CITY OF PHOENIX

BUILDING STANDARDS AND REVIEW PROCESS

Facilities Review Committee
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INTRODUCTION – Building Standards

The Facilities Review Committee (FRC) prepared "The City of Phoenix Building Standards" manual which details standards and processes. These standards are intended to maintain design criteria reflecting current state-of-the-art technology in the building industry, which will enable the City of Phoenix to ensure quality of design and economy of operation and maintenance for City facilities. The criteria set forth herein are designed to create standards for constructing new and remodeling existing City facilities.

Facilities Review Committee

The Facilities Review Committee was created by the City Manager to review plans for construction or renovation of City facilities. The primary charge of the committee is to ensure compliance with City standards and economy of construction, operation, and maintenance. Job Order Contracts (JOC) must comply with these standards.

Reviews focus on issues such as: office size or modular work stations, interior and exterior finishes, energy conservation, roof type, floor covering, and ADA accessibility. To maximize coordination during the design process, the committee is made up of representatives from the Budget and Research (B&R), Development Services (DSD), Engineering and Architectural Services (EASD), Parks and Recreation, Information Technology (ITD), and Public Works departments.

The Facilities Review Committee is scheduled to meet on a monthly basis at which time City projects deemed appropriate to come before the Committee are presented, reviewed, discussed and approved.

Budget

Designing a project too far in advance of construction may require costly redesign should standards or conditions change before work proceeds to bid and construction. As a result, only projects reflected in the current citywide 5-year Capital Improvement Program as fully funded through construction should begin the design process.

Exceptions should be limited. Client departments are responsible for disclosing and requesting exceptions. An example of an exception would be a project funded for design late in a 5-year GO Bond program that will pursue construction funding as a high priority in the first year of the next bond authorization process. Programs with annual funding cycles would not fall within such an exception. Another exception would be projects funded for a preliminary concept only that would not generate plans and specifications for bid.

To present an exception project to Facilities Review, the client department should submit a memo explaining why early design is desirable and how needed construction funding will be sought including the likely time frame for such funds becoming available. EAS would evaluate the potential for costly design update and ability to incorporate the project into existing planned project manager workloads. B&R would review for funding feasibility. EAS and B&R comments are required prior to an item being scheduled for Facilities Review.

Leadership in Energy and Environmental Design (LEED™)

It is the intent of these Standards to effect overall project design and construction to meet LEED "Certified" level at a minimum. All facilities approved in the March 2006 bond election shall follow the most up to date LEED Certification guidelines. Documentation shall be provided by using the U.S. Green Building LEED templates. A copy of the latest version of the project checklist may be downloaded from the U.S. Green Building web site, and shall be used by the design team and the construction team to validate compliance with LEED standards.

Both entities will stamp and sign a City of Phoenix approved document verifying to the City (building owner) that the minimum LEED point requirement for "Certified" level has been met. The LEED approach allows the project team (design/construction) various options for meeting minimum LEED points. Additionally, the City of Phoenix has minimum requirements that will need to be met regardless of other LEED program prerequisites or other points achieved in the process. These include the following:

Landscape & Exterior Design to Reduce Heat Islands, (non-roof)	1 pt
Landscape & Exterior Design to Reduce Heat Islands, (roof)	1 pt
Water Efficient Landscaping (reduce by 50%)	1 pt
Water Use Reduction (20% reduction)	1 pt
Optimize Energy Performance (by 30%)	2 pts
Construction Waste Management, (divert 50%)	1 pt
LEED Accredited Professional	1 pt

All facilities from this point forward and in particular those facilities approved in the March 2006 bond election shall be "designed and constructed" to meet at least minimum LEED standards; i) LEED NC (New Construction) for new facilities; and ii) LEED EB (Existing Building) for major reconstruction and remodeling; and iii) LEED CI (Commercial Interiors). The effective LEED standard will be the latest applicable version of LEED at the start of every project's conceptual design.

Mayor's Commission on Disability Issues – Architecture and Design Committee

The Mayor's Commission on Disability Issues-Architecture and Design Committee (MCDI-ADC) has charged its architect and design committee to provide public input on City funded capital improvement projects. Criteria has been established to determine if a project is required to be presented to the Architecture and Design Committee which typically holds a public meeting on a monthly basis. It is the City's goal to go above and beyond the minimum requirements of the most currently adopted Americans with Disabilities Act Architectural Accessibility Guidelines (ADAAG) as adopted by Arizona ADAAG, currently adopted American National Standards Institute (ANSI), and other adopted related building codes related to accessibility for persons with disabilities. As a tool to assist designers and City project managers to be successful in meeting this goal, a copy of the Mayor's Commission on Disability Issues Architectural Accessibility Committee Submittal Checklist is included in Appendix E.

Central City Architectural Design Review Committee (CCADRP)

In 1988, City Council instituted a panel of professional members to oversee projects funded by the City of Phoenix or having some form of City participation to assist in developing a consistent design theme for projects located within the Downtown area. Projects planned for construction within the area bounded by 8th Street to 8th Avenue, and by Jackson Street to Coronado Road, are presented, reviewed, and approved by CCADRP which meets on a monthly basis. To facilitate the process, the City project manager will provide design consultants a copy of the "Central City Design Guidelines" upon request and coordinate with CCADRP's staff facilitator to schedule the review.

Historic Preservation

Existing facilities 50 years and older may be considered "historic" and shall require verification of the City's Historic Preservation Officer. Should a facility be deemed historic, the project manager shall comply with the appropriate regulations to ensure the facility's status is not compromised.

Environmental Review Checklist

As soon as it is deemed appropriate, the project manager and client department representative shall perform an environmental review of the proposed project to better plan the approach of the project and identify potential environmental issues that need to be addressed during the design and construction of the project. A copy of the Environmental Review Checklist is incorporated as Appendix D.

Project Manager (PM)

Each City of Phoenix capital improvement project has an assigned "project manager." This is usually, but not in all cases, an employee of the City's Engineering and Architectural Services Department, Water Services Department, Public Transit, and/or Aviation.

The project manager plays a key role in support of the FRC's directive in ensuring compliance with City Standards. This support is accomplished by providing updated standards to contracted architects and consultants. Additionally, project managers should guide the project design toward compliance; or, if needed, identify areas where deviations from City Standards are required and provide to the Committee justification for noncompliance.

The project manager also plays a key role in compliance with the directives of the FRC. The project managers will ensure that guidance provided by the Committee is followed by the design team, and that the facilities constructed adhere to City standards. See Appendix B and Appendix C for checklists.

City Team

It is the responsibility of the City's Project Manager to facilitate and coordinate the involvement of other City departments during all phases of the design and construction of a City facility at the appropriate times. Projects managed by the Engineering and

Architectural Services Department has a designated core project team, which includes the EAS project manager, EAS inspector, DCM section supervisor, EAS utility coordinator, funding/operating department representative, user representative (if different from funding/operating department), Public Works facilities coordinator, operating department's facilities representatives (if not maintained by Public Works) ITD representative, DSD Team Leader.

Early programming and design involvement with Public Works, ITD, DSD, and Fire Prevention, and EAS Environmental/OEP (if needed), is essential to a successful project.

Client Departments

The client department is responsible for ensuring compliance with Building Standards. Client departments are responsible for preparing necessary documentation to the Facility Review Committee when building standards are **not** met. The documentation shall be submitted with the "Project Summary Form" (Appendix C) indicating the item(s) not in compliance with the Building Standards, and state the justification for non-compliance.

CHAPTER 1 – General Requirements

1.1. These standards do not replace requirements of applicable federal, state, county statutes and/or City of Phoenix codes and ordinances. These standards are supplementary requirements. Compliance with the statutes, codes, ordinances, and these standards is mandatory in preparing the project documents and in constructing the facility.

1.2. Ensure that Cultural and Natural Resources and Clean Water Act 404 Permits checklists are completed. The Environmental Review Checklist is required to be completed by the project manager(s) and is included as Appendix D.

1.3. When selecting materials, consideration should be given to using domestic products.

1.4. Consideration should be given to using materials that reduce vandalism and graffiti.

1.5. The City of Phoenix is committed to the Americans with Disabilities Act. All products used should meet or exceed ADA/ADAAG requirements, providing access to all citizens and employees.

1.6. Consideration should be given to the use of recycled products, as well as having a recycling program on the construction site.

1.7. Proprietary specifications are not permitted without project manager's approval.

1.8. New buildings shall be designed for a minimum useful life of 50+ years, constructed of non-combustible materials, and fully sprinklered. This may not apply to temporary structures (i.e., Building life less than 3 years) with the approval of the project manager and the City Engineer Wood truss systems and heavy timber construction are discouraged and not allowed where exposed to weather. Wood truss system and heavy timber are combustible, but, may be allowed in renovation of existing buildings when replacing like for like. When major remodeling and/or renovation is to occur to an existing non-sprinklered wood structured facility, retrofitting the facility with fire protection should be done at that time.

1.9. Plans should include provisions for sheltered exterior areas for smokers, and relief areas for working animals, whenever appropriate.

1.10. Architect/engineer shall review design with City representatives, including the Facilities Review Committee, at the end of schematic design and design development phases, or whenever deemed appropriate by the Facility Review Committee or project manager.

1.11. If the facility is expected to **use or store hazards materials, or other hazardous waste such as** batteries, acids, toxics, flammables, caustic, mercury lamps,

pesticides, fertilizer, tires, bulk materials (gravel), scrap metal etc. ensure that storage locations meet the Fire Department requirements for storage and personnel protection (eye wash, emergency showers) and are secure with the proper fencing, canopy, and separation.

1.12. All rules and regulations governing dust control will be strictly enforced and shall be so stated in the contract.

1.13. The contractor, or subcontractor, is responsible for coordination with the appropriate utility companies.

1.14. All facilities from this point forward and in particular those facilities approved in the March 2006 bond election shall be "designed and constructed" to meet at least minimum LEED standards; i) LEED NC (New Construction) for new facilities and ii) LEED EB (Existing Building) for major reconstruction and remodeling. The effective LEED standard will be the latest applicable version of LEED at the start of every project's conceptual design.

1.15. Designated smoking areas to be located away from pedestrian traffic areas, as well as a minimum of 20 feet from facility entry/exit doorways.

1.16. Contractors and agents shall adhere to City of Phoenix security requirement including background check and badging policies and procedures when the building is occupied.

1.17. The Project Manager shall contact the City's Homeland Security Bureau to determine the Site Protection Systems, if any, would be most appropriate and practical methods for implementation of threat mitigation measures at the specific project site.

1.18. Codes and Standards

1.18.1. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation work shall comply with the currently adopted City of Phoenix Building Construction Code editions in effect 30 days prior to receipt of bids of the following codes. Systems or products not currently offering the following approvals are not acceptable.

1. 2003 International Building Code
2. 2003 International Residential Code
3. 2003 International Existing Building Code
4. 2003 International Code Council Performance Code
5. 2003 International Mechanical Code

6. 2003 International Energy Conservation Code (As amended in the 2004 ICC Supplement)
7. Arizona State Plumbing Code (with current supplements)
8. 2005 National Electrical Code NFPA 70
9. ASME A17.1 Safety Code for Elevators and Escalators
10. ASME A17.3 Safety Code for Existing Elevators and Escalators
11. ASME A18.1 Safety Standards for Platform Lifts and Stairway Chairlifts
12. Institute of Electrical and Electronic Engineers (IEEE)
13. ANSI/ASHRAE Standard 135 – BACnet (where specified)
14. LonMark Interoperability Association's "LonMark" Certification (where specified)
15. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices

CHAPTER 2 – Sitework

2.1. Access must be provided for maintenance and emergency vehicles.

2.2. Site lighting - see Chapter 16 - Electrical.

2.3. **Dry Wells** – Dry wells should not be installed in the vicinity of the storage of any hazardous materials such as petroleum fuel. In the event a drywell is being considered during design, Public Works Environmental Coordinator **and the Office of Environmental Programs dry well staff** should be notified.

2.4. **Earthwork, Utility Trenching, Backfill and Compaction**

2.4.1. Shall meet MAG Specifications and Drawings plus City Supplements for requirements.

2.4.2. Utility Trenching: Location of utilities shall be coordinated with EAS Utility Section and public utility easements (PUE) recorded. Design of new services is to be determined no later than in the Design Development Phase after loads have been determined for the project. Most projects will require design of street lights through the Street Transportation Department and cost included in the project budget.

2.5. **Asphalt Concrete Paving**

2.5.1. MAG Specifications and drawings with City of Phoenix Lab approved supplier and mix designs.

2.5.2. Pavement sections for heavy truck traffic areas shall have at least C¾ mix for the bottom lifts and then topped with D½ mix. If budget permits then the use of rubberized asphalt mixes should be used at least for the top layer. Oil content and add mixtures shall be reviewed with the City of Phoenix Lab prior to bidding this work.

2.5.3. Stabilized decomposed granite should be justified to the Facility Review Committee in heavy traffic areas and light asphalt, pavers, and/or concrete should be considered.

2.6. **Termite Treatment**

2.6.1. Refer to Engineering and Architectural Services Standards Specifications for termite treatment. A copy of the specifications is available through the EAS project manager.

2.6.2. “Torpedo” or “Dragnet” is approved with 5 year warranty. Other products may

be used with prior approval by the City and a 10 year warranty provided. All approved products shall treat soil, substrates, footing and foundation stem walls.

2.7. **Irrigation Systems**

2.7.1. Automatic Irrigation Systems: All irrigation systems are to be installed using city standards, including electric power to the controller, water service tap and meter, or any appurtenances required for a complete system. Plans showing all aspects of the system shall be drawn, including power source. Evaluate cost effectiveness of 2-inch or larger water meter size.

2.7.2. Flood Irrigation Systems: Where flood irrigation exists, it should be used if feasible.

2.7.3. Equipment and Accessories: For ease of maintenance and inventory, the City has standardized irrigation components, and the quality of irrigation appurtenance shall be as follows, or City approved equals:

2.7.3.1. Remote Control Valves-Brass
- Rain Bird PEB Series for less than 5 gpm
- Rainbird “G” Series brass valves

2.7.3.2. Controllers / Central Controllers
- Calsense ET Series

2.7.3.3. Backflow Prevention

RP
- Febco 825Y
- Wilkins 975

PVB
- Febco 765
- Wilkins 750A

2.7.3.4. Quick Couplers - Rain Bird 44LVC or 44NP

2.7.3.5. Valve Boxes - Carson “T” Style Lid

2.7.3.6. Gate Valves
- Nibco T-113 for 2 ½” and smaller
- Nibco 619 for 3" and larger

2.7.3.7. Large Pop-Up Rotors
- Toro

- Hunter 140
- Rain Bird Falcon

2.7.3.8. Small Pop-Up Rotors
- Toro 1550 Series
- Hunter 120

2.7.3.9. Spray Heads
- Toro 570Z-PRX-COM
- Rain Bird 1804 SAM-PRS

2.7.3.10. Bubblers - Rain Bird 1400 Series

2.7.3.11. Main Line Pipe
- Schedule 40 pvc for 1-inch – 2.5-inch and smaller
- Class 200 Gasket Joint pvc for 3" and larger

2.7.3.12. Lateral Pipe
- Class 200 Solvent Weld PVC ¾-inch – 2.5-inch
- Class 315 Solvent Weld ½-inch

2.7.3.13. Fittings
- Laterals - Schedule 40 pvc (no male threaded fittings)
- Main Lines - Schedule 40 pvc for 2½" and smaller (no male threaded fittings), Ductile Iron fittings on all 3" and larger

2.7.3.14. Sleeves – Sleeves for control wires and irrigation lines shall be installed under sidewalks, driveways, and roadways.

- Schedule 40 pvc (2½ times the diameter of pipe)

2.7.3.15. Emitters
- Bowsmith ML-210 Multi-Outlet
- Bowsmith S-10 and S-20 Single-Outlet
- Wye Strainer - minimum of 100 mesh
- Pressure Regulator – Walkins brass 500 series

2.8. **Landscaping**

2.8.1. The purpose of these standards is to establish design landscaping standards for municipal properties. The requirements will normally relate to landscaping to be installed in and around buildings, but may also be applicable to landscaping to be installed in and around sanitary landfills, retention dams, service centers, etc. Landscape plans shall indicate all spacing between plants and shrubs, etc.

2.8.2. Trees, Shrubs, Ground Covers, and Decorative Rock:

2.8.2.1. TREES are to be at least 15-gallon size. Larger trees should be used, particularly on east and west sides for solar screening, and such trees should be deciduous types and at least 24-inch box size.

2.8.2.2. Caution shall be used when planting trees under or near power lines; size of ultimate growth shall be carefully considered. Also, trees must be planted a minimum of two feet from the edge of any buried utility.

2.8.2.3. SHRUBS are to be at least 5-gallon size. This, however, may vary as to species, availability, or the standards as to the size the nurseries grow a given plant. Spacing of shrubs must be included in the plans. They must be placed to prevent overgrowth on roads and walkways, and must conform to Arizona Nursery Association standards.

2.8.2.4. GROUND COVERS may be any size established for a species in the nursery industry for sale or reliable survival. Turf is an acceptable ground cover only when made a part of the scope of work.

2.8.2.5. DECORATIVE ROCK, such as decomposed granite acceptable in the landscape trade, smooth river run rock, or approved equals may be used as ground covers as long as they are applied in an appropriate manner. They must be placed to prevent spilling over sidewalks and they must be applied in a manner to prevent noxious weeds from detracting from the appearance. Chemical pre-emergent must be used. Primary access for the facility shall be an approved surface.

2.8.2.6. PLANT NAMES are to be specified by use of botanical names followed by common names. Specifications as to height, spread, and caliper must be provided for all plants used.

2.8.2.7. MULCH shall be used to provide protection to roots of new plants and retain moisture in shrub beds and around trees planted in turf areas.

2.9. **Ground Preparation**

2.9.1. MOUNDS can be used as landscape features when space allows, providing there are proper details for planting, irrigation, and appropriate detention nearby. Mounded turf or ground cover areas must be constructed to provide

on-site runoff storage. Holding of irrigation water applied to the mounds must be shown with typical details.

2.9.2. TURF and all lawn areas must be supported by an automatic lawn sprinkler system. Lawn areas should be graded to prevent runoff on sidewalks or streets and parking areas. Finishing grade of lawn areas must be a minimum of 1½ inches below top of sidewalk or curbs and grading must slope away from sidewalk or roadways. Possibly allowing turf in right-of-way in historic areas.

2.9.3. SHRUBS AND TREE BEDS shall be graded level to evenly float water, and, depending on specie of plant, and shall be kept separate from lawn or rock areas by appropriate means. Shrubs shall be spaced and chosen to prevent growth onto sidewalks or into streets.

2.9.4. NATIVE PLANTS is to be encouraged to be used; however, cacti or any natives which could be injurious to pedestrians are prohibited on the public right-of-way.

2.9.5. PLANT WELLS shall be constructed by depressing a well and not by use of berms. A gentle swaled effect is desired.

2.10. Sanitary Sewer Lines and Water Lines and Main Extensions

All City projects require both DSD and County approval for sewer lines and waterline extensions. As-builts are required to comply with Water Services Standards which require sealed affidavit on the drawings and for the proper tests to be performed and confirmed by the City Engineer's representative. Spacing of manholes and clean-outs vary depending on location. If not in the right-of-way or dedicated easement, then the spacing is to be based on building code versus MAG requirements. All lines shall conform to the most restrictive requirement of both, the MAG/ Supplements and the Building Code.

2.11. Gate & Gate Operator

2.11.1. Gates require Fire Department Lock Box and Fire Department Permit. Gate Operators require either battery backup or manual release which ever is code required. The wheels for the gate shall have wearing cycle that meet shift changes and use requirements that exceed estimated use by at least twice the load count for a 5 year period. Emergency car sensor loops shall be installed for automatic gates unless approved by the City Engineer. Parks and Recreation Department has special types of standard gates for their properties. Some park gates are manual but still require lock box.

2.11.2. Card readers, intercom station may be required when designing the

fence and gate systems.

2.11.3. The size and weight of the gates should be considered when sizing of the operator and provide a large safety factor as to not under size the operator for the gates. Extended warranty is desirable for large gates that are heavy duty use. For all Fire and Police sites, the commercial heavy use wheels and operator are required.

2.11.4. Concrete aprons should be considered for the approaches for the gate.

2.12. **Alternative Transportation**

2.12.1. Bicycling - The need for bicycle racks/lockers, changing rooms, and employee showers will be reviewed as required for each project.

2.12.2. Bus – Given that the City promotes mass transit, consideration shall be given to the location of the main public entrance of a facility and its distance to the closest bus drop, if any, for convenient access to the City facility. A bus drop-off is desired by the disability community to be within 250' of a City facility. If the project is adjacent to a bus route, but, there is not a bus drop-off within a reasonable distance, the Project Manager shall engage discussions with Public Transit and coordinate the placement/ relocation of a drop-off within close proximity.

2.13. **Accessible Routes**

2.13.1. Avoid ramps whenever possible. Design a maximum slope of 1:22 to ensure that the finished grade does not exceed the AZADAAG/ANSIAG maximum of 1:20. The same principal applies to all maximum gradients. Design to a maximum cross slope of 1:55 (1.8%).

CHAPTER 3 – Concrete

3.1. Cracks, sparkling and honeycombing in finished concrete exposed to view are not acceptable.

3.2. Vapor barriers are required on all projects unless waived by the Facilities Review Committee.

3.3. The mix design shall be reviewed by the City of Phoenix Lab for approved supplier and that it meets the City of Phoenix mix requirements for maximum fly-ash and water/cement ratio.

3.4. Mix should be approved by the City of Phoenix EASD and City Lab for acceptance for all add mixtures and mix design.

3.5. On an individual project basis, the Project Manager, with approval of the City Engineer, may consider accepting a credit for under-strength in lieu of removal and replacement. Depending upon the specific location and usage of concrete, and other varying circumstances, the specifications may incorporate a statement similar to the following:

3.5.1. *"If concrete does not meet specified 28 day strength (psi), the Contractor shall credit the project 50% of concrete cost in the event concrete is allowed to remain."*

3.6. MAG Specifications and details and the City of Phoenix Supplements apply to all items of work under this section unless approved by the City Engineer and/or the Facilities Review Committee in advance.

3.7 Architectural concrete requires special consideration. Specs should address:

- Mix/tolerances
- Mixing
- Temperatures
- Form work
- Protection
- Curing
- Maintenance

3.8. All curing, sealing, and hardening agents must be compatible with each other and the final floor finish. Each agent shall be specified separately from the curing agent.

3.9 Concrete is not allowed to be in contact with aluminum materials at any given time.

3.10 Cast-in-place slab on grade concrete shall have a minimum W1.9 x W1.9 x 6 x 6 WWF properly supported during concrete placement.

CHAPTER 4 – Masonry

4.1. All materials, design, construction and quality of masonry shall comply with the adopted building codes with the City of Phoenix Amendments and Supplements, including the appropriate chapters for masonry and masonry veneer.

4.2. Alternative materials shall have International Code Council Evaluation Service and City of Phoenix Testing Laboratories approval prior to submittal to City Engineer for consideration.

4.3. No lightweight block shall be exposed to the weather.

4.4. All joints exposed to the weather shall be “tooled”.

4.5. Mortar shall not contain flyash and/or sodium chloride (NaCl).

4.6. All exposed CMU and stone masonry shall be water proof seal-coated.

4.6.1. Stone: Specifications shall require samples, mock ups, when appropriate. Natural Stone Material shall comply with the appropriate ASTM Standards in accordance with their nature and make, and reference thereof incorporated into the project specifications.

4.6.2. Existing Masonry Buildings: The structure of all existing masonry buildings for City of Phoenix use shall be certified by a Structural Engineer for the intended occupancy.

4.6.3. Full documentation shall substantiate such certification and be submitted to the City Engineer/his representative for review.

4.7. Graffiti proofing product, approved by the Project Manager, should be applied to all exposed masonry surfaces that would be considered vulnerable to vandalism.

CHAPTER 5 – Metals

5.1. All materials, design, construction and quality of metals shall comply with the adopted building codes, and City of Phoenix Amendments and Supplements, including the appropriate chapters for metals and fabrications.

5.2. Handrail and Railings: shall be dimensioned and constructed 1" higher than the minimum code allowance to ensure code compliance.

5.2.1. Aluminum metal railing that is exposed to the elements and other aluminum fabrications exposed to the sun and weather elements are not acceptable unless a manufactured applied coating.

5.2.2. All railing systems utilizing an intermediate cable railing systems shall be an approved manufactured system which complies with the adopted building codes pertaining to stairways and guardrails. Regardless of the deflection, the cable system must comply in all aspects. If allowed, structural calculations and maintenance recommendations shall be submitted for approval.

5.2.3. All coatings to metals shall be shop applied and not field-applied.

5.2.4. All metal railing exposed to direct sunlight and/or susceptible to high temperatures, shall be designed to prevent injuries (i.e., burns, blistering, skin irritations, etc.) when in contact with the railing.

5.2.5. Provisions shall be made with proper protection where an interaction may occur with dissimilar metals.

CHAPTER 6 – Wood & Plastics

6.1. All handrails and guard rails shall be dimensioned and constructed 1" higher than the code minimums to ensure code compliance.

6.2. Millwork shall be designed and specified in accordance to AWI standards.

6.3. All millwork shall have all exposed edges and sides finished, including but not limited to, the underside of the bottom cabinet shelf to be a hardboard finish to prevent water/moisture damage to the base millwork.

CHAPTER 7 – Thermal and Moisture Protection

7.1. To ensure optimum energy efficiency and for pest control purposes, all exterior joints around windows and door frames, openings between walls and foundation, between walls and roof/ceiling, and between wall panels; openings at penetrations of utility services through walls, floors and roofs; and all other such openings in the building envelope shall be caulked, gasket, weather stripped or otherwise sealed.

7.2. Minimum Insulation Values for Conditioned Space:

7.2.1. Exterior walls:
R19 (Note: very difficult to obtain in masonry walls. The consultant shall propose a wall assembly including masonry, windows, shading, etc. that will create a system approaching R-19.)

7.2.2. Interior walls adjacent to unconditioned space: R19

7.2.3. Roofs - R30
R19 is acceptable for evaporative cooled space.

7.3. Roof Slope: Minimum roof pitch shall be ½" per foot.

7.4. In addition to conforming to roofing manufacturer's specifications and recommendations, roofing details shall conform to the National Roofing Contractors Association Standards and sheet metal flashing details in accordance to SMACNA.

7.5. Minimum 10 mil plastic vapor barrier is recommended under all slabs on grade.

7.6. Anchor points shall be provided for all roofing structures that require fall protection. Pads to be provided at equipment access service points.

7.7. Walking pads shall be provided on all roofs which have rooftop equipment that will require servicing.

7.8. Roofing shall be to a minimum of FM 1-90 specification.

7.9. Spray on foam roofs requires specific approval. The top coating shall be a hard surface to withstand foot traffic, ultra violet rays, and incorporate walking pads.

7.10. Metal copings shall be installed on all parapets. Mortar caps are discouraged.

7.11. Inverted roofs shall not be allowed.

7.12. Glass guttering systems shall not be allowed.

7.13. All roofing material shall have a minimum of 80% SRI (solar reflective index) for the entire roofing system of a given facility. “Cool roof” coatings and/or systems are desired.

7.14. Manufacturer’s or sheet metal curbs are preferred for mounting of all rooftop equipment. Weather resistant wood sleepers may be used for retrofit purposes only and requires specific approval.

7.15. Curbs shall not be closer than 30” to each other or to parapet or other walls.

7.16. Skylights shall be curb mounted, triple glazed, and have proper fall protection.

7.17. Pitch pockets be avoided wherever possible.

7.18. All sheet metal, flashing, metal roofing, etc. shall comply with the latest issue SMACNA.

CHAPTER 8 – Doors and Windows

8.1. Work shall conform to SDI and KWI standards.

8.2. All wood doors shall be flush and a minimum of 1¾" thick.

8.3. All metal doors shall be flush and a minimum of 1¾" thick.

8.4. The use of folding doors shall be reviewed with the Project Manager. If used, they shall have the same STC as the surrounding walls/partitions.

8.5. Design shall allow for ease of access for reglazing.

8.6. All windows shall be an insulated window system and constructed with low-e glass. Designers should demonstrate how they have addressed in their designs consideration of solar orientation, shading of windows, and control of heat gain.

8.7. All windows and exterior doors shall be weather stripped to achieve minimum air infiltration.

8.8. Curtain walls and storefront systems shall be glazed using insulating glass.

8.9. **Finish Hardware**

8.9.1. Latchsets shall be used on all interior office and conference room doors except where specifically approved.

8.9.2. Mortised locks shall not be used except where specifically approved.

8.9.3. Door closers shall provide for minimum of 120 degree opening swing with hold open arms, except where specifically approved otherwise.

8.9.4. Panic exit devices on pair doors shall be designed so they cannot be operated from the exterior to gain forced entry. The use of astragals and coordinators is discouraged. Where practicable, use series of single hung doors or removable mullions.

8.10. All hardware shall conform to ADA requirements.

8.11. Deactivation of automatic door hardware shall not require the use of ladders, removal of panels, etc.

8.12. **Keying Requirements**

8.12.1. Provide construction cores and keys during the construction period. Each keyable lock shall have a permanent type construction core installed. Construction control and operating keys and cores shall not be part of the owner's permanent keying system or furnished on the

same keyway (or key section) as the owner's permanent keying system. The hardware dealer, prior to occupancy will furnish permanent cores and keys (prepared according to the accepted keying schedule) to the owner.

8.12.2. All cylinders shall be Sargent removable core cylinders to match owner's existing system.

8.12.3. All permanent keys and blanks shall be blank on both sides except for the keyway identifier. High security keys shall include the appropriate markings including paten or pattern number, but no manufacture logo. Permanent keys shall be stamped with the applicable key mark for identification, provided by the owner. Cores shall be marked on the face of the plug with the keyway identifier (i.e. LE =E) plus a number (i.e. E1001). This identification is to be supplied by the owner.

8.12.4. All permanent cores and keys shall be shipped from the factory direct to the owner's representative, return receipt requested.

8.12.5. Furnish keys in the following quantities:

- 2 each change keys each combination used (to owner)
- 2 each key blanks for balance of cores keyed (to owner)
- 6 each Construction master keys (to contractor)
- 1 each Control key (to contractor)

8.12.6.1. The owner or owner's agent will install permanent cores and return the construction cores to the hardware dealer.

8.13. Building standards for doors and lock (magnetic/electronic, etc.) See Section 16.9 and Appendix I.

CHAPTER 9 – Finishes

9.1. Suspended Ceilings

9.1.1. Exposed grid, suspended ceiling systems should be used in open office areas, private offices, conference rooms, cafeterias and hallways whenever possible. Gypsum board and metal stud framed ceilings shall be installed as required to meet local building codes in such areas as restrooms and kitchens. Unique architectural applications shall be considered in high visibility areas.

9.2. Gypsum Board

9.2.1. Grade Level 5 is the City standard of finish on gypsum board walls.

9.2.2. In the event plywood is used behind gypsum board for impact resistance purposes or as a backer board for wall support, the plywood must be fire treated.

9.3. Ceramic Tile

9.3.1. Specifications and details shall be in accordance with the requirements and recommendations of the Tile Council of America.

9.3.2. All tile finishes and grout joints shall be non-absorbent. All tile shall be of domestic manufacture, a minimum of standard grade with all matching trim pieces where required. Where required, tile with abrasive grain surface should be used.

9.3.3. Installation: Lay out floor so no tile less than one-half size occurs. Align all joints in both directions. Grout tile joints flush with face of tiles making a neatly finished smooth surface. Install specified grout in strict accordance with manufacturer's printed instructions.

- Ceramic tile shall be the standard wall and floor finish in restrooms. Height of tile finish on walls shall conform to the following schedule:
- Walls (front and side) with water closets and/or urinals, tile shall be full height.
- Ceramic tile in showers shall be full height and shall be set on masonry or cement board backup.
- Other walls - tile shall be toilet partition height - +/- 5'-6".

9.3.4. Manufactured mortars and grouts shall contain hallmark certifying compliance with reference standards and be type recommended by tile manufacturer for specific applications. Adhesives shall be in containers labeled with hallmark certifying compliance with referenced standards.

9.3.5. Tile samples of the size specified shall be submitted for all tile work.

9.4. **Resilient and Hard Surface Flooring**

9.4.1. Applications: Areas of use shall include utility areas, break rooms, coffee rooms, and kitchens. All other areas will be approved on a case-by-case basis. No hardwood flooring should be used other than for basketball courts. Any other cases will be reviewed on a case-by-case basis.

9.4.2. Materials: Vinyl composition tile (VCT), 12" x 12" x 1/8" thick equal to or exceeding Federal Spec. SS-T-312, Type IV, composition 1 (asbestos free). Each building shall be limited to 1 or 2 patterns, utilizing neutral colors that blend with carpet and other finishes throughout the building. An additional two unopened cartons of material shall be provided with each installation for City's future use. Avoid VCT in high traffic areas and restrooms.

9.4.3. Reducer Strips: Reducer strips shall be edge-butting type and not overlapping flooring. Cove top-set and straight carpet types 2½" or 4" high rubber, non-shrinking, 1/8" thick with matching molded inside and outside corners and end stops. The base to be a neutral color blending with floor finishes. One color base should be maintained throughout a single building. Areas which have carpet are to receive a toeless base while areas of hard surface or resilient flooring should receive a base with toe.

9.5. **Carpet**

9.5.1 The use of carpeting as a floor finish is closely controlled and any deviations from authorized applications identified in these standards must be approved on a case-by-case basis by the Facilities Review Committee.

9.5.2. Guarantee/Warranty: In addition to five-year material and workmanship guarantee, carpet shall be warranted against delamination, shrinkage, and manufacturer's flaws, and shall be guaranteed for the following:

9.5.3. Wear: Manufacturer shall guarantee that, excluding stairs, no part of

the carpet wearing surface shall wear more than 10% by weight in ten years. Crush resistance should show an 85% recovery rate.

9.5.4. Static Protection: Manufacturer shall guarantee that the carpet will maintain static generation at less than 3.5 KV at 70 degrees Fahrenheit and 20% relative humidity throughout the life of the product.

9.5.5. Color Fastness: Shall be a standard rating of good for 20 standard fading hours (2000 langleys) and 40 hours for dark colors. Color shall be versatile enough to minimize visual appearance of stains.

9.5.6. Soil Protection: All specified carpets shall have stain resistant and soil prohibiting characteristics incorporated in the milling process of the fibers/carpets. No post-installation treatments are acceptable. Carpeting, including the backing, shall be moth, vermin, and mildew resistant.

9.5.7. In areas where chemicals may be exposed to the carpet, it should be solution dyed.

9.5.7.1. Specifications shall include provisions for out-gassing.

9.5.7.2. Seaming diagrams will be provided for approval prior to installation. Seams should be avoided at pivot points, across areas that receive heavy foot traffic and seams that will run directly into a doorway.

9.5.7.3. Glue-down carpet square, minimum 32 oz wt., is recommended for high traffic areas and in areas with modular furniture, and in accordance with ADA.

9.6. Special Coatings

9.6.1. When specifying skid resistant floor finishes, take into consideration the effect the finish will have on floor cleaning and maintenance.

9.6.2. The degree of skid resistance should be appropriate to the intended use.

9.7. Adhesives & Sealants

9.7.1. All products shall not contain asbestos and/or lead.

9.8. **Paint**

9.8.1. Brands of paint, varnish and stains shall be of highest quality, made by reputable manufacturers, have identifying labels on containers and shall be approved by the City of Phoenix. All paint materials shall be factory fresh. Low sheen paint should be used in all areas. The only exceptions would be utility rooms, break rooms, kitchens and rest rooms where a semi-gloss finish would be acceptable. Any other areas would need to be evaluated on an individual basis.

9.8.2. Compatibility of the paint with the wall surface should be verified prior to painting.

9.8.3. For general offices use one color per building. Colors already in use should be considered first to avoid stocking of multiple colors. The recommended color shall be a white or off-white. In buildings where high public usage, such as those buildings used by Parks and Recreation Department, or specialized buildings, the use of multiple colors can be considered with prior approval.

9.8.4. All paints used should have a low VOC. All paint will be delivered to site in manufacturer's labeled and sealed containers. Labels shall give manufacturer's name, brand, type, batch number, color of paint and instructions for reducing. Thin only in accordance with printed directions of manufacturer. Consideration should be given to painting occupied buildings after normal business hours or on weekends.

9.8.5. All paint products and primers shall not contain lead.

9.8.6. All communications and data room walls shall have two coats of fire retardant paint.

9.9. **Wall Coverings**

9.9.1. Wall coverings other than paint and elsewhere described in the Building Standards will require approval of the City.

9.9.2. If the use of wall coverings is approved:

9.9.2.1 Color and pattern continuity should be maintained throughout a building utilizing only 1 or 2 wall coverings. Fabric wall coverings should only be used in areas such as conference rooms, reception / common areas or where a tackable surface may be required. In high usage areas or an area which requires more resilient wall covering, such as halls, coffee or break rooms, a vinyl wall covering should be utilized.

9.9.2.2. Wall coverings durability and appearance retention shall meet Voluntary Standard TS 198 and meet Federal Specification CCC V.V. 408, Type II Medium Duty or Type III Heavy Duty.

9.9.2.3. Adhesives, primers and sealers shall be as recommended by the fabric manufacturer, and strippable type.

CHAPTER 10 – Specialty

10.1. Toilet Compartments

10.1.1. Centerline dimensions between partitions shall be minimum 1" larger than code requirement.

10.1.2. Dimensions shall meet minimum AZADAAG/ANSI requirements.

10.1.3. When dimensioning, allow for encroachment of partition and wall mounted equipment.

10.1.4. Dimension from finish wall (e.g. face of ceramic tile) and not from the rough wall (e.g. masonry).

10.1.5. Acceptable materials in order of preference:

- Brushed Stainless Steel (for low vandalism areas)
- Stippled Stainless Steel (for high public use, industrial areas, high vandalism areas)
- Enameled Steel
- Phenolic Resin

10.1.6. Plastic laminate is not acceptable.

10.1.7. Toilet partitions shall be floor mounted in high public use areas. Ceiling mounted is preferred in low public use areas for ease of cleaning maintenance.

10.1.8. Urinal screens shall be same material as toilet partitions and shall be cantilevered off the wall - maximum 18" projection.

10.1.9. In addition to the required ADA accessible toilet and stall in the restrooms, provide a minimum of one additional stall with grab bars for ambulatory use.

10.2. Toilet Room Accessories

10.2.1. Where appropriate, provide baby or adult changing stations in both male and female public rest rooms, and in family/unisex restrooms.

10.2.2. Multi-use restrooms (i.e., family/unisex restrooms) intended primarily to serve as the wheelchair accessible restroom for a facility should be equipped with automatic flush valves, lavatory faucet, soap dispenser, and paper towel dispenser.

10.2.3. Paraphernalia shelves shall be provided within the toilet compartment in all restrooms. Refer to Appendix E of the Building Standards.

10.2.4. Provide coat hook/bumper in all toilet compartments.

10.2.5. Consideration shall be given to using towel dispensers that accommodate C-fold towels at manual towel dispensers.

10.2.6. No in-sinktop soap dispensers shall be used, unless automatic. Verify with the Project Manager as to the furnishing of soap dispensers. Provide wall surface area adjacent to the lavatory for future installation. In the event soap dispensers are in the scope of work, they shall accommodate 800 ml liquid soap cartridges.

10.2.7. Dual-roll toilet paper dispenser/sanitary disposal combination units are preferred.

10.2.8. If using semi-recessed trash receptacles, additional receptacles shall be provided.

10.2.9. All entries to restrooms shall be designed with privacy in mind. Layout of restrooms as it pertains to mirror locations and sight lines are critical for privacy.

10.3. Louvers & Vents/Grilles & Screens

10.3.1. Screening shall be sized to keep out bees and wasps in natural ventilated non-conditioned restrooms.

10.4. Access Floors

10.4.1. Access Floors shall meet code requirements. If a floor covering is to be installed, carpet squares is the preferred finish material. Access floors must be designed and sealed structural calculations provided by an Arizona Registrant.

10.5. Signage

10.5.1. Signage is provided for directional, area and room designation and personal space identification. Signs may be wall mounted, countertop and panel mounted. Ceiling-hung signs are permitted at areas that provide counter type services to outside parties. The City of Phoenix Graphics Standards Manual should be used as a guideline.

10.5.2. City Corporate Logo: Reproductions of the City of Phoenix symbol

should be made directly from reproduction art from the City Clerk Printing Services Section or from the City's Public Information Office. The standard color for the corporate symbol is City of Phoenix "Purple Pantone 228". Font is "Frutiger 75 Black." Placement and sizes are specified in the C.O.P. guidelines in Graphics Standards Manual. Any deviation from the corporate logo requires approval of the office of the City Manager.

10.5.3. Durability Requirements: Flexibility to accommodate changes and additions to sign system should be considered by the designer prior to the selection of materials, graphic techniques and mounting methods to be used.

10.5.4. Readability: Letters should be large enough to read from a distance of 50 feet, depending on the application and usage. Color between background and lettering should have strong contrast. Colors in signage system should also relate harmoniously with the pallet of colors selected for the building and its environment.

10.5.5. Materials & Finishes: Some signage may be fabricated through the Metro Facilities and Energy Management Division of the Public Works Department. Check with this division to assure compatibility. Braille interpretation should be checked by a knowledgeable authority within the office of the City Clerk.

10.5.6. Building Address: Address numbering of buildings shall be compatible with the architecture and material palette of the building, and displayed on building exterior in accordance with the requirements of the Fire Department.

10.6. **Lockers**

10.6.1. Shall be ventilating style.

10.6.2. Shall be mounted solid on curbs.

10.6.3. Verify locking requirements with the Project Manager. Typically a pad lock type is preferred.

10.6.4. Verify size with Project Manager.

10.7. **Mail boxes**

10.7.1. The need for mail boxes will be reviewed on a project-by-project basis.

10.8. **Operable Partitions**

10.8.1. If using for acoustical separation:

10.8.2. STC shall equal that of surrounding walls and/or partitions.

10.8.3. Close space between top of partition and underside of slab/deck with STC equivalent of partition.

10.9. **Exterior Sun Control Devices**

10.9.1. Avoid automatic controlled devices.

10.9.2. Avoid creating bird rookeries on horizontal surfaces.

10.10. **Telephone Specialties**

10.10.1. Refer to Chapter 16 – Communications for additional information.

10.10.2. Phone devices are the responsibility of the City.

10.10.3. A minimum of a TTY should be planned for each facility. Actual installation coordination will be handled by the occupying City department.

10.10.4. Coordinate with modular furniture.

10.10.5. Power poles are discouraged.

10.11. **Security, Fire/Life Safety and Audio/Visual Specialties**

10.11.1. Refer to Chapter 16 and Appendix I for additional information.

10.11.2. Electronic Security and Safety system devices are the responsibility of the City.

10.11.3. Fire Alarm and Suppression systems will be designed to meet all applicable NFPA and Local Authority Having Jurisdiction (AHJ) Codes.

10.11.4. Security systems will be designed to meet all applicable costs, site Risk Assessments and recommendations of the Homeland Defense Bureau.

10.11.5. All specialized system, installations monitored by City of Phoenix Security must be compatible with the City's Central Monitoring Station

(CMS) systems.

10.11.6. Coordinate communications requirements for these specialized systems with Telephone/Network Specialties.

10.12. **Flag**

10.12.1. Follow flag protocol.

10.13. **Drinking Fountains**

10.13.1. Where drinking fountains are to be installed, they shall be of the “high-low” configuration and operate with chilled water.

CHAPTER 11 – Equipment

11.1. **Athletic, Recreational**

11.1.1. Athletic and recreational equipment shall be reviewed with the Parks and Recreation Department staff through the EASD Project Manager**.**

11.2. **Shooting Range Equipment**

11.2.1. Shooting range equipment shall be reviewed with the Police Department and City Environmental staff through the Project Manager.

11.3. All other specialty equipment shall be coordinated with the project manager and using agency.

CHAPTER 12 – Furnishings

12.1. **Window Treatments**

12.1.1. Window coverings are used to enhance the office environment and provide light control at exterior windows. Venetian blinds are preferred over draperies due to their ease of maintenance and the low flammability of the materials. Color and pattern continuity throughout a single building is recommended. All window covering systems must be reviewed and approved by the maintaining department.

12.2. **Mini Blinds**

12.2.1. Product: Narrow 1" wide aluminum slat type with “invisible” type ladders, all steel parts shall be treated at the factory with a corrosion resistant plating or treatment.

12.2.2. Materials: Horizontal elliptical-crowned aluminum alloy nominal 1" wide (25 mm) slats, 0.010" thick prior to painting, with rounded corners and smooth finished edges and holes.

12.2.3. Finishes: Provide manufacturer’s standard plastic type paint finish applied over a catalytic undercoat and baked at a high temperature.

12.2.4. Plastic Blinds: In cases where plastic blinds are used, written verification of lead content from the manufacturer will be required.

12.3. **Space Standards**

12.3.1. The City of Phoenix has established Space Standards to serve as a management-approved guideline for space allocation in City facilities. The purpose of space standards is to enable the City of Phoenix to provide office space in a well organized and cost effective manner, creating work environments that meet the needs for productivity, function, flexibility and aesthetics. The guidelines presented here are based on the standardization of space requirements by job function and support needs.

12.3.2. Space Guidelines: The space guidelines include only the actual square footage of a private office or individual workstation. Circulation, aisle and access space is not included in the individual categories. The actual square footage required for circulation should be added in the planning phase of each project as a group or department

requirement.

12.3.3. Maximum Guidelines: The standards assigned are to be utilized as maximum guidelines for individual work areas. Project conditions, architectural constraints, and/or existing conditions may require the standard allocations to adjust per project.

12.3.4. Table 1.1 provides the guidelines for allocating space for all City positions.

12.3.5. ADA Requirements: The designer is responsible for compliance to AZADAAG/ANSI and/or other code requirements. Whichever code is the most stringent shall prevail.

12.4. Systems Furniture

12.4.1. The overall design of systems furniture must comply with all municipal codes as well as AZADAAG/ANSI standards for barrier free interiors.

12.4.2. Modular: The use of modular systems furniture is encouraged wherever the privacy of an enclosed office is not critical to job function. Open office planning creates an atmosphere of shared daylight and team interaction. Systems furniture is easily reconfigured to meet changing organizational needs. A limited number of standard workstation sizes and componetry should be applied to support typical job functions, equity among staff and efficient utilization of space.

12.4.3. Manufacturer: Manufacturer, style, colors and finishes should be specified to coordinate with any existing City of Phoenix contracts already in place to control inventory and maximize furniture usage among all City buildings.

12.5. Freestanding/Conventional Furniture

12.5.1. For each new facility, a standard for conventional furniture should be developed for each functional area such as private office, conference room, file/storage room, copy room, reception area, etc.

12.5.2. Any existing City of Phoenix contracts for conventional furniture should be utilized wherever possible. Suppliers of this furniture should be asked to provide samples and cut sheets showing furniture in their line which has been purchased for other City of Phoenix buildings. If functionality can be achieved, previously purchased furniture and fabric selections are encouraged for style consistency and standardization among City buildings.

12.5.3. All conventional furniture must be commercial quality, which is, intended for commercial use. Fabric on upholstered furniture must meet flammability testing required by code. Wearability of the fabric should be considered in relation to the intended use of the upholstered item. Furniture and fabrics must be warranted by the manufacturer against defects for a minimum of five years.

12.6. In-Stock Furnishings

12.6.1. Use in-stock systems furniture unless otherwise approved by the Facility Review Committee.

Table 1.1 City-wide Space Standards for Offices and System Furniture

For new/lease space, remodels, and reconfigurations as of May 4, 2006

WORK AREA	GRADE LEVEL
Walled Office 250-300 Square Feet*	912, 940, 980, 997, 998 City Manager, Assistant City Manager, Deputy City Manager
Walled Office 175-250 Square Feet*	900 thru 911 Executive
Walled Office 130-150 Square Feet*	081 and 086 ALL 800 Level Grades Deputy Director, Supervisor on PAP and Department Personnel Officer & Personnel Analyst II
Systems Furniture Cubicle 80 Square Feet** (8'x10')	035 through 042 638, 641
Systems Furniture Cubicle 64 Square Feet** (8'x8')	025 through 034 114 through 120, 122, 123, 125, 126 212 through 223 225 through 230 325 through 336, 634 721, 723, 725, 726, 727, 731
Systems Furniture Cubicle 24-48 Square Feet**	018, 020 through 024, 311, 313 through 324, 718 through 720
Shared Workspace with Individual Lockers**	100, 103, 108 through 120, 122, 123, 125, 126 203, 205, 207 through 223 428, 551, 552, 555, 561, 562, 565, 570, 575

The City of Phoenix has established Space Standards to serve as a management-approved guideline for space allocation in City facilities. The purpose is to enable the City to provide office space in a well organized and cost effective manner, creating work environments that meet the needs for productivity, function, flexibility and aesthetics. The guidelines presented above are based on the standardization of space requirements by job function and support needs.

*These are recommended standards for hard wall offices, any exceptions to these standards will only be granted via approval from the Facilities Review Committee. Minor variations in size may be present / allowed because of existing structural and design considerations. Contact the Public Works Department at 262-7897 to schedule a review appointment.

**These standards are general guidelines for use in space planning and design. Actual cubicle and workspace size will be determined by the following factors: reporting level within the organization, operational needs, size and functionality of the space. All final space plans will require departmental manager or designee's approval before implementation of plan.

CHAPTER 13 – Special Construction

13.1. Energy Management System/Building Automation System

13.1.1. Each facility will be designed with a control system to comply with LEED requirements and to maintain tenant comfort and minimize energy consumption. Building Automation Systems (BAS), a.k.a. Energy Management Systems or Control Systems, will be designed for easy user/operator interface and may vary dependent on size and type of facility.

13.1.2. The control system will be an open, Wide Area Networked (WAN) Building Automation System (BAS) that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The Graphic User Interface (GUI) shall be web-based and shall provide a common operating platform for all integrated control systems.

13.1.3. The BAS shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk and/or BACnet communication protocols provided under Appendix F (BAS Specification) to a Network Area Controller (NAC).

13.1.4. The installed system will also integrate lighting controls and shall provide secure password access to all features, functions and data contained in the overall BAS.

13.1.5. See Appendix F (BAS Specification) for a complete set of Building Automation Systems specs.

13.1.6. **Additional Conditioned Areas:**

13.1.6.1. All kennels and animal shelters shall be evaporative cooled.

CHAPTER 14 – Conveying Systems

14.1. Elevators shall be provided with a shunt trip switch.

14.2. Elevator entrance doors shall be center-opening two-panel sliding doors.

14.3. Buildings which do not have a freight elevator should provide one elevator with removable ceilings and freight pads to allow it to be used as a freight elevator when required.

14.4. Elevators with new technology (e.g., not requiring a separate elevator equipment/machine room), requires prior approval by Development Services and Fire Department.

CHAPTER 15 – Mechanical

15.1. The provisions of these standards regulate the design of the mechanical and plumbing systems. Emphasis is to be placed on system efficiency, energy and water conservation, economy of maintenance, and utility expense to minimize life-cycle costs.

15.2. It shall be the responsibility of the consulting engineer to secure all as-built drawings and to make field inspections, as required, and to obtain all information needed for the design.

15.3. The design criteria shall be as outlined herein and convey only the end results desired. They are not intended to inhibit the design engineer from proposing alternate methods for achieving the same desired results. Additional guidelines for consideration are provided in Appendix F and Appendix G of these Building Standards.

15.4. **Design Considerations**

15.4.1. All installations shall be designed for total system energy efficiency and conservation. HVAC systems should be designed based on a life-cycle cost analysis. Energy Compliance documentation compliant with either COMCheck or ASHRAE 90.1 shall be provided at the completion of Design Development. A comprehensive energy analysis shall be performed for all buildings 10,000 sq. ft. or more in area, using computer simulation programs such as TRACE, DOE2, or others approved for use by the federal government. The computer simulation and/or compliance program shall be used to perform the energy analysis and evaluation of alternative building methods, materials, orientations, lighting and HVAC systems.

15.4.2. All systems shall be designed so that they are easily adaptable to the future growth of the facility.

15.4.3. All design considerations shall comply with the most current ASHRAE Standards.

15.4.4. For buildings and their associated mechanical systems requiring 10 tons of refrigeration, but less than 100 tons, shall utilize several smaller unitary packaged or split systems units.

15.4.5. For buildings and their associated mechanical systems requiring 100 tons of refrigeration or more, shall when feasible, utilize high-efficiency, multiple-compressor (dual-screw etc.), water-cooled chiller systems.

15.4.6. Where economically feasible and design permits, an energy recovery ventilation system (i.e. heat wheel) or run-around coil to capture and reuse cooling energy from exhaust air in buildings with central air distribution shall be provided.

15.5. **Component Standards**

15.5.1. All equipment to be rated at Air Conditioning and Refrigeration Institute's (ARI) conditions and shall be listed by a nationally recognized testing agency.

15.5.2. Unitary air conditioners and heat pumps should be selected based on SEER (units less than 5.4 tons) and EER (units over 5.4 tons) ratings. SEER rating should be a minimum of 14 and EER rating should be a minimum of 12.

15.5.3. Chillers should utilize HFC refrigerants. Chillers should not exceed consumption of 0.56 kw/ton (100% full load in accordance with ARI standards).

15.6. Electrical Motors: All electric motors exceeding 1,000 operating hours annually shall be energy efficient and shall have minimum acceptable nominal efficiency for single speed motors as specified below. Energy efficiency rating must be made using testing methodology IEEE-112, Test Method B.

HP	Min. Rated Eff (%)
1-4	84.0%
5-9	89.5%
10-19	91.5%
20-49	92.8%
50-99	94.1%
100-124	94.5%
125 & greater	95.0%

15.7. **Equipment Placement:**

15.7.1. To minimize safety hazards and to provide for ease of accessibility for maintenance and repair, major air conditioning and heating equipment components (compressors, air handlers, heaters, etc.), shall not be located in areas immediately above hard ceilings. If the design suggests that major equipment is to be located above hard ceiling areas, approval of the Facilities Review Committee is required. In all cases, an adequate permanent work platform shall be provided for maintenance functions.

15.7.2. Roof-mounted equipment must be curbed. Roof-mounted equipment

shall not be located closer than six feet from roof edge. Safe access (i.e. fixed ladder, permanent ladder) must be provided for all roof-mounted equipment.

15.7.3. Equipment may not be placed in a space in such a manner that the maintenance, repair or removal of the equipment requires an alteration to a doorway, roof, ceiling, floor, wall or adjacent equipment.

15.7.4. Multi-storied facilities shall be designed with a minimum of one air handler per floor wherever possible.

15.7.5. Ladder-up type posts shall be provided at permanent access ladders that do not have handrails projecting above the work surface.

15.7.6. Central air distribution is to be accomplished by variable air volume systems with variable fan speed controllers rather than constant volume systems for the same system static pressure. This approach reduces energy use during part load conditions and takes advantage of each zone's operational characteristics.

15.7.7. Designs shall consider economizer cycle (free cooling) by using "plate & frame" heat exchangers for systems with cooling tower capacity exceeding 100 tons and energy management and temperature control system (EMTCS) for automated valve control.

15.7.8. Designs shall avoid multi-zoned packaged air conditioning units unless deemed feasible and appropriate for the function of the facility.

15.7.9. Evaporative Cooling shall be evaluated and installed where deemed practical. Evaporative coolers shall be UL or ETL listed as required by the Mechanical Code.

15.8. **Air Distribution System**

15.8.1. Air shall be supplied to the occupied space by low-velocity ducts whenever possible.

15.8.2. To minimize air circulation fan horsepower, ductwork shall be designed for the lowest practical total pressure drop.

15.9. **Accessibility of Valves, Controls, etc.**

15.9.1. All valves, dampers, etc., shall be located so that ready access can be had for operation, repair and maintenance.

15.9.2. Arrange all piping and instruct electrician to arrange all conduit and wiring to provide clearance for removal of access doors on equipment

and locate valves and unions in piping to allow service with minimum of dismantling and inconvenience.

15.10. **Exterior design conditions:** Outdoor design temperatures shall be:
Summer - 109°F Dry Bulb, 76°F Wet Bulb
Winter - 34°F Dry Bulb

15.11. **Interior design condition:** Interior design temperatures shall be:
Cooling - 72°F Dry Bulb
Heating - 74°F Dry Bulb
Evaporative cooling – Min. of 1 air change/2 minutes

15.12. **Plumbing Fixtures**

15.12.1. Lavatories and showers in public facilities shall be equipped with devices which limit the outlet temperature to a maximum of 105°F. Three-way tempering valves shall be used to maintain outlet temperature.

15.12.2. Water closets shall be wall mounted wherever possible and be provided with elongated rims and open front toilet seats.

15.12.3. In wheelchair accessible stalls, the water closet should be located farthest from the stall door and/or closest to the permanent wall to allow for turn around foot space.

15.12.4. Urinals shall be wall mounted, blowout type. Waterless urinals must be approved by Public Works and the City Engineer.

15.12.5. Flush valves for water closets and urinals should be those standard to City owned buildings in order to keep inventories at a minimum. Flush valve on all disabled access water closets are to be on the wide side of the stall.

15.12.6. Lavatories shall be wall mounted, with four-inch centers, commercial style or equal, with self-closing valves.

15.12.7. All in-line valves specified for general plumbing use shall be 125 psi rated bronze ball valves as manufacturers by NIBCO or equal.

15.13. **Accessibility of Restroom Piping, Valves, Cleanouts, Vents, etc.**

15.13.1. All new facilities shall incorporate a plumbing chase with a minimum width of 24” clearance for access to piping, valves, cleanouts, vents, etc. which service public restrooms. The chase shall be located so that ready access can be had for operation, repair and maintenance.

15.13.2. Arrange all piping and instruct electrician to arrange all conduit and wiring to provide clearance for removal of access doors on equipment and locate valves and unions in piping to allow service with minimum of dismantling and inconvenience.

15.14. **Janitor Closets**

15.14.1. All facilities shall be designed with at least one janitor's closet located adjacent to the restrooms per floor, equipped with mop sink, splash guard, shelving, and any other fixtures as required by the Project Manager. The minimum size of the closet shall be 30 square feet.

15.15 **Fire Sprinkler**

15.15.1 Control Valve shall be on riser.

15.15.2 Main Drain and Inspectors Test Valves discharge shall be piped outside. Discharging to interior janitors sink, floor sink, etc. is <u>not acceptable</u>. Discharging shall be where it will not impact other elements (i.e., Landscaping, sloped away from building and walkway, avoid ponding, etc.)

15.15.3 No water motor gongs permitted; Electric bells only.

15.15.4 Provide spare heads: Minimum (6) of each type. In the event NFPA/code requires more, the greater quantity shall be provided.

15.15.5 Duct Detectors: Covers shall be installed with removable fasteners (e.g., Screws, clips, etc.) for access. Contractor and design consultant shall verify new installations are connected to the fire alarm panel.

CHAPTER 16 – Electrical

16.1. All electrical work must meet the requirements of the Phoenix City Code, NEC, AND NFPA-70E standards. All electrical projects require a city building permit.

16.2. The provisions of these standards regulate the design of the electrical systems. Emphasis is to be placed on system efficiency, energy conservation, economy of maintenance, and utility expense to minimize life-cycle costs.

16.3. It shall be the responsibility of the consulting engineer to secure all as-built drawings, verify existing conditions, make field inspections, as required, determine the category rating for electrical equipment, and to obtain all information needed for the work.

16.4. The design criteria shall be as outlined herein and convey only the end results desired. They are not intended to inhibit the consulting engineer from proposing alternate methods for achieving the same desired results.

16.5. Prior to the completion of a project, at least four sets of maintenance manuals, operating manuals, parts manuals, as-built and shop drawings of all equipment covered in this section shall be submitted to the city.

16.6. Architect/engineer shall review design with city representatives, including the Facilities Review Committee, at 25% and 40% of completion.

16.7. All systems shall be designed so that they are easily adaptable to the future growth of the facility. Perimeter and landscaping lights should be designed to allow staff access to maintain without damaging the plants.

16.8. All design considerations shall comply with ASHRAE standards.

16.9. Electronic Safety and Security

16.9.1. With few exceptions, Electronic Safety and Security systems are monitored by the City's Central Monitoring Station (CMS). As part of the design phase and through construction, contractors, are to consult with the City's Alarm Services, specialized Systems Team and comply with City standards for facility alarms systems such as Fire Life Safety, Intrusion Detection (IDS), Audio/Visual and Access Control (ACS).

16.9.2. Some Electronic Safety and Security systems wiring may be handled by the ITD, Telecommunications staff.

16.9.3. Homeland Defense Bureau staff will assist departments in performing site Risk and Threat Assessment prior to performing design level work

for any Security Systems.

16.9.4. For the Electronic Safety and Security Standards see Appendix I.

16.10. The City has adopted NFPA-70E "Standards for Electrical Safety Requirements for Employee Workplaces." Contractors are to adhere to these standards when conducting work on City property.

16.11. **Electrical Equipment**

16.11.1. All equipment and accessories specified shall be new and must be approved by at least one of the following testing laboratories or City of Phoenix, Development Services Department, Building Safety Division approved equivalent:

- Underwriters Laboratories Inc. (UL)
- Factory Mutual (FM)
- ETL Electrical Testing Laboratories Inc. (ETL)
- MET Electrical Testing Co. Inc. (MET)
- Applied Research Laboratories (ARL)
- Canadian Standards Associations (CSA)

16.11.2. Other Standard/Testing Laboratories which can document that they are reciprocal with any of the above listed laboratories.

16.11.3. Minimum size wire for lighting and power branch circuits shall be # 12 AWG copper.

16.11.4. All branch circuit conductors shall be 75 degrees fahrenheit or code which ever is more strict THHN/THWN 600 V copper.

16.11.5. All panel boards, switches, motor starters and switchboard circuit breakers shall have engraved micarta nameplates.

16.12. **Metering**

16.12.1 All electric meters shall be specified with pulse output for monitoring energy consumption by the facility's energy management system.

16.12.2. Designer shall investigate utility company rates and design electrical metering system according to a long-term least-cost approach for energy costs. Where multiple meters are being recommended, designer shall consider combined metering to minimize the cost of energy. Where outdoor lighting dominates (parks, ball fields, parking lots), designer shall consider setting up a separate meter for outdoor lighting circuits to take advantage of city's available outdoor lighting

rates.

16.12.3. Where additional facilities are added to an existing campus/facility, designer shall consider totalizing meters for minimizing energy costs.

16.13. Lighting

16.13.1 Delighting shall be considered to reduce lighting load. Lighting circuits to be separated in the perimeter zones to allow for shutting off certain fixtures when they are not needed.

16.14. Fixture Types

16.14.1. In general, T-8 fluorescent lamps shall be used with electronic ballasts for general illumination of offices and related areas. City recommends Motorola, or approved equal, electronic ballasts and 3500K fluorescent lamps. The use of inefficient light sources, i.e. incandescents, shall be minimized. Compact fluorescent fixtures with PL lamps are recommended in place of incandescents. Exit lighting shall utilize LED fixtures. Lighting shall be designed using four-foot fixtures only. Consult Facility Review Committee if other than four foot fixtures are to be used (i.e. U-tubes, 8-foot, etc). Illumination values as noted, or as recommended by the Illuminating Engineering Society (1993 Edition), are to be used as a basis for calculating the lighting system requirements to ensure energy efficient building design and construction. Fluorescent fixtures should be one and two lamp ballasts instead of three or four lamp ballasts.

16.15. Illumination Level Criteria

16.15.1. Illumination levels are intended to be maintained at task surface. This does not mean that the whole facility must be maintained at the same illumination levels. In offices with a workstation environment, the illumination at task level shall be 50 FC but the general area can be maintained at 25-30 FC. The following maintained illumination levels shall be provided. (Note: illumination levels shall be based on group relamping at approximately 15,000 hours):

Area	**Level**
Service Garages	
Task surface/work bays	75 FC
general area	50 FC
walkways/driveways	20 FC
Exits at floor	5 FC
Library reading room	
study and notes	70 FC

ordinary reading	30 FC
Machine shop	50 FC
Materials handling	50 FC
Offices	
workstation/task surface	50 FC
walkways/general	25-30 FC
Equipment rooms & washrooms	30 FC
Parking Lots	0.5 FC
Parking garages (floor avg.)	5 FC
Storage rooms/warehouses	20 FC
Corridors	10 FC

16.15.2. For sports facilities lighting levels, contact the Phoenix Parks and Recreation Department.

16.15.3. Switching shall be provided for each lighting circuit or for portions of each circuit, in a single room, so that the partial lighting for custodial service, or other complementary use with natural lighting, may be selectively operated.

16.16. **Communications**

16.16.1. The following requirements are very general and will vary greatly depending on the size, occupancy, and purpose of the facility. The City's Information Technology Department (ITD) should be included during the planning and architectural design phase of any facility construction or renovation to ensure that communications needs are adequately assessed.

16.16.2. Communications station wiring will be handled by the ITD, Telecommunications staff. Wiring may be performed by the staff or by an outside contractor under the supervision of ITD, as determined by ITD.

16.16.3. For the Information Technology Standards for Telecommunications Cabling System Standards see Appendix H.

16.17. **Telephone Entrance Facility**

16.17.1. Two 4-inch conduits from basement telephone room (preferred), or first floor telephone closet where the facility does not include a basement, to the point of meet with local service provider (e.g., US West).

16.17.2. Conduits to include a minimum 300-pound pull string in each.

16.18. **Telephone Rooms**

16.18.1. To the extent possible, telephone rooms and closets shall be located near the center of each floor.

16.18.2. If structure includes more than one floor, the telephone rooms and closets must be vertically stacked, so that conduit sleeves are in line with each other between floors.

16.18.3. Conduit sleeves in the telephone rooms shall be four inch in diameter and stubbed at 6-10 inches above the floor.

16.18.4. All walls of the telephone room/closet shall be covered with 5/8" plywood, finished on one side, painted with fire retardant paint.

16.18.5. Each telephone room shall include one #6 ground buss, located a height of 7 feet, and a minimum of two double-duplex, 120-volt, 20 amp electrical outlets (clean power). If emergency generator supplied power is available, these outlets shall be included in the load from that power source.

16.18.6. Conditioned air, or positive air flow of conditioned air, shall be provided.

16.18.7. Telephone room size varies depending on intended facility use, number of occupants, and service requirements of occupants. Not all facilities shall have need of a telephone room. This requirement shall be assessed on a case-by-case basis by ITD.

16.18.8. Telephone equipment should not be housed in the same room as high voltage electric equipment.

16.18.9. Two 4" conduit sleeves for each telephone room above and below the switch room shall be provided, including four to the room/closet housing the local service provider's conduits.

16.18.10. A 5-ohm (max) ground buss shall be provided at a height of 7 feet.

16.18.11. A minimum of four 120-volt, 20 amp double-duplex electrical outlets shall be provided (one on each wall). The actual number and location of the electrical outlets shall be assessed on a case-by-case basis.

16.18.12. All electrical outlets shall appear in a separate isolation breaker box located in the switch room.

16.18.13. If emergency generator supplied power is available, all outlets shall be

included in the load from that power source.

16.18.14. Conditioned air is required 24 hours a day, seven days per week (BTU expectations shall be provided when telephone room needs are being assessed) where stand-by power is provided. Verify requirements with Project Manager.

16.18.15. No non-telecommunications equipment (e.g., alarms, environmental, or electrical) shall be housed in the telephone room.

16.19. **Service Outlet(s)**

16.19.1. Minimum 12-inch ladder rack shall be provided along hallways, and as needed in large open areas.

16.19.2. In-wall conduit shall be no less than 1-inch in diameter and stubbed 2-4 inches above the ceiling.

16.19.3. Outlet boxes shall be standard J-boxes equipped with a mud ring.

16.20. **Station Wiring**

16.20.1. Station wiring specifications are based on a complex wiring standard. As noted above, station cabling will most likely be performed by ITD's Telecommunications staff, but may be contracted out, under the supervision of Telecommunications staff. In either case, station wiring requirements must be developed under the direction of ITD's Telecommunications section. ITD must be included in the process of planning and designing the facility.

16.21. **Data**

16.21.1. Data requirements vary greatly from facility to facility depending upon the business information needs of the building occupants. Data wiring and equipment will be located with the telephone equipment in the switch room and telephone closets and will increase the size, power and air conditioning requirements for these spaces. Data patch panels, hubs, routers, fiber multiplexers, etc. will be mounted in standard 19" open ladder racks. The exact configuration of these racks will be set by ITD upon evaluation of the user's needs. To ensure that these spaces are properly designed, it is imperative that ITD Networks and Telecommunications be included during the planning and design stages of design.

16.22. **Radio**

16.22.1. Radio equipment installation requirements depend on the type of equipment required. These requirements require that ITD

Communications be included in the facility design and planning stages. In general, the following guidelines should be used for planning purposes.

16.23. **Antenna Structure**

16.23.1. Radio antenna requirements will dictate the size and placement of any required tower or antenna structure.

16.23.2. If the plans call for a microwave link, antenna size (dish diameter) and loading (weight and wind loading) must first be determined. Antenna placement must be carefully planned to ensure that a proper line of sight path is maintained to the distant site and is free of obstruction from vegetation and structures.

16.23.3. It must be determined whether zoning requires special use permits for radio tower installation. FAA approval may also be required for certain tower designs.

16.23.4. All antenna structures shall be properly bonded to the facility ground system by means of exothermic connections.

16.23.5. Weatherproof Antenna Ports
The penetration of antenna transmission line (coaxial cable and waveguide) into the building requires the installation of a commercially made port assembly. The port assembly should be sized to accommodate the required number of antenna transmission lines with some capacity for future expansion.

16.24. **Radio Equipment Room**

16.24.1. The radio equipment should be located in a properly sized and environmentally controlled space which is located as close as possible to the antenna structure.

16.24.2. If possible, the building should be planned to locate the radio equipment near or co- located with the telephone and data equipment. However, if it is not possible to locate the radio equipment near the telephone equipment, adequate cabling must be planned to link the radio equipment to the telephone equipment.

16.24.3. Proper cable management must be included in the planning. Overhead and/or under floor (computer flooring) cable trays must be provided to allow antenna, telephone, and data cabling to the radio equipment.

16.24.4. A properly sized electrical sub-panel must be installed in the radio equipment room to allow for individual electrical circuits to the radio equipment. The radio equipment sub-panel should be fed from the facility emergency power if available.

16.24.5. Service/utility electrical outlets must be provided in the walls of the radio equipment room to allow for equipment and facility servicing.

16.24.6. Adequate room lighting must be provided to allow for equipment servicing without the need for portable lighting.

16.24.7. A suitably sized single point ground window (copper bar) shall be installed in the radio room and properly bonded to the facility ground system.

16.25. **HVAC Considerations for Radio Equipment**

16.25.1.1. A thermal loading study must be performed to provide adequate ooling of the radio equipment planned for the facility with some margin for expansion.

16.26 **Fire Alarm**

16.25.1 All new and renovated facilities equipped with a fire alarm system shall be a Class “A”, fully addressable fire alarm system.

16.25.2 Proprietary fire alarm systems serviceable by only a single company shall not be provided. Training, parts availability and service work, including programming, shall be available from multiple companies or distributors.

16.25.3 The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history. A printer shall be included to record history of events log and alarms, plus maintenance printouts/sensitivity readings (i.e. NFPA required biennial sensitivity testing can be accomplished via FACP).

16.25.4 The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

16.25.5 The Fire Alarm Control Panel (FACP) and wiring systems shall have a minimum of 20% spare capacity.

16.25.6 Spare parts, including smoke detectors, heat detectors, pull stations, horn/strobes, monitor modules, etc. shall be provided in quantities appropriately proportional to those installed.

16.25.7 Contractor shall provide a minimum of two (2) separate one-half hour training hands-on training sessions emphasizing basic operation and maintenance of the system. These training sessions will be at a six (6) month interval for on-site personnel.

16.25.8 Electric bells only. No water motor gongs shall be allowed.

APPENDIX A – Facilities Review Presentation Protocol for Project Managers

The Facilities Review Committee (FRC) was created by the City Manager to ensure all City facilities are built or renovated in accordance with the City of Phoenix Building Standards. The Committee has a standing meeting on the second Tuesday of every month, usually in the Meeting Room on the 2nd floor of Historic City Hall.

PROJECT MANAGER'S ROLE

The project manager plays a key role in support of the FRC's directive in ensuring compliance with City Standards. This support is accomplished by providing updated standards to contracted architects and consultants. Additionally, project managers should guide the project design toward compliance; or, if needed, identify areas where deviations from City Standards are required and provide to the Committee justification for noncompliance.

The Project Manager also plays a key role in compliance with the directives of the FRC. The Project Managers will ensure that guidance provided by the Committee is followed by the design team, and that the facilities constructed adhere to City standards.

PROJECTS REQUIRING REVIEW

In general, any project creating new office space to be occupied by City personnel or creating spaces that must be maintained by the City need to come before the FRC. Renovation projects need to come before the Committee if they are changing the use of a space, or replacing existing building systems, to include the structural, mechanical, electrical, or security systems. Renovation projects that involve "like-for-like" replacement do not need to come before the full committee, but may be approved unilaterally by either of the Committee Co-chairs.

If there is any question that a project may or may not need to come before the Committee, the Project Manager should seek clarification from either of the Committee Co-Chairs.

PRIOR TO THE MEETING

In the months prior to presentation to the Committee, Project Managers should involve members of the FRC's technical staff in their routine design meetings as necessary. Technical staff can then review the design and submit questions, suggestions, and comments prior to the Committee review. This will allow the architect time to make changes and/or research and bring along information to answer questions at the FRC meeting.

- Schedule the project for review towards the end of Design Development, or when the design has been developed sufficiently to communicate the necessary information (listed in the checklist below) to the Committee members.
- **If exceptions to the standards will be requested, bring the facility forward for an early review at the end of schematic design.** A second review may be needed when designs are at 90%.
- Deliver the project summary form to the staff assistant two full weeks prior to presentation.
- Deliver six sets of half-size scaled plans and six sets of specifications to the staff assistant two full weeks prior to presentation.

AT THE MEETING

To review facilities in their entirety in an efficient manner, project managers should follow the following protocol during their presentation to the Facilities Review Committee:

- Bring one full-sized set of drawings, (including the site plan, floorplans, elevations, and reflected ceiling plans) and 13 sets of small prints, either 8-1/2x11 or 11x17, and sufficient copies of any other relevant documents to meeting.
- Bring easel for presentation to ensure large plans are visible to committee members.
- Bring staff and consultants needed to answer committee questions or a second review may be needed.
- Bring any photos, digital pictures or videos available of the site, and inform staff of equipment needed.
- Have all staff and consultants sign in.
- Review key elements or plans in the following manner and bring all areas of noncompliance to the attention of the committee:

  A. Interior and exterior finishes, to include materials and colors
  B. Electrical service to building and rest of campus
  C. HVAC systems to be used
  D. Access control for various areas and functions
  E. Electronic Safety and Security Systems
  F. Alarm systems and links to other city systems
  G. What meetings (or plans review) have occurred with DSD, ITD, Public Works, or other staff to review specific systems
  H. Office space, size and classification of City employees who will occupy
  I. Mayor's commission, accessibility issues
  J. Telecom space
  K. Landscape drawings

If the FRC believes one particular area needs additional attention, you may be assigned to work with the Committee Member most knowledgeable in that area. This FRC Member would be able to work directly with you and report back to the Committee on the outcome. This may prevent your project from requiring a second review by the entire FRC prior to project approval.

To assist the project manager, a “Checklist” has been attached (see Appendix B).

The Committee appreciates your efforts in facilitating an organized and comprehensive review of your project. Should you have any questions, please contact Public Works , staff assistant at (602) 262-7897. You may contact either of the two Co-Chairs, Assistant Public Works Director or Deputy EAS Director. The Building Standards and Review Process has been adopted by the Committee on July 1, 2006.

APPENDIX B – Project Manager's Checklist

Check the appropriate box: ☐ 30% Design Review ☐ 60% Design Review ☐ 90% Design Review

ITEM	DESCRIPTION	YES	NO	N/A	NOT MET	COMMENTS
1.	Two-weeks prior to the Facility Review Committee's staff facilitator (Public Works) scheduled monthly meeting, submit six (6) sets of the following: ☐ Half-size plans ☐ Specifications ☐ Appendix C (Project Summary Form) ☐ Appendix D (Site Assessment, etc.) ☐ Appendix E (MCDI Checklist and Meeting Minutes, if any)					
2.	Unless otherwise noted, bring thirteen (13) sets/copies of the following documents to the Facilities Review Committee meeting: ☐ Full-size set of plans *(One (1) copy only)* ☐ Half-size sets of plans ☐ Specifications ☐ Appendix C (Project Summary Form) ☐ Appendix D (Site Assessment, etc.) ☐ Appendix E (MCDI Checklist and Meeting Minutes, if any)					
2.	Bring easel(s) for the presentation.					
3.	Schedule the appropriate project team members, City staff, and all appropriate design consultants to attend the Facilities Review Committee meeting in order to answer questions related to their respective disciplines. Bring staff and consultants needed to answer committee questions and review key elements of plans and bring all areas of non-compliance to the attention of the committee.					
4.	Confirm invited City staffs' and project consultants' and attendance the day prior to the meeting.					
5.	Bring samples of interior and exterior finishes (including but not limited to: Masonry, metals, paint colors, flooring, etc.).					
6.	Electric Service is being provided by: ☐ SRP ☐ APS ☐ Other_____					
7.	Electric service for the facility and rest of the campus has been coordinated.					
	Lighting concepts including fixture cut sheets have been provided to the City and Public Works for review.					
8.	Description of proposed HVAC system(s) has been provided.					
9.	Is there access control for various areas and functions?					
10.	Will the Electronic Safety and Security or Alarm system(s) be linked to other City systems?					
11.	Provide an outlined summary of meetings and plan reviews conducted with DSD, ITD, Public Works, MCDI, Planning Villages, and other City staff to review specific systems.					

ITEM	DESCRIPTION	YES	NO	N/A	NOT MET	COMMENTS
12.	Describe any issues or unique conditions related to DSD, ITD, Public Works, etc?					
13.	Are any modifications or variances required?					
14.	Any required easements and/or street abandonments?					
15.	Any DSD modifications/variances required?					
16.	Is there office space? Provide office sizes, job classifications of City employees, descriptions of duties, who will occupy					
17.	Are there areas of rescue assistance?					
18.	Are there offices in this facility?					
19.	Provide sizes and job classifications, along with job descriptions to the FRC.					
20.	Are there any issues with MCDI's Architecture and Design Committee?					
21.	Provide landscaping plans including plant material palette..					
22.	Have you coordinated with ITD?					
23.	Is there telecom space?					
24.	Are there skylights?					
25.	If skylights, are they pre-manufactured?					
26.	Have you complete the Environmental Checklist (Appendix D-and addresses all action items?					
27.	Are there any environmental issues/concerns?					
28.	Provide a description to the FRC of any unique features of this projects.					
29.	Client Department has prepared justification for non-compliant design elements to present to the FRC.					
30.	Is this project to be LEED certified?					
31.	Describe "green" construction materials being incorporated into the design.					

Completed by:_____Dept.: _____ Date: _____
City Project Manager

APPENDIX C – FRC Project Summary Form

To be completed by Project Manager and submitted 2 weeks prior to scheduled meeting.

PROJECT INFORMATION

DATA

Project No./Cost Center:
Project Name:
Project Address:
Owner: ☐ City ☐ Leased
Operator: ☐ City ☐ Tenant
Maintenance: ☐ City ☐ Public Works ☐ Parks ☐ Tenant ☐ Other

OWNER

Owner/Client Dept.:
Owner's Project Manager:
Title:
Office: Cell: Fax:

PROJECT DESCRIPTION

Project Description: *(Be brief)* ☐ New ☐ Remodel

Delivery Method:
☐ D-B-B ☐ CM@R ☐ D-B ☐ JOC
Company/Firm:

FF&E:
☐ To be purchased outside of construction contract*
☐ To be included in construction contract
☐ Combination (inside and/or purchased separately*

**List FF&E to be purchased outside of construction contract.*
Date(s) of major FF&E purchases:

Estimated Area(s): *(In square feet)*
Total Site:_____s.f./_____ acres
Building: _____Gross _____Net
Hardscaped/Paved: _____
Landscaped: Unimproved:

Mechanical System: *(Describe)*

Emergency Power: ☐ No ☐ Yes *(Describe)*

Materials & Finishes:
Exterior: Walls:_____
Roof: _____
Roof Slope ≥1/2 per foot? ☐ Yes ☐ No
Interior: Wall:_____
Flooring:_____
Ceiling:_____

Security: ☐ N/A ☐ Yes *(Describe)*

Homeland Security Bureau Review Date:_____

Compliance with Space Standards:
☐ Yes ☐ No *(Funding department must provide written documentation and explanation requesting a variance of the Building Standards.)*

MCDI – Architecture & Design Committee
☐ Scheduled Presentation Date: ☐ N/A

LEED – *List target points for each category on separate sheet.*

CONSULTANTS

Design Firm:
Type: ☐ Architecture ☐ Engineering
☐ Landscape Architecture/Planners
☐ A/E ☐ E/A ☐ Other

Contact:
Title:
Office: Cell: Fax:

Sub-consultants: *(List Firm Names)*
☐ Architectural:
☐ Interiors:
☐ Civil:
☐ Structural:
☐ Mechanical:
☐ Electrical
☐ Other

SCHEDULE

Milestones:
Design Status: ☐ 30% ☐ 60% ☐ 90%
Bid/GMP Award Date:
Substantial Completion Date:
Targeted Opening Date:
Public Commitment: ☐None
☐ Yes, by whom?

BUDGET /FUNDING*

Budget info to be provided by the funding department.

Land *(not yet acquired)*: $

Design Phase Costs: FY 20___ - ___
Budget Pg. in CIP: Estimate: $

Construction Phase Costs:
Budget Pg. in CIP: FY 20___ - ___
Estimate: $ _____

FF&E Phase Costs: FY 20___ -___
Budget Pg. in CIP: Estimate: $

Other Expected Costs: *(Provide explanation)*
Estimate: $

Pending Change Orders:
Estimate: $

Total Project Cost: *(Include expenditures to-date)*
Estimate: $

Operating Costs: Fund:
Estimate: $

FF&E included in Construction Phase Cost:
Describe:
Estimate: $

Other funding sources:

**Figures to be rounded to nearest 1/10th of a million-$ X.X M; Show by Fiscal Year in which funds would be encumbered& charged in the accounting system.*

APPENDIX D – Site Assessment, Property Acquisition & Design Issues

City of Phoenix

ENGINEERING AND ARCHITECTURAL SERVICES DEPARTMENT
DESIGN & CONSTRUCTION MANAGEMENT

ENVIRONMENTAL REVIEW CHECKLIST

INSTRUCTIONS:
For projects that involve new construction or changes to the land surface, complete this checklist with the Client and identify all environmental issues which should be addressed in the course of completing your project.

Project Name	Project No.
New Construction	Remodeling ONLY
Project Address	
Client Department	
Client Contact	Client Phone

Project Phase: Date of Review

- Pre-Design / Land Acquisition _____
- Schematic Design, 25-30% _____
- Design Development, 50-60% _____
- Placement on 90-Day Bid List _____
- Pre-Construction Meeting _____
- Substantial Completion _____

A. SITE ASSESSMENT, PROPERTY ACQUISITION AND DESIGN ISSUES

PREVIOUS AND CURRENT LAND USE

1. Has an Environmental Site Assessment been completed for the site? (Contact EASD Environmental Services Section if unknown).

   YES Review to identify environmental or health and safety issues, including Clean Water Act Section 404, and archaeological or cultural

resources issues.

NO An Environmental Site Assessment must be completed before property is acquired. If the City already owns the property, an Assessment may be a useful tool for assessing current site issues. If an Environmental Site Assessment (ESA) is necessary, ask the EASD Environmental Services Section to complete one. The City follows a standard ASTM format for environmental site assessments that meets EPA requirements. ESAs must be conducted in accordance with the date EPA rule in all appropriate inquiry.

The following site features can be identified and evaluated through an Environmental Site Assessment. Do they exist on the project site?

Dry well	YES	NO
Active or inactive water well	YES	NO
Underground or aboveground storage tank	YES	NO
Fuel/chemicals/paints/hazardous material storage area(s)	YES	NO
Washrack	YES	NO
Oil/water separator	YES	NO
Septic tank	YES	NO
Contaminated soil	YES	NO
Contaminated groundwater	YES	NO
Solid waste disposal area(s)	YES	NO
Subsided area(s)	YES	NO
Disturbed soil	YES	NO
Unexplained dead vegetation	YES	NO
Pit(s), sump(s) or pool(s) of waste liquid	YES	NO
Stored drum(s) or other chemical container(s)	YES	NO
Other (describe)_____	YES	NO

If your site has any of these features, discuss the need for a Phase 2 ESA, potential project impact and abatement/mitigation options or requirements with the Client, EASD's Environmental Services Section, the Office of Environmental Programs (602-256-5669), and/or Personnel's Personnel Safety Section (602-262-7555).

2. If this is an existing City facility, has an Environmental Facility Assessment been completed by the Office of Environmental Programs contact OEP/Pollution Prevention Program (602-256-5669).

YES Review to identify environmental or health and safety issues that should be considered.

NO Client department should contact the Office of Environmental Programs (602-256-5669) to request one.

ENDANGERED, THREATENED AND PROTECTED SPECIES ISSUES

3. If the project will develop previously undisturbed land, does that land provide habitat for state or federal, threatened, endangered, protected or regulated plant or animal species? There are several places to go for this information.

Note: Most determinations are good for only one year.

a. The AZ Game and Fish Department, Habitat Branch, will conduct a review of your project area to identify any endangered, threatened or protected species of plants or animals. This review will usually incorporate the federal Endangered Species Act and the State of Arizona's Native Plant Protection Act.

Send a written request for a review, including a legal description of the property to:

Arizona Game and Fish Department
Habitat Branch (WMHB)
2221 W. Greenway Road
Phoenix, Arizona 85023
Phone (602) 789-3605
FAX (602) 789-3928

If any endangered, threatened or protected species are present coordinate with the Office of Environmental Programs 404 coordinator (602) 534-1775.

b. Removal of Arizona native plants is regulated by the AZ Dept. of Agriculture, Plant and Cactus Division, Phoenix District. Call (602) 542-7182 for information.

YES If your project site *does* or *may provide* a home to regulated plants or animals and you need a biological survey to document their presence or absence, contact EASD's Environmental Services Section to complete a biological survey of the project area.

NO No further action necessary.

ARCHAEOLOGICAL / HISTORIC PRESERVATION ISSUES

4. Does the project meet any of the following criteria:

a. Any project considered a "Federal Undertaking" (16 U.S.C. 470):
   (1) those carried out with federal assistance, i.e., funding,
   (2) those requiring a federal permit, license or approval, e.g., Clean Water Act Section 404 permit,
   (3) those that are subject to state or local regulation administered pursuant to a delegation or approval by a federal agency;
b. Projects that are located on federal or state land, including Trust Land;
c. Projects that are to receive grants from any state agency;
d. Projects located in an area likely to contain human remains, e.g., a Hohokam village, an historic cemetery or an historic canal;
e. Projects located in mountain foothills that will remove or **destroy natural boulders.**
f. Projects located on property with Historic Preservation Overlay Zoning
g. Projects that are to receive a Heritage Fund Grant from Arizona State Parks

YES to **a,b,c,d**, and/or **e**
Complete the "Archaeology Assessment Request" attached to this checklist and send it to the City Archaeologist (602-495-0901) to determine if an archaeology survey has already been completed for the area, and if not, if one is required.

YES to **a** and/or **f** (Federal Undertakings & Historic Preservation Overlay):
Coordinate with the Phoenix Historic Preservation Office in the

early/conceptual stage of the process. (602-261-8699)

YES to **g** (Heritage Fund Grants):
Coordinate with the State Historic Preservation Office in the early/conceptual stage of the process. (See contacts on the grant application form).

NO to **ALL** No further action necessary.

DEMOLITION

5. Does the Project include demolition of existing structures?

YES Whether or not the EASD Environmental Services Section manages the demolition, ask them to complete the required surveys for asbestos containing materials and lead-based paint. All demolition, contractors must submit the National Emission Standards for Hazardous Air Pollutants (NESHAP) notice required by the Clean Air Act to the Maricopa County Air Quality Department. Personnel's Personnel Safety Section (602-262-7555) should also be contacted to discuss OSHA requirements for the protection and training of City staff during construction. These issues may affect the project budget and schedule.

NO No further action necessary.

RENOVATION

6. Does the Project include renovation of existing structures?

YES Ask the EASD Environmental Services Section to complete the required surveys for asbestos containing materials and lead-based paint and any abatement necessary. If they perform the abatement, they will require the contractor to submit the National Emission Standards for Hazardous Air Pollutants (NESHAP) notice required by Clean Air Act to the Maricopa County Air Quality Department. Personnel's Personnel Safety Section (602-262-7555) should also be contacted to discuss OSHA requirements for the protection and training of City staff during construction. These issues may affect the project budget and schedule.

NO No further action necessary.

ZONING

7. Does the site require a change in zoning?

NOTE: If the site was subject to environmental clean up or abatement, some property uses may be restricted.

YES Contact the Client, the Planning Department (602-262-7131), and/or the Office of Environmental Programs (602-256-5669).

NO No further action necessary.

GROUNDWATER

8. Will the project intercept, pump or divert ground water?

YES Check with the Law Department's Natural Resources Section (602-495-5879) and/or with the Water Resources Manager Advisor (602-261-8532) to determine if you need permits or authorization from the AZ Dept. of Environmental Quality and/or the AZ Dept. of Water Resources.

NO No further action necessary.

CLEAN WATER ACT, SECTION 404

9. Does the project include an enclosed space over contaminated ground water?

   YES Evaluate whether the structure is designed to prevent vapor intrusion of contaminants. Contact the Office of Environmental Programs for assistance in identifying contaminated groundwater plumes and design criteria (602-256-5669).

   NO No further action necessary.

10. Will the construction activities include the excavation, damming, disturbance or performance of other activities in a natural drainage area such as a wash or watercourse, and/or in man-made structures e.g., pipes, ponds or canals? Complete the Clean Water Act 404 Initial Assessment Form (attached) and submit with an aerial photo to the 404 coordinator in OEP.

   YES A "Clean Water Act Section 404 Permit" issued by the U.S. Army Corps of Engineers may be required. Some construction activities may be covered by one or more Nationwide Permits; others may require individual permits. Discuss with the Client, and contact EASD's 404 Liaison, the Office of Environmental Programs 404 Coordinator (602-534-1775) for assistance and to determine if the project can be designed to minimize or eliminate 404 issues.

   NO No further action necessary.

11. When completed, will the project require maintenance or other activities in a natural drainage area such as a wash or watercourse, and/or in man-made collection drainage or water storage structures e.g., pipes, ponds or canals?

   YES While this is a client operations issue, note that the project design can affect how maintenance is performed. A "Clean Water Act Section 404 Permit" issued by the U.S. Army Corps of Engineers may be required for maintenance. Some maintenance activities may be covered by one or more Nationwide Permits; others may require individual permits. What, if any, permits are necessary should be discussed with the Client to identify design opportunities. Contact the EAS 404 Liaison, the Office of Environmental Programs 404 Coordinator (602-534-1775) or the Law

   Department Natural Resources Section (602-534-1480) for assistance, and to determine if the project can be designed to minimize or eliminate 404 issues.

   NO No further action necessary.

HAZARDOUS AND SOLID WASTE DISPOSAL

12. Will facility accumulate hazardous waste (EX: thinner, waste enamel paint, paint pigments from aerosol can puncturing, used oil) (check Hazardous Material Inventory Statement).

   YES Ensure a covered storage area that is designed with berms or at least 4' X 4' to accommodate secondary containment pallets for each waste stream. Storage area must be sited away from washes/gullies, retention basins, drywells, etc.

   If yes, the facility will need to meet applicable hazardous waste requirements

for recordkeeping, etc

NO No further action necessary.

13. Will facility accumulate used lead/acid batteries, spent mercury containing lamps, rechargeable or NiCad batteries?

YES Ensure a covered storage area that is designed with berms or at least 4' X 4' to accommodate secondary containment pallets for each waste stream. Storage area must be sited away from washes/gullies, retention basins, drywells, etc.

If yes, the facility will need to meet applicable hazardous waste requirements for recordkeeping, etc

NO No further action necessary.

14. Will toxic, corrosive, ignitable, or reactive materials in containers of 5 gallons or more be stored at the facility (check Hazardous Material Inventory Statement)?

YES Ensure a covered storage area that is designed with berms or at least 4' X 4' to accommodate secondary containment pallets. Also include storage space for safety and spill response equipment up to 55 gallon size.

NO No further action necessary.

15 Will palletized fertilizer bags be stored at this facility?

YES Ensure a covered storage area sized a minimum 10' X 12'.

NO No further action necessary.

16. Will scrap metal be stored at this facility?

YES Ensure a covered storage area sized a minimum 6' X 25'. Elevate and store to avoid direct contact with the ground.

NO No further action necessary.

17. Will new and used tires be stored at this facility?

YES Ensure a covered storage area sized a minimum 6' X 25' to accommodate up to 100 tires.

NO No further action necessary.

18. Will bulk landscape materials (granite, soil, etc) be stored at this facility?

YES Ensure 3-sided storage areas are designed to meet Maricopa County Dust Control rules (www.maricopa.gov/aq/ruledesc or call Gaye Knight at 602-261-8419.

NO No further action necessary.

19. Will janitorial products be stored onsite to clean facility?

YES Ensure storage area can accommodate at least 15 gallons and shelving is not higher than 5 ft. Include mop sink, water supply and sanitary sewer connection.

NO No further action necessary.

20. Will flammable liquids and/or acid cabinets be used to store materials at the facility?

YES Ensure a covered 4' x 4' minimum storage area for each cabinet.

NO No further action necessary.

21. Will pesticides be stored at this facility?

YES Ensure a covered secured storage area that can accommodate up to 60 gallons of pesticides for equipment and product containers. Ensure area design includes lighting, has access to water, ventilation.

If yes, personnel may be required to meet certified pest applicator requirements or institute integrated pest management through Personnel Safety at 602-262-7555.

NO No further action necessary.

22. Will site be equipped with 85 gallon blue barrel for recycling (coordinate with Public Works' Jeff Fulcher at 602-495-7678)?

YES Ensure any required draining or backwashing is discharged to turf or to the sanitary sewer (AAC R 18-5-236).

NO No further action necessary.

23. Will equipment or vehicle washing operations occur at this facility?

YES Ensure adequately sized wash pad, oil, water separator and connection to sanitary sewer are included in project plans.

If yes, check to ensure that facility is added to pumping service contract.

NO No further action necessary.

24. Will parts washing operations be performed at this facility?

YES Ensure 6'X 3' minimum space for equipment. Electrical and ventilation requirements should also be considered if parts washing tank is heated or uses petroleum hydrocarbons.

If yes, check with Pollution Prevention staff at 602-256-5669 for safest alternatives chemicals, then design system.

NO No further action necessary.

25. Will there be operations that dispose of chemicals into drains/sewer system (labs, photography, jewelry making?)

YES Ensure pre-treatment devices/equipment are included.

If yes, check with Pollution Control for appropriate disposal techniques.

NO No further action necessary.

26. Will a pool be constructed at the facility?

YES Ensure any required draining or backwashing is discharges to turf or to the sanitary sewer (AAC R 18-5-236).

NO No further action necessary.

27. Has an ingress/egress plan been drawn for posting at the facility to assist occupants in the event of a fire or emergency?

YES No further action necessary.

NO Develop a facility ingress/egress plan for facility occupants.

28. Has a Hazardous Material Permit Application (include Hazardous Materials Inventory Statement) for the facility been completed?

YES No further action necessary.

NO The Hazardous Material Permit Application can be generated and submitted electronically. As a service to the Fire Department and City departments, the application has been added to the Environmental Data Management System (EDMS) managed in the Office of Environmental Programs (OEP). Potential EDMS users need to add an initial chemical inventory to the system. Contact Jeff Menke, 602-256-3456 for assistance.

29. Will the facility use large amounts of chemicals such as toxic gases, oxidizers or flammables?

YES Facilities that use large amounts hazardous materials may be required to prepare complex Risk Management Plans that include a hazard assessment, accident prevention program and emergency response program. The list of chemicals and quantities regulated under this regulation are found at 40 CFR Part 68.130. Historically the chemical of concern found in City operations is chlorine in water and wastewater treatment plants.

If yes, significant time may be required to complete the appropriate plan.

NO Develop a facility ingress/egress plan for facility occupants.

DRYWELLS

30. Will the facility store petroleum products 1) in containers 55 gallons or greater with an aggregated quantity that exceeds 1,320 gallons above ground; or 2) 42,000 gallons or more underground?

YES Prior to operating, the facility must have an approved Spill Prevention, Control and Countermeasure Plan (SPCCP). The SPCCP requires a Professional Engineer (PE) certification. Fuel operations at most facilities (except Aviation) are managed by the Public Works Department. Contact the Public Works Environmental Coordinator at 602-534-2608 for assistance.

If yes, significant time may be required to complete the appropriate plan.

NO No further action necessary.

31. Does the project include constructing a drywell?

YES Drywells are generally discouraged as a storm water collection option because of the potential for ground water contamination.

a. Drywells must be constructed in compliance with ADEQ Guidelines and must be registered with ADEQ. Send a copy of the registration form to the Drywell Coordinator in the Office of Environmental Programs, 602-261-

8419.

b. Drywells that drain fueling areas or other areas where hazardous materials are used, stored, loaded, or treated must have a general Aquifer Protection Permit (APP) and meet other regulatory requirements found at AZ Administrative Code R18-9-C301 through C304. These drywells must include structural protection that can substantially increase the cost. Contact the drywell coordinator in the Office of Environmental Programs at (602-256-5669).
c. Special care is required if the drywell is considered in an area of groundwater contamination found in many areas of the City. Contact the Office of Environmental Programs (602-256-5669).

NO No further action necessary.

TRAFFIC

32. Will the project add a lane of ½ mile or more in length to a collector or arterial street?

YES Notify Street Transportation Department, Planning, Design and

Programming Division (602-262-6284) to ensure that the project is included in air quality, transportation plans and conformity regulations.

NO No further action is necessary.

B. ENVIRONMENTAL CONSIDERATIONS DURING CONSTRUCTION

AIR QUALITY / DUST CONTROL

33. Will construction involve earthmoving activities on more than 1/10 of an acre?

YES The project must have an air quality permit and a dust control plan approved by the Maricopa County Air Quality Department pursuant to the County's Dust Control Rule 310. Contact the Office of Environmental Programs (602-261-8419) for assistance if necessary. *Confirm that appropriate language is included in the contract specifications.*

Copies of permit(s) MUST be submitted to the City Project Manager by contractors PRIOR to starting the permitted activities.

NO No further action necessary.

34. Will construction involve earthmoving activities on more than 5 acres?

YES The Maricopa County Air Quality Department Dust Control Rule 310 requires various measures to minimize dust. Examples include: Track-out pads, water available on site, and name and phone number of person(s) responsible for dust control on the project.

Contact the Office of Environmental Programs (602-261-8419) for assistance if necessary. *Confirm that appropriate language assigning this responsibility is included in the contract specifications.*

NO No further action necessary.

35. Will the project build or construct equipment or facilities that will be a source of air pollution or will require air pollution control equipment? Examples include:

Large gas boilers over 500,000 BTU YES NO

Other fuel burners with over 500,000 BTU	YES	NO
Paint booths/abrasive blasting	YES	NO
Solvent cleaning tanks	YES	NO
Graphic Arts	YES	NO
Fuel dispensing tanks	YES	NO
Wood working / surface coatings	YES	NO
Chemical handling equipment	YES	NO
Emergency Generators	YES	NO
Incinerators*	YES	NO

YES Ensure that the contractor completes the necessary air quality permit applications for the Maricopa County Air Quality Department (602-506-6010) and provides copies to the City. *Confirm that appropriate language assigning this responsibility is included in the contract specifications.* Contact the Office of Environmental Programs (602-261-8419) for assistance if necessary.

***NOTE:** Incinerators are a prohibited land use under City Zoning Code. Consider other alternatives. Contact Planning Department to discuss zoning process. Notify Office of Environmental Programs Air Specialist (602-256-5669).

NO No further action necessary.

Existing Environmental Permits

36. Will construction of the project include remodeling or other disturbance buildings or facilities that are regulated under an environmental permit? Examples: Underground fuel dispensing tanks, wastewater discharges, storm water discharges, ponds, hazardous waste and hazardous materials.

YES Discuss with the Client to ensure facility compliance during construction. *Confirm that appropriate language assigning this responsibility is included in the contract specifications*.

NO No further action necessary.

Hazardous Waste Disposal

37. Will the construction activities themselves disturb or generate hazardous or solid waste, including asbestos containing material, paints, chemicals and liquid wastes (including pesticides), or in the storage or disposal of hazardous waste or materials?

Note: *Hazardous* waste can only be disposed of or treated at an authorized facility.

YES The contractor must have procedures for the proper handling, storage, use, disposal and cleanup of hazardous materials and waste. Personnel's Personnel Safety Section (602-262-7555) can provide assistance. (EASD's Environmental Services Section can test for and remove and dispose of asbestos containing materials). *Confirm that appropriate language is included in the contract specifications.*

NO No further action necessary.

Storm Water Management

38. Will the project disturb one acre or more?

YES The construction activity must be covered by an Arizona Pollutant Discharge Elimination System (AZPDES) permit for storm water discharges from construction sites. The permit is issued by the Arizona Department of Environmental Quality. It requires preparation and implementation of a Storm Water Pollution Prevention Plan and submittal of a Notice of Intent/Notice of Termination by the City AND the contractor.
EASD specification boilerplate includes some language; *confirm that it is adequate.* Contact EASD's Environmental Services Section for assistance if necessary.

NO No further action necessary.

C. SUMMARY OF ACTION ITEMS

ENVIRONMENTAL CHECKLIST SUMMARY SHEET Engineering and Architectural Services Department			
NO.	**TOPIC**	**ACTION / FOLLOW-UP REQUIRED**	**COMPLETED**
1	Env. Site Assessment		
2	Env. Facility Assessment		
3	Endangered Species		
4	Archeological/Historic Preservation		
5	Demolition -Asbestos		
6	Renovation - Asbestos		
7	Zoning		
8	Groundwater - Wells		
9	Groundwater – Vapor Intrusion		
10	CWA 404- Construction		
11	CWA 404- Maintenance		
12	Haz Waste Storage		
13	Batteries & Mercury Lamps		
14	Haz Mat. Storage		
15	Fertilizers		
16	Scrap Metal		
17	Used Tires		
18	Bulk Landscape Materials		
19	Janitorial Supplies		
20	Flammable Liquids		
21	Pesticides		
22	Recycling		
23	Equipment/Vehicle Washing		
24	Small Parts Washing		
25	Discharges to Sewer		
26	Swimming Pool		
27	Fire Evacuation		
28	Fire HMIS		
29	Risk Management Plan (CAA)		
30	Petroleum Storage		
31	Dry well		
32	Dust Control Permit		
33	Dust Control > 5 acres		
34	Air Permits		
35	Other Environmental Permits		
36	Hazardous Waste Disposal		
37	Storm water Management		

The Environmental Checklist Action Items have been completed. Attach notes as necessary.

EASD Project Manager:_____ Date:_____

Client Department: _____ Date:_____

City of Phoenix
PARKS AND RECREATION DEPARTMENT

Archaeology Section
Pueblo Grande Museum
4619 E. Washington St.
Phoenix, AZ 85034

ARCHAEOLOGY ASSESSMENT REQUEST

Project Name: _____ **Cost Center or CIP No.:** _____

Project Type:_____

Project Components:_____

Project Manager: _____ **Phone No.**: _____

City Department(s): _____

Project Consultants: _____

Location (T/R/ ¼ Sec or major streets): _____

Land Ownership for all Project Components (specify department, etc.):
Private: _____
City of Phoenix: _____
State of Arizona: _____
Federal: _____

Permitting or Funding Agencies (specify):
Maricopa County: _____
State of Arizona: _____
Federal: _____
Other: _____

Anticipated Construction Schedule:
Subsurface Excavations (grading, trenching, etc.): _____
Other: _____

Extent of Construction Activities:
Anticipated depth of disturbance below present ground surface: _____
Length and width of ground surface disturbance:_____
Utility Trenches (types): _____
Other: _____

Print Name: _____

Signed: _____ Date: _____

Saving the past for the future…

City of Phoenix

OFFICE OF ENVIRONMENTAL PROGRAMS
CLEAN WATER ACT SECTION 404
INITIAL ASSESSMENT FORM

FIND OUT FIRST!

Project Number:		Project Manager:			
Project Name:					
Department:		Division:		Date:	
Location:					

Type of Activity	NOTES
Pipeline	
Street (paving, curb, etc.)	
Repair	
Other	

Further Project Description:	

Are any of the following present?

Desert Wash (can be dry)	
Open Water	
Wetland	
Potentially suitable Habitat [1]	

Recommendation / Comments	To be completed by reviewer
404 Permit Required?	
List Potentially Applicable NWPs	
Need Jurisdictional Delineation?	
Need Consultant?	

Signature_____ Date_____

[1] Potentially suitable habitat for listed species such as cactus ferruginous pygmy owls, southwestern willow flycatchers, or yuma clapper rails; OR any kind of quality riparian or desert vegetation.

APPENDIX E – Mayor's Commission on Disability Issues

Submittal Checklist

Architecture and Design Committee Submittal Checklist

It is the goal of the Architecture and Design Committee that all City of Phoenix projects not only meet the intent of the ADA and the requirements of the AZADAAG/ANSI but that they enhance these requirements where greater accessibility, safety or function can be provided.

This checklist is provided to assist designers in meeting the goal of the Architecture and Design Committee and the City of Phoenix, and when applicable, assist the project team in preparation of its presentation to the Mayor's Commission on Disability Issues' Architecture and Design Committee.

This checklist is to be completed and signed by the project manager and submitted with each set of plans submitted to the Committee.

PART 1. SUBMITTAL PACKAGE & MEETING REQUIREMENTS

- ✓ In general, projects are to be submitted to the Committee for its review at an appropriate time following the City's approval of the schematic design, but, prior to completing the design development phase (i.e., approximately 50% completion).

- ✓ A review and approval of the proposed submittal shall be performed by the submitting department's MCDI liaison to determine if the documents to be submitted conform to this Checklist. This review should be scheduled approximately **three (3) weeks** prior to the monthly scheduled MCDI Architecture and Design Committee which occurs on the second Thursday of each month.

- ✓ **Six (6) sets** of plans, this Checklist, and any related documentation shall be submitted to the Equal Opportunity Department's (EOD) staff facilitator of the Mayor's Commission on Disability Issues a minimum of **two (2) weeks** before the committee meeting, to provide the committee sufficient time to review the project prior the meeting. Incomplete submittal packages may not be reviewed at the discretion of the committee. Additional and/or revised sheets may not be accepted nor submitted after the submittal package has been distributed. No revisions and/or additional plans will be accepted at the scheduled committee meeting.

- ✓ Submitted plans and documents shall not exceed a maximum size of **18" X 24"**. Larger sized documents will not be accepted. If any plan, section, elevation, etc., is too large to fit on an 18" X 24" scaled sheets, it may be printed to "fit" on 18" X 24" with all appropriate areas enlarged on additional sheets with match lines, if necessary.

- ✓ This Checklist is to be completed and signed by the project manager and submitted along with the plans and documents submitted for reviewed.

- ✓ All plan sheets **must** be legible, drawn to scale, and include a graphic scale. **Each plan sheet shall display the project name, City's project number, DSD project number, if known, and date of submittal.**

- ✓ Complex projects may require multiple submittals, as agreed to by the City's Project Manager and the Committee Chairperson.

- ✓ Each project/phase shall be submitted separately.

- ✓ Full size drawings and other graphic/ 3-D images may be brought to the meeting only with the approval of the MCDI liaison and EOD staff facilitator.

PART 2. PLAN SUBMITTAL CHECKLIST

By checking the appropriate box below, the Project Manager/MCDI Liaison is indicating if these elements are properly shown and identified on the documents to be submitted to the Architecture and Design Committee. A copy of this completed checklist must be provided with each set of plans, and indicate the project name, City project number, DSD project number (if known), and date of submittal by completing the information immediately below.

INDICATED			
Y	N	n/a	**GENERAL - Each sheet contains:**
			Project name:
			City project number:
			DSD project number (if known):
			MCDI submittal date:
			Drawn scale, graphic scale, North arrow on floor plans

INDICATED			
Y	N	n/a	**SITE PLAN –**
			Access route and distance from bus stop, public transportation, and public right-of-way to building entrance(s)
			Conceptual grading and drainage plan with all grade changes greater than 4" identified. ***Do not submit the full size grading and drainage plan; bring to meeting.***

INDICATED			SITE PLAN Continued…
Y	N	n/a	
			Locations of all ramps and sloped walkways; Indicating slopes, length and height
			Accessible parking locations and stall dimensions; Signage, graphics, and striping
			Passenger loading/ unloading areas
			Public sites amenities, such as: ☐Phones ☐Drinking fountains ☐Site furniture ☐Canopies ☐Truncated Domes (if applicable) ☐Other_____
			Dimensions for all accessible site items

INDICATED			FLOOR PLAN -
Y	N	n/a	
			1/8" scale minimum (match lines, if required)
			Enlarged plans as required
			Restroom plan(s) with dimensions. (Show all required minimum floor clearances and turning radius.)
			High-low drinking fountain locations (Show minimum floor clearances.)
			Stairs, handrails, areas of rescue assistance, and 2-way communications
			Handrail details
			Elevator and/or lift location(s), cab size(s)
			Phone/TTY locations

INDICATED			INTERIOR ELEVATIONS & SECTIONS -
Y	N	n/a	
			Reception/business transaction counter heights and locations
			Toilet rooms fixtures and accessory heights and locations. ☐ Water closet(s) ☐ Urinal(s) ☐ Lavatory(ies) ☐ Mirrors ☐ Towel dispensers ☐ Grab bars ☐ Utility shelf ☐ Coat hooks ☐ Changing Table
			Millwork and cabinets
			Graphic scale

INDICATED			EXTERIOR ELEVATIONS & SECTIONS -
Y	N	n/a	
			Canopies- heights
			Overhangs
			Graphic scale

PART 3. CODE COMPLIANCE CHECKLIST

The following checklist is provided as a tool for use by the designers and project managers comprised of code items commonly missed. It is the responsibility of the design consultants to comply with all accessibility and ADA-related codes required by law and adopted by the City of Phoenix. By no means should this checklist be construed or interpreted to be the only code issues to be addressed or of concern by this Committee and/or the City of Phoenix. This is not a comprehensive list of the codes.

By checking below, the project manager confirms that these items have been addressed in the project design and are indicated on the plans, if applicable.

	Code Item Description: Indicated if design addresses the following code items:	**Yes**	**No**	**N/A**
1.	Parked vehicle overhangs do not reduce the clear width of an accessible route (ADAAG 4.6.3). At accessible parking with a zero-curb, the distance from the parking bumper to the sidewalk is at least the minimum of 30" (2'-6"). *City of Phoenix Development Services Department policy.*	☐	☐	☐
2.	In existing construction, one or two or more fixtures are being removed to create space for one accessible stall in each existing in existing toilet room. This results in the reduction of one required water closet which is be permitted when this reduction is needed to create a conforming accessible toilet stall. (*City of Phoenix DSD Amendment*).	☐	☐	☐
3.	In toilet rooms, including single use rest rooms, door swings do not conflict with clear space at lavatories and other fixtures. (*ADAAG 4.22.2*)	☐	☐	☐
4.	There is a 42" width clearance from the centerline of the accessible toilet to the lavatory or other obstruction. (*ICC/ ANSI A117.1*).	☐	☐	☐
5.	Department of Justice AZADAAG/ANSI recommendations for Building Elements Designed for Children's Use (1996) are used, where appropriate (i.e. toilet rooms for children only).	☐	☐	☐
6.	Drinking fountains are not protruding objects. Where drinking fountains are not located in an alcove, wing walls or some other physical barrier are provided. *(ADAAG 4.4)*	☐	☐	☐
7.	Two-way emergency communication is provided in area(s) of rescue assistance. (*IBC 1007.6.3)*	☐	☐	☐
8.	Provided public-use phones have TTY capability. *(City policy)*	☐	☐	☐

		Yes	No	N/A
9.	Wall sconces that protrude more than 4” are located above 80” (6’-8”). *(ADAAG 4.4)*	☐	☐	☐
10.	Scald protection for hot water supplies and drain pipes at accessible lavatories is indicated on drawings and specified. *(ADAAG 4.19.4)*	☐	☐	☐
11.	One ambulatory accessible toilet stall is provided in all restrooms with 6 or more toilet stalls. Ambulatory stalls must be a minimum 36” wide, have an outward swinging door, and parallel grab bars. (*ADAAG 4.22.4.*)	☐	☐	☐
12.	Flush valves are shown or specified to be on the approach side of accessible toilets. (*ADAAG 4.16.5*)	☐	☐	☐
13.	Toilet stall doors are located diagonally opposite of water closet in accessible toilet stalls. *(ADAAG 4.17.3)*	☐	☐	☐
14.	Public use sinks (such as those in meeting rooms) are at the appropriate height and have sufficient knee space allowing for front approach. *(ICC/ANSI A117.1)*	☐	☐	☐
15.	Accessible counters are a minimum of 36” wide and a maximum of 36” high. Adequate knee space is provided for front approach at all accessible public transaction counters. *(ICC/ANSI A117.1)*	☐	☐	☐
16.	A paraphernalia shelf is provided at all accessible toilets. It is recommended that the shelf be located below the grab bar adjacent to the toilet. Commercial toilet tissue dispensers with an integral shelf (i.e. Bobrick B-2840) may be provided in lieu of a separate paraphernalia shelf. *(City of Phoenix DSD Amendments to Sec. IBC 1109.2)*	☐	☐	☐
17.	Where baby-changing tables are provided in multi-stall restrooms, they are not located in the accessible stall. The baby change station in any position (including the open position) does not impede the accessible route. (*ICC/ANSI A117.1*)	☐	☐	☐
18.	Truncated domes on curb ramps and adjacent to vehicular traffic are provided per Development Services guidelines. (*ADAAG 4.7.7*)	☐	☐	☐

PART 4. MCDI'S RECOMMENDATIONS FOR GREATER ACCESSIBILITY GOOD DESIGN AND/OR SAFETY

	Indicate if this project was able to go above and beyond by incorporating the following MCDI recommendations:	**Yes**	**No**	**N/A**
1.	Exceeded the minimum required accessible parking spaces.	☐	☐	☐
2.	All accessible routes through traffic areas are striped (i.e. crosswalks).	☐	☐	☐
3.	All accessible aisles from accessible parking are not in traffic routes.	☐	☐	☐
4.	Reserved accessible parking signs are mounted on the far side of a sidewalk and at a height (60" above finish floor/grade) where they cannot be obscured in order to be enforceable by the Phoenix Police Department. *(Proposed ADAAG update)*	☐	☐	☐
5.	The design is such that ramps and/or curb ramps have been avoided wherever possible along accessible routes.	☐	☐	☐
6.	Where sloped walkways and/or gradients occur, the maximum slope is 1:22, ensuring that the finish grade does not exceed the ADA maximum of 1:20. The maximum cross slope is designed at 1:55 (1.8%).	☐	☐	☐
7.	Provided non-continuous handrails extending 12" plus one tread width at bottom riser and 12" at top riser of stairs.	☐	☐	☐
8.	Family/unisex toilet rooms for public use include a baby-changing table and/or an adult-changing table, if applicable.	☐	☐	☐
9.	Hands-free faucets at accessible lavatories and other toilet room fixtures are provided.	☐	☐	☐
10.	A down light on separate dimmer circuit for sign language interpreter in any visual presentations that requires a darkened room has been provided. Large areas of glazing may make it difficult for a deaf person to be able to view a sign language interpreter in lighted rooms.	☐	☐	☐
12.	Toilet heights are 19" above finish floor. (Preferred)	☐	☐	☐

PART 5. COMMENTS AND EXPLANATIONS

Comment on any unique or unusual circumstances and/or conditions related to this project as it pertains to accessibility, code compliance, and/or MCDI's recommendations to go above and beyond the minimum code requirements. Attach a separate page to this checklist, if needed.

PART 6. DOCUMENTATION OF COMMITTEE'S RECOMMENDATIONS

City projects presented and/or review by the Architecture and Design Committee are required to document the Committee's recommendations and/or stipulations in the final construction documents. Documentation of the designer's response to the recommendations/stipulations will be in a format depicted in the sample table below and shall appear in the final construction drawing sheet containing the "Project Data" information.

Mayor's Commission on Disability Issues - Architecture and Design Committee

Recommendations/Stipulations Dated: January 12, 2006

No.	Description	Compliance		Reason for Non-compliance
		Yes	No	
1.	Remove 3" curb at accessible parking stall.	X		
2.	Sidewalks crossing driveways to have truncated domes.		X	City is not requiring domes within project boundaries.
3.	Adjust the height of accessible water closet to 19".	X		
4.	Adjust height of dispensers in restrooms.	X		

Checklist completed by: _____ **Date:**_____
City Project Manager/Dept.

Reviewed by:_____ **Date:**_____
MCDI Liaison

APPENDIX F – Integrated Automation Control of HVAC and Lighting Systems

City of Phoenix Guideline Specification
(Building Automation System)

Integrated Automation Control of HVAC

Note to Specifiers: This section is intended to provide a means to delineate the scope of work between the Division 23 contractor, typically the Mechanical Contractor and other divisions supplying products and services that will become part of the overall Building Automation System. This section must be closely coordinated with Division 25 and Division 26

PART 1 - GENERAL

1.1. Summary

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation System (BAS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

B. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

1.2. System Description

A. It is the Owner's express goal to implement an open, Wide Area Networked (WAN) Building Automation System (BAS) system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The Graphic User Interface (GUI) shall be Web based and shall provide a common operating platform for all integrated control systems. The work and products provided by the System Integrator are defined in Division 25 and are based on the Niagara Framework (or "Niagara"), a Java-based framework developed by Tridium. The work of the Division 23 contractor as it pertains to the Building Automation System (BAS) and integration with the Division 25 BAS is further defined herein.

B. The entire Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk and/or BACnet communication protocols provided under this Division to a Network Area Controller (NAC).

1.3. **General**

A. The Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices and other devices as specified herein. (i.e. lighting controls, etc)

B. The installed system shall provide secure password access to all features, functions and data contained in the overall BAS.

1.4. **Open, Interoperable, Integrated Architectures**

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135 BACnet and LonWorks technology communication protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet or RS-485 MSTP.

C. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using standard Microsoft® Internet Explorer Web browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

F. Maximum acceptable response times for devices and Graphic User Interfaces connected directly to the BAS network shall be as shown in the following table:

Note to Specifiers: The response times specified are for a typical HVAC control system. These need to be thoroughly reviewed and possibly changed for more critical systems such as fire and security or others.

System Function	Point of Origin to NAC	NAC to Point of Display or Control	Point of Origin to Point of Display or Control
Graphic display with 20 dynamic points/object and current data	5 seconds	5 seconds	10 seconds
Graphic refresh with 20 dynamic points/object and current data	5 seconds	5 seconds	10 seconds
End use device reaction to object command	5 seconds	3 seconds	8 seconds
End use device change of value	5 seconds	1 second	6 seconds
Alarm response time	5 seconds	1 second	6 seconds

G. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

1.5. **Networks**

A. The Local Area Network (LAN) shall be a 10/100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server. Coordinate with the Owner for connection to the LAN/WAN.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3
2. Cable; 10 Base-T, UTP-8 wire, category 5
3. Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

1.6. **Network Access**

A. Remote Access.

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

1.7. **Network Area Controller (NAC)**

A. The Division 25 contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided under Divisions 23 and 26. It is the responsibility of the Division 25 contractor to coordinate with the Division 23 and 26 contractors to determine the quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of LonWorks controller data and BACnet controller data
7. Network Management functions for all LonWorks based devices

C. The Network Area Controller must provide the following hardware features as a minimum:

1. One Ethernet Port 10/100 Mbps
2. One RS-232 port
3. One LonWorks Interface Port – 78KB FTT-10A
4. Battery Backup
5. Flash memory for long term data backup (Any NAC that utilizes a hard disk drive shall not be acceptable)
6. The NAC must be capable of operation over a temperature range of 0 to 50°C (32°F to 122°F)
7. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C (32°F and 158°F)
8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

E. The NAC shall support standard Microsoft® Internet Explorer Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

F. Event Alarm Notification and actions

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
    a. To alarm
    b. Return to normal
    c. To fault
4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

G. Control equipment and network failures shall be treated as alarms and annunciated.

H. Alarms shall be annunciated in any of the following manners as defined by the user:

1. Screen message text
2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
    a. Day of week
    b. Time of day
    c. Recipient
3. Pagers via paging services that initiate a page on receipt of email message
4. Graphic with flashing alarm object(s)
5. Printed message, routed directly to a dedicated alarm printer

6. Audio messages

I. The following shall be recorded by the NAC for each alarm (at a minimum):

1. Time and date
2. Location (building, floor, zone, office number, etc.)
3. Equipment (air handler #, accessway, etc.)
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

J. Alarm actions may be initiated by user defined programmable objects created for that purpose.

K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

L. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

M. Provide a “query” feature to allow review of specific alarms by user defined parameters.

N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

1.8. **Data Collection and Storage**

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

E. All log data shall be available to the user in the following data formats:

1. HTML
2. XML
3. Plain Text
4. Comma or tab separated values

F. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

1. Archive on time of day
2. Archive on user-defined number of data stores in the log (buffer size)
3. Archive when log has reached its user-defined capacity of data stores
4. Provide ability to clear logs once archived

1.9. **Audit Log**

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date
2. User ID
3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

1.10. **Database Backup and Storage**

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

C. The NAC database shall be stored, at a minimum, in XML format to allow for

user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

1.11. **Sql Database Support**

A. In addition to the standard databases provided as part of the Niagara Framework, the BAS shall have the capability to archive all data (such as log data, alarms, alerts and audit histories) to a Microsoft SQL Server database. This will enable the Owner with an SQL Server to utilize this resource for data archive storage as well as for other applications to have access to energy use or other data that is captured by the Network Area Controllers.

1.12. **Graphical User Interface Software**

A. Operating System:

1. The GUI shall run on Microsoft Windows 2000, or XP Professional.

B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

3. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

a. Create, delete or modify control strategies.

b. Add/delete objects to the system.

c. Tune control loops through the adjustment of control loop parameters.

d. Enable or disable control strategies.

e. Generate hard copy records or control strategies on a printer.

f. Select points to be alarmable and define the alarm state.

g. Select points to be trended over a period of time and initiate the recording of values automatically.

E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

F. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

H. Alarm Console

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

1.13. **Web Browser Clients**

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BAS, shall not be acceptable.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

6. Users shall have administrator-defined access privileges. Depending on

the access privileges assigned, the user shall be able to perform the following:

a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

1. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

2. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

c. View logs and charts

d. View and acknowledge alarms

e. Setup and execute SQL queries on log and archive information

7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

1.14. **Submittal**

A. Prior to the start of system installation, six copies of the following shall be submitted and approved:

1. Shop drawings of the entire control system and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system.

Terminal identification for all control wiring shall be shown on the shop drawings.

2. A complete written Sequence of Operation for all systems.

3. A complete point list of all connected points to the DDC system.

4. Control system Checkout and Testing and Demonstration forms developed in a format that fully documents the requirements as stated in

the Division 25 specification sections titled “Checkout and Testing” and “Demonstration”.

The forms shall include sections for any global or application programming performed by the Network Area Controllers.

5. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface included in the submittal. PICS to include for each product, as a minimum, a list of BACnet functional groups supported, BACnet services supported, BACnet data link options available and BACnet objects provided.

6. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device.

7. Graphic User Interface for day-to-day operations is intended to be developed by the BAS System contractor as part of the Division 25 work. However, should this project require local system graphics, the submittal shall also include a copy of each of the graphics developed for the local Graphic User Interface including a flowchart (site map) indicating how the graphics are intended to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner.

B. The Division 23 contractor supplying products and systems, as part of their submittal packages shall also provide one additional copy of their submittal package directly to the City of Phoenix.

C. Upon completion of the work, provide a complete set of ‘as-built’ drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ compatible files. Six copies of the ‘as-built’ drawings shall be provided in addition to the documents on compact disk.

1.15. **Division of Work**

A. The Division 23 contractor shall be responsible for all controllers (ILC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring, controller network wiring and Portable Operator’s Terminals and onsite workstation.

1.16. **Related Work Specified Elsewhere**

A. Division 26, Electrical:

1. Providing motor starters and disconnect switches (unless otherwise noted).

2. Power wiring and conduit (unless otherwise noted).

3. Provision, installation and wiring of smoke detectors (unless otherwise

noted).

4. Providing control devices and systems including but not limited to:
   a. Interoperable LonWorks Controllers and programming
   b. Interoperable BACnet Controllers and programming
   c. Control panels, devices and wiring
   d. Local controller and control device networks
   e. Independent system Portable Operator Terminals
   f. Lighting control panels (LCP)

1.17. Codes and Standards

See Chapter 1

1.18. Software License Agreement

A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

1.19. Ownership of Material

A. The Owner shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Network Area Controllers, Web server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the Owner.

1.20. Delivery, Storage and Handling

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.21. Job Conditions

A. Cooperation with Other Trades: Coordinate the Work of this section with that of

other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.22. **Quality Assurance**

A. The manufacturer of the HCS digital controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the HCS digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.23. **Specification Nomenclature**

A. Acronyms and other terms used in this specification are defined as follows:

AI: Analog Input

AO: Analog Output

ASCII: American Standard Code for Information Interchange

BACnet®: A data communication protocol for building automation and control networks. The rules governing this protocol are defined in ASHRAE/ANSI Standard 135.

BAS: Building Automation System

BI: Binary Input

BMP: The standard bit-mapped graphics format used in the Windows environment. By convention, graphics files in the BMP format end with a ".BMP" extension.

BO: Binary Output

Bridge: A device that connects two local-area networks (LANs), or two segments of the same LAN that use the same protocol, such as Ethernet or Token-Ring.

Client: The client part of a client-server architecture. Typically, a client is an application that runs on a personal computer or workstation and relies on a server to perform some operations. Clients rely on servers for resources, such as files, devices, and even processing power.

Client/Server Architecture: A network architecture in which each computer or process on the network is either a client or a server. Servers are powerful computers or processes dedicated to managing disk drives (file servers), printers (print servers), or network traffic (network servers). Clients are personal computers or workstations on which users run applications. Client-server

architectures are sometimes called two-tier architectures.

DDC: Direct Digital Control. The digital algorithms and pre-defined arrangements included in the control system software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

DDE: Dynamic Data Exchange

Ethernet: A local area network (LAN) technology that is probably the most prevalent in the world today due to its common usage in standard office networks. Due to its transmission speeds (10 Mbps) or Fast Ethernet (100 Mbps), most BAS control manufacturers offer Ethernet as an option for connecting their workstations and system controllers on the LAN. Ethernet can be implemented over several different types of network media including unshielded twisted-pair (UTP), coaxial cable, and fiber optic cable. (Ethernet is also known as ISO8802-3).

Firewall: A system designed to prevent unauthorized access to or from a private network. Firewalls can be implemented in both hardware and software, or a combination of both. Firewalls are frequently used to prevent unauthorized Internet users from accessing private networks connected to the Internet, especially intranets. All messages entering or leaving the intranet pass through the firewall, which examines each message and blocks those that do not meet the specified security criteria.

Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the Contractor’s cost to the designated third party trade contractor for installation. The Contractor shall connect furnished items to the system, calibrate, test, verify, warrant and document.

GIF: Graphics Interchange Format. A bit-mapped graphics file format. GIF supports color and various resolutions. It also includes data compression, but because it is limited to 256 colors, it is more effective for scanned images such as illustrations rather than color photos. By convention, graphics files in the GIF format end with a “.GIF” extension.

GUI: Graphical User Interface

HCS: HVAC Control System

Hub: A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

HTML: HyperText Markup Language. An internet programming language that defines the internet pages we look at and provides a common model for data representation.

HTTP: HyperText Transfer Protocol, the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands.

IBC: Interoperable BACnet Controller

ILC: Interoperable LonWorks Controller

Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.

Integration: The ability to link disparate control system devices into a cohesive Building Automation System.

Interoperability: The ability of disparate control system devices to work together toward a common objective through the exchange of information.

Intranet: A network based on TCP/IP protocols (an internet) belonging to an organization, accessible only by the organization's members, employees, or others with authorization. An intranet's Web sites look and act just like any other Web sites, but the firewall surrounding an intranet fends off unauthorized access.

IP: Internet Protocol. IP specifies the format of packets, also called datagrams, and the addressing scheme. Most networks combine IP with a higher-level protocol called Transmission Control Protocol (TCP), which establishes a virtual connection between a destination and a source.

Java: A high-level programming language developed by Sun Microsystems. Compiled Java code can run on most computers because Java interpreters and runtime environments, known as Java Virtual Machines (VMs), exist for most operating systems, including UNIX, the Macintosh OS, and Windows. Java is a general purpose programming language with a number of features that make the language well suited for use on the World Wide Web.

Java Applet: Small Java applications that are typically downloaded from a Web server and run on your computer by a Java-compatible Web browser, such as Netscape Navigator or Microsoft Internet Explorer.

JPEG: Joint Photographic Experts Group. JPEG is a glossy compression technique for color images. Although it can reduce files sizes to about 5% of their normal size, some detail is lost in the compression. By convention, graphics files in the JPEG format end with a ".JPG" extension.

LAN: Local Area Network. A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via the Internet, telephone lines, and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

LonMark™: A set of protocol rules and practices that has been developed and approved by a group of manufacturers that use the "Neuron" processor chip

developed by the Echelon Corporation. LonMark is also the mark awarded to devices which implement the profile for their specific device type.

LonTalk®: A local area network (LAN) technology created by the Echelon Corporation. Its speed is scaleable (32Kbps to 1.25Mbps) and is comparable to MS/TP on the low end and ARCNET on the high end. LonTalk will typically be used for application specific controller networks. LonTalk can be implemented over several different types of network media including unshielded twisted-pair (UTP) or Free Topology (FTT-10a), coaxial cable, fiber optic cable, radio frequency (RF), and infrared (IR). (LonTalk is also known as EIA-709.1)

LonWorks®: An encompassing term that includes the LonTalk communications protocol, devices that use the LonTalk protocol (LonMark devices) and the network on which the devices reside.

MSTP: Master Slave Token Passing. A local area network (LAN) technology created by ASHRAE and unique to BACnet. Its speed (approximately 76Kbps) is slower than Ethernet and ARCNET, but it is the lowest cost LAN option for BACnet. The maximum delay before a device is able to transmit a message can be determined. Many BAS control manufacturers utilize MSTP for their application specific controller networks. MSTP is implemented using EIA-485 signaling and can be used in a master-slave mode, a peer-to-peer token passing mode, or a combination of the two.

Media: The physical network wiring that is used to transmit data. Typical media includes unshielded twisted-pair (UTP) wiring, coaxial cables, and fiber optic cables.

NAC: Network Area Controller

ODBC: Open Database Connectivity. A standard database access method developed by Microsoft Corporation. The goal of ODBC is to make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data. ODBC manages this by inserting a middle layer, called a database driver, between an application and the DBMS. The purpose of this layer is to translate the application's data queries into commands that the DBMS understands. For this to work, both the application and the DBMS must be ODBC-compliant -- that is, the application must be capable of issuing ODBC commands and the DBMS must be capable of responding to them. Since version 2.0, the standard supports SAG SQL.

OLE: Object Linking and Embedding. OLE is a compound document standard developed by Microsoft Corporation. It enables you to create objects with one application and then link or embed them in a second application. Embedded objects retain their original format and links to the application that created them.

OOT: Object Oriented Technology

OPC: Object Linking and Embedding (OLE) for Process Control. This is a communication protocol utilizing Microsoft Windows NT client/server technology and Component Object Module (COM) and Distributed COM software

architecture. It uses Ethernet TCP/IP message transportation.

Peer-to-Peer Architecture: A type of network in which each workstation has equivalent capabilities and responsibilities. This differs from client/server architectures, in which some computers are dedicated to serving the others. Peer-to-peer networks are generally simpler, but they usually do not offer the same performance under heavy loads.

PICS: Product Interoperability Compliance Statement

POT: Portable Operator's Terminal

Protocol: An agreed-upon format for transmitting data between two devices. The protocol determines; 1) the type of error checking to be used, 2) data compression method, if any, 3) how the sending device will indicate that it has finished sending a message, and 4) how the receiving device will indicate that it has received a message.

Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, verify, warrant, document and supply the associated required services ready for operation.

Router: A device utilized to join two or more networks together. A router has the capability of joining together networks that use different Local Area Network (LAN) technologies such as a BACnet Ethernet LAN with a BACnet MSTP LAN. The router forwards data packets along networks and use headers and forwarding tables to determine the best path for forwarding the packets.

Server: A computer or device on a network that manages network resources. For example, a file server is a computer and storage device dedicated to storing files. Any user on the network can store files on the server. A print server is a computer that manages one or more printers, and a network server is a computer that manages network traffic. A database server is a computer system that processes database queries.

SQL: Structured Query Language. SQL is a standardized query language for requesting information from a database. Historically, SQL has been the favorite query language for database management systems running on minicomputers and mainframes. Increasingly, however, SQL is being supported by PC database systems because it supports distributed databases (databases that are spread out over several computer systems). This enables several users on a local-area network to access the same database simultaneously.

TCP: Transmission Control Protocol. TCP is one of the main protocols in TCP/IP networks. Whereas the IP protocol deals only with packets, TCP enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent.

TCP/IP: Transmission Control Protocol/Internet Protocol. The suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP. TCP/IP is used by the

Internet, making it the de facto standard for transmitting data over networks.

Thick Client: In a thick client/server architecture, the client does the majority of the processing.

Thin Client: In a thin client/server architecture, most of the processing is handled by the server and all the browser has to do is process the display.

UPS: Uninterruptible Power Supply.

Virtual Point: A point of information that is generated as a software value rather than the value being generated by an actual hardware device.

WAN: Wide Area Network. A computer network that spans a relatively large geographical area. Typically, a WAN consists of two or more local-area networks (LANs).

WBI: Web Browser Interface

XIF File: The external interface file created in Neuron C defining the LonMark product's network variables, message tags, and hardware related parameters.

XML: Extensible Markup Language. A technology for moving structured data across the internet or a corporate network. Unlike HTML, XML documents include more than just raw data by including a definition of the data structure, so the receiving computer knows what information is contained in which fields.

PART 2 - MATERIALS

2.1. General

A. The Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers and other devices as specified herein.

2.2. Open, Interoperable, Integrated Architectures

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135 BACnet and LonWorks technology communication protocols.

2.3. Interoperable Lonworks® Controller (ILC)

A. Controls shall be microprocessor based Interoperable LonMark or LonWorks Controllers (ILC). Where possible, all Interoperable LonWorks Controllers shall bear the applicable LonMark interoperability logo on each product delivered.

B. HVAC control shall be accomplished using LonMark based devices where the application has a LonMark profile defined. Where LonMark devices are not

available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device to the City of Phoenix. Publicly available specifications for the Applications Programming Interface must be provided to the City of Phoenix for each LonWorks / LonMark controller defining the programming or setup of each device. The Division 23 contractor shall provide all programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation.

C. The Division 23 contractor shall run the LonWorks network trunk to the nearest Network Area Controller (NAC). Coordinate locations of the NAC with the Division 25 contractor to ensure that maximum network wiring distances, as specified by the LonWorks wiring guidelines, are not exceeded. A maximum of 126 devices may occupy any one LonWorks trunk and must be installed using the appropriate trunk termination device. All LonWorks and LonMark devices must be supplied using FTT-10A LonWorks communications transceivers.

D. The ILCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The ILC shall provide LED indication of communication and controller performance to the technician, without cover removal.

E. All ILCs shall be fully application programmable and shall at all times maintain their LonMark certification, if so certified. All control sequences within or programmed into the ILC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

F. The Division 23 contractor supplying the ILC's shall provide documentation for each device, with the following information at a minimum:

1. Network Variable Inputs (nvi's); name and type
2. Network Variable Outputs (nvo's); name and type
3. Network configuration parameters (nci, nco); name and type

G. It is the responsibility of the Division 23 contractor to ensure that the proper Network Variable Inputs and Outputs (nvi and nvo) are provided in each ILC, as required by the point charts.

H. The supplier of any programmable ILC shall provide one copy of the manufacturer's programming tool, with documentation, to the Owner.

2.4. **Interoperable BACnet Controller (IBC)**

A. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with ANSI/ASHRAE Standard 135. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. The system supplier must provide a PICS document showing the installed systems compliance level to ANSI/ASHRAE Standard 135. Minimum compliance is Level 3.

B. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10 Mbps.

C. All IBCs shall at all times maintain their BACnet Level 3 compliance. All control sequences within or programmed into the IBC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

D. The Division 23 contractor supplying the IBC's shall provide documentation for each device, with the following information at a minimum:

1. BACnet Device; MAC address, name, type and instance number
2. BACnet Objects; name, type and instance number

E. It is the responsibility of the Division 25 contractor to ensure that the proper BACnet objects are provided in each IBC, as required by the point charts.

Note to specifiers: Specifications for computers change on a regular basis. The following specifications for the Portable Operator's Terminal, and site workstation should be reviewed and updated prior to each new project.

2.5. Site Workstation by Division 23 Contractor

A. Hardware Requirements: The server hardware platform shall have the following requirements:

1. The workstation shall be an IBM compatible, Pentium based computer with the following minimum configuration:
   a. 3.0 Ghz processing speed
   b. 1.0 GB RAM
   c. 120-gigabyte hard drive 7200 RPM
   d. 48X DVD-CDRW combination drive
   e. 1.44 MB 3.5 inch floppy drive
   f. 2-parallel ports
   g. 2-asynchronous serial ports
   h. 2-USB ports
   i. 17"flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time
   j. 104 key keyboard
   k. optical mouse with scroll wheel
2. Connection to the BAS network shall be via an Ethernet network interface card, 10/100 Mbps.

3. The workstation operating system shall be Microsoft Windows 2000 or XP Professional. Include Microsoft Internet Explorer 6.0 or later.

4. A system printer shall be provided. Printer shall be laser type with a minimum 1200 x 1200-dpi resolution and rated for 14 PPM print speed minimum. The printer shall be capable of printing wide format (11”x17”) paper.

5. For dedicated alarm printing, a dot matrix printer, either 80 or 132 column width. The printer shall have a parallel port interface.

2.6. Portable Operator’s Terminal

A. The Division 23 Contractor shall provide one Portable Operator’s Terminal (POT) for the HVAC Control System. The POT shall be complete with all vendor specific software necessary for programming and day to day operation of the system. The POT is intended to provide a text based interface only. The Graphical User Interface is specified as part of Section 1.12.

B. The POT hardware shall be based on currently available products at the time of bid and have the following minimum requirements:

1. An IBM compatible laptop computer with 15” (viewable) minimum screen size

2. Processing speed in the upper 50% of currently available products from Dell

3. 512 MB RAM

4. Hard drive size and speed in the upper 50% of currently available products from Dell

5. CDRW combination drive

6. 1.44 MB 3.5 inch floppy drive

7. 2-parallel ports

8. 2-asynchronous serial ports

9. 2-USB ports

10. Standard keyboard with built-in mouse device

11. Connection to the BAS network shall be via an Ethernet network interface card, 10/100 Mbps.

Note to specifiers: Specifications for other control system devices, sensors, actuators, etc. can be inserted here.

2.7. Other Control System Hardware

Note to specifiers: Specifications for project execution can be inserted here. Items covered should include installation, training, documentation, warranty, acceptance

testing and, if desired, system commissioning.

PART 3 - EXECUTION

3.1. Installation

A. All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems. The installing office shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience.

B. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Owner for resolution before rough-in work is started.

C. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Owner for resolution before rough-in work is started.

D. Drawings of BAS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Owner shall be furnished and installed without additional cost.

3.2. Equipment Protection

A. The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for its work and equipment until finally inspected, tested and accepted.

3.3. Wiring

A. All electrical control wiring and power wiring to the NAC and other equipment provided by the Division 23 contractor shall be provided by the Division 26 contractor.

B. Providing and maintaining the Ethernet backbone and all necessary connectors, repeaters, bridges, hubs, and routers. It is anticipated that there will be one open RJ-45 jack located in each mechanical room to facilitate the connection of a Portable Operator's Terminal to the Ethernet backbone for purposes of troubleshooting and maintenance of the mechanical room equipment.

3.4. Warranty

A. Following acceptance testing, the Division 23 contractor shall be responsible for all initial troubleshooting when a system problem arises in the integrated control system. Upon initial checkout, if the problem cannot be determined and resolved, it may require temporary isolation of the Building Automation System (BAS) from the Network Area Controller. If temporary system isolation remedies the problem, then the Division 23 contractor will need to work together in harmony with the Division 25 System Integrator to diagnose and resolve the problem to ensure that the system is functioning in full accordance with these specifications.

B. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

C. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Division 23 contractor at no expense to the Owner

3.5. **Warranty Access**

A. The Owner shall grant to the Division 23 contractor, reasonable access to the BAS during the warranty period. The Owner shall also allow the contractor to access the BAS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.6. **Checkout and Testing**

A. The Division 23, 25, and Division 26 contractors are to coordinate the Checkout and Testing of their systems.

B. The Checkout and Testing process shall utilize checklists and forms developed by the Division 23 and Division 26 contractors and previously defined under the section titled “Submittal” in Division 23 and Division 26 to document the testing results. The approved checklists and forms shall be completed for all points and systems during Checkout and Testing.

C. The Division 23 and Division 26 contractors shall perform tests to verify proper performance of components, routines, and points provided under their Division. Repeat tests until proper performance results. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

D. Division 23 and Division 26 Start-up Testing: All testing listed in this article shall be performed by the Division 23 and Division 26 contractors and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner’s Representative is notified of the system Demonstration. For all control devices and programming provided by the Division 23 and Division 26 contractors, the contractors shall:

1. Furnish all labor and test apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment furnished

under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults and verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations or as otherwise specified.

4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

5. Verify that all analog output devices (electric/pneumatic transducers, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Division 23 contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Division 23 contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify that the system adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules.

7. Tune all DDC loops.

E. Division 23 Start-up Testing: All testing listed in this article shall be performed by the Division 23 contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's Representative is notified of the system Demonstration. For all control devices and programming provided under Division 23, the contractor shall:

1. Furnish all labor and test apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults and verify that terminations are tight.

3. Verify that any global control strategies and application programs resident within the Network Area Controllers adhere to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules.

4. Alarms and Interlocks:

   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.7. **Demonstration**

A. The Division 23 and Division 26 contractors are to coordinate the Demonstration of the system such that each Division has a representative present during the activities.

B. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and demonstrate compliance with this specification. The Demonstration shall occur after the Division 23, and Division 26 have completed their tests as defined under “Checkout and Testing”. The Owner’s Representative shall be present to observe and review the Demonstration.

C. The Demonstration process shall utilize the forms and follow the processes previously defined as part of the Division 23 and Division 26 contractor submittals. The approved checklists and forms shall be completed for all systems as part of the Demonstration.

D. The Division 23 and Division 26 contractors shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including, but not limited to; day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Division 23 and Division 26 contractors.

E. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.

F. Demonstrate compliance with sequences of operation through all modes of operation.

G. Additionally, the following items shall be demonstrated:

1. DDC Loop Response. The Division 23 contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the appropriate Division 15 or Division 16 contractor.

2. Demand Limiting. The Division 23 contractor shall supply a trend data output showing the action of any demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-

minute period. Included in the trend shall be building kW, demand limiting setpoint, and the status of sheddable equipment outputs.

3. Optimum Start/Stop. The Division 23 contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

4. Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the engineer and Owner's Representative. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in a printed graphical format.

H. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Division 23, and Division 26 contractors shall be responsible for any necessary repairs or revisions to the hardware or software they each have provided to successfully complete all tests.

3.8. System Acceptance

A. All tests described in this specification shall have been performed to the satisfaction of both the Owner's Representative prior to the acceptance of the control system. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the Owner's Representative. Such tests shall then be performed as part of the warranty.

B. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved by the Owner's Representative.

3.9. Operator Instruction, Training

A. Upon the first installation of the BAS GUI, the Division 23 contractor shall provide instruction to the Owner's designated personnel on the operation of the BAS and all system integration equipment. Subsequent to that first installation, it is intended that the Owner's operating personnel will be familiar enough with the system to assist with any training issues that may arise for the Division 15 contractor operating the Graphic User Interface with which they may have less familiarity.

B. During system commissioning and at such time acceptable performance of the BAS hardware and software has been established the Division 23 contractor shall provide on-site operator instruction to the Owner's operating personnel. Division 23 training may utilize the Graphic User Interface as necessary but should focus mainly upon the equipment and systems provided as part of Division 23.

Note to specifiers: Project specific training requirements should be included here.

3.10. **Record Documentation**

A. Three copies of the Operation & Maintenance manuals for work provided under this Division shall be provided to the Owner upon completion of the project. These manuals shall be updated each time changes are made to the system. The entire Operation & Maintenance manual shall be furnished in three-ring binders with adequate indexing and also on compact disc media, and shall include the following:

1. Table of contents.
2. As-built system record drawings. Record drawings in AutoCAD format shall represent the as-built condition of the system and incorporate all information supplied with the approved submittals. These shall include sequences of operation and a complete I/O point summary.
3. Manufacturer's product data sheets for all products including software.
4. System operator's manuals.
5. Complete network diagrams that also indicate connections to the BAS Wide Area Network.
6. Wiring termination schedules.
7. Copies of all completed forms for control system Checkout and Testing and Demonstration activities including hard copies of all trend log graphs.
8. Archive copy of all controller databases (on compact disk only).

Note to specifiers: Put the required sequences of operation in this part.

PART 4 - SEQUENCES OF OPERATION

4.1. **Summary**

A. For each system listed, provide the sequence of operation as stated.

Note to specifiers: I/O Summary tables must be developed to provide a clear understanding of what points are to be provided in the user interface and what they must be able to do. For each building system to be included, list the points that are to be accessible through the Network Area Controller and the actions the Graphical User Interface and/or the Web browser interface must support. An example table has been provided as a suggested format and to identify the minimum information that is required. Each table should represent a single system. In each table, enter the name of the system, the points desired, and place an "X" in the column indicating the required functionality.

PART 5 - POINT LISTS

5.1. Summary

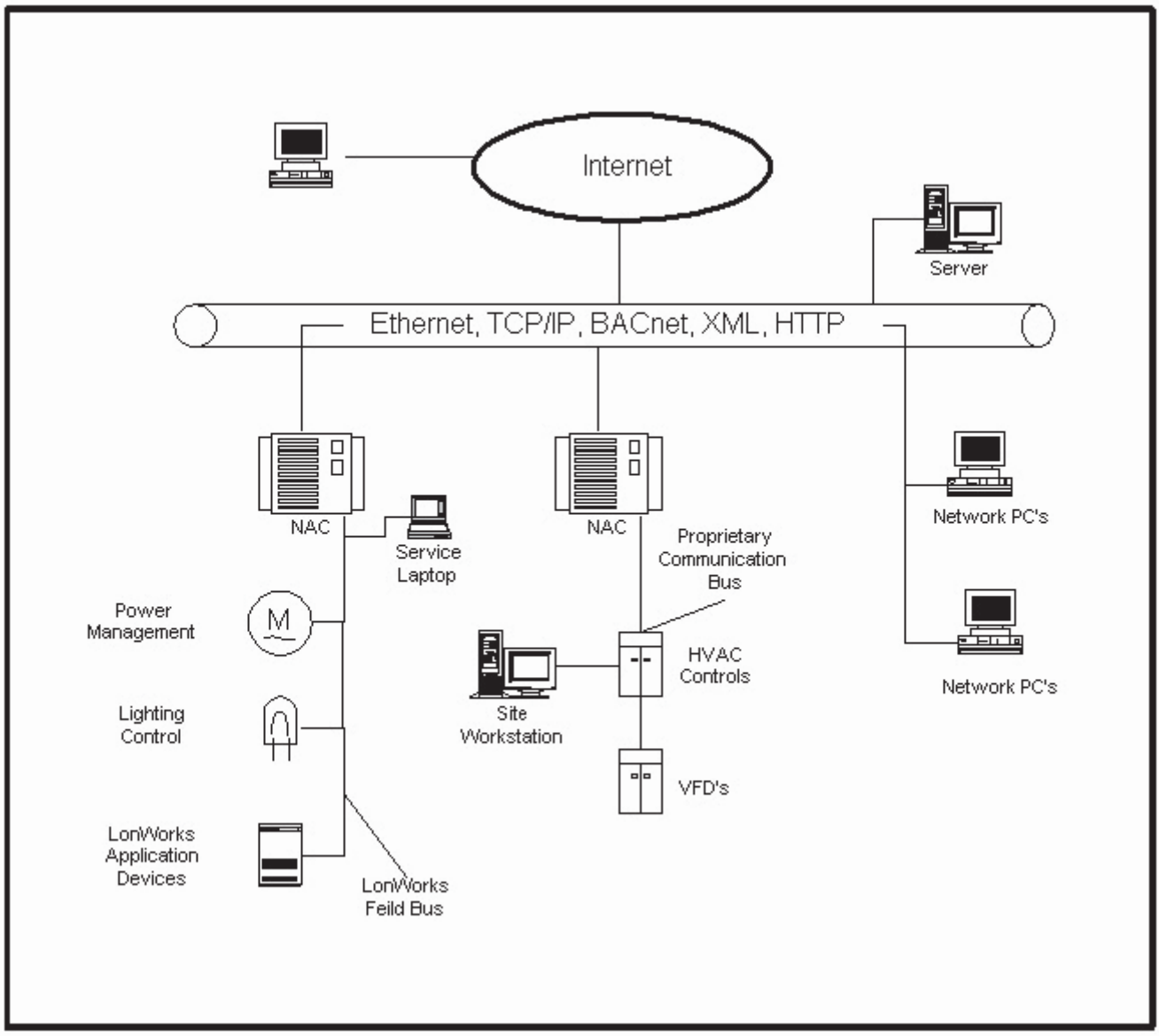
A. The points in the following table shall be accessible from the Graphical User Interface (GUI) and/or the Web browser interface (WBI), supplied under Division 23. The supplier of the ILC and IBC devices shall ensure that the points listed in this table are accessible on their respective networks, by the Network Area Controller (NAC). (The following table is presented as a suggested format and to indicate the minimum required information.)

Network Area Controller (NAC) Global Control Functions and I/O Summary

	Application Programs							
System Description	**Demand Limiting**	**Optimum Start/Stop**	**Setback/ Setup**	**Night Purge**	**Duty Cycling**	**Custom?**		
AHU-1	X	X	X					
Point Description	**Point Type**	**Units**	**Default Value**	**Read**	**Write**	**Alarm**	**Trend Interval**	**Schedule**
Supply Fan Start/Stop	BO	On/Off	Off	X	X			X
Supply Fan Status	BI	On/Off		X		X		
Return Fan Start/Stop	BO	On/Off	Off	X	X			X
Return Fan Status	BI	On/Off		X		X		
Supply Fan Static Pressure Setpoint	AO	in. H_2O	1.0 in. H_2O	X	X			
Supply Fan Static Pressure	AI	in. H_2O		X		X	5 min	
Supply Fan VSD Speed	AO	% Speed	20%	X	X		5 min	
Supply Fan kW	AI	kW		X			15 min	
Supply Fan Runtime	VI	Hours		X		X		
Building Static Pressure Setpoint	AO	in. H_2O	0.1 in. H_2O	X	X			
Building Static Pressure	AI	in. H_2O		X		X	5 min	
Return Fan VSD Speed	AO	% Speed	20%	X	X		5 min	
Return Fan kW	AI	kW		X			15 min	
Return Fan Runtime	VI	Hours		X		X		
Return Air Temp	AI	deg F		X		X	15 min	
Return Air Relative Humidity	AI	% RH		X		X	15 min	
Return Air CO_2 Setpoint	AO	PPM	800 PPM	X	X			
Return Air CO_2	AI	PPM		X		X	15 min	
Return Air Smoke Detector	BI	Nrm/Alm		X		X		
Outside Air Damper Position	AO	% Open	0%	X	X		15 min	
Outside Air Flow	AI	CFM		X		X	15 min	
Air Filter Status	BI	Nrm/Alm		X		X		
Mixed Air Temp	AI	deg F		X		X	15 min	
Supply Air Temp Setpoint	AO	deg F	55 deg F	X	X			
Supply Air Temp	AI	deg F		X		X	15 min	
Supply Air Smoke Detector	BI	Nrm/Alm		X		X		
Cooling Valve Position	AO	% Open	100%	X	X		15 min	
Heating Valve Position	AO	% Open	0%	X	X		15 min	

(*The following flowchart is presented as a typical system layout.)*

Global Control Functions Summary



END OF SECTION

APPENDIX G – Supplement to Chapter 15 - Mechanical

This supplemental language to Chapter 15 – Mechanical is intended for the use of the designing engineer for review and consideration, and may be incorporated into the construction documents at the discretion of the Engineer of Record. Some of the items are preferred and/or recommended on City projects. The designing engineer/consultant should review these with the Project Manager and the systems maintenance staff.

1. **Abbreviations**

AGA	American Gas Association
AISI	American Iron and Steel Association
AGA	American Gas Association
AISI	American Iron and Steel Association
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration & Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing & Materials
AWWA	American Water Works Association
BPVC	Boiler & Pressure Vessel Codes of ASME
CISPI	Cast Iron Soil Pipe Institute
NFPA	National Fire Protection Association
SMACNA	Sheet Metal & Air-Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories, Inc.

2. **Regulations and Codes**

All designs, work, materials and equipment shall comply in all respects with the requirements of the Federal, County, City and State of Arizona applicable ordinances, regulations and codes. In addition, the following published standards shall be adhered to as well as the City of Phoenix Building Standards:

Latest adopted issue of the International Mechanical Code and City of Phoenix Amendments
Latest adopted issue of the State of Arizona Plumbing Code and State Amendments
Latest adopted issue of the International Building Code and City of Phoenix Amendments
Current City of Phoenix Water Services Design Standards for Water & Wastewater Systems
Latest issue of the ASHRAE Guidelines
Latest issue of the SMACNA Standards
Applicable NFPA Pamphlets
American Standards Association Code for Mechanical Refrigeration (ASA)

Occupational Safety and Health Act

None of the noted code items of this section shall be construed to relieve the design engineer or contractor from complying with any requirements of the contract documents that may be in excess of the above and not contrary to same. Where the noted codes may conflict with one another, the code with the more stringent requirements shall apply.

3. **Instruction of Owner's Employees**

The Contractor shall furnish, without expense to the City, the services of competent instructors, who will give full instructions in the care, adjustment and operation of all parts of the mechanical systems and equipment to the City's employees who are to have charge of the equipment.

Each instructor shall be thoroughly familiar with all parts of the installation on which they are to give instructions and shall have full knowledge of the operating theory and practical operation-maintenance work. Instructions shall be given during the regular work week at a specific time mutually agreed on between the Contractor and City, and after the building has been accepted and turned over to the City for regular operation.

4. **Operating Manuals**

Prior to the completion of a project the Contractor shall provide to the City at least three sets of maintenance manuals, operating manuals, parts manuals, as-built and shop drawings of all equipment installed and covered in this section.

Operating Manual shall include, but not be limited to, the following:

- Catalog cuts of all major equipment items.
- Operation instructions for each major item.
- Periodic maintenance instructions for each major item.
- All other pertinent data required.

As a condition to final payment, the Contractor shall submit to the project Architect/Engineer a certificate signed by the City attesting to the fact that the instructions required have been given, that all systems have been placed into operation and that Operating and Maintenance Instructions have been given by this Contractor and received and understood by the Owner.

5. **Unlisted Equipment**

Each appliance shall be approved for safe use or comply with applicable nationally standards as evidenced by the listing and label of an approved agency. The permanently attached label of an approved listing agency may be accepted as such

evidence. Installers shall also furnish satisfactory evidence that the appliance is constructed in conformity with the requirements of the code.

Gas fired appliances, which are proposed, or found to not be listed and labeled by an approved listing agency shall have Special Inspection, be evaluated by a qualified Arizona registered professional engineer and have an Engineers Report provided prior to final acceptance by the City of Phoenix.

The installing Contractor shall employ a qualified Arizona registered professional engineer to evaluate the unlisted gas fired appliance and its installation, and prepare an Engineers Report which finds the equipment and installation to be in compliance with the Phoenix Mechanical Code; all applicable nationally recognized construction and installation standards; and declares the installation to be presently be in a "safe operational condition".

6. **Engineer or Architect Responsibility**

- Identify on the proposed construction drawings the location, make, model and, CFH of the proposed unlisted appliance.
- On the proposed construction plans show compliance with the mechanical code for the gas fired appliance in regards to combustion air, products of combustion venting, clearances to combustibles, exhaust and make-up air requirements and any other feature as governed by applicable codes.
- Denote on the proposed construction drawings that "Special Inspection shall be provided for the unlisted gas fired appliance(s) and an Engineers Report shall be provided to the City of Phoenix Mechanical Field Inspector, prior to final inspection finding the equipment and its installation to be in compliance with the UMC; all applicable nationally recognized construction and installation standards; and declaring the installation to presently be in a 'safe operational condition'".
- The Contractor, Engineer, or Architect shall identify in writing who the special inspector shall be and complete a Mechanical and Plumbing Special Inspections Certificate which shall be attached to the approved construction plans and provided with the Final Report.

7. **Special Inspector Responsibility**

- Review the approved mechanical and building construction drawings.
- The Engineer performing the evaluation of the equipment and who is to be responsible for the Engineers Report shall request in writing a temporary gas clearance for testing purposes of the unlisted gas fired appliance. The request must identify the project address, project name, name of person requesting the temporary gas clearance, appliance(s) to be evaluated, duration of time the gas shall be made available for testing purposes, and the name of the special inspector or engineer evaluating of the equipment. The temporary gas clearance letter shall be signed and sealed by the engineer who will be responsible for the

signing and sealing the final engineers report letter.

- Inspect, test and verify that the installation of the unlisted gas fired appliance has been installed per the manufacturer installation instructions, the approved construction drawings and all applicable national standards as are applicable to the appliance.

8. **Final Report:**

Reports which are submitted to the building official, as an alternative to a listing agency approval for those products or equipment which require approval, are not acceptable unless they provide at least the following:

- Date issued.
- Address at which the product or equipment is installed.
- General description of the product or equipment which is the subject of the report.
- Proposed objective to be achieved as a result of this examination.
- Data plate information which shall include at least the following:
  Manufacturer's name
  Model and serial number
  Type of fuel for fuel burning devices - input/output ratings
  Electrical rating - volts, amps, phase (if applicable)
  Operating pressures (if applicable)
- Listing of specific test criteria:
  ASTM Standards
  ANSI Standards
  UL Standards
  AGA Standards
  Other Standards
- Description of specific tests performed.
- Evaluation of the product examined, including recommendations regarding correction of deficiencies if appropriate, or a statement (as per below) that the device was in compliance with all applicable standards at the time of examination.
- Submit drawings or photograph of the equipment of which this report addresses.

Prior to concealment and/or final inspection, the Engineers Report shall be provided to the City of Phoenix Mechanical Inspector that is signed and sealed by the Engineer or Architect performing the Special Inspection certifying that:

"The equipment installation addresses by this report is provided with sufficient combustion and secondary air, has all combustion products removed to a safe and code compliant point of discharge, and included appropriate pre-purge cycling (as required), interlocking of required make-up or exhaust blowers with the fuel train, and has functioning safety devices which satisfy the requirements of ANSI, ASME, AGA, UL, FM, or other applicable equipment construction or installation standards.

In my professional opinion this installation is presently in a safe operational condition."

The Special Inspection/Engineers Report shall be received and found to be acceptable by the City of Phoenix Mechanical and/or Building Inspector(s) prior to the City of Phoenix issuance of final inspection approval or occupancy approval, including conditional occupancy approval.

A copy of the original, or revised, Mechanical and Plumbing Special Inspections Certificate shall be attached to the final report.

9. **Substitution of Equipment or Materials**

Bids shall be based on the exact materials specified, or of materials which have been accepted as equivalent. Specified products used in the design of the project and preparation of the drawings and specifications shall establish the minimum standards of function, dimension, appearance and quality necessary and requisite for the project, of which substitutes must meet to be considered acceptable. The burden of proof of equality rests with the party making the request. Requests for substitution shall be in writing and shall be received by the Project Engineer or Architect not later than seven (7) days before bid opening date. Materials not specified or accepted as equivalent shall not be acceptable for installation.

The installing Contractor shall pay, provide, install and be responsible for extra materials required by himself or any other trade due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. The Contractor shall pay other trades for any extra work they are involved in due to this substitution of equipment. They shall also be responsible and shall pay for all redesign work associated with the installation requirements of the substituted equipment, providing either revised drawings or sketches prepared by them or the Engineer. All redesign work shall be accepted by the Project Architect/Engineer.

10. **Painting**

Ventilation Subcontractor shall paint all ductwork visible from a normal viewing position behind registers, grilles and diffusers with one coat dull, black, flat paint.

11. **Insulation for Mechanical Systems**

The work covered by this specification consists of furnishing all labor, equipment, and materials for the installation of all insulation for the plumbing, heating, and air conditioning systems.

General Requirements: Insulation work may be performed whenever the Contractor elects after tests and approvals of the piping or ductwork systems have

been completed, with the understanding that should defects develop or damage occur for whatever reason, the insulation shall be removed and new insulation installed without expense to the City.

Insulation shall be applied on clean, dry surfaces. All joints shall be snugly butted against the adjoining piece and all joints, seams, voids, flat spots, etc., shall be filled with insulating cement.

Where double layers are installed, the first layer shall be fastened with binding wire. All joints shall be staggered between the two layers.

Insulation on all cold surfaces (operating temperatures below 70^{o}F) must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, and etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.

All insulation materials shall be installed in strict accordance with manufacturer's instructions, using recommended adhesives, mastics and coatings applied at specified coverage per gallon and temperature conditions.

12. **Work to be Insulated**

Insulate the following piping and ductwork:

13. **Piping**

All domestic cold water piping.
All domestic hot water and recirculation piping.
All heat pump inlet and outlet piping.
All hot water heating supply and return piping.
All chilled water piping
All refrigerant suction piping
Other piping as directed per plans.

14. **Ductwork**

See “ACOUSTICAL DUCT LINING” Section for duct liner specification, for those systems indicated to be internally insulated. All rectangular ductwork shall be internally insulated. All round ductwork shall be externally insulated.

15. **PIPING SYSTEMS - Insulation for Plumbing Systems**

DOMESTIC COLD, HOT AND RECIRCULATING WATER PIPING:

Pipes 1" and smaller	1" thick fiberglass w/ scrim kraft jacket or

	½'' black foam Rubatex, Armaflex or equal
Pipes 1-1/4" and larger	1" thick fiberglass w/ scrim kraft jacket

INSULATION FOR HOT WATER HEATING PIPING:

Hot Water Supply and Return Piping:

Pipes 1" and smaller	1" thick fiberglass w/ scrim kraft jacket
Pipes 1-1/4" through 2"	1" thick fiberglass w/ scrim kraft jacket
Pipes 2-1/2" through 4"	1-1/2" thick fiberglass w/ scrim kraft jacket

INSULATION FOR REFRIGERANT SUCTION PIPING:

Hot Water Supply & Return Piping:

Pipes 1" and smaller	1" thick fiberglass w/ scrim kraft jacket
Pipes 1-1/4" through 2"	1" thick fiberglass w/ scrim kraft jacket
Pipes 2-1/2" through 4"	1-1/2" thick fiberglass w/ scrim kraft jacket

Chilled Water Supply & Return Piping:

Pipes 1" and smaller	1/2" thick fiberglass w/ scrim kraft jacket
Pipes 1-1/4" through 2"	1" thick fiberglass w/ scrim kraft jacket
Pipes 2-1/2" through 4"	1-1/2" thick fiberglass w/ scrim kraft jacket

INSULATION FOR REFRIGERANT SUCTION PIPING:

Pipe Insulation Materials:

Pipes 1-1/8" and less	1" thick fiberglass w/ scrim kraft jacket
Pipes 1-1/4" through 4"	1-1/2" thick fiberglass w/ scrim kraft jacket

Insulation which is exposed to the weather shall be protected with an aluminum jacket.

OPTION: At the Contractor's option, portions of the suction piping may be 1" thick Armstrong Armaflex 22 or accepted equal. Fitting covers shall be mitered sections of Armaflex 22. All joints shall be sealed with Armstrong 520-620 adhesive and wrapped with closed cell elastomeric plastic tape. Insulation shall be applied in strict accordance with manufacturer's instructions.

16. **Application of Pipe Insulations**

All pipe insulation shall be continuous through wall, floor, and ceiling openings. All pipes passing through fire walls or floor slabs shall be insulated with calcium silicate insulation (or approved equivalent) of same thickness as the specified insulation and extending 1” on either side of the wall or slab. The remaining space within the sleeve shall be caulked mineral wool or approved fire stopping material. Fire stopping method shall be accepted by the proper authority having jurisdiction.

17. **Insulation for Duct Systems (External)**

All insulation for concealed round supply ductwork may be flexible blanket type.

18. **Flexible Blanket Duct Insulation:**

MATERIALS: Flexible insulation shall be 1-1/2" thick Manville Microlite, of 3/4 lb/cubic foot density and with FSK reinforced foil scrim-kraft jacket or accepted equal. Thermal conductivity shall be .33 at 100^{o}F mean temperature.

APPLICATION: Flexible (blanket) duct insulation shall be tightly and smoothly applied to the duct. All joints of insulation shall be tightly butted. Insulation shall be secured to duct with fire resistant 3M Insulation Adhesive 35 applied in 4" wide strips on 12" centers.

Flexible insulation on bottom of rectangular, horizontal, and sloping ducts more than 24" wide shall, in addition to adhesive, be secured by impaling over welding pins spaced on not more than 12" centers and secured with washers and clips. Sagging of flexible duct insulation will not be permitted.

At all joints and junctions (including points where ducts enter walls), projections such as hangers, etc., shall be pointed up and sealed with adhesive or mastic and covered with a 3" wide pressure sensitive vapor-seal tape or strips of material identical to facings, or shall have 2" wide laps drawn tight and secured with vapor-seal adhesive. The tape or laps shall be secured with flared staples, spaced 4" on centers and 1" from edges of tape or laps. The joints and all openings where the facing is pierced or punctured by pins, staples or by any other means shall be coated with 2" wide strips of vapor barrier coating compound to provide a vapor tight covering.

SUBMITTALS: Before any insulation is installed, the installing Contractor shall submit to the Project Engineer for review, as described herein for submittals, descriptive bulletins for each type of insulation and jacket proposed for use on this project.

FIRE HAZARD RATINGS: All insulation shall have composite (insulation, jacket, and adhesive used to adhere the jacket to the insulation) Fire and Smoke Hazard

ratings as tested under procedure ASTM E-84, NFPA 255, and UL 723, not exceeding:

Flame Spread	25
Smoke Developed	50

All insulation system components shall meet the fire safety requirements of NFPA 90A fire hazard classification.

19. **Air Handling Systems**
Duct Smoke Detectors

Duct smoke detectors shall be furnished and installed in the return ductwork of all air handling systems over 2000 CFM. Detectors shall be located and installed as required by the City of Phoenix Mechanical Code.

Smoke detectors associated with smoke dampers and HVAC shutoffs shall be tested by an approved testing agency or a qualified third party Special Inspector. The Special Inspector/Testing Agency shall be an independent third party individual or firm and shall not be the installing contractor. A Professional Engineer shall submit a final signed and sealed report to the Mechanical Inspector prior to city issuance of final inspection approval or occupancy approval, including conditional occupancy approval.

Duct smoke detectors shall operate on the ionization principle, and shall be capable of detecting both visible and invisible combustion products. The detector shall be listed by Underwriters' Laboratories, Inc. The installation shall include an enclosure suitable for mounting on a duct and air sampling tubes that extend full width into the duct air stream. The detector shall be base-mounted, and terminals or leads for external connections shall be provided. The detector shall have no moving parts. It shall have all solid-state circuitry. Operating voltage shall be 24 vdc, normal. Sensitivity of the detector shall be field- adjustable, and a check of sensitivity shall be possible while the detector is installed and operating. Variations in duct air velocity between 300 and 3500 fpm shall not interfere with the detector's sensitivity. Its design shall inhibit response to electrical transients. Two ionization chambers shall be used -one to detect products of combustion and the other to compensate for changes in ambient humidity, temperature, and barometric pressure. A 3-position reset/test detection of smoke in the duct relay shall be provided, capable of actuating other devices (e.g., fire alarm) upon key switch and a visual alarm indicator shall be mounted on the front of the detector housing, or where shown.

The Mechanical Contractor shall be responsible for all necessary wiring, relays, auxiliary contacts, etc. as required to provide the specified fan shut-down sequence and Fire Alarm & Protection System Interconnection. The Mechanical Contractor is also responsible for the conduit for these circuits.

Before ordering and/or installing any devices or equipment, the Mechanical Contractor shall coordinate/verify all switching and/or contact requirements with the Electrical and/or Fire Alarm Contractor. Duct detectors shall be U.L. listed for operation with all fire alarm system components (new and/or existing).

20. **Sheet Metal Ductwork**

Provide a complete system of sheet metal ductwork, fabricated and installed in accordance with the latest recommendations of the ASHRAE Guide, and the SMACNA Duct Construction Standards.

21. **Arrangement of Ductwork and Accessories**

The duct system, including supply air, return air, outside air, mixed air, and exhaust air ductwork, shall be constructed essentially as indicated with radius ells, branch take-offs, and splitter dampers where shown. Changes in duct arrangement shall be made only after written acceptance is obtained from the Engineer.

22. **Sheet Metal Specialties**
Duct-Take-Offs

Take-offs shall be made with clinch lock starters. Cutting tabs in ducts for take-offs will not be allowed.

23. **Extraction**

Extractors at branch take-offs shall be installed where shown with a locking quadrant for adjustment.

24. **Flexible Connections**

Flexible Connectors shall be installed where ductwork connects to equipment and shall be double neoprene coated "Ventglas" or other accepted material. Flexible connectors at rooftop mounted equipment will not be required unless shown otherwise. Canvas connectors are not acceptable unless specifically called for on the drawings.

25. **Flue Piping**

Provide flue piping system complete with weather proof roof cap, flashing, elbows & all accessories required for code compliance as follows:

Natural gas or propane	- Type B flue pipe metal-fab or equal
Oil or other	- Type A flue pipe metal-fab or equal

Provide stainless steel or PVC (if recommended by Manufacturer) flue piping per condensing equipment.

All flue piping downstream of power assisted blowers shall be positively pressure sealed.

26. **Fire Dampers**

Damper installations must conform to the current UL and Code requirements. Fire dampers shall be installed in the duct where shown on the drawings or where required by the Building and Mechanical Code (but not shown on the drawings). Dampers shall be multiple folding blades Class B complete with angle frame, 160^{o}F fusible link and locking device. All fire dampers, except ceiling radiation dampers, shall be installed with a metal sleeve. Sleeve thickness shall be as required by the terms of the UL listing. Sleeve shall be secured to the building structure to prevent displacement of the damper in case of duct collapse. Duct shall be secured to the sleeve with an "S" slip fitting. All fire dampers shall be installed in accordance with manufacturer's instructions and the UL listing.

27. **Combination Fire/Smoke Dampers**

Combination fire and smoke dampers shall be located as shown on the drawings. Cable and UL listed fusible link must allow the damper to close upon receipt of an electric signal from a remotely located detection device. Dampers must automatically open and reset in the ready position after the smoke has cleared and power is restored. Motors shall be line voltage (115 volts). Smoke detector and wiring shall be by the Electrical and/or Controls Contractor. All fire dampers in exit corridor walls shall be combination Fire/Smoke Dampers.

28. **Manual Dampers**

Manual dampers shall be provided for proper system balancing. Damper metal gauge shall be not less than duct gauge. All dampers in rectangular ducts shall be opposed blade and shall be provided with locking quadrants. Damper quadrants shall be installed to indicate whether damper is open or closed and balanced position shall be indicated on quadrant. Maximum damper blade width shall be 8".

29. **Transitions**

Duct transitions shall be made at a convergence not to exceed 1" in 4", unless shown otherwise.

30. **Elbows**

Radius elbows shall be full radius type with inner radius equal to duct width. Elbows with squared inner corner are not acceptable unless shown otherwise on the drawings.

31. **Materials**

Ductwork and fittings shall be fabricated from hot dipped, galvanized sheet steel of U.S. Standard Gauges, lock-forming quality. Gauges of all ductwork shall be as listed in the International Mechanical Code.

32. **Flexible Duct**

Unless shown otherwise on the Drawings, the maximum length of any flexible duct shall be 5 feet. Flexible ducts shall be installed in accordance with best modern practice. Duct take-offs shall be low-loss, bellmouth type with single blade volume damper and locking quadrant. Flexible ducts shall be attached to duct take-offs and diffusers with stainless steel or nylon draw-bands.

Flexible ducts shall be supported every 3 feet or less, as required to prevent sagging or kinking.

Insulated flexible duct shall be a factory fabricated assembly consisting of an inner sleeve, insulation and outer barrier. The inner sleeve shall be constructed of a vinyl coated spring steel wire helix fused to a continuous layer of vinyl coated fiberglass or Mylar. An R-6 insulating and sound attenuating blanket of fiberglass wool shall encase the mesh sleeve and be sheathed with a moisture and pressure barrier consisting of an Underwriters'

Laboratories listed vinyl impregnated and coated fiberglass fabric. The outer cover shall not "balloon" under operating pressure. None of the materials shall support combustion.

33. **Kitchen Exhaust Ducts**

All kitchen exhaust ducts from exhaust hoods shall be fabricated of #16 gauge black iron with angle iron stiffeners as required to prevent bending. Range hood ductwork shall be welded construction in conformance with NFPA #96.

Where duct passes through roof structure, it shall extend to the top of the roof curb and shall terminate with a grease-tight seal at the top of the curb. Roof curb shall be oversized to provide clearance between duct and roof as required by Code. Slope ductwork back towards hood at 2 percent gradient.

Provide bolted access panels as indicated, between elbows, and every 20 feet in horizontal and vertical ducts for cleaning and inspection purposes. Provide a residue trap, cleanout and valved drain at the base of each vertical riser. Access panels shall be on vertical surfaces of ducts to prevent dripping of residue.

Dishwasher exhaust shall be brazed throughout its length.

34. **Fire Resistive Duct Wrap**

The City of Phoenix will accept an alternative grease duct enclosure provided the product, and its installation, conforms to the following:

- Product is labeled as a "Grease Duct Enclosure Classified by Underwriters Laboratories Inc. (YYET).
- Product maintains a valid ICC or NER Evaluation Service, Inc. Evaluation Report.
- Product is installed as per Listing Report and the Manufacturers installation instructions.
- Product is limited to one floor or roof/ceiling penetration.

35. **Acoustical Duct Lining**

All ductwork scheduled as "lined" or "internally insulated" in specification section "INSULATION" or on the drawings, shall be insulated on the inside with 1" thick, 1-1/2 lb. density fiberglass duct liner. The duct liner shall meet the requirements of NFPA Standard 90A and shall carry a UL label. The duct liner shall have a minimum sound absorption coefficient of 0.63 at a frequency of 500 cps when tested on No. 6 mounting in accordance with ASTM-C-423. The duct liner shall also have a thermal conductance of 0.26 BTU/sq.ft.-degree F-Hr at a mean temperature of 75^{o}F. Duct liner shall be Manville Linacoustic fiberglass dual liner or equal.

The liner shall be installed with 100 percent coverage of fire resistant adhesive. The liner shall be additionally secured with mechanical fasteners on 15" centers (within 2" of edges of joints). All exposed edges and the leading edge of all cross joints of the liner shall be heavily coated with adhesive.

All ductwork installed with internal insulation shall be increased in size such that the final internal dimension is that indicated on the drawings.

36. **Registers, Grilles, and Diffusers**

Registers, grilles, and diffusers shall be of the size, type, and finish shown on the equipment schedule. Locations shown are approximate. Contractor shall make adjustments necessary to fit the ceiling tile pattern or to center between studs in the case of wall registers.

37. **Motorized Dampers**

All motorized dampers shall be furnished and installed by the Mechanical Contractor.

38. **Refrigeration/Refrigerant Systems**
Certification of Pipe Fitters Requires:

All personnel who cut, fit, solder, weld, or otherwise permanently join the refrigerant piping must be certified to perform such work. This certification shall be in writing and provide proof of completion of coursework and experience in dealing specifically with the joining of refrigerant piping. Certificates shall be those awarded by the appropriate labor union or by educational institutions offering formal programs and training in this area. Proof of such certification of personnel must accompany the contractor's bid. If the mechanical contractor does not employ such persons, a subcontractor employing certified personnel shall carry out this portion of the work.

Regardless of certification, the person performing this work must be aware of the need for thorough cleaning of the piping, purging of the system, charging with inert gas prior to assembly, control of joining temperatures, and all other techniques required to construct a clean, tight piping system.

39. **Refrigeration Valves, Piping and Accessories**
Expansion Valves

Provide necessary thermostatic expansion valves, properly sized for the direct expansion coil supplied in the air conditioning units.

40. **Solenoid Valves**

Provide necessary solenoid valves, properly sized, ahead of the expansion valve if required to achieve the necessary control sequence.

41. **Strainers**

Cleanable type strainers shall be installed ahead of each refrigerant solenoid valve. All strainers shall have 60 mesh screen as manufactured by Sporlan.

42. **Refrigerant Filter-Drier**

Provide a sealed type filter-drier similar to Sporlan. Unit shall be sized in accordance with manufacturer's published charts for the tonnage of the system.

43. **Liquid and Moisture Indicator**

Provide a liquid-moisture indicator in the refrigerant line to clearly show liquid flow.

44. **Shut-off Valves**

Furnish and install all necessary shut-off valves shown or required for the system operation. Valves shall be of the packless, diaphragm or bellows type designed for refrigeration service.

45. **Refrigerant Piping**

Furnish and install all piping and fittings for a complete system. All elbows shall be of the long radius type. All piping shall be Type "L" copper and shall be carefully reamed to full size after cutting and shall be thoroughly cleaned before installation. Furnish flexible pipe connections at the condensing unit. Flexible connections shall be Style BF Spring-Flex of line size and length recommended by the manufacturer.

All fittings shall be of the wrought copper type and shall be assembled with "Sil-fos".

All traps in refrigerant suction or hot gas piping shall be constructed using street ells and standard ells to provide the shortest possible horizontal dimension.

All piping shall be adequately supported with hangers, or as otherwise indicated on the drawings, to eliminate all swinging and excessive vibration.

Number of refrigerant piping circuits shall be as shown or as indicated by the model specified. Dual compressor units shall have two independent circuits and split evaporator coil.

For split systems of 5 tons or less, Contractor may use pre-sized, cleaned and sealed refrigerant line kits as offered by the manufacturer of the refrigerant equipment. Kit length shall be selected to match as closely as possible the actual distance between components.

46. **Evacuation and Charging**

Make evacuation and leak tests in presence of City's representative and/or Engineer after completing refrigerant piping systems installation. A positive pressure test will not suffice for the procedure outlined below.

Draw a vacuum on each entire system with a vacuum pump to 200 microns using a vacuum gauge calibrated in microns. Do not use cooling compressor to evacuate system nor operate it while system is under vacuum.

Break vacuum with Freon to be used and re-establish vacuum test. Vacuum shall hold for 24 hours (minimum) at 200 microns.

Conduct tests at 70^{o}F ambient temperature or above. If ambient temperatures are consistently below 70^{o}F, contact the Engineer immediately for alternative procedure and/or scheduling.

After testing, fully charge each system with refrigerant and conduct a leak test with a Halide Leak Detector.

47. **HVAC Controls and Instruments**

If no separate Temperature Control Contractor is used, the Mechanical Contractor becomes the "Temperature Control Contractor" as outlined in this section, and is responsible for all aspects of Temperature Control.

48. **Operational Instructions**

Upon completion of the work, the Temperature Control Contractor shall instruct operating personnel on the various control devices and systems.

49. **Electrical Work**

All required temperature control wiring shall be provided by the Control Contractor. All control wiring shall be run in metallic conduit (which is to be provided by the Mechanical Contractor), and shall conform to requirements of the National Electrical Code and Division 16 of these specifications.

50. **Installation of Valves and Dampers**

All automatic control valves shall be furnished by the Temperature Control Manufacturer and installed under his direct supervision by the Mechanical Contractor.

All automatic control dampers not part of equipment shall be furnished by the Temperature Control Manufacturer and installed by the Mechanical Subcontractor.

All automatic control damper motors not furnished with the equipment shall be furnished and installed by the Temperature Control Contractor.

50. **Control Devices**
Thermostats

All wall-mounted room thermostats shall be mounted at approved ADA mounting height.

All thermostats located in toilet rooms, locker rooms, corridors, shop and other unsupervised areas shall be provided with thermostat guards. A listing by room number of guarded thermostat locations and the model number of the proposed guard shall be included in the shop drawing submittal. For most applications, guard shall be 0.125" thick clear plastic.

51. **Relays and Miscellaneous Items**

Necessary relays and other incidental control items shall be furnished and installed for the successful operation of the system.

52. **Service Period**

The Contractor shall agree to service this equipment for a period of one year after acceptance of the work at no expense to the City. They shall adjust all thermostats, thermometers, and control devices throughout the building to maintain control settings.

53. **Mechanical Systems Testing**
Construction Tests

All piping systems shall be tested during the construction period. All piping shall be subjected to an air or hydrostatic test before concealing or covering with insulation. All tests shall be performed in the presence of the City's representative. A letter including the test date, representative present, and test pressures and duration will be required. Tests shall be as follows:

54. **Domestic Water System**

The water system shall be tested at 125 psi with water or air for not less than 8 hours without a drop in pressure. The water system is defined to include all chrome supply nipples capped at the fixture location and protected during the construction period.

55. **Fire Extinguishing System**

Each entire system shall be tested in accordance with Section 1-11.3 of NFPA Standard No. 13. Contractor shall conduct test in presence of Owner's Representative in strict accordance with NFPA Standard No. 13.

56. **Drainage System**

The entire drainage and venting system shall have all necessary openings plugged to permit the entire system to be filled with water to the level of the highest vent stack above the roof. The system shall hold this water level for 30 minutes without drop. A portion of the system may be tested as above by installing a temporary stack at least 10 feet high.

57. **Natural or LP Gas**

Piping shall be tested with air at 50 psi for not less than 8 hours without a drop in pressure. The temperature at each reading shall not vary over 5^{o}F, with the 8-hour period extended as necessary to obtain this requirement.

58. **Heating and Cooling Piping**

Heating and cooling piping shall be tested and proved tight as follows: All

concealed and inaccessible piping and fittings shall be tested in place prior to enclosing, with water or air pressure and proved tight. The entire piping system shall be tested after completion, with water or air pressure of 100% above the operating pressure or a minimum of 125 psig, and if possible, in service before insulation.

59. **Condensing Water Piping**

Condensing water piping shall be tested the same as the heating and cooling piping.

60. **System Testing**

At the completion of the work, the Contractor shall retain a certified AABC Testing Agency to supervise the adjustment of the air and water systems, the validation testing and the preparation of Operating and Maintenance Instructions.

The Contractor shall also supervise the initial operation of all equipment and instruct the Operator selected by the City in such operation as required to acquaint him thoroughly with the best practice.

Electric power and gas required for testing of equipment will be supplied and paid for by the Contractor.

61. **Balancing**

Air flow and water flow shall be balanced to the quantities shown. Contractor is allowed a tolerance of plus or minus 5% from the specified quantities.

62. **Test Equipment**

All test instruments required for testing and balancing shall be verified for precision, accuracy and calibration and furnished by this Contractor. Those instruments that are installed as integral parts of the system may be used to read test reports for the validation testing if they meet these requirements.

63. **Test Data and Reports**

The tests shall include all fans, mixing dampers, volume dampers, outlets, return registers, etc., normally included as a part of the air distribution and transmission system.

Balancing shall be primarily done at the fans by adjustments of fan speeds to obtain the minimum static pressure for satisfactory operation of the system. The dampers at the outlets and return registers shall be utilized only for a final "trim" balancing.

Mixing dampers at each central station shall be set to provide the proper ratio of

outside air, return air and exhaust air throughout the controlled range of operation.

All air handling devices shall be balanced per manufacturer's instructions. A complete balancing report shall be submitted to the Architect/Engineer upon completion. Balancing shall be completed to the satisfaction of the Architect, Consulting Engineer, and Owner. Initial balancing and final adjusting of any devices after occupation (if required) shall be accomplished without any expense to the Architect/Engineer or City.

Any additional balancing dampers or orifice plates required for balancing shall be furnished and installed by the Mechanical Contractor.

The following requirements shall apply when performing the tests for each and every system:

Test and adjust blower rpm to design requirements.
Test and record motor full load amperage and voltage on each phase.
Make pitot tube traverse of main supply ducts and obtain design cfm at fans.
Test and record system static pressures, suction and discharge.
Test and adjust system for design cfm return air.
Test and adjust system for design cfm outside air.
Test and record entering air temperatures (D.B. Heating and Cooling.)
Test and record entering air temperature (W.B. Cooling).
Test and record leaving air temperatures (D.B. Heating and Cooling).
Test and record leaving air temperature (W.B. Cooling).
Adjust all main supply and return air ducts to proper design cfm.
Adjust all zones to proper design cfm supply and return.
Test and adjust each diffuser, grille and register to plus or minus 5% of design requirements.
Each grille, diffuser and register shall be identified as to location and area.
Size, type and manufacturer of diffuser, grilles, registers, and all test equipment shall be used to make required calculations.
Readings and tests of diffusers, grilles, and registers shall include required fpm velocity and test resultant velocity, required (design) cfm and tested (resultant) cfm after adjustments.

All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.

64. **Liquid Systems**

This Contractor shall adjust all pumps for proper flow and head so as to obtain results within 10% of design quantities.

65. **Validation Test**

General: After the balancing data has been reviewed by the Project Engineer, a

validation test shall be scheduled. Prior to the validation test, a letter shall be submitted to the Engineer certifying that all mechanical equipment is operating as required and that all controls have been calibrated and are properly operating. The validation test shall be performed in the presence of the Project Engineer and the City's representative.

The date for the test shall be agreed upon at least two weeks prior to the test date. The test shall cover not less than a 4-hour period during which the City's representative shall be instructed in the proper operation and maintenance of the system.

The following data shall be taken and recorded at 30-minute intervals throughout the test.
Hot water supply and return temperature
Zone and/or space temperature
HVAC unit air supply and return temperature

The following data shall be taken at the beginning and end of the test:
Outside temperature (DB and WB)
Voltage and amperage of all motors

While the system is on maximum heating, air temperature rise and water temperature drop shall be recorded for all heating coils.

While the system is on maximum cooling, air temperature drop shall be recorded for all cooling coils.

66. **Test Procedure**

At least 24 hours prior to the validation test, all zone and space controls shall be set at their minimum setting, and the proper operation of all equipment verified. The test shall be started by placing all systems in the heating position and turning all zone and space controls to 85^{o}F. Heating operation shall continue until all systems have operated within their respective control range for a minimum of one hour.

All systems shall be placed in the cooling position, all zone and space controls set at 75^{o}F and the test continued until all systems have again operated within their respective control range for a minimum of one hour. All zone and space controls shall then be set at 65^{o}F and operated until all temperatures reach this condition.

All systems shall again be returned to the heating position, all zone and space controls set at an operating temperature of 75^{o}F and the systems operated for approximately two hours.

During the test all available building heat gain devices shall be on. If possible, the test shall be run on a day when the outside temperature is between 45^{o}F and 75^{o}F.

If an equipment malfunction or alarm occurs during the test which cannot be repaired in 1 hour the test shall be terminated and rescheduled at the Contractor's expense.

If zone or space temperatures fluctuate more than plus or minus 2^{o}F once the temperature comes into the control range, the cause for fluctuation shall be corrected and the test rescheduled at the Contractor's expense.

67. **Validation Report**

Within two weeks after the validation test a typewritten report of the data taken during the validation shall be submitted to the City. The report shall include all data taken during the validation test. Prior to the validation test, a letter shall be presented that all controls have been calibrated and operating properly and that all equipment has been checked for proper operation.

68. **Piping General**

All piping is to be cut, fit, reamed, erected and installed in workmanlike manner, run true 0and parallel with the building structure, and arranged to pitch or drain as required for the service in use. Unless noted or specific permission is given, all piping shall be run concealed within the building structure. PIPING WITH CARBON STEEL FLANGES AND PIPE FITTINGS MANUFACTURED IN THE PEOPLES REPUBLIC OF CHINA SHALL NOT BE ALLOWED.

The interior of the pipe shall be clean when erected. Cap open ends and use care in installation to prevent construction debris entering piping. Piping shall be anchored securely at approved points to provide equalized expansion. All connections to units, radiation, and other relative equipment shall be made with swing joints and unions.

In all closed circulating water systems provide manual air vents at all locations required for venting air from the system during filling and service.
All pipe cutting shall be operated over an oil-tight pan of sufficient area to prevent the soiling of the floor or premises with cutting oils or compounds.

Dielectric unions or insulating couplings shall be installed at all connections wherever dissimilar metals are joined.

All screw threads must be tapered and proportioned in accordance with the regulations formally adopted by the manufacturers of the pipe being used. All threads must be cut true and sharp and threaded joints shall be put together and made tight with #5 Rectorseal or other approved joint compound.

69. **Pipe and Fittings Outside of Building**

The Contractor may use one of the following types. Use of the following types shall be subject to Local Codes and Ordinances. If local standards do not allow any of the specified options, Contractor shall use conforming material.

70. **Domestic Water Service Outside of Building**

SDR 18, Class 150 PVC plastic with Ring-Tite joints, conforming to AWWA C-900.

Schedule 40 or 80 PVC Listed for potable water to NSF standards.

Type K soft copper with flare fittings up to 2" size.

71. **Fire Sprinkler Service**

Work under this section shall include furnishing all labor, materials, and equipment necessary to install an automatic sprinkler system and standpipe system in accordance with NFPA Standard No. 13 and 14. Material shall include all piping, fittings, sprinkler heads, valves, controls, alarms, hangers and any other supplemental items necessary to complete the system in accordance with engineered drawings and the Phoenix Fire Code.

72. **Storm and Sanitary Sewer**

The Contractor may use one of the following material types beginning 5' 0" outside the building foundation.

Polyvinyl chloride sewer pipe shall conform to the requirements of ASTM D 3034, SDR-35, PVC sewer pipe and fittings. O-ring rubber gaskets for PVC sewer pipe joints shall be of the elastomeric type providing a watertight seal.

No-hub cast iron with neoprene gasket and stainless steel drawband.

73. **Gas Piping**

Piping shall be schedule 40 black steel threaded pipe using threaded fittings. Pipe shall be mill coated and wrapped type CG-1 as applied by Hill-Hubbell & Co. The coating and wrap shall consist of cleaning, prime coating, 2 coats of pipe line enamel, glass mat, heavy kraft paper, and an electrical inspection. In lieu of this wrapping process, Republic Steel Company piping with a mill applied X-Tru-Coat plastic coating may be used. The fitting and joints shall be covered with Minnesota Mining Scotch-Rap-Pipe Insulation Tape #40, #50, or #51 as recommended by the manufacturer. The piping shall be swabbed internally before installation to remove foreign materials and shall be installed with two feet of cover and shall be pitched as required by the Utility Company.

Other piping materials which are acceptable with the local gas utility shall be acceptable as alternative materials.

74. **Refrigeration Piping**

As specified for above grade refrigeration piping.

75. **Pipe and Pipe Fittings in Building – Below Grade**

The Contractor may use one of the following types. Use of the following types shall be subject to Local Codes and Ordinances:

76. **Water**

Piping run in gravel or soil shall be type K soft copper with flared fittings. Where the pipe penetrates the concrete floor, the pipe shall be provided by a 6" length of Armaflex insulation. No joints are permitted below the slab.

77. **Sanitary Waste, Vent Piping and Storm Sewer**

Sanitary waste and vent piping shall be "no-hub" cast iron with neoprene gasket and stainless steel drawband. If approved by code and permitted by the Design Engineer and City, Listed ABS or PVC DWV piping may be substituted for the "no-hub" piping.

78. **Hot Water Heating, Chilled Water and Condenser Water Piping**

Type "L" soft copper with sweat fittings. Sweating shall be done with "Silfos" solder or silver solder and a brazing flux.

Where the pipe penetrates the concrete floor, the pipe shall be protected by a 6" length of Armaflex insulation.

79. **Refrigeration Piping**

As specified for above grade refrigeration piping.

80. **Pipe and Pipe Fittings in Building – Above Grade**

The Contractor may use one of the following types. Use of the following types shall be subject to Local Codes and Ordinances:

81. **Domestic Cold Water, Domestic Hot Water & Recirculating Hot Water**

Type "L" hard copper. Fittings shall be sweat pattern cast brass or wrought copper for use with type "L" copper tube. Fitting shall be done with a non-corrosive paste

flux and lead free solder for all pipe sizes.

82. **Sanitary Waste and Vent Piping**

Sanitary waste and vent piping shall be "no-hub" cast iron with neoprene gasket and stainless steel drawband. If approved by code and permitted by the Design Engineer and City, Listed ABS or PVC DWV piping may be substituted for the "no-hub" piping.

Changes in pipe size on soil, waste and vent lines shall be made with reducing fittings or recessed reducers

83. **Roof Drain Piping**

"No-hub" cast iron pipe with appropriate fittings. If approved by code and permitted by the Design Engineer and City, Listed ABS or PVC DWV piping may be substituted for the "no-hub" piping.

84. **Hot Water Heating, Chilled Water, Condenser Water and Steam Piping**

Type "L" hard copper with sweat fittings may be used for hot water heating piping and chilled water piping. Fitting shall be done with non-corrosive paste flux and 50/50 solder for pipes up to 1" and 95/5 solder on pipes 1" and over.

85. **Cooling Coil Condensate Drain Piping**

Piping shall be type "M" hard copper with sweat fittings. Fittings shall be cast bronze or wrought copper. Fitting shall be done with non-corrosive paste flux and solid core 50/50 solder. Traps shall be provided on piping for draw through coils. Trap seal depth shall be 1" more than the air handling unit static pressure.

86. **LP or Natural Gas Piping**

Schedule 40 black steel. Pipe shall be pitched in the direction of flow with a drip leg at the bottom of each drop or rise. Fittings shall be wrought iron.

87. **Refrigeration Piping**

Dehydrated and capped Type "L" hard drawn copper tubing otherwise known as "ACR" tubing with wrought copper fittings using "Silfos".

88. **Special Joints**

The joining of copper pipe and steel pipe or any pipe of dissimilar metals shall be done with dielectric or insulated type union. This requirement applies to all piping, including black steel to copper connections.

89. **Valves**

Furnish and install all valves indicated on the drawings or required for the proper sectionalizing or operation of the different piping systems.

Except where other suitable valves such as balancing valves or plumbing fixture stops are indicated, ball valves shall be provided in the piping connections to each item of equipment to permit isolation of that equipment from the piping systems for service or replacement.

90. **Floor, Wall and Ceiling Plates**

Where exposed piping passes through floors, walls, or ceilings in the finished portions of the building, install chrome plated escutcheons complete with clamping device to hold plate firmly against the adjacent structure.

91. **Pipe Hangers and Anchors**

Unless specified or shown otherwise, all hangers for steel pipe shall be of heavy wrought iron or malleable iron adjustable ring type. All steel and copper piping shall have Grinnell Fig. 97 adjustable wrought ring hanger. Hanger for copper piping shall be vinyl coated or copper plated when in direct contact with the pipe. This Contractor shall furnish all inserts, clamps, sockets, bolts, clips or rods, to complete all hangers. Hangers for insulated cold piping shall be large enough to encompass the insulation.

Hangers for hot piping may be pipe size with the insulation butted against the hanger, and all gaps covered with insulation tape.

Piping shall be supported in such a manner as to provide an absolute minimum of expansion or contraction stress, or piping and valve weight, being transmitted to the equipment.

Horizontal steel piping shall be supported as follows:

Pipe Size	Rod Dia.	Max Spacing
Up to 1-½''	¼''	8ft.
1-½'' & 2''	3/8''	10ft.
2-½'' & 3''	½''	12ft.

Horizontal copper tubing shall be supported as follows:

Nom Tube Sizing	Rod Dia.	Max Spacing
Up to 1''	¼''	6ft.

1-¼'' & 1-½''	3/8''	8ft.
2''	3/8''	9ft.
2-½''	½''	9ft.
3'' & 4''	½''	10ft.

Cast iron soil pipe shall be properly supported at each hub or connection.

Under no condition will perforated strap hangers or wire hangers be allowed.

Hanger material shall match the material of the pipe it supports except that galvanized hangers will be allowed on black steel pipe.

Pipe 2" in diameter or smaller may be laid directly on top of the bottom chord of steel joists as directed or in accordance with details shown. Insulated piping shall be provided with saddles at support points. Support point spacing shall not exceed the distance specified above.

UNDER NO CONDITION SHALL ANY PIPE OR DUCT STRUCTURE BE USED TO SUPPORT ANOTHER.

Groups of pipes at the same elevation or graded flow may be supported on trapeze hangers using Unistrut P-1001 channels with threaded rod connected to inserts. Details of trapeze supports and their method of attachment to the structure shall be submitted to the Engineer for review. Furnish pipe clamps to control spacing. Clamps shall span the outer surface of the insulation or pipe.

92. **Flashings**

Openings in the roof for roof drains, ductwork or other piping, shall be flashed watertight by caulking or other acceptable means. Flashing shall extend not less than 12" from the outside edge of the vent, drain or pipe, and shall be mopped in with roofing material to make a watertight installation. Flashing method shall be as accepted by the Engineer.

93. **Curbs**

All roof curbs and flashing for exhaust fans, duct penetrations, or equipment support shall be provided by others, except prefabricated curbs, where indicated, shall be provided by this Mechanical Contractor. Mechanical Contractor shall be responsible for coordination of the size, location, and supporting steel for all curbs. Curbs shall be set In-place by the Mechanical Contractor and shall be flashed and coordinated with the roofing system by the Roofing Contractor.

94. **PLUMBING FIXTURES**
Soil and Waste System
Soil, Waste and Vent Piping

Waste and vent piping shall grade at 1/4" per foot, where possible, but in no case shall grade less than the minimum allowed by the applicable Code. When an end or circuit vent from any fixture or line of fixtures is connected to a vent line serving other fixtures, the connection shall be at least 5 inches above the flood rim of the highest fixture in the battery, to prevent the use of a vent line as a waste. Horizontal waste lines receiving the discharge from two or more fixtures shall be provided with end vents, unless separate venting of fixtures is noted.

Changes in pipe size shall be made with reducing fittings or recessed reducers.

95. **Sewer-Water Crossings**

City of Phoenix MAG Concrete Encasement Standard 404, which is used for public right-of-ways when the sewer line crosses above potable water lines are prohibited for onsite sewer systems. Concrete encasement of water or sewer lines is strictly forbidden.

96. **Manholes**

City of Phoenix MAG Manhole Detail 420 is to be modified for onsite sewers as to provide flexible compression joints on the inlet and outlet pipe connections to the manhole which shall be no closer than 12 inches and not farther than 36 inches from the manhole. No compression joint shall be embedded within the manhole.

97. **Backflow Prevention**

If any plumbing fixtures are proposed to have flood rim elevations below the upstream manhole rim elevation, then all such plumbing fixtures are to be routed through an approved backwater valve in an accessible vault. All plumbing fixtures with flood rim elevations above the upstream manhole rim elevation are not permitted to flow through the backwater valve

98. **Roof Drain Separation**

Primary roof drain systems may not be directly connected to the onsite storm drain system unless the entire onsite storm drain system design complies with the plumbing code. In order to separate plumbing code systems from the onsite storm drain system provide some means of overflow (bubbler box, catch basin etc.) at the ground level which provides a transition with overflow/daylight provision for the primary roof drain system.

99. **Vent Termination**

Vent stacks from sewer, soil, waste, and drain pipes shall be extended at least 12" above the roof. Locations of vent terminals shall be coordinated to insure necessary separation from outside air intakes and other ventilation openings.

100. **Multiple Buildings Served by Common Sewer**

Compliance with the State of Arizona's Aquifer Protection Permit, General permit 4.01sewege collection requirements are required for buildings utilizing a shared sewer ejector system or those onsite sewers exceeding flows of 3000 GPD serving multiple buildings. The General Permit 4.01 Private Sewage Collection System shall not be placed in service until an Approval of Construction and a Notice of Verification of General Permit Conformance has been issued by the City.

The following information submittal requirements for the APP 4.01 Approval to Construct and/or Provisional Verification of General Permit Conformance are required to be submitted to the City's County Health Delegate:

a. *Engineer's Design Reports*. Design shall provide wastewater flows including the basis for the calculations; describe the proposed construction and basis of design; provide design data and hydraulic calculations; and establish the adequacy of the design of the sewer system to meet system sewer flows. Design reports shall be signed and sealed by an Arizona registered professional engineer.

b. *Operations and Maintenance Plan* (Onsite Sewers and Lift Stations Only). If the proposed onsite sewage collection system is not within a sewer easement owned and operated by the Water Services Department and meets the criteria of an APP 4.01 sewage collection system, submit an operation and maintenance plan per R18-9-E301.C.6 of the rule.

c. *Certified Operator of System* (Onsite Systems Only). If the proposed water system and/or sewage collection system is not within a utility easement owned and operated by the Water Services Department, an ADEQ certified operator at the appropriate grade is required. Provide name, firm, address, and 24-hour phone number for the certified operator(s) of the system(s).

d. *CC&R's* (Onsite Systems Only). Provide draft CC&Rs providing evidence of financial provisions regarding the operation, maintenance, and replacement responsibility of the onsite system by the homeowners association or other ownership group.

101. **Valves**

All in-line valves specified for general plumbing use shall be 125 psi rated bronze ball valves as manufacturers by NIBCO or equal.

102. **Cleanouts**

Full size cleanout plugs (to a maximum size of 4") shall be furnished and installed at the foot of all waste stacks, in all waste piping not over 50 feet apart, at all 90^{o} turns in mains, where the waste piping leaves the building, at all points shown on the drawings, and where necessary to permit the entire drainage system to be rodded out easily.

103. **Hot Water System**
Boiler Cleaning and Filling

After installation, clean or boil out the boiler in strict accordance with manufacturer's step-by-step instructions, using the recommended dosage of caustic soda and/or trisodium phosphate. For hot water systems, the water containing cleaning compound shall be circulated through the entire system.

After the cleaning is completed, the final water fill shall be deaerated by heating to at least 180^{o}F and charged with a water treatment compound as recommended by the manufacturer.

104. **Boiler Startup, Tests, & Inspection**

Boiler startup shall be performed by a factory trained service representative. Owner's representative shall be present during startup to receive instruction in care and maintenance of the unit. Permits and inspections shall be obtained from the State of Arizona Boiler Inspections Division.

105. **Hot Water Specialties**
Air Vents

Furnish and install air vents at all high points in the hot water piping system, at the end of all mains and risers and at all other points where required or indicated to vent air from the system.

106. **System Water Treatment**

Provide an initial dosage of a non- chromate corrosion inhibitor, Dearborn B-239 or equal, in the quantities recommended by the manufacturer. If the system is drained for repairs during the Warranty period, Contractor shall recharge the system with inhibitor in sufficient quantity to meet original recommendations.

107. **System Antifreeze Solution**

After system cleaning is completed, system shall be refilled with a solution of 30% by volume Dowtherm SR-1 inhibited propylene glycol and 70% water. Solution shall be hand pumped into the system, vented, and rechecked for leaks under

operating pressure. If system is drained for repairs at any time during the 1-year warranty period, refilling shall be done with the specified strength solution.

108. **Chilled Water System**

After installation, flush out chiller piping system in accordance with the manufacturer's instructions.

109. **Chiller Startup, Tests, & Inspection**

Chiller startup shall be performed by a factory trained service representative. Owner's representative shall be present during startup to receive instruction in care and maintenance of the unit.

110. **System Water Treatment**

Provide system water treatment as recommended by the manufacturer.

111. **System Antifreeze Solution**

After system cleaning is completed, system shall be refilled with a solution of 30% by volume Dowtherm SR-1 inhibited propylene glycol and 70% water. Solution shall be hand pumped into the system, vented, and rechecked for leaks under operating pressure. If system is drained for repairs at any time during the 1-year warranty period, refilling shall be done with the specified strength solution.

112. **Radiant Floor Systems**

- Tubing shall not be installed closer than 6" from walls.
- Contractor shall completely photograph all areas of tubing before the concrete slabs are poured.
- Provide Ultra CBF concrete barrier rFoil insulation under all heated concrete slabs.
- Radiant tubing shall be pressurized to 15 PSI during concrete pour & continuously monitored for pressure drop.
- Tubing shall be attached to the rebar grid with Rehau approved accessories such as wide crown staples, star clips, cable binder ties, screw clips, or rail fix plastic channels as dictated by concrete slab construction.
- Provide "Pro-Balance" manifolds and circuit actuator for individual circuit control on multiple circuit manifolds.
- Provide Rehau plastic protection sleeve at all points where tubing enters slab.
- Provide support bends at all 90^{o} bends in tubing.

Prior to the completion of a project, at least three sets of maintenance manuals, operating manuals, parts manuals, as-built and shop drawings of all equipment covered in this section shall be submitted to the city.

All installations shall be designed for total system energy efficiency and conservation. HVAC systems should be designed based on a life-cycle cost analysis. A comprehensive energy analysis shall be performed for all buildings 10,000 sq. ft. or more, using computer simulation programs such as TRACE, DOE2, or others approved for use by the federal government. The computer simulation program shall be used to perform the energy analysis and evaluation of alternative building methods, materials, orientations, lighting and HVAC systems.

All systems shall be designed so that they are easily adaptable to the future growth of the facility.

All design considerations shall comply with ASHRAE standards.

APPENDIX H – Telecommunications Cabling System Standards

INFORMATION TECHNOLOGY STANDARDS	**No.** nt1.10 Page 1 of 45
	Domain Network & Telecom
Title Telecommunications Cabling System Standards	**Effective Date** November 1, 2001

PURPOSE

The purpose of the Telecommunications Cabling System Standards Standard is to define a set of guidelines for deploying and managing the growing environment in the City of Phoenix. The Telecommunications Cabling System Standards is to establish an efficient, logical, cost-effective and strategic foundation for the support of the physical communications layer installed for the City's telecommunications systems. Following this standard will ensure that citywide installation of all telecommunications cabling infrastructure - both inside and outside plant - will meet end-user needs, current industry safety standards, technical and performance specifications, and warranty requirements for all systems and equipment. This document is to be used as a minimum guideline.

Future revisions of this standard will be made when competing industry efforts indicate a clear direction is established, based upon industry-wide acceptance of standards.

APPLIES TO

These standards apply to departments, architects, contractors, and design professionals who are involved in telecommunications cabling projects for the City of Phoenix. These standards should be used for all projects involving provision of telecommunications cabling and services.

BACKGROUND

A structured cabling system is defined as the complete collective configuration of cabling and associated hardware at a given site that has been installed to provide a comprehensive telecommunications infrastructure. This infrastructure is intended to serve a wide range of usage, such as to provide telephone service or computer networks and should not be device dependent.

This document also assumes that the user is familiar with telecommunications distribution

systems, with the cable and hardware used in them, and with the installation of cabling in many different environments; including, but not limited to, LANs, MANs, WANs and campus distribution systems. It is not intended to be a training manual in telecommunication distribution systems or to replace existing industry standards.

STANDARD

1 The application of standards and guidelines for telecommunications cabling systems remains facility sensitive. The size, architecture, location and intended use of a facility can significantly affect the particular design of the telecommunications cabling system for a building or campus. The design for specific facilities should be developed by the staff of the department or functional area in partnership with the City's Telecommunications Engineer, as part of the normal facilities design, review and approval process. The City's Telecommunications Engineer will always assist staff in evaluating both standard practices and alternatives, recommending telecommunications design solutions that are technically appropriate to meet the department's present operational and business needs, and those of the foreseeable future.

Changes and updates to this document will be made as necessary to keep it current with standard industry practices.

Requests for a waiver of these standards, or for technical clarification of specific design issues must be forwarded to the ITD Telecommunications Engineer, who will review all requests in a timely and professional manner:

Lead User Technology Specialist at ITD, 251 W Washington
(602) 495-3746

Work performance and standards must warrant that the installation of all materials shall be completed in a good and workmanlike manner and in accordance with the highest standards of the telecommunications industry.

All work and materials shall be in full accord with the requirements of the Arizona Administrative Code, the State Fire Marshall, the Division of Industrial Safety, the National Electric Code and other applicable City and state laws or regulations. Nothing in the specifications shall be construed to permit work not conforming to these codes and orders.

The Information Technology Department's Responsibilities for Telecommunications Projects

ITD is responsible for City of Phoenix inside and outside telecommunications system facilities, network connectivity and the associated backbone cabling. These responsibilities include the review of all telecommunications cabling project plans. These responsibilities are outlined below.

1.2.2 ITD will indicate, on the design drawings and in the design specifications, the

locations and specifications of the physical infrastructure required for a complete telecommunications cabling pathway and distribution system. This infrastructure shall include:

a) Identifications and Workstation locations

Connectivity for a complete telecommunications cabling system, including connecting hardware and cabling requirements

The infrastructure necessary to support the horizontal and riser cabling systems

The required telecommunications closet size and locations (TC)

The required Main telecommunication closet size and location (MTC).

The necessary infrastructure to interconnect buildings: including routes, conduit, manholes, pull boxes and building entrances, cables, splices, D-marc points.

Grounding and bonding requirements

ITD shall be provided copies of the Telecommunication Service Request (TSR) or other such documents describing the approved project. These documents shall be provided to ITD upon approval of the department responsible for managing that project.

ITD shall be provided Schematic Design (SD) documents for review at each stage of the schematic design process, and be provided a minimum of ten workdays from the date documents are received by ITD for review and return of comments.

ITD shall be provided Design Development (DD) documents for review at each stage of the design development process, and be provided a minimum of ten workdays from the date documents are received by ITD for review and return of comments.

ITD shall be provided Construction Documents (CD) for review at each stage of the construction document process, and be provided a minimum of ten workdays from the date documents are received by ITD for review and return of comments.

When a new project, building or building renovation is planned, architectural drawings are typically released for review by ITD in the following order:

Schematic - These are the initial planning documents and design drawings that assist departments in the early stage of the project. The Schematic Design documents shall consist of system narrative, including MTC/TC information, and campus connection points.

The schematic design documents should also include drawings composed of a title sheet, single line diagrams, and site plans. These plans may be part of the overall site and or electrical plan.

Design Development -- As the architectural design process progresses, overlays are developed to show the various structures and systems planned for the building. Design Development documents shall consist of outline specifications. Drawings should include title sheet, single line diagram site plan, enlarged floor plans of the proposed MTC/TC and details.

Construction Documents -- These documents depict the final design before bid submittal is undertaken. The Construction Documents shall consist of a completed cabling specification and drawing set.

Working Copy -- This is the Bid Copy.

Final Documentation and Drawings- these drawings and documents represent the project as it is finally constructed and delivered prior to final inspection of the project.

The Telecommunications System Design and Install Process for the City of Phoenix

These specifications provide a minimum configuration that must be used when planning new construction, remodeling and or any ADDS, MOVES, OR CHANGES of an existing facility. ITD must be consulted during the early planning phase of the project. Each project may have technical requirements requiring a modification of these specifications.

City of Phoenix's' telecommunications distribution system design process is broken down into six segments:

The Functional Requirements explains the functional vision that the City of Phoenix has planned for in the future.

The Horizontal Segment consists of the workstation outlets, cabling to the TC and all associated pathways

The Riser Segment refers to the riser cable, and the sleeves, slots, and conduits that enable the cable to pass from floor to floor: Main Telecommunication Closet (MTC) to the TC's
The Campus Segment or Metropolitan Area Network (MAN) refers to the cabling and infrastructure that interconnect buildings and or systems on a campus or within a metro area.

The Telecommunication Closet (TC) contains the hardware i.e., patch panels, and punch down blocks and racks for terminating the cabling from the workstation outlets, electronic equipment, and riser cables.

The Main Telecommunication Closet (MTC) is the room that houses common system equipment and hardware for terminating the campus and riser cables.

Special Systems

FUNCTIONAL REQUIREMENTS

General Requirements

In general, this document refers to the physical elements required to support voice and data, or any other hardware systems within a specific environment.

Information is provided; nonetheless, it shall be the installer's responsibility to confirm or determine the specific telecommunications infrastructure that will be required to support the required voice and data cable systems.

It is anticipated that the cable plant will be required to support Voice and Data needs for the next 5 to 10 years.

New intra-building Voice and Data station cable will be required to support anticipated communications systems. This cabling will distribute to hard wall offices and modular furniture workstations. This station cable must support initial requirements for 10BaseT (10 Mbps), 10/100, and potential future requirements, e.g., ATM and Gigabit Ethernet.

All new intra-building backbone copper cables and fiber optic composite (multimode) cables will be required between the floor building entrance facility and the MTC. The multimode fiber is intended primarily for data networking purposes; however it will be capable of supporting additional (e.g., voice, energy management, broadband, baseband video, etc.) communications services. The copper cable is intended primarily for voice and special systems.

Complete testing of intra-building backbone copper and fiber cable is required to insure that all fiber strands and copper pairs will accommodate the anticipated communications systems.
THE HORIZONTAL SEGMENT

Overview

All intra-building Voice, Data and LAN cable systems will support high-speed data network requirements. Complete testing must be done on all horizontal cabling and backbone cabling between the MTC/TC, Building entrance and workstations. Exposed cable will not be acceptable.

All voice and data applications, 4-pair UTP or fiber optic cables shall be run using a star topology from the telecommunications closet (TC) on each floor to every individual workstation and information outlet. All cable routes shall be approved by the ITD prior to installation of the cabling.

All horizontal cables, serving the floor areas, shall originate from this one MTC/TC and

shall travel above the ceiling to their destination.

This station cable shall be installed in cable trays, hard walls, surface mount raceways and communications poles.

In hard wall offices, cables are to be routed within walls. At modular furniture workstations (cubicles), route station cables within cubicle chases (when available) to non-metallic faceplates. When cubicle chases are not available, spiral-wrapped cable to furniture surfaces.

The Design Process

The horizontal segment consists of two elements:

The horizontal cable and connecting hardware that provide the means for transporting the telecommunications signals between the work station outlet and the horizontal cross-connect in the Telecommunication Closet (TC).

The horizontal cabling pathways and spaces that distribute and support the horizontal cable and connecting hardware between the work station outlet and the TC and from TC to TC.

Horizontal cables will not be connected directly to telecommunications equipment. Suitable connecting hardware (i.e. patch panels/cords and punch-down blocks) and equipment cables must be used to make the connection.

Installation of cable must meet all specifications identified in the applicable TIA/EIA Commercial Building Wiring Standards. Care must be taken to avoid excessive bending radii and to not over pull, microbend, kink, or overbind cable during installation.

Care is required in the management of the station cable as it enters telecommunications closets. All cables must be neatly organized, routed and secured with Velcro tywraps to the cable support systems and management hardware in an aesthetically pleasing manner. Cable must have the appearance of being combed, with no tangles. Cable overlap must be kept to a minimum.

All Category 5e cable shall be tested per Category 5e performance level standards.

Category 5 termination methods for Category 5e-station cable must be followed for termination at telecommunication closet patch panels and at station jacks. Specific care must be taken to maintain pair twists up to point of termination, or no less than within 1/2" of termination.

Horizontal UTP cable at any time will not be spliced.
All conductive cabling and associated components must comply with NFPA 70 Article 800 of the NEC (1999). Furthermore, all fiber optic cabling must comply with Article 770 of the

NEC (1999)

The following information given will to be used to assist ITD in its design and install activities.

This section will describes the procedures for the installation and design activities relating to:

Identify the type and number of outlets in the work area.

Identify the type equipment used in the work area.

Determine termination hardware requirements at the outlet

Design the structures needed to support the horizontal cabling. Sketch the route of the conduit and the cable tray on the floor plan.

Assign and document the work station identification numbers to the appropriate locations.

Verify that the distance from each outlet to the TC does not exceed 295 feet. This distance must include the planned cable path as well as any vertical transitions

Cable testing and procedures

Documentation and drawings

The Type and Configuration of Outlets

Work area outlets at the City of Phoenix fall into three general configurations:

The *basic voice only* design supports voice only applications. It consists of 2 RJ11 single jacks split between 1 one or more 4-pair plenum unshielded twisted pair (UTP) Category 5e cables. within the work station outlet.

Note: A *basic voice only* workstation outlet may be used for a wall phone, modem pool a courtesy phone, and a card reader.

The *basic data only* design supports data only applications. It consists of 2 single jack RJ45 within the work station outlet supported by one or more 4-pair plenum unshielded twisted pair (UTP) Category 5e cables.

Note: A *basic data only* workstation outlet may be used applications such as server farms, labs and computer room environments.

The *standard* design supports both voice and data applications. It consists of 4 RJ45 jacks, one voice cable split in the A position and One Data jack in the C or D position per

workstation outlet. One 4-pair plenum UTP Category 5e cable to support voice and one 4-pair plenum UTP Category 5e cable to support data. This was the most commonly used configuration at the City of Phoenix as of June 2001.

The *enhanced* design supports complex systems including voice, data and 10/100-switched applications. It consists of three RJ45 jacks, one voice jack in the A position, one Data jack in the C position and one Data jack in the D position per workstation outlet. One 4-pair plenum UTP Category 5e cable to support voice and two, 4-pair plenum UTP Category 5e cables to support the data outlets.

Note: This will become most commonly used configuration at the City of Phoenix as of June 2001.

Note: The features of these three designs may be combined in the most cost-effective manner with ITD's written approval.

Cable Types and Lengths

City of Phoenix recognizes two types of cables for use in the horizontal segment:

Unshielded twisted pair (UTP) cable will be 4-pair plenum, 24 AWG, solid conductor Category 5e and Category 3 cabling that meets or exceeds all of the latest ANSI/TIA/EIA 568-A and TIA/EIA 568-A-1
Fiber optic cable: single mode and multi-mode, graded index, and loose and tight-buffered cable.

Approved manufacturers for copper and fiber are:
Ber-Tek
Hitachi
Corning Cable
Seicor
Alcoa

Or an ITD approved equal.

All station cables shall be Category 5e plenum 4-pair unshielded twisted pair (UTP) copper cable. No substitutions will be accepted.

All cables shall be installed per EIA/TIA 568A building standards to designated stations. Voice cable shall be terminated on wiring blocks (all four pairs) within TCs and on RJ-45 modular jacks at the station end. Data cable shall be terminated on Category 5e patch panels within the TCs and on Category 5e rated RJ-45 modular jacks at the station end.

The maximum lengths of horizontal distribution cables from the workstation to the TC will not exceed 295 feet.

Patch cords and cross-connect jumpers in the TC will not exceed 20 feet

All cabling will be UL Listed Type CMP if it is placed in air-handling plenums without conduit. The cable sheath will be marked with the UL listing. (Note: all indoor cable will be plenum rated)

All patch cords cables and cross-connect that attach directly to active equipment and must meet the same performance requirements as the installed cabling system

Care must be taken to maintain minimum bending radii and to avoid kinking when dressing excess cable at termination locations.

Cable service loops must be provided at both ends of cable runs to accommodate future cabling system changes.

The minimum amount of slack must be 5 feet for UTP cables and 10 feet for fiber optic cables at the work area outlet. At the MTC and TC, slack will remain the same as the work area.

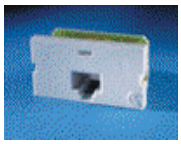
Service Loops placed during installation of 4-pair horizontal cables should be coiled neatly above the ceiling in a figure-eight configuration.
Service Loops placed during installation of fiber optic cables should be coiled neatly above the ceiling in a large loop configuration that will meet the manufactures, minimum bend radius requirements.

The service loops must be included in all testing and length calculations to ensure that the horizontal cable does not exceed 295 feet.

Termination Hardware Requirements at the Outlet

Each voice UTP plenum Category 5e cable will terminate 2 pairs to one RJ11 6-pin, 6-conductor universal T568A/B modular jack and 2 pairs to another RJ11 6-pin, 6-conductor universal T568A/B modular jack at the outlet.

Approved manufactures:
ORTRONICS: OR-60950011, OR-60950012 SERIES II, or OR-63750001 TRACJACK Module Information Outlet




Each data UTP plenum Category 5e cable will terminate all 4 pairs at the outlet with an RJ45 8-pin, 8-conductor universal T568A/B modular jack.
Approved manufactures
ORTRONICS: OR-60950011, OR-60950012 SERIES II, or OR-63750001 TRACJACK Module Information Outlet


Faceplates for any designated outlets must be from the same manufacture with coinciding part numbers for the jacks being used.

Faceplate will be a single gang 4 position configuration, for hard walls and furniture.


Workstation Identification

The workstation identification numbers are assigned by ITD. They are crucial to the implementation of service to the project. Contact the ITD installation department at 602-495-3746 to obtain blocks of Workstation Identification numbers for all project assignments.

Pre-assign the workstation identification numbers to the floor plans.

The ITD will need to know how many Voices, and Data workstation identification numbers are required.

Each workstation identification number will be pre-assigned by ITD, prior to any bid or installation.
The ITD will provide the unique 8-digit workstation identification numbers. This number is

referred to as a workstation identification number or workstation Id.

Prepare workstation identification cut sheets.

Ensure that a cross connect sheet is provided which identifies all cross connects from the workstation identification to the TC and to the MTC.

Workstation identifications are to be labeled either on a pre-printed label or they must be printed using computer-generated labels or a label maker. No workstations identification numbers will be hand written labels. Hand written labels will be accepted.

Each workstation identification number will be unique.

After workstations identification numbers have been pre-assigned to the floor plans, ITD will then input workstations identification numbers into the City of Phoenix cable management database.

Workstations identification numbers are to be completed at the beginning of Construction Document preparation. A hardcopy of the workstations identification numbers shall be provided to the installation team, as well as an Excel 2000 spreadsheet file is to be provided to ITD upon completion of the installations.

ITD will ensure that specifications are placed in the contract documents that inform the installation team regarding use of and maintenance of the workstations identification numbers for the project.

Workstations identification numbers will be configured as follows: Building, Floor, North/South/East/West when applicable and workstation outlet.

Sample: 251-6S-001

All cables shall be labeled with a computer-generated label within 6” of the Jack and within 2 to 4” from the Patch Panel.

The workstation identification number will be placed above the workstation identification on the faceplate, outlet and cubical area. ITD will provide locations for the workstation Id’s.

When a surface mounted outlet is used the top of the outlet will be labeled. The cable supporting a voice workstation identification number must be located in the A position of the faceplate.

Cross Connecting Voice workstations

ITD shall ensure that the Installers/Contractors will provide Voice workstation identification

cut sheet, which identifies all cross connections from the workstation to the TC and then to the MTC.

The Voice workstation cut sheets shall be provided by the installer/contractor to ITD as part of the final documentation.

The Voice workstation cut sheets shall be provided prior to final inspection and acceptance of the cabling work being done.

All voice cross-connect wire will be a minimum 24 AWG, twisted pair category 3

AVAYA Part # 105597264 24-1pair , color BL/W
AVAYA Part # 105617955 24-2pair
AVAYA Part # 105597512 24-4pair color BL/W/W/BL, OR/W/W/OR, G/W/WG, BR/W/W/BR
Or ITD approved equivalent

Cross-connects from the workstation outlet to the building distribution riser will be configured on a per job basis. This is dependent on the specific number of devices and or special systems the Information outlet requires.

Data Patching /Cross Connecting workstations

ITD shall ensure that the Installers and or Contractors will provide Data workstation identification cut sheet, which identifies all Patch cables, cross connections and port assignments from the workstation to the TC.

The installer and or contractor shall provide the Data workstation cut sheets to ITD as part of the final documentation.

The Data workstation cut sheets shall be provided prior to final inspection and acceptance of the cabling work being done.

All Data patch cords will be UTP stranded category 5e.

All patch cords cables and cross-connect that attach directly to active equipment must meet the same performance requirements as the installed cabling system.

Structures for Supporting the Horizontal Cabling

General: Structures for Supporting the Horizontal Cabling and for determining and providing the required materials (e.g., freestanding and wall mount relay racks, cabinets, mounting brackets, cable runway, J-hooks, cable management hardware, mounting hardware, tywraps, etc.) for supporting the systems herein described.

Special attention must be given when designing and installing the type and layout of

structures to support the horizontal cabling. The design and install must accommodate all foreseeable cabling changes needed for future capacity and applications.

The City of Phoenix requires that the spaces above the ceiling grid and or under a raised floor be used to route the horizontal cabling.

Hard walls and Power poles will be used at the work area.

Relay racks: Freestanding relay racks, Heavy Duty 19" x 84", drilled both sides per EIA/TIA with universal thread standards, properly anchored will be used. Wall mount racks will only be used with ITD written approval.

Open ceiling cabling: When cable tray is not feasible to install, cable supports (J-HOOKS) shall be used. J Hooks must be installed by means that is structurally independent of the suspended ceiling, its framework, or supports. These cable supports shall be spaced no more than 5 ft apart.

Cable Tray: Cable trays must be aluminum trays or corrugated ventilated trays. They must be at least 18 inches wide and 2 inches deep. Smaller buildings and secondary tray sections serving fewer than 50 work areas may utilize a 12 inch wide tray.

In the TC where cable trays or cable racking are used, the appropriate means of cable management such as reusable Velcro cable managers (cable ties) to create a neat appearing and practical installation must be provided

Cable trays must be secured on 10-foot centers using single center-mounted steel supporting rods and bottom "T" connector, angled wall supports, or a standard trapeze type support system.

Cable trays will be used only over areas with ceiling access and must transition to a minimum of three 4-inch conduits when routed over fixed ceiling spaces larger than 10 feet in length.

Cable trays must be grounded and bonded end-to-end.

Cable trays must extend into and down to the TC to protect cables from potential damage.

All cable tray penetrations through firewalls must allow cable installers to fire-seal around the cables after they are installed. Mechanical firestop systems will be used when a cable tray must penetrate a fire barrier.

Cable trays will not be placed within 5 inches of any overhead light fixture and within 12 inches of any electrical ballast.

Cable trays will not run above and parallel to the building lighting system.

A minimum clearance of 8 inches above the cable tray must be maintained at all times. All bends and joints in the cable trays must be fully accessible.

Conduits: Conduit is to be sized appropriately for the fill of cable it is to accommodate.

Hard walls: A 1-inch EMT conduit or larger if appropriate can be used from the workstation outlets, stub into the above ceiling.

All firewalls and or bearing walls will require a minimum 4” conduit sleeve for access between the wall.

All conduits will be firestopping accordance with fire codes as interpreted by the City of Phoenix Fire Marshal.

All firewalls shall be properly sleeved with metallic chases terminated with connectors and plastic bushings, and fire stopped per local fire codes with a re-enterable compound. Sleeves shall have connectors and plastic bushings on both ends and be properly anchored to walls (e.g., anchored unistrut with strut clamps).

Conduit will be installed with a pull string with a minimum test rating of 200 pounds.

The ends of all conduits installed will be reamed and bushed to eliminate sharp edges that can damage cables during installation.

Conduit runs must be designed and installed to:

Follow the most direct route possible with no more than two 90□ bends between pull boxes

Contain no continuous sections longer than 100 feet. Pull boxes must be used for runs that exceed 100 feet in length.

Be bonded to ground on one or both ends.

Conduit must not be run through areas in which flammable materials may be stored or over or adjacent to boilers, incinerators, hot water lines, or steam lines.

Bend Radius:

The radius of a conduit bend must be at least 6 to 10 times the diameter of the conduit, depending on its size. Choose the bend radii for conduit using the following.

2 inches or less, 6 times the internal conduit diameter
2 inches or more,10 times the internal conduit diameter

Note: For additional information on conduit bend radius requirements and recommendations, see specifications in ANSI/NFPA 70 and ANSI/EIA/TIA 569.The

guidelines used by ANSI/EIA/TIA-569 on cable capacity for horizontal conduit that have no more than two 90□ bends. The diameter of the conduit increases incrementally as the run approaches the TC from the furthest outlet. This is based on 40% fill ratio.

Back Boxes, Mud rings:

New Construction: A 4 ´ 4 ´ 2½ inch back box with a single gang plaster ring must be used at each work area for cable installations.

For existing installations a metal single gang box eliminator will be required.

Cable Testing and Procedures

General: This section describes performance tests required for Acceptance of newly installed cables. Tests shall be conducted in accordance with TIA/EIA Standards. All installed cables are to be tested.

1.1.1 These tests are designed to detect damage or errors that may have occurred in the manufacturing, placing or splicing of cable.

1.1.2 Cables with bad pairs must be properly labeled and documented in a manner, which clearly identifies the cable pairs tested and test(s) failed. Materials and installation should be of a high quality, which minimizes the number of bad pairs in any cable.

1.1.3 No bad pairs will be accepted in any cable with a total of 100 or fewer pairs. For all other cables, one bad pair per each additional 100 pairs is acceptable.

1.1.4 Acceptance Criteria: Prior to acceptance, installed cable must be thoroughly tested to demonstrate that all materials and installation will meet performance specifications.

1.1.5 No cables with bad fibers will be accepted. Cables not meeting the manufacturer performance specifications and those, and may be additionally described herein, must be replaced.

1.1.6 Acceptance Testing For Copper Backbone Cabling: Acceptance tests are to be conducted to ensure the engineering design is achieved in actual construction, and that transmission quality meets specifications and objectives described herein

a) All riser copper cable shall be tested end-to-end, after termination, using 25-pair testing equipment. All tests for each 25-pair binder group are to be documented on an ITD approved result worksheet. Cables shall be tested for the following characteristics:
b) DC Continuity
c) Reversals

d) Shorts
e) Opens
f) Overall loop resistance/cable length, Mapping
g) Attenuation
h) Continuity
i) Crosses
j) Polarity
k) Split or transposed pairs
l) Polarity
m) Grounds

1.1.7 Acceptance Testing For Fiber Optic Cabling: Acceptance tests are to be conducted to ensure the engineering design is achieved in actual construction and transmission quality meets specifications and objectives. The horizontal fiber optic cable must be tested using a double-ended loss test. The cable must be tested in-line between two reference cables. One cable will be attached to the source and the other to the meter to measure the dB loss from both connectors, as well as any dB loss associated with the cable between the connectors.

1.1.8 Basic Guidelines for Loss Measurements for Installed Fiber Optic Cables:

a) Connector loss: 0.75 dB per mated pair

b) Fiber signal loss: Multi-mode: 2.5 dB/km @ 850 nm, 2.5 dB/km @ 1300 nm

c) Fiber signal loss: Single mode: 1.0 dB/km @ 1310 nm

1.1.9 Optical source meter is stabilized and has a center wavelength within ± 20 nm of the multi-mode nominal wavelength.

1.1.10 Power meter and the light source are set to 850 nm if testing multi-mode fiber or 1310 if testing single mode fiber.

1.1.11 These tests are designed to detect damage or errors that may have occurred in the manufacturing, placing, connectorizing or the splicing of cable. The following tests must be conducted as described below and in the following order.

a) On-Reel (OTDR) Testing: Optical Time Domain Reflectometer (OTDR) testing shall be conducted on all fibers to detect damaged or attenuated fibers.

b) On-reel uni-directional test shall be conducted prior to installation of cable to assure the integrity and length of all fibers. Hard copies of OTDR strip reports, at 850 nm for multimode fiber, must be submitted to ITD prior to removal from reels.

c) OLTS Testing: Optical Loss Test Set (OLTS) testing shall be conducted for all installed multimode fibers to measure end-to-end attenuation, and installed length. Testing for multimode fiber shall be conducted Bi-directionally at 850 nm and 1300 nm. Certified test records of all OLTS test results shall be provided as documentation and will become part of the "as-built" record.

d) Optical Time Domain Reflectometer (OTDR) testing will be accepted as a substatute for OLTS or light meter tests and shall be conducted on all multimode and single mode fibers to detect damaged or attenuated fibers.

1.1.12 Acceptance Testing for Voice and Data Station Cabling: Testing will be done on all installed and terminated voice and data cables. Cable tests are to be conducted to ensure that the engineering design is achieved in the actual construction and that transmission quality meets specifications and objectives described herein. These tests are designed to detect damage or errors that may have occurred in the placing or termination of the cable.

1.1.13 Voice Cable Testing: The tests shall be performed end-to-end from each termination block on each pair of the cable, complete 4-pair testing is required in one direction for the following characteristics: Cables shall be tested end-to-end test and shall include the following:

a) DC Continuity
b) Reversals
c) Shorts
d) Opens
e) Overall loop resistance/cable length, Mapping
f) Attenuation
g) Continuity
h) Crosses
i) Polarity
j) Split or transposed pairs

1.1.14 All submitted test result documentation indicating "pass" condition with notations indicating any required repairs. Test result documentation shall be dated and signed by test technician and shall be neatly bound.

1.1.15 Data Category 5e Cable Testing: All tested, installed and terminated Category 5E 350MHz 4-pair cable shall be tested with full sweep frequency measurements from 1 MHz to 100 MHz for TIA/EIA CATEGORY 5-Link performance measurement. Complete 4-pair testing is required in both directions for the following characteristics:

1.1.16

a) Near-end-cross talk (NEXT)
b) Mapping
c) Attenuation-to-Crosstalk Ratio (ACR)
d) Length
e) Resistance
f) Impedance
g) Attenuation
h) Capacitance

1.1.17 Use of test equipment with a two-way injector that measures NEXT and ACR simultaneously from both cable ends of the link will preclude the requirement for bi-directional testing.

1.1.18 ITD requires that all Category 5E cable pairs must be tested at a minimum using a Category 5 Level II or Level III tester for full compliance with Category 5e specifications regardless of intended use.

1.1.19 All field-testing must comply with the **worst case** EIA/TIA 568A Commercial Building Telecommunications Wiring specification and must be used as a framework for testing all UTP cables at the City of Phoenix.

1.1.20 Documentation of Test Results:

1.1.21 For testers that will document results in electronic and printed form: Hard and soft (prints/disk) copies of all test results shall be provided as documentation and will become part of the "as-built" record. One set of all test results shall be neatly bound and provided prior to systems acceptance.

1.1.22 For all cables, test documentation must include the following:

1.1.23 All voice and data Category 5 test results are to be documented on a ITD approved testing sheet, along with Category 5 tester generated test results sheets.

1.1.24 All testing must include confirmation of continuity and proper pair terminations and that pairs are free of shorts, crosses, opens and polarity reversals

1.1.25 OTDR trace printouts and disk copy must be provided for all fibers installed and tested.

1.1.26 OLTS results are to be documented on installer-provided and ITD approved result worksheet.

1.1.27 All submitted test results and documentation indicating "pass" condition must have notations indicating any required repairs. Test result documentation shall

be dated as to when the test was completed.

2 THE RISER SEGMENT

2.1 Overview:

2.1.1 The Building entry Telecommunications Main Point of Presence serves as the building point of entry and the main inter-building termination point for communications services. These facilities then get extended into the Main Telecommunication Closet (MTC)/Server room

2.1.2 The building riser system provides copper and optical fiber connectivity between the MTC and the MTC and from the MTC to the TC. (Building Entrance Facilities to Computer room.

2.1.3 The riser segment consists of the riser cable and the supporting infrastructure within a building or cluster of buildings that connect the and the building distribution frame (MTC)

2.2 The Design Process:

2.2.1 This section describes the policies and procedures for the following design activities:

a) The types and sizing of the riser cable.

b) Designing the structures to support a vertically aligned riser segment.

c) Designing the structures to support a horizontally offset riser segment.

2.2.2 The riser segment must be designed one segment at a time, even though the riser cables may follow the same path.

2.2.3 The termination hardware shall be tested and labeled in accordance with ITD specifications.

2.2.4 All riser pairs cable shall be terminated on a 110-300 pair style punch down blocks in the MTC and in the TC for all new construction. For existing installs a m66 style punch down will be accepted.

2.2.5 All punch downs will be wall mounted on a minimum 4ft x 8ft ¾ in. fire treated plywood with stamp clearly visible, on all walls applicable of the MTC and the TC

2.2.6 Inside plant copper riser cables shall consist of 24 AWG, category 3 or better, CMP riser/rated, multi-pair cables

2.2.7 Every voice jack will have 2 (one) 1 pair cross connect to riser. Riser cables and station cables shall be separately terminated and linked with a 1 or 2-pair, cross

connect wire. This cross-connect wire shall be constructed of unsheathed, 24 AWG, UTP, 1 or 2-pair category 3 or better for voice.

2.3 The Size of the Copper Riser Cable

2.3.1 The size of the riser cable is a direct function of the number of voice outlets on floor being supported by the TC on that floor.

2.3.2 The most commonly available cable sizes are 50, 100, 200, 300, 600, 900 and 1200 pairs.

2.3.3 The minimum number of copper cable pairs required for each type of outlet is as follows

a) Voice Only Basic outlets = 1.5 pairs
b) Standard outlet=2.0 pairs
c) Enhanced outlets=2.5 pairs
d) Example: Type and #of outlets per TC* Riser pairs =

2.4 The Size of the Fiber Optic Riser Cable

2.4.1 The size of the fiber optic cable from the MTC to the TC will be no less than a 12-strand multimode.

2.5 Structures to Support Vertically Aligned TC's

2.5.1 TCs that are vertically aligned must be connected with sleeves. A sleeve is a circular opening through the ceiling or floor of a TC that allows the passage of cables and wires.

2.5.2 3 4" sleeves it the TC is minimum.

2.5.3 Sleeves and slots must be positioned with in 12" of a near wall on which the riser cables can be supported.

2.5.4 Sleeves are not be placed directly above or below the termination fields.

2.5.5 All sleeves installed must conform to the National Electrical Code (NEC) and local fire codes.

2.5.6 Sleeves must not be left open after cable installation and they must be properly fire-stopped at all times in accordance with all applicable building codes.

2.5.7 Sleeves must extend a minimum of 4 inches above the floor level.

2.5.8 Sleeves shall have connectors and plastic bushings on both ends and be properly anchored to walls (e.g., anchored unistrut with strut clamps)

2.5.9 Rigid conduit sleeves must be 4 inches in diameter unless a structural engineer requires a smaller size or obstructions are present. They must be fitted with plastic bushings on both ends and equipped with pull strings.

2.5.10 All unused sleeves must be filled and capped.

2.5.11 In a multi-story building, cable grips must be specified to support the riser cable's weight as it passes through the TC.

2.5.12 The minimum number of 4-inch sleeves that must be used based on the total feet that the sleeves support.

2.5.13 Up to 50,000 sq. = 4, 4”

2.5.14 50,000 to 100,000sq.= 5, 4”

2.5.15 100,000 to 300,000sq.=5-8, 4”

2.6 Structures to Support Horizontally Offset TC

2.6.1 ITD recommends stacking all TC within a building, IDT also understood that there are times when this cannot be met.

2.6.2 TCs that are not vertically aligned must be connected with cable trays and or conduits.

2.6.3 Determine the number of conduits required. This number is the same as the number of sleeves required if the TCs had been vertically stacked.

2.6.4 Pull boxes are required in sections of conduit that are 100 feet or more in length or that contain more than two 90° bends. Pull boxes must not be used in lieu of a bend.

2.6.5 Cable trays and conduit that are used to support horizontal cabling may be used to support riser cables provided the following conditions are met:

a) The cable trays' carrying capacity can accommodate the riser cables.

b) The riser cables must be UL Listed Type CMP or OFNP if they are run in a air-handling plenums without conduit.

c) The riser cables conform to NEC Article 800-3(b)(1), NEC Article 800-3(b)(3), and comply with the State of California fire codes as interpreted by the State Fire Marshal's department.

d) Conduit will be used to route the riser cables between the TC.

e) Cable tray can be used if the Horizontal cable and riser cable are in separate tray.

f) Conduit will be grounded at each end.

g) Conduit will be installed with a true tape and bushings at both to protect the cable from damage

2.6.6 Cable trays and conduits that enter the TC must be placed near the corner and as close as possible to the wall where the backboard is mounted to allow for proper cable racking and to minimize the cable route inside the TC.

2.6.7 Cable trays and conduit located in the ceiling must protrude into the TC 1 to 2 inches and above 71/2 feet above the finished floor.

2.6.8 Conduit must be grounded using a path other than the telecommunications ground provided in the TC.

2.6.9 All riser cables are to be labeled based on a cable number assigned by ITD. The number of cable pair will also be included in this label.

3 THE CAMPUS and MAN SEGMENTS

3.1 The Design Process

3.1.1 These specifications provide a minimum configuration that must be used when planning a campus or Metropolitan Area Network (MAN) segments. ITD must be consulted during the early utilities planning phase of a project to provide technical requirements that require a modification of these specifications.

3.1.2 The campus and Metropolitan Area Network (MAN) segments consists of the cables and structures needed to inter-connect building to building and building to metro area distribution frames (MADFs). It includes underground conduit, underground cables, direct buried cables, splice boxes, manholes, pull boxes, aerial cables, pole lines, outside terminals, and support structures.

3.1.3 This section describes the activities for identifying cable routes from building to building selecting cable distribution methods, determining the underground and direct buried cable requirements identifying the types of cable used in the segment, determining splice boxes, manholes, pull boxes requirements, determining aerial cable requirements and satisfying electrical protection and bonding/grounding requirements

3.1.4 All campus and MAN segments must be designed and installed to BICSI, Customer-Owned Outside plant manual and ANSI/EIA/TIA-758 Specifications for Outside Plant Construction.

3.1.5 The cable routes steps must be taken to identify the routes between new buildings and major building renovations.

3.1.6 Obtain a MAN and or campus layout drawing.

3.1.7 Determine where the cable entrance points are for each building.

3.1.8 Sketch the cable route from the starting point to the terminating point in the buildings to be served.

3.1.9 Note any obstacles, existing cable facilities, or other underground utilities on the campus layout map.

3.1.10 Note and document all of the right-of-ways and easements, to determine if permits required.

3.1.11 Review proposed cable route to determine if conditions exist that require would require an environmental impact. Identify all possible sources of future cable maintenance problems.

3.2 Cable Distribution

3.2.1 ITD and City of Phoenix engineers must be contacted to determine the best cable distribution method along a proposed cable route. The methods used may be one or a combination of the following.

a) Underground cable in conduit
b) Direct buried cable
c) Directional boring,
d) Aerial.

3.2.2 Underground cable systems consists of cables placed in buried conduits, using manholes and/or pull boxes for splices in large runs. The conduit runs from the building entrance location to a pole, pedestal, or manhole. ITD recommend that all outside plant cabling be placed in conduits.

3.2.3 Direct buried cable systems consist of cables and associated splices directly placed in the earth. The trench runs from the building entrance location to a pole, pedestal, or manhole. This is not an ITD recommended distribution method.

3.2.4 Aerial cable systems is installed on aerial supporting structures such as poles, sides of buildings, and other above ground structures.

3.3 Underground Conduits and Direct Buried Cable Requirements.

3.3.1 Underground cabling in conduit and direct buried cable projects must be worked from engineering drawings approved by ITD and EAS (Engineering and Architectural Services).

3.3.2 All submitted drawings and documentation must include the following information.

a) Submittals and/or details of a typical trench cross sections showing cable and duct locations in the trench, clearances from final grade, backfill materials and depths, pavement cutting information, and compacting requirements for both paved and unpaved areas.

b) Construction notes applicable to the work being performed.

c) Scale drawings showing location ties to existing structures, cable, conduit, utility boxes, and any conflicting substructures and profile drawings of congested areas where vertical and horizontal separation from other utilities is critical during cutting and placing operations and any other areas as requested by ITD.

d) Legends explaining symbols of all relevant structures and work operations.

e) Cable types counts, and directions of feed.

f) Conduit types, dimensions, and wall-to-wall measurements when used with pull boxes splice boxes, manholes.

g) Manhole drawings showing cable-racking information, applicable cable counts conduit assignments, splicing details, north point arrows, and street names. Manhole drawings must be consistent with ITD standards.

3.3.3 All areas around the conduit entrances must be free of any construction, storage, or mechanical apparatus.

3.3.4 Conduit stubs entering the building must extend beyond the foundational landscaping. All conduit ends adjacent to the building must be flagged for easy identification

3.3.5 All entrance conduits must be securely fastened to the building to withstand a typical placing operation.

3.3.6 All unused entrance conduits must be capped and installed with pull strings

3.3.7 Conduit entering from a below grade point must extend 4 inches above the finished floor.

3.3.8 Conduit entering from ceiling height must terminate 4 inches below the finished ceiling.

3.3.9 All cables entering a building must conform to the grounding and bonding requirements listed in NEC Articles 250 and 800.

3.3.10 Conduit must be positioned on the field side of the poles. The field side refers to the side that is protected from the normal flow of traffic.

3.3.11 All utilities need be identified and located prior to any digging. This is to locate all subsurface facilities such as power, gas, water, traffic and outdoor lighting.

3.3.12 Warning tape color orange for the telecommunications cables containing metallic tracings must be placed a minimum of 18 inches above the buried conduits and or cables to minimize any chance of an accidental dig-up.

3.3.13 The minimum depth of a trench must allow 24 inches of cover from the top of the cable to the final grade point. See NEC 300-5 for condition pertaining to other depths.

3.3.14 The following minimum vertical or horizontal separations that must be maintained between telecommunications facilities and other facilities sharing a common trench.

a) Power or other foreign conduits: 3” of concrete, 4” of masonry, or 12” of well-tamped earth.

b) Pipes such as gas, oil, water: 6” when crossing, 12” when parallel

c) Railways: 3’ below top of rails.

3.3.15 Conduit must be encased in concrete when the following conditions exists:

a) Minimum conduit depth cannot be attained

b) Conduit must pass under roads, driveways, railroad tracks, or when bend points are subject to movement.

3.3.16 Reinforcing bars and or crutches within the concrete must be used at any location subject to potentially extreme stress.

3.3.17 The inside-the-building end of the conduit must be sealed to prevent rodents, water, or gases from entering the building.

3.3.18 All bends must be long, sweeping bends with a radius not less than 6 times the internal diameter of a conduit 2 inches or smaller, or 10 times the internal diameter of a conduit larger than 2 inches.

3.3.19 Conduit must be PVC Schedule 40, corrosion-resistant plastic with a 4 inch inside diameter

3.3.20 There must be no more than two 90□ bends between pulling points on all entrance cables

3.3.21 Conduit bends that extend above ground are to be metallic.

3.3.22 All metallic conduit and sleeves must be reamed, bushed, and capped.

3.3.23 Metal sleeves through foundation floors and or walls must extend to undisturbed earth to prevent shearing.

3.3.24 All open conduits must be provided with a # 12 Tracer wire with a minimum pull tension of 200+ pounds.

3.3.25 The City of Phoenix minimum number of conduits standard for any installation of cable will be:

a) 3 -4” conduits, 2 open, 1 filled with 2-1.5 inch 1-1 inch interducts.

3.3.26 The quantity and size of underground entrance conduit are based on the anticipated number and type of telecommunications circuits that will be brought into the building. ITD requires 2 entrance pairs per 100 square feet of usable office space. The following shows the data for determining the quantity and size of underground entrance conduit.

3.3.27 Telephone Entrance Copper Pairs Conduit Required

a)	1 – 1000	1 each 4-inch conduit + 2 spare 4-inch conduit
b)	1001 – 2000	2 each 4-inch conduit + 2 spare 4-inch conduit

3.3.28 Fiber optic Entrance Cable Conduits Required

a)	2-48 strand	1 each 4-inch conduit + 2 spare 4-inch conduits + 3 Interducts
b)	48+	2 each 4-inch conduit + 2 spare 4-inch conduits +3 Interducts

3.3.29 If installing both fiber and copper cable utilize the City of Phoenix minimum standard.

3.3.30 All conduits containing interducts must be provided with a # 14 Tracer wire.

3.4 **Cable Types**

3.4.1 ITD recognizes two types of cable for outside use in the campus and MAN segments: copper cable and fiber optic cable.

3.4.2 Indoor/Outdoor copper and fiber cable will be used in all outside plant installs.

3.4.3 Filled polyethylene-insulated conductor (PIC) cable must be used for direct buried copper cable. Filled cable preserves the integrity of the cable by providing physical protection against moisture penetration and seepage.

3.4.4 Direct buried cable requires an armored sheath to resist rodent and penetration type damage.

3.4.5 All cables must be marked with cable length, cable code, date and location of manufacture, and manufacturer.

3.4.6 The following standard designations for copper exchange cable have been assigned by the Rural Utilities Services (RUS): PE-39 refers to filled cable with

solid insulation for direct-buried applications. PE-89 refers to filled cable with an expanded insulation for direct-buried applications.

3.4.7 Indoor/Outdoor Fiber Optic Cable Construction is to be:

3.4.8 Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 mm.

3.4.9 Each buffer tube shall contain up to 12 fibers.

3.4.10 The fibers shall not adhere to the inside of the buffer tube.

3.4.11 Each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-A, Optical Fiber Cable Color Coding.

3.4.12 The cable shall contain at least one ripcord under the sheath for easy sheath removal of all-dielectric cable.

3.4.13 The cable shall contain at least one ripcord under the inner sheath and under the steel armor for armored cable.

3.4.14 The dielectric yarns shall provide tensile strength. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

3.4.15 All dielectric cables (non-armored) shall be sheathed with medium density polyethylene (MDPE).

3.4.16 Armored cables shall have an inner sheath of MDPE. The armor shall be a corrugated steel tape, plastic-coated on both sides for corrosion resistance, and shall be applied around the outside of the water blocking tape with an overlapping seam with the corrugations in register.

3.4.17 The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C and Grades J4, E7 and E8.

3.4.18 All cable jackets or sheaths shall be free of holes, splits, and blisters.

3.4.19 The cable jacket shall contain no metal elements and shall be of a consistent thickness.

3.4.20 Cable jackets shall be marked with manufacturer's name, sequential meter or foot markings, month and year or quarter and year of manufacture, and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC).

3.4.21 The actual length of the cable shall be within -0/+1% of the length markings.

3.4.22 The cable jacket of a cable containing two different fiber types (hybrid construction) shall be marked to indicate quantity of each fiber type, identity of each fiber type, and the fiber sequence.

3.4.23 The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term), and 890 N (200 lbf) long term installed.

3.4.24 Performance Single Mode:

3.4.25 Chromatic Dispersion

3.4.25.1 Minimum Zero Dispersion Wavelength: 1301.5 nm
3.4.25.2 Maximum Zero Disperison Wavelength: 1321.5 nm
3.4.25.3 Maximum Zero Dispersion Slope: 0.090 ps/nm2 per km

3.4.26 Dispersion:

3.4.26.1 <-3.2ps/(nm.km) from 1285 nm to 1330 nm
3.4.26.2 <18 ps (nm.km) at 1550 nm

3.4.27 Polarization Mode Dispersion: <- 0.5 ps/km

3.4.28 Attenuation:

3.4.28.1 Point Discontinuity: <-0.10 dB at 1310 nm or 1550 nm
3.4.28.2 Water peak attenuation at 1383 (+-) 3nm : <- 2.1 dB/km
3.4.28.3 Bending Attenuation: induced @ 1550 nm, with 100 turns on 75mm diameter mandrel >0.10dB
3.4.28.4 Water Immersion: Induced attenuation, 23 degrees C water immersion: <- 0.05dB/km

3.4.28.5 ITD approved manufacturer

a) Corning
b) Seicor
c) Bertek
d) Hitachi
e) Or approved equal.

3.4.29 Multimode Performance:

3.4.30 Bandwidth: (1) 850 nm >220 MHz at 1 km (2) 1300 nm> 600 MHz at 1 km

3.4.31 Chromatic Dispersion:

3.4.31.1 Minimum Zero Dispersion Wavelength 1332 nm

3.4.31.2 Maximum Zero Dispersion Wavelength: 1354 nm
3.4.31.3 Maximum Zero Dispersion Slope: 0.098 ps/nm^2.km

3.4.32 Attenuation: Max attenuation point discontinuity: <0.2 dB at any design wavelength.

3.4.33 Bending Attenuation: induced @ 1550 nm, with 100 turns on 75mm diameter mandrel: <0.10dB.

3.4.34 ITD approved manufacturer

a) Corning
b) Ber-Tek
c) Hitachi
d) Or approved equal.

4 THE TELECOMMUNICATION CLOSET

4.1 The Design Process

4.1.1 Overview: The Telecommunication Closet (TC) is the space where the voice and data horizontal cable is terminated on patch panels, 110-blocks, connector panels, and is were the cross-connect to the riser cable is located.

4.1.2 The TC supports the voice, data, and other low voltage needs of one floor of a building.

4.1.3 The TC may also be used to support other building information systems such CATV, alarms, security, audio/Video, 800mhz radio, other wireless systems, and other telecommunications low voltage systems.

4.1.4 A MTC and TC can be collocated within the same room. Additional space, racks, electrical and cable management are required to support the MTC.

4.2 The Size of the TC

4.2.1 The size of the TC depends on its function and the size of the usable floor space it will serve.

4.2.2 Usable floor space refers to the occupied areas used for normal daily work functions.

4.2.3 There must be at least a minimum of one TC per floor

4.2.4 Multiple TCs are required if the usable floor space to be served exceeds 10,000 square feet or the cable length between the work area outlet and the horizontal cross-connect in the TC exceeds 295 feet or 90 meters.

4.2.5 Additional floor space in the TC will be required for additional applications such as Video Distribution cabling, equipment, fire alarm panels and/or building monitoring equipment.

4.2.6 The minimum TC sizes shown are based on providing telecommunications service to one individual work area of 100 sq. ft. Minimum TC sizes are as follows:

a) 5,000sq. or less = 10 × 8 finished room size

b) 5,000 to 8,000= 10 × 10 finished room size

c) 8,000 to 10,000= 10 × 12 finished room size

4.3 The Location of the TC

4.3.1 Since the TC is the main focal point for many communications services located for a specific floor, it must be designed as an integral part of the overall building.

4.3.2 The TC must be located as close as possible to the center of, and on the same floor as, the workstation area it serves , this will minimize the horizontal cable lengths.

4.3.3 Access to the TC must be located directly from hallways, not within classrooms, offices, and electrical or mechanical spaces.

4.3.4 The TC must be located above any threat of flooding. All water threats must be removed or contained. TC with a water threat located within the space at a minimum and if approved by ITD will require a drain.

4.3.5 At no time is a TC to be located near power supply transformers, elevator or pump motors, generators, radio transmitters, and other potential sources of electromagnetic interference.

4.3.6 TCs must not share space with electrical, janitorial, or storage facilities.

4.3.7 TCs must be stacked vertically in a multi-story building. Special conditions will need prior approval from ITD.

4.3.8 When secure and controlled access to a TC cannot be guaranteed, free standing or wall mounted lockable cabinets will be used.

4.3.9 At all time the locations of the TCs must be submitted for inclusion in the construction drawings, and they must be annotated on any and all floor plan.

4.4 Design Requirements

4.4.1 Major factors that must be considered when designing the TC are as follows:

4.4.2 Minimum ceiling height must be 8 feet, 6 inches.

4.4.3 The doors must be a minimum of 3 feet wide and 6 feet, 8 inches tall. The doors must be lockable.

4.4.4 The floor must be sealed concrete or a VCT type tile to minimize dust and static electricity.

4.4.5 There must be continuous and dedicated environmental control (24 hours per day, 365 days per year).

a) Heating, ventilation, and air conditioning sensors and control equipment must maintain the room temperature between 64° F and 87° F.

b) The relative humidity must be 20% to 80%.

4.4.6 The TC must not have a drop tile or other false ceiling.

4.4.7 The lighting in the TC must provide a minimum equivalent of 50 foot-candles when measured 3 feet above the finished floor.

4.4.8 All light fixtures must be mounted a minimum of 8 feet, 6 inches above the finished floor.

4.4.9 All controls and light switches must be located inside the room.

4.4.10 All walls must be lined with 3/4-inch fire treated plywood with stamp clearly visible, 8 feet high, as measured 3" from finished floor.

4.4.11 3/4-inch AC Grade plywood can be used if painted with two coats of white fire-retardant paint.

4.4.12 The plywood must be securely fastened to the wall-framing members.

4.5 **Minimum electrical requirements for the TC are as follows:**

4.5.1 A minimum of four dedicated 3-wire 120V AC quad electrical outlets on separate branch circuits and 20-ampere rated.

4.5.2 Separate duplex 120V AC convenience outlets (for tools, test sets, vacuums, etc.) installed at least 18 inches above the finished floor at 6-foot intervals around perimeter walls.

4.5.3 Each TC must be provided with an electrical ground on a system and building sized buss bar as defined by NEC Article 250-71(b).

4.5.4 Buss bars must be mounted 6 feet, 6 inches above the finished floor if ladder racking is included in the design. If ladder racking is not part of the design,, buss bars must be located near, but not behind, the riser sleeves between floors.

4.5.5 This grounding bar must be connected to a main building ground electrode, and it must be common to all TCs. *Reference ANSI/EIA/TIA-607.*

4.5.6 All grounding systems must be provided in the TC, MTC and MDF which shall include but not limited to, cable bonding, cabinet and relay rack ground kits with #6 THHN wire, ground busses, and ground clamps.

4.5.7 All grounds are to be installed per ANSI/TIA/EIA-607, *Grounding and Bonding Requirements for Telecommunications in Commercial Buildings.*

4.6 Termination Hardware Requirements in the TC

4.6.1 They must be wall mounted or rack mounted in either equipment racks or enclosed data cabinets.

4.6.2 Space for terminations of each type of cable must be located on one continuous wall or rack.

4.6.3 A clear space of at least 8 inches above and below the connecting hardware must be provided for cabling handling

4.6.4 There must be additional backboard space for routing cables, patch cords, and/or cross-connect jumpers

4.6.5 The horizontal cabling must be terminated on, RJ45, 110 type, patch panels for data cabling and 110 type punch blocks for the voice cabling, in the TC.

4.6.6 All UTP data cables must be terminated on 24 or 48 fixed-port high density Category 5e patch panels which are to mounted on wall racks, in a free standing equipment rack, or in an enclosed data cabinet

4.6.7 For smaller installations, smaller port density patch panels can be used if approved by ITD.

4.6.8 Patch panels must support RJ-45 modules wired to the TIA/EIA 568-A standard on the front, and have 110-style IDC connectors on the back.

4.6.9 Patch panels must be clearly labeled with a type or computer generated label above the RJ45 module.

4.6.10 The City of Phoenix approved manufacturer for all data patch panels is
- a) Ortronics
- b) Or a ITD approved equivalent

4.6.11 110-type Wiring Blocks for all Voice cabling will be used.

4.6.12 The connecting block shall support the appropriate Category 3/5 applications, will use either cross-connect wire or patch cords.

4.6.13 The blocks shall: Be made of flame-retardant thermoplastic, with the base consisting of horizontal index strips for termination up to 25-pairs of conductors.

4.6.14 Be available in 50-, 100-, and 300- pair sizes. Have detachable standoff legs.

4.6.15 Contain access opening for rear to front cable routing to the point of termination.

4.6.16 Have termination strips on the base to be notched and divided into 4 or 5-pair increments.

4.6.17 Have clear label holders with the appropriate inserts available. The insert labels provided with the blocks shall contain vertical lines spaced on the basis of circuit size (1-, 3-, 4- or 5-pair) and shall not interfere with running, tracing or removing cross connect wire/patch cords.

4.6.18 Have bases available in 19-inch panels and high-density frame configurations for rack or wall mounting with cable management hardware.

4.6.19 Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords.

4.6.20 All connecting blocks shall be available in 2-, 3-, 4-, and 5-pair sizes.

4.6.21 All connecting blocks shall have color-coded tip and ring designation markers and be single piece construction.

4.6.22 Have connecting blocks with a minimum of 200 re-terminations without signal degradation below standards compliance limit.

4.6.23 All connecting blocks must support wire sizes of Solid 22-26 AWG

4.6.24 All bases and blocks must be UL LISTED 1863, ANSI/TIA/EIA-568-A, ISO/IEC 11801 and Category 5e compliant and meet TIA/EIA proposed Category 5e electrical performance.

4.6.25 Fiber optic cables will be terminated on Connector panels in a fiber distribution cabinet

4.6.26 All terminated fibers shall be properly dressed and mounted in Rack-Mount fiber connect panels.. All patch panel bulkhead spaces must contain either connector panels or blank panels.

4.6.27 16-gauge heavy steel rack mount patch panels are required

4.6.28 The Patch panel connector panels shall contain multimode and or single mode (ceramic ferrule) connector coupling compatible with the ceramic ST connectors.

4.6.29 Multimode connector panels must be preloaded with metal inserts.

4.6.30 The single mode connector panel must be preloaded with 568SC adapters with ceramic inserts. Color of connector shall be blue or beige.

4.6.31 A minimum 12 strand Fiber housing units will be used to mount all terminated fiber in the TC.

4.6.32 The fiber-housing unit must be configured with fiber patch cable troughs to assist in cable management.

4.6.33 Relay Racks shall be freestanding relay racks, CPI Heavy Duty 19" x 84", drilled both sides per EIA/TIA universal thread standards, and properly anchored

4.6.34 Cross-connect fields, patch panels, and active equipment in the TC must be placed to allow all cross-connections and interconnections via jumpers, patch cords, and equipment cables whose lengths per channel do not exceed:

a) 20 feet per patch cords or jumpers in the horizontal cross-connect.
b) 33 feet total for patch cords or jumpers and line cords used to connect to the outlet.

4.7 Structures to Support the Cabling in the TC

4.7.1 A 3-foot working clearance must be maintained in the front and in the back of each equipment rack, and a 2-foot working clearance must be maintained at both ends of the equipment rack or rack rows. This clearance must be measured from the outermost surface of the equipment and connecting hardware rather than from the equipment rack since some of these devices may extend beyond the equipment rack

4.7.2 Ladder racking, equipment racks, plywood backboards, data equipment cabinets, and wire management brackets must be used in the TC to keep the cabling and equipment organized, and to allow the cable plant to be installed to ITD's, BICSI distribution methods and EIA/TIA 569 specifications.

4.7.3 Ladder racking must be used to route bulk telecommunications cables within the TC.

4.7.4 Ladder racking must be at least 12 inches wide and placed 7 feet above the finished floor to coincide with the top of the equipment racks and/or cabinets.

4.7.5 All ladder racking must be bonded and grounded to the ground point in the TC.

4.7.6 Free Standing Equipment racks must be as noted in 5.5.29, 19 inches wide by 84 inches tall, double sided with ANSI/EIA-310D spacing and 12-24 threads.

4.7.7 All racks and cabinets must be grounded and bonded to the ground point in the TC.

4.7.8 Equipment and connecting hardware may be wall mounted on a plywood backboard that is permanently attached to the wall and treated with a nonconductive, fire-resistant covering.

4.7.9 Wire management brackets must be used to manage cables and jumpers.

THE MAIN TELECOMMUNICATIONS CLOSET

4.8 Overview: The Main Telecommunication Closet serves as the main inter-building termination point for communications services

4.8.1 The Main Telecommunication Closet MTC (also known as a computer room) is the room that houses the telecommunications equipment that meets the voice, data, and other low voltage needs of an entire building. This equipment may include Private Branch Exchange (PBX), switching nodes, local area network hubs, and video distribution equipment, and/or network routers

4.8.2 The MTC contains cross-connect facilities for terminating cables and for connecting the horizontal and riser segments to each other and to telecommunications equipment. The MTC may also support other building information systems such CATV, alarms, security, audio, and other telecommunications systems.

4.8.3 A MTC can be collocated with a TC and/or a Building Entry Telecommunications Main Point of Presence. Additional racks, electrical and cables management will be required. The quantity of additional equipment is dependent upon the quantity of workstations that must be supported.

4.9 The Design Process

4.9.1 Whether the space is separated or combined with the building service entrance, it is, by definition, a specialized area. This room will house sensitive electronic components that will generate heat 24 hours a day, 365 days a year, and must be cooled to maintain operating performance.

4.9.2 The air handling system for equipment rooms must be designed to provide positive airflow and cooling even during times when the main building systems are shut down. This may require separate air handlers and/or small stand-alone cooling systems that are thermostatically controlled in this space.

4.9.3 If this room is to be used as an Metro Area Distribution Facility (MADF), the air handling system should be connected to the building's backup power generation system.

4.9.4 Because this room will house sensitive electronic components and is a specialized area. Detailed attention to the design will need to be done.

4.10 **Design Requirements**

4.10.1 Most of the requirements for the MTC are transparent ton the TC.

4.10.2 The major factors that must be considered when designing the MTC are as follows:

4.10.3 The minimum ceiling height must be 8 feet, 6 inches.

4.10.4 Ceiling protrusions must be placed to assure a minimum clear height of 8 feet 6 inches to provide space over the equipment frames for cables and suspended racks.

4.10.5 The doors must be double doors that are 6 feet wide by 7 feet, 6 inches tall. The doors shall be keyed and or badge accessible only to the department directly responsible.

4.10.6 The floor must be raised floor, sealed concrete or tile to minimize dust and static electricity.

4.10.7 There must be continuous and dedicated environmental control, 24 hours per day, 365 days per year.

4.10.8 Heating, ventilation, and air conditioning sensors and control equipment must be located in the MTC.

4.10.9 The room temperature must be maintained between 64□ F and 80□ F.

4.10.10 The relative humidity must be 30% to 55%.

4.10.11 Heat load is 5,000 BTUs per hour average per cabinet, equipment rack.

4.10.12 Positive air pressure differential must be maintained with respect to surrounding areas.

4.10.13 The lighting in the MTC must provide a minimum equivalent of 50 foot-candles when measured 3 feet above the finished floor.

4.10.14 The light fixtures must be mounted a minimum of 8 feet, 6 inches above the finished floor.

4.10.15 The light switches must be located inside and near the entrance of the MTC.

4.10.16 Power for the lighting must not come from the same circuits as power for the telecommunications equipment.

4.10.17 The MTC electrical requirements must be provided based on the equipment needs.

4.10.18 Outlets are to be located on active equipment racks 24" AFF.

4.10.19 Separate duplex 120V AC convenience outlets (for tools, test sets, etc.) must also be installed at 18 inches above the finished floor at 6-foot intervals around perimeter walls.

4.10.20 The MTC must be provided with an electrical ground pursuant to NEC Article 250-71, ANSI/EIA/TIA-607.

4.10.21 Acoustic noise levels in the MTC must be maintained to a minimum by locating noise-generating equipment outside the MTC.

4.10.22 Additional equipment such as fire alarm panels and/or building monitoring devices must not be housed in the MTC. Separate space for these services can be provided as part of the electrical room or in a separate space.

4.11 The Size of the MTC

4.11.1 The size of the MTC depends on the size and variety of the equipment to be installed and the size of the area that the room will serve.

4.11.2 The MTC must provide enough space for all planned equipment and cables, including any environmental control equipment, power distribution units/conditioners, and uninterrupted power supply systems that will be installed there.

4.11.3 The MTC must also provide space for access to the equipment for maintenance and administration, and for equipment changes with minimal disruptions.

4.11.4 The MTC should be sized according to the equipment's needs. And not by the square foot print.

4.11.5 The minimum size of the MTC can be determined as follows:

4.11.5.1 In a MTC dedicated to communications and if the environment allows open equipment cabinets or racks, a 19" x 84" space will be utilized with 6" vertical cable management on each side. This equates to a 32" per equipment bay. A minimum of three bays will be installed in any size building with a wall minimum of 10 feet.

4.11.5.2 A minimum of 2 feet shall be left at the end of the row of equipment bays. A minimum of 5 feet between walls and equipment bays will allow space for wall mounted copper cable terminations and the required 36" distance from equipment for workspace.

4.11.5.3 In larger size buildings requiring additional rows of equipment bays, the bays shall be lined up in rows with 5 feet between the rows and walls.

4.12 The Location of the MTC

4.12.1 The MTC must be located as close as possible to the building entrance so that it is accessible for the delivery of large equipment.

4.12.2 The MTC must not be located in any place that may be subject to water or steam infiltration, humidity from nearby water or steam, heat, and any other corrosive atmospheric or environmental conditions.

4.12.3 The MTC must not be located near electrical power supply transformers, motors, generators, transmitters, radar transmitters, induction heating devices, and other potential sources of electromagnetic interference.

4.12.4 The MTC must not share space in or be located near electrical closets, boiler rooms, washrooms, janitorial closets, and storage rooms.

4.13 Termination Hardware Requirements in the MTC

4.13.1 The MTC serves as the main cross-connect for riser cables and common equipment circuits coming from the PBX, and riser cables that extend to the TCs. Campus cables and service provider cables are also cross connected in the MTC.

4.13.2 ITD has standardized on the 110-type blocks for voice cabling.

4.13.3 See section 6 for 110 block details

4.13.4 The distribution cabinets must be configured with jumper troughs to aid in jumper management, and they must be racks mounted in either equipment racks or enclosed data cabinets.

4.13.5 Cabinets are used in lieu of equipment racks based upon. Security, and cleanliness of the room in which the proposed equipment rack is to be placed.

4.13.6 If the communications room is a single use room, for communications access only, and is a secure, heated and cooled space with appropriate lighting, racks can be used in lieu of cabinets.

4.13.7 All midsize/larger MTCs and ADFs require cabinets. 4. UTP cables supporting data workstations must be terminated on Category 5e patch panels (see section 6).

4.13.8 Space for voice and data terminations must be located on one continuous wall or rack.

4.13.9 There must be a clear space of 6 to 8 inches above and below the top and bottom of the connecting hardware for cabling handling.

4.13.10 There must be additional backboard space for routing cables, patch cords, and/or cross-connects jumpers.

4.13.11 Cross-connect fields, patch panels, and active equipment in the MTC must be placed to allow cross-connections and interconnections via jumpers, patch cords, and equipment cables whose lengths per channel do not exceed. 20 feet per patch cords or jumpers in the horizontal cross-connect and 33 feet total for patch cords or jumpers and line cords used to connect to the outlet.

4.14 Structures to Support the Cabling in the MTC

4.14.1 Some of the Structures to Support the Cabling in the MTC are the same as the TC (see section 6 for details).

4.14.2 Ladder racking, equipment racks, data equipment cabinets, and wire management brackets must be used in the MTC to keep the cabling and equipment organized, and to allow the cable plant to be installed to EIA/TIA 569 specifications.

4.14.3 Cable Tray and Ladder racking must be used to route bulk telecommunications cables within the MTC.

4.14.4 Cable tray and Ladder racking must be at least 12 inches wide and placed under a raised floor or 7 feet above a finished floor to coincide with the top of the equipment racks and cabinets.

4.14.5 Cable Trays and Ladder racking must provide a proper clearance from HVAC ducting or other obstacles.

4.14.6 All cable trays and ladder racking must be bonded and earthed.

4.14.7 Free Standing Equipment racks must be 19 inches wide by 84 inches tall, double sided with ANSI/EIA-310D spacing and 12-24 threads.

4.14.8 Enclosed Cabinets are equipped with 10-32 threads

4.14.9 3-foot working clearance must be maintained in the front and in the back of each equipment rack, and a 2 foot working clearance must be maintained at both ends of the equipment rack or multiple rack assemblies. This clearance must be measured from the outermost surface of the equipment and connecting hardware

rather than from the equipment rack since some of these devices may extend beyond the equipment rack.

4.14.10 The equipment racks must meet, all grounded and bonded requirements to the TGB in the MTC.

4.15 Cable Pathway Entering the MTC

4.15.1 Sleeves, slots, and conduits are used to route the cables entering and exiting the MTC. The cross-connect points must be located near the end of the riser pathways to minimize the need for cable routing in the MTC.

4.15.2 Sleeves must conform to the firestopping requirements as established by the National Electrical Code (NEC) and local fire codes.

4.15.3 Sleeves must not be left open after cable installation and they must be properly firestopped in accordance with applicable building codes. All conduits will be firestopped in accordance with fire codes as interpreted by the State Fire Marshal

4.15.4 Conduit will be metallic conduit, 4 inches in diameter.

4.15.5 The conduit will be grounded on both ends.

4.15.6 The conduit will be equipped with a pull string.

4.15.7 The conduit ends will be bushed to protect the cable.

5 SPECIAL SYSTEMS

5.1 Radio Communications equipment and cabling shall be installed in accordance with manufacturer instructions and the Motorola R-56 Quality Standards manual. The City of Phoenix Cabling System Standards Document will apply in situations where the R-56 manual does not.

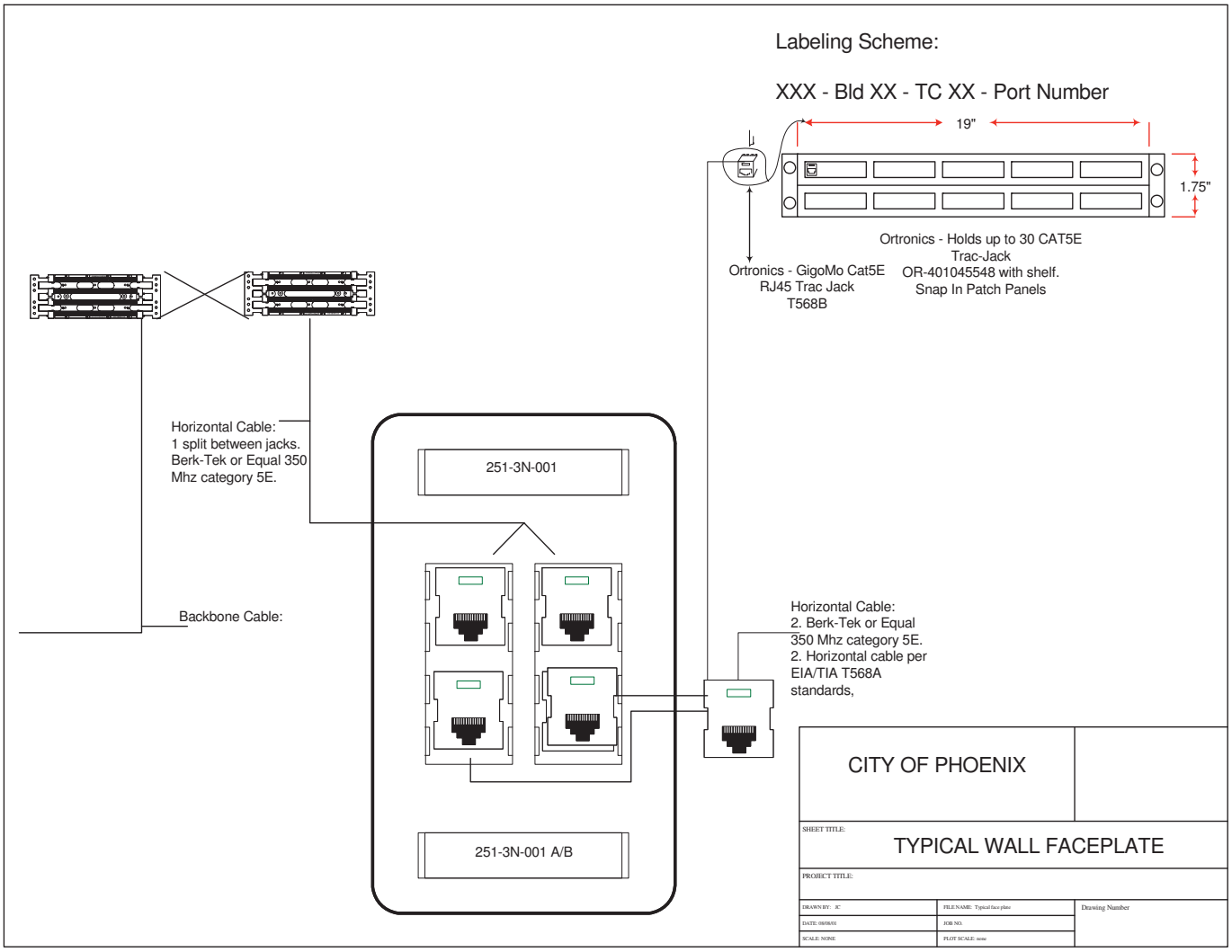
5.2 Special Circuits. Since special circuits (such as data circuits, T1s, or alarms) are usually non-switched, they shall be treated differently than voice and modem circuits. The protector modules shall be marked to indicate a special circuit. Various colors of protector modules are available to help in this differentiation. The special circuits shall be cross connected to designated blocks on the horizontal side. (not to the switch blocks).

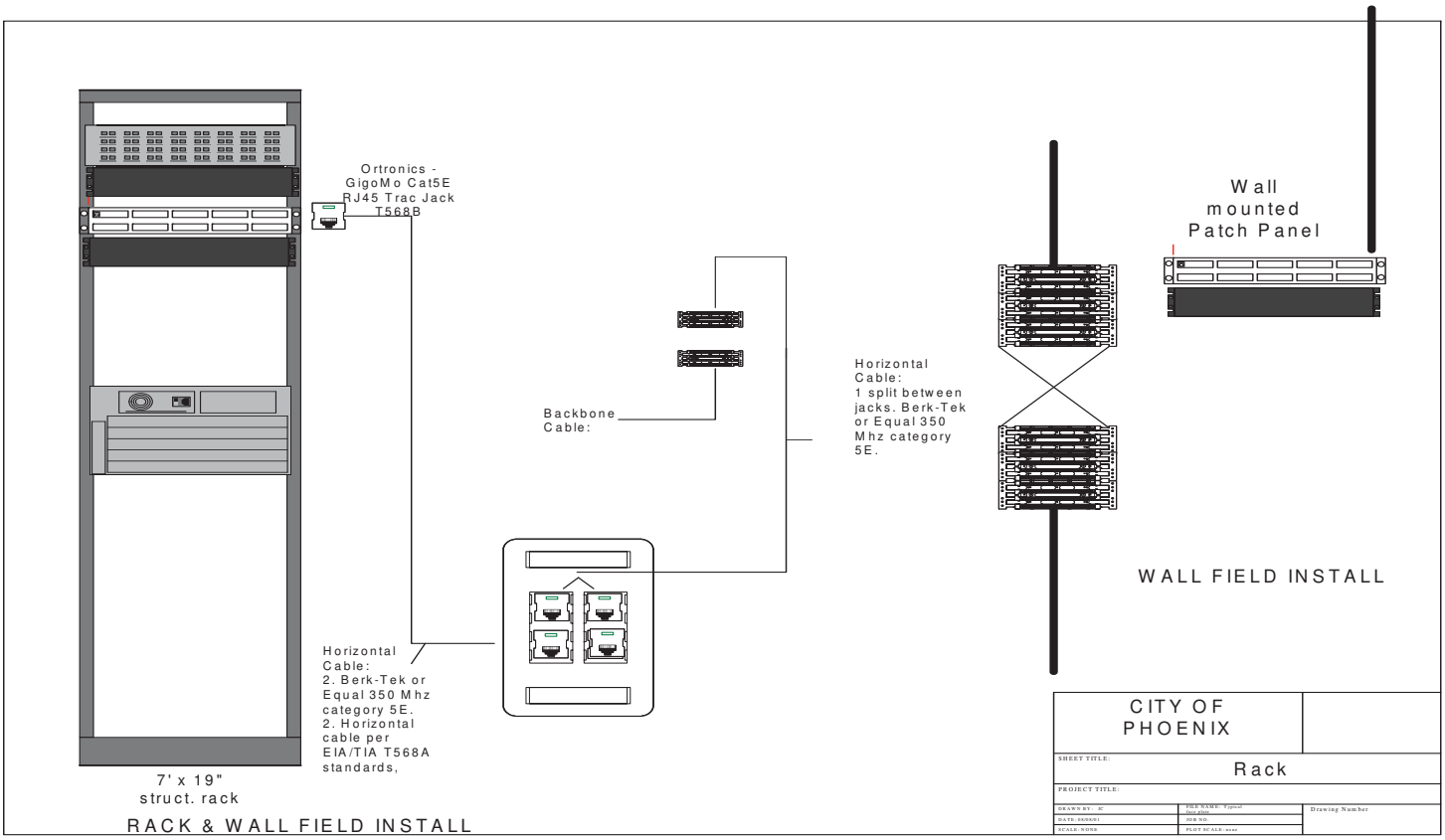
5.3 Coaxial Cable. When CATV or CCTV requirements are identified, either a broadband coaxial cable or single-mode fiber optic cable system shall be installed. When a coaxial system is installed, care shall be taken to ensure the correct cable is used. The table below lists cable type with the corresponding distance limitation.

6.3.1 Cable Distance, RG-59 <=150 feet, RG-6 <=250 feet, RG-11 <=400 feet

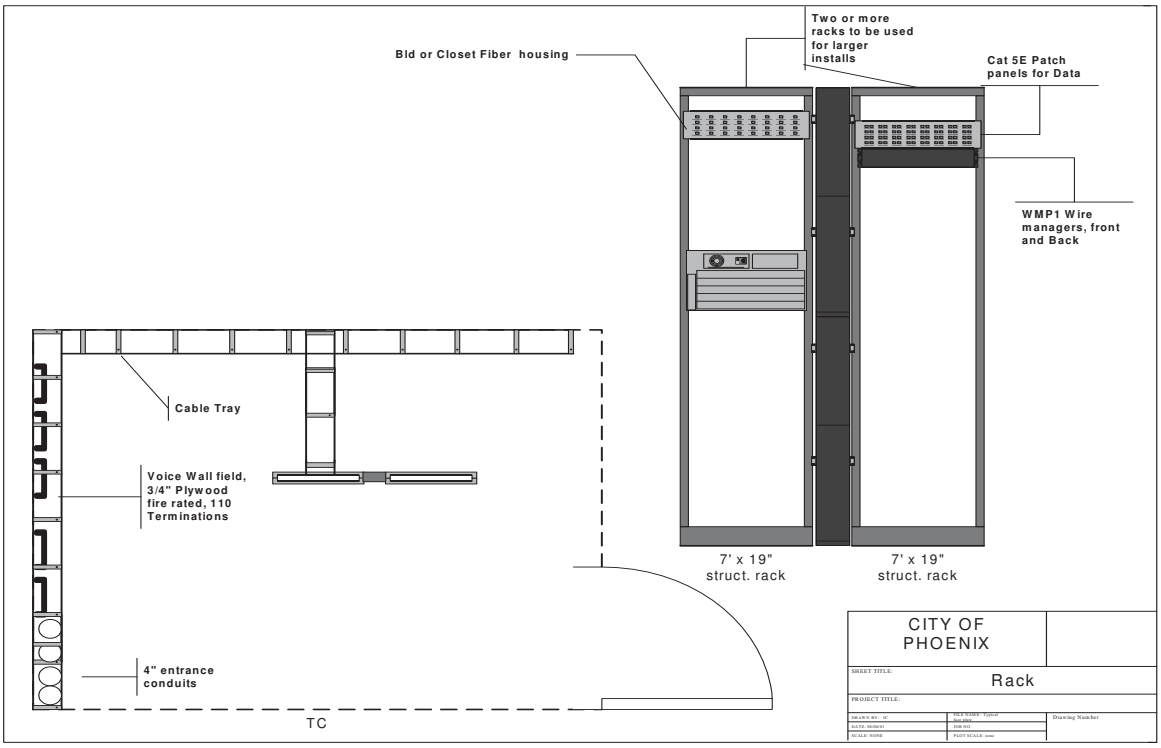
6 SAMPLE DRAWINGS

6.1 The following drawings are to be used as representations of City of Phoenix installations, both the Telecommunication closets and workstation information outlets. They are also an example of the final documentation received upon completion of any City of Phoenix install.


Labeling Scheme:
XXX - Bld XX - TC XX - Port Number
19"
1.75"
Ortronics - Holds up to 30 CAT5E
Trac-Jack
OR-401045548 with shelf.
Snap In Patch Panels
Ortronics - GigoMo Cat5E
RJ45 Trac Jack
T568B
Horizontal Cable:
1 split between jacks.
Berk-Tek or Equal 350
Mhz category 5E.
Backbone Cable:
251-3N-001
251-3N-001 A/B
Horizontal Cable:
2. Berk-Tek or Equal
350 Mhz category 5E.
2. Horizontal cable per
EIA/TIA T568A
standards,
CITY OF PHOENIX
SHEET TITLE:
TYPICAL WALL FACEPLATE
PROJECT TITLE:
DRAWN BY: JC
FILE NAME: Typical face plate
Drawing Number
DATE: 08/08/01
JOB NO.
SCALE: NONE
PLOT SCALE: none



RACK & WALL FIELD INSTALL


Two or more racks to be used for larger installs
Bld or Closet Fiber housing
Cat 5E Patch panels for Data
WMP1 Wire managers, front and Back
Cable Tray
Voice Wall field, 3/4" Plywood fire rated, 110 Terminations
4" entrance conduits
TC
7' x 19" struct. rack
7' x 19" struct. rack
CITY OF PHOENIX
SHEET TITLE:
Rack
PROJECT TITLE:
Drawing Number

WAIVER

There may be other circumstances that may require a department to request a waiver from this standard. Specific implementations that require approval of a waiver and coordination with ITD include real-time remote synchronization with, or connection to, an Enterprise network resource; connection to or synchronization with resources on a network other than the City's; or selection of a manufacturer or operating system not cited herein.

In order to be considered for a waiver, a department must:

Submit a memo to the Chief Information Officer requesting a waiver to the Standard. The request must include:

Description of the waiver request.
Business need that requires a solution not covered by this standard.
Description of the proposed alternative environment or solution.
Assessment of risk to the Enterprise or departmental systems, data, or security.

The Chief Information Officer will approve or disapprove the waiver request, based on the justification provided in the requesting memo.

Approved by:

_____
Danny Murphy, Acting Chief Information Officer
(*SIGNATURE ON FILE)*

APPENDIX I – Electronic Safety and Security

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

ELECTRONIC SAFETY AND SECURITY GUIDELINES AND STANDARDS

PUBLIC WORKS DEPARTMENT
ALARM SERVICES SECTION
SPECIALIZED SYSTEMS
Last revision 4/12/06

INTRODUCTION

The following design guidelines have been prepared by the City of Phoenix Alarm Services, Specialized Systems Section to provide the Registered Design Professional with a brief overview of the general requirements related to the design of security, fire, and life / safety systems at City of Phoenix facilities, and describe minimum standards to meet the needs of users, City of Phoenix personnel and the public.

This standard is intended to achieve consistently high levels of Intrusion Detection System (IDS), Access Control Systems (ACS), Closed Circuit Television (CCTV), Audio/Visual and Fire Alarm Control (FAC) performance by:

- Allowing designers to incorporate required or desired features as early in the design development process as possible.
- Assuring all systems are designed to meet all applicable codes, ordinances, laws, and sound engineering judgment.
- Providing a basis for a general understanding among all parties involved in the design of systems.
- Streamline the process for installation and upgrades of IDS, ACS, CCTV, and FAC systems by clearly identifying roles and responsibilities of those involved.
- Reduce the incidence of subscriber and user error and false alarms.
- Provide a structure to effectively manage the security, fire, and life / safety systems at City of Phoenix facilities.

Designing security into a facility and/or campus should begin with interior security, fire, and life / safety concerns. Design should then progress to the exterior and then to the outer perimeter. The following sections provide more detailed guidelines for providing security, fire, and life / safety systems to City of Phoenix buildings.

These guidelines are not intended to supplant or supersede any of the requirements prescribed by building and fire codes, industry standards and local ordinances, and by no means relieves the Registered Design Professional from his or her duties and responsibilities to ensure that the design and installation meets the requirements outlined in this document. The City of Phoenix does not assume any responsibility or liability for the accuracy of any codes, standards or ordinances referenced herein nor their relevance to any particular project.

Background

The City of Phoenix's Alarm Services, Specialized Systems section is charged with technical support of citywide Security, Fire, Life/ Safety and Audio/Visual systems installed or operating in City of Phoenix facilities. These systems include, but are not limited to, IDS, CCTV, FAC, and ACS. All design, installation, and commissioning of this equipment must meet the standards presented in this document and current practices of the City of Phoenix. All design, configuration, equipment selection, installation, and commissioning must be reviewed and approved by the Alarm Services, Specialized Systems section.

REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.
B. NFPA 72 - National Fire Alarm Code; National Fire Protection Association.
C. NFPA 730 - Guide to Premises Security.
D. NFPA 731 - Standards for the Install of Electronic Premises Security Systems

28 01 00 Operation and Maintenance of Electronic Safety and Security

This section will cover the functionality and required performance of all security / fire / life / safety systems used in City of Phoenix facilities. The below listed standards do not supersede existing industry, national, state, local, or city codes. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .

28 06 00 Schedules for Electronic Safety and Security

This section will cover functionality and required performance of all equipment to be used in City of Phoenix facilities to provide security, detect fires, protect life, and insure safety of all personnel, the public and property. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .

28 08 00 Commissioning of Electronic Safety and Security

This section will cover processes and procedures for the commissioning of any new or upgraded specialized systems. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .

28 13 00 Access Control

This section will cover the functionality and required performance of Access Control System (ACS) used in City of Phoenix facilities. ACS consists of, but not limited to, authorized person identification and a locking mechanism to prevent an unauthorized person from entering the protected area. This locking mechanism will always have a

device that will allow free egress from the secure area. The object is to prevent defeating the locking mechanism or gaining access to the protected area via force and maintaining the security of personnel and property within the protected area.
The design of ACS must follow applicable fire code and consider life / safety as well. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .

28 16 00 Intrusion Detection
This section covers the functionality and required performance of the Intrusion Detection Systems (IDS) used in City of Phoenix facilities. The primary purpose of the IDS is to deter would-be intruders and to signal the presence of unauthorized personnel. The design of the IDS must consider perimeter and area protection, as well as, object protection as needed. The most common points equipped with sensing devices for premise perimeter protection are doors, windows, vents, skylights, and any other exterior to interior opening. Area protection will detect an intrusion whether or not the perimeter protection was violated. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .

28 23 00 Video Surveillance
This section covers the functionality and required performance of Closed Circuit Television (CCTV) Systems used in City of Phoenix facilities. The City uses CCTV to deter, apprehend, and prosecute offenders. The main objective of the CCTV system is not to apprehend a thief, but rather to increase deterrence though security so as to prevent thievery and provide a safe and secure environment for City personnel and the public. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .

28 31 00 Fire Detection and Alarm
This section covers Fire Alarm Control (FAC) systems functionality and required performance used in City of Phoenix facilities. All fire detection systems must be designed and approved by the Phoenix Fire Department prior to any construction. The fire detection system must consist of both unattended and attended triggers; visual, audible, and remote indicators of system activation; and meet current City of Phoenix Fire Code. The system is to be designed with consideration of protecting the life and safety of City personnel and the public, as well as, City assets from a fire or other hazardous situation. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .

27 40 00 AUDIO-VIDEO COMMUNICATIONS
27 41 00 Audio Systems
This section covers building audio systems functionality and required performance used

in City of Phoenix facilities. City of Phoenix – Alarm Services is responsible all Public Address (PA) and Professional Audio systems used in City of Phoenix properties. The design of the PA/Audio system should consider the intended use of the system and the acoustical properties of the site. Also reference Sections 27 61 16, 13, and 13.13. Until further details are provided for this section coordinate with PW/Alarm Services, Specialized Systems section during the design phase and prior to any installation and/or Electronic Safety or Security Systems modification work .