SECTION 01015

TECHNICAL REQUIREMENTS

# GENERAL

## COMPLIANCE

The Contractor's design and construction must comply with technical requirements contained herein for all features of work that are design-build in nature. The designer shall have a minimum of 5 years experience with the design and construction of projects equal to or greater in magnitude and complexity as those in this project. The Contractor shall provide design and construction using the best blend of cost, construction efficiency, system durability, ease of maintenance and environmental compatibility.

## ASBESTOS CONTAINING MATERIALS

Asbestos containing material (ACM) shall not be used in the design and construction of this project. If no other material is available which will perform the required function, or where the use of other material would be cost prohibitive, a waiver for the use of asbestos containing materials must be obtained from the Contracting Officer.

## LIMITATION OF WORKING SPACE

Except where required for service connections or other special reason(s), the Contractor shall confine his operations strictly within the boundaries of the site. Workmen will not be permitted to trespass on adjoining property. Any operations or use of space outside the boundaries of the site shall be by arrangement with all interested parties. The Contractor shall take all practical steps to prevent his workmen from entering adjoining property, and in the event of trespass occurring the Contractor will be held entirely responsible.

Areas located immediately outside the site boundaries and construction area may contain mines and unexploded ordnance (UXO). Contractors assume all risks when venturing in or out of the designated work area.

## TEMPORARY STRUCTURES

The Contractor shall erect suitable temporary fences, lighting, and necessary structures to safeguard the site, materials and plant against damage, theft, and protection of the general public; and shall adequately maintain the same throughout the course of the Contract.

## SUBCONTRACTORS

Compliance by all subcontractors with the provisions of this section shall be the full responsibility of the Contractor.

## technical references

### LIST OF CODES AND TECHNICAL CRITERIA

This project shall conform to all codes and technical criteria that are provided with this Contract (refer to Appendix A-2). References made within each code and technical criteria reference shall be required and adhered to. If there is conflict in the criteria, the most stringent requirement shall be applied. This list is not exhaustive and is not necessarily complete. The publications to be taken into consideration shall be those referenced in Chapter 35 of the 2009 IBC or the most recent editions unless noted.

### AED Design Requirements documents

Unless specifically stated herein, the AED-N Standard Design Requirements (latest version) shall be adhered to in this Contract. These documents are available from the AED-N website located at:

<http://www.aed.usace.army.mil/engineeringtop2010.asp>

These documents shall be used as the basis for design and construction, and for selecting options within the United Facilities Guide Specifications (UFGS). When provided, it’s the Contractor’s option to use either the specifications contained in the AED-N Standard Design Requirements, or to adapt the UFGS specifications to match the requirements provided in the AED-N Standard Design Requirements. Site or project specific data and requirements in the AED-N Standard Design Requirements shall supersede UFGS language where there are differing criteria which must be evaluated and selected.

# civil requirements

The project includes furnishing all materials, equipment and labor for constructing electrical, water, communication, wastewater treatment and storm sewer service lines, as applicable, and connecting to the existing utility networks.

## ENVIRONMENTAL PROTECTION

The Contractor shall comply with all requirements of Section 01355 ENVIRONMENTAL PROTECTION.

## GEOTECHNICAL

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

### GEOTECHNICAL INVESTIGATION PLAN

The Contractor shall submit a geotechnical investigation plan prior to commencing any field investigation to the USACE-AED Engineering Branch through the COR for review and approval. Once the plan is reviewed and approved, the Contractor can start the field investigation.

### SOIL INVESTIGATION

The Contractor shall develop all pertinent geotechnical design and construction parameters based on findings from field investigation, laboratory test and analysis results. All geotechnical laboratory and field work shall be based on standards set forth by ASTM International. Contractor shall not use DIN standards. Standard penetration test (SPT) shall be performed per ASTM D1586. Given the presence of loess in many regions of the country, the selected geotechnical testing lab must be able to perform ASTM D 5333. Soil investigations shall conform to AED Design Requirements: Geotechnical Investigations for USACE Projects, latest version.

### GEOTECHNICAL rEPORT

The Contractor shall produce a detailed geotechnical report. The Geotechnical report shall be submitted with all the design review submittals as specified in Section 01335 SUBMITTAL REQUIREMENTS. No design review submittal shall be considered complete without an approved geotechnical report. Geotechnical investigation plans and report of investigations shall be submitted promptly in accordance with Section 01335 SUBMITTAL REQUIREMENTS.

Information in the report shall include, but is not limited to:

1. Introduction describing: purpose, scope and limitations of the geotechnical engineering services; project location; previous and proposed work used as the basis for the conclusions and recommendations provided in the report; and summary of findings from the investigation. Date(s) of the investigation, weather conditions, observations and problems encountered during exploration, field equipment (e.g. drill rig, hammer, sampler, etc.), field and laboratory test results shall be provided. Exploration logs with depth to groundwater, if encountered, field and lab test results shall be provided in the Appendix of the report. Laboratory test reports shall also be provided in the Appendix.
2. Site conditions as described by:
	1. Project location, topography and drainage within and near the project site. Provide a site plan showing proposed development, topography and subsurface explorations.
	2. Regional and local geology. Highlight potential geologic hazards of the region, including: seismic motions, liquefaction, landslides, floods, and soil collapse.
	3. Land use. Identify historical and existing land use and infrastructure, including: structures, paving, manmade fills, karez, wells, utilities, and other subsurface structures. Identify areas of contamination or potential contamination sources.
	4. Interpreted subsurface profile with groundwater level based on findings from geotechnical investigation. Provide approximation of seasonal variations in groundwater level.
	5. Summary of investigation findings. Explorations shall be conducted according to AED Design Requirements for Geotechnical Investigations, at a minimum in the footprint of: water tower, waste water treatment plant, all critical structures (including, but not limited to: headquarters building, administration building, fire crash rescue building, DFAC, communications building, rotary wing detachment operations facility, aircraft hanger, and mission support group facility) and select structures strategically locate explorations to maximize subsurface data for interpolation. Sample at 0.75 meter increments and where soil type changes. The standard penetration test (SPT) shall be performed for all samples in boreholes, and when possible, in test pits. Laboratory tests on samples collected in each exploration shall include, at a minimum:
* Grain size/ sieve analysis (ASTM D 422) on every sample;
* Atterberg limits (ASTM D4318) on all samples with fines content greater than 5%;
* Soil classification according to Unified Soil Classification System (ASTM D 2487) on every sample;
* Moisture content (ASTM D2216) on every sample;
* Specific gravity (ASTM D854) on a sample from each stratum or where soil type changes for each exploration;
* Direct shear test under consolidated drained conditions (ASTM D3080) on samples collected at 1.5, 2.25, and 3 meters.

For fine-grained soils, the tests listed above and below are required:

* Hydrometer test (ASTM D 422) on samples collected at 1.5, 2.25 and 3.0 meters;
* One dimensional consolidation test (ASTM D 2435) on samples collected at 2.25 and 3.0 meters, Test Method A in accordance with Section 11 default load increments;
* Unconfined compressive strength test (ASTM D 2166) on samples collected at 1.5 and

For samples with a liquid limit (LL) and soil dry density that falls within the “collapsible” soil region in Figure 5 on page 7.1-40 in NAVFAC DM7.1, perform

* a collapse test (ASTM D 5333)

For samples collected in the proposed road alignments:

* California Bearing Ratio (CBR) Test (ASTM D1883) on samples collected at 1.5 meters.
1. Assumptions or explanation of determination of physical and engineering properties of soil or rock, and procedures used for geotechnical analyses. Where applicable, engineering analyses shall include, but not be limited to: seismic site class evaluation; bearing capacity; settlement (immediate and consolidation settlement, seismic-induced settlement, soil collapse); active, at rest, and passive lateral earth pressure, slope stability, and liquefaction.
2. Conclusions, recommendations and limitations. Provide factors of safety, minimum footing widths, allowable soil bearing pressures (with a maximum provided in Table 1804.2 in the International Building Code (IBC) 2009), recommendations on most appropriate foundation system and alternatives along with the expected level of performance with respect to load capacity, settlement and variations in actual conditions.
3. For Site Adapt buildings and structures listed in Appendix B-2, the foundations shall be as per the standard drawings. Standard buildings and structures with foundation designs based on 2000 psf soil bearing will not be required to be redesigned if lower allowable soil bearing values have been determined unless unique circumstances have been determined by USACE-AEN and the Contractor has been directed to perform a redesign.
4. Recommendations for pavement design per CBR test results and K values should be provided for road projects.
5. Contractor shall provide as part of the geotechnical report a comprehensive action plan of how collapsible soils will be handled should it be discovered at the project site. This action plan will incorporate all remediation listed within the paragraph below entitled “COLLAPSIBLE SOILS,” as well as any further remediation the contractor deems necessary. The action plan will describe in detail how remediation will be implemented.
6. For construction recommendations, include required materials, execution (e.g. for earthwork, include recommendations for clearing, importation of fill, excavation and compaction, temporary seepage and drainage control measures, slope protection and erosion control measures, etc.), monitoring, testing, or other quality control measures.

### GEOTECHNICAL QUALIFICATIONS

A geotechnical engineer or geotechnical firm responsible to the Contractor shall develop all geotechnical engineering design parameters. The geotechnical engineer or geotechnical firm shall be qualified by: education in geotechnical engineering; professional registration; and a minimum of ten (10) years of experience in geotechnical engineering design. The geotechnical firm conducting either the field investigation or laboratory work be certified by the Quality Assurance Branch USACE-AED listed at <http://www.aed.usace.army.mil/documents/Labs_AEN.pdf>. Certification document shall be submitted as part of the Geotechnical Report.

### collapsible soils

### general

The Contractor is responsible for determining if the site is underlain with collapsible soils. The geotechnical engineer or geotechnical firm shall use the direct method described in ASTM D 5333 (Standard Test Method for Measurement of Collapse Potential of Soils) to assess whether or not a site may exhibit collapse potential. ***Note: Include the following sentence for projects requiring collapsible soils bid option – see next paragraph for more information*** [For project sites where collapsible soils are identified during the geotechnical investigation the following procedures shall be executed as a COLLAPSIBLE SOILS BID OPTION for grading, drainage and foundation preparation.]

### [grading (COLLAPSIBLE SOILS BID OPTION)]

***Note to engineer: The collapsible soils bid option is to be included only when the project location is north of latitude 35.5° N and west of longitude 69.5°E. For all other projects delete this option.***

Water shall not be allowed to stand or pond on the site under any circumstance, during or after completion of construction. The site shall be graded at all times during construction so that surface water flows into the constructed drainage ways. Finished grade shall slope away from structures at a minimum of 5% (0.15 meters for 3 meters) within 3 meters of the structures. An impermeable surface shall be provided within 3 meters of structures with low plasticity clay compacted to a minimum of 95% of the maximum dry density and moisture content within 2% dry of optimum to optimum, as determined by the Modified Proctor per ASTM D1557 to a minimum thickness of 200mm. The clay shall be compacted in loose layer no greater than 100mm, and with a 10 ton roller compacted. Sand cone density tests (ASTM D 1556) or nuclear gauge test shall be performed on the compacted clay as directed by the COR. All paved areas shall have a minimum slope of 1.5%, with 2% to 3% being preferable, directing runoff away from structures and towards collection points.

###  [drainage (COLLAPSIBLE SOILS BID OPTION)]

* 1. All required drainage facilities should be constructed first and the area sloped to provide draining with no ponding prior to the start of building construction. Ensure that all surfaces have and maintain slope away from structures and off of paved areas (e.g. 5 % slope around buildings and slope paving away from structures on all sides). Minimum slope of paved areas shall be 1.5%, with 2% to 3% being preferable. Allow no areas where ponding could occur on the paved area.
1. Utility lines such as sewer lines, pressurized water lines, and storm drain lines, shall be sleeved for a distance of 3 meters away from the foundation of any building or structure. The Contractor is allowed to use other means to prevent discharging water into the foundation soils with approval of the Contracting Officer.
2. The bottom of utility trenches shall be continuously sloped to provide adequate drainage.
3. The drainage shall be designed to accommodate a 25-year design storm as a minimum.
4. Provide roof drainage to include rain gutters, down spouts and concrete lined channels to convey water 3 meters away from the exterior of the building.
5. Excavations shall be covered at all times so that no rainfall enters the soil. Temporary grading around all excavations is required to keep stormwater runoff from entering.

### [foundation preparation (COLLAPSIBLE SOILS BID OPTION)]

1. To mitigate damage due to collapsible soils, over excavation of soil within the footprint of all foundations included in this contract is required.
2. Collapsible soil shall be excavated 0.7 meters below the bottom of the footing and within 1.5 meters beyond the outside edge of each foundation.
3. The bottom of the excavation shall be compacted to a density of 95%. The face of the excavation shall be sloped no steeper than 1H:1V.
4. Backfill material shall be a well-graded soil classified as SW, GM or GC containing no more than 12% fines from an offsite borrow location approved by the COR prior to construction. Backfill shall be compacted to a minimum dry density of 95% of the maximum dry density as determined by the Modified Proctor per ASTM D 1557 at a moisture content between plus or minus 2% of optimum moisture content (OMC). Backfill shall be placed in loose lifts no greater than 300mm thick, unless difficulty in achieving the required density occurs, in which case lifts shall be reduced to 150mm thick. Backfill material must meet the requirements of the paragraph titled “SATISFACTORY MATERIALS” and be compacted per the paragraph titled “EXCAVATION AND COMPACTION OF FILL” provided in Section 01015.
5. To ensure that backfill meets requirements, at least one sample shall be classified per ASTM D 2487 from each truckload of import fill. The lab shall be capable of providing classifications within one day of material delivery from the borrow source. Material shall be stockpiled on site and properly covered to protect against inclement weather until testing results have been approved by the COR. Once approved, the Contractor may proceed with placement of material. If it is determined that any material is unsatisfactory a second classification shall be run. If the second classification fails, then the entire truckload shall not be used. Material determined to be unsatisfactory that has previously been placed shall be removed to ensure that collapsible soils are not used under any buildings.

## SITE DEVELOPMENT

### Site Plan

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope. Compare against the 01010 when doing your edits to make sure there is no duplication.***

The Contractor shall provide the following plans, and submit as part of the required design review process as defined in Section 01335 SUBMITTAL PROCEDURES.

### Site SURVEY Plan

1. As located and defined by the coordinates provided in Section 01010 SCOPE OF WORK, the Site Survey Plan shall be performed by a licensed professional (surveyor, civil engineer or architect), and shall show the closure of the property boundaries, identification of all property corners, and establishment of horizontal and vertical controls. These controls shall list all bearings and distances of property lines from the centerline of all adjacent roads. The surveyor shall place property corner markers and a monument on the property showing site elevations, coordinate grid systems and WGS 84 latitude longitude. The site survey shall meet the requirements of World Geodetic System 1984 in decimal degrees.
2. The plan shall be based on a professional survey of the project site, and shall include and locate the following existing information: topographic contours, corners of existing buildings and significant structures, trees, wadis, adjacent and/or on-site roads with names and widths, utility easements, right-of-ways, setbacks, parking and paved areas, storage containers, stoops, sidewalks, barriers, ECPs, perimeter walls and towers, above ground utilities, and bunkers.

### master site plan

* 1. The Master Site Plan shall identify and show all proposed work including the following: site limits, perimeter walls and all its related components, entry control point components, buildings, roads, parking areas, fenced-in areas, sidewalks, utility structures, landscape features, drainage structures. The Master Site Plan shall refer to the provided Conceptual Site Plan, other provided drawings and all requirements stated in Section 01010 SCOPE OF WORK to assist in developing the layout. All site improvements shall be clearly defined, noted and dimensioned. Buildings shall be located to provide adequate access for emergency vehicles and fire-fighting equipment.
1. Roads and parking areas shall be designed using the turning radius for the largest vehicles entering the compound. All roads and areas where tractor-trailer vehicles will travel shall be designed for the worst-case turning radius. Design and construction of roads and pavements shall be based on recommendations from the required Geotechnical Investigation Plan and Report.
2. The Survey Site Plan and the Master Site Plan shall be drawn in the following projection and datum for incorporation into the U.S. Army Corps of Engineers GIS system:

**WGS 1984 UTM Zone 42 N**

### Demolition

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

1. Demolition shall include clearing and grubbing of the site, and the removal of all existing structures, foundations, pavements, and utilities. All refuse and debris shall be promptly and properly disposed of off-site.
2. Holes and depressions shall be backfilled and compacted in lifts not to exceed 200 mm in height unless specified otherwise. Fill materials shall be composed of satisfactory soils or aggregates defined in ASTM D 2487 as GW, GP, GM, SP, SM, and SW. Minimum soil compaction shall be 95 percent of maximum density as defined in ASTM D 1557
3. Scrap metal shall become the property of the Host Government. The scrap metal shall be moved to an area away from the site perimeter, or areas of ongoing site work, as directed by the Contracting Officer’s Representative, and left for the Host Government to remove and/or salvage. Demolished fencing and concertina wire shall be neatly rolled up for reuse by the Host Government. Demolished fence posts and outriggers shall be neatly stockpiled for reuse by the Host Government.

### Site Grading

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

1. The Contractor shall provide all necessary site grading to insure that no areas will be flooded due to a rainfall of a 10-year frequency. Drainage of the area shall be compatible with the existing terrain. Building floor elevations shall be a minimum 150mm above grade. Grade shall slope away from all sides of the buildings at a minimum of 3% for 3 meters. Protect all facilities from flood waters originating offsite, as based on a rainfall for a 25-year frequency event.
2. Rainfall data utilized for hydrology calculations shall be obtained from official meteorological records collected in Afghanistan. National agencies may be consulted for data. In the absence of site specific data, intensity-duration-frequency curves contained in the AED-N Standard Design Requirements – Hydrology (latest edition) shall be used. These curves shall be developed by extrapolating the rainfall intensity information from the stations in closest proximity to the project. Under no circumstances will relationships developed by extrapolation from foreign countries be used for hydrologic studies.

## EARTHWORK AND FOUNDATION PREPARATION

### capillary water barrier

Capillary water barrier shall meet the requirements of ASTM C 33 for Size Number(s) 57 or 67, Class 1S.

### satisfactory materials

Satisfactory materials shall be provided in accordance with Section 31 00 00 EARTHWORK.

### unsatisfactory materials

Any materials which do not comply with the requirements set forth in the Satisfactory Materials paragraph. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction; and materials classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 75mm. The Contracting Officer shall be immediately notified of any unsatisfactory materials.

### clearing & grubbing

Unless indicated otherwise, remove tress, stumps, logs, shrubs, brush and vegetation, and other items that would interfere with construction operations within lines 1.5 meters outside of the building and structure line. Remove stumps entirely. Grub out matted roots and roots over 50mm in diameter to at least 460mm below existing surface.

### excavation & compaction of fill

1. Excavate to elevations and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Site shall be graded to drain and that the use of ditches and earthen berms, or other acceptable means, shall be implemented to keep surface water from entering the excavation as determined by the designer of record. Groundwater, where encountered, shall be removed from the excavation through the use of ditches with sumps and pumps or other appropriate means as determined by the designer of record. Excavate soil disturbed or weakened by Contractor’s operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed by the COR. Refill with satisfactory material and compact to at least 95 percent of the maximum dry density, as determined by the Modified Proctor laboratory procedure. ASTM D 1557 shall be used for producing the Modified Proctor moisture-density curve, unless the soil to be compacted includes more than 30% retained on the 19 mm (3/4") sieve. In this case, the Contractor shall replace the ASTM D 1557 laboratory compaction procedure with AASHTO T 180, Method D, corrected with AASHTO T 224.
2. During compaction, the moisture content of the soil shall be within 1.5 percent of the optimum moisture content, as determined by the Modified Proctor laboratory procedure. The thickness of compacted lifts shall not exceed 15 cm and the dry density of each compacted lift shall be tested by either sand cone (ASTM D 1556) or nuclear gage (ASTM D 6938). If the nuclear gage is used, it must first be compared to sand cone tests for each soil type to verify the accuracy of the nuclear gage measurements for moisture content, wet density, and dry density. Furthermore, every tenth nuclear gage test must be accompanied by a sand cone test and these verification data must be summarized and submitted to the Contracting Officer. Density tests shall be performed at a frequency of not less than one test for each 200 square meters and not less than two tests per compacted lift.

## Roads, parking & sidewalks

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

### Roads

1. Aggregate roads shall have a road surface of 7.3 meters wide, unless noted otherwise, graded for proper drainage with necessary drainage structures. Prescribed road surfaces shall be provided in accordance with applicable sections of UFC 3-250-18FA and UFC 3-250-01FA. The roads shall be designed to carry traffic from 40 metric-ton five-axle vehicles. Aggregate pavement surfaces shall consist of at least 75mm thick aggregate surface course, 150mm thick aggregate base course material compacted to 95% maximum proctor density and placed above 150mm of scarified subgrade compacted to 95% maximum density at a minimum.
2. Asphalt roads shall have a wearing surface 7.3 meters wide, unless noted otherwise, graded for proper drainage, provided with necessary drainage structures and completed with prescribed surfaces in accordance with applicable sections of UFC 3-250-18FA and UFC 3-250-01FA. The road section shall consist of at least 75mm hot-mix asphalt (placed in two 37.5mm lifts); 200 mm base course compacted at 95% maximum proctor density and placed above 150mm of scarified subgrade compacted to 95% maximum density at a minimum.
3. All roads shall be provided with 1.0 meter wide shoulders on both sides. Shoulders shall consist of a 50mm aggregate surface course above a 150mm thick aggregate base course with a 2.0% slope away from the road surface.
4. Culverts shall have access barriers on both the inlet and outlet side of the culvert. Access barriers shall be constructed with 20 mm minimum reinforcing steel or equivalent spaced a maximum of 100 mm on-center each way anchored securely into the culvert. A second barrier of 20 mm vertical bars at 150 mm on-center shall be anchored securely into the culvert 1 meter behind both the primary inlet and outlet barriers. Culverts shall be 200 mm minimum but no more than 300 mm square or diameter. Multiple culverts with the same equivalent area are preferred over one larger culvert. If a penetration over 300 mm wide or tall is unavoidable the horizontal and vertical bars shall be welded together for stiffening.

### bridges & site grading plan

Preliminary investigation indicates no need for bridges or major drainage structures. The Contractor shall notify the Contracting Officer immediately if initial site survey determines that area hydrology requires major drainage structures or bridges. The Contractor shall design a site grading plan that provides positive drainage and minimizes the requirement for major structures in a cost effective manner.

### parking areas and motor pools

1. Aggregate pavement surface shall consist of 150mm thick Aggregate Base Course (ABC) material compacted to 95% maximum proctor density, placed above 150mm of scarified subgrade compacted to 95% maximum density. ABC material must be graded for proper drainage, durable, uniformly moistened, and mechanically stabilized by compaction. Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure in ASTM D 1557.
2. Asphalt pavement shall consist of a 200 mm base course minimum compacted at 98% maximum proctor density and shall be surfaced with minimum 50 mm hot mix asphalt concrete compacted at 100%, be graded for proper drainage, provided with necessary drainage structures and completed with prescribed surfaces in accordance with applicable sections of UFC 3-250-18FA and UFC 3-250-01FA.
3. Provide 1.0 meter wide shoulder around all parking areas and motor pools, consisting of a surface of an ABC material 150mm thick at a 2.0% slope.

### Rigid Pavement

Design of rigid pavement shall be performed in accordance with UFC 3-250-01FA, UFC 3-250-18FA, and UFC 3-250-04. The minimum rigid pavement section shall be 175mm thick plain Portland Cement Concrete placed above 150mm thick aggregate base course material in accordance with Section 32 11 16 AGGREGATE BASE COURSE, and placed above 150mm of scarified sub-grade compacted in accordance with Section 32 11 16 AGGREGATE BASE COURSE. Joint spacing shall not exceed 4 meters. The joint layout pattern shall be submitted as part of the design. A full depth expansion joint shall be provided everywhere the rigid pavement abuts a structure. Expansion joint filler shall be a preformed material conforming to ASTM D 1751. Expansion joint filler shall be 19mm thick, and shall be furnished in a single full depth piece. Saw-cut joints shall be sealed with a sealant meeting ASTM D 6690 (Type II or Type III). Provide backup material that is a compressible, non-shrinking, non-staining, non-absorbing material, and nonreactive with the joint sealant. The material shall have a melting point at least 3º Celsius greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789.

### Sidewalks

[Aggregate sidewalks shall be a minimum of 1.5M wide and shall be constructed in accordance with Section 32 15 00 AGGREGATE SURFACE COURSE.]

[Concrete sidewalks shall be a minimum of 1.5M wide and shall be constructed in accordance with Section 03 31 00.0010 CAST-IN-PLACE STRUCTURAL CONCRETE.]

## FORCE PROTECTION DESIGN

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### PERIMETER WALLS

Perimeter Security Walls shall consist of a 300 mm thick reinforced concrete core with native stone or masonry veneer in accordance with the details provided in Appendix B-4. The height of the walls shall measure at least 3.0 m from the inside grade. Inside grade shall in all cases be equal to or higher than outside grade. The foundation width shall be based on USACE standard drawings. The wall shall be capped with a cast-in-place reinforced concrete capping. Outriggers, described below, to support six strands of barbed wires and a single-coil concertina style razor wire shall be provided and installed by the contractor. Site grading must slope away from the walls for at least a distance of 5 m. The wall shall be designed to prevent visual access to the inside of compound by all pedestrian and vehicular traffic outside the compound which may require the wall to be built at a higher level in some locations. Any penetrations through the Perimeter Security Wall for site drainage purposes shall have force protection such as a welded bar grill, welded grating, or other pre-engineered access barrier. Access barriers shall be constructed with 20 mm minimum reinforcing steel spaced a maximum of 100 mm on-center each way or equivalent anchored securely into the wall outlet penetration. Penetrations shall be 200 mm minimum but no more than 300 mm square or diameter. Multiple penetrations with the same equivalent area are preferred over one larger penetration. If a penetration over 300 mm wide or tall is unavoidable the horizontal and vertical bars shall be welded together for stiffening.

### SLIDING GATES

* 1. A standard design sliding gate shall be provided for vehicle access at Entry Control Points per Appendix B-3. The construction of the gates shall insure that it is dimensionally stable, square, true and planar. Sliding Gate shall not rack or deflect when open, closed, or in motion. Gate tracks shall be anchor mounted to galvanized steel stanchions. The gate tracks will be an upside down “V” and the gate wheels will be heavy duty steel with a “V” cut out of them to prevent snow and other debris making the gate inoperable. The thickness of face plates on each side of the gate shall be 6mm thick for the two sides added together. That is 3mm + 3mm, 2mm + 4mm or any similar combination. A frame of tube steel members shall make up the body of the gate between the face plates. Frame members shall be spaced at a maximum of 1250mm OC in each direction.
	2. Provide a locking mechanism that holds the gate closed. Provide reinforced grade beam across gateway flush with pavement to lock gate with flush mounted vertical sliding bolts, bolts shall be 50 mm diameter solid steel. The sliding gate will also have a built- in personnel gate with its own locking mechanism. The vehicular sliding and personnel gates will have three strands of tensioned barbed wire installed on top. The gates will be painted two coats of good quality metal primer and two coats of a good quality finish coating. The final color selection will be made by the COR from samples provided by the contractor.

###  SWING GATES

* 1. Hinged vehicle gates shall be a pair of 3.00 m wide x 3.0 m high leafs, constructed of a steel tube frame and steel tube intermediate posts and rails. The thickness of face plates on each side of the gate shall be 6mm thick for the two sides added together. That is 3mm + 3mm, 2mm + 4mm or any similar combination. A frame of tube steel members shall make up the body of the gate between the face plates. The minimum size tube shall be Box 100x60x4 for the outer perimeter of the assembly and for all intermediate vertical members and Box 60x60x3 for all horizontal intermediate members. Frame members shall be spaced at a maximum of 750mm OC in each direction. Provide 50mm tall by 200mm wide viewport with 6mm thick sliding cover located 1500 mm above ground level to the top of the viewport in each leaf of the swing gate and in the personnel gate. Provide a locking mechanism that holds the gates together when in the closed position as well as a 25mm min diameter drop bolt that engages a steel sleeve embedded in the pavement.

b. Personnel gates shall be 1.3 m wide x 3.0 m high. The design of the gates shall insure that it is dimensionally stable, square, true and planar. Gate leafs shall not rack or deflect when install on its hinges. Gates shall have a sufficient number of hinges to support each gate leaf. Provide 50mm tall by 200mm wide viewport with 6mm thick sliding cover located 1500 mm above ground level to the top of the viewport.

### OUTRIGGERS

Outrigger supporting arms shall be “Y” shaped with 50 mm diameter metal tube middle post, securely embedded 400 mm into the top of the wall. Posts shall conform to ASTM F 1083, Pipe, Steel, Hot Dipped Zinc Coated (Galvanized) Welded. Outriggers shall be spaced a maximum of 3000 mm on center.

### REINFORCED BARB TAPE

Reinforced barbed tape shall be 600 mm diameter concertina style coil consisting of 31 loops. Each loop shall consist of 19 barb clusters per loop. Adjacent coils loops shall be alternately clipped together at three points about the circumference to produce the concertina effect upon deployment. Spacing between attachments points when deployed shall be 400 mm. The reinforced barbed tape shall be fabricated from 430 series stainless steel with hardness range of Rockwell (30N) 37-45 conforming to the requirements of ASTM A 176. Each barb shall be a minimum of 30mm in length, in groups of 4, spaced on 100 mm centers. The stainless steel core wire shall have a 2.5 mm diameter with a minimum tensile strength of 895 MPa. Sixteen gauge stainless steel twistable wire ties shall be used for attaching the barbed tape to the barbed wire. The reinforced barbed tape shall be equivalent to NSN: 5660-01-457-9852.

### chain link fence & gates

* 1. Chain link fence and gate fabric shall be No. 9 gage wires woven into a 50 mm diamond mesh. Fabric shall be coated with 366 grams per square meter zinc galvanizing. Posts shall be ASTM F 1083 Pipe, Steel, Hot Dipped Zinc Coated (Galvanized) Welded or equal. Top of fence and gates shall be provided with outriggers and reinforced barbed tape as indicated above. Post sizes shall be as shown on drawings.
1. Fence gates shall be swing type. Swinging vehicle gates shall be a pair of 3.00 m wide x 2.4 m high minimum leafs, constructed of a steel tube frame and steel tube intermediate posts and rails. Personnel gates shall be 1.3 m wide x 2.4 m high minimum. The design of the gate shall insure that it is dimensionally stable, square, true and planar. Gate leafs shall not rack or deflect when install on its hinges. Gates shall have a sufficient number of hinges to support each gate leaf. Provide a locking mechanism that holds the gates together when in the closed position as well as a drop bolt that engages a steel sleeve embedded in the pavement.

### sniper screen

Sniper screen material will be ultraviolet light resistant and guaranteed against sunlight degradation for five years. Material will allow wind to blow through, without stretching the material, or distorting the frame. Sniper screen material will be fastened to standard galvanized fencing (see above) mounted to a rigid frame. The frame shall be securely embedded into the top of the wall. Frame components shall conform to ASTM F 1083, Steel Pipe, Hot Dipped Zinc Coated (Galvanized Welded).

### manual drop arm barrier gate

Manual drop arm barrier gates shall be constructed per the Standard Design in Appendix B-4.

### concrete barriers

Barriers shall be concrete blocks of one meter by one meter by one meter dimensions. Similar arrangements of large stones (one cubic meter size), jersey barriers or equal sized obstacles may be used.

### hesco barriers

1. Barriers shall be made of geo-textile fabric shall be 2 mm non-woven polypropylene and bound with 8 gauge galvanized steel wire mesh size 7.62 cm grid. The coil hinges and joining pins shall be 8 gauge hardened steel. Fill material shall be a mixture of sand and gravel. The gravel shall not be more than 1.8 cm in size. The materials shall be compacted in lifts no greater than 25 cm.
2. Hesco Bastions shall be provided with suitable foundations as recommended by the manufacturer depending on the height, and filled with a sand & gravel mixture. Provide a gravel base at least 50 cm deep and extending around the bottom edge of the barrier by at least 50 cm, for proper support and drainage. The gravel base material shall have no stones large than 2.5 cm, due to the risk of becoming projectiles in a blast.
3. Protection from UV light shall be provided with an application of a protective coating such as UV CAM, cement slurry not greater than 0.3 cm (1/8”) thick. The cement slurry is a mixture of cement powder and water, mixed to a proportion of 1:1, but this may be adjusted to suit the application method. Sand may also be added as necessary.
4. Submittal Requirements:
5. The manufacturer of this product must have been in this business for at least 5 years.
6. Installers must be certified by the manufacturer.
7. Welded mesh and wire must be ASTM A641 Class 3.

## utilities

### water supply

The Contractor shall provide water distribution mains, branches, service connections to include all pipe, valves, bends, thrust blocking, fittings and appurtenances. Exterior water line construction shall include service to all buildings as described in Section 01010 SCOPE OF WORK. The required average daily flow (ADF) shall be the average daily demand (ADD) per person - derived from 155 liters per capita per day (lpcd) – times a capacity factor, times the effective population. A capacity factor of 1.5 shall be used if the effective population is less than or equal to 5,000. The capacity factor for larger populations is found in the AED Design Requirements: Water Tanks & System Distribution. The capacity factor shall be utilized as described in the following paragraph. In the event potable or non-potable use water is required prior to completion of the water facilities infrastructure the Contractor may be issued a Request for Proposal to provide non-potable (tank truck) and potable (bottled or other reliable source) consumption. Provide a minimum of one (1) outside water hydrant (hose spigot) for all buildings with water service. All buildings with water supply shall have a water meter installed in a locked cabinet area inside the building.

#### features

Features of the water system shall be sized to provide flow or storage capacity as described below.

#### water tanks

Capacity shall be based on ADF (ADD x c x CF). (NOTE: If a minimum volume of storage is provided in the contract documents, that value is to be taken as the average daily storage capacity and will be multiplied by the capacity factor to determine the actual required storage volume for the facility.)

#### booster pumps

For installations with fewer than 400 persons, the capacity shall be based on the installation wide, total fixture unit flow. For installations with greater than 400 persons, the capacity shall be based on the installation wide, total fixture unit flow or 2 times the average daily flow (16 hour basis), whichever is greater. Three identical pumps shall be provided which are all sized to deliver 50% of the calculated capacity. Pumps shall automatically alternate to distribute wear and shall automatically turn on and off based on demand and system pressures. The total dynamic head (TDH) of the booster pumps shall be calculated to maintain a minimum, residual system pressure of 40 psi at the calculated capacity unless stated otherwise in the contract documents. Either a bladder style expansion tank or a hydro-pneumatic tank shall be supplied when booster pumps are used in the water system.

#### hydro pneumatic tanks

Volume and pressure regulation to maintain a pressure range provided in the technical requirements based on a rate equal to the ADF (ADD x c x CF).

#### water mains

Diameter based on the installation fixture unit flow or two times the ADF (ADD x c x CF) and velocity requirements per this guide unless a minimum diameter is specified which is adequate to provide flow and meet the specified maximum velocity. The flow through the system shall be distributed on the basis of fixture unit flow in each the buildings serviced or per Contract.

#### water service lines

Diameter based on fixture units of the building serviced or per Contract.

#### service booster pumps

Contractor shall provide a booster pump station with capacities defined above with end suction or split case double suction horizontal split case (frame mounted) centrifugal pumps arranged in parallel for pumping water storage into the main distribution system. The pumps and controls shall be designed to supply and maintain acceptable system pressure throughout the distribution network given the full range of flow conditions (low flow to peak). Provide suitable expansion tank for booster pump system sized for anticipated pressure surges, if hydro pneumatic tanks are not to be used. The suction side of the service booster pumps shall have an eccentric reducer and gate valve installed. The discharge side shall have a gate valve, check valve between the pump and the gate valve and concentric reducer, pressure gage and air relief valve.

#### water storage tanks

[Attention Editor: ANA Garrisons are constructed with a Ground Storage Tank as the standard. Only in limited cases are elevated water storage tanks used at ANA bases. Unless otherwise instructed, GST shall be retained in the RFP and elevated tanks deleted. As a side note: ANP typically has an elevated tank due to lower populations.]

[Contractor shall develop and provide a steel or concrete ground storage reservoir (GST) with concrete foundation to be located on the ground surface. Volume of the GST shall be a minimum storage volume of a full days demand. The Contractor shall verify storage volume requirements based on final design population. The storage facility shall be located above drainage areas and locations subject to flooding as approved by the Contracting Officer. The storage facility shall be located on the higher elevations of the site to promote gravity flow and reduce pumping requirements. Overflow and air vents shall be screened so that birds, rodents and debris cannot enter the reservoir. The tank shall meet all applicable codes for potable water storage. The interior coatings for the tank shall meet NSF/ANSI 61 requirements]

[The Contractor shall develop and provide a steel, elevated water storage tank. The bottom of the storage tank shall be 20 meters above the finished grade at the base of the tank and shall be at least 20 meters above the finished floor elevation of the highest building ground floor. Volume of the water storage tank shall be a minimum storage volume of a full days demand. The Contractor shall verify storage volume requirements based on final design population. The storage facility shall be located above drainage areas and locations subject to flooding as approved by the Contracting Officer. Overflow and air vents shall be screened so that birds, rodents and debris cannot enter the reservoir. The elevated water storage tank and supporting structure shall be constructed in strict conformance with the furnished drawings and specifications. The tank shall meet all applicable codes for potable water storage. The interior coatings for the tank shall meet NSF/ANSI 61 requirements.]

#### Hydro-pneumatic Water Storage Tank

The Contractor shall provide horizontally mounted and insulated above ground hydro-pneumatic tank(s) containing water and compressed air located adjacent to the well house to maintain system pressures between 275 kPa to 282 kPa (40 psi to 70 psi). A compressor is required to charge the tank with air. At low level the water remaining in the tank shall be at least ten percent of the capacity of the tank. The tank size shall be determined such that the pump cycles not less than 4 times per hour or more than 10 times per hour. Storage may be divided between duplicate units in cases where a single tank would be too long to easily transport to the site. Volume of the tank shall be a minimum storage volume of a full days demand. The Contractor shall verify storage volume requirements based on final design population. The storage facility shall be located above drainage areas and locations subject to flooding as approved by the Contracting Officer.

#### disinfection & chlorination system

Use sodium hypochlorite chlorine for disinfection. A manufacturer assembled, self-contained, skid-mounted, hypo-chlorinator consisting of mixer, mixing tank, pump pipe injector, and control panel shall be used to feed a sodium hypochlorite solution of 1- 5% available chlorine into the system. Hypochlorite compound may be a liquid or solid form. The pump shall feed a hypochlorite solution in proportion to the water demand. The hypo-chlorinator shall have a pumping rate, liters per day (lpd) (gallons per day (gpd)) adequate to deliver 5 percent (%) available hypochlorite solution adjustable to the quantity of water being produced from the source. The chlorine-feeding system shall consist of controls and devices necessary for a complete operating system. Dosage rate will vary somewhat depending on actual pump production rate and available residual chlorine in the system. Contractor shall determine the required dosage rate milligrams per liter (mg/l) to maintain the required chlorine residual (usually 0.2-0.4mg/l) in the distribution system. Chlorine solution tank shall be large enough to hold a three day supply of hypochlorite solution. A fresh solution shall be prepared every two or three days because the solution will lose its strength over time and this will affect the actual chlorine feed rate. Hypochlorite shall be stored in a cool dry place. Sodium hypochlorite can lose from two to four percent of its available chlorine content per month at room temperature. Contractor shall verify required minimum residual chlorine in accordance with local requirements verified and approved by the Contracting Officer. The chlorination system shall have the capability for manually adjusting the dosage rate and be installed in such a manner that the system can be easily disconnected and bypassed in the event of health safety or routine maintenance and repair. Disinfection of water mains shall be in accordance with AWWA standard C651-86 and disinfection of storage facilities in accordance with AWWA standard C652-86. The package disinfection system shall be located in the well pump house.

####  Water Distribution System

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

The Contractor shall provide a water distribution system. The distribution network shall be laid out in a combination grid and looped pattern with dead ends not exceeding 30m. Use similar piping materials for all buildings and pipe runs in the distribution system for efficiency of future maintenance activities. Distribution lines shall not be less than 100mm in diameter. Dead end sections shall not be less than 150mm diameter and shall either have blow off valves or fire hydrants (flushing valves) installed for periodic flushing of the line. Any pipe with a fire hydrant on the line shall be at least 150mm in diameter. Water supply distribution shall connect to a building service at a point approximately 1.5m outside the building or structure to which the service is required. All piping and joints shall be capable of at least 1.03 MPA leakage testing and 1.38 MPa hydrostatic test pressure, unless otherwise specified. Pipe diameters shall be adequate to carry the maximum flow of water at velocities less than 1.5m/sec. Piping segments where velocities less than 0.15 m/sec are anticipated, shall be noted and brought to the attention of AED.

#### OPERATING PRESSURE RANGE

The operating pressure range for the distribution system shall be as follows.

1. For systems with elevated water tanks the operating pressure shall be between 206kPa to 480kPa at all points of the distribution system. If pressures greater than 480kPa cannot be avoided, pressure-reducing valves shall be used. A system pressure below 206kPa shall be considered a deviation in the technical requirements requiring Contracting Officer approval.
2. For systems with ground storage water tanks and booster pumps the operating pressure shall be between 276kPa to 480kPa at all points of the distribution system. If pressures greater than 480kPa cannot be avoided, pressure-reducing valves shall be used. A system pressure below 276kPa shall be considered a deviation in the technical requirements requiring Contracting Officer approval.
3. Contractor shall not use uPVC or HDPE pipe and fittings without specific approval from AED through the variation process. This applies even if the existing project water distribution system had this pipe material. Pipe material shall meet the requirements of Pipe below
4. Adequate cover must be provided for frost protection. A minimum cover of 800mm is required to protect the water distribution system against freezing. Water lines less than 1.25 meters deep under road crossings shall have a reinforced concrete cover of at least 150 mm thickness around the pipe extending out to 1m from each road edge.

#### pipe

* 1. The Contractor shall provide pipe of adequate strength, durability and be corrosion resistant with no adverse effect on water quality.
1. Water Mains and Branches: Pipe material for water mains and branches shall be PVC or Ductile Iron (DI). The exterior surface of the pipe must be corrosion resistant. Distribution lines shall be 100mm and larger and shall be reduced only at the junction of building connections. Pipe diameters shall be selected to meet the previously specified flow, velocity, and pressure conditions. If Ductile Iron (DI) pipe is installed underground the pipe shall be encased with polyethylene in accordance with AWWA C105. Ductile iron pipe shall conform to AWWA C104. DI fittings shall be suitable for 1.03MPa pressure unless otherwise specified. Fittings for mechanical joint pipe shall conform to AWWA C110. Fittings for use with push-on joint pipe shall conform to AWWA C110 and C111. DI fittings shall be cement mortar lined (standard thickness) in accordance with C104. All pipes and joints shall be capable of at least 1.03 MPa and 1.38 MPa hydrostatic test pressure unless otherwise specified herein. Polyvinyl Chloride (PVC) pipe shall conform to ASTM D 1785. Plastic pipe coupling and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B. PVC screw joint shall be in accordance with ASTM D 1785, Schedules 40, 80 and 120. Pipe less than 80mm, screw joint, shall conform to dimensional requirements of ASTM D schedule 80. Elastomeric gasket-joint, shall conform to dimensional requirements of ASTM D 1785 Schedule 40.
2. Water Service: Building service lines will be sized according to the following guidance. Water service connections from the mains to the buildings shall vary from 19mm, 25mm, 38mm, 75mm, to 100mm as calculated, depending on the maximum flow velocity and minimum pressure requirements as determined by hydraulic analysis of fixture flows. Pipe service connections from the distribution main to the building shall be either Polyvinyl Chloride (PVC) plastic Schedule 80 ASTM D 1785 or copper tubing conforming to ASTM B 88M, Type K, annealed. PVC pipe couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B. Contractor shall not use HDPE for any of the water pipes.

#### hydrostatic, leakage & disinfection tests

* 1. The Contracting Officer will be notified not less than 48 hours in advance of any water piping test and will be given full access for monitoring testing procedures and results. Where any section of water line is provided with concrete thrust blocking for fittings or hydrants, tests shall not be made until at least 5 days after installation of concrete thrust blocking, unless otherwise approved. Pressure and leakage testing shall be as specified in AED Design Requirements – Water Tank and Water Distribution Systems, latest version.
1. Pressure Test: After the pipe is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants and valves shall be carefully examined during the partially opened trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered following this pressure test shall be removed and replaced and retested until the test results are satisfactory.
2. Leakage Test: Leakage tests shall be conducted after all pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and, during the test, water lines shall be subjected to not less than 1.38 MPa. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure to within 34.5kPa of the specified leakage test pressure after the pipe has been filled with water and all air expelled. Pipe installation will not be accepted if leakage exceeds the allowable leakage, as determined by the following formula:

L = 0.0001351ND (P raised to 0.5 power), where:

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the government.

1. Bacteriological Disinfection:
2. Disinfection Procedure: Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. After pressure tests have been completed, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. Flushing will be performed in a manner and sequence that will prevent recontamination of pipe that has previously been disinfected. The chlorinating material shall be liquid chlorine, calcium hypochlorite, or sodium hypochlorite. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipelines shall be chlorinated using only the above-specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times.
3. Sampling: For each building connected to the water system, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with approved methods. The commercial laboratory shall be verified to be qualified by the appropriate authority for examination of potable water. Contractor shall submit a water sampling protocol for approval. This shall include at a minimum the name of the laboratory, parameters to be tested, the Company conducting the sampling, and the sample locations.
4. Acceptance Requirements: The disinfection shall be repeated until tests indicate the absence of bacteria for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained. All retests shall be conducted at the Contractor’s expense.
5. Time for Making Tests: Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipeline jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.
6. Concurrent Tests: The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be recorded for submission and approval. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government. Pressure and leakage testing may be conducted concurrently. Hydrostatic tests and disinfection may be conducted concurrently using water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be re-accomplished.

#### valves

1. Gate & Butterfly Valves: Valves (Gate valves w/box) shall be placed at all pipe network tees and cross intersections, and the number of valves shall be one less than the number of lines leading into and away from the intersection. For isolation purposes valves shall be spaced not to exceed 3600 mm. Gate valves shall be in accordance with AWWA C 500 and/or C509. Butterfly valves (rubber seated) shall be in accordance with C504 et. al. The valves and valve boxes shall be constructed to allow a normal valve key to be readily used to open or close the valve. Provide traffic-rated valve boxes. Provide concrete pad, 1 meter square, for all valve boxes. Valves shall be pressure rated to 1.38 MPa.
2. Vacuum & Air Release Valves: Air release valves are required to evacuate air from the main high points in the line when it is filled with water, and to allow the discharge of air accumulated under pressure. Vacuum relief valves are needed to permit air to enter a line when it is being emptied of water or subjected to vacuum. Contractor shall submit manufacturer’s data for properly sized combination air and vacuum release valves and determine their locations on the distribution system subject to review and approval of the Contracting Officer.
3. Blow-Off Valves: The Contractor shall provide 40-50mm blow-off valves at ends of dead end mains. Valves should be installed at low points in the mains where the flushing water can be readily discharged to natural or manmade drainage ditches, swales or other.

#### thrust blocking

Contractor shall provide concrete thrust blocking at any point where the layout of the system changes the direction of the flow, increases the velocity, or decreases or stops the flow. At these points, the pipes and fittings must be anchored and kept from moving or pulling apart by the use of thrust blocks installed against undisturbed earth.

### WATER WELLS

The Contractor shall construct water well(s) inside the compound, to provide sufficient supply for the facility. The new well capacity shall be based on the allowable safe yield of the new well determined by a well pump test as described in the USACE- AED Design Requirements - Well Pumps & Well Design/Specifications, latest version. The new well site shall be at a location approved by the Government. The new well site shall be no closer than 75 meters from any existing wells. Well construction shall be in accordance with the USACE-AED Well Design Guide and Water Well Guide Specification.

#### well test plan

After de-mining, but prior to the construction of any structures, the Contractor shall submit a well test plan to drill and test the water well, conduct well design activities, and submit all required information to AED for review prior to installing any permanent well features. Drilling shall not proceed without an AED Engineering approved well drilling plan. A plan for decommissioning dry wells shall be included with the well drilling plan. It is acknowledged that water may not be available at the site despite Contractor good faith efforts to find it. The Contractor shall include in his proposal, services required to either drill two (2) wells each to a maximum of 120m or one (1) well to a maximum depth of 240m. The decision whether to drill one or two wells shall be at the discretion of the COR and shall be made at any point before or during the drilling of the initial well. The Contractor is responsible for having appropriate equipment on site to execute either drilling scenario at the contract price. If water is not found after drilling a total linear depth of 240m, the Contractor will be considered to have fulfilled the terms of the contract and will be entitled to the full price of the contract CLIN for well drilling. Even if water is not found, the Contractor must still furnish all other parts of the water distribution system as described in the specifications. At this time, off site water wells and other alternatives may be considered upon approval by the COR.

#### well capacity

Well Capacity shall be equal to one day’s demand delivered over 16 hours of pumping time.

#### well construction

Well construction shall be in accordance with AED Design Requirements - Well Pumps & Well Design/Specifications, latest version - which includes, but is not limited to, requirements for well screen, casing, gravel pack, well pump, disinfection, and testing requirements. All design requirements, material specifications, and testing contained in this document shall be used and submittals shall be made promptly in accordance with Section 01335 SUBMITTAL REQUIREMENTS. Failure to follow the construction and submittal procedures outlined may, at AED’s discretion, result in rejection of the well and, the contractor having to remove the well casing and screen, re-drill the well and reinstall the proper features per the approved design.

#### design and construction requirements

1. Well Depth: The well shall be drilled to a minimum depth of 20 m below the existing water table. The depth of the permanent well shall take into consideration the drawdown depth, screen depth and pump submergence as described in the AED Design Requirements document.
2. Casing: Selection of the casing diameter, material and depth shall be per the AED Design Requirements document. All wells will be cased 150 mm above grade (i.e., base of pit, ground surface, etc.) and be fitted with a lockable cap with air gap (vacuum relief during pumping). Each section of casing will be joined with standard couplings and full-threaded joints, or by proper welding, so that all joints are sound and watertight. Well casing alignment shall not interfere with the proper installation and operation of the pump.
3. Screen: The casing will be fitted with a well screen that will permit maximum transmission of water without clogging. The material of construction, opening requirements, minimum lengths and placement shall be per the AED Design Requirements document.
4. Sealing: The drilling process will create a hole (borehole) larger than the casing. To protect the well and properly finish construction, the entire space between the casing and the edge of the borehole will be filled with gravel, overburden, or concrete as follows:
	1. The upper 3 m of the well bore will be sealed with cement grout. Grout shall be placed in one continuous mass and be impermeable;
	2. The space around the well screen will be filled with material that will form a filter and not clog the slots in the screen (e.g. washed coarse sand for a fine bore wall material);
	3. The space between the top of the filter pack and the base of the grout seal shall be backfilled with bentonite clay material.
5. Crushed Stone: Per the AED Design Requirements, crushed stone for well sealing shall consist of crushed stone containing angular shapes and surfaces with no rounded surfaces shall be used for sealing the solid wall casing and edge of the borehole area. All aggregate shall contain less than 5% of shale, clay lumps, coal, lignite, soft or unfragmented stone, or other deleterious materials.
6. Source Protection: Surface drainage within 30 m of wellhead shall ensure no ponding, flooding or collection of runoff adjacent to the well. This can be accomplished through surface grading or use of gravel drains to modify site drainage in the vicinity of the well. Contractor shall identify all sources of contamination and ensure the proposed well site meets minimum standoff distances as indicated below:
	1. Sewage storage areas (outhouses, tanks, individual sewage pits, lagoons, and WWTP) – 30 m
	2. Septic fields (infiltration galleries) – 30 m
	3. Fuel storage, engine maintenance/repair – 30 m
7. Well Pump: A submersible, centrifugal pump shall be installed inside the casing set no less than 2.0 meters from the base of the excavation. Capacity and total dynamic head (TDH) shall be based on an adjusted ADF (ADD, times the population, times the capacity factor) over a 16 hour period). Control of the pump shall be by means of a Hand-Off-Auto (HOA) switch. In the “Auto” position, the pump shall be started and stopped automatically by water levels in the water storage tank. Pump shall start at low level and shall stop at high level. Level controls shall be adjustable. Manual start shall be the Hand position.
8. Expansion Tank: Provide bladder style expansion tank for well pump to minimize pressure surges and water hammer effects.

#### well pump testing

Well pump testing and water clarity testing after well development shall be per the requirements in AED Design Requirements - Well Pumps & Well Design/Specifications, latest version or most recent version.

#### water quality sampling & analysis

* 1. The Contractor shall perform water quality sampling and testing at the source. The Contractor shall utilize well-qualified and equipped testing capability in the project site area, if available. If professional testing services are not available in the area, the Contractor will submit an alternative practical testing source for approval.
1. See USACE-AED Well Pumps & Well Design Guide with Attachment A – Guide Specifications for Drinking Water Wells, latest version and Appendix A of TM 5-813-3 (UFC 3 230 08a Water Supply Water Treatment, January 2004) for requirements for laboratory testing.

#### well house

At new wells or springs, construct a permanent well house with reinforced concrete slab floor, reinforced CMU walls, and a reinforced concrete roof as per the Standard Design in Appendix B-2. The floor of the well house shall slope away from the casing approximately 3 mm per 300 mm and drain to the outside. Floor of well house shall be minimum 300mm above adjacent grade. The well house design should be such that the well pump, motor, and drop pipe could be removed readily by providing an insulated hatch in the building roof provided with a hasp and lock. The well house shall protect valves and pumping equipment plus provide freeze protection for the pump discharge piping beyond the check valve. The well house shall be insulated and have a heating unit provided. The entry door shall be made of heavy duty metal and metal frame with no louvers. The well shall be protected from unauthorized use by a security fence with lockable gate. Provide outriggers, barbed wire and concertina wire on fence and gate.

#### raw water disinfection

Contractor shall perform disinfection of the well water in accordance with AED Design Requirements - Well Pumps & Well Design/Specifications, latest version. Bacteriological samples shall be collected and examined in accordance with Standard Methods for the Examination of Water and Wastewater by a qualified lab as approved by the Contracting Officer.

#### hand pump

The Contractor shall provide a hand pump with separate intake piping in the well casing to allow water supply during periods without electricity. Water drawn from the well by the hand pump shall not flow through the electric well pump. The pump shall be valved so that it can be used to fill the water storage tank or discharge to a spigot outside the well house. The capacity of the pump shall be at least 20 liters per minute. The pump shall be lever operated while standing in the well house.

### Sanitary Sewer

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

#### general

1. There are no functional or salvageable sanitary sewer collection, treatment or disposal facilities at this site. The Contractor shall obtain topographic information or other maps that show vegetation, drainage channels and other land surface features such as underground utilities and related structures that may influence the design and layout of the collection system. If maps are not available, or do not provide satisfactory information or sufficient detail of the site, field surveys shall be performed. Sanitary sewers less than 1.25 meters under road crossings shall have reinforced concrete cover at least 150 mm thick around the pipe. Concrete cover will extend out to at least 1 m from each road edge.
2. Exterior sanitary sewer line construction shall include service to all buildings as described in the Scope of Work Section 01010. Contractor shall design sanitary sewer collection system using approved field survey data and finished floor elevations. Depending upon the topography and building location, the most practical location of sanitary sewer lines is along one side of the street. In other cases they may be located behind buildings midway between streets. Main collection sewers will follow the most feasible route to the point of discharge. The sewer collection system shall be designed to accommodate the initial occupancy and a reasonable expansion capability. Sewer collection capacity shall be based on the two times the average daily wastewater flow unless minimum diameter specified is adequate to provide flow and required maximum velocity; wastewater flow through the system shall be distributed on the basis of fixture unit flow in each the buildings serviced by multiplying the proportion of the total fixture flow from each building or facility times the total wastewater flow for the project or installation as determined above.
3. All sewers shall be located outside of the roadways as much as practical, and minimize the number of roadway crossings. To the extent practical, a sewer from one building shall not be constructed under another building, or remain in service where a building is subsequently constructed over it. Construction required shall include appurtenant structures and building sewers to points of connection with building drains 1.5m outside the building to which the sewer collection system is to be connected.
4. The Contractor shall use the following criteria where possible to provide a layout which is practical, economical and meets hydraulic requirements:

Follow slopes of natural topography for gravity sewers;

Check subsurface investigations for groundwater levels and types of subsoil encountered. If possible, avoid areas of high groundwater and the placement of sewers below the groundwater table;

Avoid routing sewers through areas which require extensive restoration or underground demolition;

Depending upon the topography and building locates, the most practical location of sanitary sewer lines is along one side of the street. In other cases they may be located behind buildings midway between streets. The intent is to provide future access to the lines for maintenance without impacting vehicular traffic;

Avoid placing manholes in low-lying areas where they could be submerged by surface water or subject to surface water inflow. In addition, all manholes shall be constructed 50 mm higher than the finished grade, with the ground sloped away from each manhole for drainage;

Sewer lines shall have a minimum of 800 mm of cover for frost protection;

Locate manholes at change in direction, pipe size, or slope of gravity sewers;

Sewer sections between manholes shall be straight. The use of a curved alignment shall not be permitted;

If required by the design, locate manholes at intersections of streets where possible. This minimizes vehicular traffic disruptions if maintenance is required;

Sewer lines less than 1.25 meters deep under road crossings shall have a reinforced concrete cover of at least 150mm thickness around the pipe or shall utilize a steel or ductile iron carrier pipe. It is recommended to continue the reinforced concrete cover or carrier pipe a minimum of one (1) meter beyond the designated roadway;

Verify that final routing selected is the most cost effective alternative that meets service requirements.

#### protection of water supplies

The Contractor shall ensure that the sewer design meets the following criteria:

Sanitary sewers shall be located no closer than 30m horizontally to water wells or reservoirs to be used for potable water supply.

Sanitary sewers shall be no closer than 3 m horizontally to potable water lines; where the bottom of the water pipe will be at least 300mm above the top of the sanitary sewer, horizontal spacing shall be a minimum of 1.8m.

Sanitary sewers crossing above potable water lines shall be constructed of suitable pressure pipe or fully encased in concrete for a distance of 2.7m on each side of the crossing. Pressure pipe will be as required for force mains in accordance with local standards and shall have no joint closer than 1m horizontally to the crossing, unless the joint is fully encased in concrete.

#### quantity of wastewater

The Contractor shall verify the average daily flow considering both resident (full occupancy) and non-resident (8hr per day) population. The average daily flow will represent the total waste volume generated over a 24-hour period, and shall be based on the total population of the facility and water usage rate of 155 liters per capita per day (water usage). The wastewater flow rate shall be calculated as approximately 80% of water usage rate, or 124 liters per capita per day times the capacity factor requirements.

#### gravity sewer

1. General: Sanitary sewers shall be designed in accordance with the AED Design Requirements for Sanitary Sewer and Septic Systems, latest version to flow at a maximum in the following way:
2. Sanitary sewer laterals, mains and trunk lines flow velocities shall be designed to provide a minimum velocity of 0.6 meters per second (mps);
3. A minimum velocity of 0.8 to 1.05 mps at the peak diurnal flow rate;
4. Flows shall be based on allocating the proportion of the average daily or peak daily flow to each building or facility on the basis of fixture unit flow developed for the plumbing design; and
5. Minimum pipe slopes shall be provided regardless of the calculated flow velocities to prevent settlement of solids suspended in the wastewater.

Minimum pipe slopes are provided in the AED Design Requirements for Sanitary Sewer and Septic Systems.

1. Unless otherwise indicated (see Building Connections and Service Lines), gravity sewer pipe shall be installed in straight and true runs in between manholes with constant slope and direction. Adequate cover must be provided for frost protection. A minimum cover of 800 mm will be required to protect the sewer against freezing.
2. Manholes: The Contractor shall provide standard depth manholes (MH), (depth may vary) an inside dimension of 1.2m. Manholes shall be made of cast-in-place reinforced concrete with reinforced concrete cover. Alternate pre-cast manhole option shall taper to a 750 mm cast iron frame that provides a minimum clear opening of 600 mm. In every case, the manholes, frames and covers shall be traffic rated, H-20 load rating. All manholes shall be provided with a concrete bench with a flow line trough, smoothly formed to guide waste flow to the outlet pipe from the inlet pipe(s). The top surface of the bench shall be above the crown of all pipes within the manhole. All surfaces of the bench shall be sloped smoothly toward the trough to guide flow, even under peak flow conditions. Sanitary sewer lines shall enter at the manhole flow line. Where the invert of the inlet pipe would be more than 0.5 meter above the manhole floor, a drop inlet shall be provided. No internal drop structures shall be permitted at lift stations. Inlet to lift station wet wells shall enter below the lowest water level of the pump operating range, and if necessary a drop inlet approach pipe external to the lift station may be used to avoid cascading influent flow.
3. Manhole Design Requirements: Manholes are required at junctions of gravity sewers and at each change in pipe direction, size or slope, except as noted hereinafter for building connections. Manholes shall be installed at start of all main runs.
4. Spacing: The distance between manholes must not exceed 120m in sewers of less than 460mm in diameter. For sewers 460mm and larger, and for outfalls from wastewater treatment facilities, a spacing of up to 180m is allowed provided the velocity is sufficient to prevent sedimentation of solids.
5. Piping Connections: The crown of the outlet pipe from a manhole shall be on line with or below the crown of the inlet pipe.
6. Frames & Covers: Frames and covers shall be cast iron, ductile iron or reinforced concrete, traffic rated in any case to an H-20 load rating. Cast iron frames and covers shall be traffic rated, circular with vent holes.
7. Steps for Manholes: Steps shall be cast iron, polyethylene coated, at least 15mm thick, not less than 400mm in width, and spaced 300mm on center.

#### pipe

1. General: Pipe shall conform to the respective specifications and other requirements as follows: Provide Polyvinyl Vinyl Chloride (PVC) conforming to ASTM D 3034, Type PSM with a maximum SDR of 35, size 380 mm or less in diameter. PVC shall be certified as meeting the requirements of ASTM D 1784, cell Class 12454 B. Minimum pipe sizes for the main lines shall be 200mm diameter and service lines/laterals shall be a minimum of 150 mm diameter. Smaller diameters shall not be used.
2. Fittings: Fittings shall be compatible with pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and requirements as follows: provide PVC fittings conforming to ASTM D 3034 for type PSM pipe.
3. Joints: Joints installation requirements shall comply with the manufacturers installation instructions. Flexible plastic pipe (PVC or high density polyethylene pipe) gasket joints shall conform to ASTM D3212.
4. Branch Connections: Branch connections for new piping installations shall be made using regular fittings. Branch connections for upgrades or repairs may be made using regular fittings or solvent-cemented saddles as approved. Saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.The minimum depth of the cover over the pipe crown shall be 0.8m.
5. Building Connections & Service Lines: Building connections and service lines will be planned to eliminate as many bends as practical and provide convenience in rodding. Bends greater than 45 degrees made with one fitting should be avoided; combinations of elbows such as 45-45 or 30-60 degrees should be used with a cleanout provided. Connections to other sewers will be made directly to the pipe with standard fittings rather than through manholes. However, a manhole must be used if the connection is more than 31m from the building cleanout. Tee connections to the main or branch are not allowed. Service connection lines will be a minimum of 150 mm (6 inch) diameter and laid at a minimum 1% grade. Service laterals shall be at least 150 mm (6 inch) and sloped to maintain the minimum velocity as described in paragraph “Gravity Sewer.”
6. Cleanouts: Cleanouts must be installed on all sewer-building connections to provide a means for inserting cleaning rods into the underground pipe. Install manufactured wye fittings. In lieu of a wye fitting, an inspection chamber may be installed. The inspection chamber shall be of the same construction as a manhole. Preferably the cleanout will be of the same diameter as the building sewer, and never be smaller than 150mm. Cleanouts shall be located within 1 meter from the building.

#### grease interceptors

1. Grease interceptors are used to remove grease from wastewater to prevent it from entering the sanitary sewer and septic systems. All Dining Facilities (DFACs) shall incorporate preliminary treatment with use of a grease interceptor prior to the sanitary sewer system. The only waste lines upstream of the grease interceptor shall be grease laden waste from the kitchen or other areas. Grease interceptor design shall be based on AED Design Requirements - Grease Trap, latest version. The grease interceptor shall be a design-build structure of reinforced cast-in-place concrete, reinforced precast concrete or equivalent capacity commercially available steel, with removable three-section, 9.5 mm checker-plate cover, and shall be installed outside the building. Steel grease interceptors shall in be installed in a concrete pit and shall be epoxy-coated to resist corrosion as recommended by the manufacturer. Concrete shall have 28MPa minimum compressive strength at 28 days. The grease interceptor shall connect to the sanitary sewer system.
2. Contractor shall provide bollards around the tank and construct a minimum 4 m wide access road from the closest roadway to the grease interceptor for a pump truck. The access road shall be of the same material as the main roads in the compound. Under no circumstance shall the grease interceptor be installed inside the building. Provide outside water spigot for cleaning.

#### field quality control

1. Field Tests & Inspections: The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment and incidentals required for testing.
2. Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically a full circle of light through the pipeline when viewed from the adjoining end of the line. When pressure piping is used in a non-pressure line for non-pressure use, test this piping as specified for non-pressure pipe.
3. Test lines for leakage by either infiltration tests or exfiltration tests. Prior to testing for leakage, backfill trench up to at least lower half of the pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe to prevent movement during testing, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.
4. Infiltration tests and ex-filtration tests: Perform these tests for sewer lines made of specified material, not only concrete, in accordance with ASTM C 969M, ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969M and ASTM 969.
5. Low-pressure air tests: Perform tests as follows:
6. Concrete pipe: Test in accordance with ASTM C 924M, ASTM C 924. Allowable pressure drop shall be given in ASTM C 924M ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924M, ASTM C 924;
7. Ductile-iron pipe: Test in accordance with the applicable requirements of ASTM C 924M, ASTM C 924. Allowable pressure drop shall be as given in ASTM C 924M, ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924M, ASTM C 924;
8. PVC Plastic pipe: Test in accordance with applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.
9. Deflection Testing: Deflection testing will not be required however; field quality control shall ensure that all piping is installed in accordance with deflection requirements established by the manufacturer.

### Wastewater Treatment Systems

***Note to Civil Engineer: Define the type of WWTP System in this section. Most ANA projects are Package WWTP. The largest installations will have a lagoon system. Leach fields sewage holding tanks are rare at ANA sites.***

#### general

1. Permanent base waste water treatment plants shall be designed in accordance with Unified Facilities Guide Specifications UFGS 44 41 13, Prefabricated Biochemical Wastewater Treatment Plant, Oct 07.
2. Package Wastewater Treatment Plants (WWTP) & Lagoons shall be designed in accordance with AED Design Requirements - Package Wastewater Treatment Plants and Lagoons, latest version. Package WWTP or lagoon treatment systems may be considered for installation size greater than 300 effective design population. The plants shall meet standards of industry care in its design and construction.
3. Septic Systems shall be designed and installed in accordance with AED Design Requirements - Sanitary Sewer and Septic Systems, latest version. Contractor shall provide a minimum 4 m wide access road to the septic tank. Bollards shall be installed around the absorption field as well as the septic tank. The access road construction shall be of the same thickness and material as the roadway on the compound. The access roadway shall tie to the nearest road network. Septic tank and leach field disposal systems shall be limited to effective design populations under 300 personnel.
4. The Contractor shall not use sewage holding tanks for the wastewater disposal system unless specifically required as the only method in the contract section 01010 and 01015. When soil conditions make septic systems with leach fields unfeasible, the contractor may request consideration for sewage holding tanks from the USACE-AED Engineering Branch. This policy applies only for facilities with 60 personnel or less and shall be considered on a case by case basis.
5. Medical waste water treatment shall be designed in accordance with UFC 4-51-01 Design: Medical Military Facilities. Contractor shall provide a medical waste incinerator for all regulate medical waste (RMW) as defined in the UFC. The facility shall be located on a reinforced concrete pad with minimum 2 m high chain link fence and gate per design criteria in this Section.

#### sewage holding tank(s)

1. Generally, when determining an appropriate tank location, the Contractor shall provide protection for the system by ensuring that vehicles, material storage, and future expansion shall be kept away from the area. Signage or other prevention methods (i.e. pipe bollards) shall be used to provide this protection. The finished grade for the site shall ensure that storm water runoff shall drain away from the site to prevent ponding, inflow, and infiltration. Once an appropriate site is located, the Contractor shall conduct soil investigations for the site to determine ground water levels, and soil conditions.
2. Holding tanks are buried, watertight receptacles designed and constructed to receive wastewater. Liquid depth should be between 2 m and 3 m. This depth is determined by the outlet pipe invert elevation. The sewage holding tank(s) shall be designed to accommodate the total facility compound population as specified in the Scope of Work plus 25% and verified by the contractor. The tank shall be a design-build structure constructed of reinforced, cast-in-place concrete, with a minimum compressive strength of 28MPa at 28 days. The tank(s) shall have a minimum earth backfill cover of 300mm. Access shall be provided at points of the tank by installing reinforced concrete risers, with steel access hatches, that will rise 50mm above the finished grade.
3. The Contractor shall locate and design the tank in such a way that once the base sanitary sewer is available, the line entering the tank(s) can be tied to this system.

#### [Wastewater Treatment Plant (wwtp)]

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

#### wwtp capabilities

The wastewater treatment system shall be designed to accommodate the total facility compound population as specified in the Scope of Work and verified by the Contractor with the project manger prior to design. System capacity shall be calculated based on a hydraulic waste load equivalent to 80 percent of the Average Daily Demand (ADD) water usage rate or calculated using methods provided in UFC 3-240-09fa, Domestic Wastewater Treatment guidance. The wastewater treatment plant shall be designed and constructed such that it operates with the ability to process inflow rates to the wastewater plant headworks based on the calculated peak hourly flow. Feed rate to the plant components shall be determined by the Contractor from the analysis of the installation peak flow and average daily flow evaluation.

#### requirements of design

* 1. Design Population: See equivalent design population in Section 01010 SCOPE OF WORK.
1. Wastewater Hydraulic Load: Individual waste water generation rate of 80 percent domestic waster use as stated above.
2. Influent Characteristics of Wastewater: BOD5 – 400 mg/L or based on 0.09 kilograms (0.20 pounds) per person per day whichever is greater loading.
	1. TSS –400 mg/L
	2. TKN – 80 mg/L
	3. Fecal Coliform – 108 MPN /100 mL
3. Effluent Criteria Limitations for Direct Surface Water Discharge:
	1. BOD5
	2. The 30-day average will not exceed 30 mg/L.
	3. The 7-day average will not exceed 45 mg/L.
	4. CBOD5 may be substituted for BOD5. In those cases the following limits will apply:
	5. 30-day average will not exceed 25 mg/L.
	6. The 7-day average will not exceed 40 mg/L.

Note: Parameter CBOD5 limit, if substituted for the parameter BOD5, should be at least 5 mg/L less than each numerical limit for the 30 day and 7 day average for the BOD5 limit. The CBOD5 test procedure suppresses the nitrification component in the BOD5 test procedure, thereby reducing the value or effects and lowering the oxygen demand.

1. TSS: The 30-day average will not exceed 30 mg/L; the 7-day average will not exceed 45 mg/L.
2. pH: The effluent pH values will be maintained between 6.0 and 9.0.
3. Temperature Ranges: See the mechanical section for the range of temperatures that apply.
4. Processes: To be determined by the Contractor as part of the scope of work subject to Government approval as required in AED Design Requirements - Package Wastewater Treatment Plants and Lagoons latest version. They shall include the generic components: preliminary treatment, primary treatment, secondary treatment, sludge digestion and disposal, effluent disposal including disinfection. A modular conex box shall be provided for the onsite laboratory.
5. The biological rate constant shall be 0.276 per day (units are day-1) based on a 20 degree Celsius temperature which shall be assumed for the waste water temperature design of aeration lagoon size.

#### site survey & plan requirements

1. Topographic survey and geotechnical investigation of the proposed sewage treatment site is required and the Contractor shall design the package wastewater treatment system to be compatible with site and soil conditions.
2. Wastewater Plant Site Survey. The Contractor shall conduct a topographic survey to determine existing site characteristics. The Contractor shall conduct a utility survey to determine the locations of any nearby security fences and buildings, water lines, wells, sanitary sewers, storm sewers and communication/electrical lines.
3. Sanitary Sewer Collection Network System Layout. The Contactor shall design modifications to the sanitary system layout required for the transport of wastewater to the headworks of the WWTP. Pipe, fittings, and connections shall conform to the respective specifications and other requirements as listed in Section 01015 and all of its referenced codes.
4. Wastewater Treatment Plant Layout. The Contractor shall design a layout for the system to include all tank geometry, wastewater inlet and lift station configurations, number of process compartments, yard piping, laboratory and operational buildings, aeration and disinfection equipment shelters and piping, effluent contact chambers and discharge facilities including the outfall system, and sludge drying and disposal facilities and related site preparation and earthwork. See wastewater treatment plant design submittal requirements.
5. Wastewater Reuse Plan. If required by the contract section 01010, provide a wastewater reuse plan for landscape irrigation. AED engineers will review the plan and provide comments regarding its acceptability. Site specific requirements will be developed on a case by case basis with AED design engineers.

#### modular container laboratory

Provide 8 feet by 20 feet modular conex unit to be used as the onsite laboratory. Provide heating and cooling using a split pack heat pump unit, exhaust fan with makeup air opening and two counter mounted stainless steel sinks. Provide hot and cold water, drain and venting for the sinks. Provide a floor drain and hose bib to facilitate wash down of the laboratory.

#### start up & testing

All WWTP projects shall include a proposed start-up testing and training program in including operation and maintenance manuals. When the wastewater system construction nears completion and all units are operative, the contractor shall commence a commissioning and startup procedure for the treatment system. The treatment system includes all lift stations, force main, gravity sewers, treatment plant units and associated equipment, sludge holding and digestion, septage dump pad, and laboratory building. The contractor will operate the treatment facility for a trial period of two months performing all daily and weekly operation and maintenance (O&M) tasks recommended by the equipment manufacturer. The contractor shall utilize services of qualified operators; including the use of at least two Afghan Nationals that the contractor shall train. During the routine O&M, the contractor shall perform all sampling and testing necessary to ensure proper daily operations in achieving the required effluent standards. The contractor shall maintain a log that includes records of daily O&M activities, e.g. repairs, inflow measurement, aeration cycles, effluent cycling, waste and return sludge pumping, and sludge drying. The contractor shall also maintain and operate the sludge disposal operation during the trial period.

### Septic System

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

#### general

Generally when determining an appropriate septic tank location, the Contractor shall provide protection for the septic system by ensuring that vehicles, material storage, and future expansion shall be kept away from the area. Signage or other prevention methods (i.e. pipe bollards) shall be used to provide this protection. The finished grade for the site shall ensure that storm water runoff shall drain away from the site to prevent ponding, inflow, and infiltration. Once an appropriate site is located, the Contractor shall conduct soil investigations for the site to determine ground water levels, soil conditions, and the percolation rate. Septic systems shall be designed and installed in accordance with UFC 3-240-09A, Domestic Wastewater Treatment, 16 January 2004 edition, and the requirements of the following paragraphs.

#### site survey

The Contractor shall conduct a topographic survey to determine existing site characteristics. The Contractor shall conduct a utility survey to determine the locations of any nearby water lines, wells, sanitary sewers, storm sewers and electrical lines.

#### percolation testing

At proposed sites for holding ponds and the absorption field, the Contractor shall perform 6 or more percolation tests. Percolation tests determine the acceptability of the site and serve as the basis of design for the liquid absorption. Percolation testing shall be conducted in accordance with AED Design Requirements - Sanitary Sewer and Septic Systems (latest version). Percolation tests shall be accomplished uniformly throughout the area where the absorption field is to be located.

#### Septic tank

1. Septic tanks are buried, watertight receptacles design and constructed to receive and partially treat wastewater. The tank separate solids from the liquid, provides limited digestion of organic matter, stores solids, and allows the clarified liquid to discharge for further treatment and disposal. Settle able solids and partially decomposed sludge accumulate at the bottom of the tank, while scum rises to the top of the tank’s liquid level. The partially clarified liquid is allowed to flow through an outlet opening position below the floating scum layer. The clarified liquid will be disposed of to the absorption field for further treatment and disposal.
2. Factors to be considered in the design of a septic tank include tank geometry, hydraulic loading, inlet and outlet configurations, number of compartments and temperature. If a septic tank hydraulically overloaded, retention time may become too short and solids may not settle properly.
3. For Afghanistan, a baffled multi-compartment or dual chamber design shall be utilized. Refer to AED Design Requirements - Sanitary Sewer and Septic Systems (latest version) for sizing and details. The septic tank shall be designed with a length-to-width ratio of 2:1 to 3:1 and the liquid depth should be between 1.2 m and 1.8m. This depth is determined by the outlet pipe invert elevation. If not specified in the contract, the septic tank shall be sized based on the average daily demand of 190 liters/capita/day, plus an additional 100% for sludge storage capacity and peak flows. The tank shall be a design-build structure constructed of reinforced, cast-in-place concrete, with a minimum compressive strength of 28MPa at 28 days. When feasible, wastewater shall enter and exit on the short sides of the tank, which will allow the wastewater longer detention and settling time. The baffle tank shall have two compartments, with the first compartment (influent entry point) having 2/3 thirds the volume capacity of the tank. The tank shall have a minimum earth backfill cover of 300mm. Access shall be provided at the entry (influent) and exit (effluent) points of the tank by installing reinforced concrete risers, with steel access hatches and gooseneck vents with bird and insect screens that will rise 50mm above the finished grade.
4. The septic tank shall be a design-build reinforced concrete structure.

#### ABSORPTION field

1. Absorption fields (also termed “leach fields”) are used, in conjunction with septic tank treatment, as the final treatment and disposal process for the wastewater treatment system. Absorption fields normally consist of perforated distribution pipe laid in trenches or beds that are filled with rock. Refer to AED Design Requirements - Sanitary Sewer and Septic Systems (latest version) for absorption field sizing and performance requirements. The septic tank effluent shall be distributed by a perforated pipe and allowed to percolate through the ground, where it is filtered and treated by naturally occurring bacteria and oxygen. If percolation testing indicates that soil absorption rates are not between 0.1 min/25cm and 60 min/25cm, the Contractor shall notify the COR.
2. Once effluent is released from the septic tank, it travels by gravity through a solid PVC pipe, at a minimum 1.0% slope, to the distribution box or dosing tank. The distribution box is a reinforced concrete structure that distributes the septic tank effluent evenly throughout the absorption field through several 100mm diameter perforated (distribution) pipes. The distribution pipes shall be evenly distributed over the absorption trenches or beds; the perforated distribution pipes shall have a maximum slope of 0.5% and shall be capped at the end of each pipe. Generally, distribution piping is spaced from the one meter to 1.8 meters apart and is not longer than 30 meters.

### Storm Sewer Systems

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

#### design storm return period (baseline frequency)

Developed portions of the site installation such as administration, industrial and barracks areas, shall be based on a rainfall of 10-year frequency. Basic system design shall be in accordance with UFC 3-230-17A, Chapter 2. Potential damage or operational requirements may warrant a more severe criterion or in certain areas a lesser criterion may be appropriate. The design of roadway culverts and other on-site storm drainage features & structures will normally be based on 10-year rainfall event. Protection of installations against flood flows originating from areas exterior to the base installation shall be based on a 20-year or greater rainfall depending on cost vs. benefit considerations.

#### Storm drainage System design

The Contractor shall be responsible for the complete design of the storm drainage system. Drainage of runoff from turf areas onto pavements shall be minimized. If storm drain piping is required it shall comply with the requirements in this section. Where storm drain pipes are of different diameters, the pipe crown elevations should be matched at the drainage structure. Storm drain lines shall be located outside of paved areas to the extent possible. Under no circumstance shall storm drain lines be located beneath buildings. Erosion control shall be provided for all storm drain structures during construction. Water from roof down spouts shall be drained off building site. All storm drain pipe and structures shall comply with the requirements specified in UFGS Section 33 40 01 STORM-DRAINAGE.

#### hydraulic design

New storm drain pipes shall be designed for gravity flow during the design storm baseline unless otherwise approved by the Government. The hydraulic grade line shall be calculated for the storm drain system and all energy losses accounted for. Design computations shall adhere to procedures contained in UFC 3-230-17A. Storm drain systems shall be designed to provide a minimum flow velocity of .75 meters per second when the drains are one-third or more full.

#### area inlets

1. Area inlets shall be properly sized and designed to accommodate the design flows. All grates shall be of a “bicycle safe” design.
2. Concrete Pipe: Reinforced concrete pipe shall be a minimum Class III. Type I cement may be used only when sulfates in the soil are 0.1 percent or less and dissolved sulfates in the effluent are 150 ppm or less. Type II cement may be used only when sulfates in the soil are 0.2 percent or less and dissolved sulfates in the effluent are 1,500 ppm or less. Only Type V cement may be used if sulfates in the soil exceed 0.2 percent or dissolved sulfates in the effluent exceed 1,500 ppm. Concrete pipe shall be assumed to have a minimum design service life of 50 years unless the Contractor determines that conditions at the site will reduce the service life. Concrete culverts and storm drains shall be protected by a minimum of 1 meter of cover during construction to prevent damage by heavy construction equipment.
3. Plastic Pipe: Stiffness of the plastic pipe and soil envelope shall be such that the predicted long-term deflection shall not exceed 7.5 percent. Plastic culverts and storm drains shall be protected by a minimum of 1 meter of cover during construction to prevent damage by heavy construction equipment. Split couplers shall not be allowed for corrugated high-density polyethylene pipe. Plastic pipe shall be assumed to have a minimum design service life of 50 years unless the Contractor determines that conditions at the site will reduce the service life (then plastic pipe shall not be used).

#### oil / water separators

***Note to Civil Engineer: Edit this section to include full and clear technical requirements descriptions only…Scope of the work is described in 01010. Do not describe scope.***

Oil / water separators shall be utilized for all drains from industrial sites. Separators shall be installed as close as possible from the drain location. Storm sewer system shall not be mixed with sanitary sewer system and shall be in accordance with UFC 3-240-07FA, latest edition.

# STRUCTURAL

## GENERAL

***Note to Structural Engineer: Edit the entire Structural section to include full and clear description.***  Buildings and structures indicated as Site Adapt shall be constructed exactly as provided in the Site Adapt drawings furnished in Appendix B-2. Any new buildings, structures, or portions of structures that are necessary but that are not included in the Site Adapt construction documents in Appendix B-2 shall be designed to the structural standards and design criteria noted in this Section 3.0 Structural. Calculations, construction drawings, and product data shall be submitted for any structure or portion of a structure required but not included in Appendix B-2 to this contract. Submittals shall be provided in accordance with the requirements of Section 01335 SUBMITTAL REQUIREMENTS of this Contract.

## DESIGN

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

Design shall be performed by a competent and knowledgeable structural engineer qualified by education and a minimum of five years experience in the type of structural design work to be performed. Calculations shall be in SI (metric) units of measurements. All components of the structures shall be designed and constructed in conformance to the design criteria herein and as specified in Appendix A-2.

## material strengths and standards

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

The Contractor shall use the following U.S. standards to provide an adequate and competent structural design. Local or other standards may be used if such standards are clearly shown to be equivalent to or exceed the specified U.S. standards. The Contractor shall follow American Concrete Institute Standards (ACI) for design and installation of all concrete structures.

### structural concrete

Concrete ASTM C 39 and ACI 318; f’c = 28 MPa (4,000 psi) minimum specified compressive strength @ 28 days

Water-cement ratio 0.45 (maximum)

Steel Reinforcement Deformed bar ASTM A 615 (ASTM A 706 for weldable rebar); fy = 420 MPa (60 ksi) yield strength

Welded Wire Fabric ASTM A 185

Non-Shrink Grout 35 MPa (5000 psi) min compressive strength at 28 days, ASTM C827

### masonry

Masonry Assemblage f’m = 10.4 MPa (1500 psi) minimum net area compressive strength per IBC Table 2105.2.2.1.2.

Concrete Masonry Units ASTM C 90; Normal Weight, minimum 13.1 MPa (1900 psi) net area compressive strength (average of 3 units)

Mortar ASTM C 270; Cement-Lime Type S, minimum 12.4 MPa (1800 psi) average compressive strength at 28 days

Grout ASTM C 476; minimum 14 MPa (2,000 psi) compressive strength @ 28 days

### structural steel

Plates, Shapes & Bars ASTM A 36; Fy = 250 MPa (36 ksi) minimum yield strength

Hollow Sections ASTM A 500, Grade B; Fy = 318 MPa (46 ksi) minimum yield strength

High Strength Bolts ASTM A 325

Standard Bolts ASTM A 307

Anchor Bolts ASTM F 1554; Grade 36 steel

Welding AWS D1.1 (American Welding Society)

Welding Electrodes E70XX

Sheets ASTM A 653; Grade 340 (50), Class Z275 (G90) for galvanized coating

Non-Shrink Grout ASTM C827, minimum 35 MPa (5000 psi) compressive strength at 28 days

### COLD-FORMED STEEL

Arch-Span Sheets ASTM A 653; Grade 340 (50), Class Z275 (G90) for galvanized coating

Studs & Cold-Formed Shapes ASTM A 653; Grade 230 (Fy = 33 ksi) or ASTM A1003 Grade 230 (Fy = 33 ksi) with G60 galvanized coating

## loads

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

### dead & live loads

Dead loads consist of the weight of all materials of construction incorporated in the building and the weight of fixed service items and equipment. Live load used for design shall be in accordance with the structural load data, UFC-3-310-01, Table B-1.

### snow loads

Snow Loads shall be calculated using a Ground Snow Load of 1.5 kPa.

### wind loads

Wind Loads shall be calculated using a "3-second gust" wind speed of 135 km/hr Exposure C minimum, Iw = [1.0].

### seismic loads

The building and non-building structures and all parts thereof shall be designed for the seismic requirements as defined by the International Building Code referenced herein. Spectral ordinates shall be Ss = [1.28]g and S1 = [0.51]g with Ie = 1.0. Seismic load combinations per ASCE 7 Section 12.4.2.3 shall be included in the design analysis.

***Note to Structural Engineer: If Ss is greater than 1.5 add a statement “Regular structures less than five stories in height with a period, T, less than 0.5 s may be designed using a value of Ss = 1.5 per ASCE 7-05, 12.8.1.3.”***

## structural concrete

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

### general

Concrete structural elements shall be designed and constructed in accordance with the provisions of the American Concrete Institute, Building Code Requirements for Structural Concrete, ACI 318.

### concrete placing & curing

Where concrete is cast-against and exposed to soil, a minimum concrete cover over reinforcement of 75 mm shall be provided. No concrete shall be placed when the ambient air temperature exceeds 32 degrees C unless an appropriate chemical retardant is used. In all cases when concrete is placed at 32 degrees C or hotter it shall be covered and kept continuously wet for a minimum of 48 hours. The curing requirements and recommendations in ACI 308 - Guide to Curing Concrete [(and ACI 506 – Guide to Shotcrete)] shall be followed for all temperature conditions. The contractor shall submit to AED plans for placing and curing concrete during cold weather (per ACI 306 - Cold Weather Concreting) and hot weather (per ACI 305 - Hot Weather Concreting).

### Precast (tilt-up) concrete Panels

1. Precast wall panels shall be designed to resist all the following forces:
2. Forces developed from differential support settlement, deformations, from creep and shrinkage, structural restraint, and the effects of environmental temperatures;
3. Forces due to construction, handling, storage, transportation, erection, impact, gravity dead and live loads, as well as lateral loads from soil, hydrostatic pressure, wind, and seismic forces;
4. Local stress concentrations in the vicinity of connections and applied loads must be considered;
5. Forces developed from thermal movement or bowing as well as volume change of the panel, with respect to the supporting structure, must be considered.
6. Insulated precast concrete sandwich wall panels shall be designed, detailed, and constructed to maintain structural integrity between the inside and outside wythes of concrete under design and construction loads.
7. The contractor is responsible for designing and detailing additional reinforcement and embeds required for lifting & erecting panels and for temporarily bracing the panels against wind or other forces that may occur during construction and until connections to the permanent structural system are completed.
8. Panel units shall be safely and adequately seated and anchored by mechanical means capable of sustaining all loads and stresses that may be applied to the panel, including positive and negative wind pressures and seismic forces. Connections shall properly transfer gravity and lateral (wind and seismic) between panels and to the shear walls and foundations.
9. Use 35 MPa non-shrink grout as necessary between the bottom of wall panels and the foundations to provide full bearing.
10. Whenever possible, panels should be concentrically supported to avoid bowing and warping of panels due to stress differential between inside and outside faces of the panel.
11. Additional guidance may be found in the PCI Design Handbook and the PCI Design and Typical Details of Connections for Precast and Prestressed Concrete

## MASONRY

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

* 1. Masonry shall be designed and constructed in accordance with the provisions of the Building Code Requirements for Masonry Structures, ACI 530/ASCE 5/TMS 402. Masonry shall not be used below grade.
1. All cells of exterior CMU walls, interior bearing walls, and interior walls that are part of the lateral force resisting system shall be fully grouted. For interior CMU non-bearing walls or CMU walls not a part of the lateral force resisting system, only the reinforced cells need to be grouted. All interior and exterior CMU walls shall have reinforced concrete horizontal bond beams at the top and bottom of the walls and at a maximum spacing of 1,200 mm on center. All CMU block shall be placed running bond.
2. Brick and unreinforced masonry shall not be used as a construction material for any buildings.
3. All CMU elements in this project are classified as nonparticipating elements as defined in ACI 530 (ASCE 5) 08, 1.17.3.1. As such, CMU shall be isolated in-plane from the seismic force-resisting system except as required for gravity support.
4. Analysis of the CMU wall by ETABS and STAAD are not acceptable as these programs do not have CMU design modules incorporating the TMS 402/ACI 530/ASCE 5 Masonry Code for design.

## STRUCTURAL and cold-formed STEEL

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

### general

1. Structural steel shall be designed and constructed in accordance with the provisions of American Institute of Steel Construction (AISC), Specifications for Structural Steel Buildings (AISC 360) and the Seismic Provisions for Structural Steel Buildings, including Supplement No. 1 dated 2005 (AISC 341).
2. Cold-formed steel structural members shall be in accordance with the provisions of American Iron and Steel Institute (AISI), Specifications for Design of Cold-Formed Steel Structural Members and the AISI Standards for Design of Cold-Formed Steel Framing.

### pre-engineered metal building (peb)

1. For the purpose of these project technical requirements, a Pre-Engineered Metal Building (PEB) shall be defined as a metal building system whose primary lateral transverse system consists of steel rigid frames with field-bolted sections of hot-rolled or built-up steel shapes (consisting of steel plate flanges and steel plate tapered or prismatic webs) having extended end plate moment connections. The PEB shall be designed by an experienced manufacturer regularly engaged in the design and fabrication of PEBs using standardized details, components, and design processes in accordance with MBMA (Metal Building Manufacturers Association) criteria and fabricated in a plant dedicated to PEB production. Metal Building Systems are defined as a complete integrated set of mutually dependant components and assemblies that form the building including primary and secondary framing, covering, and accessories.
2. Steel framing for PEBs shall be designed for all vertical and lateral loads specified herein including dead, live, (including crane loads where applicable), snow, wind, and seismic loads. PEB foundations, piers, and column anchor bolts [shall be designed based on the final reactions from the building manufacturer][shall be as per the site adapt drawings in Appendix B-2]. Foundations will not be cleared for construction until these components are properly submitted, reviewed, and approved by USACE AED-North Engineering Branch.
3. If exterior or interior CMU walls are specified in conjunction with a PEB, the CMU walls must be designed for out-of-plane loads perpendicular to the wall by one of three methods:

The CMU wall designed to be supported out-of-plane at the top of the wall by the PEB structure (recommended);

The CMU wall designed and reinforced to span horizontally between perpendicular CMU walls;

The CMU wall designed as a cantilevered wall with vertical reinforcing acting in conjunction with a properly designed footing.

If a CMU wall exceeds 3 meters in height it shall be designed as per Method 1 or Method 2; the Method 3 cantilevered wall is not allowed due to excessive deflection at the top of the wall. For the preferred Method 1, the PEB manufacturer is responsible for determining and furnishing the size of the transfer girt, the connection of the transfer girt to the PEB column, and correctly applying the CMU lateral wall loads to the PEB frames and columns. The Contractor is responsible for designing the CMU wall reinforcing and associated footings. For Methods 2 and 3, the Contractor is responsible for designing the CMU wall reinforcing and associated footings.

## CRANES

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

### hoist & bridge girder design Criteria

* 1. Crane hoists and bridge girders shall be designed and constructed in conformance to CMAA 70 (Crane Manufacturer’s Association of America) or CMAA 74 service class C (moderate service) classification.
	2. If the bridge crane is supported by a steel structure integral or independent of the building, the bridge crane shall be designed in conformance to criteria in this specification, including *AISC Steel Design Guide 7, Industrial Buildings, Roofs to Anchor Rods.*
	3. PEB structures supporting a bridge crane shall be designed per the requirements of the Metal Building Manufactures Association (MBMA) *Metal Building Systems Manual.*

### contractor requirements

Cranes (trolley, bridge girder, trucks motors, and related parts) shall be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of crane required to meet the design requirements stated herein.

## ROOFS

### roof trusses

Trusses that are not continuously underlain by a concrete roof slab are considered to be structural trusses and shall meet the following requirements. Structural trusses shall be fabricated structural steel trusses. These structural steel trusses shall be designed with all connections bolted and shall be assembled in the shop to ensure that all bolt patterns in truss members and gusset plates are aligned within AISC tolerances. The trusses may be disassembled prior to delivery and reassembled in the field if desired. If steel purlins are part of the truss roof system, they shall be installed perpendicular to the steel roof trusses and shall be bolted to clip angles which have been shop-welded to the top chords of the trusses. Unless specified otherwise, steel roof trusses shall be designed by the Contractor. Design drawings shall specify all bridging, bracing, and anchorages required for stability, lateral loads and wind uplift.

Trusses that are continuously underlain by a concrete roof slab are considered to be architectural trusses. Architectural trusses shall be built with structural steel, cold-formed, or wood. Truss member connections for architectural structural steel trusses may be bolted or shop or field welded. Truss member connections for architectural cold-formed steel trusses shall be screwed; welding of cold-formed members is prohibited. Truss member connections for architectural wood trusses shall be nominal 50 mm x 100 mm chord and 50 mm x 75 mm minimum web members and have plywood gussets with screws or nails, or other connections that preclude splitting of the wood truss members. Design drawings for architectural trusses shall specify all bridging, bracing, and anchorages to the concrete slab required for stability, lateral loads and wind uplift.

### steel roof joists

Steel roof joists shall be placed according to the roof design drawings and specifications. Steel purlins or sub-purlins shall be installed perpendicular to the steel joists as required. Unless specified otherwise on the standard design drawings, steel roof joists shall be designed by the Contractor. Design drawings shall specify all required blocking, bracing, connections, and anchorages.

### STEEL deck

Steel deck units shall conform to SDI Publication Number 31. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span three or more supports with 50 mm minimum bearing at supports. Side laps shall be interlocking or nested and be stitched together as specified per the design documents. Steel deck shall be galvanized and be a profile and thickness as required by the design.

### metal roofing panel

Metal roofing panel sheets shall be continuous from ridge to eave to avoid intermediate roof seams. In lieu of the continuous metal roof sheets, the Contractor may submit a plan for consideration of intermediate roofing seams, including sufficient details specifying how leaks will be prevented. The Contracting Officer must approve the plan prior to the Contractor commencing and installing the work.

## welding

***Note to Structural Engineer: Edit as appropriate for the project*** Field welding shall not be used for any part of the Main Structural Force Resisting System for structures with building occupants. The Main Structural Force Resisting System is that assemblage of structural elements providing the required support and stability for the overall structure to adequately resist gravity (dead; live, etc.) loads and lateral (wind; seismic, etc.) loads. Bolted connections in lieu of welding are strongly recommended. Exemptions to these guidelines would be minor structural connections such as metal trusses bearing on a reinforced concrete roof and other non-load bearing applications. Such welding shall be performed only by AWS Certified welders.

### shop welding

* 1. Shop welding is permitted, provided the welders are AWS certified.
1. Shop welding of pre-engineered buildings shall be by an AISC or AWS certified shop.

### weld procedure specification

Where field or shop welding is utilized, a WPS (Weld Procedure Specification) with the following information shall be submitted for review before fabrication:

1. AWS certificates of the certified welders to be used for field welding or for shop welding; the certificate shall state the type of weld for which the welder has been tested and certified to perform;
2. AWS or AISC shop certification, if shop welding is utilized;
3. Plan for how each shop and field weld will be non-destructive tested to meet IBC and AWS special inspection requirements;
4. A WPS (Weld Procedure Specification) with the following information shall be submitted before fabrication:
	1. The welding process (FCAW, SAW, SMAW, GMAW) to be used;
	2. The filler metal to be used with the base metal;
	3. Welding parameters; including the maximum electrode diameter, maximum current, maximum root pass thickness, joint detail, and weld type; and
	4. Minimum preheat and interpass temperature requirements.
5. Plan for how the material and equipment will be stored on site and protected from the elements.

## FOUNDATIONS

***Note to Structural Engineer: Edit this entire Structural section to include full and clear description of the technical requirements only. Scope of the work is described in 01010.***

* 1. ***NOTE TO EDITOR: For purely site-adapt projects, delete the second “design-build” paragraph below and coordinate the allowable soil bearing pressure language in the first paragraph with the criteria from each standard building. For purely design-build projects, delete the first paragraph and keep the second paragraph. For combination projects, edit the first paragraph and keep the second)*** Foundations shall be properly placed on suitable compacted soil and shall be in accordance with the recommendations from the geotechnical investigation. Building foundations shall be founded a minimum of 800 mm below grade or 300 mm below frost line, whichever is lower with respect to finish grade.
	2. Foundations for Standard Design (Site Adapt) buildings shall be constructed as shown on the construction documents and are not to be redesigned except for special case deficiencies as directed by USACE-AEN.
	3. The foundations for design-build structures shall be designed based on the geotechnical findings and recommendations for allowable soil bearing pressure, foundation type, and sub-grade preparation.
	4. Foundations shall be designed for the reactions resulting from the load combinations required by the design criteria, including reactions provided by the PEB manufacturer.
	5. Footing subgrades shall be inspected and approved by the Contracting Officer prior to concrete placement.

# ARCHITECTURAL REQUIREMENTS

## GENERAL

### materials & standards

All material approved shall become standardized material to be used throughout the facilities under this Contract. Different sub-contractors shall not use different material or standards under the Contract. Intent of the project is to use locally procured materials (unless specified otherwise) and labor to the maximum extent possible while satisfying applicable codes and standards. Conflicts between criteria shall immediately be brought to the attention of the Contracting Officer for resolution. In such instances, the Contractor shall furnish all available information with justification to the Contracting Officer.

### design criteria

* 1. [Site Adapt designs shall be used without deviation to the documents to create a complete and usable facility.]
	2. [Schematic Design-Build designs for the facility types requested in this proposal shall be used to design and construct a complete and usable facility that meets the minimum requirements stated in these documents.]
	3. The Codes, Standards, and Regulations listed in these documents shall be used in the construction of this project. The publications shall be as referenced in Appendix 2 TECHNICAL REFERENCES, or the most recent editions. Standards other than those mentioned may be accepted provided they meet the minimum requirements and the proof of equivalency as submitted to the Contracting Officer for approval.

***Note to Architect: DELETE THE SECTIONS BELOW FOR SITE ADAPT ONLY PROJECTS. USE THESE SECTIONS FOR DESIGN BUILD AND HYBRID PROJECTS. Edit this entire Architectural section to include full and clear descriptions of the technical requirements only. Scope of the work is described in 01010. Do not describe scope. Compare against the 01010 when doing your edits to make sure there is no duplication. Delete those paragraphs that do not apply to this specific project. Otherwise the Bidders may think that that scope is to be included in their bids.***

## CONCRETE

### finish

Horizontal finishes shall be troweled or screed. If finish is exposed concrete, then the surface shall be a broom finish for texture, and shall not interfere with the surface slope or drainage. Vertical work shall have a form finish. Exposed concrete shall be coated with an approved sealer.

### insulated concrete sandwich wall system (3d building system)

NOTE TO ARCHITECT: Only include this paragraph if specifically requested by client.

As an option to standard masonry construction, the Contractor may construct walls of single story buildings using an insulated concrete sandwich wall system. Insulated concrete sandwich wall systems shall be field fabricated and composed of a 50 mm expanded polystyrene core for interior walls, and 100 mm for exterior walls, that spans in a single piece from floor elevation to top of wall elevation. The polystyrene core shall have a welded wire fabric, 50 mm x 50 mm mesh, 2.52 mm (12.5 gauge) wire attached to both faces of the polystyrene core. The welded wire mesh shall be installed at 13 mm from the face of the polystyrene core. On each face, the welded wire mesh shall be attached to each other and the polystyrene core with diagonal truss wires. Apply sprayed-on concrete (shotcrete) to a minimum thickness of 45 mm, or as structural calculations require, whichever is greater. Method of placing the shotcrete shall be in conformance with ACI 506R-85. Concrete finishing shall be done by appropriate hand tools (darby, trowel, etc.) to provide the specified finish effect.

### precast

Store precast units in a dry place and covered with a plastic or protective layer. Precast unit shop drawings shall be submitted for approval, and include details describing size, shape and location of installation. Precast units shall meet the minimum concrete strength requirements.

## Masonry

### general

Store masonry units in a dry place and covered with a plastic or protective layer. Incomplete open walls shall be covered each day to keep them protected and dry. Masonry wall and construction systems shall be reinforced.

### CONCRETE masonry units

1. Concrete masonry units (CMU) used for exterior walls shall be either 190 mm or 290 mm wide x 390 mm x 190 mm high, as shown on drawings. Install only quality units set level and plumb in a running bond pattern. The surface shall be free of chips, cracks, or other imperfections that would detract from the overall appearance of the finished wall. Defective CMU or mortar shall be rejected.
2. Mortar joints shall be 10 mm on all sides between CMU. Joints shall be struck with a concave tool to provide a smooth recessed curved surface without gaps. Weep holes shall be provided at regular intervals in cavity wall systems.

## Stone

Stone type shall be identified and submitted for approval during the design process. Mortar shall be of lower strength than the stone provided. Stone veneer finishes shall be sufficiently secured to a stable backer-wall system. Stone cavity wall systems shall be reinforced with weep holes provided at regular intervals.

## THERMAL PERFORMANCE OF EXTERNAL BUILDING ASSEMBLIES

### thermal performance

Exterior building assemblies shall meet the following requirements:

UFC 1-200-01, General Building Requirements

In addition to the above criteria, building assemblies shall meet the following minimum requirements:

|  |  |
| --- | --- |
| **ASSEMBLY** | **MINIMUM THERMAL VALUE** |
| Exterior Walls (above grade) | RSI 2.280 (R 13) |
| Ceilings/Roofs | RSI 5.284 (R 30) |
| Floors (over unheated space) | RSI 3.346 (R 19) |
| Exterior Doors | RSI 0.252 (R 1.43) |
| Exterior Windows (includes glazing within doors) | RSI 0.308(R 1.75) |
| Skylights | RSI 0.180 (R 1.02) |

Notes:

1. This table is a summary of ANSI/ ASHRAE 90.1 Table 5.5-5, Climate Zone 5 (A,B,C)
2. RSI measured in K-m2/W, R measured in SF-F-hr/BTU. 1 K-m2/W = 5.678 SF-F-hr/BTU.

### PASSIVE SOLAR DESIGN

When possible due to site constraints, orientate the buildings to take advantage of solar heat gain through windows to help with the heating of buildings. Include insulation and exterior window shading techniques to reduce and/or control building heat loss and heat gain. Contractors shall include energy efficient heating and cooling solutions to minimize energy consumption.

## CARPENTRY

### general

The use of wood framing as indicated below is acceptable only where allowed by IBC and NFPA 101.

### wood purlins

If allowed, the Contractor may provide and install roof purlins of locally available natural wood material, securely wedged 1 meter on center between the structural steel joists.

### plywood roof decking

Plywood roof decking shall be 20 mm minimum thick with the long dimension installed over supports spaced 600 mm maximum on-center. Plywood end joints shall occur over supports. Plywood roof decking shall be screwed to steel or cold-formed steel supports and nailed or screwed to wood supports with a minimum 3 mm minimum diameter x 60 mm minimum long fasteners spaced 150 mm maximum on-center at panel ends and 300 mm maximum on-center field.

### wood battens

If allowed, the Contractor may provide and install wood ceiling batten strips of 20 mm x 60 mm nailed to the bottom of the wood purlins. Battens shall be spaced at 400mm on center for the support of a plaster ceiling, or per UBC requirements if sheetrock is substituted for plaster.

## ROOFING AND WEATHERPROOFING

### building entries

All exterior entryways shall be covered by roofs or canopies, and shall be protected by rain gutters or diverters to prevent water from falling on the entryways below. Mechanical, electrical and other utility room exterior entries are exempt from this requirement.

### sloped metal roofs

1. All buildings, other than arch-span buildings, shall have low-sloped metal roofs with eaves and soffits finished with the same metal roofing material. A sloping roof shall be as defined in the IBC. Where a pre-detonation sloping roof is not required, provide and install 0.6mm (24 gauge) galvanized steel panels in either corrugated or standing seam design. For pre-denotation sloping roofs, use 0.7mm (22 gauge) galvanized steel panels in either corrugated or standing seam design. Augment pre-detonation roof/ceiling assemblies with sand bags laid on top of the flat roof/ceiling deck.
2. All metal roofing shall be anchored to steel “Z” purlins or wood deck sub-surface using exposed fasteners at 300mm on center at all seams, and at 600mm on center in the panel field. Wood deck sub-surface shall consist of either solid-wood boards or plywood sheets. Fasteners shall be placed at the top of the corrugation taking care not to dent panel. Roof sealant or adhesive shall be placed over each anchor head. Roofing system shall include all edge, ridge and penetration flashings necessary for a watertight installation and as described in this Section. Panels shall be overlapped two corrugations side to side and be continuous sheets from ridge to eave. Do not splice together separate panels along the vertical rise. Provide continuous ridge vents at all gable roofs.
3. Provide continuous or periodic vents in the soffits to provide adequate air flow and venting of the roof attic spaces.
4. [If the Collapsible Soils Bid Option is exercised, then all building roof drainage shall be collected in a gutter and downspout system which shall discharge at least 3 meters from foundation walls into a concrete lined drainage way.]

### low-sloped Built-up roofs

A low-slope roof shall be as defined in the IBC. Provide and install 3 ply built up roofing over concrete deck. Contractor may propose to the Contracting Officer an alternate roofing system with justification for consideration and alternate pricing. Concrete roof deck shall slope 21 mm per m.

#### built-up roofing

Insulated-Deck, Coal Tar, Glass-Fiber, Aggregate Roofing (ICGA-BUR): Provide built-up, aggregate-surfaced roof system with coal tar bitumen and glass-fiber ply felts (roof manufacturer’s separation layers) for layup as indicated.

#### insulation

1. Provide a 50 mm thick extruded polystyrene rigid thermal insulation boards, conforming DIN, EN 13164 BS, EN 13164, k=0.2 @ 75 degrees F mean temperature, 2.82 kg/sq cm compressive strength, hydrophobic, Type VI. Provide thickness by multiple boards to meet the designed R-value.
2. Comply with insulation manufacturer's instructions and recommendations for handling, installing, and bonding or anchoring insulation to substrate. Insulation boards shall be installed loose, without glue, in staggered manner. Attention should be paid not to leave separation along edges. Where overall insulation thickness is 50 mm or greater, install required thickness in two layers with joints of second layer offset from joints of first layer a minimum of 300 mm each direction. Trim surface of insulation where necessary at roof drains so completed surface is flush with drain ring. Polyester felt or geotextile shall be installed over insulation layers as a filter layer to prevent the passage of fines in gravel layer to lower strata.

#### primer

ASTM D 41 primer as recommended by roofing manufacturer.

#### coal tar bitumen

ASTM D 450, Type III, as an option to asphalt.

#### bitumen membrane

ASTM D312 or the equivalent EN 1849-1 for thickness and unit weight,

ASTM D312 or the equivalent EN-1426 for penetration,

ASTM D312 or the equivalent EN-1427 for softening point

ASTM D312 or the equivalent TS 11758-1 for flash point or heat stability

ASTM D4601 or the equivalent TS 11758-1 for width and area of roll

ASTM D4601 (moisture percentage) or the equivalent EN 1928 (water tightness)

ASTM D226 (pliability) or the equivalent EN 1109 (cold bending).

#### fiberglass roofing felt

ASTM D 2178, Type IV or VI, except felts for coal tar systems shall be impregnated with a bituminous resin coating which is compatible with coal tar bitumen.

#### organic roofing felt

ASTM D 2626 for use with asphalt roofing system.

ASTM D 226 for use with asphalt roofing system and ASTM D 227 for use with coal tar roofing system. Organic felts may be used for bitumen stops and edge envelopes.

#### roof membrane installation

1. Prime surface of concrete deck with asphalt primer per manufacturers recommended application rate.
2. Cant Strips/Tapered-Edge Strips: Wood, not less than 90 mm high, 45-degree insulation cant strips at juncture of membrane with vertical surface. Provide tapered-edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
3. Base Layer: Install one lapped course of base sheet. Attach first layer of roofing membrane material to substrates and elsewhere as indicated. Mop to non-nailable substrate with hot bitumen or apply with torch method per manufacturer’s specifications
4. Second Layer: Install second layer of roofing membrane material over the first course staggering joints and seams in both directions by at least 300 mm. Mop top layer of membrane to base layer, or attach via torch method per manufacturer’s specifications.

#### composition flashing & stripping

1. Install composition flashing at cant strips, at other sloping and vertical surfaces, at roof edges, and at penetrations through roof. Install composition flashing in accordance with membrane manufacturers specifications. Nail or provide other forms of mechanical anchorage of composition flashing to vertical surfaces as recommended by manufacturer of primary roofing materials.
2. Install composition stripping where metal flanges are set on roofing. Provide not less than two plies of woven glass-fiber fabric, each set in a continuous coating of roofing cement and extended onto the deck 100 mm to 150 mm (4 inches and 6 inches), respectively. Except where concealed by aggregate surfacing or elastic flashing, apply a heavy coating of roofing cement over composition stripping.
3. Roof Drains: Fill clamping ring base with a heavy coating of roofing cement. Set built up roofing membrane in to the clamping ring base and fix the drain top on it.
4. Allow for expansion of running metal flashing and edge trim that adjoins roofing. Do not seal or bond built-up roof membrane or composition flashing and stripping to metal flanges that are over 914 mm (3 feet) in length.
5. Counterflashings: cap flashings, expansion joints, counterflashings, and similar work to be coordinated with built-up roofing work, are specified in other sections of these specifications.
6. Roof Accessories: Miscellaneous sheet metal accessory items, including insulation vents and other devices and major items of roof accessories to be coordinated with built-up roofing work.

#### gravel layer

A gravel layer of 16 to 32 mm diameter stone will be laid at least 50 mm thick on top of the filter layer in non-trafficable flat roofs The gravel layer will be applied as soon as possible to prevent UV damage and/or wind damage to insulation and filter layers. Connections and Jointing.

## Connections and Jointing

### soldering

Soldering shall apply to copper and stainless steel items. Edges of sheet metal shall be pre-tinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pre-tinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

### seaming

Flat-lock and soldered-lap seams shall finish not less than 25 mm. wide. Unsoldered plain-lap seams shall lap not less than 75 mm. unless otherwise specified. Flat seams shall be made in the direction of the flow.

### cleats

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 3 mm. apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 300 mm. on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

## MetalS

### steel handrails

Steel handrails shall be steel pipe conforming to ASTM A 53/A 53M, and shall have a nominal diameter of 50 mm. Handrails shall be designed to resist loads as per the 2009 IBC. Installation of handrails shall be with expansion shields and bolts into masonry and/or concrete, and full length welds of metal posts to stair stringers. Railings shall be hot dipped galvanized and shop painted. Pipe collars of the same material and finish as the handrail shall be provided.

### metal stairs

Provide galvanized steel stair stringers and treads. Treads shall be [concrete pan, checkered plate steel, grated galvanized steel] along with welds or fasteners. Stairs shall be designed and constructed to support live loads per the 2009 IBC

### materials

Any metal listed by ASTM, DIN, BS or EN standards. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in ASTM, DIN, BS or EN standards. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

### galvanized sheet steel

Zinc-coated steel sheet conforming to ASTM A 653, DIN BS or EN Standards.

### wall capping

Aluminum wall capping shall conform to ASTM B 209 M, DIN 18339, BS or EN Standards. Wall Capping shall be installed according to the manufacturer’s recommendations.

### flashing

Flashing shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer’s recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be installed on top of joint reinforcement. Lashing shall be formed to direct water to the outside of the system.

#### through-wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further in to the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

#### lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 50 mm, or shall be applied over top of masonry and pre-cast concrete lintels. Bed joints of lintels at joints shall be under laid with sheet metal bond breaker.

#### valley flashing

Valley flashing shall be provided at intersections of roofs where a valley is formed. Flashing shall be a minimum of 500 mm centered on the valley (extending each direction a minimum of 250 mm). Valley flashing shall have a small ridge in the center to allow for expansion and contraction. Material shall be stainless steel, galvanized or match finished roofing metal.

#### sill flashing

Sill flashing shall extend the full width of the sill and not less than 100 mm beyond ends of sill except at joint where the flashing shall be terminated at the end of the sill.

### fascia & soffits

No wood fascias and/or soffits are allowed. Use metal fascias and soffits throughout. Extend roof decking out over fascia a minimum of 20 mm. Provide a 40 mm drip flashing over edge of roof decking so that it extends past bottom of decking on all sides of the building. Soffits shall be a minimum width of 600mm extending from the building wall. Enclose soffits and return to vertical wall. Provide continuous soffit venting of all overhangs on the underside of the soffit. The opening shall be no larger than 100 mm and set in a minimum of 50 mm from the exterior fascia edge.

### ridge vents

For sloping roofs, provide continues metal ridge vent at the top of roof along the ridge. Ridge vent shall be sized to provide adequate ventilation of the roofing system.

### insect screens

Provide insect screen for all soffit, ridge, vents, louvers and all openings except for doors and windows unless otherwise specified.

### expansion joints

Metal expansion joints shall have a profile to allow deflection and expansion in two directions. Metal shall be treated for exterior conditions. Expansion joints shall be water proof.

### roof gutters

Roof gutters shall be installed as indicated. Roof gutters shall be rigidly attached to the building. Supports for roof gutters shall be spaced according to manufacturer’s recommendations. A 600 mm overlap, jointing with approved crimping or welding shall provide a continuous gutter along the building eaves.

### downspouts

Downspouts shall be designed and fabricated for each specific application. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 13 mm hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing and shall not block the flow of water to the downspout for low sloped roofs. Downspouts shall be rigidly attached to the building with supports a minimum of 1.5 M apart. At the base of each downspout, concrete splash block shall be placed to eliminate damage to the building due to rain water runoff toward the building. [In rural locations, a layer of rock 10 - 80 mm in size, 100 mm thick, may be substituted upon governmental approval.]

## Sealants

### general

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and cannot be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool smooth fresh sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints; apply sealant, and tool smooth as specified. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

### interior Sealants

ASTM C 834 or ASTM C 920, Type S or M, Grade NS, Class 12.5. Use NT, DIN, BS, or EN equal standards.

### exterior Sealants

For joints in vertical and horizontal surfaces, provide ASTM C 920, Type S or M, Grade NS, DIN, BS, or EN equal standards.

### floor joint Sealants

(ASTM C 920) Type S or M, Grade P, class 25, use T.

### primers

Provide a non-staining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application. Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

### bond breakers

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint. Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

### backing

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated. Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified.

### surface preparation

Surfaces shall be clean, dry to the touch, and free from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

### masking tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

### protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

### final cleaning

Provide cleaning solvent type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant. Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

### masonry & other porous surfaces

Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

### metal & other non-porous surfaces

Remove excess sealant with a solvent-moistened cloth.

## louvers

### interior louvers

SDI 111-C, Louvers shall be stationary sight-proof or lightproof type as required. Louvers for lightproof doors shall not transmit light. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 0.90 mm thick steel and louver blades of a minimum 0.60 mm. Louvers for lightproof doors shall have minimum of 20 percent net-free opening. Sight-proof louvers shall be inverted "V" blade design with minimum 55 or inverted "Y" blade design with minimum 40 percent net-free opening.

### exterior louvers

Louvers shall be inverted "Y", "V" or "Z" type. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect screens secured to room side and readily removable. Provide aluminum wire cloth, 7 by 7 per 10 mm or 7 by 6 per 10 mm mesh, for insect screens.

## windows

### general

1. Windows shall be [operable] [fixed] [as indicated in drawings]. Operable windows shall be [slider] [awning] [casement] type [as indicated in drawings].
2. Where security bars are noted: provide 20 mm diameter steel bars, 100 mm on center spacing, in a steel frame. Secure with fasteners a minimum of 100 mm deep.

### materials

#### frames

Provide aluminum extrusions with alloy and temper as recommended by the window manufacturer for the strength, corrosion resistance, and application of required finish, meeting the DIN 1725 raw material requirements, but not less than 215 N/mm2 ultimate tensile strength and not less than 1.5 mm thick at any location for main frame and sash members. Note: At the contractor’s option extruded PVC windows may be provided in lieu of aluminum windows.

#### fasteners

1. Provide aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.
2. Where fasteners screw-anchor into aluminum less than 3 mm thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard non-corrosive pressed-in splined grommet nuts.
3. Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match the finish of the member or hardware being fastened, as appropriate.

#### anchors, clips & accessories

Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel or iron complying with the requirements of DIN 1748; provide sufficient strength to withstand design pressure indicated. As a minimum provide 3 anchors on each side of the frame.

#### sealants

For sealants required within fabricated window units, provide type recommended by the manufacturer for joint size and movement. Sealant shall remain permanently elastic non-shrinking, and non-migrating. Comply with Sealants of these specifications for selection and installation of sealants.

#### insect screens

Wire Fabric Insect Screen shall be permanently fixed to the exterior of operable windows.

#### hardware

Provide the manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended. Provide at a minimum one locking device on the interior of each window. Any operable window over 2 square meters shall have two locking devices as a minimum.

### fabrication

Provide aluminum windows with factory finish in all buildings as indicated in the design drawings. Window openings shall be provided with insect screening permanently fixed to the exterior. Provide a minimum of 3 anchors on each side of the frame into the adjoining structure. Provide weather stripping system for all exterior windows and doors.

### sills

Galvanized metal window sills, 0.90 mm (20 gauge), shall be installed on the exterior of all windows. The metal window sills shall have a turn down of 50 mm over the exterior masonry and stucco. Metal sills shall extend from side to side of the masonry opening in a single piece. Extend the metal window sill a minimum of 20 mm under the bottom of the aluminum windows. Install masonry mortar as required for a smooth surface under the window sills. Sills shall slope a minimum of 6 mm to the exterior and not allow water to puddle.

### finishes

Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting. Color shall be white meeting the requirements of DIN 50018.

### installation

1. Comply with manufacturer's specifications and recommendations for installation of window units, hardware, operators, and other components of the work. Set window units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place. Set sill members and other members in a bed of compound or with joint fillers or gaskets, as shown, to provide weather tight construction. Refer to the Sealant sections for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the work.
2. Inspect openings before beginning installation. Verify that rough or masonry opening is correct and the sill plate is level. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.
3. Adjust operating sash and hardware to provide a tight fit at contact points and at weather stripping for smooth operation and a weather tight closure.

### final cleaning

Clean aluminum surfaces promptly after installation of windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances. Lubricate hardware and other moving parts.

## doors

### exterior doors

All new and renovated exterior doors shall be heavy duty metal doors with metal frames.

### interior doors

All new and renovated interior doors shall be hollow metal doors with hollow metal frames, except as noted otherwise.

### overhead doors

1. Overhead doors shall be sized as required. Doors shall be fabricated from interlocking cold-rolled slats, designed to withstand building wind loading and be installed with wind locks. Curtain door slats shall be continues for the width of the door and steel interlocking flat-profile design. Standard steel slats shall be made of roll-formed steel [22, 18, or 16] gauge steel, either primed & painted galvanized, stainless steel or anodized aluminum as provided by manufacture. Channel or curtain door guides shall be provided on each side of door.
2. Overhead doors shall have a weather stripping bottom bar, head and jambs. Weather stripping and astragals shall be natural rubber or neoprene rubber.
3. [Overhead steel doors shall have manufactured vision panels.]
4. A manual pull chain shall be connected to the operation of the rolling door to provide open and close operation. [A locking pin shall be provided on each jamb of the interior side of the door. Door shall have manufacturer’s standard five pin tumbler locks, keyed.]
5. Coiling housing shall be mounted above all opening, on the interior side.
6. For rated openings, a fusible link shall be provided on the most hazardous side (example: kitchen rather than dining area). The coiling shutter shall also be rated and designed accordingly by the manufacture for the required fire rating. Hoods shall be fabricated from steel sheets with minimum yield strength of 227.5 MPa.
7. Doors shall be counterbalanced by an adjustable, steel, helical torsion spring mounted around a steel shaft in a spring barrel and connected to the door curtain with the required barrel rings. Counterbalance-barrel components shall be as follows:
8. Spring barrels shall be hot-formed structural-quality carbon steel, welded or seamless pipe. Pipe shall be of sufficient diameter and wall thickness to limit deflection to a maximum of 1/360 of the span;
9. Counterbalance springs shall be oil-tempered helical steel springs designed with a safety factor of 4. Springs shall be sized to counterbalance the weight of the curtain at any point of its travel, and shall be capable of being adjusted to counterbalance not less than 125% of the normal curtain load. Spring adjustment shall be arranged in such a way that the curtain need not be raised or lowered to secure the adjustment;
10. Counterbalance shafts shall be case-hardened steel of the proper size to hold the fixed ends of the spring and carry the torsion load of the spring;
11. Barrel plugs shall be fabricated from cast steel machined to fit the ends of the barrel. Plugs shall secure the ends of the spring to the barrel and the shaft;
12. Barrel rings shall be fabricated from malleable iron of the proper in-volute shape to coil the curtain in a uniformly increasing diameter;
13. Shaft bearings shall be factory sealed ball bearings of the proper size for load and shaft diameters;
14. Door operators shall consist of an endless steel hand chain, chain-pocket wheel and guard, and a geared reduction unit of at least a 3:1 ratio. Required pull for operation shall not exceed 16 kg. Chain hoists shall have a self-locking mechanism allowing the curtain to be stopped at any point in its upward/downward travel and to remain in that position until moved to the fully open or closed position. Hand chains shall be cadmium-plated alloy steel with a yield point of at least three times the required hand-chain pull. Pretreated zinc-coated steel sheets shall be given the manufacturer’s standard prime coat and an enamel finish coat applied to the exterior face after forming;
15. After installation, doors, track, and operating equipment shall be examined and tested for general operation and weather against the specified wind pressure, and weather resistance. Doors that fail the required tests shall be adjusted and retested. Doors that have been adjusted and fail subsequent tests shall be removed and replaced with new doors at no additional cost.

### wood doors

Provide solid core wood doors. Wood doors shall meet the requirements and standards of the Window and Door Manufactures Association (WDMA) and the American Architectural Manufactures Association (AAMA) and ASTM 2074-00 Fire Test for fire rated doors. Doors shall be 44.5 mm thick.

### steel doors

Provide steel doors that meet SDI A250.8, except as specified otherwise. Prepare doors to receive specified hardware. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 44.5 mm thick, unless otherwise indicated. Doors shall be constructed using heavy gauge steel with minimum thickness of 1.2 mm.

### solid plastic doors

Solid plastic doors and frames are for interior wet room use only. Solid plastic doors and frames may be used for bath stalls, shower stalls, and toilets stalls.

### rated doors

The requirements of NFPA 80 and NFPA 105 respectfully shall take precedence over details and penetration restrictions indicated or specified. Fire rated door assemblies including hollow metal frame and hardware shall be provided as indicated in the design drawings. Rated doors and frames shall be tested and approved as an assembly and shall be provided by a single manufacturer/distributor. Hardware for fire rated door assemblies shall be labeled as appropriate for fire rated applications and shall be coordinated with door manufacturer.

### thresholds

All exterior doors shall be provided with manufactured metal thresholds conforming to ANSI/BHMA A156.21. Doors at all wet areas with ceramic tile or terrazzo tile flooring shall be provided with solid marble thresholds with marble threshold set 13 mm above tile. Thresholds shall span continuously from jamb to jamb.

### frames

#### standard steel frames

SDI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for doors, transoms, sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated.

#### welded frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

#### stops & beads

Form stops and beads from 0.9 mm thick steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space the fasteners approximately 300 to 400 mm on centers. Miter molded shapes at corners. Use butt or miter square or rectangular beads at corners.

### weatherstripping

Provide weather-stripping that is a standard cataloged product of a manufacturer regularly engaged in the manufacture of this specialized item. Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals. Weather stripping shall be looped neoprene, synthetic rubber gasket, or vinyl held in an extruded non-ferrous metal housing. Air leakage of weather stripped doors shall not exceed 0.003125 cubic meters per second of air per square meter of door area when tested in accordance with ASTM E 283.

### anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, anchors not lighter than 1.2 mm thick.

#### wall anchors

Provide at least three anchors for each jamb. For frames which are more than 2285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

#### floor anchors

Provide floor anchors drilled for 10 mm anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

### hardware

#### hardware preparation

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI A250.8 and ANSI A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI A250.8, as applicable. Punch door frames, with the exception of frames that will have weather-stripping or lightproof or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

#### hinges

1. Commercial duty exterior hinges shall have non-removable pins and be satin-chrome steel or stainless steel; Grade 1 anti-friction or ball bearing; and 3 each of 115 mm x 115 mm per leaf up to 900 mm wide door 125 mm x 125 mm for doors 900 mm to 1,200 mm wide.
2. Commercial duty interior hinges shall be Grade 1; antifriction or ball bearing; and 3 each of 115 mm x 115 mm per leaf up to 900 mm wide door 125 mm x 125 mm for doors 900 mm to 1,200mm wide.
3. Hinges for labeled fire doors must be either steel or stainless steel. Hinges shall conform to ANSI/BHMA A156.1 and A156.7.

#### locksets

1. Exterior doors shall have commercial duty mortise locks conforming to ANSI / BHMA A156.13 for metal doors. Emergency exit devices shall be Grade 1, flush mounted type.
2. Interior doors shall have mortise locksets conforming to ANSI / BHMA A156.13, Series1000, Grade 1.
3. All locks and latchsets shall be the product of the same manufacturer.
4. Locksets, padlocks and latchsets shall be provided, as required, with lever handles on each side.
5. Provide heavy duty hasp and locks at all fuel storage tanks.

#### closers

Closers shall be provided on all exterior doors and fire-rated doors. All exterior doors and interior doors that require security or privacy such as toilet room shall be provided with heavy-duty hydraulic closers. Closers shall conform to ANSI/BHMA A156.4, Grade 1. Closers shall be surface-mounted, modern type, with cover. Closer shall be adjustable type and have slow-down control to prevent door leaf from slamming to frame. Provide door silencers on all door frames provided with closers.

#### door stops

Door stops shall be provided on all exterior and interior doors. Door stops shall comply with ANSI/BHMA A156.16 and shall be satin chrome on bronze, Grade 1.

#### keying system & lock cylinders

1. Provide locks for all doors. Provide thumb latch on inside of each door such that no key is necessary to exit any room or the building. Coordinate the final keying schedule with the Contracting Officer prior to ordering locksets.
2. A Master key system shall be provided. Master key system shall include a separate & different key for each door with a master key provided to open any & all doors. Each building shall be provided with eight (8) master keys fitting all locks, eight (8) sub-master keys fitting all exterior doors and three (3) keys for each interior door. Provide 25% spare key blanks for the total amount of keys required for each building. Provide numbering system identifying which key is associated to which room door.
3. Lock cylinders shall comply with BHMA A156.5. Lock cylinder shall have six pins. Cylinders shall have key removable type cores. All locksets, exit devices, and padlocks shall accept same interchangeable cores.

### finishes

#### general

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI A250.8, or paintable A25 galv-annealed steel without primer. Where coating is removed by welding, apply touchup of factory primer. Provide door finish colors as selected by the Contracting Officer from the color selection samples.

#### sealers

Provide a water-resistant sealer compatible with the specified finish as approved and as recommended by the door manufacturer.

### fabrication

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 3 mm larger than the actual masonry thickness. Design other frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

### installation

#### general

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 2 mm minimum, 3 mm maximum clearance at sides and top, and a 5 mm minimum, 6 mm maximum clearance over thresholds. Provide 10 mm minimum, 11 mm maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 3 mm in 50 mm. Door warp shall not exceed 6 mm when measured in accordance with WDMA I.S. 1-A. Hang doors in accordance with clearances specified in SDI A250.8. After erection and glazing, clean and adjust hardware.

#### frames

1. Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. When an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.
2. For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

#### weatherstripping

Install doors in strict accordance with the manufacturer's printed instructions and details. Weather strip the exterior swing-type doors at sills, heads and jambs to provide weather tight installation. Apply weather stripping at sills to bottom rails of doors and hold in place with a brass or bronze plate. Apply weather stripping to door frames at jambs and head. Shape weather stripping at sills to suit the threshold. Insert gasket in groove after frame is finish painted.

#### protection & cleaning

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is completely removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat. Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

#### pre-fitting doors

At the Contractor's option, doors may be provided factory pre-fit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, beveled edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

## glazing

### general

All glazing shall be double laminated and insulating. Laminated glazing shall be constructed of two panes of minimum 3 mm annealed glass laminated to a minimum 0.75 mm polyvinyl-butyral (PVB) interlayer. Two panes of laminated glazing shall be installed in each window with hermetically sealed 13 mm airspace between them. After installation of windows, the contractor shall install a minimum 3 mil tinted film (Scotch Shield Ultra Safety and Security Window Film or approved equal) to the inside face of the glazing in accordance with manufacturer’s instructions.

### tempered glazing

Tempered glass shall be kind FT fully tempered flat type. Class 1 clear, condition A uncoated surface, Quality q3-glazing select, conforming to ASTM, DIN, BS or EN standards. Color shall be clear.

### sealant

Sealant shall be elastomeric conforming to ASTM, DIN, BS, or EN standards. Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulation glass. Color of sealant shall be as selected from manufacturer’s full range of standard colors by Contracting Officer.

### gaskets

1. Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners.
2. Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM, DIN, BS or EN standards.
3. Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM, DIN, BS, or EN standards.
4. Unless otherwise indicated, and at the manufacturer's option, provide compressible stripping for glazing and weatherstripping such as molded EPDM or neoprene gaskets.

### putty & glazing compound

Glazing compound shall conform to ASTM, DIN, BS, or EN standards for face-glazing metal sash. Putty shall be linseed oil type conforming to DIN, BS, or EN standards for face-glazing primed wood sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

### installation

1. Neoprene setting blocks shall be dense extruded type conforming to ASTM, DIN, BS, or EN standards. Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.
2. Glass and glazing work shall be performed in accordance with, glass manufacturer’s instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted.
3. Openings and framing systems scheduled to receive glass shall be examined for compliance with glass manufacturer’s recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be removed from glazing rabbet and glass surfaced and wiped dry with solvent. Glazing surfaces shall be dry and free of frost.

### cleaning

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer’s recommendations.

### protection

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth, or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

## finishes

### general

All exterior metal surfaces, including container exterior shall be painted to match existing adjacent buildings. Interior shall be painted gypsum board or plaster ceilings and walls. Provide color boards with all materials, paints and finishes for COR approval prior to ordering materials. Color boards shall remain on site in view or with the project engineer until completion of the facility.

### renovation work

Disturbed, patched, repaired and renovated areas shall be finished to provide protective coatings. At a minimum, wall and ceiling areas shall be plastered with similar material to match adjacent surfaces. Areas shall be sanded, cleaned and prepared for primer and two coats of paint. Paint shall be feathered out a meter over the existing surfaces to blend in patch work with existing. Areas requiring tiles shall match existing tile areas. All renovated areas shall be returned to a new finished state.

### PAINTS & COATINGS

#### general

Paints and coatings shall be provided as a specification 09 90 00 Finishes, Paints and Coatings.

#### concrete sealers

Concrete sealers shall be a liquid chemical sealer-hardener compound. Apply a minimum of two coats. Sealer shall be compatible with climate temperatures and not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing or other materials applied to the concrete.

#### paint

1. Paint shall be oil based or latex. A primer shall be placed prior to any coats of paint. A minimum of two (2) coats of paint shall be used for each surface.
2. [Existing painted material shall be cleaned, cracks patched, and prepared for new paint. Existing sealant shall be inspected, cleaned or removed and new sealant placed.]
3. Exposed exterior steel shall include items such as trim, frames, door, pipe rails and other exposed steel surfaces. Paint with one coat oil-based primer, with 2 coats of oil-based alkyd gloss enamel, color to be selected by the Contracting Officer from the color board provided by the Contractor.
4. Exposed wood shall include items such as trim, frames, doors and other exposed wood surfaces. Paint with one coat oil-based primer, 2 coats of gloss enamel, color to be selected by the Contracting Officer from the color board provided by the Contractor

### expansion joints

In plaster and stucco, expansion joints shall be provided as specified in ASTM, DIN 18339, BS or EN Standards for all walls, floors and ceilings.

### exterior walls

The exterior of all buildings shall be stucco conforming to ASTM C926. A temperature of between 4 and 27 degrees C shall exist for a period of not less than 48 hours prior to application of plaster and for a period of at least 48 hours after plaster has set. Control joints shall be designed for expansion and contraction of plaster work due to thermal exposure. Control joints shall comprise of back to back casing beads. Install new stucco in 2 coats. The first coat shall be a scratch coat approximately 10 mm thick. Allow 7 days to cure. The second coat shall be finish stucco, smooth finish, approximately 10 mm thick. Allow 7 days to cure before painting. Stucco showing over sanding, cracks, blisters, pits, checks, discoloration or other defects is not acceptable. Defective plaster work shall be removed and replaced with new plaster at the expense of the Contractor. Patching of defective work will be permitted only when approved by the Contracting Officer. Patching shall match existing adjacent work in texture and color. All exterior color finish shall be integral with the stucco finish. No painted stucco shall be permitted due to minimize future maintenance.

### interior walls

#### plaster walls

Interior walls shall be plaster applied in a similar manner as exterior stucco. Paint with 2 coats of semi-gloss off-white with less than .06% lead by weight color to be selected by the Contracting Officer from the color board provided by the Contractor.

#### gypsum board walls

NOTE TO ARCHITECT: Gypsum board should only be used in arch-spans unless specifically allowed in the Statement of Requirements from the client.

Gypsum board walls shall consist of 16 mm thick gypsum board on steel studs spaced at 400 mm on center. Fire rated walls shall have Type X gypsum board and shall be constructed in accordance with an appropriate UL or WHI detail for the required hourly rating. For walls to receive ceramic tile, use cement backer board instead of gypsum board.

#### sound control

Walls between sleeping rooms shall have a Sound Transmission Class (STC) minimum 45-55 or better, An STC value is a single number rating used to characterize the sound insulating value of a partition (wall, floor, or ceiling). All walls shall be caulked at floor and ceiling prior to installing wall base. All openings between rooms shall be caulked or sealed. Doors shall have rubber seal around frames and threshold.

#### hardened interior walls

Hardened interior walls shall be either CMU (minimum 100 mm thick), 3D panel, or reinforced concrete. Interior walls shall be plaster applied in a similar manner as exterior stucco. Paint with 2 coats of semi-gloss off-white with less than .06% lead by weight color to be selected by the Contracting Officer from the color board provided by the Contractor.

#### Wall TILE

Walls in wet areas and kitchens shall be tiled with 150 mm x 150 mm glazed ceramic tile up to 2000 mm above the floor to include interior of toilet stalls, showers and behind sinks. Joints shall be 2-3 mm. Waterproof gray grout shall be applied full depth of the tile. Grout shall cure for 72 hours and then be sealed with a commercial grout sealant in two coats. Color of tile shall be selected by the Contracting Officer from samples provided by the Contractor.

### interior ceilings

1. Ceilings shall be plaster applied in 2 coats over wire mesh, which is to be stapled or secured by wire to the 20 mm x 60 mm wood battens. Paint ceiling with 2 coats of flat white, with less than .06% lead by weight.
2. Gypsum board used in lieu of plaster shall be minimum 16 mm thick and have structural fastener supports and fasteners that adhere to ASTM C 840. Fire rated gypsum shall be minimum 16 mm thick type X or European EN 520 equivalent. Paint ceiling with 2 coats of flat white, with less than .06% lead by weight.
3. Concrete ceilings shall be exposed concrete painted with 2 coats of flat white, with less than .06% lead by weight.
4. [Suspended grid ceilings with metal panel tiles are allowed in office areas. Tile ceilings are not allowed where fire-resistant ceilings are required or in wet areas.]

### floors

1. Floors in wet areas shall be [ceramic] [300 mm x 300 mm terrazzo] tile with thin set mortar. Floors shall slope, minimum 1/50, to floor drains. Slope shall be obtained with sloping mortar bed of minimum 20 mm thickness. Provide continuous waterproofing membrane beneath sloping mortar bed, turn up wall 300 mm behind wall base. Membrane shall be fully sealed at joints and shall shed water into body of floor drain.
2. Floors in Kitchens shall be [terrazzo tile] [slip resistant quarry tile] [sealed concrete]. Floors in Dining areas shall be [sealed concrete**]** [terrazzo tile].
3. Floors in administration areas, living quarters, corridors, and all rooms unless otherwise stated shall be [300 mm x 300 mm terrazzo tile with thin set mortar] [carpet] [sealed concrete]. [All other floors are to be completely cleaned and sealed epoxy. Color to be selected by the Contracting Officer from samples provided by the Contractor.]

### tile work

#### general

1. Tile work shall not be performed unless the substrate and ambient temperature is at least 10 degrees C and rising. Temperature shall be maintained above 10 degrees C while the work is being performed and for at least 7 days after completion of work.
2. Joints shall be 2-3 mm. Waterproof gray grout shall be applied the full depth of the tile.
3. Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer’s approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a non-corrosive soap or other approved method of protection.
4. Color of tile shall be selected by the Contracting Officer from samples provided by the Contractor.

#### tile renovation

1. Existing floors shall be cleaned, inspected and damaged areas fixed. A damaged tile shall be replaced as a full tile. Grout around it shall be removed to allow bonding to the adjacent grout lines. Existing floors shall be covered with a clear epoxy sealer.
2. Floors that require renovation shall be cleaned and grout removed 10 mm down from the surface by tools. Grout shall be swept clean and new grout placed. Damaged tiles shall be replaced as full tiles. Floor areas damaged from water shall be cleaned, swept and tiles removed and reset. Finished renovated floors shall be covered with a clear epoxy water proof sealer.
3. Where requested, floor tiles shall be carefully removed for reuse. Grout shall be ground down and removed. Floor shall be leveled with a concrete floor leveler, brush finished and sealed. Floor drains and other imbedded items shall be made operable by sloping to drains and addressing other imbedded items appropriately to their function.

## SPECIALtIES

### mirrors

600 mm x 900 mm, 6 mm plate glass shall be mounted above all lavatories. Mount bottom of mirrors 1100 mm above finished floor.

### toilet paper holders

Toilet paper holders with removable pin shall be stainless steel, installed approximately 200 mm above floor by eastern toilets and 600 mm above floor by western toilets.

### shower rods & curtains

Shower curtain rods, stainless steel, heavy duty, 1.20 mm (18 gauge) shall be mounted between the walls of each shower stall. Mount rod 2000 mm above finished floor. Provide a shower curtain with support rings for each shower stall.

### grab bars

Stainless steel grab-bars, heavy duty, 1.20 mm (18 gauge), two each 900 mm and 1050 mm long, 40 mm diameter shall be mounted behind and beside all eastern toilets, and bathtubs as they occur. Mount grab-bars between 610mm - 900 mm height on the walls. Each bar shall support no less than 91 Kg in any direction.

### paper towel dispensers

Paper towel dispensers, 0.683 mm Type 304 stainless steel, surface mounted. Furnish tumbler key lock locking mechanism.

### metal shelves

Provide a 600 mm long x 150 mm wide, light-duty stainless steel shelf with integral brackets over each lavatory and laundry sink.

### robe hooks

Provide a minimum of two robe hooks on all toilet and shower stalls.

## Building Systems

### arch span building systems

1. Insulated Arch-Span metal roofing systems shall be supported by reinforced concrete stem walls approximately 2500mm in height. Stem walls shall be insulated and finished with gypsum board or plaster on the interior, and finished with stucco on the exterior. The floor slab shall be reinforced concrete with a minimum thickness of 150 mm placed on a clean vapor barrier above a capillary water barrier of 150mm minimum thickness on properly compacted soil.
2. Arch-span panels shall be insulated with a minimum of R-18 insulation. The roof insulation system shall be spray applied and harden to a durable rigid surface, as per the Arch-Span manufacturer’s standards. The Insulation system shall have a smoke-developed index less than 450 and a flame spread rating less than 75. The insulation system shall be protected by a spray-applied 15-minute rated thermal barrier.
3. Ribbed steel roof panels shall be mechanically fabricated from prefinished steel coil and joined by machines and operators, all certified by the Arch-Span building manufacturer. The Contractor shall present certificates of manufacturer’s training for machine operators, and certificates of authenticity for proprietary machines and equipment.
4. Only prefinished steel coil certified by the Arch-Span system manufacturer shall be used on this project. Fasteners for accessories shall be manufacturer’s standard. All materials and concealed fasteners for steel roof panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel. Fasteners for structural connections shall provide both tensile and shear strength of not less than 350kg per fastener.

### pre-engineered building systems (peb)

Metal building systems shall comply with the requirements of the MBMA Low Rise Building Systems Manual-latest edition. Facilities designated as long-span, shall have no interior columns.

### modular container units

1. All modular containers shall be tightly bolted to anchors set in a concrete foundation, be stack and bolted tightly to adjacent containers, with corridor, stairs etc. as indicated in drawings.
2. Minimum clear ceiling height shall be 2400mm.
3. All interior walkways shall be a minimum of 1500mm wide at the latrine area and minimum 1300mm at all other areas.
4. Metal stairs shall be designed per IBC 2006 codes.
5. The Contracting Officers Representative (COR) reserves the right to inspect and reject any modular containers not in good condition. All modular containers shall be inspected and accepted by Architect prior to leaving factory. See plans and these technical requirements for extent of work.
6. Provide exterior walls with a minimum insulation with a value of R-13, floors with R-19 and ceilings with R-30. All insulation in exterior toilet walls containing water pipes shall be rigid foam board insulation. Insulation in areas next to concrete or earth shall be rigid foam board insulation. All insulation between living quarters and living quarters and corridor shall have a Sound Transmission Class (STC) minimum 45-55 or better. All walls shall be caulked at floor and ceiling prior to installing wall base. All openings between rooms shall be caulked or sealed.
7. Doors shall have rubber seals around frames and thresholds. Doors shall be hollow metal with metal frame and have one (1) hour rating.
8. Exterior metal Color: off-white semi gloss.
9. The windows shall be operated from the interior and be provided with insect screens mounted on the exterior. Glazing shall be 6mm laminated glass.
10. For force protection reasons, roof structure shall be 0.60mm (24 gauge) metal corrugated roofing over asphalt membrane layer over 25mm plywood layer. Conex container box roof shall contain a 70 mm layer of sandbags. The Contractor shall determine the structural load capability of the Conex container roof as part of the design effort.

## facility types

***Note to Architect: Insert below the project specific Buildings and Facilities ONLY.* No quantities! That goes in the 00010 Bid Schedule. For *Design-Build facilities, describe in as much detail as possible the program, construction and materials that are not described elsewhere (drawings). A list of Design-Build facilities with their unique requirements are located in the Architecture folder on R Drive. Copy and paste over what you need for this project.***

### Dining Facilities (Example)

1. Ceilings of Dining Facility shall be exposed concrete painted with 2 coats of flat white, with less than .06% lead by weight.
2. Provide steel cook top in kitchen minimum thickness of 25 mm. Provide circular cut outs. Consult with the Contracting Officer for the diameter of circular cutouts. Provide steel infill plates for all cut out openings. Cook top can be made of several pieces for ease of handling. Adjacent plates shall be tight fitting to each other.
3. Provide 1.6 mm (16 gauge) stainless steel, or 40 mm marble, pass through counter tops at openings between the kitchen and dining area. Edges shall be turned down 30 mm and corners shall be welded and ground smooth. Provide anchor angles welded to the bottom of the counters to anchor tops to masonry walls below. Provide a minimum of six (6) anchors on the Dish Return Counter, three (3) on each side of the wall. Provide a minimum of eight (8) anchors on the Serving Counter, four (4) on each side of the wall. Anchor angles to wall with masonry expansion sleeves and stainless steel screws. Counter tops are to be 600 mm wide x length of opening shown. Counter height is 1000 mm above floor finish (AFF).
4. Fire Counter Shutters shall be installed in conjunction with the Pass-Through Counter Tops described in the paragraph above. Fire counter shutters shall be used to separate the kitchens from the dining areas, and shall be U.L labeled for gypsum board, masonry and steel openings, and rated at 90 minutes in full compliance with NFPA-80 standards. Finish of shutter, guides and hoods shall be stainless steel. System shall be activated by 74˚ C (1 65˚ F) fusible links, and by electrical switches located near exit doors. Bottom bar sliding bolt locks shall be provided to secure the shutters in the down position; bolts shall be operated from the kitchen side of the shutter.

# MECHANICAL

***Note to Mechanical Engineer: Edit this entire Mechanical section to include a full and clear descriptions of the technical requirements only. Scope of the work is described in 01010. Do not describe scope. Compare against the 01010 when doing your edits to make sure there is no duplication. Delete those paragraphs that do not apply to this specific project. Otherwise the Bidders may think that that scope is to be included in their bids.***

## GENERAL

The work covered by this Section consists of the design, supply, fabrication, and installation of new building systems for Heating, Ventilation and Air-Conditioning (HVAC) for design-build features of the contract It also includes the delivery to the site, erection, setting to work, adjusting, testing, balancing and handing over in perfect operating and running condition all of the HVAC equipment, including all necessary associated mechanical work.

##  SPECIALIST SUB-CONTRACTORS QUALIFICATIONS

1. The HVAC works shall be executed by an air-conditioning specialist sub-contractor experienced in the design and construction HVAC equipment including conventional compression systems, heat pump units, space heaters, and knowledge in fabricating specialized units consisting of supplemental electric resistance heaters in satisfying the specified indoor design conditions.
2. HVAC equipment will normally consist of split-pack heat pump units with supplemental electric heating elements, ducted packaged heat pump units with supplemental duct mounted electric resistance heaters, industrial quality unit heaters, air ventilation systems and specialized industrial ventilation systems.
3. The HVAC heating and cooling load calculations shall be prepared using recognized HVAC load analysis programs such as Trane “Trace” or Carrier “HAP”. The heating and cooling load calculations shall take into account the site elevation and ambient design temperatures when determining required HVAC equipment capacities and airflows. The HVAC specialist shall submit the complete HVAC analysis with equipment layout drawings at the 65% design submittal. The HVAC analysis shall clearly state and the drawings shall clearly show the type of systems to be used, and how the system will satisfy the specified indoor design conditions. Provide related psychrometric charts showing the air wet bulb and dry bulb temperatures at each section of the heat/cool unit during both design heating and cooling operation.
4. Provide complete, edited specifications using the UFGS specs for selected HVAC system. The edited specifications shall be submitted along with the 65% Design Submittal. The Contractor shall coordinate the specifications with the manufacturer of the equipment used.

## CODES, STANDARDS AND REGULATIONS

The equipment, materials and works covered under the heating, ventilation and air-conditioning services shall conform to the referenced standards, codes and regulations where applicable except where otherwise mentioned under each particular clause.

## outside DESIGN CONDITIONS

Outside Design Conditions: [The Contractor shall verify the ambient conditions with available and reliable local weather data] [Contractor shall use the below weather date for equipment compatibility with the site conditions:].

***Note to Mechanical Engineer: Delete all areas below except for the one that applies to this project location.***

Bagram Area :

Latitude – (approx.) 35 deg. deg. North

Longitude – (approx.) 69 deg. East

Elevation – (approx.) 1490 M (4888 ft.)

Summer - 35 deg C (95 deg F) Dry Bulb (DB) & 18.6 deg C (66 deg F) Wet Bulb (WB)

Winter – (-12.8 deg C/9 deg F)

Daily Range – 18.3 deg C (33 deg F)

Darualaman Area:

Latitude – (approx.) 34.42 deg. North

Longitude – (approx.) 69.11 deg. East

Elevation – (approx.) 1737 M (5700 ft.)

Summer – 34 deg C (93 deg F) Dry Bulb (DB) & 15.6 deg C (60 deg F) Wet Bulb (WB)

Winter – (-8 deg C/18 deg F)

Daily Range – 19 F)

Farah Area

Latitude – (approx.) 32.22 deg. North

Longitude – (approx.) 62.11 deg. East

Elevation – (approx.) 700 M (2297 ft.)

Summer – 41.1 deg C (106 deg F) Dry Bulb (DB) & 22.5 deg C (72.5 deg F)] Wet Bulb (WB)

Winter – (1.6 deg C/35 deg F)

Daily Range – data unknown)

Gardez Area:

Latitude – (approx.) 33.60 deg. North

Longitude – (approx.) 69.22 deg. East

Elevation – (approx.) 2350 M (7710 ft.)

Summer – 29 deg C (84 deg F) Dry Bulb (DB) & 12.2 deg C (54 deg F)] Wet Bulb (WB)

Winter – (-10deg C/ 14deg F)

Daily Range – data unknown)

Ghazni/ Khair Kot Area:

Latitude – (approx.) 33 deg. North

Longitude – (approx.) 68 deg. East

Elevation – (approx.) 2183 M (7162 ft.)

Summer – 30.5 deg C (87 deg F) Dry Bulb (DB) & 15.6 deg C (60 deg F)] Wet Bulb (WB)

Winter – (-7.2 deg C/19 deg F)

Daily Range – data unknown)

Herat Area:

Latitude – (approx.) 34.22 deg. North

Longitude – (approx.) 62.22 deg. East

Elevation – (approx.) 964 M (3163 ft.)

Summer – 38 deg C (100 deg F) Dry Bulb (DB) & 20 deg C (68 deg F) Wet Bulb (WB)

Winter – (-6 deg C/21 deg F)

Daily Range – 17 F)

Jalalabad Area:

Latitude – (approx.) 34 deg. North

Longitude – (approx.) 70 deg. East

Elevation – (approx.) 580 M (1903 ft.)

Summer – 39.6 deg C (103 deg F) Dry Bulb (DB) & 25.6 deg C (78 deg F)] Wet Bulb (WB)

Winter – (4.6 deg C/40 deg F)

Daily Range – data unknown)

Kabul Area:

Latitude – (approx.) 34.55 deg. North

Longitude – (approx.) 69.22 deg. East

Elevation – (approx.) 1790 M (5876 ft.)

Summer – 35.6 deg C (96 deg F) Dry Bulb (DB) & 15.6 deg C (60 deg F) Wet Bulb (WB)

Winter – (-12.8 deg C/9 deg F)

Daily Range – 19 F)

Kandahar Area:

Latitude – (approx.) 31.5 deg. North

Longitude – (approx.) 65.85 deg. East

Elevation – (approx.) 1010 M (3314 ft.)

Summer – 41 deg C (106 deg F) Dry Bulb (DB) & 21.7 deg C (71 deg F)] Wet Bulb (WB)

Winter – (-1.7 deg C/29 deg F)

Daily Range – 21 F)

Khost Area:

Latitude: 33 22 degrees N

Longitude: 69 58 degrees E

Elevation: 1146 meters (3760 ft)

Summer: 35.5 C (96º F) DB and 25.8º C (78.5º F) WB.

Winter: 0º C (32º F) db

Range of DB: Summer 15.5 (28)

Average Extreme Wind: 40 kph (25 mph)

Kunduz Area:

Latitude – (approx.) 36 deg. North

Longitude – (approx.) 68 deg. East

Elevation – (approx.) 432 M (1417 ft.)

Summer – 38.8 deg C (102 deg F) Dry Bulb (DB) & 22.8 deg C (73 deg F)] Wet Bulb (WB)

Winter – (0 deg C/32 deg F)

Daily Range – data unknown)

Lashkar Gah Area (unconfirmed):

Latitude: 31.58 degrees N

Longitude: 64.37 degrees E

Altitude: 773m (2536ft)

Summer: 44.4 C (112F) db and 24.4º C (76º F) WB.

Winter: -5.5º C (22º F) db

Range of DB: Summer 17.8 (32)

Average Extreme Wind: 40 kph (25 mph)

Prevailing Wind Direction: Summer SE, Winter ENE

Mazar-e-Sharif Area:

Latitude – (approx.) 36 deg. North

Longitude – (approx.) 67 deg. East

Elevation – (approx.) 391 M (1284 ft.)

Summer – 37.8 deg C (100 deg F) Dry Bulb (DB)] & 20.5 deg C (69 deg F) Wet Bulb (WB)

Winter – (0 deg C / 32 deg F)

Daily Range – data unknown)

Pol-e-Charki Area:

Latitude – (approx.) 34.56 deg. North

Longitude – (approx.) 69.37 deg. East

Elevation – (approx.) 1830 M (6000 ft.)

Summer – 34 deg C (93 deg F) Dry Bulb (DB) & 15.6 deg C (60 deg F) Wet Bulb (WB)

Winter – (-8 deg C/18 deg F)

Daily Range – 19 F)

Qalat Area:

Latitude: 32 degrees N

Longitude: 66 degrees 54 E

Altitude: 1565 meters (5135 ft)

Summer: 37.7 C (100º F) DB and 16.1º C (61º F) WB.

Winter: -3.9º C (25º F) db

Range of DB: Summer 18.3 (33)

Average Extreme Wind: 40 kph (25 mph)

Prevailing Wind Direction: Summer W, Winter

## INDOOR DESIGN CONDITIONS

### DESIGN

1. Design the mechanical systems using the following requirements for specific building types:
2. Warehouses do not normally require any temperature control unless materials requiring special temperature control are stored. In general, warehouses, laundry, and storage buildings and vehicle maintenance bays shall be provided with ventilation to maintain the indoor conditions to 10 degrees F above the summer ambient DB temperature. If areas within the warehouse are to be occupied (people working), provide infrared heaters to spot heat the space where the people normally work. Vehicle maintenance bays shall be provided with infrared heaters or unit heaters.

### NOISE LEVELS

Noise levels inside occupied spaces generated by HVAC systems indoors shall not exceed NC 35.

### INTERNAL LOADS

1. Occupancy: Use ASHRAE standards to calculate sensible and latent heat from people. In general, light/moderate office work is 73watts sensible and 45watts latent.
2. Lighting: Provide 21.5 W/m2 maximum (however lighting levels shall meet minimum requirements and shall be accounted for in the heating and cooling loads based on the actual lighting design).
3. Ventilation: provide outdoor air ventilation per ASHRAE Standard 62.1 with the exception of guard towers, guard shacks, and storage facilities. In general this requires 2.5 L/s/Person and 0.3 L/s per square meter of floor space; outdoor air requirements can be satisfied by opening windows and doors for facilities without a ducted system.
4. Latrine/Bathroom Exhaust: Provide 85 CMH per toilet, urinal, or shower head.
5. Building Pressurization: Provide 1.3 mm W.G. (0.05 in W.G.); Maintain negative pressure in latrine areas. This is only applicable for buildings provided with central ducted forced air systems

## NEW AIR COOLING & HEATING

### EQUIPMENT

Environmental control of the facilities shall be achieved by HVAC equipment as listed below and approved by the U.S. Government. Unless otherwise noted, the Contractor may choose any combination of equipment to achieve the inside design conditions specified for the floor plans that is the most Life Cycle Cost Effective to the government. Contractor shall size and select equipment based on equipment manufacturer’s performance data at the project site elevation and ensures the equipment’s performance meets the design heating and cooling sizing requirements.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Facility Type** | **Cooling** | **Heating** | **Type of HVAC System** | **Remarks** |
| Enlisted Barracks | None | 20C68 F | Wood Heaters | Provide ceiling fans |
| Officers Barracks | None | 20C68 F | Wood Heaters | Provide ceiling fans |
| Flag Officers Barracks | 25.6C78 F | 20C68 F | Split pack heat pump units |  |
| Administration Buildings/Offices | None | 20C68 F | Wood Heaters | Provide ceiling fans |
| Battalion HQs | None | 20C68 F | Wood Heaters | Provide ceiling fans |
| Army Brigade and Corps Offices | 25.6C78 F | 20C68 F | Split pack heat pump units |  |
| Bathroom/Shower/Laundry\*(4 or less fixtures not counting lavatories) | None | 20C68 F | Unit Heaters | Provide adequate ventilation |
| Bathroom/Shower/Laundry\*(greater than 4 fixtures not counting lavatories) | None | 20C68 F | Unit Heaters  | Provide supply air with fans and electric duct heaters. Provide exhaust fans |
| Storage | None | 7.2 C45 F | Unit heaters | Provide adequate ventilation |
| DFAC (Dining Area) | None | 20C68 F | Unit Heaters | Provide ceiling fans |
| DFAC (Kitchen) | None | 20C68 F | Unit Heaters | Provide adequate ventilation |
| Comm rooms and Comm Maint | 25.6C78 F | 20C68 F | Split pack heat pump units |  |
| Medical Treatment Rooms and inpatient rooms | 25.6C78 F | 20C68 F | Split pack heat pump units |  |
| Classrooms (not training buildings) | 25.6C78 F | 20C68 F | Split pack heat pump units |  |
| Gymnasium | None | 20C68 F | Wood Heaters |  |
| POL Storage | None | none |  | Provide adequate ventilation |
| Arms Storage | None | 7.2 C45 F | Unit heater | Provide adequate ventilation |
| Vehicle Maintenance | None | 12.7 C55 F | Unit heaters  | Provide adequate ventilation |
| Enclosed Power Plant(Office space to be provided with split pack heat pump unit) | None | 12.8C55 F | Provide manually adjusted recirculation air from radiator exhaust. | Provide adequate ventilation. |
| Guard House | None | 20C68 F | Wood Heaters | Provide ceiling fans |
| Guard Tower | None | 20C68 F | Wood Heaters | Provide ceiling fans |
| Well House | None | 12.7 C55 F | Unit heaters  | Provide adequate ventilation |
| Detention Cell | None | 20C68 F | Unit Heaters | Provide adequate ventilation |

### UNITARY DUCTED HEAT PUMP UNITS

Ducted, packaged heat pump units shall be provided for all large occupied buildings such as DFACs, Administrative, barracks and operational facilities. Ducted forced air systems are required to satisfy the indoor air quality as specified in ASHRAE 62.1 and to maintain positive pressure of 1.3 mm W.G. in the buildings. Ducted heat pump units shall be unitary in design and factory manufactured ready for installation. Heat pump units shall provide cooling during summer and heating during winter. The unit shall consist of DX coil, blower, supplemental electric heater elements, washable filter, and condenser unit containing the compressor, condenser coil, fans and all internal controls/fittings complete all mounted in a weatherized housing finished for exposed installation. The unit shall be suitable for exterior installation and be mounted on steel supports or on a concrete pad. Copper refrigerant suction and liquid piping shall be sized, insulated and installed in accordance to unit manufacture recommendations. Unit temperature control shall include wall mounted adjustable thermostat, blower on-off-auto switch and heating-cooling change over control. Heat pump units shall be limited to 10 tons each. Facilities requiring more than 10 tons of cooling shall be provided with multiple heat pump units.

### UNITARY DUCTLESS SPLIT-PACK HEAT PUMP UNITS

Unitary ductless split-pack heat pump units shall be provided for small and isolated rooms, such as the guard tower, guard shed and remote small buildings, or as noted otherwise. Ductless split units shall be unitary in design and factory manufactured ready for installation. Heat pump units shall provide cooling during summer and heating during winter. **Heat pump units shall be suitable for low ambient operation.** Interior evaporator fan coil units shall consist of a DX coil, blower, without supplemental electric resistance heat, and washable filter all mounted in a housing finished for exposed installation. Cooling coil condensate piping shall route to and discharge to a safe location outdoors. The exterior condensing units shall contain compressor, condenser coil, and all controls/fittings enclosed in a weatherized housing. Outdoor condensing unit shall be wall-mounted on steel supports or on a concrete pad. Copper refrigerant suction and liquid piping shall be sized, insulated and installed in accordance to unit manufacture recommendations. Unit temperature control shall include wall mounted adjustable thermostat, blower on-off-auto switch and heating-cooling change over control.

### SUBMITTALS

The Contractor shall submit the following for the equipment to be provided under this section of the specification in accordance with Section 01335 SUBMITTAL REQUIREMENTS: manufacturer’s data including performance characteristics at design conditions; catalog cuts showing dimensions, performance data, electrical requirements, compliance with referenced standards; drawings indicating location and installation details.

## DUCTWORK

### general

Air shall be distributed from central Air Handling Units (AHUs) to achieve proper airflow throughout the facility by means of air distribution ductwork. Air distribution system shall be comprised of supply and return ductwork, fittings, manual volume control dampers, grilles, registers, and/or diffusers. Ductwork shall be constructed of galvanized steel or aluminum sheets and installed as per SMACNA “HVAC Duct Construction Standards (Metal and Flexible).” Flexible non-metallic duct may be used for final unit/diffuser connection in ceiling plenums. These flexible duct run-outs shall be limited to 3 meters in length.

### duct insulation

Duct insulation shall be provided for all supply ductwork that is not located in the conditioned space and for return ductwork not located within the conditioned space. All ductwork exterior to the building shall be insulated with a minimum RSI=0.88 (R5) and covered with a metal jacket. In general interior ducts shall be exposed to the rooms and will not be insulated. The heat lost or gained from the un-insulated ducts shall be considered as part of the heating or cooling of the conditioned space.

### diffusers, registers & grills

Diffusers, registers and grilles shall be factory fabricated of steel or aluminum and distribute the specified air quantity evenly over the space intended. The devices shall be round, half round, square, rectangular, linear, or with perforated face as determined by the design. Units will be mounted in ceilings, high sidewalls, or directly to ductwork and shall be sized for the airflow to be delivered with a maximum NC rating of 35. Pressure loss through the diffuser shall be considered in sizing the duct system and the system static pressure calculations.

### branch take-offs

Air extractors or 45° entry corners shall be provided at all branch duct take-offs. Manual volume control dampers shall be included at the branch duct take-offs and where required to facilitate air balancing and shall be shown on the design drawings.

### wall penetrations

Building wall penetrations shall be carefully made so as not to deteriorate the structural integrity of the wall system. The Contractor shall consult with the building manufacturer, if possible, to determine the best way to penetrate the wall. If the building manufacturer is not available, a structural engineer shall be consulted. In either case, the recommendations of the engineer shall be strictly adhered to. Exterior wall penetrations exceeding 620 square centimeters shall be provided with barrier bars to prevent unauthorized access to the building.

### air filtration

All supply air shall be filtered using manufacturer’s standard washable filters mounted inside the unit. In addition, all outdoor air intakes shall be equipped with 50 mm thick washable filters.

### control wiring & protection devices

Control wiring and protection of the air conditioning units being offered must be the manufacturer’s standard, pre-wired, installed in the unit at the factory or as recommended. Thermostats shall be located near the unit return, and shall include lockable housing that allows viewing of settings without permitting access. For units serving more than one area, the thermostat shall be located near the return of the space with the highest heat generation.

## COLD STORAGE ROOMS & CONEX BUILDINGS

### general

The Contractor shall provide the Contracting Officer shop drawings for approval of appropriately sized walk-in refrigerator and freezer to include proposed manufacturer, construction details, manufacturer’s instructions, evacuation and charging procedures, operation and maintenance date, start-up and initial operational tests.

### modular construction

Walk-in coolers shall be panel type modular construction. Doors shall be swing type. Refrigeration equipment shall be remote located on the exterior of the building. Provide a temperature/ alarm system. Provide interior lighting with exterior switch. Floors of cool rooms shall be insulated panelized construction from the manufacturer of the cool rooms. The concrete floor will not be depressed. Walk-in freezer shall be able to maintain the product temperature between -10 to 0 deg F. Walls, ceiling and flooring of the coolers and freezer shall not contain any wood or wooden material. Walls and ceiling shall be made of sandwiched panels filled with polystyrene or urethane insulation material. Panels shall be aluminum or stainless steel. Ramps shall be provided at the door of the cooler and freezers.

### piping

Refrigeration piping shall be annealed or hard drawn seamless copper tubing in conformance with ASTM B280. Refrigeration systems shall be remote type.

### electrical

Electrical characteristics shall match local power 400v/3ph/50Hz and 230v/1ph/50Hz.

### packing material

Preservation and packing shall be commercial grade.

### temperature record & control

Provide a recording thermometer. Provide temperature alarm with connector to remote temperature alarm.

### outdoor condensing unit

Provide outdoor condensing unit cover and security fence or wall to protect outside units. Provide condensing unit outdoor controls for operation down to –18 degrees C ambient temperature.

### refrigeration equipment

Refrigeration equipment shall be designed for remote installation. Design units for 16 to 18 hour operation at the indicated interior temperature in –18 degree C ambient temperature. Capacities, air delivery, and dimensions shall be as indicated. Remote condensing units shall be factory fabricated and rated in accordance with UL303 and ARI 365. Provide with motor, air cooled condenser, receiver, compressors, mounted on a common base. Compressors shall be hermetic type. Evaporators shall be factory fabricated and rated in accordance with UL 412 and ARI 420. Forced convection, unit cooler type, made to suspend from the ceiling panels, with forced air discharged parallel to the ceiling. Provide with air circulating motor, multi-fin tube type coil and grille assembled within a protective housing. Air circulation motors shall be lifetime sealed, and the entire unit-cooler assembly shall be accessible for cleaning. Provide a drip pan and drain connection. When the cold storage room is used for freezing, provide an automatic electric heat defrosting system. Provide a timer type defrost controllers.

### drain lines

Provide condensate drain lines and drains below freezer floors with electric heating cable, thermostatically controlled to maintain 10 degrees C at zero flow rate. Cable shall be sized in accordance with manufacturer’s recommendations.

### installation instructions

Submit a copy of installation instructions to the Contracting Officer covering both assembly and installation of the refrigeration equipment prior to start of work.

### testing

Start up and initially operate the systems upon completion of the installation of the equipment and refrigerant piping. Adjust the safety and automatic controls to place them in operating sequence. Record manufacturer’s recommended readings hourly. Operational test shall cover a period of not less than 24 hours. Upon completion of Operational test the systems shall be performance tested. Test duration shall not be less than 8 hours. Test shall include the following information to be in the report with conclusions regarding the adequacy of the systems:

1. Time, dates and duration of tests.
2. Inside dry-bulb and wet-bulb temperatures maintained in each room during the tests employing recording instruments calibrated before the tests.
3. Outside dry-bulb and wet-bulb temperatures obtained from recording instruments calibrated and checked hourly with a sling psychrometer.
4. Evaporator and condenser entering and leaving temperatures taken hourly with the compressors in operation.
5. The make, model, and capacity of each evaporator and condensing unit.
6. Voltmeter and ammeter readings for condensing units and evaporators.

### operations & maintenance

Provide chart showing the layout of the refrigeration systems, including piping, valves, wiring, control mechanisms, and unit supply cfm. Submit printed instructions covering the maintenance and operation of refrigeration equipment. Tag shutoff valves in accordance with the instructions. Provide any special tools necessary for repair and maintenance of the systems. Upon completion of the work and at a time designated by the Contracting Officer, provide instruction to designated personnel in the operation and maintenance of each refrigeration system. The period of instruction shall not be less than one 8-hour day.

### clean-up

Remove any packing material. Wash and clean floors, walls, ceilings and equipment inside of cool rooms. Wash and clean exposed surfaces on outside.

## VENTILATION AND EXHAUST SYSTEMS

### general

1. All fans used for building ventilation, exhaust, and pressurization shall be selected for minimum noise level generation. All fans used for supply, roof, or ducted wall exhaust shall be centrifugal forward curved, backward inclined, or airfoil fans with non-overloading characteristics of high efficiency and quiet running design. The fans shall be of the heavy-duty type with durable construction and proved performance in a desert environment. Each wall exhaust fan shall be provided with motorized or gravity dampers which close automatically when the fan is not running. Each ventilation or intake air fan shall be provided with an interlocked motorized damper which closes automatically when the fan is not running and shall be sized for and provided with filter and insect screen. Also, each fan shall be complete with vibration isolator, external lubricators, [individual wall on/off switches,] and all accessories and sound attenuators as necessary.
2. Consideration shall be given to wall-mounted fans (except for batter rooms) to reduce roof penetrations and possibility for water leaks (especially for metal roofs).
3. Supply intake or makeup air openings for exhaust fans shall be provided with motorized dampers which are interlocked with the exhaust fans and provided with air filters and insect screens. The motorized dampers shall open or close when the exhaust fan is on or off respectively. Louvered intake openings (for exhaust fan system) shall be sized for a maximum static pressure (SP) drop (that includes filter resistance) of 25 Pa to prevent excessive negative pressurization of the building.
4. Maintenance shops and similar spaces that use solvents and oils shall be provided with mechanical exhaust air systems. Intake or makeup air openings for an exhaust fan system shall be provided as indicated above. The exhaust systems shall consist of a fan, ductwork, exhaust grills, and interlock controls. Design shall be in compliance with the latest addition of the Industrial Ventilation UFC 3-410-04N or ACGIH Industrial Ventilation manual.
5. Supply intake or makeup air openings for gravity or natural ventilation type or turbine ventilators shall be a louvered opening. Louvers shall be adequately sized to induce convection flow through the gravity or turbine ventilators and provided with insect screens only.
6. To reduce sand and dirt migration, outside air intakes shall be installed as high as possible within architectural constraints or a minimum of 1.5 meters above the ground. The intakes for gravity or natural ventilation type systems shall be sized so that the free air velocity is below 2.5 m/s.
7. Toilet and Wash Area: Minimum exhaust ventilation shall be 85 CMH per water closet, urinal or shower head. At extreme cold in winter these values can be reduced for short periods to 10 m3/h / m2 or 40 m3/h / toilet (WC) to conserve heat. Provide two speed fans.
8. Attic: Provide side wall exhaust fans and filtered intake louvers to vent all attic spaces. Unless otherwise noted, exhaust rate is to be designed at two air exchanges per hour.

### kitchen hood exhaust & make-up air

1. As required and per Kitchen design specialist and equipment supplier requirements. Kitchen exhaust hood shall be constructed out of 20 gauge stainless steel material. Include baffle type aluminum filters to trap grease/oil. Exhaust flow rate shall be a minimum of 2200 CMH per linear meter of hood length. The designer shall take special note that multiple large LPG stoves will be installed in the kitchen. The steam generated by the local style of cooking with large pots is immense in comparison to western standards, and the additional need for ventilation must be accounted for in the design. Also, the cooks are accustomed to standing on top of the stoves in order to stir the large cauldrons of food. This common cooking practice should be taken into consideration when designing the exhaust hood. The height of the hood above the stovetop should be 2.0 meters. Design per NFPA 92A, 96, 204, and 211. Hoods shall extend a minimum of 225mm beyond the front edge ad ends of the stove(s). Hoods shall be sealed to the rear wall. Hoods shall be provided with a side panel at each end to close in the area between the stove and the hood. Side panels shall be the width of the hood and shall extend to the rear wall at 45 degrees. Approximate dimensions are 37 inches by 37 inches by 45 degrees (925mm by 925mm by 45 degrees). If a non-combustible wall abuts a stove, then a side panel shall not be required on that side of the hood. Joints, seams and penetrations shall be externally wel**d**ed or brazed to form a watertight seal with a smooth surface that is readily cleanable. Hoods shall be securely supported with non-combustible materials.
2. Exhaust ducts shall be constructed of 18 gauge stainless steel, or 16 gauge carbon steel and be independent of other duct systems. Joints and seams shall be continuously welded, brazed, or gasketed water tight. Bracing and supports shall be constructed of non-combustible material securely fastened to the structure. Bolts, screws, rivets, and other fasteners shall not penetrate the duct walls. Airflow in the ductwork shall be not less than 150m/min nor greater than 450 m/min. Ducts shall be placed a minimum of 450mm from combustible material or 75mm from gypsum wallboard attached to non-combustible structures. Ductwork terminating through the roof shall extend a minimum of 18 inches (450mm) above the roof. Where roof terminations are not possible, ducts may be terminated through an exterior wall. All ductwork terminating through an exterior wall shall be located a minimum of 3 feet (900mm) from exterior openings. Ductwork shall be pitched to drain back to hood. All ductwork terminations shall be a minimum of 10 feet (3000mm) horizontally from other buildings and property lines.
3. Exhaust fans shall be centrifugal up-blast, rated for 250C grease applications, and with motors located outside the airstream. Fan discharge shall not impinge on the roof, other equipment or appliances, or parts of the building. Discharge outlet of exhaust fans shall be a minimum of 1000mm above the roof. Up-blast fans shall be hinged and supplied with a flexible weatherproof electrical cable to permit inspection and cleaning. Connection between ductwork and exhaust fan shall be flanged, gasketed, and bolted
4. Provide centrifugal type supply air fan(s) to make up 80% of the exhaust volume. Make up air intake shall be integral with the hood system or be located as close to the exhaust intake to prevent cold drafts. To reduce sand and dirt migration, outside air intakes shall be located as high as possible within architectural constraints. The intakes shall be sized so that free air velocities are below 2.5 m/s. For inhabited buildings locate all air intakes at least 1.5 (center-line of intake) meters above the ground. Each air intake shall be provided with a motorized damper. Make-up air inlets shall be located a minimum of 3m from exhaust outlets or a minimum of 1m below the exhaust outlet and with at least 1.5m separation.
5. Provide on/off controls to operate matched sets of exhaust and supply fans from a single switch. Fans shall be electrically interlocked to prevent system operation without both fans in service.
6. A performance test shall be conducted upon completion and before final acceptance of the system installation. The test shall verify the rate of exhaust and make-up air flow. The test shall be witnessed by the COR.

### battery room exhaust

Battery room exhaust shall comply with UFC 3-520-05 dated 14 April 2008. The UFC is available at <http://www.wbdg.org/>. The exhaust fan for the lead acid shop shall be sized to maintain concentrations of hydrogen gas in the battery room to below 1 percent concentration. The exhaust fan shall be sized larger when required for mechanical ventilation cooling. The fan shall have a non-sparking wheel and the motor shall be located out of the airstream. Any components such as fan and ductwork in contact with the exhaust air shall be constructed out of fiberglass reinforced plastic (FRP) or polyvinyl chloride (PVC). The ventilation system for the shop shall be designed to provide a negative static pressure by exhausting 10% more air than is supplied. Supply air for the shop shall be 100% outside air.

### outside intake louvers

Outside air louvers shall be factory fabricated of steel or aluminum and allow the specified air quantity into the space intended. Louvers shall be rectangular with rain-proof exterior face blades and internal grille. Louvers shall be mounted a minimum of 1.8 m above the floor on the sidewalls. Consideration shall be given to locating the louvers near the heating and cooling unit and encourage air floor across the room in conjunction with the exhaust fan. Louvers shall be provided with air filter (See Air Filtration), insect screen, and motorized dampers interlocked to open when the laboratory exhaust fan operates. Minimum louver dimensions shall be 300 mm x 300 mm.

### wall penetrations

Building wall penetrations for fans and louvers shall be carefully made so as not to deteriorate the structural integrity of the wall system. The Contractor shall consult with the building manufacturer, if possible, to determine the best way to penetrate the walls. If the building manufacturer is not available, the Contracting Officer shall be consulted. In either case, the recommendations of the manufacturer and/or Contracting Officer shall be strictly adhered to. Penetrations through exterior and other secure walls that exceed 620 square centimeters shall be protected with barrier bars to prevent unauthorized access to the facility.

### air filtration

All outside air shall be filtered using manufacturer’s standard washable filters mounted inside the louvers. Outdoor air intakes shall be equipped with 50 mm thick washable filters.

### submittals

The Contractor shall submit the following for the equipment to be provided under this section of the specification in accordance with Section 01335 SUBMITTAL REQUIREMENTS: manufacturer’s data including performance characteristics at design conditions; catalog cuts showing dimensions, performance data, electrical requirements, compliance with referenced standards; drawings indicating location and installation details.

## ELECTRIC HEATERS

### general

Electric heat trace cable for freeze protection shall not be provided as a substitute for space heating system.

### unit heaters

Electric resistance unit heaters shall be installed in spaces where only heating is required. Generally, unit heaters shall be mounted as high as possible. Unit heaters shall be of the industrial grade, very durable and securely fastened to the ceiling, wall or structure. Provide a self-contained electric heating unit, suspended from ceiling or structure, fan with at least two-speeds and heating elements. Provide control-circuit terminals and single source of power supply with disconnect. Heating wire element shall be nickel chromium. Include limit controls for overheat protection of heaters. Provide hard-wired tamper resistant integral thermostat located as indicated on the drawings.

### [cabinet] [convector] HEATERS

Use of cabinet heaters shall be limited to spaces requiring heating and is not subject to misuse or abuse. Use of cabinet heaters is allowed only as directed by the User. Provide a self-contained electric heating unit, recessed mounted in wall or structure, and heating elements. Provide control-circuit terminals and single source of power supply with disconnect. Heating wire element shall be nickel chromium. Include limit controls for overheat protection of heaters. Provide tamper resistant integral thermostat.

### submittals

The Contractor shall submit the following for the equipment to be provided under this section of the specification in accordance with Section 01335 SUBMITTAL REQUIREMENTS: manufacturer’s data including performance characteristics at design conditions; manufacturer’s certificate stating that each unit will perform to the conditions stated, catalog cuts showing dimensions, performance data, electrical requirements, compliance with standards as stated in paragraph codes, standards and regulations; complete shop drawings indicating location and installation details. The manufacturer shall also submit a 2 year warranty for each of the units.

## FINAL TESTING

### GENERAL

1. After completion of the work, the Contractor shall demonstrate to the Contracting Officer that the installation is adjusted and regulated correctly to fulfill the function for which it has been designed. The Contractor shall test, adjust, balance and regulate the section or sections of concern as necessary until the required conditions are obtained. Operational test shall be conducted once during the winter and once during the summer. Coordinate with the Contracting Officer on when the test shall be scheduled. Include tests for all interlocks, safety cutouts and other protective device to ensure correct functioning. All such tests shall be carried out and full records of the values obtained shall be prepared along with the final settings and submitted to the Contracting Officer in writing.
2. The following tests and readings shall be made by the Contractor in the presence of the Contracting Officer and all results shall be recorded and submitted in a tabulated form:
3. Ambient DB and WB temperatures
4. Room Inside Conditions:
5. Inside room DB & WB temperatures
6. Air flow supply, return and/or exhaust
7. Plot all temperatures on psychrometric chart
8. Air Handling Equipment: Air quantities shall be obtained by anemometer readings and all necessary adjustments shall be made to obtain the specified quantities of air indicated at each inlet and outlet.
9. Following readings shall be made:
10. Supply, return and outside air CMH (CFM) supplied by each air conditioning system.
11. Total CMH (CFM) exhausted by each exhaust fan
12. Motor speed, fan speed and input ampere reading for each fan.
13. Supply, return and outside air temperature for each air-conditioning system.
14. Electric Motors: For each motor:
15. Speed in RPM
16. Amperes for each phase
17. Power input in KW

## ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

1. Note that electrical requirements for all HVAC systems shall be designed and installed to operate on the secondary power standard required herein. The existing power distribution system may require modifications or upgrades to support the additional power required by the HVAC unit. The Contractor is responsible to field verify all the conditions and provide complete shop drawings showing any incidental power upgrades. All electrical work shall comply with the National Electric Code.
2. All thermostats shall be wall-mounted [near the return grilles in the room with the highest heat load generation.] [as indicated on the drawings]. In lieu of a thermostat, a temperature sensor may be located in the same location or in the return duct and connected to a thermostat located near the unit return. Wall-mounted thermostats shall be mounted 1.5 meters above the finished floor and be easily accessible. Thermostats for the latrine facilities shall be located near the unit return and mounted 1.5 meters above the finished floor. Operation of the control system shall be at the manufacturer’s standard voltage for the unit.
3. The following are the minimum requirements for motors regarding enclosure, insulation and protection:
4. Compressor Hermetic: Provide inherent (internal) overload protection.
5. Condenser: Provide internal thermal overload protection.
6. Evaporator (Open Class "A") fan motor type provides internal thermal overload protection.

## CEILING FANS

### GENERAL

Provide minimum 1300mm diameter ceiling fans at one per 40 square meters of floor space unless otherwise indicated. Fans shall have reversible motors. Fans shall be centered or distributed evenly throughout the room. Coordinate placement with the lighting plan to prevent conflict or casting shadows. Fan mount shall be flush, standard, or angle mount depending on ceiling height. Fan shall be mounted such that the fan blade is approximately 2.5 meters above the finished floor. The fan shall be provided without light kit. The finish shall be factory painted white. The controls shall be wall-mounted from either a single pole switch or from two (2) 3-way switches to provide on/off operation. The electrical supply shall be[ 230 volts, single phase, and 50 hertz][ as indicated]. Install per manufacturers’ instructions.

### SUBMITTALS

The Contractor shall submit the following for the equipment to be provided under this section of the specification in accordance with Section 01335 SUBMITTAL REQUIREMENTS: manufacturer’s data including performance characteristics at design conditions; catalog cuts showing dimensions, performance data, electrical requirements, compliance with referenced standards; drawings indicating location and installation details.

## LPG COOKING STOVE

### GENERAL

1. Provide kitchen hood exhaust, exhaust fan, and makeup air system.
2. New LPG stoves shall be installed with consideration to ease of cooking operation and daily cleanup. The new LPG stoves shall be set into a formed concrete opening such that it can easily be removed for replacement, maintenance and cleaning.
3. Each LPG stove shall be provided with three burners. The LPG stoves shall be of commercial quality and be capable of producing the highest BTU heat output with all three burners on. The center burner is low heat, center and middle burner is medium heat and all three burners is high heat. Total heating value shall be between 55,000 btu/hr and 100,000 btu/hr A shut off valve for each burner shall be provided at the face of the LPG appliance.
4. Piping from the LPG tanks to the respective LPG stoves shall be wrought iron, ASTM B36.10M or steel (black or galvanized), ASTM A53. The steel piping shall terminate in front of the LPG stoves with a shut off valve and quick disconnect nipple. A stainless steel flexible hose shall connect from the LPG stove to the steel piping. Each end of the flexible hose shall be provided with quick disconnect fittings.
5. The LPG piping shall not be embedded in the concrete floor. Installation of the LPG piping in vented/open concrete trenches is highly recommended. The piping may be surface mounted provided that it is not susceptible to damage or causes any safety hazards. Piping passing through the exterior wall shall be provided with pipe sleeves.

### LPG FUEL STORAGE & DISTRIBUTION

1. LPG Storage and Distribution shall be provided to support operation of the LPG stoves for cooking and boiling tea. The storage of fuels shall consist of above-ground steel bottles located outside. The standard bottle size is 45 kg. LPG tanks shall be secured using chain to prevent the bottles from toppling over. LPG storage tanks shall be provided and installed in accordance with NFPA 58. The LPG storage tanks shall be installed on a concrete pad, and provided within an enclosure to protect the tanks from the elements. Provide chain link fence and gates around entire LPG storage facility This project will require that the Contractor provide specified amount of fuel tanks filled with LPG fuel at time of completion.
2. Unless noted otherwise, provide 4 bottles for every stove, 2 shall be manifolded in service, and 2 shall be kept as storage. Locate up to 20 bottles with zero clearance to the building and zero clearance between bottles. Clearance shall be 1.5 meters to a source of ignition, and 1 meter to building openings below the level of pressure regulator/relief. Provide two stage regulator with relief on each bottle to reduce pressure from the bottle pressure to 2.7 kPA. Provide 25mm supply pipe to 2 stoves, 20 mm supply pipe to 1 stove.

## WOOD BURNING STOVES – (Outside Kitchen Facility)

1. Wood stove kitchens shall have commercial grade wood fired cooking stoves. The cooking stove tops shall be accessible by stairs for walking on top of the stoves and the stove tops shall be wide enough for a person to walk on. The hood height shall not interfere with a person standing on the stove top. The ceiling of the annex shall not be less than 3 meters high to allow smoke and/or heat to be ventilated outside of the building.
2. This annex shall be separated from the main kitchen by a [contractor developed] covered walkway.
3. Construct a covered wood storage area next to the annex which shall be secured and surrounded with fencing as to prevent pilfering. Gates and locks shall be provided as part of the security.
4. Water service shall be provided for the cooking annex. Water piping shall be insulated to prevent piping from freezing. Freeze proof wall hydrants shall be considered.
5. Provide a trench drain that extends the length of the cooking line-up and a minimum 75mm trap and waste line.
6. Stove shall be constructed out of fire bricks and topped with 50mm thick cast iron countertop. Route the chimney runs inside the building envelope (inside the heated space) so air and flue gases stay at least as warm as the air in the building until they are expelled outside. The minimum flue thickness shall be no less than 1.5mm black steel. The Contractor shall protect chimney by means of metal rails or masonry wall from damage from large pots during cooking. The chimney shall penetrate the highest part of the building envelope so the chimney functions better. The chimney shall rise at least 600mm above the roof ridge and its top is clear of obstacles to wind flow so it can produce stable draft and it has a chimney (rain) cap because without one, any chimney is vulnerable to adverse wind pressures. The chimney flue shall be insulated and be the correct size for the appliance so flue gases are kept warm and flow quickly through the system. The flue pipe, if used, shall run straight up from the appliance to the chimney and the chimney has no offsets because each change in direction presents resistance to flow. The appliance and venting system shall be reasonably well-sealed to prevent leaks that introduce cool air and make the system more vulnerable to adverse pressures. The system shall be installed in a building that has a balanced ventilation system. There shall be high exhaust fan in the stove exhaust hood. The wood stove kitchen shall be well vented with louvers located high at walls on the building ends. The wood feeding doors shall be located on the outside of the building.

## SOLID-FUEL WOOD BURNING HEATING STOVES

1. Commercial grade wood burning stoves shall be free standing and constructed and installed in accordance with NFPA-221 and the ICC-IFC. Stoves shall not be located closer than 3.0 meters from any exit and 1.0 meter from any wall. Stoves shall be constructed of minimum 3.0 mm steel, elevated a minimum of 150 mm off the floor. Sizes and capacity of the stoves shall be proportional to the size of the room served. Stoves shall be primed and painted with black heat-resistant paint.
2. Each stove shall be designed to be vented separately to the outside air; two (2) or more stoves connected to one (1) chimney shall not be permitted. Each stove shall be equipped with a manually adjustable inlet (or combustion air) damper and an outlet (or vent or chimney) damper. Vent or chimney shall be constructed of black steel with a minimum thickness of not less than 1.5 mm (14-gauge). The chimney shall be routed inside the building heated envelope to allow vent gases to cool as close to room temperature as possible before expelled outside.
3. The chimney shall rise at least 600 mm above any roof surfaces within a 3 meter radius of the chimney so the top clears any obstacles to wind flow needed to produce a stable draft. Outside vent or chimney shall be provided with (rain) cap.
4. The stove and venting system shall be reasonably sealed to prevent leaks that introduce cool air and make the system more vulnerable to adverse pressures. The chimney, supports, and rain cap shall be primed and painted with black heat-resistant paint.
5. Covered wood storage areas shall be provided next to the building [as indicated] and shall be secured and surrounded with chain link fencing to prevent pilfering. Gates with lockable latches shall be provided as part of the security (occupant to provide paddle locks).

# PLUMBING

### general

1. The Contractor shall design and build domestic cold and hot water systems, waste, drain and vent systems, waste-oil collection and storage and fuel-oil storage and distribution systems required in the facilities identified in Section 01010 SCOPE OF WORK and as described herein. The Contractor shall also be responsible for complete design and construction of all domestic and special plumbing systems required for full and safe operations in the Generator Plant, Water Storage and other facility or structures required in this contract.
2. The work covered in this scope also includes the delivery to site, erection, setting to work, adjusting, testing and balancing and handing over in full operating condition all of the plumbing equipment and associated plumbing works.

### sub-contractor qualifications

The plumbing systems shall be executed by a plumbing specialist sub­contractor experienced in the design and construction of these types of systems.

### standard products

All materials and equipment shall be standard product of a manufacturer regularly engaged in the manufacture of the product and shall duplicate items that have been in satisfactory use for at least two (2) years prior to bid opening.

### codes, standards & regulations

The design and installation of equipment, materials and work covered under the plumbing services shall conform to the standards, codes and regulations referenced in this Contract and its appendices.

## PLUMBING SYSTEMS REQUIREMENTS

### water

Domestic cold and hot water shall be provided in the facilities to serve the water usage and plumbing fixtures provided for the facility. Water service to each facility shall enter the building in a mechanical, toilet, storage, or similar type space. The building service line shall be provided with a shut off valve installed either outside in a valve pit or inside the mechanical room or similar spaces. Water piping shall not be installed in or under the concrete foundation except for the service line. All water piping shall be routed parallel to the building lines and concealed in all finished areas. Insulation shall be provided where required to control sweating of pipes or to provide protection from freezing. Electric heat trace cable for freeze protection shall not be provided as a substitute for space heating systems.

### piping material

Domestic cold water shall be distributed by means of standard weight (schedule 40) galvanized steel pipe. Domestic hot water shall be distributed by means of standard weight (schedule 40) galvanized steel pipe. Waste and vent piping can be made of either galvanized steel pipe (schedule 40), or Polyvinyl Vinyl Chloride (PVC) conforming to ASTM D 2665. Corrosion protection shall be provided if galvanized piping comes in contact with earth or masonry floors, walls or ceilings. All piping not placed in the occupied portion of the building shall be installed in a utilities chase.

### plumbing water fixtures

The following typical plumbing fixtures shall be provided:

1. Eastern Water Closet with flush tank assembly. Provide acid resisting fired porcelain enameled cast iron water closet complete with rotating No-Hub 'P' trap and No-Hub coupling to meet piping requirements. Eastern Style water closet shall be furnished with integral non-skid foot pads and bowl wash down non-splashing flushing rim. The water closet shall be completely self supporting requiring no external mounting hardware and shall be flush with floor. The Eastern Style water closet shall incorporate waterproofing membrane flashing flange. Provide a cold water spigot 300mm above finished floor on the right (from a perspective of standing inside of the cubicle and looking out) sidewall of the cubicle. Spigot shall have a flexible hose and spray nozzle such that the occupant can wash over the water closet. Toilets shall be oriented north and south. Toilets shall not face east or west.
2. Western style toilets with flush tanks shall be provided as requested by the User. Western style toilets shall be white vitreous china, siphon jet, round bowl, floor mounted with floor outlet. Top of toilet seat height shall be 356 to 381 mm. Water closet shall be flush tank type.[ Provide a cold water spigot 300mm above finished floor. Spigot shall have a flexible hose and spray nozzle.]
3. Flush Valve Urinals. Urinals shall be white, vitreous china, wall-mounted, wall outlet, siphon jet, integral trap and extended side shields. Provide urinal with the rim 610 mm above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.5 liters per flush. Mount flush valves not less than 279 mm above the fixture.
4. Lavatories. All sinks shall be the [trough type constructed of block and concrete with ceramic tile exterior and lining capable of withstanding abuse][ vitreous china wall-mounted type]. Provide maintenance access to waste piping and P-traps from under the sink.[ Lavatories inside the prison cells shall be tamper-proof with integral spout, soap depression, and outlet connection to slip 40mm OD tubing.]
5. Sink and Lavatory Faucets. Faucets shall be wall-mounted, chrome plated brass or bronze alloy with hot and cold water valves for manual mixing. Faucet handles shall be chrome plated brass or bronze alloy and non-lever type. **No goose neck faucet fixtures shall be used**. Basis of design for faucet is Zurn Model #Z841M1 (see below).



1. Janitor’s Sink. Floor mounted sink, enameled cast iron with copper alloy rim guard. Provide hot and cold water valves with manual mixing. Faucet handles shall chrome plated brass or bronze alloy. Include a stainless steel shelf and three mop holders.
2. Shower. Showerhead and faucet handles shall be chrome plated brass or bronze alloy. Provide hot and cold water valves for manual mixing. In addition to a shower head, provide each shower stall with a threaded plug to allow for future addition of a nozzle of the bottom of valve assembly. Shower shall be provided with low flow shower head. The shower head shall be heavy duty type and securely fastened to the wall. Basis of design for shower valve/head assembly is Chicago Faucet Model #CP 752 (see below) with two additional standoffs.



1. Emergency Shower and Eye Wash Assembly. Provide emergency shower and eye wash assembly in Generator Power Plant and in other facilities where lead-acid batteries exist and where appropriate. Provide a floor drain in the area, if appropriate.

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Instructions to RFP preparer – Floor drains in area where emergency water flowing on the floor is environmentally hazardous, additional safety or operational issues may need resolving.

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1. Service Sink. Standard trap type, enameled cast iron. Service sinks provided in maintenance areas shall be concrete. Service sinks in battery rooms shall be acid resistant.
2. Kitchen Sink. [Single bowl] [Two (2) compartment] sink shall be corrosion resisting formed stainless steel. Faucet bodies and spout shall be chrome plated brass or bronze alloy. Handles, drain assembly, and stopper shall be corrosion resisting steel or brass/bronze alloy.
3. Ablution Trench. See building floor plans for size and construction of trench and number of stations. Provide trench drain with brass grating and strainer. Provide each station with hot and cold water valves with manual mixing. Faucet handles shall be copper alloy.
4. Grease Interceptor (Exterior only). Shall be manual cleaning type with removable checker-plate cover complete with flow control valve. Tested and rated in accordance with PDI G-101. Concrete shall have a minimum compressive strength of 21 MPa in 28 days (kitchen use only).
5. Floor Sink. Provide floor sink, circular or square, with 300mm overall width or diameter and 250mm nominal overall depth. They shall have acid resistant enamel interior with cast iron body, aluminum sediment bucket and perforated grate of cast iron. Outlet size as indicated on plans.
6. Floor or Shower Drain: Cast iron construction with galvanized body, integral seepage pan, and adjustable perforated or slotted chromium plated bronze, nickel-bronze, or nickel brass strainer consisting of a grate and threaded collar. Toilet room floor drains are similar except are provided with built-in, solid, hinged grate.
7. Trench Drains: Floor trench shall be concrete construction with a cast iron grate. The cast iron grate shall be sectionalized and hinged so that it can easily be opened to clean out the trench. Iron grates shall be fabricated in sections in length not greater than 1500 mm. The floor trench shall be provided with perforated aluminum pan inserts which can be removed to clean out large food particles. The floor trench drain shall be adjustable perforated or slotted chromium plated bronze, nickel-bronze, or nickel brass strainer consisting of a grate and threaded collar. This style of floor trench shall be installed in the kitchen area of the DFACs in response to kitchen cleaning practices of the local national staff.



1. Room hose bibs and floor drains shall be provided as required. Afghan dining facility kitchen area clean-up hose bib to be supplied with connecting hose on reel including approximately 12 meters of hose. Provide clean-up spray nozzle with hose assembly.
2. Provide P-Traps per International Plumbing Code IPC for all fixture drains, floor and trench drains, and shower drains. P-traps shall have minimum of 50 mm water seal.
3. Large Pot sink, provide clean-up spray nozzle with hose assembly.

### hot water

Hot water shall be provided for the facility to supply 49°C hot water to fixtures and outlets requiring hot water. Hot water of a higher temperature shall be provided only where required for special use or process. Hot water piping shall be routed parallel to the building lines and concealed within finished rooms. All hot water piping shall be insulated. A hot water re-circulating pump shall be provided if hot water piping run exceeds 30m.

#### hot water heaters

1. The hot water shall be generated by electric water heaters. The unit(s) shall be typically located inside a mechanical room, storage room, toilet/janitor room or similar type space and be wall-mounted or be floor-mounted on a 100 mm raised concrete pad. The unit(s) shall be of the commercially available tank type having low or medium watt density electric heating elements.
2. In cases where the pressure of the water coming into the tank will violate manufacturer recommendations, a pressure reducer shall be installed in the line before the water heater. Each water heater shall be equipped with a vacuum relief valve and temperature and pressure (T&P) relief valve installed in the top 150mm of the storage tank that discharges into a nearby floor drain; discharge piping shall terminate 50 mm above the floor drain. Multiply water heaters shall be connected by common inlet and outlet manifolds to ensure equal flow and drawdown rates.

### waste, drain & vent system

1. Floor drains shall be provided in each room that contains a water source. Floor drains shall be provided in the mechanical equipment and toilet rooms as required. Floor drains shall be provided next to the electric water heaters. In mechanical rooms, floor drains shall be provided to avoid running drain piping long distances above or over the floor. A trench drain shall be provided for the DFAC Kitchen. All waste and vent piping shall be provided in accordance with the latest edition of IPC. Drain outlet shall use p-trap system to trap sewer gases. P-trap drain should be a one-piece system without removable parts.
2. Every trap and trapped fixture shall be vented in accordance with the IPC. In order to minimize vent piping, consider incorporating circuit venting or combination drain and vent systems in accordance with Section 911 and 912 of the IPC.IPC Section 708.3 states that cleanouts be provided no more than 100 feet apart measured from the upstream entrance of the cleanout. AED standard is to provide cleanouts at 25 feet intervals due to the limitation of the cleanout routers available in Afghanistan

### plumbing for battery rooms

Water, drain and associated plumbing features for the battery room shall comply with requirements in Part 6 of UFC 4-229-01N.

## special plumbing systems

### general

Contractor shall design and construct compressor air storage and distribution, waste-oil collection and storage, fuel-oil storage and distribution and other plumbing systems that are required for full performance of equipment and operations and for maintenance in the Power Plant and Vehicle Maintenance facilities. These systems shall be designed and built in accordance with codes and publications referenced herein before and in compliance with equipment manufacturer recommendations.

### compressed air systems

Compressed air system shall be in accordance with UFC 4-229-01N. Compressed air shall be provided using a packaged air-cooled electric motor driven compressor and ASME rated receiver with air cooler and moisture separator to remove moisture and oil. Compressed air system shall be capable of operation up to 200 psig maximum for 125 psig normal units. High-pressure system (above 200 psig) shall be provided to supply compressed air to equipment where required. Provide an engine driven air compressor where generator electrical power is unreliable. The air distribution system shall be provided with necessary regulator valves to maintain desired pressure. Compressed air drops shall be provided in each maintenance bay, tire shop, tool room, paint shop and other areas requiring compressed air service. Where required, line filters, lubricators, and/or hose reels shall be provided. Compressed air piping shall be black steel pipe and painted to match wall color. Noise level of air compressor should not exceed acceptable db limits.

### waste & hazardous drainage

1. Waste or hazardous drainage from battery repair/charging areas shall be treated prior to entering the base general waste drainage system. Hazardous waste drainage piping shall be acid resistant. Smaller battery rooms shall have waste treatment available using an acid neutralizing tank.
2. Waste oil storage tanks shall be provided for collection of waste oil in the power plant and vehicle maintenance facilities. Waste oil storage tanks shall be underground and be with either double-wall fiberglass, double-wall steel with cathodic protection, or a concrete secondary containment vault with applied POL-resistant coating. Underground waste oil piping shall be provided with either double-wall fiberglass, double-wall steel with cathodic protection, or a concrete secondary containment trench with removal covers and applied POL-resistant sealant. The secondary containment vault shall be sized to contain 110% of the total waste oil in the tanks. Provisions should be made in the design of the underground storage tank that enable manual detection of leaks, prevent overfilling, facilitate liquid level detection, and allow for vapor release.

### drainage from maintenance areas

Drainage from maintenance areas, fueling areas, POL areas, etc., shall be treated prior to entering the base general waste drainage system. Treatment shall consist of sand and oil separators as required by facility function. Buried oil storage tanks shall be provided where required.

## FUEL storage & distribution

### storage tanks

1. Provide above-ground, horizontal storage tanks within a concrete containment dike. Tanks shall be factory fabricated and shall be of the manufacturer standard sizes. Tanks shall be protected by a weatherproof canopy structure.
2. The containment dike shall be sized to contain 120% of the total fuel in the largest storage tanks. The dike structure shall be designed and constructed of reinforced concrete. Underground fuel piping shall be installed in a concrete secondary containment trench with removal covers and applied POL-resistant coating.
3. Bulk storage tanks shall be complete with fill tube and cap, suction tube, tank gauge, vent, 25mm lockable freezeproof water draw off valve at the tank low point, an antisyphon valve on the supply line, and other fittings and appurtenances required for full and safe operation. Tanks shall be provided with support saddles, platform/stair and concrete foundation pad. The attachment of the tank to the saddle by a steel strap or other means to prevent movement during a seismic event and the saddle anchorage to the foundation shall be contractor developed items; as well as the saddle itself if not supplied by the tank manufacturer. Steel saddles shall be between 150mm and 300mm tall at the base of the tank. There shall be a 3 mm minimum thick neoprene gasket between the tank or saddle and concrete to inhibit corrosion.
4. Tanks of 3,780 to 45,430 liters capacity shall be provided with 760 mm diameter manways. Tanks larger than 45,430 liters shall be provided with 915 mm diameter manways. Tanks 3,780 liters and larger shall be provided with a minimum of one (1) tank manway to allow for internal tank access. Piping will not penetrate through access manways. Tank shall be provided with a combination cleanout and gauge connection.
5. Vent pipe sizing shall be not less than 32 mm nominal inside diameter Vent shall be the rupture disc type calibrated to burst at 14 kPa pressure, and operate at 80 percent of burst setting. Tank shall be provided with an overfill alarm system. Tank shall be provided with two (2) stick gauges graduated in m and mm. Stick gauge shall be of wood and treated after graduating to prevent swelling or damage from the fuel being stored. Each storage tank shall be provided with an automatic analog reading gauge which is directly mounted to a tank's manway cover. Cathodic protection shall be provided for metal components in accordance with the manufacturer's recommendations. Storage tanks shall be handled with extreme care to prevent damage during placement and shall be installed in accordance with the manufacturer's installation instructions. External platform/ladder access to tank top (i.e. manhole) shall be installed on a concrete pad.
6. A tightness test shall be performed on each above ground storage tank. The tests shall be performed prior to making piping connections by the following procedure:
7. Close and seal all openings, except one at the highest point on the tank.
8. At the highest opening, install a 25mm x 1.5 meter tall standpipe with open top.
9. Fill tank with water, including the standpipe.
10. The tank shall be consider to pass the tightness test if after two hours, there are no visual leaks, and the height of water in the standpipe does not drop more than 250mm.
11. If there are no visual leaks, but the water level has dropped more than 250mm, the water may be refilled and the test repeated. Water level may change due to water temperature change or air trapped in the top of the tank.
12. Step 5) may be repeated.

Following the tank tightness test, each storage tank shall be leak tested in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is different from the tightness tests already performed.

1. The Contractor shall provide a full supply of fuel to each tank at the time of turnover to the Government.
2. A fuel filling system shall be provided for unloading fuel from fuel tanker into individual bulk storage tanks comprising of truck pad(s), fuel transfer pump, piping manifold and valves. A float or hydraulically operated overfill prevention shutoff valve shall be provided on the fill connection of each tank. Provide an independent unloading system for each fuel type. If the pump capacity is not specified provide pump sufficient to fill the storage tank or empty the delivery truck in 30 minutes whichever is less.

### GENERATOR FUEL SYSTEM

1. Provide generator fuel storage and piping system. Storage capacity shall be as specified in section 01010 SCOPE OF WORK.
2. Fuel shall be transferred from the bulk storage tanks to the generator belly tanks by use of automatic level controls and duplex transfer pumps. Transfer pumps may be omitted if the fuel can be totally transferred by gravity. Transfer pump shall be twice the generator demand or able to fill the day tank in 30 minutes, which ever is greater.

### VEHICLE REFUELING

* 1. Fuel storage and distribution shall be provided to support the vehicles used at various locations on base. The fuel shall be stored in above-ground horizontal steel tanks as per capacity specified in Section 01010 SCOPE OF WORK.
	2. Fuels shall be transferred from the storage tanks by transfer pumps located within the fuel dispensing units. Fuel piping shall be steel for piping located above grade. Underground piping shall be provided within a concrete secondary containment trench with removal covers and applied POL-resistant coating. Provide separate dispensing units for diesel and MOGAS. Each dispensing unit shall be equipped with dual nozzles and key control. Fuel dispensing unit shall be installed on an island such that two vehicles can simultaneously fuel on either sides of the dispensing unit. Coordinate site design and route all contaminated drainage water from the fuel dispensing pad through an oil/water separator. Dispensers shall have mechanical registers.

## testing & commissioning

The Contractor shall test all piping systems in accordance with IPC International Plumbing Code. The final test shall include a smoke test for drainage and vent system and pressure test for the domestic water piping. After completing the work, the Contractor shall demonstrate that all plumbing systems operate to fully satisfy the function for which these systems have been designed. The Contractor shall test, adjust, balance and regulate the system and its controls as necessary until the required designed conditions are met. The Contractor shall include tests for interlocks, safety cutouts and other protective devices to demonstrate safe operation. All such tests shall be carried out in the presence of the Contracting Officer and full written records of the test data and final settings shall be submitted to the Contracting Officer. After all tests are complete, the entire domestic hot and cold water distribution system shall be disinfected. The system shall not be accepted until satisfactory bacteriological results have been obtained.

# ELECTRICAL

## GENERAL DESIGN requirements

### design analysis

Calculations in the Design Analysis, at a minimum, shall include:

* 1. Load Analysis
	2. Voltage Drop for all feeders and one worst case branch circuit per feeder
	3. Lighting Calculations
	4. Generator and Transformer Derating Calculations
	5. Available Fault Current Calculations

### conflicts in standards

Conflicts between criteria and/or local standards shall be brought to the attention of the Contracting Officer for resolution. In such instances, all available information shall be furnished to the Contracting Officer for approval.

### installation

All electrical systems and equipment shall be installed in accordance with the requirements set forth in the documents referenced herein.

### testing

Acceptance test procedures shall be performed on all systems provided. As a minimum the testing procedures shall comply with the requirements of the National Fire Protection Association (NFPA) and the International Electrical Testing Association (NETA).

### units

Electrical design shall be in the International System of Units (SI).

## PRODUCT CRITERIA

***Option 1: 50 Hz Systems***

[All electrical material and equipment shall be IEC manufactured and type-tested by an independent testing laboratory. The independent testing laboratory must be certified by the Worldwide System for Conformity Testing and Certification of Electrotechnical Equipment and Components (IECEE). Contractor shall supply product-specific testing certification and IECEE certification for all IEC manufactured equipment. After construction submittals are sent to USACE, product-specific certificates will be verified with the independent testing agency. Material tested and marked by a Nationally Recognized Testing Laboratory (NRTL), such as Underwriters Laboratories (UL) or Canadian Standards Association (CSA) may be used in lieu of IEC-manufactured, type-tested material as long as the material/equipment is rated for use at the system voltage and frequency. ]

***Option 2: 60 Hz Systems
Note: For U.S. or Coalition-Occupied facilities, TF POWER policy currently requires product-specific*** ***NRTL marking, without deviation. Omit IEC language for these projects.***

[All electrical material and equipment shall be tested and marked by a Nationally Recognized Testing Laboratory (NRTL), such as Underwriters Laboratories (UL) or Canadian Standards Association (CSA). After construction submittals are sent to USACE, product-specific certificates will be verified with the independent testing agency.

[ In the event that NRTL-tested materials are not available, the contractor may then select applicable IEC manufactured material that has been type-tested by an independent testing laboratory. The testing laboratory must be certified by the Worldwide System for Conformity Testing and Certification of Electrotechnical Equipment and Components (IECEE). Contractor shall supply testing certification and IECEE certification for all IEC manufactured equipment. ] ]

* 1. Material and equipment installed under this contract shall be for the appropriate application and installed in accordance with manufacturers recommendations.
	2. Equipment enclosure types shall be in compliance with the National Electrical Manufacturer's Association (NEMA) or the International Electro-Technical Committee (IEC) standards.
	3. Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a non-corrosive and non-heat sensitive plate, securely attached to the equipment. All equipment delivered and placed in storage, prior to installation, shall be protected from the weather, humidity and temperature variation, dirt and dust, and any other contaminants. All equipment shall be in new condition, undamaged and unused
	4. All material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least two (2) years prior to bid opening.

## system STANDARDS

### GENERATOR POWER SYSTEM

#### GENERATOR STANDARDS

Generators shall meet one of the following requirements:

* UL-2200 listed
* CSA certified (C22.2 No. 100-04 Class 4215-01)
* CE-marked AND BS5000 AND ISO 8528 AND ISO 3046 AND IEC 60034 AND VDE 0530 AND NEMA MG-1.

#### GENERATOR REQUIREMENTS

Generator diesel engines shall meet the requirements of NEMA MG-1 Part [16, Emergency/Stand-by Duty and a temperature rise of 130°C][22, Continuous Duty and a temperature rise of 105°C]. Generators shall be rated for [stand-by duty at 100][continuous duty at 110] percent of the power rating. Winding insulation shall be Class H and meet the requirements of UL 1146. Generator engines shall be provided with a cool down relay with adjustable cool down time. The generator control panel shall be provided in accordance with NEMA ICS 6, enclosed and mounted on the engine/generator set with vibration isolation. Generator circuit breakers shall be UL 489 listed or manufactured to BS/EN 60947 AND CE marked AND type tested. The complete factory assembled generator shall be tested prior to shipment in accordance with IEEE 115, NEMA C 50 10, IEC 60034-2 and NEMA MG 1. The generator shall be provided with skid mounted radiator suitable for the installed conditions. Generators installed indoors shall have radiators rated for not less than 50C. Generator manufacturer shall provide equipment mounted fuel filtration and water separation devices sufficient to filter fuel to 10 microns and to include water-in-fuel sensor with alarm. Provide drain from water separator. Generator sets shall have double air filtration for combustion air.

#### gENERATOR RATINGS

Generators shall be derated as necessary for the ambient temperature and altitude of the site. Derating calculations shall be provided in the design analysis and shall be based on the generator manufacturer’s recommendations. When the scope of work specifies a generator capacity the generator(s) provided shall be rated at sea level and 40 C ambient outdoor temperature (gross capacity). Derating percentages have already been considered in the sizing. When the scope of work specifies that generators meet a demand load, the generator(s) provided shall be rated at installed conditions (net capacity).

#### ENCLOSURE REQUIRMENTS

1. Exterior generators shall be provided with a weatherproof enclosure complying with IP54 and protected from the elements with a design-build structural foundation and covered (roof only) shelter which extends over the bulk fuel storage tank(s) with chain link security fence for both the generator(s) and the fuel storage tank(s) based on the drawings provided.
2. Interior generators shall be non-weatherproof generator sets installed in a totally enclosed building with intake and exhaust louvers fitted with bird screens. When interior generator set(s) are classified as "standby," inlet and outlet louvers shall be provided with motorized dampers that open automatically when a generator comes online. Generators located inside buildings or not provided with a weatherproof enclosure shall be drip-proof per the requirements of IP22.

#### ventilation and generator cooling

Generator design analysis is to consider the local ambient conditions as well as the as-installed condition to determine if an over-sized radiator is required. Ambient design condition is to be based on the air temperature anticipated (measured) at the engine combustion air intake and the altitude at the installed location. Air flow calculations for static pressure (SP) shall be provided in the design analysis (DA) for all indoor and/or ducted generator sets. Calculations shall clearly state the following information located in the manufacturer's specifications: a) minimum air flow through the radiator, b) minimum engine combustion air flow, c) maximum SP allowable by the radiator fan. Actual SP calculations shall include and clearly show the SP drop across any louvers, bird screens, dampers in the open position, duct transitions, and any equipment that restricts air flow. Demonstrate flow rates and pressure drops with catalog information of material used as a basis of design. Generator set facilities shall be oriented with the prevailing winds when possible (with the alternator upwind) to assist ventilation air flow across the alternator and engine and promote heat removal by the fan and radiator

#### noise

Generator noise levels shall be based on the location. For continuous day-nighttime operation in a residential area (i.e. Barracks, etc.), 45 dB(A) shall be the maximum noise level outside the nearest residential building. For continuous day-nighttime operation in a non-residential area (i.e. Workshops, Offices, etc.), 60 dB(A) shall be the maximum noise level outside the nearest occupied building. All generator sets shall be provided with [sound attenuation enclosure (manufacturer's canopies),] vibration isolators[ and vibration isolating foundation], as a minimum, to reduce noise[ and prevent damage to the building structure]. Exterior exhaust system shall be, with minimal backpressure, directed to disperse the noise away from people, and be located near the radiator air discharge.

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Instructions to RFP preparer – Include "sound attenuation enclosure" when installed outdoors near residential areas or highly critical facilities. Include "and vibration isolating foundation" only for highly critical facilities. Include isolating foundation when generator is sharing a common concrete pad with a roof-covered enclosure with or without walls, "and prevent damage to the building structure".

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#### heating

Heating devices for the generator set cooling system, oil pan, and starter batteries shall be provided as per manufacturer's recommendation for cold starting.

#### fuel storage

Provide double wall day tanks integral with the engine generator base (belly tanks). Each belly tank shall have storage for not less than 2 hours full load operation. For Generators above 500 KW separate day tank installed inside a containment dike may be provided in lieu of integral tanks. For fuel bulk tank requirements, see Plumbing Section, paragraph entitled "FUEL STORAGE & DISTRIBUTION."

#### generator set documentation

1. Submit shop drawings for the product and prior to placing order with the manufacturer. Shop drawings shall come complete with all dimensional and performance data, including recommended spacing of the installed units for multiple unit installation. Note any deviations from the criteria above as well as from the enclosed specifications so that deviations may be resolved prior to order.
2. Generator sets shall be provided with complete set of manuals to include parts manual and service manual and/or electronic files (CD). Units can be shipped fully assembled in the enclosure; otherwise, provide graphic assembly instructions suitable for installer with low or no English and the language predominantly spoken in the vicinity of the project site. The instructions should be specific to the unit and contain a comprehensive parts list and a list of the parts for routine maintenance.

#### generator set spare and maintenance parts

1. Push Package 1 (Routine Maintenance): Provide with each generator the following spare parts. Push Package 1 must be delivered as a group for each generator.

20 each Air Filter Elements

20 each Oil Filter Elements

20 each Fuel Filter Elements

2 each Fan Belts

1 set Radiator Hoses

1 each set Rocker Cover Gaskets

1 each Thermostat Kit

1 set Fuel System Hoses

Plus any other parts required for routine maintenance recommended by the manufacturer at the recommended quantity for 8000 hours of operation.

1. Push Package 2 (Unscheduled Repair): For each size of unit delivered to a job site, the following parts must be provided. (For instance, if six (6) 1000 kVA units are delivered to a single site and two (2) 500kVA units are delivered to the same site, one package of the parts would be provided for each size.) Additionally, the parts need to be packaged in a separate bundle for each model so it is clear which parts go with which model generator. Each bundle shall include the maintenance and operation manual for the generator model the bundle pertains to.

 1 each automatic voltage regulator (AVR) board

1 each 24 VDC battery charging alternator

1 each water pump kit

1 each upper engine gasket (Joint) kit

1 each lower engine gasket (Joint) kit

1 each joint head gasket

1 each starter motor

1 each oil pump

1 each turbocharger

### electrical distribution SYSTEM

#### general

* 1. [Aerial distribution systems, shall be on steel poles with vertical and horizontal clearances meeting the requirements of the National Electrical Safety Code (NESC) and designed in accordance with TM 5-811-1.]
1. Underground distribution systems, [if applicable,] shall be in concrete encased schedule 40 PVC ductbanks under roadways, parking lots and heavy traffic areas, and direct buried Schedule 80 PVC ductbanks in other areas. Underground ducts shall be not less than 100mm diameter and not less than 1220mm below grade. Manholes and handholes shall be provided at changes of direction of more than 40 degrees and elsewhere as required to limit the pulling tension and sidewall pressure on the cables during installation to acceptable levels as defined by the cable manufacturer. Manholes shall be provided for ductbanks with more than 2 ducts. Handholes shall be provided wherever a manhole is not required by quantity of ducts or by cable manufacturer’s installation recommendations.
2. The system shall be configured as a loop system and the feeders shall be provided with tie capabilities through the use of pad-mounted load-break switches. “T-tap” style splices shall not be allowed in manholes.

#### transformers

1. Oil-filled, pad-mounted medium voltage transformers shall conform to either IEC 60076 or ANSI C57.12. Primary side load-break disconnecting means shall be provided with all transformers. Transformer substations shall be dead front, loop-feed, pad-mounted, compartmental, self-cooled type. Transformers shall come complete from manufacturer; use of third party transformer housings or add-on transformer housings shall not be permitted. Transformers shall have no exposed live components. Transformers shall be Primary ‘Delta’ and Secondary ‘Wye’ connected. Transformer selection, design, and installation shall be governed by NEC, NESC, ETL 1110-3-412, TM 5-684, UFC 3-550-03FA, UFC 3-550-03N, IEEE C57.12.28, ANSI/IEEE C57.12.22, IEEE C57.12.34, and C57.12.80
2. Aluminum windings shall not be used in transformers. Transformers shall be strategically located close to the loads. Dedicated transformer substations shall be provided for large loads.
3. Each pad-mounted transformer shall be sized to provide power for the total load of the facility served without being loaded to more than 110% of its rated capacity.

#### transfer switches

* 1. Transfer Switches shall meet one of the following requirements:
* UL listed;
* Tested and Marked by another NRTL;
* BS/EN 60947-6-1 or IEC 60947-6-1 manufactured, AND type-tested assembly (TTA).
1. Transfer Switches shall be rated for 600V, 50Hz.

#### panelboards

* 1. Panelboards shall meet one of the following requirements:
* UL67 listed
* Tested and Marked by another NRTL
* BS/EN 60439 or IEC 60439-manufactured, AND type-tested assembly (TTA)
1. All panelboards shall be circuit breaker ‘bolt-on’ type panels.
2. Enclosures for exterior and interior applications shall be NEMA Type 3 (IEC Classification IP54) and NEMA Type 1 (IEC Classification IP10) respectively.
3. Circuit breakers shall be connected to copper bus bars within the panelboards. Daisy chain (breaker-to-breaker) connection(s) made with conductor or interconnecting busbar are not acceptable. A 3-pole circuit breaker shall be a single unit and not made up of 3 single pole circuit breakers connected with a wire or bridge to make a 3-pole breaker.
4. For large panels (225 Ampere and above) provide an ammeter, voltmeter and kilowatt-hour meter to monitor energy usage. Selector switches shall be provided for each meter to read all 3 phases.
5. All panelboards shall be surface mounted. All panels shall be provided with a minimum of 25% spare capacity for future load growth.
6. All panelboards shall be provided with a nameplate including the following information:
7. Manufacturer’s Name or trade mark
8. Type designation or identification number, or other means of identification making it possible to obtain relevant information from the manufacturer
9. Mark of the NRTL (such as UL), IEC 60439-1, or BS/EN 60439-1
10. Rated current, operational voltage, and impulse withstand voltage
11. Short-circuit withstand strength
12. Degree of Protection
13. All panelboards and load centers shall be provided with a panel schedule. All circuit breakers shall be labeled with an identification number corresponding to the panel schedule. Panel Schedule shall be type written in English, Dari and Pashto. The panel schedule shall identify the conductor color code present in the panel.
14. All loads shall be coordinated to provide balanced loading. Phase imbalance at each panel shall not exceed 5%.
15. Any building with any branch circuit breakers larger than 32A, 3 pole shall have at least one distribution panel for the larger breakers

#### circuit breakers

* 1. Circuit breakers shall meet one of the following requirements:
* UL 489 listed;
* Tested and marked by another NRTL;
* BS/EN 60947 or IEC 60947-manufactured;
* BS/EN 60898 or IEC 60898-manufactured.
1. Circuit breakers shall not be rated less than 15-amperes.
2. All Breakers feeding wet areas shall be Residual Current Breakers w/ Overload (RCBO) or Ground Fault Circuit Interrupter (GFCI).
3. [Circuit breakers feeding general purpose receptacles shall be RCBO type.]
4. All circuit breakers shall use down-stream coordination to ensure the breaker nearest a fault or overload is the first to trip
5. The use of 75° or 90°C (minimum) terminals is required.

#### conductors

1. All cable and wire conductors shall be copper. Conductors shall be single core; multiconductor cables shall not be used. All wiring, unless noted otherwise, shall be conductor-in-conduit. Conductor jacket or insulation shall be color coded to satisfy IEC requirements. For a three-phase system, phase A shall be brown, phase B shall be black, phase C shall be grey, the neutral shall be blue and the ground shall be green/yellow. Conductor color coding shall be identified on the plans. If a new feeder is added to an existing panelboard, colored electrical tape shall be used on the new conductors to match the existing color code. The grounded (neutral) conductor shall be permanently identified by a tag, label, or marking at the interface with an “N” on both the old and new grounded (neutral) conductor.
2. Conductors shall be rated 70°C minimum, but higher degree C rated conductors shall be used in locations where necessary (e.g.- for light fixtures, search lights, unit heaters, and other heat generating equipment). Use of higher degree C rated conductors on circuits with protective device (breaker) terminals rated at a lower degree C must be derated to the rating of the device terminals.
3. Aluminum conductors shall not be specified or used except as bare steel reinforced (ACSR) overhead conductors in an aerial primary distribution system.
4. All branch circuit wiring shall be copper, minimum #2.5 mm2 (#14 AWG) installed in metal conduit.
5. Conductors shall be sized in accordance with the AED Design Requirement entitled “Breaker and Conductor Sizing.” Manufacturer-provided ampacity charts shall not be used in determining conductor size.
6. Voltage Drop for branch circuits shall be limited to no more than 3%; voltage drop for branch and feeder circuits combined shall be limited to no more than 5%.
7. Steel wire armored cables shall not be allowed.

### interior distribution system

Contractor shall design and provide circuits for all mechanical equipment and any other equipment that requires power and make the final connections.

#### conduit

Metal conduit (EMT) system shall be complete, to include but not limited to, necessary junction and pull boxes for all surface mounted conduit systems. Surface-mounted Nonmetallic Raceways or PVC conduit shall not be allowed. Smallest conduit size shall be no less than 20mm (0.75 inch) in diameter. All empty conduits shall be furnished with pull wire or cord or rope (depending on the size of conduit and length of run). Conduit shall be surface mounted in all areas.

#### cable tray

Cable trays shall be ladder type and provided with, but not limited to, splices, end plates, dropouts and miscellaneous hardware. System shall be complete with manufacturer’s minimum standard radius and shall be free of burrs and sharp edges. Nominal width of cable tray shall be 300mm (12 inch) and rung spaced at 150mm (6 inch). Nominal depth shall be 100mm (4 inch). If cable trays are used, cable tray fill calculations shall be provided in the design analysis.

#### receptacles

1. Receptacles shall be placed at a maximum of 3-meter (10 feet) intervals. Areas with computer work-stations or similar equipment will have additional receptacles. Receptacles shall not be provided in latrines, bathrooms, restrooms, ablution areas, shower rooms, or other wet areas. Total number of duplex receptacles shall be limited to six (6) per 16-ampere circuit breaker.
2. Receptacles (outlets) shall be duplex type [16A, 250V, type CEE 7/4 (Schuko Type F).] [20A, 125 V, NEMA 5-20R.] [13A, 240V, BS1363 for use with fused plugs.]

***Note to Electrical Engineer:***

 ***Delete this Lighting Design Section if this project is solely site-adapt***

### Lighting

Design levels shall be per IES standards as a minimum. For convenience, the following lighting level table is listed.

Note: All spaces listed below may not be within the work required within this Contract.

Living room/Quarters 35 FC (350 Lux)

Toilets, Showers, Latrines, washrooms 20 FC (200 Lux)

Mechanical/Electrical rooms 30 FC (300 Lux)

Corridors and Stairways 20 FC (200 Lux)

Offices (private) 50 h/5 v FC (500 h/50 v Lux)

Office areas (open) 30 h/5 v FC (300 h/50 v Lux)

Kitchens (commercial) 70 h/3 v FC (700 h/30 v Lux)

Dining Areas 20 h/3 v FC (200 h/30 h Lux)

Auditoriums (assembly) 100 h (10 h Lux)

Auditoriums (social) 5 h/3 v FC (50 h/30 v Lux)

Conference 30 h/5 v FC (300 h/50 v Lux)

Video Conference 50 h/30 v FC (500 h/300 v Lux)

Armories 30 h/3 v FC (100 h/30 v Lux)

Reading (in chair-casual) 30 h/5 v FC (300 h/50 v Lux)

Reading (in chair-serious) 50 h/10 v FC (500 h/100 v Lux)

Reading (at desk-casual) 30 h/3 v FC (300 h/30 v Lux)

Reading (at desk-serious) 50 h/10 v FC (500 h/100v Lux)

Patient Rooms (general) Per UFC 4-510-01

Patient Rooms (critical) Per UFC 4-510-01

Egress path (incl. exterior) 1 FC (10.8 Lux)

Stairwells 10 FC (108 Lux)

Around Fences 0.5 FC (5 Lux)

Outside Gatehouses 3 FC (30 Lux)

In EPC Areas 1 FC (10 Lux)

FC = FootCandle

h = horizontal component

v = vertical component

#### indoor lighting

1. Indoor lighting for all areas shall consist of fluorescent surface mounted light fixtures. Exterior lighting shall be HID (metal halide or high pressure sodium) as referenced. Moisture resistant/waterproof (IPx4 rated or better) fluorescent light fixtures shall be provided in high humidity and wet areas such as latrines, showers and outside. Battery powered ‘emergency’ and ‘exit’ lights shall be provided within each building, as applicable, for safe egress during a power outage. All light fixtures shall be factory finished, complete and operational, to include but not be limited to, lens, globe, lamp, ballast etc. Industrial type fluorescent light fixtures shall not be used. Every room shall be provided with a minimum of one light switch. Light fixtures shall be mounted approximately 2.5-meters (8 feet) above finished floor (AFF) minimum. Fixtures may be pendant or ceiling mounted, depending on the ceiling type and height.
2. Lighting in large rooms/areas may be controlled from multiple switches. Three-way or four-way lighting shall be provided in all rooms / areas with multiple entrances.
3. Above mirror lights shall be provided in toilet rooms. Above-mirror lights shall be IPx4 rated if within Zone 2 as identified in BS7671.

#### emergency lighting

* 1. Battery powered emergency lights shall be provided within each building per NFPA 101. Fixtures shall be provided with self-contained nickel cadmium battery pack to operate on stand-by circuit for 90-minute minimum. Unit shall have test/re-set button and failure indication lamp.
	2. Emergency light fixtures shall be UL 924 listed, marked/tested by another NRTL, or IEC 60598 manufactured.

#### light fixtures

Lighting fixtures shall be a standard manufacturer’s product. Fluorescent surface mounted light fixtures shall be power factor corrected and equipped with standard electronic ballast(s). Fixtures in medical facilities shall also have electronic ballasts. All light fixtures shall properly operate using standard lamps available locally. Fixtures shall be fully factory wired and designed for appropriate application i.e. appropriate for that location where installed.

#### illuminated exit signs

1. Battery powered exit lights shall provided where required by NFPA 101. Exit lights are not required where the exit or way to reach the exit is readily apparent to the occupants
2. Fixtures shall be single or double sided as required by the location and for wall/ceiling mounting. Unit shall illuminate continuously and be provided with self-contained nickel cadmium battery pack, to operate on floated-battery or trickle charge circuit. Fixture shall operate satisfactorily for 90 minutes during a power outage. Unit shall have test/reset button and failure indication lamp.
3. Illuminated exit signs shall be green “Running Man” style, in accordance with ISO 7010 or CAN/ULC-S572, and ISO 3864-1.

#### [search lights

* 1. Contractor shall provide search lights in accordance with the requirements indicated below:
1. Prison grade
2. Nickel reflectors (bullet resistant)
3. 65 million candlepower (1000 watts)
4. Manual operation from below with one hand
5. Xenon lamp
6. Weatherproof design
7. Search light shall be bonded to lightning protection system.]

### single line diagram

Complete single line diagrams shall be provided for all systems installed. All major items in each system shall be identified and labeled for respective ratings. Single line diagrams for each system, installed in a clear plastic frame, shall be provided.

### surge protective devices (spd)

Surge Protective Devices (SPD’s) shall be provided utilizing surge arresters to protect sensitive and critical equipment. Provide SPD protection at each panel serving electronic loads and the well house (if applicable). Show each SPD in its respective panel schedule.

### well pump motor protection

If a submersible well pump is a requirement of this contract, provide a well pump motor protector. At a minimum, the motor protector shall protect against the following problems:

* + - Dry well
		- Flow restrictions
		- Overcurrent
		- Overvoltage
		- Undervoltage
		- Rapid cycling
		- Underload
		- Overload
		- False Start (Chattering)
		- Current Imbalance and Phase Reversal

The motor protector shall be rated for the correct voltage, frequency, and number of phases, shall be compatible with the pump chosen, and have a NEMA 3R or IP54 (min) rating. The protector shall be capable of manual or automatic reset.

### grounding & bonding

Grounding and bonding shall comply with the requirements of [BS7671][NFPA 70]. All raceways shall include insulated equipment grounding conductor (protective earth conductor), and grounding electrodes (earthing) shall be installed at every building or structure. Grounding electrodes shall include, at a minimum: Concrete encased electrode, bond to building steel (if available), bond to metallic water pipe (if available), and ground rod(s). All grounding electrodes present at a building or structure (including lightning protection and communications electrodes) shall be bonded together, and underground connections shall be exothermally welded. All exposed non-current carrying metallic parts of electrical equipment in the electrical system shall be grounded. Final measurement of the ground resistance shall not exceed 25 ohms when measured more than 48 hours after rainfall. Ground rods shall be copper clad steel, with minimum diameter of 17.2mm and minimum length of 3000mm.

#### [earth fault loop impedance test

An earth fault loop impedance test shall be performed on the most distant point of every final (branch) circuit. A test chart shall be developed and submitted to the Government for review and approval. Earth fault loop impedance tests shall be performed in accordance with Appendix 14 of BS7671. ]

### lightning protection system (lps)

*USE BOTH PARAGRAPHS IF PROJECT IS HYBRID (INCLUDES BOTH D/B AND SITE ADAPT)*

*USE THIS PARAGRAPH IF DESIGN/BUILD WORK IS INCLUDED IN THE CONTRACT*

[The Contractor shall perform a Lightning Risk Assessment IAW NFPA 780 for every design/build structure provided in this Contract, and submit the calculations in the Design Analysis. If the Lightning Risk Assessment determines that a Lightning Protection System (LPS) is required, the LPS shall be designed and installed by the contractor IAW NFPA 780. At a minimum, a LPS shall be provided for Medical Facilities, Fuel Storage, Ammo Storage, Power Plants, Communications Buildings, and any building over 8 meters at its peak. A yearly average flash density of 4.0 flashes/km2 shall be used for all regions of Afghanistan. The LPS shall be bonded to the electrical grounding system.]

*USE THIS PARAGRAPH IF SITE-ADAPT BUILDINGS ARE INCLUDED IN THE CONTRACT*

[The Contractor shall install Lightning Protection Systems where shown on the [site-adapt] plans, and install IAW NFPA 780.]

### fire detection & alarm system

GWOT/MILCON. Add requirement for compatibility with existing when facilities are added to an existing site.

A Fire Detection and Alarm System shall be provided [where required by NFPA 101 or UFC 3-600-01] and installed in accordance with NFPA 72 requirements. System shall include, but not limited to, addressable Fire Alarm Control Panel (FACP), manual pull stations, horns, strobes, and smoke and/or heat detectors (with alarm verification feature). [The system shall be capable of automatically transmitting the alarm signal, via telephone lines, to the local fire department/fire station or other location designated by the Contracting Officer.] Fire alarm system shall be complete and a standard product of one manufacturer [and shall be compatible with the existing predominant standard system in place at the installation]. The fire alarm system shall either be UL listed AND FM approved or European standard “EN 54” certified AND CE marked.

**ANSF**. *USE BOTH PARAGRAPHS IF PROJECT IS HYBRID (INCLUDES BOTH D/B AND SITE ADAPT)*

*USE THIS PARAGRAPH IF DESIGN/BUILD WORK IS INCLUDED IN THE CONTRACT*

For design/build structures, provide smoke alarms where a fire alarm system is required by NFPA 101. Smoke alarms shall be line voltage (230V) stand-alone type with 9V battery backup. [Where more than one smoke alarm is provided in a room, smoke alarms shall be wired such that one unit alarming in the space will cause all units to alarm.]

*USE THIS PARAGRAPH IF SITE-ADAPT BUILDINGS ARE INCLUDED IN THE CONTRACT*For site-adapt buildings, omit central fire detection and alarm systems as shown on plans. Replace central fire detection and alarm systems (including, but not limited to: fire alarm control panel, notification appliances such as horns and strobes; initiation devices such as manual pull stations and smoke detectors; and interconnecting wiring) with stand-alone single-station smoke alarms that are line voltage powered (230V) with 9V battery backup. Line voltage (230V) can be obtained from the nearest unswitched lighting circuit. A smoke alarm shall be installed in every location where a smoke detector is currently shown on site-adapt building plans. If smoke detectors or alarms are not shown on the standard site-adapt plans, provide smoke alarms in all sleeping rooms.

## loud speaker & alarm system

Loud Speaker & Alarm System shall be capable of alerting the entire compound via panic button from any guard tower or other guard post station. Speaker & Alarm System shall be exterior grade components to withstand severe weather conditions of cold, heat, rain, sleet, and dust storms. System shall be designed such that maximum distance of personnel from the sound system speaker is 550m. Conduit with pull-string shall be installed as part of this Contract. Cabling and connection work shall be provided by others.

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# COMMUNICATIONS SYSTEM

The communications infrastructure for [this project] \_\_\_\_\_\_\_\_\_\_\_\_ shall be designed and constructed by the Contractor.

## source of communications

The Contractor shall route all communications to the Main Distribution Frame in the [existing Communications Building] [*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*].

## ductbank system

[The Contractor shall extend the existing manhole/handhole and duct system.]

### manholes/handholes

1. Manholes and handholes shall be constructed per UFC-3-550-01. The maximum distance between manholes and/or handholes shall be 140m.
2. The main ductbank shall be 6-way minimum, three conduits wide by two conduits deep (3x2) with innerducts installed in two conduits. Laterals off of the main duct system shall be 4-way (2x2) minimum, with one duct having inner ducts. Two conduits shall be provided from a manhole/handhole to a building, with one duct having innerducts. All conduits shall be terminated in ABS plastic terminators cast into the walls of the concrete structures. In manholes, all conduit windows shall be recessed.
3. Cable racking diagrams (manhole/handhole butterflies) shall be provided for the manholes and handholes.

## Exterior Conduit (ducts)

Conduit shall be concrete-encased schedule 40 PVC under roadways, parking lots and heavy traffic areas, and direct buried Schedule 40 PVC in other areas. Conduit shall be 100mm diameter and buried 1000mm below grade.

Innerducts shall be four (4) 25mm PVC innerducts field-installed in the outer duct. The innerducts shall be installed in the duct face and secured with properly sized duct plugs which expand to seal the duct.

## interior Distribution System

The Contractor shall provide communications boxes as shown on the site-adapt plans. For design/build buildings, the Contractor shall provide two boxes per bedroom (one box on each of the long interior walls), one box per workstation, and three boxes in each conference room.

1. Provide all empty conduits with a pull rope.
2. Cabling, racks, patch panels, PET’s, 110 blocks, and RJ45 faceplates will be provided by others.
3. Metallic conduit and cable tray shall be used to distribute the telecommunications cabling (provided in future, by others) throughout the building. Minimum conduit size shall be 13mm.

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# communications System

## GENERAL

The communications system infrastructure is to be designed and constructed by the Contractor. The contractor shall provide all exterior PVC conduit, interior surface-mounted nonmetallic raceway and communications outlet boxes.

## outside plant

*Insert the source of communications and the location of the server room.*

Two (2) 100mm conduits with pull string shall be provided between [\_\_\_\_\_\_\_\_\_\_\_\_\_\_] and [\_\_\_\_\_\_\_\_\_\_\_\_\_\_]. The conduit run shall have no more than three 915mm sweeps. If more than three turns are required, a 1220mmx1220mmx1220mm handhole shall be installed.

*If the source of communications is a new satellite pad, use the following language*

## Satellite Pad

1. Provide [a 4m x 4m x 200mm concrete pad] for satellite antenna (weight 1360 kg). Design the base to anchor the antenna and withstand high winds on site. Provide a frame ballast of 80 CMU Cinder blocks. Satellite antenna pad will be placed in a manner so that there is an unobstructed view to the south 180º.
2. Conduit at satellite pad must be bent, using a 915 mm sweep, so that the opening is pointing down (not up) with at least 305mm clearance from the pad surface. A weatherhead shall be provided at the dish location.
3. See Structural Section for Satellite Frame and Pad requirements.

## Communications Room and Connections

1. Provide a Main Communications Room in the office building. The Main Communications Room size shall be 5 meters by 3 meters.
2. Conduit entry into the room shall be through an LB, 460 mm above the communications floor.
3. Communications rooms shall have four (4) dedicated 32 amp circuits and disconnect switches.
4. Communications rooms shall have two (2) ductless split system HVAC units (24,000 BTU).

## Communications grounding

1. Provide a 100mm x 6mm communications ground bar in the communications room. Length of ground bar shall be determined by the contractor based on the number of racks in the communications room. Bond all racks to the communications ground bar, and bond the ground bar to the connex frame, a concrete encased electrode, the ground bus in the power panel, and all grounding electrodes present at the building.
2. Provide two (2) 3 meter Ground Rods with a minimum of 3 meter separation outside the main communications room.
3. [Provide two (2) 3 meter Ground Rods at the Satellite Dish location.]
4. All Ground Rods and other Grounding Electrodes present at the structure, including grounds for the electrical system, shall be bonded together. A grounding detail shall be provided showing all grounding electrodes.

## interior wiring

1. Two (2) communications outlet boxes shall be provided in each billet room; one (1) outlet on each long wall. In the office space an outlet box shall be installed every 1.8 meters along the interior walls. Conference Rooms shall have three (3) outlet boxes.
2. Outlet boxes shall be installed 610mm above finished floor.
3. An electrical receptacle shall be provided within 300mm of each communications outlet.
4. Surface-mounted nonmetallic raceway shall be provided for communication cable only (not to be used for electrical wiring), and spaced at least 150mm from electrical conduit.
5. Contractor shall coil 4 meters of excess cable in the communications room for termination, and 460mm of excess cable at each outlet location. Two CAT6 cables shall be installed for each communications outlet. Maximum length of each CAT6 homerun shall not exceed 100 meters. Category 6 (CAT6) communications cable will be government furnished, contractor installed, government terminated.

## communications equipment

1. Government Furnished Material

The following communications equipment will be government furnished:

• Category 6 (CAT 6) Cable (Government Furnished, Contractor Installed, Government terminated, tested, and labeled)

• Communications enclosure and equipment

• Faceplates

• Keystone Inserts

1. Contractor Furnished Material

The remainder of communications equipment shall be contractor furnished, contractor installed. This equipment includes, but is not limited to:

• Surface-mounted nonmetallic raceway

• Exterior PVC Conduit (Schedule 40, direct buried at least 800mm below grade)

• Outlet boxes

### exterior conduit

1. Communications conduit shall be 100mm diameter and not exceed 100 meters in length.
2. Conduit shall be PVC Schedule 40 PVC, buried at 1000mm to the top of the conduit.
3. The conduit interior must be free of protrusions at the joints to allow smooth, non-cutting surfaces for the wire or fiber optics that will eventually be pulled through.
4. Conduit joints shall be glued with an approved PVC cement.
5. Conduit is to be installed with a pull wire/rope.
6. Each bend must continue through a minimum of 155 mm of straight pipe before the next bend. The bends shall have 915mm sweeps.
7. Conduit must be buried no less 610mm, and maintain a minimum of 610mm separation from all power conduit.

## SIPRNET

All SIPRNET installations will meet the requirements of “Uncontrolled Access Area” per NSTISSI 7003. The installation shall be one of the hardened distribution systems, either hardened carrier, alarmed, or continuously viewed. The conduit shall be constructed of EMT utilizing all connectors, couplings, etc of the same material. All connections shall be permanently sealed completely around all surfaces. Pull boxes must be sealed and secured with a GSA approved changeable combination lock. Daily visual inspections and random technical inspections are required.

-END OF SECTION-