



**Request for Bids  
Capital Region Airport Authority**

<b>Solicitation Number</b>	20-01 (RFB)
<b>Solicitation Title</b>	90 KVA 400 HZ / 28 VDC Solid State Ground Power Unit
<b>Purpose</b>	To solicit bids from responsive and responsible bidders to provide 90 KVA 400 HZ / 28 VDC Solid State Ground Power Unit in accordance with the attached specifications.
<b>Deadline for Bid Submissions</b>	<b>Friday, February 21, 2020 @ 3:00 PM EST</b>
<b>Submit Bid to This Address</b>	Capital Region Airport Authority 4100 Capital City Blvd. Lansing, MI 48906
<b>Required Bid Copies</b>	One (1) original and two (2) copies
<b>Direct All Inquiries To</b>	<a href="mailto:purchasing@craa.com">purchasing@craa.com</a>
<b>This RFB is Comprised Of</b>	Part 1 – Instruction to Bidders Part 2 – Standard Terms and Conditions Part 3 – Specifications Part 4 – Required Bid Form

**INSTRUCTIONS TO BIDDERS**  
**90 KVA 400 HZ / 28 VDC SOLID STATE**  
**GROUND POWER UNIT**  
**January 22, 2020**

The Capital Region Airport Authority (CRAA) hereby invites from persons, firms, or corporations, who meet the qualifications hereinafter, set forth, sealed bids to provide one 90 KVA 400 HZ / 28 VDC Solid State Ground Power Unit for use at Capital Region International Airport, Lansing, Michigan. There will be no FAA funds used for the purchase of this equipment. The entire bid will be locally funded.

For the information of prospective bidders and their convenience in the submission of a bid, the following documents, which constitute the bid Package, are being furnished to each bidder and are attached hereto:

1. Instructions to Bidders;
2. Standard Terms and Conditions;
3. Ground Power Unit specifications;
4. Bid Form

This bid package shall constitute contract documents for the successful bidder. Please read all terms and conditions thoroughly before submitting bids.

Any variations from the specifications listed in the Bid Specifications must be listed on a separate page and included in the bid submittals. Variations from the specifications listed in the Bid Specifications will be considered by the CRAA when awarding the bid.

Each bidder must complete and return the attached Bid Form, filling in the form completely and in full accordance with these instructions; so that the bid is received in the office of the Capital Region Airport Authority, Capital Region International Airport, Lansing, Michigan, by 3:00 pm, February 21, 2020 at which time bids will be opened. Bids received after this specified time will not be given consideration. **Bid forms returned without authorized signature will be rejected in whole.**

The CRAA reserves the right to consider the relative experience and qualifications of each of the respective bidders and to select the bidder to whom it will award the bid.

The CRAA reserves the right to reject any and all bids and to waive any informality or irregularity in the submittals. The CRAA shall be the sole judge of the adequacy of bidder's qualifications. The CRAA will award to the bidder best meeting the airport's needs, as determined by the CRAA in its discretion. The CRAA is not bound to award a contract to the lowest bidder. The CRAA reserves the right to negotiate with one or more bidders after opening bids. The CRAA may, in its discretion, conduct one or more interviews with bidders prior to selection.

Should a bidder find any discrepancy in or omissions from these "Instructions" or other bid documents, he/she should at once notify the CRAA in writing, which will send clarifying written instructions to all prospective bidders. The CRAA will not accept responsibility for any other explanations or interpretations of the instructions. Bids shall be submitted to Bonnie Wohlfert, Executive Assistant, Capital Region Airport Authority, 4100 Capital City Blvd., Lansing MI 48906.

No bid will be considered from any person, firm or corporation who has failed to perform acceptably in any existing or prior contract or agreement with the CRAA.

## **Part 2 – Standard Terms and Conditions**

### **1. Introduction:**

The Capital Region Airport Authority (Authority) invites and will accept bids for the goods outlined in Part 2 - Specifications. The Authority intends to use the results of this process to issue a purchase order.

### **2. Specifications:**

The specifications herein are the minimum acceptable. When specific manufacturer and model numbers are used, they are to establish a design, type of construction, quality, functional capability or performance level, or any combination thereof, desired. When alternates are proposed, they must be identified by manufacturer, stock number, and such other information necessary to establish equivalency. The Authority shall be the sole judge of equivalency.

### **3. Deviations and Exceptions:**

Deviations and exceptions from terms, conditions, or specifications shall be described fully on the vendor's letterhead, signed, and attached to the bid. In the absence of such statement, the bid shall be accepted as in strict compliance with all the terms, conditions, and specifications, and vendor shall be held liable for any injury resulting from any deviation.

### **4. Quality:**

Unless otherwise indicated in the request, all materials shall be first quality. No pre-owned, remanufactured, obsolete, discontinued or defective materials shall be used.

### **5. Quantities:**

The quantities shown herein are based on estimated needs. The Authority reserves the right to increase or decrease quantities to meet actual needs.

### **6. Delivery:**

Deliveries shall be F.O.B. destination freight prepaid and included unless otherwise specified. Authority will reject shipments sent C.O.D. or freight collect.

Failure of the vendor to adhere to the delivery schedule as specified or to promptly replace rejected materials shall render the vendor liable for all costs in excess of the contract price when alternate procurement is necessary. Excess costs shall include administrative costs.

### **7. Warranty:**

Unless specifically expressed otherwise in writing, goods and equipment purchased as a result of this request shall be warranted against defects by the vendor for one (1) year from the date of receipt. An equipment manufacturer's standard warranty shall apply as a minimum and must be honored by the vendor.

**8. Clarification/Questions:**

Any questions concerning this Bid must be submitted in writing by mail, fax or email at least FIVE WORKING DAYS prior to the bid deadline. Requests submitted after that time WILL NOT be considered. All inquiries must be directed to the person indicated on the cover page.

**9. Addendums:**

In the event that it becomes necessary to provide additional clarifying data or information, or to revise any part of this RFB, revisions/amendments and/or supplements will be posted on the Capital Region International Airport website at [www.flylansing.com](http://www.flylansing.com). Bidders are reminded to regularly monitor the web site for any such postings.

The Authority has the sole authority for modifications of this specification and or bid.

**10. Acceptance:**

Bid shall remain fixed and valid for acceptance for sixty (60) calendar days starting on the due date of the bid. The Authority also retains the right to accept or reject any or all bids, to waive any technicality in any bid submitted and to accept any part of a bid as deemed to be in the best interest of the Authority.

Bids must be received by the Authority at the location specified on or before the date and time that the bid is due. Late bids will be rejected – NO EXCEPTIONS.

**11. Withdrawal of Bids:**

Bidders may withdraw a bid in writing, at any time up to the bid due date and time. The written request must be signed by an authorized representative of the bidder and submitted to the Authority. If a previously submitted bid is withdrawn before the bid due date and time, the bidder may submit another bid, at any time up to the bid due date and time.

**12. Preliminary Evaluation**

Bids must be submitted on the attached bid forms. The bid will be reviewed initially to determine if any technical requirements are met (when applicable).

**13. Award:**

Written notice of award to a vendor in the form of a purchase order or other document, mailed or delivered to the address shown on the bid will be considered sufficient notice of acceptance of bid.

The Authority will award the bid to the responsive and responsible bidder whose bid is most advantageous to the Authority. In determining the most advantageous bid, the Authority will consider criteria such as, but not limited to, cost, bidder's past performance and/or service reputation, and service capability, quality of the bidder's staff or services, customer satisfaction, references, the extent to which the bidder's staff or services meet the Authority's needs, bidder's past relationship with the Authority, total long term cost to the Authority, fleet continuity and any other relevant

criteria listed elsewhere in this solicitation. The Authority may opt to establish alternate selection criteria to protect its best interest or meet performance or operational standards.

The Authority reserves the right to accept or reject any bids, or to award a purchase order on such basis as deemed to be in the Authority's best interest.

**14. Termination of Contract:**

If for any reason the successful bidder fails to fulfill the requirements of the purchase order for providing the specified goods, the Authority shall have the right to cancel the purchase order at any time and negotiate with another vendor. This paragraph shall not relieve the Authority of its responsibility to pay for goods or services provided or furnished to Authority prior to the effective date of termination.

**15. Satisfactory Work:**

Any goods found to be in any way defective or unsatisfactory shall be corrected by the vendor at its own expense at the order of the Authority. The Authority also reserves the right to purchase substitute goods elsewhere. The Authority reserves the right to charge the vendor for any or all costs incurred or retain/deduct the amount of such costs incurred from any monies due or which may become due under this purchase order.

**16. Pricing:**

The price quoted shall include all materials and other costs necessary in accordance with the specifications of this request for bid.

All prices, costs, and conditions outlined in the bid shall remain fixed.

State Sale Tax/Federal Excise Tax: Bids should not include Federal Excise and Michigan Sales Taxes, as the Authority is exempt from payment of such taxes. The Authority's Tax Identification Number is 38-1949776.

**17. Payment Terms and Invoicing:**

Payment: The Authority's normal payment terms are net 30 days.

Unless otherwise agreed, the Authority will pay properly submitted vendor invoices within thirty (30) days of receipt of goods. Payment will not be made until goods are delivered and accepted as specified.

Vendor shall submit invoice(s) for all goods delivered. All invoices shall contain complete and accurate information.

Invoices presented for payment must be submitted in accordance with instructions contained on the purchase order. In no instance shall the vendor invoice the Authority for more than is authorized by the Authority on the issued purchase order.

NON-ALLOWED CHARGES. Other incidental or standard industry charges not specifically identified in the purchase order will not be allowed. Examples of such charges are those used to help the vendor pay various fluctuating current and future costs including, but not limited to, costs directly or indirectly related to the environment, energy issues, fuel charges, service and delivery of goods and services.

**18. Waiver of Default:**

In no event shall the making of any payment or acceptance of any service or product required in this bid constitute or be construed as waiver by the Authority of any default of the successful vendor, and the making of any such payment or acceptance of any such service or product by Authority while any such default shall exist shall in no way impair or prejudice the right of Authority with respect to recovery of damages or other remedy as a result of such default.

# NEW 90 KVA 400 HZ AND 28 VDC SOLID STATE GROUND POWER UNIT

## CAPITAL REGION AIRPORT AUTHORITY

### LANSING, MICHIGAN

January 22, 2020

#### PART 3 – GENERAL Specifications

##### 1.1 WORK INCLUDED

- A. Provide 90 KVA point of use Combination 400 Hz, 115/200V AC, 3 phase, 4 wire output solid state ground power (frequency converter) and 28vdc units located at the aircraft end of an existing Passenger Boarding Bridge (PBB).
- B. The Combination 400 Hz and 28vdc power unit shall be integrated with the boarding bridge.
- C. The 400 Hz and 28vdc power unit shall include all necessary disconnects, controls, the output cables, and other accessories to provide completely operational unit for the aircraft power. The 400 Hz and 28vdc unit shall be connected to the loading bridge 480 V, 3 phase, 4 wire, 60 Hz power and shall provide the necessary interlocks with the loading bridge input power.

##### 1.2 APPLICABLE CODES AND STANDARDS

- A. Standards and codes which are generally applicable to the work of this section are listed below:
  - 1. *MIL-STD-704D - Aircraft Electrical Power Characteristics.*
  - 2. *MIL-S-19500 - Semiconductor devices.*
  - 3. *MIL-STD-461B - Electromagnetic emission and susceptibility requirements for the control of electromagnetic interference.*
  - 4. *DFC-400 - 400 Hz aircraft ground power.*
  - 5. *ST-20-1972 - Dry type transformer for general application (R-1978).*
  - 6. *IEEE 127- Aerospace equipment and frequency rating.*
  - 7. *IEC 146 - Semiconductor converters.*
  - 8. *ISO-1540 - Aerospace characteristics of aircraft electrical systems.*
  - 9. *ATA-101 - Ground equipment technical data.*
  - 10. *ARP-1940 - Solid state frequency converters (1986).*

11. *ISO-6858 - Aircraft ground support electrical supplies.*
12. *NFPA 70 - National Electrical Code.*
13. *ANSI - American National Standards Institute.*

### 1.3 SUBMITTALS

- A. Complete shop drawings of the unit, to scale, with dimensions. Diagrams of all the electrical systems involved shall be included.
- B. Brochures including basic manufacturer's illustrations and performance data of all components. All product data shall be edited to identify accessories and special features provided.
- C. Operating details, diagrams, etc. as necessary for a complete description of the converter.
- D. Point-to-point wiring diagrams with all conductors and terminal points identified.
- E. Spare parts list.
- F. List of required special tools.
- G. Operational and Maintenance Manuals.
- H. Equipment Manuals.
- I. Test Reports.

### 1.4 FACTORY TEST

- A. A factory test report shall be furnished for the frequency converter including test results, instrument used, test procedures, and final conclusions. Each test report shall be dated and signed by authorized personnel and shall be neat, readily legible and self-explanatory.
- B. The unit shall be tested at no load and full load conditions and shall be given a "burn-in" test for at least 24 continuous hours.
- C. In addition to load tests, the following tests shall be performed:
  1. *THD (Total Harmonic Distortion).*
  2. *Voltage balance (output).*
  3. *Voltage balance (input).*
  4. *Transient voltage dip and response at 0.8 pf (output).*
  5. *Frequency regulation (output).*

6. *Overload.*
7. *Each safety operating device.*
8. *Line drop compensation circuit.*

## 1.5 WARRANTY

- A. Equipment furnished under this specification shall be guaranteed against defective parts and workmanship under the terms of the manufacturer's warranty for a period of not less than 1 year from the date of final acceptance at the project site. The warranty shall include labor, parts and travel time for necessary repairs at the project site.

## 1.6 OPERATION AND MAINTENANCE MANUALS

- A. A complete manual in a protective binder or cover shall be provided for the converter and shall contain the following information:
  1. *Converter description, theory of operation and specification.*
  2. *Installation and maintenance procedures.*
  3. *Starting, operation, maintenance and troubleshooting instructions*
  4. *Schematics and connection wiring diagrams.*
  5. *Recommended spare parts list.*
- B. The manuals shall be in accordance with ATA Spec. 101, Revision 4. All binder punch holes shall be reinforced.

## 1.7 SPARE PARTS

- A. Provide **Two (2) Recommended Spare Parts Lists** to permit ordinary service of any component of the system. Provide value and parts breakdown.
- B. Provide load bank equipment for 400 HZ and 28 VDC

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. The 400 Hz output solid state ground power unit shall be complete with components and accessories coordinated so that the complete unit shall function as specified. The specifications are based on jet power PWM2 solid state frequency converter.
- B. The units shall have required output circuits and connectors for connection to the aircraft mix.

- C. Provide fusible power disconnect switch or individually mounted circuit breaker for the 400 Hz power unit at the point of interception of the loading bridge power. The intent is to have ability to isolate 400 Hz unit without interrupting power for the boarding bridge operation.

## 2.2 MANUFACTURERS

- A. Manufacturer's power unit shall be approved by Boeing, Airbus, Embraer, and Bombardier to be used with their aircrafts.
- B. Manufacturers listed as acceptable must meet the performance and quality requirements listed in this specification, and shall be regularly engaged in manufacturing of the product for at least 5 years. Equipment proposed must mount to the underside of a Jetway PBB at the aircraft cab.

## 2.3 INPUT POWER

- A. Input Voltage: Nominal voltage, 480 V, 3 phase, 3 wire, 60 Hz at -15 percent and +10 percent of nominal voltage rating.
- B. Phase Rotation: Any, with automatic phase lock for either ABC or CBA output phase rotation.
- C. Inrush Current: Shall not exceed 100 percent of rated full load current and shall be equipped with a fully automatic soft start circuit.
- D. Protection: The frequency converter shall be equipped with the following input power protections:
  - 1. *Phase loss protection.*
  - 2. *Phase sequence protection.*
  - 3. *Over/under voltage protection.*
  - 4. *Thermal overload protection.*
  - 5. *Overcurrent protection.*
- E. Voltage Operating Range: The frequency converter output voltage shall be capable of being adjusted over a range of +10 percent from rated voltage.

## 2.4 OUTPUT POWER

- A. Output Power Rating: Nominal rating 90 kVA at 0.8 power factor. Unit shall be capable of operating between 0.0 pf to unity power factor at rated KVA.
- B. Output Voltage: The output voltage shall be rated at 115 / 200 volts AC. This voltage may be adjusted plus or minus 10%.
- C. Output Voltage Drift: With the unit operating at a constant load, a change in ambient temperature up to 55 degrees C in an eight-hour period or as the unit stabilized from a cold condition at any load, the output voltage shall not change by more than 1% of its originally set value.
- D. Output Voltage Regulation: Output voltage shall recover to the steady state condition less than 50 ms after any load change up to 100%. The voltage shall not exceed the limits of MIL-STD-704E during transient recovery.
- E. Output Voltage Distortion (Total Harmonic Distortion): Total harmonic distortion on the output voltage wave form shall not exceed 3% with any rated load up to 100% load. Any single harmonic will not exceed 2% of the fundamental.
- F. Output Voltage DC Content: The DC voltage at the output terminals shall not exceed 0.1 volts under any rated load conditions.
- G. Output Voltage Modulation: The modulation of the voltage waveform shall not exceed 0.5% as measured from the peak of one waveform to the peak of another adjacent waveform under steady state, rated load conditions.
- H. Output Voltage Balance: The maximum output voltage deviation of any of the three output phases shall not exceed 1% from the average of the three output phase voltages under balanced load conditions. The maximum voltage deviation of any of the three output phases will not exceed 3% from the average of the three phase voltages with a 15% unbalanced load.
- I. Output Frequency Drift: With the unit operating at a constant load, a change in ambient temperature up to 55 degrees C in an eight-hour period, or as the unit stabilizes from a cold condition at any load shall not cause the output frequency to change by more than 0.1%.
- J. Output Frequency Regulation: The output frequency shall be 400 Hz plus or minus 0.1% at any rated load condition.
- K. Output Current: 90 kVA (260 amps) at .8 power factor load continuous.
- L. Output Power Factor: The unit will be capable of operating with an output power factor of 0.0 to 1.0.
- M. Output Phase Displacement: The phase angle between each of the three output phases shall be 120 degrees plus or minus 1.5 degrees under all rated, balanced

load conditions. The phase angle displacement with an unbalanced load of 15% the unit's rated current shall be 120 degrees plus or minus 4 degrees.

- N. Efficiency: The overall efficiency of the unit shall not be less than 91% at 50% or greater load.
- O. Overload Capacity: The unit shall be capable of supplying overloads of up to 125% for 10 minutes, 150% for five minutes, 200% for 10 seconds, and 250% for 1 second.
- P. Short Circuit Capability: The unit shall be capable of withstanding without damage, an output short circuit cleared by internal solid-state circuitry.

## 2.5 ENVIRONMENTAL CONDITIONS

- A. The solid-state frequency converter shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage, degradation of operating characteristics, or loss of normal expected life:
  - 1. *Operating Ambient Temperature: -30 degrees C to +55 degrees C.*
  - 2. *Nonoperating and Storage Ambient Temperature: -30 degrees C to 70 degrees C.*
  - 3. *Relative Humidity: 10 percent to 95 percent noncondensing for all temperatures within the temperature range stated in "1" above.*
  - 4. *Barometric Pressure:*
    - a. Operating: From sea level to 2,000 feet above.
    - b. Nonoperating and Storage: From sea level to 40,000 feet above.
  - 5. *Wind Conditions: Up to 119 mph.*
  - 6. *Audible noise level shall not exceed 64 db at 4 feet distance.*

## 2.6 CONTROL AND SPECIAL FEATURES

- A. Controls:
  - 1. *The frequency converter shall be designed to start and stop by means of depressing momentary push buttons, mounted on the converter control panel.*
  - 2. *The frequency converter shall be equipped with a fused, isolated 28 vdc power supply for operation of all control and indication devices.*
  - 3. *All fuses shall be suitably marked as to the circuit designation.*

- B. Power On: The remote "power on" pushbutton shall make the 400 Hz power available to the aircraft plug. This power shall be available for only 4 seconds unless the aircraft plug is connected to the aircraft and the 28 VDC safety circuit is complete.
- C. Power Off: The remote "power off" pushbutton shall turn power off to the aircraft plug. The 400 Hz power shall be turned off instantly if the aircraft plug is removed from the aircraft receptacles by breaking the 28 VDC safety circuit.
- D. Automatic Reset: The reset function shall be accomplished by operation of the "power off" pushbutton.
- E. Automatic Restart: The automatic restart function shall restart the unit and bring "Ground Power Available" indication back to the aircraft should the aircraft be configured to overload the unit. Reconfiguring the aircraft to a lower level of power consumption allows continuation of service without manually resetting the unit with controls located on the ramp. This function shall allow 3 automatic resets. The fourth time shall require the unit to be reset manually.
- F. Output Contactor: The frequency converter output shall be connected to an output contactor of sufficient capacity to handle rated load and overload specified. The output contactor shall be electrically interlocked with input circuitry so that frequency converter will be immediately isolated when converter is being shut down. The operating push-button and associated light indicators shall be mounted on the door-mounted control panel.
- G. Line Drop Compensation: The voltage regulation means shall include an electronic line drop compensation circuit for maintaining the voltage regulation at a single point distance from the converter and shall be adjustable at full load to at least 5 percent of rated output voltage.
- H. Aircraft Interlock Circuit: The "E" and "F" interlock circuit shall instantaneously isolate the converter output in the absence of a 28 vdc signal from the aircraft. The "E" and "F" interlock circuit indicator shall be provided to display the status of "E" and "F" interlock.
- I. Aircraft Bypass Switch: For testing purposes, an aircraft bypass switch shall be provided inside the converter to allow the unit to deliver the output power without the 28 vdc power from the aircraft. An indicator shall be provided to indicate that the bypass circuit has been selected.
- J. Output Voltage Adjust: A voltage adjusting potentiometer located on the back of the primary access panel shall be provided to permit adjustment of the converter output voltage.
- K. Bridge Control Interlock: The converter unit and the cable hoist shall be interlocked with the bridge control circuit so that the bridge cannot be moved away from the

aircraft while frequency converter is plugged to the aircraft or the load cable is not fully stowed.

- L. Alarm Indicator Reset: A reset push-button shall be provided to reset all indicators from cleared alarm signals.

## 2.7 FAULT SYSTEMS AND INDICATORS

- A. Fault Systems: The unit shall be capable of monitoring the following items and shutting down in the event they are out of tolerance. The faults listed below shall be displayed in plain English on a 2-line text display.

1. *Input voltage 10% higher than nominal rating.*
2. *Input voltage 15% less than nominal rating.*
3. *Output voltage less than 100 vac per MIL-STD-704E.*
4. *Output voltage greater than 125 vac per MIL-STD-704E.*
5. *Output overload.*
6. *No 28vdc returned on EF wires.*
7. *DC bus discharge circuit overheated.*
8. *Overtemperature of an IGBT or Rectifier heatsink.*
9. *Output frequency out of tolerance.*
10. *IGBT failure.*

- B. Indicators: A two-line LCD meter shall display the following in plain English text:

1. *Input volts phase A.*
2. *Input volts phase B.*
3. *Input volts phase C.*
4. *Input volts (average of 3 phases).*
5. *Input current (average of 3 phases).*
6. *Output volts phase A.*
7. *Output volts phase B.*
8. *Output volts phase C.*
9. *Output volts (average of 3 phases).*

10. *Output current phase A.*
11. *Output current phase B.*
12. *Output current phase C.*
13. *Output current (average of 3 phases).*
14. *Output kVA (total).*
15. *Output frequency.*
16. *+5vdc power supply.*
17. *+15vdc power supply.*
18. *+24vdc power supply.*
19. *Unit settings (kVA, input voltage).*
20. *Event and fault history: The most recent 400 events (start/stop/fault) shall be stored internally and are available to be viewed from the 2-line LCD display on the front panel. The following data is stored:*
  - a. *Time of data sample.*
  - b. *Date of data sample.*
  - c. *Kilowatts used for docking cycle.*
  - d. *Fault.*
  - e. *Output volts at time of fault.*
  - f. *Output amps at time of fault.*
  - g. *Output volts max for docking cycle.*
  - h. *Output volts min for docking cycle.*
  - i. *Output amps max for docking cycle.*
  - j. *Start/stop, which output on.*
21. *A 16-position keypad shall control which of the above information is displayed. A non-resettable hour meter shall be mounted internally to indicate total operation hours. It shall be capable of displaying up to 99,999 hours.*
22. *LEDs will indicate the following items:*

- a. Specific IGBT in the event of an IGBT failure.
- b. Input phase rotation of ABC.
- c. Input phase rotation of BAC.
- d. Start push button pressed.
- e. Stop push button pressed.
- f. +5vdc present.
- g. +15vdc present.
- h. +24vdc present.
- i. -15vdc present.
- j. 28v Bypass switch in bypass position.
- k. 28v EF voltage present.
- l. IGBT drive circuits operating.

23. *Front panel lights will indicate the following:*

- a. Red light steady B fault occurred.
- b. Yellow light steady B input voltage applied to unit.
- c. Yellow light flashing B 28v bypass switch in bypass position.
- d. Green light steady B output voltage present.
- e. Green light flashing B 28v EF voltage missing.

C. Remote Monitoring: The following information shall be available in real time from a serial RS485 signal:

- 1. *Kilowatt-hours (2 bytes).*
- 2. *Fault (1 byte).*
- 3. *Output volts, phase A, B, C, avg. (4 bytes).*
- 4. *Output amps avg. (1 byte).*
- 5. *Output on, unit in bypass mode (1 byte).*
- 6. *Volts in (3 bytes).*

## 2.8 PHYSICAL CHARACTERISTICS

- A. The unit shall be so designed and constructed that parts will not work loose in service. It shall be designed to withstand the strains, jars, vibration and other conditions incident to shipping, storage, installation and service.
- B. The physical size and weight of the unit shall be suitable to provide integrated loading bridge operation.
- C. The converter and inverter sections of the frequency changer shall be modularized solid state components. The standard construction shall have no moving parts and shall require a minimum service or maintenance. All cards shall be equipped with vibration resistant latching mechanism.
- D. Transistorized inverters shall be utilized throughout the frequency converter to eliminate the need for forced commutation reactors and controlled rectifiers for enhanced reliability.
- E. Components shall be cooled by forced draft cooling. All fans shall be equipped with permanent, washable aluminum mesh air filters.
- F. The power transformers shall be mounted in separate compartments from the solid-state equipment.
- G. The electronics shall be completely sealed from the environment and the system cooling fans. The electronic compartments shall be equipped with environmentally safe vapor type corrosion inhibitors.
- H. The frequency converter shall be equipped with approved weathertight fittings for all wiring that passes through the weathertight compartments to preclude the entrance of moisture and dust into isolated electronic compartments.
- I. All printed circuit boards shall be conformably coated to protect against the effects of humidity, corrosion and salt fog. All integrated circuits shall be soldered to protect against vibration effects.
- J. The frequency converter shall be so constructed that adjustments and repairs can be easily made by maintenance personnel.
- K. All major components and sub-assemblies shall be stenciled or labeled with identification number or letter code on or near the device. The code shall be readily visible when servicing the frequency converter.

## 2.9 CABINET

- A. The cabinet enclosure shall be NEMA 3R designed to be suitable for the intended environmental conditions and location on the bridge. The cabinet shall be mounted in such manner that no damage will occur as a result of transportation. The complete frequency changer shall be designed for lifting and transporting by

forklift. Means shall be provided for easy access to all components and subassemblies. All electronic components shall be installed in NEMA-4x enclosure.

- B. A door interlock switch shall be provided to shut down the unit and suitable warning labels or covers shall be provided where internal voltages decay slowly after shut down.
- C. The control panel shall be mounted in, or be part of the converter cabinet. Provision shall be included for attaching remote controls to operate the frequency converter from remote position.

## 2.10 FINISHES

- A. Steel surfaces shall be coated with the Aultimate three coat@ paint system.
- B. Aluminum surfaces shall be anodized per ASTM B580 or coated with manufacturer's standard coating.
- C. Color of exposed surfaces of frequency converter installed on the passenger boarding bridge shall be a special custom to match the Passenger Boarding Bridge Color.

## 2.11 WORKMANSHIP

- A. The frequency converter, including all parts and accessories, shall be fabricated and finished in a workmanlike manner. Particular attention shall be given to freedom from defects, burrs, sharp edges, quality of soldering, welding, brazing, painting, wiring, riveting, alignment of parts and tightness of assembly screws, bolts, etc.

## 2.12 400 HZ & 28 VDC AIRCRAFT GROUND POWER CABLE

- A. Provide 400 Hz aircraft ground power cable (at least 60 feet long) complete with molded head aircraft plug and other accessories to accommodate all aircrafts. The aircraft cable shall consist of multiple single conductors banded together every 18 inches for ease of use and maintenance. The power cable shall use 2/0 conductors and shall be equipped with a field replaceable head.
- B. Cable shall meet Mil. Spec. #5756C.
- C. Cable and output head shall be as manufactured by an approved manufacturer with proven record for reliability. The cable assembly shall be the one typically used by Delta Airlines for their own 400 Hz system at other airports.
- D. Provide cable grips for cable installation on the cable hoist.

## 2.13 RAIN GUTTER EXTENSION

- A. Provide PBB rain gutter drop tube extension with each unit.

## 2.14 28VDC UNIT

- A. Scope:

1. *This general document describes the 28vdc output section of a FMC Jetway Systems PWM2 combination ground power unit designed to be capable of powering commercial or military aircraft with 28.5vdc output from a suitable 50/60 Hz utility power source. This 28vdc system shall operate off of the existing 400 Hz output.*

- B. Terms:

1. *Combo Ground Power Unit (Combo GPU): Refers to the entire unit which consists of both a 400 Hz converter and a 28vdc system.*
2. *28vdc System: Refers to only the portion of this unit required to produce and control the 28vdc power supply.*

- C. Applicable Documents:

1. *NEC (National Electric Code).*
2. *MIL-STD-704E (Aircraft Electrical Power Characteristics).*
3. *MIL-STD-461B (Electromagnetic Interference Characteristics).*
4. *ARP-1247 (400 Hz Ground Power Performance Requirements).*
5. *CSA (Canadian Standards Association).*
6. *ETL (Intertek Testing Services).*
7. *UL (Underwriters Laboratories).*
8. *NEMA (National Electrical Manufacturers Association).*

- D. Nominal Rating: There is one size requirement for servicing commuter aircraft - 28.5vdc at 600 amp continuous.

- E. Performance Characteristics:

1. *Input Power: The following items are related to the 28vdc system within the ground power unit:*
  - a. AC Input Voltage: The Combo GPU shall operate with input voltages not varying more than plus 10 percent or minus 15 percent of the sources nominally rated voltage. Nominal ratings are 480 vac, 415 vac, 400 vac, or 380 vac, 3 phase power.

- b. AC Input Frequency: The Combo GPU will operate on input power frequencies ranging from 45 Hz to 65 Hz.
- c. Input Current Requirements at Rated Load: The nominal input current requirements for the Combo GPU at rated load are:

<u>Input Volts</u>	<u>90kva</u>
480	100 amps
415	116 amps
400	120 amps
380	126 amps

- d. Input Inrush Current: On startup the inrush current shall not exceed 100 percent of that input current required when the unit is operating at rated load output.
  - e. Input Circuit Breaker: The Combo GPU shall contain an internally mounted circuit breaker on the input power lines to allow the input power to be removed in the case of a fault or for maintenance. Provide a separate input circuit breaker for the stand-alone 28vdc unit.
2. *Output Power: The following items are related to the 28vdc system within the ground power unit:*
- a. Output Voltage: The output voltage is rated at 28.5vdc +/- 1 percent of nominal under all conditions of line, load and temperature.
  - b. Output Voltage Drift: With the unit operating at a constant load, a change in ambient temperature up to 55 degrees C in an eight-hour period or as the unit stabilizes from a cold condition at any load, the output voltage shall not change by more than 1 percent of its originally set value.
  - c. Output Voltage Regulation: Output voltage shall recover to the steady state condition in accordance with ISO Specification 6858.
  - d. Output Voltage Modulation: The modulation of the voltage waveform shall not exceed the limits set forth in ISO Specification 6858.
  - e. Output Voltage Adjustment: Adjustment capability of 10 percent +/- of its nominal output value.
  - f. Output Current: 0 to 600 amps continuous. Up to 2000 amps starting current.



F. Physical Characteristics:

1. *Weight: The 28vdc will add approximately 300 pounds to the weight of an existing 400 Hz unit. The combined unit weights will be as follows:*
  - a. 90kVA 1,400 pounds (640 kg).
2. *Cabinet Dimensions: The 28vdc system fits inside of the Jetpower PWM2 enclosure. Therefore, the dimensions are identical to the PWM2 product:*
  - a. Height: 24 inches (0.61 m).
  - b. Width: 60 inches (1.53 m).
  - c. Depth: 50 inches (1.27 m).
3. *Cabinet Material: The entire 28vdc system will be housed inside of the Combo GPU's enclosure cabinet. The cabinet will be constructed from painted alodined aluminum. This corrosion resistant material will provide years of trouble-free operation.*
4. *Weather Rating: When mounted on a PBB with a properly designed cover, the enclosure shall be rated as NEMA 3R or IP54.*
5. *Hardware: All mounting hardware shall be stainless steel.*
6. *Wiring: All wires or cables are numbered or labeled.*
7. *Acoustical Noise: The unit shall not emit more than 68dBA at 1.5 meter height and 1.0 meter distant.*
8. *Temperature Rating: The unit will operate at a temperature of -40 to +55 degrees C.*

G. Ancillary Equipment:

1. *Cable Storage: DC output cables can be managed using hoists, cable racks, or a combination of both.*
2. *Push Button Controllers: Push button control boxes are available for managing both the DC and AC system features of the ground power unit.*

H. DC Output Cables:

1. *Provide 28vdc service cable as approved by the user airlines at the airport as well as appropriate for mating aircraft plugs.*
2. *400 Hz/28vdc ground power and load cable interlock: All bridge motions shall be prevented from occurring whenever 400 Hz/28vdc frequency*

*converter has been actuated or 400 Hz/28vdc load cable is not in the stowed position.*

3. *28vdc converter to be same cabinet (for new PBB) mounted as 400 Hz GPU, but must be interlocked to prevent simultaneous operation of both units.*
4. *Provide separate electric cable hoist with interlock to prevent horizontal movement of the PBB while either the 400 Hz or 28vdc converter is connected to the aircraft or operational in any mode.*

## PART 3 - EXECUTION

### 3.1 START-UP

- A. The manufacturer of the units shall furnish a competent factory-based engineer to assist in placing the units in operation and to instruct personnel in their proper use.

### 3.2 INSTALLATION

- A. The unit shall be installed on the boarding bridge by this bidder and coordinated with the boarding bridge owner for boarding bridge mounting power connection and 400 Hz cable hoist.

### 3.3 LOAD BANK TESTING AND DEMONSTRATION

- A. The unit shall be tested, demonstrated and certified as indicated on the attached certification procedure, Appendix A.

### 3.4 FACTORY WITNESS TESTING

- A. The manufacturer shall notify the owner at least 45 days before final testing of the unit at the factory.

### 3.5 TRAINING

- A. On-site training of 4 hours shall be provided to the Owner and their designated personnel in complete operation and maintenance of the units.

**APPENDIX A**  
**90 KVA, 400 HZ / 28 VDC SOLID STATE GROUND POWER UNIT**  
**ON SITE CERTIFICATION PROCEDURES**

I. Unit Description

Model Number \_\_\_\_\_ Part # \_\_\_\_\_ Hr. Mtr. \_\_\_\_\_

Serial Number \_\_\_\_\_ Size \_\_\_\_\_ Date \_\_\_\_\_

Location \_\_\_\_\_ Gate \_\_\_\_\_ Customer \_\_\_\_\_

Bridge Model No. \_\_\_\_\_ Bride S/N \_\_\_\_\_

Hoist \_\_\_\_\_ Rack \_\_\_\_\_ Other \_\_\_\_\_ RH # \_\_\_\_\_

II. Preliminary Checks with Power Off

A. Visually inspect the entire installation and ensure that the ground power unit and its associated equipment has been installed in accordance with manufacturer's installation manual, NEC requirements and all local codes.

\_\_\_\_\_

B. Visually inspect and ensure that the wires from the push button control station and the interlock relays are routed correctly.

\_\_\_\_\_

C. Open both sides of the converter and verify that all connectors and circuit boards are properly seated and that there is not visible damage to the unit.

\_\_\_\_\_

III. Preliminary Checks with Power On.

- A. Verify that the input power is present by observing the six (6) green LEDs on the power supply circuit board. \_\_\_\_\_

- B. Using a hand-held voltmeter, measure the incoming voltages at the inputs to the SCRs.

Vab \_\_\_\_\_ VAC

Vab \_\_\_\_\_ VAC

Vab \_\_\_\_\_ VAC

- C. Verify that the phase rotation of the incoming voltages is correct by observing that the red light located on the front of the converter is not flashing. \_\_\_\_\_

- D. Verify that the stop push button is wired correctly by observing that the red LED on the edge of the logic board lights only when the stop button is pressed. \_\_\_\_\_

IV. Operational Checkout

- A. Plug the output cable into a portable Cannon load bank or its equivalent \_\_\_\_\_

- B. Place the E and F switch on the load bank to the on position. \_\_\_\_\_

C. Verify that the auto/manual switch on the voltage control board is in the auto position.

\_\_\_\_\_

D. Depress the start push button and verify that the converter starts by observing the green run LED on the logic board and the green run light on the front of the converter.

\_\_\_\_\_

E. Using the voltage adjust potentiometer, adjust the output voltage to read 115 volts when measured at the output cable's head.

\_\_\_\_\_

F. Verify that the 400 Hz. output power phase rotation is correct by observing that the yellow ABC light on the front of the load bank is on.

\_\_\_\_\_

G. Use the reed frequency meter on the load bank to verify the output voltage's frequency is 400 Hz.

\_\_\_\_\_

H. Using a hand-held voltmeter, record the output voltages at the aircraft connector.

Vab \_\_\_\_\_ VAC Van \_\_\_\_\_ VAC

Vac \_\_\_\_\_ VAC Vbn \_\_\_\_\_ VAC

Vbc \_\_\_\_\_ VAC Vcn \_\_\_\_\_ VAC

- I. Verify the operation of the IV sense board, the diagnostic system board and the key pad by depressing the appropriate key and recording the following readings.

A INPUT \_\_\_\_\_ VAC    A OUT \_\_\_\_\_ VAC

B INPUT \_\_\_\_\_ VAC    B OUT \_\_\_\_\_ VAC

C INPUT \_\_\_\_\_ VAC    C OUT \_\_\_\_\_ VAC

+ 5 V \_\_\_\_\_ VAC    VOLT OUT \_\_\_\_\_ VAC

+ 15 V \_\_\_\_\_ VAC

- J. Using the digital panel meter, record the over and under voltage shut off points.

Under voltage shut off \_\_\_\_\_ VAC

Over voltage shut off \_\_\_\_\_ VAC

- K. Using a Fluke 77 multimeter or its equivalent, reset the output voltage to read 115 volts at the output plug when measured between phase A and neutral.

\_\_\_\_\_

- L. To verify the excessive current is not being drawn, measure the current draw in the main power panel at the rotunda with the converter operating.

A Phase \_\_\_\_\_ amps

B Phase \_\_\_\_\_ amps

C Phase \_\_\_\_\_ amps

M. Verify the proper operation of the 400 Hz. engaged light and buzzer on the passenger boarding bridges control console.

\_\_\_\_\_

N. Verify that the passenger boarding bridge cannot be driven horizontally when the converter is operating.

\_\_\_\_\_

O. Check the 28-volt safety circuit by placing the E and F switch on the load bank to the off position.

Verify that the ground power unit shuts off and the green light on the front of the converter begins to flash.

\_\_\_\_\_

P. Turn the E and F switch on the load bank back to the on position.

\_\_\_\_\_

Q. Reset the converter's logic by depressing the stop push bottom.

## V. Load Testing

It is suggested that small 75 kW for 90 kVa unit cannon load bank or its equivalent be used.

A. Adjust the load bank so that there will be no load applied to the ground power unit.

B. Turn the ground power unit on by depressing the start button.

C. Record the following voltages using the keypad and the digital panel meter on the front of the convert.

Phase	Input Voltage	Output Voltage	Output Current
A			
B			
C			
Average			

D. With the ground power unit operating, increase the load in whatever steps are desired, up to and including full load.

Record the following information:

Phase	Load kVa	Output Voltage	Output Current	Time Run in Min.
-------	----------	----------------	----------------	------------------

A				
B				
C				

A				
B				
C				

A				

B				
C				

A				
B				
C				

I certify that the preceding tests were performed in a satisfactory manner and that all measurements were recorded as accurately as possible.

Manufacturer: Name \_\_\_\_\_

Date \_\_\_\_\_

Owner's Representative: Name \_\_\_\_\_

Date \_\_\_\_\_

Signatory Airline: Name \_\_\_\_\_

Date \_\_\_\_\_

**PART 4**  
**CRAA BID FORM**

Instructions: Mail form to arrive or deliver by the time and place shown in the bid invitation in sealed envelope clearly marked with item being bid on. No late, faxed, or emailed bids will be accepted.

The undersigned has read and understands the bid specification and agrees to provide products and/or services in accordance with the bid specifications as follows:

90 KVA 400 HZ / 28 VDC Solid State Ground Power Unit

Price FOB:     \$ \_\_\_\_\_

**In submitting bids, successful bidder agrees:**  
**To supply CRAA with one (1) Ground Power Unit as specified in the Bid Specifications.**  
**Quote prices FOB Capital Region International Airport**

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<b>COMPANY</b>	<b>TELEPHONE</b>
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<b>ADDRESS (Include Zip Code)</b>
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<b>AUTHORIZED SIGNATURE</b>	<b>PRINT NAME</b>	<b>TITLE</b>	<b>DATE</b>
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