

Exhibit C - Design and Constructions Guidelines
RFP 24-0006 Public Address System Replacement

DESIGN AND CONSTRUCTION GUIDELINES

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1.) GENERAL

- a. Applicable Codes and Ordinances. All new construction shall comply with current city of Phoenix Building Construction and Accessibility Codes.
- b. The Contractor shall take all necessary safety precautions to protect workers, the general public, and private and public property, and shall comply with all requirements of the Occupation Safety and Health Act (OSHA).
- c. A professional architect licensed in the State of Arizona shall prepare all drawings and specifications in accordance with the Design Criteria and all applicable City of Phoenix Codes and recognized architectural practices.
- d. A structural engineer licensed in the State of Arizona shall prepare all drawings, calculations, and specifications associated with hanging equipment, metal framed soffits/ceilings, and support of heavy equipment on platforms.
- e. No coring will be allowed through existing steel or cast in place beams. Floor and wall structures must be x-rayed, and all coring locations are to be documented and approved by a structural engineer under the employment of the Contractor and approved/designated by the Owner.
- f. Construction document files (if available) shall be provided by the Aviation Department upon request. The Owner offers no assurances or guarantees that such file documentation will be sufficient to provide all information that may be required by the Contractor. The Contractor shall not rely on the accuracy of the file documentation, but shall field-verify dimensions, locations, and capacities of all building features, services, and systems prior to submitting an initial concept.
- g. Inclusive Process-The City of Phoenix owns Phoenix Sky Harbor International Airport, Phoenix Deer Valley Airport, and Phoenix Goodyear Airport. The Aviation Department manages and oversees the operations of these airports. Several divisions within the Aviation Department will be given the opportunity to review the projects and ask questions before final approval is given. The divisions are:
 - i. Administration
 - ii. Business and Properties
 - iii. Design and Construction Services
 - iv. Planning, Environmental and Capital Management
 - v. Facilities and Services
 - vi. General Aviation
 - vii. Operations
 - viii. Technology

2.) BILLING

- a. Monthly
- b. Schedule of Values
- c. Retention

3.) PROJECT MANAGEMENT

- a. Conduct **Preconstruction Conferences**
 - i. Schedule and conduct a preconstruction conference before starting each phase of construction, at a time convenient to Owner and Architect.
 - ii. Include the following attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties.
 - iii. Notify participants of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 - iv. Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - v. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - vi. Discuss items of significance that could affect progress, including the following:
 1. Responsibilities and personnel assignments.
 2. Tentative construction schedule.

3. Phasing.
 4. Critical work sequencing and long lead items.
 5. Designation of key personnel and their duties.
 6. Lines of communications.
 7. Use of web-based Project software.
 8. Procedures for processing field decisions and Change Orders.
 9. Procedures for RFI's.
 10. Procedures for testing and inspecting.
 11. Procedures for processing Applications for Payment.
 12. Distribution of the Contract Documents.
 13. Submittal procedures.
 14. Sustainable design requirements.
 15. Preparation of Record Documents.
 16. Use of the premises and existing building.
 17. Work restrictions.
 18. Working hours.
 19. Owner's occupancy requirements.
 20. Responsibility for temporary facilities and controls.
 21. Procedures for moisture and mold control.
 22. Procedures for disruptions and shutdowns.
 23. Construction waste management and recycling.
 24. Parking availability.
 25. Office, work, and storage areas.
 26. Equipment deliveries and priorities.
 27. First aid.
 28. Security.
 29. Progress cleaning.
- vii. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- b. **Conduct Pre-Activity Meetings**
- i. Conduct a preinstallation conference at Project site before each construction phase or when required by other sections or when required for coordination with other construction.
 - ii. Include the following attendees: PSM2, Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties.
 - iii. Notify participants of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 - iv. Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - v. Coordination with PSM2 for impairment and all required airport notifications.
 - vi. Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 1. Contract Documents.
 2. Related RFI's
 3. Related Change Orders.
 4. Purchases/Deliveries.
 5. Submittals.
 6. Possible conflicts.
 7. Time schedules.
 8. Manufacturer's written instructions.
 9. Warranty requirements.
 10. Compatibility of materials.
 11. Acceptability of substrates.
 12. Temporary facilities and controls.
 13. Space and access limitations.

14. Regulations of authorities having jurisdiction.
 15. Testing and inspecting requirements.
 16. Installation procedures.
 17. Coordination with other work.
 18. Required performance results.
 19. Protection of work area and personnel.
- vii. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
 - viii. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- c. Conduct **Progress Meetings (like the weekly OAC)**
- i. Conduct progress meetings at weekly or biweekly intervals.
 - ii. Coordinate dates of meetings with preparation of payment requests.
 - iii. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - iv. Notify participants of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 - v. Prepare the meeting agenda: Distribute the agenda to all invited attendees.
 - vi. Review Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - vii. Review present and future needs of each entity present, including the following:
 1. Items of significance that could affect progress.
 2. Status of submittals.
 3. Deliveries.
 4. Access.
 5. Progress cleaning.
 6. Quality and work standards.
 7. Status of correction of deficient items.
 8. Status of RFI's.
 9. Status of Change Orders.
 10. Documentation of information for payment requests.
 - viii. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- d. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting. Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- e. The Aviation's Project Management Information System where all Project related documents will reside and be securely exchanged is Oracle's Primavera **Unifier** Application Documents to be submitted and routed for approval via Unifier include, but are not limited to:
- i. Product Data Submittals
 - ii. Shop Drawings Submittals
 - iii. Substitution Request
 - iv. Request for Information
 - v. Meeting Minutes
 - vi. Change Orders
 - vii. Proposal Requests
- f. Impairment Coordination

- i. Proper notification, scheduling, and coordination with the Aviation Design and Construction Services Department, the Aviation Technology Department and the Improving PHX / Pardon Our Dust Program (PSM2) is required prior to the commencement of any construction, utility shutdowns or roadway restrictions affecting Airport Operations or other Tenants.
- g. Refer to Improving PHX/Pardon Our Dust (PSM2) website at [Improving PHX/Pardon Our Dust](#) for more information.

4.) PARKING

- a. The Contractor or subcontractor employees are not permitted to park their personal vehicles in airport garages or other parking areas intended for passengers.
- b. Use designated areas of Owner's existing parking areas for construction personnel.
- c. Coordinate designated areas with Aviation Department.

5.) ELECTRIC

- a. Electric power from Owner's existing system is available for use without metering and without payment of use charges.
- b. Connect to existing Aviation Department electric power service when it is of sufficient size, capacity, and power characteristics required for construction operations.
- c. Should an additional outlet be required, Aviation Facilities and Services will provide direction on what power panels can be used for new connections and extensions of services at the cost and responsibility of the Contractor.
- d. Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- e. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- f. Use wall convenience outlets for all tools, vacuums and equipment used during the installation of the project. Do NOT use rack and cabinet power for tools, vacuums, etc.
- g. Upon approval of City of Phoenix ITS group, rack and cabinet power can be used for permanent telecommunications equipment.

6.) SITE UTILIZATION PLAN

- a. The contractor shall arrange for the bulk storage of materials off Airport property. Small storage areas can be arranged with Terminal and Airside Operations as the project progresses through its phases.
- b. Submit a plan showing:
 - i. temporary facilities
 - ii. temporary utility lines and connections
 - iii. staging areas
 - iv. waste collection area
 - v. elevator use
 - vi. lift storage and charging
 - vii. construction site entrances
 - viii. vehicle circulation
 - ix. parking areas for construction personnel
- c. Contractor is responsible to coordinate with Aviation Operations and PSM2 for the items above and attain approval for plan prior to commencement of work.
- d. Locate facilities where they will serve Project adequately, result in minimum interference with performance of the Work and limit site disturbance.
- e. Relocate and modify facilities as required by progress of the Work.
- f. Enforce strict discipline in use of the facilities.
- g. Maintain facilities in good operating condition.

7.) DUST AND HVAC-CONTROL PLAN

- a. Prevent dust, fumes, and odors from entering occupied areas as well as telecommunications spaces.
- b. Maintain dust partitions, floor coverings and walk off mats during the Work.

- c. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
- d. Use vacuum collection attachments on dust-producing equipment.
- e. Isolate work within occupied areas using portable dust-containment devices.
- f. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- g. Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation.
- h. Include the following:
 - i. Locations of dust-control partitions at each phase of work.
 - ii. HVAC system isolation schematic drawing.
 - iii. Location of proposed air-filtration system discharge.
 - iv. Waste-handling procedures.
 - v. Other dust-control measures.
- i. Materials
 - i. Dustproof partitions to be two layers of 6-mil polyethylene sheets. Overlap and tape full length of joints.
 - ii. Floor coverings to be two layers of 6-mil polyethylene sheets, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints.
 - iii. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum 36 by 60 inches.
- j. Progress Cleaning: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - i. Coordinate progress cleaning for joint-use areas where Design-Builder and other contractors are working concurrently.
 - ii. Clean and return work space and adjacent areas to condition existing before project operations began.
 - iii. Remove liquid spills promptly.
 - iv. Remove debris from concealed spaces before enclosing the space.
 - v. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - vi. Apply protective covering to ensure protection from surrounding work.

8.) CONSERVATION

- a. (who defines requirement for this?)
- b. Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
- c. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

9.) WASTE DISPOSAL

- a. See detail for 01 74 19
- b. The Contractor shall provide and pay for trash containers and disposal. It is the responsibility Contractor to break down and remove all trash and debris from the premises on a daily basis and place in the containers supplied for that purpose. Provide waste-collection containers in sizes adequate to handle waste from construction operations.
- c. Comply with requirements of authorities having jurisdiction.
- d. Dispose of demolished items and materials promptly. Do not allow demolished materials to accumulate on-site.
- e. Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.
- f. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- g. Transport demolished materials and dispose of at designated spoil areas on Owner's property.
- h. Do not burn demolished materials.
- i. Submit a Waste Management Plan within 30 days of date established for the Notice to Proceed.
 - i. Include a Waste Identification Plan

1. Indicate the anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work.
2. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste.
3. Include estimated quantities and assumptions for estimates.
- ii. Include a Waste Reduction Work Plan
 1. List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.
 2. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste.
 3. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
- iii. Include Salvaged Materials for Reuse Plan:
 1. For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 02 41 19 "Selective Demolition."
 2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
- iv. Include Recycled Materials Plan
 1. Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
- v. Include Disposed Materials Plan
 1. Indicate how and where materials will be disposed of.
 2. Include name, address, and telephone number of each landfill and incinerator facility.
- vi. Include Handling and Transportation Procedures
 1. Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- j. Regularly review methods and procedures related to waste management including, but not limited to, the following:
 - i. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
 - ii. Review requirements for documenting quantities of each type of waste and its disposition.
 - iii. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - iv. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - v. Review waste management requirements for each trade.

10.) ELEVATOR USE

- a. Use of Owner's existing elevators shall be approved by Aviation Operations Department prior to use.
- b. Use of the existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner.
- c. Do not load elevators beyond their rated weight capacity.
- d. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work.
- e. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

11.) SECURITY AND ACCESS

- a. The Air Operations Area (AOA) prohibits access to unauthorized persons, vehicles, or equipment. The AOA consists of all areas beyond the security checkpoint and areas of the Airport used for the landing, take-off, or surface maneuvering of aircraft.
- b. No one enters the AOA without proper authorization and violators are subject to fines and/or arrest. All construction personnel requiring airside access, must obtain a security badge.
 - i. For more information, please visit: Security and Badging Information or call 602-273-2036.

- c. Temporary fences and/or gates installed during construction shall remain closed and locked unless continuously staffed by a badged individual. All locks utilized must be Aviation Department approved.
- d. Anyone operating a motor vehicle within the AOA shall have a valid airfield driver's permit issued by the Airport Security Badging Office. In addition to the permit, the contractors must have a valid driver's license and adequate vehicle insurance for airside access.
- e. All tools used in the AOA must be secure and kept in immediate control of the contractor at all times.
 - i. For more information, please visit: Operations Website or call 602-553-0005.
- f. Working hours in the public circulation areas will be limited to the hours approved by Aviation Operations Department which will likely be limited to the hours between last flight departing at night and first flight departing in the morning.

12.) DCS INSPECTORS

- a. When Contractor conducts any excavation, saw cutting, pot holing, drilling (including hammer drilling) or coring activities, a DCS Inspector must be advised and be present prior to and during the construction activity. If not, the project will be stopped.
- b. All floor or wall penetrations require radar/GPR investigation.
- c. A Design and Construction Services (DCS) Inspector must be present for all Radar/GPR investigations.
- d. If floor or wall penetrations occur without a DCS Inspector present, the project will be stopped.
- e. It is the Contractor's responsibility to coordinate access and obtain written proof of inspection approvals.

13.) CONSTRUCTION DOCUMENTS

- a. Shall Include: (see matrix developed by designer.)
 - i. Key plan showing location of the demised premises within the terminal or concourse.
 - ii. Reflected ceiling plans (scale 1/4" = 1'-0") with speakers locations, ambient microphone locations, conduit routing, wall penetrations and zones.
 - iii. Rack Layouts
 - iv. TR Room Layouts
 - v. Electrical power plan prepared by a licensed electrical engineer
 - vi. Electric load schedule
- b. Construction Document Review
 - i. After completion of the Design Narrative, the Contractor shall submit to the Owner a 30% Construction Documents Package for review and comment.
 - ii. The Owner will review and comment on the 30% Construction Documents package within three weeks.
 - iii. If drawings are returned to the Contractor with comments, the Contractor shall respond to the comment log indicating how the issue will be addressed.
 - iv. After successful comment resolution, the Contractor shall proceed to the 60%, 95% and IFC Construction Documents package repeating the same comment/resolution process.

14.) PROTECTIONS

- a. Property
 - i. Protect walls, ceilings, floors, and other existing finish work that are exposed during project operations.
 - ii. Cover and protect furniture, furnishings, and equipment that have not been removed.
- b. People
 - i. Provide protection to ensure safe passage of people around work areas.
 - ii. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - iii. Do we provide these or do they buy them?
 - iv. See detail for Pedestrian Control Equipment-11 14 13

15.) MAINTAIN EXISTING SERVICES

- a. Unless otherwise indicated; keep existing services in service and protect against damage during operations.
- b. If an interruption to existing services is anticipated, propose and attain approval for temporary services that will be provided during the interruption.

- c. Coordinate with Aviation Technology to discern the hours that public circulation spaces can be accessed for the purpose of doing work in the ceilings. This time will likely be between last flight and first flight in the surrounding area.

16.) GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

- a. See detail for 27 05 26
- b. Also see AR 1.73 Telecommunications Cabling Systems with Aviation Supplement, update coming out in March.

17.) CONDUIT SYSTEMS

- a. Conduit
 - i. Comply with NECA 1, NECA 101, and ANSI/TIA-569 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
 - ii. The inside radius of bends in conduit shall be:
 - 1. 6 times the internal diameter for 2-inches or less.
 - 2. 10 times the internal diameter for greater than 2-inches.
 - iii. Any single conduit run extending from an MDF/IDF shall not serve more than one outlet.
 - iv. Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.
 - v. Underground minimum clearances
 - 1. Minimum 3 inches when near electrical conduits.
 - 2. Minimum 12 inches when running parallel to electrical conduits.
 - 3. Minimum 6 inches when crossing petroleum, water and other pipelines.
 - 4. Minimum 12 inches when running parallel to petroleum, water and other pipelines.
 - 5. Minimum 12 inches when below railroad rails.
 - 6. Orange colored, detectable, plastic warning tapes shall be installed to prevent accidental dig-ups.
 - vi. Conduit protruding through the floor shall be terminated at 2 to 4 inches above the floor surface.
 - vii. All conduit penetrations shall be provided with the proper conduit sleeves.
 - 1. Sleeves shall extend three inches AFF or four inches below finished ceiling, with a bushing.
 - 2. Sleeves shall be installed in the communications room floor or ceiling a minimum of two to four inches on center from the wall.
 - 3. Conduit floor sleeves shall be spaced to allow space for ground bushing and insulated bushing for cable protection.
 - 4. Shall be installed in a single tier or row from left to right horizontally. If two tiers or rows are required, the conduits shall be staggered minimum of 2 inches between tiers.
 - 5. Cable support anchors shall be installed 18 to 24 inches from the sleeves.
 - viii. All cable (horizontal, riser or backbone) wall or ceiling penetrations shall be provided with the proper conduit sleeves.
 - 1. Sleeves shall extend three inches AFF or four inches below finished ceiling, with a bushing.
 - 2. Sleeves shall be installed in the floor or ceiling a minimum of two to four inches on center from the wall.
 - 3. Sleeves shall be installed in the walls at a minimum of two inches extended on each side of the wall.
 - 4. Cable floor, ceiling and wall sleeves shall be spaced to allow space for ground bushing and insulated bushing for cable protection.
 - 5. Shall be installed in a single tier or row from left to right horizontally.
 - 6. If two tiers or rows are required, the conduits shall be staggered minimum of 2 inches between tiers.
 - 7. Cable support anchors shall be installed 18 to 24 inches from the sleeves.
 - 8. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-waterpipes. Install horizontal pathway runs above water and steam piping.
 - ix. Complete pathway installation before starting conductor installation.

- x. Comply with requirements in Section City Standards for "Hangers and Supports for Electrical Systems" for hangers and supports.
 - xi. Arrange stub-ups so curved portions of bends are not visible above finished slab.
 - xii. Contractor shall provide pull boxes for all conduit pathways which exceed 100-feet or exceed 180-degrees in bends (two 90-degree, four 45-degree, six 30-degree, or any combination thereof). Support the pathway within 12 inches of changes in direction.
 - xiii. Utilize long radius ells for all optical-fiber cables.
 - xiv. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - xv. Support conduit within 12 inches of enclosures to which attached.
 - xvi. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 - xvii. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
 - xviii. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
 - xix. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
 - xx. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
 - xxi. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- b. Junction and Pull Boxes:
- i. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
 - ii. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
 - iii. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - iv. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
 - v. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - vi. Set metal floor boxes level and flush with finished floor surface.
 - vii. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- c. Sleeve and Sleeve-Seal Installation for Communications Penetrations
- i. A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.
- d. Firestopping
- i. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- e. Protection
- i. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.
- f. Also see AR 1.73 Telecommunications Cabling Systems with Aviation Supplement, update coming out in March.

18.) RACEWAYS, BASKET TRAYS, BOXES

- a. See AR 1.73 Telecommunications Cabling Systems with Aviation Supplement, update coming out in March.

19.) CABLES, CONNECTORS AND MISCELLANEOUS EQUIPMENT

- a. Coax is not specifically covered. Develop stanrd from our previous installations.
- b. Audio and Control Cable
 - i. Microphone and line-level audio circuits, installed within conduit and equipment rack, #22 AWG nominal, 2-conductor, stranded, aluminum polyester shielded, with separate drain wire.
 - ii. Loudspeaker circuits installed in conduit, equipment rack, or exposed interior benign environment (except return air plenums); stranded, unshielded, jacketed.
 1. #18 AWG, 2-conductors
 2. #16 AWG, 2-conductors
 3. #14 AWG, 2-conductors
 4. #12 AWG, 2-conductors
 - iii. Where applicable for Fire Code, Loudspeaker circuits installed in conduit from PAS equipment cabinet to first loudspeaker in each circuit, 2-hour fire-rated, UL-compliant, stranded, unshielded, jacketed.
 1. #14AWG, 2-conductors
 2. #12AWG, 2-conductors
 - iv. Control circuits, for loudspeaker volume control priority over-ride relays shall be the #18 AWG version of the same type loudspeaker cable used for associated loudspeakers.
- c. Also see AR 1.73 Telecommunications Cabling Systems with Aviation Supplement, update coming out in March

20.) ACCESS PANELS

- a. See ATTACHED cut sheet to match recent DAS work.

21.) EQUIPMENT CABINETS AND ACCESSORIES

- a. Equipment Racks and Cabinets Equipment Rack/Cabinets for public address system, listening assistance system, and SCADA equipment shall be provided as shown on drawings.
 - i. Equipment Cabinet, floor mounted, with side panels, with front (perforated) and rear locking doors, 77-inch rack height (44RU), minimum nominal 32-inch deep (30 inches usable) are to be Middle Atlantic BGR-4532 (with included vented rear door) with BVD-45 Vented Front Door, BSPN-45-32 Rack Side Panels, BGR-276FT-FC Top Vent Fan & Top Panel, BGR-RR45 Rear Rack Rails, and LACE-44-OWP Vertical Cable Managers.
 - ii. Provide second Equipment Cabinets when needed for Audio Frequency Induction Loop Assistive Listening System and Fire Alarm SCADA Panel as shown on the drawings.
 - iii. Where revisions to existing equipment cabinets are indicated, verify all existing space requirements, and adjust other existing equipment within equipment cabinet(s) as required and as indicated on shop drawings submitted for review.
 - iv. All equipment cabinets and racks shall be properly grounded to the Telecommunications Ground Busbar (TGB) in the TR Room. Refer to Technology drawings and specifications for grounding details.
 - v. Any rack front panel details shown on the drawings are for concept only. Shop drawings are required for all equipment rack layouts (using the exact equipment to be furnished), and shall clearly identify existing equipment to be relocated.
 - vi. All standard sized rack panels used to mount controls or connectors shall have formed edges.
 - vii. Rack panel mounting screws shall be as short as practical for equipment to be mounted.
 - viii. Except as noted on the drawings, vent or blank panels shall be used above and below all equipment and as recommended by equipment manufacturers.
 - ix. Sliding Shelf, 1RU, steel, ball bearing slides, minimum 50-lbs capacity, black to match equipment cabinet(s)
 1. Atlas Sound VTD1-16; or
 2. Chief SLS-1; or
 3. Lowell RSD-116; or

4. Middle Atlantic SS.
 5. Furnish and install sliding shelf unit(s) in Floor Standing Equipment Racks approximately 40 inches above the floor and as shown on the rack layout drawings.
- x. Brush Grommet Panel, 1RU, steel, to enable cables to pass securely between front and rear of cabinet, with strain relief tie points, black to match equipment cabinet(s)
 1. Chief NAG1BW; or
 2. Middle Atlantic BR1; or
 3. Approved equal.
 - xi. Refer to the drawings for conceptual equipment rack layouts. Submit shop drawings illustrating proposed equipment rack layouts (indicating equipment labels to be used), including conditions for any phased temporary/interim and final conditions.
- b. Hardware and Accessories
 - i. Type 1 Barrier Strip, for termination of audio circuits in equipment rack
 1. TRW-CINCH 140 series; or
 2. Approved equal.
 - ii. Type 2 Barrier Strip, high density, for termination of loudspeaker circuit in junction box
 1. Phoenix Contact High Density UK series; or
 2. Approved equal.
 - iii. LED indicator, separately mounted, Digi-Key (Thief River Falls, Minnesota, 1-800-344-4539)
 1. P303, green LED, 5mm (Panasonic LN31GPHL); or approved equal.
 2. P306, amber LED used for yellow applications, 5mm (Panasonic LN41YPHL); or approved equal.
 3. P307, orange LED used for red applications, 5mm (Panasonic LN81RPHL); or approved equal.
 - iv. L3000-2, single piece panel mount holder with clear lens (IDI4312) or approved equal; one required for each LED furnished.
 - v. Spade Tongue Terminal, brazed seam, uninsulated type only
 - c. Power Strips/UPSs/PDUs
 - i. Furnish any additional multi-receptacle AC power strip(s) for AC circuit(s) as required for public address system equipment in each cabinet. Each power strip shall have at least two spare receptacles.
 - ii. Connect power amplifiers to 120V 20A AC power circuits so that maximum rated input power can be delivered to each power amplifier without exceeding the power handling capacity of any AC power circuit.
 1. All equipment AC power switches that are accessible from the front of the equipment racks shall be covered by security covers to prevent components from being turned off inadvertently.
 2. Where provided, use orange colored outlets for all UPS circuits. Label all uninterruptible power supply AC power receptacles with a label which reads "UPS".
 - d. Uninterruptable Power Supply (UPS)
 - i. Rack mounted UPS systems shall be provided to protect the public address systems against transients and temporary loss of normal AC power.
 - ii. Provide UPS systems with Ethernet connectivity for status alarms (fault, battery test failure, etc.) and ports/sensors for environmental monitoring (high temperature). Provide connections to City of Phoenix network switches as required.
 - iii. Provide mounting brackets and other accessories as required for installation in public address system cabinets. Verify UPS compatibility with public address system components and equipment cabinets.
 - iv. UPS systems shall include appropriate length 120V 30A NEMA L5-30P power cords for connection to electrical receptacles mounted above equipment cabinets.
 - v. Review and coordinate UPS systems to ensure that the proper quantity of appropriately sized UPS units are provided for the public address system equipment installed in each cabinet.
 1. Type 1 UPS System, for AFILS Hearing Assistance and SCADA systems, minimum 1,500 VA capacity, APC Smart-UPS 1500VA LCD RM 2U 120V (SMT1500RM2UC) with AP9631 UPS Network Management Card.
 2. Type 2 UPS System, for Public Address System, minimum 3000 VA capacity, APC Smart-UPS X 3000VA Rack/Tower LCD 100-127V with Network Card (AP9631) (SMX3000RMLV2UNC).
 - e. Power Distribution Unit (PDU)

- i. Rack mounted PDU equipment shall be provided to power the public address, hearing assistance, and SCADA systems.
- ii. Provide mounting brackets and other accessories as required for horizontal rack mounted installation in public address system cabinets.
- iii. Provide connections to City of Phoenix network switches as required.
 - 2. PDU, 2RU, breakers; status LCD; display of load current monitoring; Ethernet control and Monitoring; alarm thresholds; Chatsworth eConnect PDU with Temperature & Humidity Probes (Chatsworth 17761-001) and input power cord plug configuration as required for compatibility with furnished UPS units.

22.) FINAL SYSTEM COMMISSIONING AND USER ACCEPTANCE TESTING

- a. System commissioning for the public address system furnished and/or installed with this project will include the following tests, adjustments, and configuration verification
 - i. Adjustment of all gain controls to proper levels and with proper headroom free from distortion and signal clipping.
 - ii. To achieve proper acoustic levels, select loudspeaker transformers may require re-tapping as required and directed.
 - iii. Equalization of the loudspeaker distribution system broadband parametric equalizers, using both objective measurement techniques and subjective listening using pre-recorded messages and live microphone paging station announcements, to provide uniform/natural frequency response and high levels of speech intelligibility. The Speech Intelligibility Index (STI) of the system shall be compliant with the applicable NFPA 72, Annex D Speech Intelligibility, Article D.2.4.1.
 - iv. Adjustment of audio delays to provide alignment between adjacent loudspeaker circuits with overlap and significant time arrival differences.
 - v. Calibration of each ambient noise microphone and configured channel. Confirmation of proper operation for each ambient noise configured power amplifier channel. Adjustment of ambient microphone thresholds for proper adjustment of system levels based on facility operational conditions.
 - 6. PAS control system configuration of each microphone paging station, including button assignments and LCD screens.
 - vi. PAS control system configuration of all zone outputs and zone groups.
 - vii. PAS control system configuration of all prerecorded messages including messages with automatic playback schedules and messages configured for playback on demand from paging stations.
 - viii. PAS control system configuration for all prerecorded flight announcement messages related to flight boarding, arrival, baggage claim, and other typical airport operations, based on the airlines operating in the terminal.
 - ix. Setup and configuration of all equipment requiring a password with user/site specific password(s). System or product default passwords shall not be used. All passwords information shall be documented and provided to the Owner with close-out submittals.
- b. The above described PAS control system configuration shall be based on typical airport operations, manufacturer recommendations, and input from the Owner or designated representative. Revisions to the PAS control system configuration shall be made during the system commissioning process as requested by the Owner or Acoustical Consultant.
- c. Approximately one to two weeks after the completion of a significant phase, the above described system settings and adjustments, including but not limited to system levels, equalization, ambient noise microphone calibration, and system programming/configuration, shall be reviewed on-site by the Systems Contractor and revised as required based on operational conditions of the facility and any Owner direction. This review and any required adjustments shall be coordinated with the Owner.
- d. The Systems Contractor shall furnish the services of competent technician(s), having knowledge of the system installation and proper system commissioning techniques, to adjust the paging system equipment and connections as required during the time reserved for system commissioning. It is estimated that this technician should be available on-site for approximately eight 10-hour days.
- e. The PAS control system manufacturer shall furnish the services of a competent engineer, one having knowledge of the system hardware and software, to provide assistance with PAS control system

configuration (including high-level programming issues) as required during the time reserved for system commissioning. It is estimated that the manufacturer's engineer should be available on-site for approximately three 10-hour days.

- f. These system commissioning periods of time will be used for equalization and final system tests and adjustments. They will not, however, include the time that might have to be expended in the correction of system wiring errors, improper system performance due to noise, oscillations, correcting software problems, etc. The Systems Contractor shall make his own assessment of the total time required for the technician and manufacturer's engineer referenced above.
- g. During commissioning, the Systems Contractor shall provide User Acceptance Testing that demonstrates proper system operation with user scenarios in real-world system related passenger processing and airport operations.
- h. The Contractor shall be responsible for providing confirmation of completion of User Acceptance Testing and shall notify all parties of the remaining unresolved malfunctions encountered during system tests.
- i. If, in the opinion of the Owner, the system does not appear to be functioning properly, the Systems Contractor and/or manufacturer's engineer may be required to perform tests on any individual item of equipment or software to determine its operational status. Any measurements deemed necessary shall be made for frequency response, distortion, speech intelligibility, etc.
- j. If after maximum effort by all concerned, it should prove impossible to complete the system commissioning within the stipulated period, the technician and/or manufacturer's engineer shall be made available for additional hours at no additional cost to the Owner if such assistance is necessary.
- k. The Owner and/or Acoustical Consultant may be present to witness (or otherwise participate in) the satisfactory completion of the specified final system commissioning and User Acceptance Testing for the project.

23.) OPERATIONS AND MAINTENANCE DOCUMENTATION PACKAGE

- a. Provide O&M manuals electronically via Unifier.

24.) RECORD DRAWINGS

- a. Redlined specifications showing the final configuration of the system installed shall be provided by the contractor at project closeout. This document is to reflect any changes and modifications that took place throughout the course of the project.
- b. Include As-Built of each item in Drawing Package Matrix.
- c. See Sheet Example Package from T4S1 As Builts

25.) INSTRUCTION OF OPERATING PERSONNEL

- a. Contractor to provide a phased training program that matches the phased turn up by area for the new system.
- b. Provide knowledgeable, manufacturer-authorized representative(s) to give full instruction to designated personnel in the operation and maintenance of the installed public address system.
- c. All training shall be scheduled with the Owner with at least seven days advance notice.
- d. **Operations Training:** Provide training sessions for designated airport and airline representative as necessary to match the phased implementation of the project. These sessions shall include, but not be limited to, instruction on the following:
 - i. Description of major public address system components such as the microphone paging stations, PAS control system and audio distribution system (zone definitions).
 - ii. Overview of PAS control system features including announcement types, priority levels, prerecorded messages, ambient noise analysis system, and system monitoring and logging functions. Review simplified operating instruction notes.
 - iii. Hands-on demonstration and training for microphone paging station operation including use of handheld microphone with PTT button, keypad functions, LCD/LED indicator description, User ID and lockout capabilities, and zone selection and assignment of entry codes.
 - iv. Hands-on demonstration and training for paging announcement procedures including local announcements (live and recorded), terminal announcement (recorded), telephone announcements (authorized users only), emergency announcements (authorized users/stations only).

- e. **Maintenance Training:** Provide two (2) two-hour maintenance training sessions, for a minimum of six (6) designated airport representatives each. In addition to the material described above for Operations Training, these sessions shall include, but not be limited to, instruction on the following:
 - i. More detailed description and physical identification of public address system equipment including components installed in equipment rack assemblies.
 - ii. Demonstration of PAS control system configuration software including microphone paging station setup, zone and zone group assignments, prerecorded message setup and scheduling, flight announcement system setup and sequencing, monitor system testing, and system logging functions.
 - iii. Description of public address system distribution equipment (power amplifiers, circuits, loudspeakers, etc.) including operation of backup (hot standby) amplifiers.
 - iv. Review of any public address system interfaces to other systems (fire alarm system, etc.) to demonstrate proper operation and functions.
 - v. Review of operating instructions, maintenance notebooks, system drawings, and spare parts (including spare parts installation) to provide an overview of the tools required to conduct basic troubleshooting of the system.
 - vi. Explanation and demonstration of typical procedures required to test and maintain the public address system.
 - vii. Description of warranty and servicing procedures for the system

26.) SPARE PARTS

- a. Contractor responsible for turning over required spare parts prior to the first cutover phase.