

Town of Branford
BRANFORD WPCF PROCESS SYSTEM UPGRADES
Branford, Connecticut
Contract #052225
Addendum #3

Date: June 23, 2025

New Submission Date: June 27, 2025, 11:30 am (per this addendum)

Prospective bidders, and all those concerned, are hereby informed that the following is made a part of the bid documents, which should be amended as follows:

ATTACHMENTS*

A. Revised Appendix B, Figure E0-03

C. Addendum No. 2, Attachment C - Revised Specification 11375 High Speed Turbo Compressors

*Note: Revisions to attachments are provided in red.

Questions Submitted by Bidders:

1. Note No. 1 on Figure E0-03 of Appendix B is confusing. Please clarify.

A key word is missing from Note No. 1 on Figure E0-03. The revised Figure E0-03 is attached.

2. Attachment C of Addendum No. 2 is the same as Attachment B. Please provide Attachment C.

Addendum No. 2, Attachment C is included as an attachment to this addendum.

3. Given the delay in receiving Attachment C of Addendum No. 2, will there be an extension on the bid submission deadline?

The bid submission deadline has been extended to June 27, 2025, 11:30 am.

Respectfully submitted,

Brian Devlin,
Sanitation Superintendent

Please acknowledge receipt of addendum below and submit with your bid submittal.

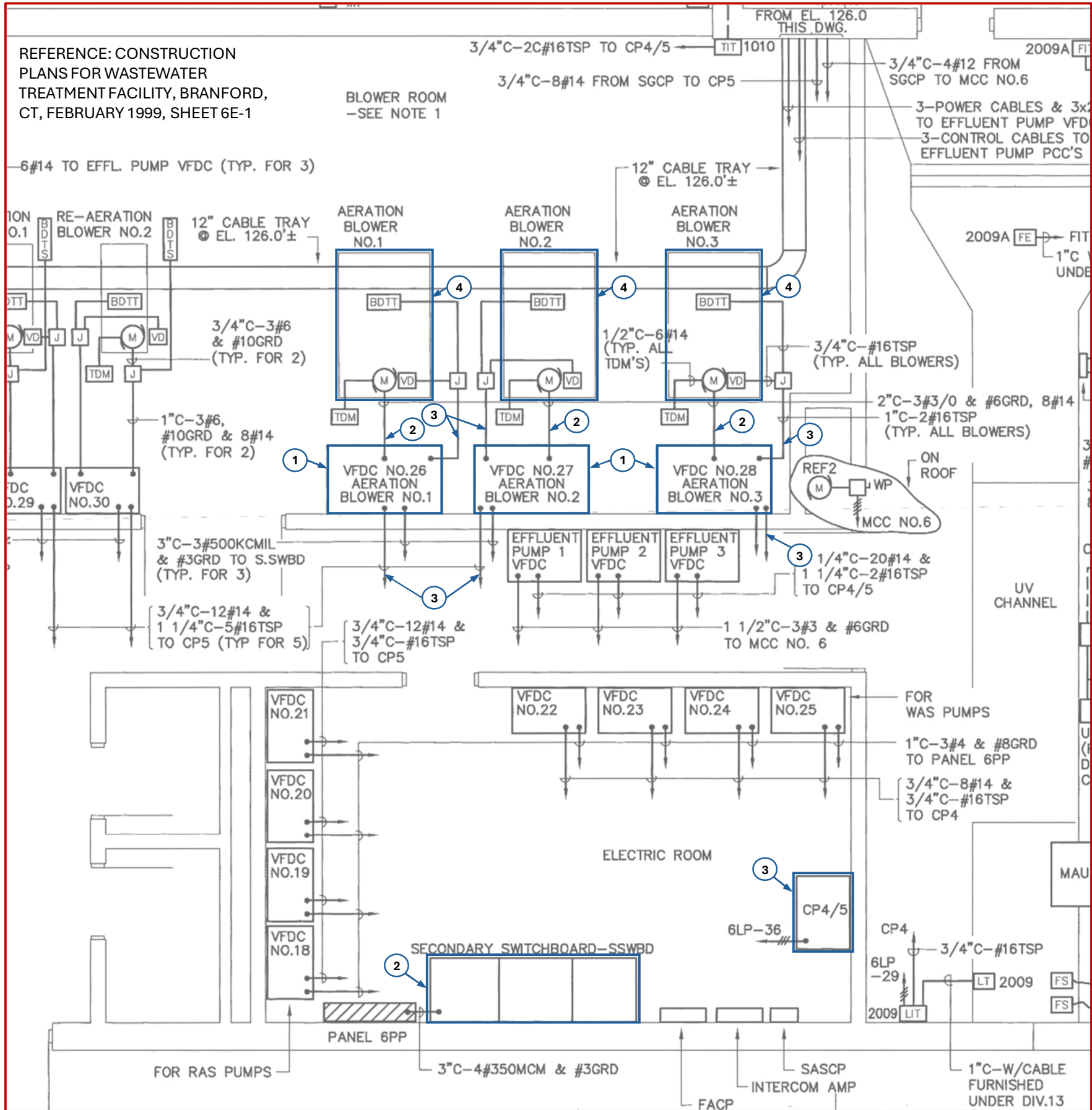
Signature: _____ Date: _____

Title: _____

Company: _____

ATTACHMENT A

Revised Appendix B, Figure E0-03



NOTES:

1. DEMOLISH AND REMOVE EXISTING AERATION BLOWER VFD (TYP. OF 3).
INSTALL PROPOSED DISCONNECT SWITCH AND EXTERNAL HARMONIC
FILTER (IF NEEDED) IN PLACE OF EXISTING VFD.
2. CONNECT SECONDARY SWITCHBOARD POWER FROM EXISTING VFD TO
PROPOSED DISCONNECT SWITCH AND ROUTE TO NEW BLOWER DRIVES
(TYP. OF 3).
3. CONNECT SIGNALS FROM PROPOSED AERATION BLOWER TO CONTROL
PANEL CP4/5 (TYP. OF 3).
4. REFER TO SHEET M0-01.

Per Addendum No. 3

Per Addendum No. 2

Per Addendum No. 2

Per Addendum No. 2

FIRST FLOOR PLAN – SECONDARY PROCESS BUILDING
SCALE: NTS

JUNE 2025

**FIGURE
E0-03**

Addendum No. 2 - ATTACHMENT C
Revised Specification 11375 High Speed Turbo Compressors

SECTION 11370

MAGNETIC BEARING HIGH SPEED TURBO BLOWERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish, install and test three high speed, magnetic bearing turbo blowers complete with accessories. Each blower will be provided with an inlet filter, inlet silencer, outlet flexible joint, outlet silencers, back flow barrier, manual isolation valve, blow-off valve and silencers, motor cooling air outlet silencer, acoustic sound enclosure, VFD, local control panel, magnetic bearings and other appurtenances as described in this specification section needed for a complete system. The same supplier shall furnish the turbo blowers and accessories.
- B. Blowers shall be complete pre-packaged units. High efficiency, high speed motors shall be furnished as integral part of the Blower Core assembly. Units shall have an integrated air filter, variable speed drive, and controls. Blowers shall be magnetic bearing type. Air bearing turbo blowers will not be accepted.
- C. All components in this Section shall be factory fabricated by an authorized distributor of the blower unit into a complete operational package system.
- D. Related Work Specified Elsewhere:
 - 1. Instrumentation and Control are specified in Division 13.
 - 2. Piping and valves are specified in Division 15.
 - 3. Electrical is specified in Division 16.

1.02 REFERENCES

- A. The turbo blower and accessories shall be in accordance with the referenced standards listed below.
 - 1. American Iron and Steel Institute (AISI)
 - 2. American National Standards Institute (ANSI).
 - 3. International Standards Organization (ISO) 5389: 1992 – Turbo compressor.
 - 4. ASME PTC 10 – 1974, reaffirmed 1986 Compressors & Exhausters.

1.03 QUALITY ASSURANCE

- A. The package blower systems, including blower, motors, controls and all appurtenances to form an integrated blower package, shall be supplied by one manufacturer who shall provide all the equipment and appurtenances regardless of manufacturer and shall be responsible to the Contractor for satisfactory operation of the entire blower package.

B. Qualifications of Manufacturer:

1. Firms experienced in manufacturing high-speed turbo blowers similar to those indicated for this Project and that have a record of over three years successful in-service performance in North America for similar municipal wastewater treatment applications. Manufacturer must have blowers permanently installed and operational with proven reliability in at least 20 wastewater treatment facilities in North America. Five of these facilities must be of 100 hp or over units similar in design to what is specified. Finally, manufacturer must also have a history of manufacturing and providing this equipment for at least 20 years (can include non-North American experience).
- C. The blower stage Manufacturer shall provide a written statement for the blower and the blower package stating that they have reviewed the design and application, and that the equipment is appropriate for the application, and that the blower package is properly designed.
- D. Complete blower package shall be certified by a NRTL such as UL, CSA, or TUV, and affixed with a label for the enclosure and all equipment.

1.04 SUBMITTALS TO THE ENGINEER

- A. Submit manufacturer's literature, maintenance data and operating instructions in accordance with the General Conditions and Section 01300.
- B. Submit shop drawings including but not limited to the following:
 1. Certified dimensional drawings of the turbo blower unit assembly, including accessories shall be provided.
 2. Certified anchor bolt layout drawings.
 3. All dimensional drawings necessary to coordinate piping layout with structural, architectural, and/or other mechanical work.
 - 3-4. Inlet and discharge connections will vary by blower manufacturer. Submit piping details.
- C. Quality Assurance Submittals:
 1. Performance Test Reports signed by the Manufacturer's test engineer shall be submitted after fabrication of complete unit, but prior to shipment of the turbo blowers unless the Engineer or Owner waives this requirement. Test shall be performed on complete unit only, testing of high-speed unit only will not be acceptable. Tests shall be conducted on each individual contracted unit, as testing of other than all turbo blowers shall not be acceptable.
 - a. Results of each test shall be summarized in a separate, certified, standard factory written test report.
 - b. Reports shall be organized and clearly present testing methods and procedures, testing equipment used as well as the test data. A copy of the

report shall be placed in a metal holder that is part of the electrical cabinet door for reference.

- c. One copy of each certified written test report shall be submitted to the engineer for review and acceptance. Test reports shall be reviewed and accepted by the Engineer prior to shipment unless the Engineer or Owner waives this requirement.
 - d. Certified test report(s) shall include the following:
 - 1. Performance curves that includes air flow rate in scfm versus input horsepower for each turbo blower.
 - 2. Hydrostatic test results.
 - 3. Dynamic balancing test results for each turbo blower.
- D. In addition, the following items shall also be submitted:
- 1. Requirements for storage and protection prior to installation.
 - 2. Installation instructions including leveling, alignment, pre-startup checklist and initial startup procedures.
 - 3. Requirements for routine maintenance required prior to plant startup.
 - 4. Catalog data for equipment and appurtenances identified within this specification, and as required for a complete and operating package blower system.
 - 5. The weight of each component and the total shipped weight.
 - 6. Blower performance data including performance curves and noise levels five feet from the enclosure, in dBA, for the startup operation and the operating conditions.
 - 7. Factory Acceptance Test results compliant with ISO-5389 and VDI 2045, parts 1 and 2, stamped by a registered PE from the testing facility.
 - 8. Data sheets and product manuals for all instrumentation.
 - 9. Complete description of all controls and control panel, including complete master wiring diagrams, elementary or control schematics, and panel outline drawings.
 - 10. Materials of construction for all major turbo blower components and accessories.
 - 11. A list of the manufacturer's recommended spare parts.
 - 12. Motor performance tests.
 - 13. UL certification forms.
- E. Where deviations to Contract Documents are proposed, submit a list of deviations. Provide a detailed description and explanation for each deviation.
- F. Manufacturer's Field Reports: A manufacturer's certification report shall be submitted in accordance with Section 3.04.B.
- G. Submit qualifications of Service Engineer.
- H. Confirmed Power Guarantee Table 1 (provided later in this specification)

1.05 DESIGN CRITERIA

A. Aeration blowers to meet the following design criteria.

Total Number of Blowers	3 (2 duty, 1 standby)
Method of Operation	parallel, continuous
Blower Type	Magnetic Bearing
Drive Type	Direct
Design Ambient Barometric Pressure	14.64 psia
Design Relative Humidity	90%
Design Site Elevation (NGVD)	113.5 ft
Design Inlet Air Temperature	-22 14 to 122 100 Deg F
Blower Inlet Pressure Loss (Ductwork and Filter)	0.1 psig
Design Blower Maximum Capacity (per blower)	1200 SCFM
Design Blower Minimum Capacity (per blower)	700 ICFM
Maximum System Capacity at Duty Point	2,400 SCFM
Design Discharge Pressure	23.2 psia
Design Differential Pressure	8.5 psig
Discharge Flange	10 inch
Primary Air Source	Ducted Inlet
Inlet Flange	10 inch
Maximum Motor Horsepower (VFD Rated)	100
Maximum Design Speed	43,500 RPM
Available Power Voltage	460/480 V
Available Power Phase	3 Phase
Maximum Noise at 5 Feet	75 decibels
Maximum weight of unit	2,500 lbs
Allowable vibration level	< 20µm/sec

B. Guaranteed Not to Exceed Performance:

1. The Blower Manufacturer shall Guarantee wire-to-air kW values. The wire kW shall include all cooling, electrical, mechanical, and aerodynamic losses associated with blower unit at all specified operating points and shall be in accordance with factory performance testing requirements specified in Paragraph 2.10. Table 1 will be considered the basis of the Power Guarantee and all requirements as specified herein.

Table 1

Town of Branford, Connecticut

WPCF Upgrade - Process Aeration Energy Estimate and Proposed Power Guarantee

Design Point	Number of Blowers Operating	Flow per Blower	Input Power per Blower		Total Input Power		Guaranteed Wire-to-air
		SCFM	HP	kW	HP	kW	kW
1	1	752	42.8	31.9	42.8	31.9	31.9
2	1	821	45.8	34.2	45.8	34.2	34.2
3	1	1116	61.2	45.6	61.2	45.6	45.6
4	2	835	45.6	34.7	93.2	69.5	69.5
5	2	1242	69.8	52.0	139.6	104.1	104.1
Notes: 1. Input Power is +/- 2%, include power losses from the VFD, MBC, and LCP and are based on 8.5 psi/ 68 def F/ 70% Relative Humidity. 2. Total Input Power = Number of Blowers x Input Power per Blower.							

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

1. Protect equipment during shipment in accordance with manufacturer's recommendations and Specification Section 01610.

1.07 WARRANTIES

- A. The blower manufacturer shall furnish the Owner with a comprehensive, non-prorated written warranty to cover the Blower Package, including motors, VFDs, and control components against defects in workmanship and material for a period of five years from the date of Substantial Completion, not to exceed 66 months from date of shipment. The manufacturer's warranty shall be issued in the Owner's name.

1.08 MANUFACTURER'S SERVICE

- A. Contractor shall coordinate the work schedule of the manufacturer's service personnel during construction, testing, start-up and acceptance, as required in Part 3.
- B. Provide services of a factory trained Service Engineer, specifically trained on the type of equipment specified. Submit qualifications of Service Engineer for approval. One workday is an 8-hour day on-site per blower, plus time as required for integration with the master control unit. The minimum work-day requirements specified are exclusive of travel time and do not relieve Contractor of their obligation to provide sufficient service to place equipment in satisfactory operation and in accordance with the Manufacturer's instructions and warranty requirements. All workdays not used during the project shall be credited back to the Owner.
- C. Time and materials used to correct defective equipment at no additional cost to Owner and in addition to time periods specified above.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sulzer Pump Solutions, Inc.
- B. Or equivalent.

2.02 GENERAL

- A. Blower package shall be designed for heavy, continuous, municipal service, be capable of providing a minimum of 20 starts per hour and have a minimum design life of 20 years before any mechanical rebuild will be needed,
- B. Blower packages shall be designed to minimize the life-cycle costs and maximize plant environmental operating conditions, availability and reliability.
- C. Noise emission from the blower package shall not exceed 80 dBA in the Blower Room, at the air intake, startup blow-off system, or at the discharge piping system.
- D. The single-stage radial centrifugal turbo blowers shall be of the magnetic bearing type and shall not require oils or lubricants for adequate continuous operation.
- E. The blowers shall be capable of variable speed operation with a minimum turndown as required to meet the specified operating points. Each blower shall be capable of operating continuously and satisfactorily at any point between the minimum and maximum flows without any surge, vibration, hunting, or excessive heating of bearings or motor.
- F. Rotor critical speed must be a minimum of 20 percent above the operating design speed. Each blower shall be designed to operate to maximize overall system efficiency over the range of operating conditions.
- G. Complete blower package shall be certified by a NRTL such as UL, CSA, or TUV.
- H. All elastomeric materials for couplings, valves, etc., shall be rated for minimum 250 ° F.
- I. System components shall be designed for continuous operation in an environment with conditions as follows:

1. Range of Ambient Service Conditions

Inlet Air Temperature Range	14 to 105 <u>100</u> degrees F
Relative Humidity	25 to 95 percent
Ambient Pressure	14.7 psia
Ambient Temperature	14 to 113 <u>100</u> degrees F

2.03 BLOWERS

- A. Turbo blowers shall be of a single-stage centrifugal design utilizing oil-free non-contacting magnetic bearing technology. Each blower shall be designed to not surge at or above specified flow rates corresponding to specified discharge pressure.
- B. Blower impellers shall be shaped from a solid forging on a numerical machining center using computer aided manufacturing technology to ensure consistent efficiency. Semi-open impeller design with three-dimensional shaped blades shall be optimized for the design range of each turbo blower. The impeller shall be attached directly to the motor shaft without a coupling or keyway. The impeller shall be of a standard design configuration.
- C. The magnetic bearing system shall consist of two radial and two axial active magnetic bearings, two rotor position sensors, and a magnetic bearing controller (MBC). The position sensors shall continuously measure the shaft position and send a signal to the MBC controlling the energy in the active magnetic bearings keeping the motor rotor shaft levitated and centered. The magnetic bearing system shall not require oil lubrication.
- D. The motor rotor shaft shall be continuously levitated in a magnetic field by the digitally controlled magnetic bearing system when power is on. This system shall consist of two radial and two axial active magnetic bearings, two rotor position sensors and a magnetic bearing controller (MBC). The position sensors shall continuously measure the shaft position and send a signal to the MBC controlling the energy in the active magnetic bearings, keeping the motor rotor shaft levitated and centered. There shall be no mechanical contact at any time between any moving and stationary surfaces during the turbo compressor operation, eliminating friction and wearing of all moving parts. The magnetic bearing system shall not require any oil lubrication.
- E. There shall be no mechanical contact at any time between any moving and stationary surfaces during the blower operation eliminating friction and wearing of all moving parts.
- F. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum of expected ten years between major overhauls.
- G. Each blower shall be supplied with a sound enclosure covering the entire blower package. The sound enclosure shall be designed for easy inspection and maintenance of all blower package components. Provide quick release panels, each with at least two handle locations and weighing less than 55 pounds (as mandated by OSHA), enabling easy and quick access for routine maintenance of the blower package components. Should the panels be heavier than 55 pounds, supply hinged doors with the appropriate frame, reinforcements, and supporting elements. The blower package enclosure shall protect against falling water, condensation, and dust. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.
- H. The high speed unit shall be enclosed in a noise reduction system that reduces the noise levels to less than 80 dBA at 3 feet from blower enclosure.
- I. Blowers shall not allow heat caused by motor or electrical cooling to be exhausted into blower room. Contractor shall provide additional in-kind ductwork needed to connect the

- blower's motor cooling outlet to the existing cooling air duct above the existing VFDs, as shown on the Figures.
- J. Each blower shall be designed with a flanged inlet to introduce air from an outside air source through an inlet filter.
 - K. Intake and filter performance losses shall be included by the blower vendor in the blower performance calculation. Filters shall be easily serviceable.
 - L. Each blower shall be supplied with built-in vibration isolating mounts. Blower manufacturer shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required nor shall any vibration from the blower package be transmitted to the floor or intake and discharge base or the piping. Manufacturer shall supply acceptable vibration levels for the entire blower assembly over the entire operational range of the supplied unit.

2.04 APPURTENANCES

- A. Provide all necessary electrical components and wiring on the blower skid for a complete, functional blower system. All equipment on the blower skid shall be pre-wired.
- B. Each blower shall be supplied with a round flexible EPDM inlet duct connector to connect between the blower and the inlet duct. The inlet expansion joint shall have galvanized steel flanges with an EPDM bellows. Bolt hole pattern and size shall match the blower inlet ANSI flange dimension specified in the Design Criteria.
- C. Each blower package shall include a flexible connector to be installed on the discharge aeration piping prior to the main air header. The flexible connectors shall be sized for a standard pipe diameter and shall prevent the transmission of noise and vibrations from the blower package into the piping. The flexible connector shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream per Section 15210. Provide stainless restraining bolts and hardware. The flexible connector shall have galvanized steel flanges and 304 stainless steel bellows.
- D. Each blower shall be supplied with one wafer-style, dual plate check valve that shall be installed on the discharge line. It shall silicon coated or have a silicon sealing surface, and it shall prevent back flow into the turbo blower and be installed in the horizontal section of the discharge pipe.
- E. A manual short body wafer type butterfly shut off valve shall be provided for each turbo blower. The shutoff valve shall be geared for ease of operation. It shall be installed in the discharge pipe to isolate the turbo blower from the process. The valve discharge shall be supplied with a properly sized blow-off silencer.
- F. An inlet scrap trap shall be installed in the inlet pipe to prevent particles larger than 0.08 inches (2 mm) by 0.08 inches (2 mm) from entering the turbo blower. The inlet scrap trap shall be located between two flanges as close to the turbo blower inlet flange as possible.
- G. Each blower shall be provided with an integrated intake / inlet filter. Intake filter performance losses shall be included by the blower vendor in the blower performance

calculation. The intake / inlet filter shall be integrated into the overall blower and enclosure design per manufacturer's recommendations and shall fit within the room that houses the existing blowers. Inlet filter shall be suitable for outdoor installation and mounted directly to the inlet flange of the blower.

1. The intake shall have a round ANSI flange of the diameter specified above to attach to the intake ductwork. The flange shall be tapped to accept correctly sized flange bolts to allow connection to the inlet vibration dampener.
 2. The filter media must have an efficiency of 90% by weight per ASHRE 52-76 with synthetic dust equivalent to separation > 95% @ 10 microns. Filter element shall be removable without disconnecting the inlet duct and shall be washable by maintenance personnel as a preventative maintenance procedure.
- H. Each blower shall be equipped with the following integrated instrumentation.
1. Inlet Differential Pressure Sensor (Installed across inlet filter)
 2. Inlet and Discharge Pressure Sensor
 3. Inlet and Discharge Temperature Sensors
 4. Bearing Temperature sensor
 5. Motor Temperature sensor
 6. Blower Speed Sensor
 7. Rotor Vibration Sensor
 8. Magnetic Bearing Controlling System
- I. Temperature Sensors
1. Provide temperature sensors in the inlet and outlet connections, motor, and VFD for each turbo blower.
 2. Temperature sensors shall be manufacturer standard and integral to the blower enclosure.
- J. Pressure Gauges
1. 2½-inch dial, 0 to 15-inch water column vacuum intake range, and 0 to 15 psig discharge range, with snubbers.
 2. Suction and discharge pressure gauges shall be supplied for each blower. The pressure gauges shall meet the requirements outlined herein.
 3. Pressure gauges shall be as manufactured by Ashcroft, or equal.
- K. Battery Backup for MBC:
1. Each turbo blower shall have an integral battery backup system that provides a secondary source of power for the magnetic bearing controller (MBC). This system is a backup feature that is the first line of safety if a power outage occurs assuring that the turbo blower will spin down without damaging the high-speed unit.

2. The battery backup system shall have batteries sufficiently sized to provide multiple safe spin-downs.

2.05 MOTORS

- A. An air-cooled, VFD compatible, high speed, special duty electric induction motor specifically designed for high-speed service shall be provided.
- B. The maximum allowable motor horsepower shall be as specified in the Design Criteria.
- C. The motor shall have Class F winding insulation (with Class H on critical components) with thermal sensors that are tied into the thermal protection surveillance software built into the blower control system.
- D. The motor rotor shaft shall be supported by magnetic bearings at all times while power is supplied to the turbo blower, providing a smooth vibration free rotation over the entire speed range. Blowers that use bearing systems that contact stationary parts during start up or if power is lost are not an acceptable alternative.
- E. Each motor shall operate on 460/480 volts, three-phase, 60-Hz input power. The maximum allowable motor horsepower shall be as specified in the Design Criteria. Motors shall be premium efficiency type.
- F. The motor shall be air cooled by a cooling fan that is mounted directly to the end of the motor rotor shaft. Units that are cooled by separately driven fans or by anything other than ambient air shall not be considered as equal.
- G. Each motor shall have a 1.15 service factor. The motor shall be able to start under the starting conditions required. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor. Certified tests shall be submitted to the Engineer prior to shipment of the equipment.
- H. Additional requirements for the blower motors are:
 1. Maximum Ambient temperature: ~~113~~100 Deg F
 2. Minimum Ambient Temperature: 14 Deg F
 3. Duty: Continuous.
 4. Bearings: Magnetic Bearings.

2.06 INVERTER / VFD

- A. Each blower shall be equipped with a high efficiency UL certified VFD (Variable Frequency Drive) with 97% efficiency at full rated motor speed and power.
- B. The VFD along with internal high-speed controller (ICE) shall automatically control the turbo blower performance from either an air header pressure transducer, D.O. probes, or if in local mode, directly from the local control panel.
- C. Each blower VFD shall meet all relevant technical requirements for VFDs specified in Division 16.

- D. Each VFD shall have a manufacturing operation in the USA for manufacturing, support, and provision of replacement parts.
- E. Each VFD shall be supplied with a passive harmonic filter that reduces the THD (Total Harmonic Distortion) to < 5% in compliance with IEEE 519 rating. The filter shall consist of capacitance portion of the unit which shall be controlled via a contactor to operate and be switched with the operation of the VFD. The harmonic filters shall be supplied by Transcoil (TCI), Artech, Mirus International, or approved equal.
- F. Each VFD shall have an integrated user interface that includes field bus connection and free available support software. Provide control of VFD via touch screen control panel and PLC.

2.07 INSTRUMENTATION AND CONTROLS

A. General:

- 1. Each blower shall have a Local Control Panel (LCP) that is an ICE-based control system to allow for the operation, adjustment, protection, and monitoring of each blower. Each LCP shall be provided with a face-mounted operator interface terminal (OIT) that will display blower information and allow an operator to start, stop and set the speed of the blower. These local control panels will be an integral part of the blower system.
- 2. The Blower manufacturer shall provide the Owner's System Integrator with a PLC address list that includes all required monitoring points for the SCADA system. The Blower manufacturer shall also coordinate with the Owner's System Integrator to ensure proper communication between the Blower LCPs and the plant control system.
- 3. All control panel cabinets and enclosures shall be provided in accordance with Division 16. All control stations, selector switches, pushbuttons, control circuit fuses, relays, timing relays, indicating lights, fuse blocks, terminal strips and control power transformers shall be provided in accordance with Division 16.
- 4. All components in the control panels shall be completely factory wired and shall include all necessary controls for both the manual and automatic operation, as indicated. All external control connection points (power and control connections) shall terminate on terminal blocks. The terminal strip shall have box type connectors, and all terminals shall be clearly marked for easy identification. A ground terminal strip shall also be provided. At least 10 percent of terminals supplied shall be spare.
- 5. The Local Control Panel will include a complete panel wiring diagram including exterior devices and motors to be connected shall be encased in a clear re-sealable plastic pouch(es) mounted on the inside surface of the access door.
- 6. Wiring shall comply with the latest edition of the National Electrical Code.
- 7. All electrical connections to external devices and equipment shall be provided by the Contractor.

8. All equipment and controls shall have nameplates. The nameplates shall be of black lamicoid with white filled engraved legends.
 9. Install equipment and controls furnished by other manufacturers in accordance with their instructions, where applicable.
 10. Each PLC in the Local Control Panels (LCPs) shall interface with the Plant SCADA System via CAT6 Ethernet connection from Ethernet data switches in each of the LCPs to an Ethernet data switch in CP-5. The communication with the facility's new SCADA network will be configured by others using addresses approved by the Owner and configured by the LCP supplier. The CAT6 cable is furnished and installed under Division 16.
 11. The Blower manufacturer shall supply the Plant System Integrator with a PLC I/O address list for all of the signals that will be required for monitoring and control by the existing Owner's SCADA system.
- B. Miscellaneous Electrical Devices:
1. Provide a 120VAC to 24VDC power supply to power the PLC inputs, and other 24VDC powered devices. The 24VDC power supply shall have a voltage adjustment, run light, built-in noise filter, and built-in over current protection with automatic reset.
 2. Lightning and Surge Arrester: All electrical equipment shall be protected by a UL approved Category C and Category B surge arrester which shall suppress excessive voltage surges on incoming power. The device shall withstand an impulse of 10Kv/10Ka under IEEE C62.41 Category C and shall withstand a ringwave of 6Kv/500a and an impulse of 6Kv/3Ka under Category B. Pass voltage for a 480v device to the end equipment shall not exceed 1800V when subjected to an 8 x 20 microsecond waveshape, resulting in the following performance statistics: 3720 joules minimum dissipation at 82,500,000VA and 1800V maximum voltage. Response time shall be less than 5 nanoseconds.
- C. Ethernet Switch:
1. Each blower LCP will include a minimum 5 port industrial ethernet switch to connect the ICE, operator interface, control panel power/data port. The Ethernet switch shall be Allen-Bradley 1783-LMS5 Stratix 2500.
- D. Blower Local Control Panel Hand Functions:
1. The LCP will include Locked Stop pushbutton on the front of the LCP, which will immediately stop the blower when pushed. The status of this switch shall be monitored by the PLC.
- E. Blower Local Control Panel Functions:
1. The Blower LCP will provide all interlocking and control functions required for the proper operation of the blower.
 2. The LCP will continuously monitor all blower instrumentation and display all conditions on the local OIT.

3. The LCP will continuously calculate the blower's curve based on the inlet conditions and will calculate a minimum and maximum allowable speed based on this curve. The LCP will only allow the blower to run between these minimum and maximum calculated speeds in order to keep the blower from running in surge and overload conditions. The LCP will also calculate surge and overload warning and alarm setpoints based on this blower curve.
 4. The LCP will allow an operator to locally start, stop, and manually adjust the blower's speed from the local OIT. The operator will also be able to place the blower in an "Auto" mode, which will allow a remote PLC to start, stop, and send a remote speed setpoint. The blower PLC will not allow the blower to be below the minimum calculated minimum or calculated maximum speed setpoint in Local mode or Auto mode.
- F. Blower Local Control Panel Operator Interface Terminal (OIT) Functions:
1. The OIT functions listed in this section are intended to provide a basic minimum of each blower's OIT functionality; any additional items that are required by the blower vendor for operation of their equipment shall be included in addition to the functions listed in this section.
 2. The blower OIT will indicate the following conditions:
 - a. Blower Status (RUN/STOPPED)
 - b. Blower Inlet Filter Pressure Drop Indication
 - c. Blower Suction Pressure Indication
 - d. Blower Discharge Pressure Indication
 - e. Blower Suction Air Temperature Indication
 - f. Blower Discharge Air Temperature
 - g. Blower Motor Temperature Indication
 - h. Blower Bearing Temperature Indication
 - i. Blower Rotor Vibration Indication
 - j. Blower Enable/Not in Remote Status
 - k. Blower Speed Indication (0-100%)
 - l. Blower Run Times (Hours)
 - m. Blower Amp Draw (amps)
 - n. Blower Airflow (SCFM)
 - o. Blower Min and Max Operating Speeds (based on Blower Curve)
 - p. Blower Surge and Overload Speeds (based on Blower Curve)
 3. Blower OIT alarms:
 - a. Local indication of alarm conditions shall be provided on the Local Control Panel OIT.

- b. The OIT shall display an alarm history with a date and time stamp of occurrence. This list shall include a scroll function as well as an acknowledge and reset function. Alarms shall include:
 - 1. Blower Fail
 - 2. High Rotor Vibration
 - 3. High Bearing Temperature
 - 4. High Motor Temperature
 - 5. Surge Warning
 - 6. Surge Alarm & Shutdown
 - 7. Overload Warning
 - 8. Overload Alarm & Shutdown
 - 9. High Inlet Differential Pressure
 - 10. High Suction Temperature
 - 11. High Discharge Pressure
 - 12. High Discharge Temperature
 - 13. VFD Fault
 - 14. Phase Loss

G. Fused Disconnect Switch

- 1. For each blower, provide a fused disconnect with fuses sized and selected by manufacturer to protect components in the local control panels. Provide two spare sets of fuses for each unit.

2.08 SHOP PAINTING

- A. The blower enclosure shall be painted per manufacturer's standard.

2.09 TOOLS

- A. Manufacturer shall furnish one set of special tools required for normal repair and maintenance of all equipment furnished under this project, as required.

2.010 SPARE PARTS

- A. The following spare parts shall be provided:
 - 1. Two (2) Sets of replacement Inlet Air Filters

2.011 SOURCE QUALITY CONTROL

- A. All equipment shall be factory tested in accordance with the following tests for compliance with the operational requirements specified herein. The objective of performance tests is to confirm the inlet volume flow and head producing capabilities and the power consumption of the blower package specified. The tests shall also include determination of the surge points.

- B. Tests shall be performed on the actual assembled unit being supplied for this project. Prototype model tests and calculated values based on previous model testing will not be acceptable.
- C. The performance tests shall be conducted in accordance with the ISO-5389 Turbo blowers – Performance Test Code and VDI 2045 – Acceptance and Performance Tests on Turbo Blowers and Displacement Blowers, parts 1 and 2.
 - 1. The test shall be conducted on the turbo blower package with all specified field installed components that affect power connected to form an operational machine to simulate the field installation.
 - 2. The actual inlet volume flow rate and head shall be measured and recorded with no negative tolerance. No other tolerances or measuring uncertainties used in reporting test results will be allowed.
 - 3. All test equipment shall be calibrated and certified by an independent test agency no more than twelve (12) months prior to the test date. Certificates shall show the stability of calibration over a period of at least one year per ISO 9001.
 - 4. Submit certified test reports.
- D. In the event the blower equipment fails to meet the performance requirements specified, the Engineer shall have the right to require the Contractor to modify or replace the blower equipment to enable said system to meet the performance requirements specified.
- E. The second test, if required, and any subsequent tests as may be necessary to ensure compliance with these Specifications shall be performed at no additional cost to the Owner.
- F. All costs arising from project delays caused by the failure to meet the performance requirements specified herein shall be borne by the Contractor.
- G. The Contractor shall notify the Engineer and Owner at least 20 days prior to conducting the factory performance tests if witness testing is required.
- H. Each turbo blower package shall be functionally tested with the electric actuated blow-off valve, discharge valve (if provided), and appurtenances. All start/stop sequences, and all safety and alarm systems shall be tested, simulating start of the blower motor.
- I. Test results not in verbatim agreement with test results presentation format per the Code shall be cause for rejection of the performance tests.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the turbo blower and accessories in accordance with manufacturer's recommendations found in the Installation Manual and any addendums including alignment of components, mounting level and connections.
- B. In accordance with the Figures in Appendix B.

3.02 INSPECTION

- A. Inspect the turbo blower and accessories for shipping damage and to ensure that all accessories arrived undamaged and are in conformance with the specifications.
- B. The following inspection of the installation shall be completed before the turbo blower is started.
 - 1. Piping and accessories are properly aligned.
 - 2. All accessories are adequately supported per the specification and Figures.
 - 3. The turbo blower is adequately grounded per the manufacturer's installation instructions.
 - 4. The turbo blower anchor bolts and all accessory fasteners are properly torqued.
- C. Assure that all electrical systems are properly connected, and terminals are tight.

3.03 MANUFACTURER'S REPRESENTATIVE

- A. Following installation but prior to startup or testing, the Manufacturer shall send a representative to the job site to inspect the installation as required by Section 01800 and as listed below. Any deficiencies noted during the Manufacturer's inspection must be corrected prior to startup or testing. The manufacturer shall note their findings in a written Installation Deficiency Report to the Contractor, with a copy provided to the Engineer.
- B. The Contractor shall remedy the deficiencies noted by the Manufacturer in the Installation Deficiency Report. The Manufacturer shall re-inspect the installation and this process shall be repeated until the Manufacturer finds the equipment to be installed in accordance with its recommendations and requirements.
- C. After no further deficiencies are found, the manufacturer shall issue the Equipment Certification Form provided in Section 01800.
- D. After installation of all plant equipment has been completed the manufacturer shall provide one trip (minimum one 8-hour day) per blower to conduct field tests under actual operating conditions, to determine the operation is satisfactory and free from excessive vibration as defined by the blower manufacturer. The test shall consist of 3 hours' operation of each blower with readings taken and recorded as directed by the manufacturer. Readings shall be taken every 10 minutes for each blower.
- E. Provide Training in accordance with Section 01800.
- F. After the equipment has been placed into operation by the Owner for a minimum of 45 calendar days, the equipment manufacturer shall provide one 8-hour day of equipment follow-up for equipment inspection and Owner review. This visit shall be coordinated with the Owner.
- G. The factory authorized representative shall also provide training for owner's personnel in the operation and maintenance of the turbo blower system. The allotted time for the training

shall be one (1) day and occur after the turbo blower's inspection and startup have been completed.

3.04 START-UP AND TESTING

A. Inspection and Check-out:

1. Prior to operating the turbo blower, complete the inspection as outlined in paragraph 3.02, test all support systems, including but not limited to power systems, control systems, piping systems, safety systems, etc.
2. Complete electrical system shall be tested to ensure proper function.
3. Instrumentation and Controls:
 - a. A complete functional test of the internal instrumentation and control systems shall be completed to assure they have not been damaged during shipment.
 - b. Set operational limits (start/stop, etc.) and alarm and shutdown limits as needed.
4. Inspect piping to assure it is clean and free of any contaminants that may harm the turbo blower.

B. After successfully completing startup, Certified Equipment Testing field tests shall be made after the blower(s) has been installed and is ready for operation. The final field test shall be made by the Contractor in the presence of the Engineer and a representative of the blower manufacturer and shall demonstrate the following:

1. That blower(s) has been properly installed and are in proper alignment.
2. Has been properly connected.
3. That all units operate without overheating or overloading of any parts and without objectionable vibration as defined by the Engineer.
4. That there are no mechanical defects in any of the parts of any blower(s).
5. Has not been damaged by transportation or installation.
6. Is free of excessive noise.
7. Shall operate as specified with the control system.
8. That the blower(s) can deliver the specified pressure.
9. That the controls meet the performance requirements stated herein.

C. Any defects in the equipment or failure to meet the requirements of the Specifications shall be promptly corrected by the Manufacturer.

D. Final acceptance will be dependent upon the satisfactory operation and performance after installation.

END OF SECTION