



**ATTACHMENT 23
TECHNICAL SPECIFICATIONS**

1. TO Contractors shall only use approved shelter designs. The following manufacturers have pre-approved designs:

- Cellxion- www.cellxion.com
- Fibrebond - www.fibrebond.com
- Thermobond - www.thermobond.com

A. Site Preparation Work

- i. Location of any buried electrical and/or telephone cables on all of the property affected by the site construction and installation of electrical and communications conduits.
- ii. The TO Contractor shall follow the approved sequence of constructions as shown in the attached construction drawings. Any deviations must be approved by the State and/or County as required.
- iii. Construct one (1) 12x28ft equipment shelter foundation at each site. The foundation design shall be approved by the shelter manufacturer. At a minimum, the footers shall extend at least six inches below the local frost line. The supply and installation of the equipment shelter foundations shall include the construction of each concrete foundation, contain an integrated continuous stoop for the doors, and be designed to support a 12x28x10ft concrete equipment shelter (height is the inside dimension).
- iv. Construct one (1) 4x20ft concrete foundation for one (1) 1,000-gallon LP fuel tank at each site. The foundations will be constructed on compacted dirt and no less than three (3) inches of #57 stone. The foundations shall be at least six inches above final grade and be reinforced with rebar or 6x6 metal mesh.
- v. Install shelter ground rings per the latest version of Motorola R56 installation standards. This will include at least one test well per site. Test wells shall not interfere with vehicular traffic. Locations will be verified by the State Project Manager.
- vi. The TO Contractor shall restore all areas which have been disturbed during construction.

2. 12x28 ft Shelter with 35 Kw Generator:

- A. Shelter installations must be in conformance with manufacturer's requirements for application of warranties provided by the manufacturer, as well as be compliant with the current version Motorola R56 grounding requirements.
- B. The equipment shelter supplied shall be a one-piece concrete communications equipment shelter and include a 35 Kw vapor propane fueled generator, 200-amp integrated load center, such as a Transtector ISP Series, incorporating the main service disconnect, manual transfer switch, surge protection and load center with installation. The supplied equipment shelter shall be nominally sized 12x28x10 ft (height is inside dimension) and configured with two rooms as depicted in the Attachment 26B– Typical 12x28 Equipment Shelter with Generator.
- C. The double room shelter shall be provided with a NEMA 4, 250 Volt D.C., 600 Volt A.C. 200 amp, weatherproof emergency generator receptacle such as Appleton AJA20044-200, mounted on the front of the shelter to allow connection of a suitable portable emergency generator in case of failure of the internal generator during a power outage. The generator receptacle shall be located in such a place that it will not interfere with the operation of the equipment room door. The receptacle's operation will be controlled by operating the manual transfer switch inside the equipment shelter.
- D. TO Contractor shall furnish a compatible Appleton plug such as AP20044CD with 50 feet of conductors terminated in a pigtail. The plug will be designed to interface a portable generator with the Appleton receptacle mounted on the building. The plug will be weatherproof and the conductors shall be adequately insulated and weatherproofed. They should be sized to safely connect a temporary generator and mitigate any voltage drop. The cable assembly shall be provided with each shelter and installed inside the generator compartment on an adequately sized hose bib in accordance with the attached shelter layout. If made of a conductive material, the cable holder shall be bonded per the latest version of R56.
- E. Two 16-port cable entry points complete with weatherproof caps shall be provided for antenna cable entry. One entry point will be located on the long side of the equipment shelter and the second entry point will be located on the end wall of the equipment shelter between the air conditioner units. These locations are shown in the supplied attachment. Each port within both assemblies shall be four (4) inches in diameter, and shall be located with the top of the assembly located directly under the cable rack, in four (4) rows of four (4) ports each. In addition to the cable entry points, one single four inch PVC conduit sleeve for communications conduits and one single two inch PVC conduit sleeve for possible installation of S. O. cables to the tower lighting system, both with temporary end caps shall be installed. The actual

location of these penetrations and sleeves must be confirmed with the Project Manager prior to the fabrication of the shelter.

- F. Cable ladders (24 inches wide) shall be mounted, using all-thread and “cherry” insulators, eight feet above the finished floor, as measured from the floor to the bottom of the cable ladder, as shown in Attachment 26B– Typical 12x28 Equipment Shelter with Generator.
- G. Two 5-ton 230/208V-Single-phase, dual (redundant) wall-mounted, vertical, self-contained HVAC units with 5-kw heat strips shall be installed at the locations specified on the equipment shelter drawing. Separate circuit breakers for each unit shall be installed in the main load circuit panel. The provided HVAC units shall have sufficient capacity for the equipment shelter size supplied, fully loaded with equipment. Each unit shall contain a time delay/startup relay, low ambient control, and a forced air resistive heat strip. The HVAC controller will include a humidity control feature. The outside portions of the units shall be weather/rodent and tamper proof.
- H. All shelters shall be equipped with 16” ventilation fans with gravity operated backdraft louvers and 16” gravity intake damper with filter and hood (bug and rodent intrusion resistant). Each fan shall be connected to a thermostatic device to allow automatic fan on-off control. The openings will be provided with shutters and weather hoods. All required exhaust piping and intake and exhaust plenums required for the manufacturer’s recommended air flow shall be included as part of the installed equipment. All openings in the shelter structure for the provision of entry or exit of cables, equipment, ventilation, etc. must be sealed to prevent the invasion of the shelter interior by insects, rodents and external moisture.
- I. Electric baseboard heater strips shall supply heating for the generator room. A thermostat mounted on the wall opposite the heater shall control the heater strips. The heater strips shall be sufficient for the size of the generator room to maintain a room temperature of 72 degrees F.
- J. Insulation shall be non-combustible, with a vapor barrier. Wall and floor thickness shall provide an R-11 (minimum) rating, and the roof shall have an R-19 (minimum) rating.
- K. Concrete Construction – The wall outer finish shall be natural stone aggregate finish with an aesthetically pleasing earth tone.
- L. Each foundation shall be comprised of concrete piers or concrete pad with steel reinforcement. The top of the finished foundation shall be 6 inches above finished grade. The foundations shall level each shelter such that all foundation to shelter contact points shall have equal loads. The equipment shelter is to rest flush on the poured concrete foundation without showing any gaps between shelter and pad and to be level to within ½ degree. The shelter

shall have an integrated continuous stoop for the doors, and steps if necessary, to provide safe entry into the shelter. Installations requiring stoops more than 24 inches above grade shall have safety rails installed.

- M. The minimum floor loading design shall be 300lbs. per square foot (PSF).
 - i. The minimum roof loading design shall be 100lbs PSF.
 - ii. The minimum wall loading design shall be 34 lbs PSF.
 - iii. The minimum wind loading design shall be 50 lbs. PSF.
- N. Two reinforced steel finished doors shall be located on each shelter, per the attached drawings. The doors will be finished to match the appearance of the shelter. The doors shall be pre-hung, gasket sealed, insulated, approximately 3 foot by 7 foot, and in a metal frame. Doors shall be supplied with door-closer, magnetic weather stripping, drip strip over door, doorstop, door sweep and a 42-inch door canopy. Door checks and doorstops shall be provided along with a three (3) point locking system for maximum security. The doors shall have non-removable ball bearing hinges and deadbolt locks with tamper plates installed. These deadbolt locks shall be security type with removable cylinders, such as “Best” locks. Each generator and equipment room door shall be bonded to its frame with welding cable of an appropriate gauge in accordance with the latest version of R56. Braided cable shall not be used.
- O. The equipment shelter floor shall be covered with 1/8”, 12” x 12” vinyl tile, and light in color (beige, tan or white). The walls shall be trimmed with a 4-inches high and 1/8 inch thick rubber base trim against the floor.
- P. The walls will be covered with a minimum of white wood-grained paneling or white vinyl over 1/2-inch plywood. The equipment shelter shall have a 3/4” X 4ft X 8ft plywood telephone mounting board installed as per attached shelter layout drawing.
- Q. Electrical installation and wiring shall conform to the latest version of the National Electrical Code. Surface mounted, grounded, duplex outlets shall be provided at five (5) foot intervals (where possible) around the interior walls. All wiring shall be installed in surface mount EMT conduit. Outlets shall be installed 18 inches above finished floor. Horizontal runs of conduit will be installed a minimum of 7 1/2 feet above the floor whenever possible with vertical connections to the surface mounted devices to minimize interference with installing equipment against the wall. Two weatherproof outlets will be installed on the exterior of the shelter. These outlets are to be located at both ends of the shelter. In addition, circuits supplying power to equipment racks # 3-8 in the shelter shall extend downward six (6) feet from boxes mounted at 22” intervals on the ceiling as shown in the supplied TORFP Attachment – 26B Typical 12X28 Equipment Shelter with Generator.

- R. Wiring for these drops shall be housed in “Sealtite” flexible conduit and each drop shall be terminated in a quad receptacle box. Each quad box shall contain two circuits and each circuit shall have its own dedicated neutral, ground and a 15 or 20-amp circuit breaker. These drops shall be planned to fall immediately adjacent to the edge of the cable tray. The exact location for each drop must be confirmed with the State Project Manager before the shelter is fabricated. The circuit breakers for the 240 VAC quad boxes supplying power to equipment racks # 1-2 shall be located in the main load center. Racks #1-2 shall be supplied with one junction box each containing one 240 Volt 20 amp circuit. In accordance with the shelter drawings and supplied photos, the junction box will be fastened to the wall. All circuits will have a dedicated neutral installed in accordance with the latest Motorola R56 standard. The junction boxes will be mounted in line vertically.
- S. All low voltage wiring (i.e. alarm, control, etc.) shall be routed in separate conduits in accordance with the national electrical code.
- T. Power to each shelter shall be fed through a properly sized 240-Volt, fused single-phase disconnect switch mounted on the exterior rear wall of the shelter. See Attachment 26B - Typical 12X28 Equipment Shelter With Generator.
- U. Shelter is to be provided with 200-amp, 20-position (minimum) main load center, equipped with a minimum of twenty (20) 20-amp breakers. Breakers shall be “high magnetic” or high inrush current type (Square D, HM or equivalent). This box shall be installed at one end of the equipment area within five (5) feet of the primary cable entry port. In addition to the 200-ampere main load center, a minimum 20-position quad box load center shall be installed, fed from the main load center; the quad box load center shall be located on the generator room wall and shall supply power to quad boxes above rack positions 3-8. Load centers, circuit breakers and quad boxes shall be properly marked.
- V. An interior system ground (halo) with a single #2 AWG stranded wire will be provided with proper connections to the shelter and, in turn, to the tower ground system. The halo will have a 6-inch break roughly opposite the Master Ground Bar. The #2 AWG ground wire for each row of racks will be suspended on independent ground lead stand offs as outlined in the typical shelter drawing. They will be positioned to ensure the #2 AWG lead is isolated from the main cable racks. No electrical conduit is allowed to bridge the 6” gap in the halo ground. The internal ground system will be mounted on the wall using 2-inch (2”) standoff insulators, connected to two (2) minimum ¼” x 5”x 24”, (33 hole pairs) minimum copper master ground bus bars that are installed directly under each cable entry port. The ground bus system shall be a Harger EPK16MOT bus bar system or an approved substitute. The copper ground bars on the back interior wall of the shelter will be connected to the corresponding exterior ground bar with stainless steel insulated feed

through. The external ground bar will be connected through a minimum of three (3) 2-inch copper straps to the external building ground ring and tower grounding system. All exterior connections shall be exothermically welded to ensure proper connection. Electrical ground will be bonded to the RF ground.

- W. Purchase and installation of the following lightning protection devices in the equipment shelter:
- i. An IEEE Type 1 SAD/MOV protection device shall be part of the integrated load center and approved for use in the latest version of R56.
 - ii. An IEEE Type 2 MOV protection device will be installed at the main power input inside the shelter, by means of a 60-Ampere (per “leg”) breaker or fused disconnect, across the utility lugs of the transfer switch. The device will be installed inside of the equipment shelter and approved for use in the latest version of R56 such as Transtector IMAX series. Its installation will comply with the latest version of R56 and maintain the device’s UL1449 (latest edition) listing.
 - iii. All surge suppression devices will have the ability to create a dry contact alarm (contact closure upon alarm). This alarm will be integrated with the shelter alarm wiring. The dry contact alarms will be enabled from the factory.
- X. The air conditioning units shall be connected to the internal (halo) grounding system only, not to the external equipment shelter grounding system.
- Y. 48-inch, two or four-tube, energy efficient fluorescent fixtures shall provide sufficient lighting (minimum 50 foot candles) for the shelter in accordance with Attachment 26B– Typical 12x28 Equipment Shelter with Generator.. The lights shall be controlled by a wall switch / timer internal to the shelter, and located next to the entry door. An exterior entry light shall be installed outside the main doorway of the structure. This light shall be controlled by a motion sensor wired through a wall switch inside the shelter.
- Z. The shelter shall be pre-wired, with the following functions, to a common point in the radio compartment and terminated with a split 66 Block. The 66 Block shall be mounted in the upper right-hand side of the punch block board. All alarms shall be punched down on the left-hand side of the punch block using solid wire. The 66 block will not be enclosed in any box or enclosure.
- i. All functions/alarms will be programmed to be normally open. Upon alarm, they will close.
 - ii. High Temperature Alarm – Adjustable for over-temperature alert (may be integrated with HVAC system).

- iii. Low Temperature Alarm – Adjustable for under-temperature alert (may be integrated with HVAC system).
- iv. HVAC Failure Alarm- derived from the HVAC controller
- v. Generator Running Alarm – Closure when generator is running.
- vi. Remote Generator Start – No transfer to load (a dry contact closure will remote start the generator but will not transfer to the load if commercial power is good)
- vii. Generator transfer to Load (a dry contact closure will initiate a transfer to load. If the generator is off, it will start the generator)
- viii. Low Oil Pressure Alarm
- ix. Low Coolant Alarm
- x. Generator Overcrank Alarm
- xi. High Coolant Temperature alarm
- xii. Transfer Panel Switched- indicates that the transfer panel has switched to backup power
- xiii. Equipment Room Door Alarm
- xiv. Generator Room Door Alarm
- xv. Equipment Room Smoke Alarm
- xvi. Equipment Room Heat Detector Alarm
- xvii. Generator Room Smoke Alarm
- xviii. Generator Room Heat Detector Alarm
- xix. Type I Surge Suppressor Alarm
- xx. Type II Surge Suppressor Alarm
- xxi. Type III Lighting Controller Surge Suppressor Alarm (if used)
- xxii. Strobe White Alarm (per strobe controller if used)
- xxiii. Strobe Red Alarm (per strobe controller if used)
- xxiv. Marker Alarm (per strobe controller if used)

xxv. Spare

xxvi. Spare

- AA. On these double room shelters, there shall be a partition wall separating the emergency generator from the room containing the RF equipment. This partition wall shall have a one (1) hour fire rating (from the inside out and outside in). The floor under this section shall be reinforced to handle additional loading. Two gravity intake louvers and one exhaust fan with gravity louvers shall be installed. All louvers and openings will be wire covered for security and prevention of entry by rodents. A separate outside door shall be installed on this room and shall be identical to the equipment room door. See Attachment 26B– Typical 12x28 Equipment Shelter with Generator.
- BB. The lighting for this room shall be controlled by a separate wall switch / timer internal to the room and located next to the entry door.
- CC. The TO Contractor shall supply with each equipment shelter a 35 Kilowatt, liquid propane vapor fueled, 1800-RPM generator, 60 Hz, 120/240 volt, single phase with a 200-amp Automatic Transfer Switch (ATS).
- DD. Installation shall include all materials, parts, labor, etc. to provide a fully functional generator back-up system. Included in the installed price is the transfer switch and all associated wiring as well as generator alarm programming in accordance with state requirements. Block heaters with necessary wiring are to be included. Fuel tank hookup, fuel tank, fuel tank pad and fuel supply piping to the shelter is to be provided by the TO Contractor. Fuel supply piping shall be non-metallic to comply with R56 single point grounding requirements. The fuel tank shall be connected to the tower ground ring.
- EE. Fuel strainers on the propane fuel systems must be installed for proper drainage to prevent moisture buildup in the line. Proper sized flex fuel lines need to be installed on all generators and the fuel line so as not to impede the proper flow of fuel and must not be sharply bent, or crimped. The flex jumper must be placed to ensure minimal engine vibration is transferred to the fuel solenoid assemblies to prevent rupture. The fuel line from the secondary regulator to the manifold shall not be less than 1” to minimize fuel pressure drop from no load to full load. The metal fuel line inside the room shall be bonded to the internal halo where it enters the room. This can be done with a c-clamp style device at the fuel line. Proper venting of the fuel system must be installed to ensure no buildup of pressure and safe venting will occur. Fuel lines run in conduit or sleeves must be sealed from moisture. All exhaust piping that can be in contact with personnel shall have a heat shield installed. Proper battery chargers must be installed for the appropriate system, either 12 VDC or 24 VDC, 110 VAC.

Note: two (2) 12 VDC battery chargers is not acceptable on 24-volt systems.

- FF. The TO Contractor must perform and supervise the on-site startup of the generator under full load, using a load bank. The original of this form must be completed and submitted prior to submission of an invoice for work performed. The State Project Manager or his designee must be notified in advance to attend the event at their discretion. The load bank test shall be at least one hour and conducted under full load. The startup shall also include the programming of all generator related alarms/function.
- GG. All alarm outputs from the generator are to be extended to the radio compartment via a data cable and terminated in a remote annunciator panel, which provides both visual and audible alarm indications for each circuit monitored. The annunciator panel shall also provide either normally open or normally closed dry contacts which can be field selectable as needed to provide the proper inputs to the existing 66 block for the dissemination of alarm information to the system. The annunciator panel shall be located directly below the existing 66 block in the radio compartment.
- HH. All wiring for the generator must be routed overhead. It is unacceptable to cross the floor with conduits.
- II. An external minimum of ¼" x 4" x 24", (36 hole pairs) copper ground bar is to be installed on the outside of the shelter directly under the main cable entry port and attached with three (3), solid tinned copper, 2-inch ground straps, to the single ground point directly below the main cable entry port. Refer to Harger EPK16MOT)
- JJ. The shelters shall be designed and installed per the latest version of Motorola R56 to include eyewash station, first aid kit, chemical and CO2 type fire extinguishers mounted on the partition wall in the radio compartment.
- KK. Each shelter shall include one broom and dustpan (mounted to the wall), one six-foot stepladder, one 30-gallon (plastic) garbage can and one box of 30-gallon garbage can liners.
- LL. An external ground ring shall be provided around each shelter foundation. Above-grade ground tails will be provided for both shelter foundations. The buried external ground ring shall be in direct contact with the earth at a depth of 30 inches below the earth's surface with ground rods driven into the earth at intervals not to exceed twice the ground rod length. In the event 10-foot ground rods cannot be driven, shorter rods are acceptable if driven at the proper intervals. The external ground ring is to be placed 3 feet outside each shelter foundation in order to be outside the drip line of the shelters.
- MM. All grounds must be bonded together. This includes the shelters, fuel tanks, fencing, and equipment shelter grounding systems, the ice bridge and

the tower. The ground test reading must not normally exceed 5 OHMS. The State shall test all grounds using a fall-of-potential method test to determine compliance. In the event 5 OHMS cannot be reached by reasonable means and through no fault of the TO Contractor, the State will determine the course of action to be taken by the TO Contractor at an additional cost to the State. Grounds must test fewer than 10 OHMS for the site to be acceptable for reasons of personal safety.

3. Installation Specifications

- A. Purchase and installation, at each site, of one (1) 12x28x10 ft. concrete equipment shelter (height is inside dimension) with a 35kW generator. The equipment shelter must rest flush on the poured concrete foundation without showing any gaps between Equipment Shelter and pad and leveled to within ½ degree. Attachment 26B– Typical 12x28 Equipment Shelter with Generator is to be used for pricing purposes.
- B. An approved/certified shelter manufacturer representative shall be on site for each shelter delivery to supervise the setting of the shelter. This individual shall correct any foundation gaps or any deficiencies found due to shipment. This individual shall also supervise the installation of any field installable items (e.g. hoods, light fixtures, etc).
- C. Provision and installation of a liquid cooled, 1800 RPM, 35 kW propane vapor fueled generator complete with a 200-Amp automatic transfer switch capable of zero cross-over (in-phase switching) and time-delay neutral switching to eliminate service interruptions of the electronic equipment and the tower lighting system. The transfer switch shall also have a programmable exercise timer. Time delay neutral shall be programmable from at least 0-3 seconds. The exercise timer shall allow preprogramming of time and date of weekly generator runs. The transfer switch shall allow the weekly generator runs to be conducted with or without load.
- D. Purchase and installation of one (1) new 1,000-gallon LP fuel tank at each site with hookup to the generator and shall include first LP fill-up. Underground fuel supply piping shall be “plastic” high-performance polyethylene piping or equivalent. The above ground piping must be UV rated rubber jacketed corrugated metallic piping. Both underground and above ground piping shall be sized so that the flow of fuel is not impeded with the system operating at full load. The fuel tanks shall be connected to the shelter and tower ground rings.
- E. Generator start-up and test under full load (using load bank) after permanent power is connected to the equipment shelter must be coordinated with the State Project Manager. The test using the load bank shall extend for one hour. The startup shall include generator alarm/function programming.

- F. Purchase and install, for each site, one (1) extruded metal, 24-inch wide, no cantilever ice-bridge with a four tier “tee” or “tree” trapeze cable management system to facilitate easy installation and removal of cables, such as Andrew WB-T24-4 or suitable equivalent. Ice bridge posts shall be no less than 3” in diameter, spaced no more than 6’ apart. Posts shall be buried 36” encased in concrete. The ice bridge shall be electrically insulated from the tower. The trapeze sections shall be no more than four (4) feet apart. The ice bridges shall be bonded to the external ground bus bars.
- G. At the Rockefeller Court site, purchase and install one (1) 24” cable ladder on one face of the existing 450’ tower extending to a height (approx.400’) sufficient to accommodate the installation of the feed lines for the state’s antennas and microwave dishes on the tower. The cable ladder shall be grounded according to R56 standards. (e.g.) tower ground bus bar for grounding of feed lines, etc.
- H. Purchase and installation at each site, per local utility standard, of an approved 200-amp electrical service connection to include a main disconnect and at least one (1) electric company approved meter socket.
- I. Purchase and installation of two (2) schedule 40 4-inch conduits at each site, one for power and one for communications from the existing utility backboard to the appropriate locations on the back of the shelters. The power conduits terminate in fused disconnects and the communications conduits terminate in 12 x 12 x 12 NEMA enclosures in locations determined by the State Project Manager.
- J. Purchase and connection of electrical wiring, per local electrical code, from the utility source to the fused disconnects on the back of the shelters and from fused disconnects located on the back of the shelters into each equipment shelter’s 200-amp load center. Electrical work must be completed by a State of Maryland certified electrician.
- K. All supplied materials shall be purchased, not leased. A VALID BILL OF SALE FOR EACH FUEL TANK MUST BE PROVIDED UPON INSTALLATION.
- L. The TO Contractor will provide placards affixed to each equipment and generator room door stating there is Electro Magnetic Energy danger. These signs will comply with the latest version of Motorola’s R56.

4. Commencement of Work

Notice to Proceed, authorized by the State Program Manager.

5. Approvals

Prior to ordering the following drawings/designs shall be approved by the State Project Manager:

- Shelter drawings (Final drawings will have PE stamp)
- Foundation designs (Final drawings will have PE stamp)
- Shop drawings for LP tank foundations
- Bill of sale for each fuel tank.

6. Final Acceptance Sign-off

The TO Contractor will provide all items as outlined in Attachment 31 - Closeout Process Final. The following is to be demonstrated to the State of Maryland Project Manager upon project completion:

- A. All deficiencies noted by the State have been corrected to the State's satisfaction.
- B. All construction materials, equipment, excess tools and other materials will be removed from the site. Any disturbance or damage to either site because of construction activities shall be repaired prior to acceptance by the State. The shelter interiors (equipment and generator rooms) will be swept and all protective paper removed from the floors. The sites should be neat and organized.