifold;
 4. Vacuum insulated piping system;
 5. Instrumentation and controls including but not limited to mass flow meters and control valves.

1.02 LOCATION AND CONDITIONS OF SERVICE

- A. The project is located at the Central Park Pump Station in Topeka, KS.

1.03 QUALITY CONTROL

- A. Reference Standards
1. American National Standards Institute (ANSI)

2. American Society of Mechanical Engineers (ASME)
 - a. Section VIII, Division 1 - Rules for Construction of Pressure Vessels.
 3. ASTM International
 4. Compressed Gas Association (CGA)
 - a. CGA G-4.1 – Cleaning Equipment for Oxygen Service.
 - b. CGA G-4.4 - Industrial Practices for Gaseous Oxygen Transmission and Distribution Piping Systems.
 - c. CGA G-10.1 - Commodity Specification for Nitrogen.
 5. Institute of Electrical & Electronics Engineer (IEEE)
 - a. IEEE Standard 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 6. National Electrical Code (NEC)
 7. National Electrical Manufacturers Association (NEMA)
 8. National Fire Protection Association (NFPA)
 - a. NFPA 50 - Standard for Bulk Oxygen Systems at Consumer Sites.
 - b. NFPA 55 – Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks.
 9. National Safety Council (NSC)
 10. Occupational Safety & Health Administration (OSHA)
 - a. Standard No. 1910.104 – Hazardous Materials - Oxygen.
 11. Underwriters Laboratories (UL) B.
- B. Materials and Manufacture
1. Quality of Materials: Unless otherwise specified, all materials and equipment furnished and installed shall be new, unused, and free from defects and imperfections.
 2. All materials and materials testing shall be to ASTM or other applicable US Standards or their equivalent with cross-reference to their US standards.
 3. Manufacturers of equipment furnished under this Section shall have a minimum of ten (10) years verifiable experience in the design and manufacture of such equipment.
 4. Installation Contractor of equipment furnished under this Section shall possess Class A General Engineering Contractor license and have a minimum of ten (10) years verifiable experience in the installation of the equipment and assemblies of same or larger size and operation, as specified herein.
 5. Installation of the Vacuum Insulated Piping System shall be by the piping system manufacturer or installer shall be supervised by the vacuum insulated piping manufacturer.
- C. Field Quality Control
1. The services of a qualified Engineer, or qualified field service representative, shall be furnished by the LOSVS manufacturer for the minimum time required to instruct and assist the Provider in the handling and installation of the equipment. The minimum required field time is five (5) days.
 2. The services of a qualified Engineer, or qualified field service representative, shall be furnished by the LOSVS manufacturer for the minimum time required to instruct and assist the Provider and City Representative's in the training, testing, startup, operation and proper maintenance of the equipment. The minimum required field time is five (5) days.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with the required submittal procedures. All submittals, drawings, equipment data, calculations, etc. shall be in English and use the English system of units. Submittals shall include, at a minimum, the following:
1. Complete drawings and data to adequately describe the system and indicate full compliance with this Section. At a minimum, this shall include a piping and instrument diagram, details with dimensioned equipment and piping layout, and data sheets or catalog cuts on all system components.
 2. Literature and drawings describing all equipment in sufficient detail, including parts list, materials and details of construction, to indicate full compliance with this Section.
 3. Equipment layout plans and a complete list of the following mechanical and electrical equipment for review and approval by the City Representative. The equipment list shall

include all equipment to be furnished and installed including tanks, vaporizers, valves, and instrumentation equipment. The Contractor shall use the equipment tags/numbers based on the plan. In addition, the Contractor shall submit conduit routing and embedment plans for review and approval by the City Representative prior to construction of concrete foundation slab.

4. Certified dimensional drawings of major equipment and auxiliary apparatus and vacuum insulated piping, including installation drawings and details. Installation drawings shall clearly state the requirements for installation of the system, requirements for their inspection and acceptance, and any other requirement for successful installation, testing and commissioning of the system.
 5. Anchor bolt details for LOX storage tanks and vaporizers, including locations, quantity, diameter, material, minimum edge distance, and depth of embedment for each anchor bolt.
 6. Electrical schematics, panel layouts, wiring diagrams, P&IDs, instrumentation sheets, and product data sheets for all equipment being supplied.
 7. A complete bill of materials for all equipment.
 8. Material test reports, upon request.
 9. Design data for the oxygen system components as follows:
 - a. Manufacturer and model number, size, type, materials of construction, pressure and temperature ratings for the LOX storage tanks.
 - b. Manufacturer and model number, size, type, working pressure, materials of construction, oxygen flow capacity and operation cycle time for the vaporizers.
 - c. Manufacturer and model number, size, type, materials of construction, pressure rating and location of pressure gauges, relief valves, flow meters, etc.
 - d. Manufacturer and model number, size, type, materials of construction for vacuum insulated piping system for liquid oxygen.
- B. Anchor bolts shall be sized by the licensed Engineer of Record and supplied by the Provider. Each tank and vaporizer and its structural support system shall be designed to withstand all loads, including wind and seismic, and applicable combinations as require by the CBC.
- C. Spare Parts
1. Furnish all spare parts anticipated to be replaced during the first two years of operation and special tools suitably packaged and indelibly labeled. A recommended spare parts and special tools list including costs shall also be furnished.
- D. Record Drawings
1. Submit a complete set of record drawings following final adjustments and testing of the LOSVS. The record drawings shall indicate as-built changes to the final approved shop drawings.
 2. Two complete sets of USB media (USB) shall be submitted along with one complete set of prints generated from the USB along with a description of each file provided in the submittal.
- E. Operations and Maintenance Data
1. Operating and maintenance instructions shall be furnished and shall also describe safety procedures and precautions.

1.05 HANDLING, DELIVERY, AND STORAGE

- A. Equipment, including spare parts, shall be shipped by the manufacturer insured, at the manufacturer's cost, to the project site. The Provider shall be responsible for receiving, unloading, and properly storing the equipment in accordance with the manufacturer's instructions. The Provider shall report equipment receipt and all evidence of damage in transit, if any, to the manufacturer no later than ten (10) days after receipt of delivery.

1.06 WARRANTY

- A. Manufacturer's warranty shall be provided for all equipment, systems and controls specified in this section.

1.07 OXYGEN SERVICE

- A. All equipment to be used with oxygen shall be cleaned, sealed and protected in accordance with CGA publication G-4-1 and certified for oxygen service before shipping to the job site. The

LOX storage tanks and the ambient air vaporizers shall be sealed with Grade M or better Nitrogen as described in CGA G-10.1 at a minimum pressure of 10 psig.

- B. All equipment, valves, valve seats, seals, gaskets, instruments, welds, and all associated appurtenances to be used with oxygen shall be furnished of materials resistant to degradation and gas losses due to the use of this gas.

PART 2 PRODUCTS

2.01 PROVIDERS

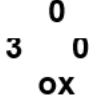
- A. Airgas / Air Liquide
- B. Linde / Praxair
- C. Chart Industries, or approved equal

2.02 LIQUID OXYGEN STORAGE SYSTEM

- A. The LOX storage system shall include all related safety devices, appurtenances and equipment required for operation.
- B. The design of each storage tank shall be based on the following conditions:
 - 1. Capacity of Tank (gallons): 3,000
 - 2. Configuration of Tank: Vertical
 - 3. Normal Operating Pressure (psig): 100
 - 4. Maximum Allowable Working Pressure (psig): 175
 - 5. Design Temperature (° F): -320 to 120
- C. Each tank shall be a conventional, cylindrical, double-walled, insulated cryogenic tank. The inner vessel shall be designed, fabricated, tested, inspected and stamped in accordance with the ASME Pressure Vessel Code, Section VIII, Division 1 and shall be registered with the National Board of Boiler & Pressure Vessel Inspectors. Material shall conform to ASME Section II, Part A, and shall be SA-240 T304 stainless steel or approved equal. The outer vessel (vacuum jacket) shall be constructed of carbon steel, designed for full vacuum internal with a safety factor not less than two (minimum collapse pressure of 30 psi) and to support the inner vessel. No code stamp is required for the outer vessel.
- D. Each tank shall be provided with a mounting base. Anchor bolts shall be sized by a licensed Civil Engineer of record of the Contractors and supplied by the Contractor. Each tank and its structural support system shall be designed to withstand all loads, including wind and seismic loads.
- E. Each tank shall be provided with an internal vessel pressure relief system consisting of both automatic primary and secondary relief devices and manual tank vent valves, and an external vessel pressure relief system consisting of an automatic relief device.
- F. The insulation shall be Super-Fiber, or composite insulation in the annular ring and a high vacuum such that the tank boil-off rate shall not exceed 0.20 percent of the tank capacity by weight per day. Boiled-off gaseous oxygen shall be vented to atmosphere.
- G. Each tank shall be equipped with a pressure build-up system to maintain the specified normal operating pressure at the maximum draw-off rate required to feed the ambient air vaporizers.
- H. Each tank shall be furnished with liquid withdraw system, a vapor return line from the economizer system, a differential pressure indicator/ transmitter, a pressure indicator/transmitter, and both top and bottom fill capability. The differential pressure/transmitter shall measure the differential pressure between the liquid space and the head space. Fill lines shall be sized for a minimum fill rate of 100-gpm and shall be fitted with quick connect couplings for tanker truck delivery of LOX.
- I. Internal piping and fittings shall be Type 304 stainless steel and of all welded connections. Valves shall be of all stainless steel construction, designed and manufactured specifically for use in cryogenic systems. All liquid valves shall have extended stems and bonnets. All piping sections in which liquid oxygen could be trapped by manual or automatic closing of valves shall be protected by safety relief valves. All LOX piping from fill station to tanks and from tanks to vaporizers and from the vaporizers to the point where the piping expands to welded stainless steel pipe as shown on drawings shall be vacuum insulated piping system. Details of the control system and list of instruments to be furnished as the package, including instruments that

may be furnished by the installation contractor, are shown in the Instrumentation and Control (I&C) drawings and specified in Division 40 of these specifications.

- J. Each tank shall be provided with hazardous material signage arrangements painted on both ends and both sides following field painting. Each signage arrangement shall be a 10-inch by 10-inch diamond shaped background painted white. The health sign shall be painted blue, the flammability sign shall be painted red, and the reactivity sign shall be painted yellow. All signs shall be 5-inch high. In the diamond-shaped sign arrangement, the health sign shall be identified at the left, the flammability sign shall be identified at the top, the reactivity sign shall be identified at the right, and the bottom shall be used to identify special hazard. The following numerical grading shall be given to the signs: Health - "3",
1. Flammability - "0", Reactivity - "0" and "OXY" shall be identified as a special hazard.
- Example:

NFPA 704		Diamond		Hazard	Value	Description
				 Health	3	Can cause serious or permanent injury.
				 Flammability	0	Will not burn under typical fire conditions.
				 Instability	0	Normally stable, even under fire conditions.
				 Special	OX	Possesses oxidizing properties.

2.03 LIQUID OXYGEN VAPORIZATION SYSTEM

- A. Ambient air vaporizers shall be provided for the LOX vaporization system including all related safety devices, appurtenances and equipment required for operation. The vaporization system shall be capable of providing continuous feed of gaseous oxygen to process with two parallel units ONLINE and two parallel units OFFLINE for defrosting on an 8-hour switch cycle.
- B. The design of each vaporizer shall be based on the following conditions:
 1. Production capacity: 1,500 standard cubic feet of oxygen per hour (for a duration of 24 hours)
 2. Minimum Period of Operation for continuous vaporization cycle at minimum outdoor ambient temperature and capacity of vaporizer shall be 8 hours.
 3. Normal Operating Pressure (psig): 100
 4. Maximum Allowable Working Pressure (psig): 450
 5. Working Temperature (° F): - 320 to 120
 6. Discharge Gas Temperature (° F): Within 20-degrees of ambient
- C. Each vaporizer shall be of all aluminum construction designed per ANSI B31.3, with Type 6061 aluminum alloy welded base frame and Type 6063 aluminum alloy internal and external finned extrusions. Connections between fins and support frames shall be by mechanical means. Welded connections will not be accepted. Thermal expansion and contraction of materials shall be considered when designing and fabricating the connections. Lifting lugs shall be furnished on each vaporizer.
- D. Automatic vaporizer valve controls shall be furnished to provide automatic switchover to standby vaporizers on a timed basis to prevent vaporizer freeze-up. The vaporizer switching system shall consist of an adjustable cycle timer assembly within the vaporizer switching panel with AUTO/MANUAL control feature of the solenoid switching valves.
- E. Anchor bolts shall be sized by a licensed Civil Engineer of record by the Contractor and supplied by the Contractor. Each vaporizer and its structural support system shall be designed to withstand all loads, including wind and seismic loads.
- F. LOX ambient vaporizers must be fabricated and manufactured by the same company as the LOX storage tanks manufacturer.

2.04 SYSTEM VALVES

- A. Provide valves rated for cryogenic application for all valves that may contact the liquid oxygen flow. Provide extended stems and bonnets for all valves carrying cryogenic liquid.

- B. Cryogenic globe valves:
 - 1. Manufacturers: The following or equal:
 - a. Herose 01341
 - b. Or Approved Equal
 - 2. Design:
 - a. Extended stem and bonnet.
 - 1) Rated to a working pressure of 275 psig.
 - 2) Capable of service between the temperatures of minus 320 degrees Fahrenheit and plus 150 degrees Fahrenheit.
 - 3) Cleaned for liquid oxygen service.
 - 4) End connections: Butt welded
 - 3. Materials:
 - a. Seat: PCTFE.
 - b. Body, Packing Gland, and Bonnet: Stainless steel
 - c. Stem: Stainless Steel.
 - d. Packing Spring and Washer: Stainless steel.
- C. Cryogenic liquid oxygen service check valves:
 - 1. Manufacturers: The following or equal:
 - a. Herose 05414
 - b. Or Approved Equal
 - 2. Valve design:
 - a. Rated for a minimum pressure of 300 psig.
 - b. Capable of service between the temperatures of -325 degrees Fahrenheit and +150 degrees Fahrenheit.
 - c. Cleaned for liquid oxygen service
 - d. End connections: Butt welded
 - 3. Materials:
 - a. Body, cap and arm: Stainless steel.
- D. Cryogenic temperature safety relief valves:
 - 1. Manufacturers: The following or equal:
 - a. Rego 9400 Series.
 - 2. Materials:
 - a. Body, seat retainer, adjusting screw, and pipe-away adapter: Stainless steel
 - b. Spring: Stainless steel.
 - c. Seat: PTFE.
 - d. Clean and package for oxygen service
 - e. Pressure rating: 600 psig, minimum.
 - f. Pressure relief setting: 150 psig.
 - g. Temperature rating: -320 to +165 degrees Fahrenheit.
 - h. Size: 1/4 inch.
 - i. Provide with candy cane riser tube for each valve.
 - j. Minimum capacity at relief pressure: 150 scfm.

2.05 GOX FILTERS

- A. Manufacturer: The following or equal.
 - 1. Donaldson P-EG
 - 2. Or Approved Equal
- B. Materials:
 - 1. Housing, center core and filter support shall all be Type 316L stainless steel.
- C. Capacity and performance:
 - 1. Each GOX filter shall be capable of filtering a minimum of 11,000 standard cubic feet per hour of 99 percent oxygen at a 20 psig inlet pressure, 60 degrees Fahrenheit inlet temperature, and with a maximum pressure drop of 0.5 pound per square inch.
 - 2. GOX filters shall be capable of removing 99.9 percent of particles sized 1.0 micron and larger and 98 percent of particles sized 0.4 micron and larger.
- D. Design and ratings:

1. GOX filters shall be designed and constructed in accordance with the ASME BPVC.
 2. GOX filters shall be designed for a minimum pressure of 100 psig.
 3. GOX filters shall be designed for a minimum temperature range of -20 degrees to +120 degrees Fahrenheit.
- E. Connections:
1. Inlet and outlet gas connections shall be 2-inch, flanged fittings.
 2. Provide 1/4-inch gauge connections on the inlet and outlet nozzles for the differential pressure gauge.
 3. Provide 1/2-inch drain and vent connections.
 4. Contractor shall provide valves and instrumentation as specified elsewhere and indicated on the Drawings for a complete and operable filtration system.
- F. Cleaning:
1. GOX filters shall be cleaned for oxygen service

2.06 GOX PRESSURE REGULATORS

- A. Manufacturer: The following or equal:
1. Fisher Controls Company.
- B. Design:
1. External pilot-operated regulator type with integrally mounted actuator suitable for use in gaseous oxygen system.
 2. Size: NPS 1.
 3. Suitable for connections to 1-inch Class 150 stainless steel flanges sized as indicated on the Drawings.
 4. Performance requirements:
 - a. Provide regulators suitable for service under upstream pressures equal to and less than 150 psig.
 - b. Output pressure operating range: 10 to 30 psig.
 - c. Normal pressure set point: 22 psig or as required by Ozone System Supplier.
 - d. Maximum pilot supply pressure: 150 psig.
 - e. Maximum allowable pressure: 150 psig.
 - f. Include an integral filter for the pilot, which will remove particles of diameter greater than 50 microns.
 - g. Provide pressure gauge immediately downstream near the regulator, with the same range as specified for the regulator.
 - h. Required flow rate range: 3 to 200 scfm.
 - i. Normal upstream pressure operating range: 50 to 70 psig.
 - j. Setpoint shall be capable of being set/changed in the field.
 - k. Provide a travel indicator to indicate the position of the actuator on a scale of 0 to 100 percent.
- C. Materials and components:
1. Main valve body: CF8M Stainless Steel.
 2. Trim type: Linear.
 3. Trim material: S41600 stainless steel.
 4. Trim disk/seal material: NBR.
 5. Main spring range: 60 to 125 psig.
 6. Actuator material: Type 304 stainless steel.
 7. Actuator diaphragm: NBR 17E44.
 8. Pilot spring range: 3 to 40 psig.
 9. Pilot body and spring case material: Aluminum.
 10. Pilot trim material: NBR/stainless steel
 11. Pilot diaphragm material: NBR.
 12. Pilot tubing and fittings materials: Stainless steel.

2.07 LIQUID OXYGEN PIPING SYSTEM

- A. The liquid oxygen piping between the vessel and vaporizers shall be vacuum insulated piping (VIP) system designed by the manufacturer and installed by manufacturer or certified installer. Chart MVIP or approved equal

- B. Inner Carrier
 - 1. Shall be designed and manufactured in accordance with ASME B31.3 - Chemical Plant and Petroleum Piping and latest applicable addenda with X-ray and pressure testing.
 - 2. Inner pipe material shall be 304/L Stainless Steel pipe with a minimum wall thickness of 5S per ASTM A312, welded, schedule suitable for the inner line pressure per B31.3.
 - 3. Inner pipe fittings, including elbows, tees and reducers, shall be Type 304 stainless steel, ASTM A403/SA403. The fittings shall comply with ASTM B16.9.
 - 4. Expansion Bellows shall be located on the outer line. The expansion bellows will be designed to absorb thermal contraction of the inner pipe when operating at low temperatures. Bellows material shall be Stainless Steel, grade 321 or 316L.
- C. Vacuum Jacket
 - 1. Shall be designed in accordance with ASME Code for Unfired Pressure Vessel, Section VIII for an internal vacuum and external atmospheric pressure with the assembly at ambient temperature.
 - 2. Material shall be 304/L stainless steel, ASTM A312 welded pipe, schedule
 - a. 5 with a bright annealed finish. Jacket sizes are as follows:
 - b. 1/2-inch pipe size inner X 2-inch pipe size jacket b. 1-inch pipe size inner X 3-inch pipe size jacket
 - c. 1-1/2-inch pipe size inner X 3-1/2-inch pipe size jacket
 - d. 2-inch pipe size inner X 4-inch pipe size jacket e. 3-inch pipe size inner X 5-inch pipe size jacket
 - e. Jacket elbows shall be a mitered design. Jacket tees shall be a branch tee design. Elbows and tees will be manufactured from the standard jacket material, 304/L stainless steel, ASTM A312 welded pipe, schedule 5 with a bright annealed finish.
- D. Vacuum Annulus
 - 1. The inner carrier shall be supported within the jacket by a support system designed to absorb thermal loads on the inner pipe when partially or completely filled with product, to minimize heat leakage, withstand loading (a, b, and c below) during shipping and loading, and (d) during and after installation
 - a. Three "G" load applied vertically downward. b. Three "G" load applied vertically upward.
 - b. Two "G" load applied horizontally, longitudinally, or laterally combined with one "G" load vertically downward.
 - c. Meet uniform building code for Zone 4 seismic requirements.
 - 2. The inner line shall be "super insulated" with alternate layers of aluminum foil or double aluminized Mylar and cryogenic grade spacer paper.
 - 3. Each spool shall have molecular sieve and a hydrogen converter installed in the vacuum annulus for the purpose of removing the majority of vacuum contaminants released by out gassing.
 - 4. Each spool shall be equipped with a combination evacuation/relief valve port complete with a Hastings DV-6R vacuum transducer for monitoring the vacuum level without breaking the vacuum annulus.
 - 5. Heat shall be applied during the pumping to accelerate outgassing. Means shall be employed on the vacuum pumping system to prevent oil from
 - 6. back-streaming into the spool vacuum space. Spools shall be sealed at less than 10 microns.
 - 7. All welds shall be leak-tested with a helium mass spectrometer calibrated to a sensitivity of 1×10^{-9} standard cc/second and shown to be leak free.
- E. Pressure Ratings
 - 1. Carrier pipe design pressure: 200-psig
 - 2. Annular Relief Setting: 5-psig
- F. Manufacturing facility shall have ISO-9001 approved quality system. The quality system must be audited and registered by a certified ISO-9000 inspection agency.
- G. Manufacturing facility shall have an ASME "U" stamp certification which indicates the approved implementation of systems and requirements related to the manufacture of ASME pressure vessels.

2.08 PAINTING AND CLEANING

- A. Vessel shall be painted white per manufacturer's standard paint system.
- B. Prior to coating, all weld splatter and other irregularities shall be removed by chipping or grinding, and all sharp corners grounded to 1/16 inch minimum radius. All oil and other contaminants shall be removed by solvent washing or steam cleaning.
- C. All tanks and piping interior to be in contact with gaseous and liquid oxygen shall be properly clean with no trace of oil and dirt. Upon thorough cleaning of interior, seal the openings to ensure no re-contamination during transport and shipping.

PART 3 EXECUTION

3.01 COORDINATION

- A. Provider shall coordinate with LOSVS manufacturer and other equipment suppliers to obtain all parts and proper installation instructions.
- B. Provider is responsible for coordinating with Crossland Construction to coordinate installation, startup and maintain the overall schedule of the project for delivery to the City of Topeka to be ready for testing on 11/2/2026.

3.02 INSTALLATION

- A. Installation of all equipment shall be in strict accordance with the manufacturer's written installation instructions and recommendations in the locations shown on the Drawings.
- B. All marred and damaged coatings shall be repaired and corrected by the Contractor so as to maintain coating integrity in accordance with the manufacturer's requirements.

3.03 FIELD INSPECTION AND TESTING

- A. Furnish the services of a factory representative who has complete knowledge of the proper installation, startup and operation of the LOSVS, to inspect the final installation and supervise a test run of the system. If there are difficulties in operation of the system due to the manufacturer's fabrication or Contractor's installation, additional service shall be provided at no additional cost to the City.
- B. Provider shall be responsible for scheduling, ordering and supplying liquid oxygen onto site for all required field and startup testing. Provider shall coordinate with manufacturer on the amount of liquid oxygen required for the testing.
- C. After the installation of the LOSVS has been completed and approved by the manufacturer's representative and the system operated for a sufficient period to make all desirable corrections and adjustments, the system shall be given a field test in the presence of the City Representative and Crossland Heavy Construction Representative to determine that operation is satisfactory and in compliance with this Section and that all safety and protective devices are in proper adjustment. During this test period, the system shall be operated for not less than 12-hours, during which time readings of all essential data shall be taken and recorded at 2-hr intervals. A field test report, including a test data sheet, shall be submitted to the City Representative for approval at least 30-days prior to testing the equipment. Testing shall include the following:
 - 1. Test the tank fill line to demonstrate that the liquid flow rate meets the minimum specified value.
 - 2. Test each storage tank under actual start-up and operating conditions to demonstrate that the operation is satisfactory, that the pressure building system and economizer system are operating properly and that the liquid oxygen boil-off rate does not exceed the specified value. The test data shall indicate, at a minimum, the time and corresponding tank level, pressure and temperature.
 - 3. Test each vaporizer under actual start-up and operating conditions to determine that the operation is satisfactory, and that the duration of vaporization to freeze at the design flow rate and the duration of defrosting period do not exceed the specified values. The test data shall indicate, at a minimum, the time and corresponding gas flow rate, gas pressure, gas temperature, and vaporizing and defrosting cycle times. A minimum of
 - a. two complete vaporizing and defrosting cycles shall be conducted for each
 - b. vaporizer.

- D. In the event the equipment fails to meet the requirements specified herein, corrective measures shall be taken, or the equipment shall be removed and replaced with units that meet these specifications and retested at no additional cost to the City.
- E. Electrical, Instrumentation and Control System
 - 1. Testing, startup and commissioning of the Electrical and Instrumentation & Control System shall be in accordance with Division 26 and Division 40 of these specifications.

3.04 TRAINING

- A. Provide up to 8-hours of training on liquid oxygen technology, in accordance with this Section.
 - 1. Liquid Oxygen/Gaseous Oxygen Properties: Physical characteristics and behavior of oxygen. Discussion of flashpoint, triple point, critical points, and thermodynamics of oxygen.
 - 2. Liquid Oxygen/Gaseous Oxygen Handling: Discuss safety and practical procedures for the handling of liquid and gaseous oxygen.
 - 3. Liquid Oxygen/Gaseous Oxygen Process Equipment and Materials: Special equipment and materials need to handle liquid and gaseous oxygen. Discuss items such as cryogenic control valves and storage tank materials, process piping and construction.
 - 4. Liquid Oxygen/Gaseous Oxygen Production and Purity: Discuss technology behind the production and transportation of liquid and gaseous oxygen. Discuss purity and the various items that affect purity. Discuss dew point control and testing.
 - 5. Liquid Oxygen/Gaseous Oxygen Regulations: Regulations pertaining to production, transport, storage and handling of liquid and gaseous oxygen.
 - 6. Applicable Fire Safety and Fire Codes.

3.05 IDENTIFICATION

- A. The vessel provided shall have a nameplate securely attached at a readily visible location. The nameplate shall be engraved with the following minimum information, in units specified.
 - 1. City equipment number
 - 2. Manufacturer Size and Model Number
 - 3. Equipment Serial Number
 - 4. Rated Pressure (psig)
 - 5. Rated Capacity (gallons or scfh)
 - 6. Manufacturer's bearing identification numbers, if applicable

PART 4 CONTRACT

- A. The initial term of the contract is for two (2) years from the date of contract execution by written agreement of both parties with three (3) additional one (1) year renewal options subject to acceptable performance by the Provider and by mutual consent of both parties under the same terms and conditions of the award.
- B. Bids will be analyzed and the award made to the lowest responsive and responsible bidder whose products and services conform to and/or meet or exceed specifications listed for the equipment. The City reserves the right to accept or reject any and all bids and all or part of a bid and to waive informalities, technical defects and minor irregularities in the bids received. However, to receive consideration, all items must be provided for competitive evaluation of the bid. The City will be the sole judge of equality and suitability.