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SECTION 01 14 00

WORK RESTRICTIONS REVISED BY AMENDMENT NO. 0002

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SECTION 01 14 00

WORK RESTRICTIONS
REVISED BY AMENDMENT NO. 0002

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29.05 20 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Medical plan; G M/R

Transportation of personnel, materials, and equipment; G M/R

List of Contact Personnel; G M/R

Personnel List; G M/R

Vehicle List; G M/R

Statement of Acknowledgement Form SF 1413; G M/R

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. Mark Contractor equipment for identification.

Refer to Section 01 15 00.12 10 SUPPLEMENTARY REQUIREMENTS for Base Rules and Regulations.

1.2.1.1 No Smoking Policy

Smoking is prohibited within and outside of all buildings on installation, except in designated smoking areas. This applies to existing buildings, buildings under construction and buildings under renovation. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas.

1.2.2 Working Hours

Regular duty hours are from 0600-1800 Sunday through ~~Thursday~~Friday.

If the Contractor desires to carry on work outside regular base duty hours, or on Qatari or US official holidays, contractor shall submit an application to the COR. The Contractor shall allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. At night, exterior lighting shall be provided in conformance with EM-385-1-1 entitled "Safety and Health Requirements Manual."1.2.3 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, air conditioning, heating, fire alarm, compressed air are considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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DIVISION 01 - GENERAL REQUIREMENTS

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SECTION 01 15 00.12 10

SUPPLEMENTARY REQUIREMENTS
REVISED BY AMENDMENT NO. 0002

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29.05 20, SUSTAINABITY REPORTING. Refer to Section 01 33 00 SUBMITTAL PROCEDURES for specific information.

1.2 UNSCHEDULED WORK STOPPAGES

The Contractor should anticipate unscheduled removal from the work site an average of 10 hours per month. If the total unscheduled removal hours varies above or below the monthly average, an equitable adjustment may be made upon written demand of either party. Upon the receipt of a written request for a time extension, the Contracting Officer will ascertain the facts and, if in the judgment of the Contracting Officer and extension is justified, make an adjustment for extending the completion date.

1.3 DIGGING PERMITS

1.3.1 Requirements for Digging Permits

Prior to the start of any work activity which requires excavation within the current base, the Contractor shall obtain a digging permit.

1.3.2 Requests for Digging Permits

Contractor shall renew digging permits in a timely manner so as to avoid expiration of the permit. Requests for Digging Permits shall be submitted through the Contracting Officer to the Base a minimum of seven (7) days prior to the start of the work activity covered by the permit. The request for a Digging Permit shall include a narrative description of the work to be performed and a detailed map of the area of the excavation clearly marking the location of all known utilities or other obstructions. If the work activity covered by the Digging Permit request also requires a utility outage, a separate request for the outage shall be submitted.

1.3.3 Preparation of Requests for Digging Permits

Prior to submitting a request for a Digging Permit, the Contractor shall carefully review the area to be excavated to determine the location of existing utilities and other obstructions. The Contractor will review available drawings and will conduct a visual inspection of the site. The Contractor will utilize underground utility detecting devices such as metal and cable detectors to determine the location of existing utilities. All utility lines found shall be clearly flagged or marked and the location of

the utility shall be shown on the drawing to be submitted with the request for Digging Permit.

1.3.4 Existing Underground Utilities

Existing utilities may be present in the construction area which may not be shown, or are inaccurately shown, on the base as-built drawings and the contract drawings. The Contractor shall exercise utmost care in researching locations of existing utilities and reducing damage to existing utilities. Any utilities damaged by the Contractor shall be promptly repaired by the Contractor. The Contracting Officer will review and approve any proposed repairs. Any damage to existing utilities will be immediately reported to the Contracting Officer and the Base.

1.3.5 Use of Underground Utility Detecting Device

Prior to any excavation, a metal and/or cable detecting device shall be used along the route of the excavation. All underground utilities discovered by this method will be flagged a minimum distance of one-half (1/2) meter on each side of the location.

1.3.6 Hand Excavation

Hand excavation methods and special supervisory care shall be used between any flagged markers, in areas of known or suspected hazards, and in areas known or suspected to have multiple and/or concentrated utility lines or connections.

1.4 Repair of Damaged Utilities

The Contractor shall be responsible to repair any utilities damaged by him. The method of repair and schedule for performance of the repair shall be coordinated with, and subject to the approval of, the COR. The repair work and any temporary work required to keep the system operational while repairs are being completed, shall be performed at no cost to the Government.

1.5 PROTECTION AND MAINTENANCE OF TRAFFIC

1.5.1 General

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the COR. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the base authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with base traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.6 USE OF EXISTING ROADS AS HAUL ROUTES

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control shall be in accordance with the Special Clause entitled DUST CONTROL. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the COR. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the COR shall be removed.

The Contractor shall be responsible for coordinating with the Host Government use of any existing roads as haul routes. Construction, and routing of new haul roads, and/or upgrading of existing roads for the Contractor's use, is the sole responsibility of the Contractor. It shall be the Contractor's responsibility to obtain such local authorizations, permits and licenses necessary to establish his mobilization camp, quarry operations, batching operations and haul routes.

1.7 CONTRACTOR'S MOBILIZATION AREA

Prior to mobilization, the Contractor shall submit his proposed means of providing project security to prevent unauthorized access to equipment, facilities, materials and documents, and to safeguard them against sabotage, damage, and theft. The Contractor shall be responsible for physical security of all materials, supplies, and equipment of every description, including property which may be Government-furnished or owned, for all areas occupied jointly by the Contractor and the Government, as well as for all work performed.

1.7.1 General

1.7.1.1 General Work Area

The Contractor will be permitted to use an area designated by the COR for operation of construction equipment and plants, shops, warehouses, and offices. The Contractor shall not be authorized to have living accommodations for his work force on the site. The Contractor is responsible for obtaining any additional mobilization area required above that designated in the area use plan. On completion of the contract, all facilities shall be removed from the mobilization area by the Contractor and shall be disposed of in accordance with applicable Host Government Laws and Regulations. The site shall be cleared of construction debris and other materials and the area restored to its previous condition.

1.7.1.2 Mobilization Areas

All mobilization areas, to include construction sites and material storage areas, shall be secured with required physical barriers (to include but not limited to temporary fence) around the perimeter unless otherwise approved in writing by the Contracting Officer. Construction fencing shall be completely secured and obstruct visibility as necessary to limit public access to hazardous areas, maintain accountability of escorted personnel, prevent loss of material, prevent spread of debris, and screen construction areas. Temporary construction fencing materials may utilize chain link

with galvanized steel supports with fabric mesh attached or as approved by the COR. All facilities within the Contractor's mobilization area shall be of substantial construction suitable for the local weather conditions. Sanitary facilities shall meet the requirements of Corps of Engineers, Safety and Health Requirements Manual EM 385-1-1.

1.7.1.3 Storage Area/Laydown Yard

In the absence of required physical barriers to enclose the storage area, the Contractor shall construct a temporary 1.8 meter high chain link fence around the construction security area as assessed by the Wing Escort Program Manager (WEPM) and designated by the Contracting Officer. Fence posts may be mounted with concrete foundations or driven into the ground where soil conditions permit, however posts shall not be driven or buried without an approved Dig Permit. The fence shall include plastic strip inserts, colored green or as otherwise approved, so that visibility Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless approved in writing by the Contracting Officer.

1.7.2 Contractor's Temporary Facilities

1.7.2.1 General

All facilities within the Contractor's mobilization area shall be of substantial construction suitable for the local weather conditions. Sanitary facilities shall meet the requirements of Corps of Engineers, Safety and Health Requirements Manual EM 385-1-1.

1.7.2.2 Administrative Field Offices

The Contractor may provide and maintain administrative field office facilities within the mobilization area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.7.2.3 Storage Area

The Contractor shall construct a temporary 1.8 meter high chain link fence around trailers and materials with in the contractor's mobilization Area. The fence shall include plastic strip inserts, colored green or brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless approved in writing by the COR.

1.7.2.4 Plant Communication

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

1.7.2.5 Appearance of Mobilization Site Facilities and/or Trailers

Mobilization Site Facilities and/or Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers or other transportable structures which, in the opinion of the COR, require

exterior painting or maintenance will not be allowed on the construction site until such work or maintenance has been performed to the satisfaction of the COR.

1.7.2.6 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse with construction equipment or other vehicles unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of soil onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. It shall be the contractor's responsibility to restore such areas to original conditions as directed by the COR.

1.7.2.7 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own facilities and equipment.

1.7.2.8 Sanitation

Sanitary Facilities: The Contractor shall provide and maintain within the Contractor's temporary facilities area minimum field-type sanitary facilities in accordance with the requirements of EM 385-1-1 Safety and Health Requirements Manual and approved by the COR. Government toilet facilities will not be available to Contractor personnel.

Trash Disposal: The Contractor shall be responsible for collection and disposal of trash from the construction work areas and from the mobilization area. All trash shall be disposed of off base in accordance with Host Nation requirements. Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Loose debris capable of being windblown, shall be immediately placed in sealed or covered containers to prevent it from being blown onto taxiways or runways. Any dirt or soil which is tracked onto paved or surfaced roadways shall be cleaned daily. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above. Stored material not indoors, whether new or salvaged, shall be neatly stacked when stored.

1.7.2.9 Communications

The Contractor shall make all arrangements and pay all costs associated with provision of Communication services intended for their own construction operations. The contractor shall submit a request to the COR for approval of cell phones. Use of cell phones is restricted to key personnel only.

1.7.2.10 Project Communication Installers

The Contractor shall provide a complete Telecommunications system to be owned and maintained by the government consisting of backboards, cabinets, patch panels, cable, pathways, conduit, and outlets with connector jacks in all offices and other user required locations. Network active devices are by others.

Coordinate with the local CATV service provider. Include amplifiers,

splitters, combiners, line taps, cables, outlets, tilt compensators and all other parts, components, and equipment necessary to provide a complete and usable CATV system. Include the headend amplifier as part of the system when required by the local provider. Passive CATV devices must support 1 gigahertz bandwidth.

The Contractor shall install the conduits and cabling for the Electronic Security Systems (ESS). The security system active devices are not included, these are by others.

Due to security policies, installation of certain communications systems may require installers to have a US Secret Security clearance. It shall be the contractors responsibility to acquire the services of said installers should this requirement exist within the contract.

1.7.2.11 Restoration of Storage Area

Upon completion of the project and after removal of mobilization facilities, trailers, materials, and equipment from within the fenced area to include all buried materials and water tanks, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other usage, shall be restored to the original or better condition. Gravel used to traverse unpaved areas shall be removed and all such areas restored to their original conditions.

1.8 PROJECT SIGN

Within thirty (30) calendar days after receipt of Notice to Proceed, the Contractor shall furnish and install a project sign at or adjacent to the project site where directed by the COR. The sign shall be in the English and Arabic languages. The sign shall be constructed with a face sheet of exterior grade plywood, 4-feet high by 8-feet wide by one-half-inch thick, mounted on suitable framing which shall be approved by the COR. All parts of frames and signs shall be given a prime coat of exterior oil base paint and a minimum of two (2) finish coats of white semi-gloss paint. The COR will supply the Contractor with all information to be displayed on the sign, i.e. wording, letter size, pictorial display, etc. The Contractor shall maintain the sign in good condition, as determined by the COR, throughout the project construction period. Upon completion of the work under this contract, the sign shall be removed by the Contractor and disposed of as directed by the COR. No direct payment will be made for the sign.

1.9 DUST CONTROL

Aggregates required for the maintenance of traffic, water, liquid asphalt, asphalt emulsion, cationic emulsified asphalt or calcium chloride for use as dust palliatives, shall be furnished and applied as directed by the COR. Water or other dust palliative shall be used on haul roads and any location on the project to minimize pollution from dust at all times during construction. Vehicle speeds shall be controlled to reduce dust. Temporary roads shall be constructed when called for, and such roads, as well as the road under construction, shall be surfaced and maintained with aggregates, as shown on the Plans or as directed by the COR's Representative. Vehicles transporting sand, cement, gravel or other materials creating a dust problem shall be covered, as directed by the COR, or in accordance with local Air Base Laws, codes, and regulations.

1.10 CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in accordance with Section 01 33 00 SUBMITTAL PROCEDURES. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company involved and shall contain the name and address of the Contractor, the project name and location, description and the quantity of the items involved, and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material.

1.11 ACCIDENT PREVENTION

The Contractor shall comply with all applicable Host Country laws and with such additional measures as the Contracting Officer may find necessary. Applicable provisions of the Corps of Engineers manual entitled Safety and Health Requirements Manual EM 385-1-1, will be applied to all work under this contract. The referenced manual may be obtained from the Contracting Officer's Representative at the jobsite or from the Middle East District at Winchester, Virginia.

1.11.1 Accident Prevention Program

Within fifteen (15) days after receipt of Notice to Proceed, and at least ten (10) days prior to the accident prevention pre-work conference, four (4) copies of the Accident Prevention Plan shall be submitted for review by the COR. The Contractor shall not commence physical work at the site until the Accident Prevention Plan (APP)has been reviewed and accepted by the COR or his authorized representative. The APP shall meet the requirements listed in Appendix "A" of EM385-1-1. The Activity Hazard Analysis is a method in which those hazards likely to cause a serious injury or fatality are analyzed for each phase of operations. Corrective action is planned in advance which will eliminate the hazards. An analysis is required for each new phase of work. On large or complex jobs the first phase may be presented in detail with the submittal of the Accident Prevention Plan rather than presenting the complete analysis. If the plan is to be presented in phases, a proposed outline for future phases must be submitted as a part of the initial Accident Prevention Plan submittal. Accident Prevention Plans will be reviewed for timeliness and adequacy at least monthly with a signature sheet signed and dated documenting that these reviews took place. The contractor shall provide a copy of their company policy statement on Accident Prevention and any other guidance as required by EM 385-1-1, Appendix A.

1.11.2 Ground Fault Circuit Interrupter (GFCI) Requirement - Overseas Construction

The Corps of Engineers Health and Safety Manual, EM 385-1-1, section 11.C.05.a. states: "The GFCI device shall be calibrated to trip within the threshold values of 5 ma +/- 1 ma as specified in Underwriters Laboratory (UL) Standard 943." A variance from USACE has been granted allowing 10 ma, in lieu of 5 ma, for overseas activities that use 220 Volts(V)/50 hertz(hz) electrical power.

1.11.3 Temporary Power - Electrical Distribution Boxes

EM 385-1-1 section 11.A.01.a. states "All electrical wiring and equipment shall be a type listed by a nationally recognized testing laboratory for the specific application for which it is to be used." This includes temporary electrical distribution boxes. Locally manufactured electrical boxes will not be allowed. Only manufactured electrical distribution boxes that meet the European CE requirements, with 10 ma CE type GFCIs installed shall be allowed.

Contractors shall:

a. Make no modifications that might void any CE or manufacturer certification.

b. Test the installed systems to demonstrate that they operate properly and provide the 10 ma earth leakage protection.

c. Ensure GFCIs will have an integral push-to-test function. The testing shall be performed on a regular basis.

d. Check that proper grounding is checked regularly and flexible cords, connectors, and sockets inspected before each use.

1.11.4 Reinforcement Caps

All rebar and other protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement. The guarding shall be capable of withstanding a 113 kilo Grams (KG) (250 lbs) weight dropped from 2.3 meters (7'6") without the rebar or other protruding reinforcing steel breaking through, using protective devices such as steel reinforced covers and wooden troughs. Individual blocks of wood or mushroom style plastic rebar caps manufactured for "scratch protection" only shall not be used unless they can meet the 113 kg requirement.

1.12 LOCALLY AVAILABLE SERVICE FOR EQUIPMENT

All equipment furnished under this contract, regardless of country of manufacture or purchase, must have in-country service availability. In the event that the Contractor proposed to provide equipment for which in-country service is not available, the Contractor must provide written justification for the Contracting Officer's approval. This justification shall be submitted for each product or material for which a waiver is sought concurrently with the submittal required by the Technical Provisions. Submission of group or "blanket" waivers is unacceptable.

1.13 ESTABLISHING A LOCAL OFFICE

It shall be the contractor's sole responsibility to investigate all requirements for and for obtaining a license to operate and perform work in the State of Qatar.

1.14 TEMPORARY PROJECT FENCING AND BARRICADES

The Contractor shall impose all measures necessary to limit public access to hazardous areas and to ensure the restriction of workers to the

immediate area of the construction and mobilization site. The COR may require in writing that the Contractor remove from the work any employee found to be in violation of this requirement.

1.14.1 Barricades

Barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night. Travel to and from the project site shall be restricted to a route approved by the COR.

1.14.2 Temporary Construction Fencing

All contractor mobilization areas, to include construction sites, general work areas, and storage areas shall be secured with required physical barriers (to include but not limited to project provided 1.8 meter high temporary fence) around the perimeter unless otherwise approved in writing by the Contracting Officer. Temporary construction fencing shall limit public access to hazardous areas, maintain accountability of escorted personnel, prevent loss of material, prevent spread of debris, and screen construction areas.

1.14.2.1 Construction Security Area (CSA)

In the absence of required physical barriers to enclose any CSA, the Contractor shall construct a temporary 1.8 meter high chain link fence around the CSA as detailed in the contractor Area Use Plan, assessed by the Wing Escort Program Manager (WEPM), and designated by the Contracting Officer. Fence posts may be mounted with concrete foundations or driven into the ground where soil conditions permit, should be installed in a straight line with sections vertically aligned, and shall be adequately anchored to withstand the local wind load conditions, however posts shall not be driven or buried without an approved Dig Permit. Temporary construction fencing materials may utilize chain link with galvanized steel supports, shall be completely secured at the top and bottom to prevent access, and attach opaque dark green woven mesh fabric screening to obstruct visibility or as otherwise approved by the Contracting Officer Representative (COR).

1.14.2.2 Temporary Construction Fence Screening

Weather proof green fabric mesh may be applied on the outside of temporary chain link fencing or similar material may be incorporated as part of the fence design if it meets the visibility and other guidelines. Construction screens must block 80% or more when viewed from a perpendicular angle. Fabric screening shall be designed to withstand the local wind loads and attached securely to prevent coming loose or tearing in the wind. Fabric must be pulled taut and attached squarely for a neat appearance. All fabric shall run uninterrupted the length of the fence, except for authorized gates. Fabric may be attached to individual fence section if they must be moveable and all gates are to be screened unless safety requires otherwise. The contractor shall replace or repair in a timely manner all fences and screening sections that have damage or develop unsightly rips or holes. All construction fencing and screening shall be removed only upon the completion of construction activities.

1.15 CONTRACTOR'S OFF BASE MOBILIZATION AREA

The Contractor shall provide, furnish, operate and maintain facilities for his batching operations (e.g. concrete, asphalt, etc.) major shops and living facilities for his workers in an area off base. The specific area must be located such that no new contractor facilities are within the "Inhabited Building Clear Zone" (approximately 1355 meters, radius) surrounding ammunition/explosives storage and/or handling areas. The Contractor must submit his desired site location to the Contracting Officer for approval. All utilities will be the responsibility of the Contractor and shall be provided at no cost to the Government. On completion of the contract, all facilities shall be removed by the Contractor and shall be disposed of in the manner directed by the Contracting Officer. The site shall be cleared of construction debris and other materials and the area restored to its original condition. See Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES for additional requirements.

1.15.1 Facilities Within the Mobilization Site

All facilities within the Contractor's mobilization site shall be of substantial construction suitable for the local weather conditions. Housing, messing and sanitary facilities shall meet the requirements of Corps of Engineers Safety and Health Requirements Manual EM 385-1-1. The Contractor shall provide all utilities required to make the site self-sufficient.

1.15.2 Employee Parking

Contractor employees shall park vehicles in an area approved by the COR. Contractor employee parking shall not interfere with existing and established parking requirements of Base authorities.

1.16 CONNECTIONS TO EXISTING UTILITIES

1.16.1 General

Any outage of any utility service shall be requested in writing at least fifteen (15) days in advance of the date requested for the commencement of the outage. The Contractor shall provide a request, detailing the type of outage needed (water, sewer, electrical, steam, etc.), the time needed to perform the work, the reason for the outage, and the known affected facilities. The COR shall be contacted prior to the outage to confirm the time and date. If the Contractor fails to initiate work at the approved time, the COR may cancel the approved outage and may direct the Contractor to resubmit a new request. No part of the time lost due to the Contractors failure to properly schedule an outage shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

1.16.1.1 Performance of Work During Non-Standard Hours

To minimize outage impact to the mission of the Base, all outages shall be scheduled on Qatari weekends or from 2100 - 0530 hours on duty days. The period proposed for performance of the outage shall include sufficient contingencies to preclude impact to the working hours 0600 - 1800 hours during the work week.

1.16.1.2 Portable Exterior Night Lighting

Lighting for work during power outage Exterior night lighting shall be

provided in conformance with EM-385-1-1 entitled Safety and Health Requirements Manual.

1.16.2 Existing Underground Utilities

The Contractor shall exercise the utmost care in researching locations of existing utility lines by implementing control measures to eliminate, or reduce to a level acceptable to the COR, the chance of damaging or destroying existing utilities.

1.17 WATER (CONTRACTOR PROVIDED)

The Contractor shall provide and maintain water at his own expense for his use for construction and domestic consumption, and shall install and maintain necessary supply connections and piping for same, but only at such locations and in such manner as may be approved by the COR. Water required for final testing, adjusting and balancing of HVAC systems will be furnished by the Contractor. Before final acceptance of systems, or facilities, all temporary connections and piping installed by the Contractor shall be removed at his expense in a manner satisfactory to the COR.

1.18 ELECTRICITY (CONTRACTOR PROVIDED)

Electrical service is not available for use under this contract; therefore all electric current required by the Contractor shall be the responsibility of the Contractor, furnished at his own expense. Electricity required for final testing and balancing of all building systems and supporting site structures and equipment will be furnished by the Contractor. All temporary connections for electricity shall be subject to the approval of the COR and shall comply with Corps of Engineers manual EM 385-1-1 entitled Safety and Health Requirements Manual. All temporary lines shall be furnished, installed, connected and maintained by the Contractor in a workmanlike manner satisfactory to the COR. Before final acceptance of systems, or facilities, all temporary connections installed by the Contractor shall be removed at his expense in a manner satisfactory to the COR.

1.19 USE OF EXPLOSIVES

Explosives of any kind are not allowed under any circumstances under this contract within the Base.

1.20 PHYSICAL CONDITIONS

The indications of physical conditions on the drawings and in the specifications are the result of site investigations. Exploration logs (FOR INFORMATION ONLY) are presented as an attachment to section 31 00 00.00 06.

1.20.1 General

The Contractor shall furnish the facilities and services listed in this clause for Corps of Engineers personnel and other persons as designated by the COR. All facilities, furnishings, materials, and equipment shall be new or like new condition when furnished at the site. The Contractor shall fully maintain and repair all facilities, furnishings and equipment listed below. All facilities furnished and/or installed by the Contractor under this clause shall remain the property of the Contractor.

1.20.2 Office Area

Beginning not more than 30 calendar days after issuance of NTP, the Contractor shall provide a furnished, air-conditioned office area for two (2) US Government employees. Equipment to be provided within this office area shall meet the minimum requirements specified herein. Office furnishings shall consist of work desks, chairs, filing cabinets (2 of each item), and a work table. Desks shall be a minimum of .914 m x 1.52 m and have a minimum of two filing drawers. Filing cabinets shall have a minimum of 5 drawers and able to accommodate A-4 size paper. The Government employee office area shall also include a work table (approximately 1.21 m X 1.50 m) and a hanging drawing file. The hanging drawing file shall be sufficient to accommodate full size drawings.

The US Government employees office area can be within the same office trailer the Contractor establishes for his own staff; however, the US Government offices must be separated from the Contractor's office space by a locking door or hard wall. If the US Government employee's office is in a separate trailer, the US Government employees shall have access and use of the Contractor's photo copier, and rest rooms at all times. The quality of the office area should at least be equal to the quality of the office area for the Contractor's management staff. The office area will accommodate US government communication as set forth in section 1.24 RESIDENT MANAGEMENT SYSTEM (RMS) and will be for the sole use of Government employees for the life of the contract.

1.21 STANDARDIZATION

Where two or more items of the same type or class of equipment furnished in this project are required, the units shall be products of the same manufacturer and shall be interchangeable when of the same size, capacity, performance characteristics, and rating. The only exception to this requirement is where the items are interchangeable due to conformance with industry standards (valves, fittings, etc.), they need not be by the same manufacturer. This requirement applies to all manufactured items in the project which normally require repair or replacement during the life of the equipment.

1.22 ON-BASE PHOTOGRAPHY PROHIBITION

The Contractor shall not engage in any form of photography at any time while on base. All photography will be requested through the USACE field office and approval granted only after receipt of approval by the Al Udeid Air Base Command and the Contracting Officer.

1.23 PUBLIC RELEASE OF INFORMATION

1.23.1 Prohibition

There shall be no public release of information or photographs concerning any aspect of the materials or services relating to this bid, contract, purchase order, or other documents resulting therefrom without the prior written approval of the Contracting Officer.

1.23.2 Subcontract and Purchase Orders

The Contractor agrees to insert the substance of this clause in all purchase orders and subcontract agreements issued under this contract.

1.24 UNEXPLODED ORDNANCE

1.24.1 UXO Safety Support During Construction

The project site has been cleared by an Explosive Ordnance Disposal (EOD) team. However, unexploded ordnance (UXO) may be discovered and/or uncovered within or around the construction work areas. It is the responsibility of the Contractor to be aware of the risk of encountering UXO and to take all actions necessary to assure a safe work area to perform the requirements of this contract. If at any time during contract performance, the Contractor becomes aware of or encounters UXO or potential UXO, the Contractor shall immediately stop work at the site of the encounter, move to a safe location, notify the contracting Officer, and mitigate any delays to scheduled or unscheduled contract work. The Contractor shall not perform nor incur any costs for the removal or disposal of UXO. The Contractor assumes the risk of any and all personal injury, property damage or other liability, arising out of and resulting from any Contractor action hereunder.

1.25 RESIDUAL CONSTRUCTION MATERIAL

All Contractor purchased materials and equipment intended for incorporation into the completed facilities and which are later determined excess to the actual construction requirements, will become the property of the Government. The residual materials and equipment shall be tagged (giving the area where like type material and equipment were installed), and stored in an orderly manner in a designated area as directed and approved by the Contracting Officer.

1.26 COMPLIANCE WITH HOST COUNTRY RULES AND CUSTOMS

The laws of Host Country may prohibit access to certain areas of the country which are under military control. The Contractor shall furnish the Contracting Officer the names of personnel, type, and amounts of equipment, dates and length of time required at the site, and the purpose of entering the host country. It is understood that areas to which rights of entry are provided by the Host Government are to be used only for work carried out under the contract and no destruction or damages shall be caused, except through normal usage, without concurrence of the Host Government.

1.26.1 Contractor's Responsibilities

The following items are the sole responsibility of the Contractor to investigate, estimate as to cost, and assume the risk, as normally encountered by Contractors. The Contractor shall be responsible for determining the effect of the following on his own cost of performance of the contract and for including sufficient amount in the contract price:

a. Official language and type of accounts required to satisfy the officials of the Local Government.

b. Entry and exit visas, residence permits, and residence laws applicable to aliens. This includes any special requirements of the Host Government, including those required by local Labor Offices, which the Contractor may have to fulfill before an application for a regular block of visas will be accepted.

c. Passports, health and immunization certificates, and quarantine

clearance.

d. Compliance with local labor and insurance laws, including payment of employer's share of contribution, collecting balance from employee and paying into insurance funds.

e. Customs' waiver expirations should be resubmitted by the contractor at least 45 days in advance of anticipated expiration.

f. Shipment of goods and equipment into the country should be planned by the contractor such that delays due to Ramadan and local holidays may be avoided.

g. Strikes, demonstrations and work stoppage.

h. Collection through withholding and payment to local Government, of any Host Country income tax on employees subject to tax.

i. Arranging to perform work in the Host Country, to import personnel, to employ non-indigenous labor, to receive payments and to remove such funds from the country.

j. Operating under local laws, practices, customs and controls, and with local unions, in connection with hiring and firing, mandatory wage scales, vacation pay, severance pay, overtime, holiday pay, 7th day of rest, legal notice or pay in lieu thereof for dismissal of employees, slowdown and curtailed schedules during religious holidays and ratio of local labor employed in comparison to others.

k. Possibility of claims in local bureaus, litigation in local courts, or attachment of local bank accounts.

l. Compliance with workmen's compensation laws and contributions into funds. Provisions of necessary medical service for Contractor employees.

m. Special license required by the local Government for setting up and operating any manufacturing plant in the Host Country, e.g. concrete batching, precast concrete, concrete blocks, etc. It shall be the contractor's responsibility to coordinate the procurement of concrete necessary to fulfill the requirements of the contract. Should the contractor desire to set up a batching plant on base to meet the requirements of the contract it shall be the responsibility of the contractor to coordinate and acquire approval from the Host Nation (HN) Base authorities for this requirement.

n. Sales within the host country of Contractor-owned materials, and equipment.

o. Special licenses for physicians, mechanics, tradesmen, drivers, etc.

p. Identification and/or registration with local police of imported personnel.

q. Stamp tax on documents, payments and payrolls.

r. Base passes for permanent staff, day laborers, motor vehicles, etc.

s. Compliance with all customs and import rules, regulations and restrictions, including, but not limited to, local purchase requirements.

t. Application, Coordination and approval of the Services Design and Control Application. See section xxxxx

1.27 MILITARY BASE RULES AND REGULATIONS

1.27.1 General

The Contractor and his employees and subcontractors shall become familiar with and obey all Base rules and regulations including fire, traffic, and security regulations. All personnel employed on the Base shall keep within the limits of the work (and avenues of ingress and egress), and shall not enter any Restricted Areas, unless required to do so and prior clearance for such entry has been obtained. The Contractor's equipment shall be conspicuously marked for identification.

1.27.2 Base Security and Installation Entry

The Base Security Office maintains the ultimate authority for establishing, monitoring, and enforcing security requirements for base security. All contractor, subcontractor, or vendor personnel and vehicles at any tier working at any location on the Base are subject to a thorough search upon entering, departing, or at any time deemed necessary by the Base Security Personnel. The Contractor shall be responsible for compliance with all the Base security requirements. The Government reserves the right to deny access or to require the contractor to remove any personnel or equipment deemed to be a threat to the security of the base or the base personnel. The Contractor shall work through the COR's Representative (COR) to ensure the Base Security Regulations and Al Udeid Air Base (AUAB) Installation Entry requirements are complied with.

1.27.3 Escorts

Force Protection concerns dictate the requirements for trained security escorts to escort workers, vehicles, and delivery trucks to and from the main gate, within construction areas, between various processing and screening, and as otherwise required in performance of contracted services. Local National/ Other Country National (LN/OCN)/contractor personnel with Category I badges require escort at all times unless the installation commander deems otherwise. The Contractor shall work through the Contracting Officer Representative (COR) to ensure the Base Escort Program requirements are complied with and escort support is available and scheduled as necessary.

1.28 IDENTIFICATION OF EMPLOYEE'S PERSONNEL AND VEHICULAR ACCESS TO THE PROJECT SITES

1.28.1 General

Contract Pass Coordinator (CPC). The Contractor shall perform the duties of Unit Pass Coordinator (UPC) as applicable to this contract and will also be referred to as the Contract Pass Coordinator (CPC). Contractor employee(s) assigned UPC duties must have a thorough knowledge of base entry procedures. The CPC must comply with base entry procedures and assist in the preparation of both Qatari Emiri Air Force (QEAF) and USAir Force (USAF) access pass and badge request documents. The CPC tracks, processes,

and coordinates with the 379 AEW Host Nation Liaison Office (HNLO) on all contractor Entry Authorization Application (EAA) request. The CPC also tracks, processes, and coordinates with the Biometric Identification System (DBIDS) Office on Installation Authorization Application (IAA) requests as well as the Locally Employed Personnel (LEP) Team on all LEP screenings. CPCs should also be the point of contact for equipment and material movements within their company. The Contractor will provide a complete listing of all base passes issued to OCNs employed under this contract and shall comply with additional requirements indicated by the Air Base Security Forces Commander.

1.28.1.1 EAA Package Requirements

1.28.1.1.1 General

All applications for QEAF Access Badges, along with other documents, must include a valid passport and Qatari work visa. Both the passport and visa must be valid for a minimum of six (6) months at the time of application.

1.28.1.1.2 Temporary EAA Package

A temporary EAA package allows entry onto the installation for 6-days or less. The following required information shall include but not necessarily be limited to the following documents when applying for the temporary EAA:

a. Unescorted Entry Authorization Application Memorandum.

b. Contact and/or subcontracts, along with one (1) photocopy of the contracts and one (1) copy of the Commercial Registry.

c. Valid passport and visa, along with two (2) photocopies of each.

d. Personal Identification Page. This provided document must be accomplished in both Arabic Script and English and both versions require original company stamps.

e. Vehicle drivers must submit copies of driver's license, vehicle registration, and vehicle insurance policy.

1.28.1.1.3 Initial EAA Package

Initial EAA package allows entry onto the installation for six (6) months or less. The following required information shall include but not necessarily be limited to the following documents when applying for the initial EAA:

a. Unescorted Entry Authorization Application Memorandum.

b. Contact and/or subcontracts, along with one (1) photocopy of the contracts and one (1) copy of the Commercial Registry.

c. Valid passport and visa, along with two (2) photocopies of each.

d. Two (2) current color passport sized photographs

e. Personal Identification Page. This provided document must be accomplished in both Arabic Script and English and both versions require original company stamps.

f. Vehicle drivers must submit copies of driver's license, vehicle registration, and vehicle insurance policy.

1.28.1.1.4 Renewal EAA Package

A renewal EAA package allows entry onto the installation for six (6) months or less. The renewal package requires the same documents as the initial, except it is to also include a copy of the previously completed Initial/Renewal EAA which shows prior approval by Qatar Counter-Intelligence Division (QCID) and photocopy of the approval memorandum. Applicants requiring a renewal must complete a renewal EAA package and submit it at least 30 days prior to the expiration of their current badge. Renewals submitted during major holidays may take up to an additional 30 calendar days to process.

1.28.1.1.5 Installation Authorization Application (IAA) Process

1.28.1.1.5.1 General

This process fulfills 379 Air Expeditionary Wing (AEW) U.S. Air Force (USAF) entry requirements. The USAF access badge allows the cardholder entry onto the U.S. controlled areas to include Construction Security Areas. Category I badges are red in color and the cardholder requires escort. Category II badges are blue in color and allow the cardholder unescorted access to AUAB. However, unescorted entry onto AUAB by OCNs is prohibited unless a request for exception to this policy has been approved by the Defense Force Commander (DFC). All IAA packages must be submitted through the Defense Biometric Identification System (DBIDS) office. This process also includes a separate Locally Employed Personnel (LEP) team screening of applicants.

1.28.1.1.5.2 IAA Package Submittals

1.28.1.1.5.3 IAA Processing Time

It is important all IAAs are submitted well before the applicant requires base access to ensure the fulfillment of mission critical tasks. Once the EAA is approved (Qatari Armed Forces Pass has been issued), the applicant (CPC or someone who represents the applicant) must submit the IAA package to the DBIDS office and obtain a registration appointment within 15-days of the approved EAA. This process is subject to change and the contractor shall comply with current base directives.

1.28.1.1.5.4 IAA Processing Time

In order to allow for proper coordination and approval, IAA requests must be submitted at least 45 calendar days prior to entry to allow proper verification and coordination of USAF approvals.

1.28.1.1.5.5 Contractor Responsibility

The CPC should be responsible for reviewing the information for accuracy. The contractor is responsible for providing all of the information required for the IAA packages and submitting IAA packages to the DBIDS Office. The CPC is responsible for tracking their employee packages and, therefore, must continually follow-up with the DBIDS office to ensure their package is being coordinated. It is the contractor's responsibility to arrange government provided escort the LNs/OCNs/contractors to scheduled appointments.

1.28.1.1.5.6 IAA Package Requirements

The US Air Force Central Command (USAFCENT) Installation Access Application (IAA) must be submitted for all OCNs. Page one of the IAA should be completely filled out. Page two requires original signatures and dates from both the applicant's sponsor and the requesting authority (RA); these are typically completed by the CPC and Contracting Officer's Representative (COR) or designee respectively. The submitted IAA Package shall include the completed USAFCENT IAA along with but not necessarily limited to the following required documents:

a. Current copy of the Passport

b. Current copy of the Qatari Work Visa

c. Current copy of the Qatari ID Card.

1.28.1.1.5.7 DBIDS Registration Appointments

DBIDS registrations will be conducted by appointment only. All IAA packages must first be submitted through the DBIDS Office. Appointments are arranged by submitting the applicant(s) IAA package(s), in person (applicant or CPC), at the DBIDS office. Allocation of appointments is typically arranged on a first come, first served basis, with daily and weekly limits on the number of submittals accepted. Failure to submit the required paperwork within 15-days of an approved EAA will result in denied installation access. If the contractors demand for appointment exceeds typical allotments, submit to the Contracting Officer's Representative (COR) or designee a request with justification and the estimated number of appointments required weekly by contract for each of the next two (2) months. Once an IAA package has been accepted, an appointment will be made for the employee typically to occur within 5 to 15-days.

1.28.1.1.5.8 Locally Employed Persons (LEP) Screening

Contractors are also required to have all OCNs screened and interviewed by the LEP Screening team typically before any badge can be issued. Subsequent to IAA submittal within DBIDS, the contractor is responsible to contact the Locally Employed Persons (LEP) Screening Team to set up employee LEP screening appointments. All OCNs are required to complete a biographical data sheet and the LEP Screening Team can provide this form in advance of the appointment. It is the contractor's responsibility to arrange government provided escort of the LNs/OCNs/contractors to attend the scheduled screening appointment. All OCNs are required to bring their biographical information, original passport, Qatari Identification, and base access badge to their interview. This process is subject to change and the contractor shall comply with current base directives.

1.28.1.1.5.9 DBIDS Registration

It is the contractor's responsibility to arrange government provided escort of the LNs/OCNs/contractors to their scheduled registration appointment. Failure to report during the prescribed appointment may delay or deny installation access. During this appointment, an applicant's biometric data will be collected. After collection, it requires up to 72 hours for a DBIDS Access Card (red badge) to be produced. CPCs should follow-up with the DBIDS office on status of badges no earlier than 72 hours after biometrics have been collected. Once available, it is again the contractor's

responsibility to coordinate with the USAF to have an escort provided to escort the OCN with proper identification to claim the badge. Badges not claimed within 30-days are to be destroyed.~~Once available, it is again the contractor's responsibility to escort the OCN with proper identification to claim the badge. Badges not claimed within 30-days are to be destroyed.~~

1.28.1.1.5.10 USAF Access Badge Renewal

Applicants requiring a renewal must complete a renewal IAA package and submit it a least 15-days prior to the expiration of their current badge. Once a renewal IAA package is accepted, the individual's profile will be updated and a new access badge produced. CPCs should follow-up with the DBIDS office on status of renewal badges no earlier than 3-days after submittal. Once available, it is the contractor's responsibility to coordinate with the USAF to have an escort provided for the OCN with proper identification to claim the renewal badge.~~Once available, it is the contractor's responsibility to escort the OCN with proper identification to claim the renewal badge.~~

1.28.1.1.5.11 Common Access Card (CAC)

All U.S. citizens requiring access to the Base must apply for and secure a CAC. Access clearance for this badge could take up to 4-6 month's for newly initiated security verifications. CAC issuance based on interim security clearance verifications is no longer allowed. If the individual does not have a CAC or does not qualify for a CAC card, that individual must possess or apply for the local area credentials i.e. Qatar Red Badge.

1.28.1.1.5.12 USAF Access Card Return

All USAF access cards issued to the contractor will be returned to the DBIDS Site Security Manager (SSM) before final payment is made. Access cards must be returned to the SSM when the contract is completed or when a contractor employee no longer requires access (e.g., quits or is terminated). If unable to retrieve the access card, notification to the SSM must be made in writing stating all applicable facts.

1.28.1.2 Employee Identifications

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work, to display identification as approved and directed by the COR Representative COR. Prescribed identification shall immediately be delivered to the COR for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.29 PROJECT ELECTRICAL INSTALLATION

All Interior and exterior electrical works must be performed by a KAHRAMAA approved Grade 'A' licensed contractor. The Prime Contractor shall be responsible for the hiring of an approved contractor to carry out electrical systems' construction. Upon completion of all works the prime contractor shall be responsible to have the installed electrical works inspected, approved and provision of an approval stamp by KAHRAMAA. Qatar International Trading Power Company (QIT) is the 11kilovolts(KV) power provider inside Al Udeid Air base and all exterior 11KV works shall be coordinated with QIT.

1.30 EMPLOYEE, VEHICLE, AND CONTRACT INFORMATION

The Contractor shall be required to maintain personal and background information, prepare forms, applications and other documents, and provide copies and/or photos as necessary for each employee. Documents may have to be accomplished in both English & Arabic and require original company stamps.

Each Contractor vehicle, machine, piece of equipment, or towed trailers, shall show the Contractor's name such that it is clearly visible on both front doors of the vehicle and both sides of a towed trailer. A valid Qatari license plate shall be displayed at all times. Contractor vehicles and equipment operated on Government property shall be maintained in a good state of repair, shall be insured, and shall be registered in accordance with Qatari Law. This information will be reviewed by Host Nation and Base Security officials. The required information and documentation shall include but not necessarily be limited to the following:

a. Full name, place and date of birth, along with other personal information for each applicant

b. Copies of valid Passport

c. Copies of valid Qatar resident work permit and/or Visa

d. Current color passport sized photographs

e. A valid copy of Qatari driver's license for each driver assigned under this contract.

f. Registration, insurance company, policy number and expiration date for each vehicle.

g. Copies of notice of contract, Standard Form 1442, Solicitation, Offer, and Award shall be stamped by Ministry of Justice.

h. Copies of contract between the contractor and the subcontractor, when applicable, with company stamp and shall be stamped by Ministry of Justice.

i. Copies of the Commercial Registry

j. Other information mandated by local law, the Base Security Regulations, or are required to coordinate and process the necessary documentation with the government offices responsible for the approval.

1.31 SPECIAL PASS/TEMPORARY ACCESS CARD REQUIREMENTS

1.31.1 Special Qatar Emiri Air Force (QEAF) Pass Requests

A special pass is utilized for events or situations which require access normally on a one time basis for personnel who are not residents of Qatar. Contract bidding, site visits, and other similar meetings hosted by US forces are examples of the special pass. These requirements must be routed for coordination through Host Nation Coordination Cell (HNCC). Requests must be submitted to 379 Air Expeditionary Wing (AEW)HNCC at least 30 days prior to the event to allow proper coordination of approvals. Requests submitted during major holidays may take up to an additional 30 calendar days to process.

In addition to the special pass approval, individuals require DBIDS vetting and issuance of a temporary DAC for base access. Upon arrival to the installation and after biometrics are captured, the individual will exchange either their passport/visa or valid identification card for a yellow temporary DAC. This Access Card grants entry for one (1) day only.

1.31.2 Entry Authorization Application (EAA) Process

1.31.2.1 General

This process fulfills 379 Air Expeditionary Wing (AEW) Host Nation Qatari Emiri Air Force (QEAF) entry requirements. The QEAF access badge allows the cardholder entry onto the installation. All EAA packages must be submitted through the HNLO. Base Security officials then review and forward the package to the Qatari Pass Office.

1.31.2.2 EAA Package Submittals

Applicable for non-US civilians, contractors and sub-contractors affiliated with Department of Defense (DOD) contracts (in possession of a Qatar resident work permit). The request for entry/exit to/from AUAB must be completed, via Initial, Renewal, or Temporary EAA, and submitted to the HNLO by the CPC. Individuals without a Qatar resident work permit must request a special pass.

1.31.2.2.1 EAA Processing Time

In order to allow for proper coordination and approval, Temporary or Initial EAA requests must be submitted through the HNLO at least 75 calendar days prior to entry to allow proper 30 calendar day coordination of Host Nation approvals. Requests submitted during major holidays may take up to an additional 30 calendar days to process.

1.31.2.3 Contractor Responsibility

The contractor is responsible for providing all of the information required for the EAA packages. The CPC should be responsible for reviewing the information for accuracy and producing an official EAA memorandum. The contractor is responsible for submitting a signed "Submission of Pass Application" cover memorandum with each EAA package submitted to the HNLO. The memorandum must be signed by the COR Representative (COR) or designee in writing prior to forwarding to HNLO. The CPC is responsible for tracking their employee packages and, therefore, must continually follow-up with the Qatari Pass Office to ensure their package is being coordinated. It is the contractor's responsibility to arrange government provided escort of the LNs/OCNs/contractors to the Host Nation Pass Office as required.

1.31.2.3.1 Associated Fees

The contractor is responsible for all fees required for the EAA packages. Qatari Badges have the following associated fees:

a. Initial & Renewal EAA: 50 Riyals per person

b. Temporary (6 days or less) EAA: 50 Riyals per person

c. Stolen/Lost Badge Renewal: 300 Riyals per person

d. Discolored/Damaged Badge Renewal: 50 Riyals per person

1.31.3 Security Plan

The Contractor shall submit to the Contracting Officer, within fifteen (15) calendar days after contract award, his proposed personnel and vehicular access plan. This plan shall cover all elements for issuance of the access passes, safeguarding of unissued passes, escort program requirements, security operations, lost passes, temporary vehicle passes, and collection of passes for employee's and vehicles on 1)- temporary absence; 2)- termination or release; and 3)-termination or completion of contract. The plan shall address in detail the contractors proposed procedures, and organization necessary to produce and maintain effective security within the contract limits twenty-four (24) hours a day seven (7) days a week.

1.31.4 Constraints to Base/Project Site Access

Contractor access to the Base for all personnel, vehicles, equipment and materials will be limited to the North Gate, as shown on the contract drawings. Refer to the Civil Drawings for the location of the North Gate and a representation of the route the Contractor will traverse to the project site with Al Udeid Air Base. During the period of this contract, other contractors will also utilize the North Gate and may have mobilization areas in the area of Project Site. The Contractor shall work through the Contracting Officer's Representative to coordinate access to the construction site. At anytime during the duration of this contract FPCON CHARLIE is in effect the Base will be open for work activities 24 hours, seven days per week. At anytime during the duration of this contract FPCON DELTA is in effect, the Base may be closed for all installation activity. The Base Security actions to safeguard the Military and Civilian personnel on the Al Udeid Air Base, during any security condition, may have a negative effect on the contractors' employees, vehicle and materials access and overall ability to perform. Any such action taken by Base Security is considered necessary for the security and protection of US military and civilian personnel. The Contractor should typically expect delays of 30 to 90 minutes or more for his workers, material, and equipment to access the Air Base depending upon threat conditions. This potential delay is also to be anticipated for construction material being brought on base, such as ready mix concrete.

1.31.5 Identification of Employees in the Project Site

Project Site Entry Access List (EAL). The Contractor shall provide a list of all employees who will need access to the Project Site. The access list shall contain the following information: name, company, nationality, age, profession, passport number, date and place issued and expiration date, residence permit and expiration date, and name of sponsor. In order to get on the access list, one (1) photocopy of passport, residence visa and two (2) colored photographs shall be provided. All of these three (3) documents must be valid at all times to remain on the access list. The Contracting Officer, through Middle East District Management Office, will provide the needed forms, to include the Personal Identification Form 2 and the Personal Identification Form 3 that the Contractor is required to submit. These forms require employee's thumbprint, signature and the employer's validation stamp and signature. The initial and revised access list will be provided in three (3) copies through the Contracting Officer to the Base Security Officer within a week of any additions/deletions. The Contractor shall plan his employee force requirements such that the access list will

contain all those employees who will need access to the Project Site for the period the list is in effect. Supplemental updating of the employee access list will be allowed only at the discretion of the Contracting Officer with the approval of the Base Security Officer. Employees who no longer require access to the Project Site should be removed from the list. Each contractor employee seeking entrance to the Site must be on the approved Access List.

1.31.6 Access to Operational Areas

Contractor personnel are expressly prohibited from entering operational buildings or areas without the specific authorization of the Base Security Office. Necessary access to operational buildings or areas shall be coordinated through the Contracting Officer and approved by the Base Security Officer a minimum of seven (7) days before access is required.

1.31.7 Personnel Violating Base Policies

Contractor personnel who violate certain base policies will have their base access badges (blue or red) permanently revoked for a first offense violation. It is the prime contractor's responsibility to assure all employees are briefed and checked daily. Violations that will result in permanent removal include: having an unauthorized camera, cell phone, sim card(s) or computers.

1.31.8 Local National (LN)/Other Country National - Escort (OCN-E) Program

Compliance with the base Escort Program is mandatory, to include but not limited to requesting escort support, obtaining support, and scheduling support as necessary for workers, vehicles, and delivery trucks operating within Al Udeid Air Base, Qatar.

1.31.8.1 Escort Responsibilities

The 379 ECES/Force Protection Flight (CEE) Wing Escort Program Manager (WEPM) oversees all 379 AEW escort requirements and is responsible for scheduling and providing qualified escorts in support of construction operations. The WEPM will provide feedback to the contractor and others with a need-to-know on the program. The Contractor is responsible to work through the Contracting Officer Representative (COR) and request escort support, obtain support, and schedule support as necessary with the WEPM or as otherwise arranged. Requests for government provided escort support are subject to limited escort resource availability. To allow for proper coordination and scheduling, escort support requests must be submitted through the COR at least fifteen (15) calendar days prior to the required escort support date to allow for proper resource management. Requests submitted late or in excess of available resources may have to be adjusted as necessary to maintain compliance with the base Escort Program requirements and available resources.

1.31.8.2 Escort Requirements

Escort requirements are based on local threat and conditions and may be modified at any time by the installation commander. Escort requirements may vary depending on the type of work and/or location of work. These requirements are determined based on risk assessments conducted by the WEPM and are subject to change. Risk assessments shall be accomplished upon establishment or modification of any construction security area. After these assessments, contractors will be instructed on any changes in normal

escort procedures / circulation controls and construction security area utilization. If the project site is not contained to allow for complete control or other unique circumstances exist, variation of these requirements will be determined by the WEPM.

1.31.8.3 Vehicle Escorts

LNs/OCNs/contractors required to operate their own vehicles on the installation to include but not limited to transit from the installation Entry Control Point (ECP) to the work area(s) shall have a vehicle escort. Mandatory minimum ratios for escorting vehicles to OCN/contractor vehicles may limit vehicle convoys to three (3) or eight (8) OCN/contractor vehicles or fewer based on local risk assessments and available escort resources. All vehicles to be operated on the airfield shall comply with base Airfield Operations requirements. The vehicle escorts shall not exceed maximum allowable ratios without prior written approval from the WEPM.

1.31.8.4 Normal Escort Procedures

Prior to construction of required physical barriers or when practical, standard escort procedures shall be followed. These procedures include but are not limited to escorted personnel remaining within 150 feet of the escort at all times. Mandatory minimum ratios of escort to LNs/OCNs/contractors may limit work parties to five (5) or ten (10) LNs/OCNs/contractors based on local risk assessments and available escort resources. Normal escort procedures shall be complied with, unless escorting procedures are accomplished through establishment and operation of an approved exception.

1.31.8.5 Exceptions to Normal Escort Procedures

1.31.8.5.1 Construction Security Areas (CSA)

Construction sites shall be established as "Free Zones" or Individual Construction Site Security Areas (ICSSA) to the maximum extent possible, as coordinated and approved by the wing commander or his/her designee. A free zone is defined as an enclosed work area with controlled entry(ies) and exit(s). Construction sites not in restricted or controlled areas should be established as Individual Construction Site Security Areas (ICSSA). An ICSSA is also defined as an enclosed work area with controlled entry and exit. When any CSA is established, a minimal number of entry/exit points will be manned continuously by a qualified entry control point (ECP) escort while contractors are working in the area.

1.32 RADIO TRANSMITTER RESTRICTIONS

To preclude accidental actuation of sensitive electronic equipment, the Contractor shall not use radio transmitting equipment without prior approval of the Contracting Officer.

1.33 BASE HOT WORK PERMITS

1.33.1 Requirement for Hot Work Permits

Prior to the start of a work activity including hot work (welding, burning, etc.) or the operating of other flame producing devices, the Contractor shall obtain a Hot Work Permit.

1.33.2 Requests for Hot Work Permits

Requests for Hot Work Permits shall be submitted through the Contracting Officer to the Base Fire Department a minimum of 7 days prior to the start of the work activity covered by the permit. The request for a Hot Work Permit shall include a narrative description of the work to be accomplished, a list of equipment to be used, and a description of special safety precautions that the Contractor will put in place during the work to assure compliance with EM 385-1-1 and Base Fire Regulations.

1.33.3 Preparatory Inspections and Inspection of Equipment

During the Preparatory Inspection for any work activity including hot work, the Hot Work Permit shall be reviewed. During the Preparatory inspection, all hot equipment and safety equipment shall be checked to assure that it is in proper working order. Safety equipment required by the Hot Work Permit shall be checked at the beginning of each shift to assure that it is in proper working order.

1.34 CONTRACTOR TRANSPORTATION AND CUSTOMS CLEARANCE

1.34.1 General

All materials and equipment which are not to be incorporated into the project, such as office trailers, cranes, metal forms, etc., may be shipped free of duty, if the following actions are taken:

1.34.2 Shipments of Materials

All shipments of materials into the country for use in performance of work under this contract and supplies or services necessary for support of the Contractor's personnel shall be addressed to the shipping address furnished to the Contractor by the COR. Address will be furnished upon request by the Contractor.

1.34.3 Contractor's Responsibilities

The Contractor shall be responsible for all customs clearance actions. All necessary arrangements, clearance procedures, and coordination with the Host Government customs, will be the sole responsibility of the Contractor. The Contractor shall submit to the COR, with a cover letter, information copies of the shipping documents for the shipment(s) involved. The Contractor shall submit custom clearance requests a minimum of 45 days prior to the scheduled port arrival date. The Contractor should plan for an additional 30 calendar days for those clearances requests submitted during major holiday periods. As a minimum, the following shall be included as enclosures, with the cover letter to the COR in three (3) copies:

a. Invoice. (Include a copy in Arabic)

b. Bill of Lading.

c. Certificate of Origin.

d. Statement on the cover letter as to Port of Customs Clearance, estimated arrival date, general description of the shipment, quantity and the name of the carrier.

e. Packing list and Customs Waiver Log.

1.34.4 Physical Handling of Materials

The Contractor shall be responsible for performance of all loading, unloading, transportation or other physical handling of materials as may be required, including all movement from carrier unloading site to delivery at the job site and all movement required at the customs area.

1.34.5 Certification

Upon receipt of request of shipping documents, the Construction Management Office Deputy shall issue a letter to the Director of Customs through U.S. Host Nation Coordination Cell certifying that the materials are being brought into Qatar duty-free. The contractor should expect four (4) to six (6) weeks for the processing of the Customs Clearance from the receipt date of the submission.

1.35 BASE SECURITY AND ACCESS REQUIREMENTS

1.35.1 General

The Government of Qatar controls access to the Base by establishing, monitoring, and enforcing its security requirements, which includes granting or denying base access to individuals, materials, and equipment. It shall be the responsibility of the contractor to determine what such restrictions may apply to its workforce and to maintain an adequate workforce to perform the requirements of the contract even as controls or restrictions on installation access change before and during the performance of the contract. The contractor is responsible for all workers granted access pursuant to work under this contract.

The contractor should expect that the Government of Qatar will impose additional screening measures for certain individuals seeking access to the base, based on criteria set forth by the Government of Qatar. The contractor should also anticipate that the Government of Qatar may restrict or prohibit base access for certain individuals seeking access to the base, based on criteria developed and set forth by the Government of Qatar, including nationality and other factors.

The U.S. Government makes no representation as to who will or will not be permitted to access the base. Base access policies and/or restrictions are subject to change, and it will be the responsibility of the contractor to fully investigate and meet those requirements at all times, and to stay apprised of any changes. Any assistance provided by U.S. Government personnel in base access procedures shall not absolve the contractor of the sole responsibility to investigate and meet the base access requirements.

All Contractor, sub-Contractor, or vendor personnel and vehicles working at any location on the Base are subject to a thorough search upon entering, departing, or at any time deemed necessary by Base Security Personnel and USAF Base Security Personnel. The Contractor shall be responsible for compliance with all Base security requirements.

1.35.2 Site Access

The U.S. Government controls access to the project site and may impose controls and restrictions in granting or denying site access to

individuals, materials, and equipment. It shall be the responsibility of the contractor to determine what such restrictions may apply to its workforce and to maintain an adequate workforce in the Qatar and secure installation access for sufficient personnel, materials, and equipment to perform the requirements of the contract even as controls or restrictions on project site access change before and during the performance of the contract. The contractor is responsible for all workers granted access pursuant to work under this contract. Site access policies and/or restrictions are subject to change, and it will be the responsibility of the contractor to fully investigate and meet those requirements at all times, as well as stay apprised of any changes.

1.35.2.1 Defense Biometric Identification System (DBIDS) Processing

The following DBIDS process cannot be started until after the Contractor has obtained their Permanent Base Passes. The Installation Access Application (IAA) (SEE APPENDIX F) is required to be completed for each person wishing to gain access to US controlled areas. The IAA must be submitted in paper form to Resident office (RO) for signatures. The RO will then submit the paperwork to the DBIDS Office. If a complete and current IAA with attachments is not provided, the employee will not be granted base access. Section 1, 2, 3, 4, and 5 of the IAA must be completed by the individual or company. Please ensure that all four pages of the application are submitted. In addition to the information provided on the IAA, each application will need to include copies of both Current Passport and a Current Qatar Residency Visa or Entry Stamp (without these documents the individual will not be allowed base access), as well as a color copy of the Qatar Emirati permanent base pass.

DBIDS Registrations: A completed and signed IAA must be turned in before individual can be registered in DBIDS. Individuals registered in DBIDS are required to depart the installation once completed, not to return before 72 hours.

DBIDS Access Cards: DBIDS Access Cards are issued 72 hours after registration. Cards can be issued for up to 1 year, but expiration dates are directly connected to the expiration dates of the individual's passport, visa and contract. If an updated passport, visa or contract is available, and a card has already been issued then a new application will need to be submitted with updated documents.

1.35.3 Base Access

Base access procedures, including those described below, are subject to change, and it will be the responsibility of the contractor to fully investigate these requirements, and stay apprised of any changes. The contractor is solely responsible for the completeness and accuracy of base access applications and supporting documents. Any assistance provided by U.S. Government personnel in base access procedures shall not absolve the contractor of the sole responsibility to investigate and meet the base access requirements.

Once the permanent base passes have been obtained from the Qatar Government, Contractor entrance for personnel, vehicle and materials deliveries shall be through Gate Number 3, Sunday through Thursday, which is located at the south east side of the base perimeter. The contractor shall provide a packet with the documents and information contained in paragraph 1.33.3.1, for each person for which the contractor will seek base access. These packets shall be sent to the ~~United Arab Emirate Air Force~~

~~and~~ Qatar Centralized Pass & I.D. Office, through the Contracting Officer.

1.35.3.1 Gate Passes

The following applies to any contractor who will require entry on the installation collectively for over three days throughout a calendar year:

a. Permanent Gate Entry (Prime Contractor)

1. Contractor Spreadsheet (Arabic)
2. Gate Pass Letter (English and Arabic)
3. Work Letter (Arabic)
4. Copy Commercial License
5. Copy of contract between USACE and Host Nation Contractor
6. Qatar Armed Forces Background Check Form
7. 2 Hard - Color Copy Passport Photos
8. Clear Color Copy of Passport (Include: Country of Origin, Photo, and Expiration Date Pages)
9. Clear color Copy of Residency Document (NOTE: Ensure it is not expired)
10. Clear Color Copy of Qatar Work/Employment permit for each individual
11. Clear Color Copy of Emirati National ID
12. Clear Color Copy of Driver's License, for those driving vehicles onto the base
13. Emirati Security Declaration Form

b. Permanent Gate Entry (Subcontractor)

1. Subcontractor Spreadsheet (Arabic)
2. Gate Pass Letter (by Subcontractor in English and Arabic)
3. Copy Commercial License (Subcontractor)
4. Subcontract Agreement Letter (Arabic)
5. Work Letter Listing Authorized Subcontractors (by Prime Contractor in Arabic)
6. Copy Commercial License (Prime Contractor)
7. Copy of contract between USACE and Host Nation Contractor
8. Qatar Armed Forces Background Check Form
9. 2 Hard - Color Copy Passport Photos
10. Clear Color Copy of Passport (Include: Country of Origin, Photo, and Expiration Date Pages)
11. Clear color Copy of Residency Document (NOTE: Ensure it is not expired)
12. Clear Color Copy of Qatar Work/Employment permit for each individual
13. Clear Color Copy of Emirati National ID
14. Clear Color Copy of Driver's License, for those driving vehicles onto the base
15. Emirati Security Declaration Form

c. Renewal Procedures for Blue Badges: Same as noted above and as noted below. Plus a copy of the old Blue Badge.

Entry of all labor workers with permanent badges will be through entrance designated by Contracting Officer Sunday through ~~Thursday~~Friday. All companies must adhere to wearing a uniform or coverall that shows the company's name or logo in the front and the back of the uniform. All workers must wear the same color coverall except for the foreman or supervisor which must wear a different color coverall. All who do not abide

by this rule will not be allowed on the base.

1.35.3.2 Base Access and Identification of Vehicles and Equipment

All Contractor vehicles and equipment entering the Base must be listed on the Base Vehicle Access List. The Contractor shall provide this access list to the Base Security Officer, through the Contracting Officer. This access list shall include the type of equipment, make and model, registration number, company name of owner, operator's name and Passport Number. The current access list will be provided to the Base Security Officer, through the Contracting Officer, on a bi-weekly basis. The Contractor shall plan his vehicle and equipment requirements such that the access list will contain all those vehicles and equipment that will need access to the Base for completion of the particular work item being performed. All Contractor vehicles and equipment entering will be subject to a thorough inspection by Base Security personnel, including, as a minimum, a detailed inspection of the vehicle's interior and undercarriage. The Contractor shall be responsible for requiring each vehicle engaged in the work to display permanent vehicular identification as approved and directed by the Contracting Officer. Contractor vehicles operated on Base and the project site shall be maintained in a good state of repair, shall be insured, and shall be registered in accordance with Qatar laws.

1.36 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

1.36.1 General

This provision specifies the procedure for determination of time extensions for unusually severe weather. The listing below defines the monthly anticipated unusually severe weather for the contract period and is based on National Oceanic and Atmospheric Administration (NOAA) for the geographic location of the project. The schedule of anticipated unusually severe weather will constitute the baseline for determining monthly weather time evaluations. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract each month, actual unusually severe weather days will be recorded on a calendar day basis (including weekends and holidays) and compared to the monthly anticipated unusually severe weather in the schedule below. The term "actual unusually severe weather days" shall include days actually impacted by unusually severe weather. The Contractor's schedule must reflect the anticipated unusually severe weather days on all weather dependent activities.

MONTHLY ANTICIPATED UNUSUALLY SEVERE WEATHER CALENDAR DAYS

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2	2	2	1	0	0	0	0	0	0	2	2

1.36.2 Time Extensions

The number of actual unusually severe weather days shall be calculated chronologically from the first to the last day in each month. Unusually severe weather days must prevent work for fifty percent (50%) or more of the Contractor's work day and delay work critical to the timely completion of the project. If the number of actual unusually severe weather days exceeds the number of days anticipated in the paragraph above, the COR will determine whether the Contractor is entitled to a time extension. The COR will convert any qualifying delays to calendar days.

-- End of Section --

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SECTION 01 33 29.05 20

SUSTAINABILITY REPORTING
REVISED BY AMENDMENT NO. 0002

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 189.1	(2014) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) (WHITE HOUSE)

HPSB Guiding Principles	(2016) Guiding Principles for Sustainable Federal Buildings and Determining Compliance with the Guiding Principles for Sustainable Federal Buildings

U.S. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N	(2014; with Change 2) Navy and Marine Corps Design Procedures

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

SNAP	(2016) EPA's Significant New Alternatives Policy Program

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 SUMMARY

This specification includes general requirements and procedures for projects to be designed, constructed, and documented per the federally mandated High Performance and Sustainable Building or "HPSB Guiding Principles" (GP), UFC 1-200-02 High Performance and Sustainable Building Requirements, and other requirements identified in this specification.

The usage and application of this specification shall be based on the

availability of the required sustainability on the local market and the ability of local maintenance personnel to maintain the required systems. The Contractor shall obtain written documentation form the responsible authority stating why sustainability requirement cannot be achieved and submit it to the Contracting Officer for approval.

1.3 SUBMITTALS

Submittals requirements are specified in the technical sections using Submittal Description (SD) numbers and titles. Submittals requiring Government approval use a "G" or submittal designator in the UFGS sections. In addition, submit the GPV-required sustainability documentation in this specification as "S" submittals. Submittals not having a "G" designation are for Contractor Quality Control approval.

Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with the requirements of this Section.

Government approval is required for submittals in RFP Part 2 with a "G" designation Additional construction submittals reserved for Government approval are listed in the Section 01 33 00 SUBMITTAL PROCEDURES. Submittals with a "G" designation found in the sections used by the Contractor to create construction specification, require DOR approval. DOR approved submittals are also listed in the "Construction Submittals" paragraph in each RFP PART 4, Performance Technical Specifications. Provide required certification or validation submittals in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 00 SUBMITTAL PROCEDURES, FC 1-300-09N, Navy and Marine Corps Design Procedures, and as identified below.

SD-01 Preconstruction Submittals

Preliminary High Performance and Sustainable Building Checklist; G M/R

Sustainability Action Plan

Preliminary Sustainability eNotebook; G M/R

SD-05 Design Data

Final Design High Performance and Sustainable Building Checklist; G M

Final Design Sustainability eNotebook; G M

SD-11 Closeout Submittals

Final High Performance and Sustainable Building Checklist; G M/R

Final Sustainability eNotebook; G M/R

Amended Final Sustainability eNotebook; G M/R

Amended Final High Performance and Sustainable Building Checklist; G M/R

1.4 GUIDING PRINCIPLES VALIDATION (GPV)

Provide sustainability documentation to verify achievement of HPSB Guiding Principles Validation (GPV).

Provide the following for GPV:

a. Refer to Attachment 1, HPSB Checklist at the end of this specification section. (Multiple checklists indicate multiple buildings that require HPSB tracking.)

b. Obtain approval of the HPSB Checklist from the Contracting Officer at the Post Award Kick-Off Meetings. Contracting Officer's approval establishes identified HPSB Guiding Principles Requirements as the project's sustainability goals.

   No variations or substitutions to the HPSB Checklist are allowed without written consent from the Contracting Officer. Immediately bring to the attention of the Contracting Officer any project changes that impact meeting the approved HPSB Guiding Principles Requirements for this project and Contractor must demonstrate that change will not incur additional construction cost or increase the life cycle cost.

c. Provide all work, including "S" submittals, required to incorporate the applicable HPSB Guiding Principles Requirements indicated on the HPSB Checklist and in this contract.

d. Provide Sustainable Action Plan.

e. Provide design and construction related documentation for the project Sustainability eNotebook, and keep updated with regularly-scheduled construction meetings. Include design and construction related documentation containing the following components;

   (1) HPSB Checklist

   (2) Sustainability Action Plan

   (3) Documentation illustrating HPSB Guiding Principle Requirements compliance (including "S" submittals)

1.4.1 Sustainability Action Plan

Include the following information in the Sustainability Action Plan;

a. Planned method to achieve each GP requirement.

b. For each designated HPSB Guiding Principles Requirement that is not achieved, provide narrative explaining how mission or activity precludes achieving specific sustainability requirement or goal. Provide analysis of particular requirement and level to which project is able to comply. Final government approved narrative(s) must be included in the HPSB Checklist submittal.

c. Name and contact information for: Contractor's POC ensuring sustainability goals are accomplished and documentation is assembled.

d. Include the Indoor Air Quality plan with the Sustainability Action Plan.

1.4.2 Costs

Bear all costs associated with designing, constructing and demonstrating that project complies with approved HPSB Guiding Principles Requirements.

1.4.3 Calculations

Provide all design data, calculations, product data, labels and certifications required in this specification to demonstrate compliance with the HPSB Guiding Principles Requirements.

1.5 SUSTAINABILITY SUBMITTALS

Provide updated HPSB Checklist and other documentation in the Sustainability eNotebook to indicate compliance with the sustainability requirements of the project.

1.5.1 High Performance Sustainable Building (HPSB) Checklist

Provide documentation that provides proof of and supports compliance with the completed HPSB Checklist. Prepopulated HPSB checklist may be obtained from the Government Project Manager.

1.5.1.1 HPSB Checklist Submittals

Submit updated HPSB Checklist with each Sustainability eNotebook submittal. Attach final HPSB Checklist to draft final DD1354 Real Property Record Submittal.

1.5.2 "S" Submittals for Sustainability Documentation

Submit the GPV sustainability documentation required in this specification as "S" submittals in all affected UFGS Sections. Highlight GPV compliance data in "S" submittal.

1.5.3 Sustainability eNotebook

Prepare and maintain a comprehensive Sustainability eNotebook to document compliance with the sustainability requirements identified in the approved HPSB Checklist. Sustainability eNotebook must contain all required data to support full compliance with the HPSB Guiding Principles Requirements, including HPSB checklist, Sustainable Action Plan, calculations, labels, certifications. Sustainability eNotebook is in the form of an Adobe PDF file; bookmarked at each HPSB Guiding Principles Requirement and sub-bookmarked at each document. Match format to HPSB Guiding Principles numbering system indicated herein. Maintain up to date information, spreadsheets, templates, etc. with each current submittals.

Contracting Officer may deduct from the monthly progress payment accordingly if Sustainability eNotebook information is not current, until information is updated and on track per project goals.

1.5.3.1 Sustainability eNotebook Submittal Schedule

Provide Sustainability eNotebook Submittals at the following milestones of the project:

a. Preliminary Sustainability eNotebook

Submit preliminary Sustainability eNotebook for approval at the Pre-construction conference. Include Preliminary High Performance and Sustainable Building Checklist.

b. Final Design Sustainability eNotebook

Submit updated Sustainability eNotebook no later than 60 days after final design complete submission. Identify any outstanding issues in writing, relating to achieving the sustainability goals of the project and incomplete documentation requirements. Obtain DOR approval and submit two (2) electronic copies of the Final Design Sustainability eNotebook on DVDs to the Government. Include Final Design High Performance and Sustainable Building Checklist.

c. Construction Progress Meetings.

Update GP documentation in the Sustainability eNotebook for each meeting.

d. Final Sustainability eNotebook

Submit updated Sustainability eNotebook at Beneficial Occupancy Date (BOD). Final progress payment retainage may be held by Contracting Officer until Final Sustainability construction phase documentation is complete. Obtain DOR approval and submit two (2) electronic copies of the Final Sustainability eNotebook on DVDs to the Government. Include Final High Performance and Sustainable Building Checklist.

e. Amended Final Sustainability eNotebook

Amend and resubmit the Amended Final Sustainability eNotebook to include post-occupancy corrections, updates, and requirements. Include Amended Final High Performance and Sustainable Building Checklist. Final progress payment retainage may be held by Contracting Officer until amended final sustainability documentation is complete. Submit two (2) final electronic copies of the Amended Final Sustainability eNotebook Submittal on DVDs to the Government no longer than 30 days after the GP designated data collection period.

1.6 DOCUMENTATION REQUIREMENTS

a. Incorporate each of the following HPSB Guiding Principles requirements into project and provide documentation that proves compliance with each listed requirement. Items below are organized by HPSB Guiding Principles. For life-cycle cost analysis requirements, one document with all analyses is acceptable, with Contracting Officer approval.

b. For each of the following paragraphs that require the use of products listed on Government-required websites, provide documentation of the process used to select products, or process used to determine why listed products do not meet project performance requirements.

1.6.1 Integrated Design Process

For the submittal documentation below, Follow the steps of design optimization, as applicable, in ASHRAE 189.1 Section F1.1.1 (Charrette Process), with the exception that subparagraph b. does not apply.

1.6.1.1 Design Submittal Documentation

a. Provide listing the sustainability integrated design team, and a description of their roles in all stages of a project's planning and delivery:

(1) Include Contractor's Sustainability Coordinators; Architecture and Engineering disciplines involved on the project, and the DOR in charge of the overall project and each discipline; Construction Subcontractors and the company representatives that align with each architectural and engineering discipline, Planning, Public Works, Environmental Specialist and other appropriate installation personnel.

(2) Describe their roles and responsibilities and plan-of-action for how each team member will be involved to achieve the project sustainability requirements, and how the Contractor will coordinate with Government personnel.

(3) Maintain the list and descriptions up-to-date throughout the project.

b. Provide narratives that:

(1) Indicate performance goals for siting, energy, water, materials, and indoor environmental quality along with other comprehensive design goals and ensures incorporation of these goals throughout the design and lifecycle of the building.

(2) Demonstrate integration of the goals into design and construction.

(3) Demonstrate collaboration with other providers, such as Commissioning Authority.

~~1.6.2 Optimize Energy Performance~~

~~For Commercial and Multi-Family High-Rise Residential Buildings, meet the requirements of ASHRAE 90.1 - SI, and achieve at least 30 percent energy efficiency below baseline, when life cycle cost effective.~~

~~If none of the reduction choices is life-cycle cost-effective, modify the design of the proposed building system(s) to achieve an energy consumption level at the highest level of energy efficiency that is life-cycle cost-effective.~~

~~1.6.2.1 Design Submittal Documentation~~

~~a. Narrative that provides a summary of:~~

~~(1) The decision making process leading to the selection of at least three energy-efficient solutions (for each individual building energy system) to be analyzed; and the selected design solution(s)~~

~~(2) The specific energy standard and version utilized; and the software used in the analysis~~

~~(3) The calculated energy consumption and energy use intensity (EUI in kBTU/sf/yr) of the baseline building and the proposed design alternatives~~

~~b. A minimum of the following energy modeling files and summaries for the baseline and proposed alternatives:~~

~~(1) Input, schedules and libraries; and output~~

~~(2) Calculated energy use by energy type~~

~~(3) Calculated energy use by building system~~

~~c. The life-cycle cost-analysis input and out files for the baseline and the proposed alternatives~~

~~1.6.2.2 Construction Submittal Documentation~~

~~Provide revised energy modeling for actual system constructed.~~

1.6.2 Energy Efficient Products

Provide only energy-using products that are Energy Star rated, or have Federal Energy Management Program (FEMP) recommended efficiency. Where Energy Star or FEMP recommendations have not been established, provide most efficient product available. Provide only energy using product that meets FEMP requirements for low standby power consumption. Energy efficient products can be found at: http://www1.eere.energy.gov/femp/ and http://www.energystar.gov/.

For construction submittal documentation, provide proof that product is labeled energy efficient and complies with the cited requirements.

1.6.3 Indoor Water Use

a. Meet the requirements of ASHRAE 189.1 Section 6.3.2 (Building Water Use Reduction), which incorporates USEPA WaterSense-labeled products. Water closet replacements in renovations may have a flush value of up to 1.6 GPF (6.1 LPF) to accommodate existing plumbing capacity.

b. Meet the requirements of ASHRAE 189.1 Section 6.4.2 (Building Water Use Reduction).

c. Meet the requirements of ASHRAE 189.1 Section 6.4.3 (Special Water Features).

1.6.3.1 Construction Submittal Documentation

Provide proof that fixtures are labeled EPA WaterSense or Energy Star, for products available with EPA WaterSense or Energy Star labeling; for all other fixtures, proof they comply with the cited efficiency requirements.

1.6.4 Outdoor Water Use

Potable water use is prohibited for irrigating new landscaping, other than for plant establishment. When non-potable water is life cycle cost effective and is used for new, permanent irrigation, provide the following:

1.6.5 Alternative Water

Use alternative sources of water to replace potable water usage, when life-cycle cost effective and to the extent permitted by local laws and

regulations.

1.6.5.1 Design Submittal Documentation

a. Provide design drawings and calculations that demonstrate the alternative water sources used, potable water savings as compared to non-alternative water sourcing, and projected annual potable water savings.

b. Provide life cycle cost analysis (LCCA).

1.6.6 Ventilation and Thermal Comfort

Meet the requirements of UFC 3-410-01.

1.6.6.1 Design Submittal Documentation

a. Provide design drawings and calculations that demonstrate HVAC systems and the building envelope have been designed to meet the requirements.

1.6.7 Moisture Control

Meet the requirements of ASHRAE 189.1 Section 10.3.1.5 (Moisture Control), UFC 3-410-01, Chapter 3, Sections 3-2 and 3-3 (Ventilation Air), and UFC 3-101-01 Chapter 3 (Building Envelope Requirements).

1.6.7.1 Design Submittal Documentation

a. Provide drawings of building envelope details and HVAC humidity controls.

b. Provide plan for construction material storage and protection, humidity controls during construction, and operation and maintenance plan for ongoing building moisture control.

1.6.8 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)

Meet the requirements of Table 3-1 at the end of this specification.

For Construction submittal documentation, provide certifications or labels that demonstrate compliance with cited requirements, based on the attached TABLE 3-1.

1.6.9 Indoor Air Quality During Construction

Prior to construction, create indoor air quality plan. Develop and implement an IAQ construction management plan during construction and flush building air before occupancy.

For new construction and for renovation of unoccupied existing buildings, meet the requirements of ASHRAE 189.1 Section 10.3.1.4 (Indoor Air Quality (IAQ) Construction Management), with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent.

Provide documentation showing that after construction ends and prior to occupancy, HVAC filters were replaced and building air was flushed out in accordance with the cited standard.

1.6.10 Recycled Content

Comply with 40 CFR 247. Refer to: https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program for assistance identifying products cited in 40 CFR 247. Selected products must comply with non-proprietary requirements of the Federal Acquisition Regulation, and must meet performance requirements.

1.6.10.1 Construction Submittal Documentation

a. Provide manufacturers' documents stating the recycled content by material, or written justification for claiming one of the exceptions allowed on the cited website.

b. Substitutions: Submit for Government approval for proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. For all such proposed substitutions, submit with the Sustainability Action Plan accompanied by product data demonstrating equivalence.

1.6.11 Ozone Depleting Substances

Meet the requirements of ASHRAE 189.1 Section 9.3.3 Refrigerants for no CFC-based refrigerants in heating ventilation, air conditioning and refrigeration systems (except for fire suppression system requirements, covered elsewhere in this specification). Use products from U.S. EPA Significant New Alternatives Policy (SNAP) (http://www.epa.gov/snap) or meet the criteria of SNAP. R-22 refrigerant is not permitted.

1.6.11.1 Construction Submittal Documentation

a. Provide SDS sheets for all refrigerants.

b. Provide label for each product meeting the cited standards.

1.6.12 Waste Material Management (Recycling – Design)

Meet the requirements of ASHRAE 189.1 Section 9.3.4.1 (Storage and Collection of Recyclables – Recyclables), where markets or onsite recycling exist.

For design submittal documentation, provide drawing showing an appropriately sized and placed storage area has been dedicated for recyclables.

1.6.13 Waste Material Management (Recycling – Construction)

Divert construction debris from landfill disposal where markets or on-site recycling exists.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 SUSTAINABILITY COORDINATION

3.1.1 Coordinating Sustainability Documentation Progress

Provide sustainability focus and coordination at the following meetings to achieve sustainability goals. In addition to requirement below, the following meetings requirements are further described in other parts of the RFP documents. The designated sustainability professional responsible for GP documentation must participate in these meetings to coordinate documentation completion.

3.1.1.1 Construction Progress Meetings

Review GP sustainability requirements with project team including contractor and sub-contractor representatives. Demonstrate HPSB Checklist documentation is being collected and updated to the Sustainability eNotebook.

a. Facility Turnover Meetings: Refer to Section 01 30 00 ADMINISTRATIVE REQUIREMENTS for further requirements. Review HPSB Checklist, Sustainability eNotebook for completeness and identify any outstanding issues relating to final documentation requirements.

b. Final Sustainability eNotebook Review

3.2 TABLE 3-1 VOLATILE ORGANIC COMPOUNDS (VOC) (LOW EMITTING MATERIALS) REQUIREMENTS

Refer to following table for compliance criteria for paragraph titled "Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)", based on ASHRAE 189.1 section 8.4.2 (Materials).

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

UFGS 01 33 29.05 20, Paragraph "Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)" Submittal Requirements (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	MATERIAL CATEGORY
Adhesives and Sealants	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	Adhesives (carpet, resilient, wood flooring; panel; primers) Sealants (acoustical; firestop; HVAC Air duct; primers) Caulks	**SCAQMD Rule 1168** (Use "other" category for HVAC duct sealant) (for firestop adhesive, UFC 3-600-01 overrides conflicting requirements)
			Aerosol adhesives	**Section 3 of Green Seal Standard GS-36** (except: cleaners, solvent cements, and primers used with plastic piping and conduit in plumbing, fire suppression, and electrical systems; HVAC air duct sealants when the application space air temp is less than 40 F (4.5 C).
Paints and Coatings	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	Flat and nonflat topcoats, primers, undercoaters, and anti-corrosive coatings	**Green Seal Standard GS-11**

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

UFGS 01 33 29.05 20, Paragraph "Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)" Submittal Requirements (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	MATERIAL CATEGORY
Paints and Coatings	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	Concrete/masonry sealers (waterproofing concrete/masonry sealers), concrete curing compounds, dry fog coatings, faux finishing coatings, fire resistive coatings, floor coatings, graphic arts (sign) coatings, industrial maintenance coatings, mastic texture coatings, metallic pigmented coatings, multicolor coatings, pretreatment wash primers, reactive penetrating sealers, recycled coatings, shellacs (clear and opaque), specialty primers, stains, wood coatings (clear wood finishes), wood preservatives, and zinc primers	**California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings** or **SCAQMD Rule 1113**

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

UFGS 01 33 29.05 20, Paragraph "Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)" Submittal Requirements (Interior Applications Only)

MATERIAL CATEGORY	**EMISSIONS REQUIREMENT**		**MATERIALS WITH ADDED VOC REQUIREMENT**	**MATERIAL CATEGORY**
Paints and Coatings	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	Basement specialty coatings, high-temperature coatings, low solids coatings, stone consolidants, swimming-pool coatings, tub- and tile-refining coatings, and waterproofing membranes	**California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings**
Floor Covering Materials	For carpet, all locations: **CDPH/EHLB/Standard Method V1.1 (California Section 01350)** or label for **Section 9** of **CDPH/EHLB/Standard Method V1.1 (California Section 01350)**		none	none

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

UFGS 01 33 29.05 20, Paragraph "Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)" Submittal Requirements (Interior Applications Only)

MATERIAL CATEGORY	**EMISSIONS REQUIREMENT**		**MATERIALS WITH ADDED VOC REQUIREMENT**	**MATERIAL CATEGORY**
Composite Wood, Wood Structural Panel, and Agrifiber Products particleboard medium density fiberboard (MDF) wheatboard strawboard panel substrates door cores **no added urea-formaldehyde resins** including laminating adhesives for composite wood and agrifiber assemblies	Third-party certification (approved by CARB) of **California Air Resource Board's (CARB) regulation**, Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products		none	none
	CDPH/EHLB/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications) (except: Structural panel components such as plywood, particle board, wafer board, and oriented strand board identified as "EXPOSURE 1," "EXTERIOR," or "HUD-APPROVED" are considered acceptable for interior use.)			

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

UFGS 01 33 29.05 20, Paragraph "Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)" Submittal Requirements (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	MATERIAL CATEGORY
Ceiling and Wall Systems ceiling and wall insulation acoustical ceiling panels tackable wall panels gypsum wall board and panels wall coverings	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)		none	none

-- End of Section --

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING (HDPE) ADDED BY AMENDMENT NO. 0002

-- End of Section Table of Contents --

SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING (HDPE)
ADDED BY AMENDMENT NO. 0002

PART 1 GENERAL

1.1 REFERENCES

The referenced publications listed below and indicated within the body of this specification constitute a compilation of internationally recognized standards. Contractor is responsible to comply with the most stringent requirement or standard specified herein as well as adhering to all requirements of QCS 2014. If a conflict is identified, contractor shall generate a Request for Information (RFI) complete with suggested / recommended course of action for approval by the Contracting Officer prior to commencement of work or procurement of products. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D1505	(2010) Density of Plastics by the Density-Gradient Technique
ASTM D1004	(2013) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D1603	(2014) Carbon Black Content in Olefin Plastics
ASTM D3895	(2014) Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D4218	(1996; R 2008) Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM D4833/D4833M	(2007; E 2013; R 2013) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D5199	(2012) Measuring Nominal Thickness of Geosynthetics
ASTM D5397	(2007; R 2012) Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

ASTM D5596	(2003; R 2009) Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
ASTM D5721	(2008; R 2013) Air-Oven Aging of Polyolefin Geomembranes
ASTM D5885/D5885M	(2015) Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D6392	(2012) Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
ASTM D6693/D6693M	(2004; R 2015; E 2015) Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
ASTM D7238	(2006; R 2012) Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus

STATE OF QATAR

QCS 2014	Qatar Construction Specifications 2014

Internationally recognized standards that meet the requirements of the specified standards can be used.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

High Density Polyethylene (HDPE) Membrane; G M

Primers, adhesives, and mastics; G M

Sealant; G M

SD-04 Samples

Materials

Submit material samples showing resolution of corner and field conditions.

SD-06 Test Reports

High Density Polyethylene (HDPE) Membrane

Certify compliance with performance requirements specified herein.

Field Quality Control

Verification Of Conditions

Protective Covering

SD-08 Manufacturer's Instructions

Primers, adhesives, and mastics

Submit Manufacturer's material safety data sheets for primers, adhesives and mastics.

Provide documentation confirming that the international standards used by the manufacturer meet the specified standards indicated in the contract documents.

1.3 QUALITY ASSURANCE

1.3.1 Shop Drawing Requirements

Include description and physical properties; termination details; application details; recommendations regarding shelf life, application procedures; requirements for protective covering; and precautions for flammability and toxicity.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Do not permit uncertified materials in the work area.

1.5 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing during inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive waterproofing and when ambient and surface temperatures are 4 degrees C or below. The restriction on the application of waterproofing materials when ambient and surface temperatures are below 4 degrees C will be waived if the Contractor devises a means, approved by the Contracting Officer, of maintaining the surface and ambient temperatures above 4 degrees C.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Refer to QCS for sustainability requirements.

2.2 MATERIALS

Provide one of the types of HIGH DENSITY POLYETHYLENE (HDPE) MEMBRANE and related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials within a specific type, with each other, and with the materials on which they will be applied. Materials shall conform to the applicable performance requirements cited below when tested in accordance with the referenced ASTM publications.

2.3 HIGH DENSITY POLYETHYLENE (HDPE) MEMBRANE

Polyvinyl chloride (PVC) flexible sheets with non-woven fiberglass reinforcing not less than 1.5 mm minimum thickness.

2.3.1 HDPE Membrane Performance Requirements

Provide non-reinforced smooth elastomeric liner of unreinforced high density polyethylene (HDPE), manufactured as wide as possible to minimize factory and field seams. Geomembrane sheets must be uniform in color, thickness, and surface texture. The sheets must be free of and resistant to fungal or bacterial attack and free of cuts, abrasions, holes, blisters, contaminants and other imperfections. Provide liner meeting the physical properties of Table 2.

Make resin used in manufacturing HDPE sheets of virgin uncontaminated ingredients. Use no more than 10 percent regrind, reworked, or trim material in the form of chips or edge strips to manufacture the geomembrane sheets. All regrind, reworked, or trim materials must be from the same manufacturer and exactly the same formulation as the geomembrane sheet being produced. Do not use post consumer materials or water-soluble ingredients to produce the geomembrane. For geomembranes with plasticizers, use only primary plasticizers that are resistant to migration. Submit a copy of the test reports and QC certificates for materials used in the manufacturing of the geomembrane shipped to the site.

TABLE 2 - SMOOTH HDPE GEOMEMBRANE PRP(ENGLISH)

PROPERTY	TEST VALUE	TEST METHOD
Thickness (min ave)	60 mils	ASTM D5199
Lowest individual of 10 values	-10 percent	ASTM D5199
Density (min)	0.940 g/cc	ASTM D1505
Tensile Properties(1)(min ave)		ASTM D6693/D6693M
Yield Strength	22 kN/m	
Break Strength	40 kN/m	
Yield Elongation	12 percent	
Break Elongation	700 percent	
Tear Resistance (min ave)	187 N	ASTM D1004
Puncture Resistance(min ave)	480 N	ASTM D4833/D4833M
Stress Crack Resistance (2)	300 hr	ASTM D5397

TABLE 2 - SMOOTH HDPE GEOMEMBRANE PRP(ENGLISH)		
PROPERTY	TEST VALUE	TEST METHOD
Carbon Black Content	2.0-3.0 percent	ASTM D1603 (3)
Carbon Black Dispersion	Note (4)	ASTM D5596
Oxidative Induction Time (OIT)	(min ave)(5)	
Std OIT	100 min	ASTM D3895
High Pres OIT	400 min	ASTM D5885/D5885M
Oven Aging at	(min ave) (5),(6)	ASTM D5721
Std OIT	55 percent at 90 days	ASTM D3895
or High Pres OIT	80 percent at 90 days	ASTM D5885/D5885M
UV Resistance	(min ave) (7)	ASTM D7238
High Pres OIT(8)(9)	50 percent @ 1600 hrs	ASTM D5885/D5885M
Seam Shear Strength (min) Hot Wedge, Hot Air, Ultrasonic, Extrusion Fillet (10)(12)	525 N/25mm	ASTM D6392
Seam Peel Strength (min) Hot Wedge, Hot Air, Ultrasonic (10)(11)(12)	398 N/25mm	ASTM D6392
Seam Peel Strength (min) Extrusion Fillet (10)(11)(12)	340 N/25mm	ASTM D6392

(1) Base minimum average machine direction and minimum average cross machine direction values on 5 test specimens in each direction. For HDPE geomembrane, yield elongation is calculated using a gauge length of 33 mm. For HDPE geomembrane, break elongation is calculated using a gauge length of 50 mm.

(2) For HDPE geomembrane, use the manufacturer's mean value yield stress used to calculate the applied load for test method ASTM D5397 (Appendix).

(3) Other methods such as ASTM D4218 or microwave methods are acceptable if an appropriate correlation to ASTM D1603 can be established.

(4) Carbon black dispersion for 10 different views:
- minimum 8 of 10 in Categories 1 or 2
- all 10 in Categories 1,2, or 3

(5) The manufacturer has the option to select either one of the OIT methods to evaluate the antioxidant content.

TABLE 2 - SMOOTH HDPE GEOMEMBRANE PRP(ENGLISH)		
PROPERTY	TEST VALUE	TEST METHOD
(6) Evaluate samples at 30 and 60 days and compare with the 90 day response.		
(7) The condition of the test must be a 20 hour UV cycle at 75 degrees C followed by a 4 hour condensation cycle at 60 degrees C.		
(8) Do not use the standard OIT test (ASTM D3895) in determining UV resistance.		
(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.		
(10) Seam tests for peel and shear must fail in the Film Tear Bond mode. This is a failure in the ductile mode of one of the bonded sheets by tearing or breaking prior to complete separation of the bonded area.		
(11) Where applicable, test both tracks of a double hot wedge seam for peel adhesion.		
(12) For five samples tested, four must meet or exceed the given value, with the fifth within 80 percent of the given value.		

Adhesives

a. Adhesive for HDPE membrane as recommended by manufacturer for the location and application indicated.

2.3.2 Accessories

Securement Strip: 1.90 mm stainless steel metal bar 2.54 cm wide, pre-punched 2.54 cm on center for securement.

2.4 COMPOSITE, SELF-ADHERING MEMBRANE SHEETING

Cold applied composite sheet consisting of rubberized asphalt and cross laminated, high density polyethylene film. Not less than 1.5 mm minimum thickness is required.

2.5 Primer

Asphalt composition, ASTM D41/D41M, or synthetic polymer in solvent as recommended by the membrane manufacturer.

2.6 Mastic

Polymer modified asphalt in suitable solvent of trowel-grade consistency and as recommended by the membrane manufacturer.

2.7 Sealant

Use sealant conforming to ASTM C920, Type S, Grade NS, Class 25 or better, or ASTM D5893/D5893M, Type NS, or other sealant recommended by the

geomembrane manufacturer. Sealant used must be compatible with the material being stored, as recommended by the sealant manufacturer.

PART 3 EXECUTION

3.1 GENERAL

In addition to the specific execution requirement contained herein, the execution of all work performed under the direction of this specification section shall also adhere to the technical guidance in connection with the execution of constructions in the State of Qatar as contained within the Qatar Construction Specifications 2014 (QCS 2014).

3.2 VERIFICATION OF CONDITIONS

Before starting the work, verify that surfaces to be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions that will prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.3 SURFACE PREPARATION

Ensure surfaces to be treated are clean, dry, smooth, and free from deleterious materials and projections. Thoroughly wet holes, joints, cracks, and voids in concrete with water and fill with Portland cement mortar, strike flush, and permit to dry. Cut off high spots or grind smooth. Finish top surfaces of projecting masonry or concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to be covered before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

3.4 APPLICATION

Follow manufacturer's printed installation instructions. Where indicated, adhere continuous cant strips of a high density hydrophobic material recommended by the HDPE liner manufacturer in place at vertical and horizontal corners before installing the waterproofing membrane. Do not use untreated wood or wood fiber cants. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor. Provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces as indicated and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

a. Non-Self-Adhering Membrane: Unroll membrane and allow to remain flat for at least one-half hour before application. Apply an asphalt concrete primer prior to application of asphaltic adhesive. Where solvent adhesive is applied, allow major portion of solvent to evaporate so that bonding adhesive does not stick to a dry finger touching it. Apply elastomeric waterproofing membrane in a full bed of adhesive at a uniform coverage rate in accordance with the recommendations in the membrane manufacturer's printed instructions. Pull membrane tight without stretching. As soon as adhesive is fully set and dry, recheck lap splices. Where openings or fishmouths appear, reseal and reroll lap splices.

b. Self-Adhering Membrane: Apply composite, self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with membrane manufacturer's printed instructions. Remove release sheet and apply

with tacky surface in contact with dried primer.

c. Protection: Protect membrane over horizontal surfaces from abnormal traffic during installation. Use only equipment with rubber tires. Provide walkway protection where traffic from other trades is expected. Do not store material on membrane.

3.5 FLASHING

Provide metal reglets to receive exposed edges of membrane waterproofing. Secure membrane into reglets as recommended by manufacturer of the HDPE membrane waterproofing materials. Counterflash upper edge of membrane waterproofing as detailed.

3.6 FIELD QUALITY CONTROL

Notify the Contracting Officer one day prior to date of performing tests. Before concealment, cover elastomeric waterproofing on horizontal surfaces over finished spaces with 100 mm of ponded water for 24 hours. Do not add water after start of 24 hour period. Carefully measure water level at beginning and end of 24 hour period. If water level falls, remove water and inspect waterproofing membrane. Make repairs or replacement as directed, and repeat test.

3.7 PROTECTIVE COVERING

After installation has been inspected and approved by the Contracting Officer, provide temporary railings or otherwise cover the opening to prevent other trades from damaging the membrane until permanent grating is installed provide temporary protection to not damage the membrane during the installation of the metal grating.

-- End of Section --

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DIVISION 22 - PLUMBING

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE REVISED BY AMENDMENT NO. 0002

-- End of Section Table of Contents --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE REVISED BY AMENDMENT NO. 0002

PART 1 GENERAL

1.1 REFERENCES

The referenced publications listed below and indicated within the body of this specification constitute a compilation of internationally recognized standards. Contractor is responsible to comply with the most stringent requirement or standard specified herein. If a conflict is identified, contractor shall generate a Request for Information (RFI) complete with suggested / recommended course of action for approval by the Contracting Officer prior to commencement of work or procurement of products. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4	(2015) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 189.1	(2014) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2016) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1003	(2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire

	Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1019	(2011) Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type (ANSI Approved 2004)
ASSE 1020	(2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2005) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(2010; Addenda 2011) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C153/A21.53	(2011) Ductile-Iron Compact Fittings for Water Service
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2015) Grooved and Shouldered Joints
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C652	(2011) Disinfection of Water-Storage Facilities

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(2012; R 2017) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.14.1	(2003; R 2017) Backwater Valves
ASME A112.19.1/CSA B45.2	(2013) Enameled Cast Iron and Enameled Steel Plumbing Fixtures
ASME A112.19.2/CSA B45.1	(2013) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.36.2M	(1991; R 2017) Cleanouts

ASME A112.6.1M	(1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2016) Standard for Floor and Trench Drains
ASME B1.20.1	(2013) Pipe Threads, General Purpose (Inch)
ASME B16.15	(2013) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.29	(2012) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2014) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.1	(2016; Errata 2016) Power Piping
ASME B31.5	(2016) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2010) BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	(2014) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A193/A193M	(2016) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2010) Standard Specification for Pressure

	Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A733	(2013) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A74	(2017) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A888	(2013a) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B306	(2013) Standard Specification for Copper Drainage Tube (DWV)
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B370	(2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B42	(2015a) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B828	(2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B88	(2016) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2018) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C564	(2014) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D2000	(2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications

ASTM D2239	(2012) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2683	(2014) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2737	(2012a) Polyethylene (PE) Plastic Tubing
ASTM D2822/D2822M	(2005; E 2011; R 2011) Asphalt Roof Cement
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3035	(2015) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3138	(2004; R 2011) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D3139	(1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3261	(2012; E 2014) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3311	(2011) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F409	(2012) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F477	(2014) Standard Specification for

	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2009) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2011) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(2010) Copper Tube Handbook

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2009) Accessible and Usable Buildings and Facilities
ICC IPC	(2015) International Plumbing Code

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60529	(2013-08) Degrees Of Protection Provided By Enclosures (IP Code)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(2013) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993; Reaffirmed 2010) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2011) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2011; Errata 2013) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (2013) Bronze Gate, Globe, Angle and Check Valves

MSS SP-83 (2014) Class 3000 Steel Pipe Unions Socket Welding and Threaded

MSS SP-85 (2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends

NACE INTERNATIONAL (NACE)

NACE SP0169 (2015) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2016; SUPP 2016) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2018) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF/ANSI 14 (2016) Plastics Piping System Components and Related Materials

NSF/ANSI 61 (2016) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man (2010) Firestopping: Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430 Energy Conservation Program for Consumer Products

40 CFR 141.80 National Primary Drinking Water Regulations; Control of Lead and Copper;

	General Requirements
PL 109-58	Energy Policy Act of 2005 (EPAct05)

EUROPEAN STANDARDS (EN)

BS EN 1329-1	Plastics piping systems for soil and waste discharge (low and high temerature) within the building structure. Unplasticized poly(vinyl choride) (PVC-U). Specifications for pipes, fittings and the system

BRITISH STANDARDS INSTITUTE (BSI)

BS 1010	(1973) Specification for draw-off taps and stopvalves for water services (screw-down pattern). Draw-off taps and above-ground stopvalves
BS 1212	(2016) Float operated valves. Specification for compact type float operated valves for WC flushing cisterns (including floats)
BS 1244	Metal Sinks for Domestic Purposes
BS 1394	Stationary Circulation Pumps for Heating and Hot Water Service Systems
BS 1968	(1953) Specification for floats for ballvalves (copper)
BS 2456	(1990) Specification for floats (plastics) for float operated valves for cold water services
BS 2580	(1979) Specification for underground plug cocks for cold water services
BS 2879	Specification for draining taps (screw-down pattern)
BS 3599	Specification for Electric Controls for Household and Similar General Purposes
BS 4514	Unplastized PVC soil and Ventilation Pipes, Fittings and Accessories
BS 5412	(1996) Specification for low-resistance single taps and combination tap assemblies (nominal size ½ and ¾) suitable for operation at PN 10 max. and a minimum flow pressure of 0.01 MPa (0.1 bar)
BS 5413	(1976) Specification for the performance of draw-off taps with metal bodies for water services. Hydraulic characteristics

BS 5433	(1976) Specification for underground stopvalves for water services
BS 6282-1	Specification for Check Valves of Nominal Size Up To and Including DN 54Covers Check V 1982 EDITION
BS 6282-2	Specification for Terminal Anti-Vacuum Valves of Nominal Size Up To and Including DN 5 1982 EDITION
BS 6282-3	Specification for In-Line Anti-Vacuum Valves of Nominal Sizeup To and Including DN 42F
BS 6282-4	Specification for Combined Check and Anti-Vacuum Valves of Nominal Size Up To and Incl 1982 EDITION
BS 6700	(Replaced by: 2006 BS EN 806-2:2005, BS EN 806-1:2000, BS EN 806-3:2006, BS EN 806-5:2012,BS EN 806-4:2010, BS 8558:2011) Design, installation, testing and maintenance of services suppling water for domestic use within buildings and their curtilages Specification

Internationally recognized standards that meet the requirements of the specified standards can be used.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G M

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets; G M

Flush Valve Urinals; G M

Undercounter Lavatories; G M

Kitchen Sinks; G M

Precast Terrazzo Mop Sinks; G M

Water Storage Tanks; G M

Water Heaters; G M

Pumps; G M

Backflow Prevention Assemblies; G M

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; G M

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G M

Certification of proper operation shall be as accomplished in accordance with State regulations by an individual certified by the State to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

SD-10 Operation and Maintenance Data

Plumbing System; G R

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Provide documentation confirming that the international standards used by the manufacturer meet the specified standards indicated in the contract documents.

1.3 RELATED REQUIREMENTS

Refer to Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS and 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS for additional requirements.

1.4 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6 PERFORMANCE REQUIREMENTS

1.6.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05 12 00 STRUCTURAL STEEL.

1.7 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - SI.

1.8 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify

dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.9 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.10 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Plumbing fixtures shall be water conservation type as outlined in this section.

2.1.1 Water-Efficient Products

Provide documentation that the following products meet water efficiency requirements as outlined in this section:

a. Fixtures
b. Flush valve water closets
c. Flush valve urinals
d. Countertop lavatories
e. Kitchen sinks

2.2 Materials

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as lavatory faucets, kitchen and pantry faucets, supply

stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.

2.2.1 Pipe Joint Materials

Hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310

b. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

c. Solder Material: Solder metal shall conform to ASTM B32.

d. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

e. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

f. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564k. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 110 degrees C.

g. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.

h. Solvent Cement for Transition Joints between PVC Nonpressure Piping Components: ASTM D3138.

i. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

j. Plastic Solvent Cement for PVC-U Plastic Pipe: BS EN 1329-1.

k. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

l. Copper tubing shall conform to ASTM B88M, Type L.

2.2.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.

b. Copper, Sheet and Strip for Building Construction: ASTM B370.

c. Asphalt Roof Cement: ASTM D2822/D2822M.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

l. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.2.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.3 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

2.4 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78

Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4
Draw-off Taps, Metal bodies	Relevant provisions BS 5412, Parts 1-5
Draw-off Taps, Plastic bodies	Relevant provisions BS 5413, Parts 1-5
Drain Taps	Relevant provisions BS 2879
Ball Float Valves	BS 1212 Part 2 or 3. Float complying with BS 1968 or BS 2456
Stopvalves, Aboveground 50 mm and smaller	Relevant provisions BS 6700; BS 1010:Part 2; BS 2580; BS 5433

2.4.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 20 mm male inlet threads, hexagon shoulder, and 20 mm hose connection. Faucet handle shall be securely attached to stem.

2.4.2 Wall Hydrants

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 20 mm exposed hose thread on spout and 20 mm male pipe thread on inlet. Stainless steel box and hinged cover with operating key lock and "WATER" stamped on cover.

2.4.3 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 59 kW shall have 20 mm minimum inlets, and 20 mm outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW shall have 25 mm minimum inlets, and 25 mm outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.4.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C of any setting.

Provide thermostatic mixing valve for hot water distribution system supplied from storage type water heaters. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C of any setting.

2.5 FIXTURES

Fixtures shall be water conservation type, in accordance with ASHRAE 189.1 Section 6.3.2.1 (Plumbing fixtures and Fittings). Water closet replacements in major renovations may have a flush valve of up to 6.1 LPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle

bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush valves and flushometer valves shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 82 degrees C water temperature.

2.5.1 Lavatories

Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.

2.5.2 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 356 to 381 mm, except 432 to 483 mm for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat.

Water flushing volume of the water closet and flush valve combination shall not exceed 4.8 liters per flush.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 279 mm above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.

2.5.3 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 430 mm above the floor. Provide urinal with the rim 610 mm above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 1.9 liters per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 279 mm above the fixture.

2.5.4 Undercounter Lavatories

Solid surface, self-rimming, under counter mount, minimum dimensions of 460 mm wide by 380 mm front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Water flow rate shall not exceed 1.9 L per minute when measured at a flowing water pressure of 414 kPa. Mount counter with the top surface 864 mm above floor and with 737 mm minimum clearance from bottom of the counter face to floor. Provide top mounted washerless centerset lavatory faucets.

2.5.5 Kitchen Sinks (Break and Pantry Rooms)

For sinks with designation BS-1, PS-1, BS-2 and KS-1. ASME A112.19.1/CSA B45.2 or BS 1244, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions as indicated on plumbing fixture schedule, single compartment, with underside fully sound deadened, with supply openings for use with top mounted washerless sink faucets, and with 89 mm drain outlet. Provide aerator with faucet. Water flow rate shall not exceed 1.9 L per minute when measured at a flowing water pressure of 414 kPa. Provide stainless steel drain outlet and stainless steel cup strainer.

2.5.6 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 25 mPa minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers. Sink dimensions shall be 810 mm long 810 mm wide and 300 mm high. Provide Neo-corner type sink with 150 mm drop front. Provide rim guards on three sides of mop sink. Provide chrome plated solid cast brass construction service faucet. Faucet shall be wall mounted and include atmospheric vacuum breaker spout with pail hook, wall brace and 19 mm male garden hose thread outlet. Faucet to have quarter turn compression cartridge and metal lever handles with color index. Provide with integral supply stops in body for servicing cartridges. Provide with holder for three mops. Provide back mounted washerless service sink faucets with vacuum breaker and 19 mm external hose threads. Provide rim guards on three sides of mop sink.

2.6 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the local regulatory agencies. If there is no local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

Vacuum breakers shall comply with the relevant provisions of BS 6282-2 and BS 6282-3. Check valves shall comply with the relevant provisions of BS 6282-1. Combined check valve and vacuum breaker shall comply with the relevant provisions of BS 6282-4. Double check valve assembly shall comply with the relevant provisions of BS 6282-1, with a draining tap comply with the relevant provisions of BS 2879 connected between them.

2.7 DRAINS

2.7.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains except where otherwise indicatedshall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint.Floor drains located in toilet rooms shall be linear stainless steel type complete with anchoring support, center outlet drain, adjustable leveling frame with tile edge, integral membrane flange and secured, light duty slotted heel-proof grate. Floor drains shall conform to ASME A112.6.3. See drain schedule on drawings.

2.7.1.1 Drains

Drains installed in connection with waterproofed floors shall be equipped with bolted-type device to securely clamp flashing.

2.7.2 Area Drains

Area drains shall be plain pattern with polished nickel bronze perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 300 mm nominal overall width or diameter and 150 mm nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Provide sediment bucket. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3. See FD-2 on drawing floor drain schedule.

2.7.3 Floor Sinks

Floor sinks shall be square, with 300 mm nominal overall width or diameter and 150 mm nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe. See FS-1 on drawing floor drain schedule.

2.7.4 Sight Drains

Safewaste/Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and

seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar:	0.023 square meters
Height of funnel:	95 mm
Diameter of lower portion:	50 mm of funnel
Diameter of upper portion:	100 mm of funnel

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F409 PVC for concealed locations within structure and copper-alloy adjustable tube type with slip joint inlet and swivel for exposed locations. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.813 mm thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm. The interior diameter shall be not more than 3.2 mm over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.9 WATER STORAGE TANKS

Storage tanks shall be atmospheric type suitable for storage of potable water. Water storage tanks shall to be constructed to prevent accumulation of impurities or bacterial growth. Tank shall be provided with a layer of thick foam to insulate the tank. Provide external layer on tank to prevent dust absorption and block ultraviolet rays. Storage tanks indicated on the drawing schedule as vertical or horizontal shall be constructed of high density polyethylene or fibre glassed reinforced plastic (GRP). Storage tanks indicated as sectional shall be constructed of glassed reinforced plastic (GRP). Sectional tanks shall be internally flanged type to minimize clearance requirements.

Tanks shall be supported on a firm level base capable of withstanding the weight of the tank when full. Storage tanks located on the ground or roof shall have sunscreen/shades as indicated on the Architectural Drawings. Coordinate tank dimensions and placement to provide manufacturers recommended clearances. Vertical and horizontal indicated tanks shall be provided with top access for inspection, cleaning and maintenance. Sectional tanks shall be provided with side access for inspection, cleaning and maintenance. Include openings for tank access and pipe connections. Tanks smaller than 6 m in length shall have a removable close-fitting vermin proof cover. Tanks greater than 6 m in length shall have two or more securable manhole covers. Where two or more tanks are coupled together in a series, the inlet and outlet shall be at opposite ends of the series.

Storage tanks shall have capacities as indicated on the drawings.

Storage tank fittings and connections:

1. Each tank shall be fitted with a 25 mm diameter outlet for connection to a washout pipe. The outlet pipe shall be flush with the bottom of the tank. A washout pipe and a stop-tap shall be fitted to the outlet.

2. Each pipe supplying water to a water storage tank shall be fitted with a float operated valve (or other equally effective device meeting Local Code requirements)to control the inflow of water and maintain it at the required level. The float valve shall be securely fixed to the tank and installed so that the level of water in the tank when full under normal conditions is not less than 25 mm below the level of the warning or overflow pipe. A stopvalve shall be fitted to the pipework immediately upstream of the float valve to shut off supply of water to that valve.

3. Distribution pipes for tanks shall be connected so that the lowest point of the outlet is not less than 50 mm above the bottom of the tank.

4. Connections to distribution pipe feeding hot water apparatus shall be set at a level of at least 25 mm above connectors to pipes feeding cold water outlets.

5. Any tank with an effective capacity of up to 4500 litres shall be fitted with a warning type overflow pipe. Tanks with an effective capacity exceeding 4500 litres shall be fitted with one or more overflow pipes. For capacities exceeding 4500 litres, either the lowest pipe will be a warning pipe, or a device shall be fitted that gives an audible or visual alarm when water in the tank reaches a level at least 50 mm below the lowest point of the lowest overflow pipe.

6. The invert level of the overflow pipe shall not be less than 75 mm below the invert level of the inlet pipe.

7. Overflow pipes shall be made of a rigid corrosion resistant material. No overflow or warning pipe shall rise in level outside the cistern.

8. Warning type overflow pipes shall discharge water immediately when the water in the tank reaches the overflowing level and shall discharge to a conspicuous position; these locations shall be outside the building where appropriate.

9. The overflow pipe or pipes should be able to convey water away from the tank at a rate equal to or greater than the rate of flow of water into the tank. Warning type overflow pipes shall not be less than 20 mm in diameter.

2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Water heaters shall be electric immersion type with element placed with storage tank. Water heater shall be commercial grade. All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition fused to steel at a temperature of 871 degrees C. Tank shall be cathodically protected with powered anodes. Anodes shall be replaceable. Heating element shall be high grade stainless steel or gold plated for additional resistance to scaling. The entire vessel shall be foam insulated and enclosed in round steel enclosure with baked enamel finish. Water heater shall be constructed in accordance with ASME Code. Heater shall be listed

Underwriters laboratories BS 3599 and approved to The National Sanitation Foundation or Qatar equal. Each primary water heater shall have controls with an adjustable range that includes 32 to 71 degrees C. Provide manifold kits when multiple tanks are used.Hot water systems utilizing recirculation systems shall be provided with aqua-stat and time clock. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 2000 liters storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 93 degrees C water temperature and 1034 kPa working pressure. The expansion tank size and acceptance volume shall be as indicated on drawing schedules.

2.10.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.Controls shall be electronic type with programmable large LCD display on front panel.

2.11 PUMPS

2.11.1 Circulating Pumps

Hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Circulating pump shall comply with the relevant provisions of BS 1394. Pump capacities shall be as indicated on the drawings.

Motor shall be totally enclosed, fan-cooled and shall have sufficient wattage for the service required. Each pump motor shall be equipped with a manual across-the-line magnetic controller in a IEC 60529 Type IP 55 enclosure with "START-STOP" switch in cover.

Pump motors smaller than 746 W shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.11.2 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 0.75 Kw or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.12 WATER PRESSURE BOOSTER SYSTEM

2.12.1 Constant Speed Pumping System

Constant speed pump system shall be provided for transferring water from the water storage tank at the facility. Constant speed pumping system with pressure-regulating valves shall employ a total of two pumps; one lead pump and one pump for standby. Pumps shall be high efficient vertically arranged glanded stainless steel high pressure multistage centrigal type. Pressure-regulating valves shall be provided with nonslam check feature.

The factory prepiped and prewired assembly shall be mounted on a steel frame, complete with pumps, motors, and automatic controls. The system capacity and capacity of individual pumps shall be as indicated on drawings. Current sensing relays shall provide staging of the pumps. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve. Pressure gauges shall be mounted on the discharge headers. Provide pumps with low-water cut-out switchgear in the event adequate water supply is not available. The control panel shall bear the UL listing label for industrial control panels and shall be in a IEC 60529 Type IP 65 enclosure suitable for indoor use. Booster pump system shall be suitable for indoor use and capable of operation in ambient temperatures of up to 40 degree Celsius. Provide motor driven fans as recommended by pump manufacturer. Pump controls shall be automatic with extended functions, microcomputer and touchscreen without frequency converter. Control shall alternate operation of each pump to ensure equal wear time on all pumps. The control panel shall include the following: No-flow shutdown; 7-day time clock; audiovisual alarm; external resets; manual alternation; magnetic motor controllers; time delays; transformer; current relays; "HAND-OFF-AUTOMATIC" switches for each pump; minimum run timers; low suction pressure cutout; and indicating lights for power on, individual motor overload, and low suction pressure. The control circuit shall be interlocked so that the failure of any controller shall energize the succeeding controller.

2.12.2 Hydro-Pneumatic Water Pressure System

An ASME code constructed tank stamped for 1034 kPa water working pressure shall be provided. The tank shall have a fixed or flexible diaphragm made of material conforming to FDA requirements for use with potable water and shall be factory precharged to meet required system pressure. The tank capacity shall be as indicated on the drawings.

2.13 WATER FILTER

Single cartridge water treatment for ice machine. Unit to include high capacity activated carbon filtration to reduce sediment down to 0.5 microns and reduce chlorine, taste and odor at a flow rate of 1.5 gpm for 15,000 gallons. Unit to include mounting bracket, full flow inlet shut-off valve, and built-in pressure gauge to allow visual monitoring of when filter is to be replaced. Unit shall be NSF Certified under Standard 42.

2.14 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratingsProvide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20

seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.15 MISCELLANEOUS PIPING ITEMS

2.15.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.15.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, soil, waste, and vent piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.15.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.15.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.15.3 Pipe Hangers (Supports)

Provide MSS SP-58 Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.15.4 Nameplates

Provide 3.2 mm thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and

valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 6.4 mm high normal block lettering into the white core. Minimum size of nameplates shall be 25 by 63 mm. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m outside the building, unless otherwise indicated. A gate valve or full port ball valve and drain shall be installed on the water service line inside the building approximately 150 mm above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 12 mm between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 20 mm hose bibb with renewable seat and gate or full port ball valve ahead of hose bibb. At other low points, 20 mm brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 100 mm in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground

and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm and smaller; flanges shall be used on pipe sizes 80 mm and larger.

3.1.2.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.4 Copper Tube and Pipe

a. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 50 mm and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

3.1.2.5 Plastic Pipe

PVC and PVC-U pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.2.6 Other Joint Methods

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, copper, and steel pipe, fittings, and joints shall have a protective coating. ~~Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe shall be in accordance with Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).~~ Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer. Exterior protective coating for ductile iron pipe shall be inaccordance with 33 11 00 WATER DISTRIBUTION.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 12 mm from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing / waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 4.9 kg per square meter copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5.3 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and

sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 150 mm in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.4 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 6 to 13 mm wide by 6 to 10 mm deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.5.5 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 50 mm and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and shall have

both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 100 mm and larger when the temperature of the medium is 15 degrees C or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 100 mm.

(2) Be used on insulated pipe 100 mm and larger when the temperature of the medium is 15 degrees C or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 128 kg per cubic meter or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Operating temperatures in determining hanger spacing for PVC or PVC-U pipe shall be 49 degrees C for PVC or PVC-U. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m nor more than 2 m from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 100 mm and larger when the temperature of the medium is 15 degrees C or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 100 mm a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 100 mm and larger carrying medium less that 15 degrees C a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not

desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm will not be required. A cleanout installed in connection with cast-iron and PVC-U waste soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the heater; otherwise, the P&T valve shall be installed in the hot-water outlet

piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage water heater and mounted above and within 150 mm above the top of the water heater.

3.2.2 Heat Traps

Piping to and from each water heater shall be routed horizontally and downward a minimum of 600 mm before turning in an upward direction.

3.2.3 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.4 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 1 m above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 760 mm above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1020 mm above floor. Wall-hung service sinks shall be mounted with rim 700 mm above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment,

and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.3.7 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm above the flood rim of the funnel to provide an acceptable air gap.

3.3.8 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including booster pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.5 IDENTIFICATION SYSTEMS

3.5.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.5.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished

space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 12 mm in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 1 m width, 750 mm height, and 12 mm thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 20 mm in diameter and the related lettering in 12 mm high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated.

3.6 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.7 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.7.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.7.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 3 mm on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, the factory painting system shall be designed for the temperature service.

3.7.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 50 degrees C shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 50 Degrees C: Immediately after cleaning, the metal surfaces subject to temperatures less than 50 degrees C shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.0076 mm, one coat of primer applied to a minimum dry film thickness of 0.0255 mm; and two coats of enamel applied to a minimum dry film thickness of 0.0255 mm per coat.

b. Temperatures Between 50 and 205 Degrees C: Metal surfaces subject to temperatures between 50 and 205 degrees C shall receive two coats of 205 degrees C heat-resisting enamel applied to a total minimum thickness of 0.05 mm.

c. Temperatures Greater Than 205 Degrees C: Metal surfaces subject to temperatures greater than 205 degrees C shall receive two coats of 315 degrees C heat-resisting paint applied to a total minimum dry film thickness of 0.05 mm.

3.8 TESTS, FLUSHING AND DISINFECTION

3.8.1 Plumbing System

The following tests, if permitted by Local Jurisdiction,shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.8.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and

field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.8.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.8.3 System Flushing

3.8.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 1.2 meters per second through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 1 L per 24 hour period, ten times over a 14 day period.

3.8.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh

potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - SI for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.8.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.8.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Disinfection shall occur prior to system being used. The Drainage Department shall be informed prior to discharging any chlorinated water that has been used to disinfect the system. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed. Unless otherwise stated in the Project Documentation, the Contractor is responsible for providing water for disinfection purposes.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million

(ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take addition samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer.

Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.9 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.10 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 21 degrees C delta T.

SL = Standby loss is maximum (Btu/h) based on a 38.9 degree C temperature difference between stored water and ambient requirements.

V = Rated volume in liters (gallons)

Q = Nameplate input rate in kW (Btu/h)

3.10.1 Storage Water Heaters

3.10.1.1 Electric

a. Storage capacity of 227 liters shall have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.

3.11 TABLES

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
1	Seamless copper pipe, ASTM B42			X		
2	Seamless copper water tube, ASTM B88, ASTM B88M			X		
3	Copper drainage tube, (DWV), ASTM B306			X*		
4	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29			X		
5	Unplastized PVC Soil and Ventilation Pipes, Fittings and Accessories, BS 4514	X	X		X	
6	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, (Sch 40)	X	X		X	
8	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.					

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
9	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark.					

SERVICE:
A - Underground Building Soil, and Waste Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Air Conditioning Condensate Copper only, no PVC
D - Underground and Aboveground Vent
E - Exterior Building Storm Leaders
F - Interior Rainwater Conductors Underground and Abovergrounds
G - Underground Kitchen and Grease Laden Waste and Drain (Piping to be wrapped with corrosion protective coating)
H - Underground Oily Waste and Drain (Piping to be wrapped with corrosion protective coating)
* - Hard Temper

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
1	Ductile iron pipe AWWA C151/A21.51, cement lining, AWWA C104/A21.4			X		
2	Ductile iron compact fittings AWWA C153/A21.53			X		
3	Seamless copper pipe, ASTM B42				X	

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
4	Cast bronze threaded fittings, ASME B16.15 for use with Item 3				X	
5	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**		X***	
6	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Item 3 & 5	X	X		X	
7	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 5	X	X			
8	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter				X	
9	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D3035				X	
10	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D2239				X	

TABLE II						
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
11	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D3261 for use with Items 7, 8, and 9				X	
12	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D2683 for use with Item 9				X	
13	Polyethylene (PE) plastic tubing, ASTM D2737				X	
14	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828	X	X			
15	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X			
16	Malleable-iron threaded pipe unions ASME B16.39	X	X			
17	Nipples, pipe threaded ASTM A733	X	X			

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 82 degrees C Maximum Aboveground C - Fire Service Water Belowground D - Cold Water Service Belowground E - Not Used Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints					

TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
A. STORAGE WATER HEATERS				
Elect.	227 max		10 CFR 430	EF = 0.93
Elect.	75.7 min.	12 kW max.	10 CFR 430	EF = 0.93-0.00132V minimum

-- End of Section --

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PROTECTIVE DISTRIBUTION SYSTEM (PDS) REVISED BY AMENDMENT NO. 0002

-- End of Section Table of Contents --

SECTION 27 05 29.00 10

PROTECTIVE DISTRIBUTION SYSTEM (PDS)
REVISED BY AMENDMENT NO. 0002

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

The referenced publications listed below and indicated within the body of this specification constitute a compilation of internationally recognized standards. Contractor is responsible to comply with the most stringent requirement or standard specified herein as well as adhering to all requirements of QCS 2014. If a conflict is identified, contractor shall generate a Request for Information (RFI) complete with suggested / recommended course of action for approval by the Contracting Officer prior to commencement of work or procurement of products. The publications are referred to within the text by the basic designation only.

NATIONAL SECURITY TELECOMMUNICATIONS AND INFORMATION SYSTEMS SECURITY (NSTISS)

CNSSI-7003	(2015) Protected Distribution Systems (PDS)

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-569	(2015d) Commercial Building Standard for Telecommunications Pathways and Spaces

STATE OF QATAR

QCS 2014	Qatar Construction Specifications 2014

Internationally recognized standards that meet the requirements of the specified standards can be used.

Raceways for telecommunications shall be UL listed or other international listing agency as a grounding conductor.

1.3 ADMINISTRATIVE REQUIREMENTS

~~1.3.1 Conditions~~

~~Notify the Contracting Officer if it is impossible to install Host Nation Classified Secret PDS that complies with this section and references.~~

1.3.1 Construction Methods

Methods of construction that are not specifically described or indicated in the Contract will be subject to the control and approval of the Contracting Officer.

1.3.2 PDS Design

Submit the PDS design to the Qatar Emiri Signal Corps (QESC) for a technical review prior to the acquisition of material, through the Contracting Officer.

1.3.3 PDS Design Technical Review

Coordinate with the installation and submit PDS design for technical review to Qatar Emiri Signal Corps (QESC). Provide PDS carrier shop drawings, List of Material (LOM), and any other documentation required 90-days prior to PDS carrier installation (see CNSSI-7003).

1.3.4 PDS Design Approval Request

Submit PDS design and technical review to Qatar Emiri Signal Corps (QESC) to obtain PDS design approval prior to installation.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

PDS Design; G M
PDS Design Technical Review; G M
PDS Design Approval; G M

SD-03 Product Data

PDS Hardened Carrier
Cutsheets
PDS Raceway
PDS Fittings
PDS Lock Boxes

SD-04 Samples

PDS Carrier Surface Mounted
Pull Boxes
Fittings

SD-11 Closeout Submittals

User Drop Box
Other Enclosures

Provide documentation confirming that the international standards used by the manufacturer meet the specified standards indicated in the contract documents.

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer's Qualifications

Use firms regularly engaged in manufacture of secure raceway systems, boxes, and fittings of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.5.2 Installer's Qualifications

Installer is required to obtain certification from the manufacturer of secure raceway system and install secure raceway system in accordance with manufacturer's instructions.

1.5.3 Equipment

PDS Hardened Carrier shall meet or exceed guidelines as defined by CNSSI-7003 and shall be approved for use by U.S. Army. Submit manufacturer's cutsheets and descriptive data.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver secure raceways, fittings and components in factory labeled packages. Store and handle in strict compliance with manufacturer's written instructions and recommendations. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 PRODUCTS

2.1 PDS CARRIER CONFIGURATION

Use secure raceway carrier system in office environments.

2.1.1 Secure Raceway Carrier

Provide secure raceway, fittings and components manufactured from ferrous material. Submit three 150 mm lengths of exposed type PDS carrier surface mounted conduit material, including component and fitting samples from the manufacturer, along with a LOM to the Qatar Emiri Signal Corps (QESC). Show finishes available (if applicable). PDS carrier that is comprised of Secure Raceway systems shall be:

a. Square or rectangular design with removable top covers or solid construction.

b. Raceway for horizontal and vertical riser runs. Provide applicable raceway size to accommodate cabling fill capacity as indicated below.

c. Utilize elbows, couplings, fittings and connectors constructed from the same type of ferrous material as the secure raceway.

d. Do not exceed 60 percent cable fill capacity of secure raceway with removable top cover in horizontal runs. TIA-569 cable fill standards do not apply.

e. Do not exceed 60 percent fill capacity of secure raceway of solid construction. TIA-569 cable fill standards do not apply.

2.1.1.1 Fittings and Components

Fittings and components include flat internal and external elbows, tees, couplings for joining raceway sections, nipples, wire clips, blank end fittings, and device mounting brackets and plates as applicable. Provide full capacity corner elbows and fittings to maintain a controlled 50 mm cable bend radius that meet the TIA-569 specification for Category 6A U/FTP cabling and exceeding the requirements for communications pathways.

2.1.1.2 Mounting Accessories

Mount secure raceways to the wall partition using 25 mm stand-off mounting brackets or spacers. Do not mount the secure raceways flush with the wall partition.

2.1.1.3 Through Wall Penetrating

a. Through-Wall Kit or equal and follow manufacturers installation specifications. Optional use of trim plates, threaded rigid pipe and locking rings on both the inside and outside of the raceway to secure the thru-wall penetration.

b. Provide dielectric breaks when penetrating secure room wall partitions.

c. Seal space between wall partition and through wall penetration using fire-stop material.

d. Fire-stop vertical risers and through wall penetrations of fire rated wall partitions after pulling cabling. Annotate firewall penetrations on PDS design.

2.1.1.4 Pull Points

a. Provide a pull point for secure raceway with removable top cover every 270 degree change in direction. Provide additional pull points in accordance with the manufacturer's instructions.

b. Provide a pull point for secure raceway of solid construction every 180 degree change in direction. Provide additional pull points in accordance with the manufacturer's instructions.

2.2 USER DROP BOX

Provide User Drop Box (UDB) (aka Secure User Workstation Enclosure, Drop Box, or Lockbox) that is at least 175 mm high by 150 mm wide by 100 mm deep, tamper-resistant design constructed from 16 gauge steel with welded internal hinges, without pre-punched knockouts; and has a single door that has a built-in steel hasp that accepts a GSA approved changeable combination padlock. Greenleaf Lock #8077AD or equal. UDB shall accommodate a complete line of open connectivity outlets; modular inserts for Category 6A U/FTP cable. UDB with exterior hinges, pre-punched knockouts, and built-in locks are not acceptable.

2.3 ENCLOSURES

Provide equipment and pull-box enclosures constructed from 16 gauge steel; have a single door with a built-in steel hasp or multi-point security hasp that accepts a GSA approved changeable combination padlock; Greenleaf Lock #8077AD or equal; without pre-punched knockouts; and a tamper-resistant

design with welded internal hinges.

PART 3 EXECUTION

3.1 GENERAL

In addition to the specific execution requirement contained herein, the execution of all work performed under the direction of this specification section shall also adhere to the technical guidance in connection with the execution of constructions in the State of Qatar as contained within the Qatar Construction Specifications 2014 (QCS 2014).

3.2 EXAMINATION

Examine the route and mounting locations of the raceways, boxes, distribution systems, supporting structure and accessories, to determine if conditions exist that will inhibit or prevent proper PDS installation. Notify the Contracting Officer in writing of conditions detrimental to proper completion of the work (i.e. that would render the distribution system non-compliant with governing security regulations). Do not proceed with work until unsatisfactory conditions are corrected.

3.3 PDS CARRIER ROUTING

3.3.1 General

Route the PDS carrier in a tree type fashion.

a. Start the PDS horizontal backbone at the TR with a single raceway or conduit sized accordingly (60 percent cable fill for secure raceway with removable top cover to contain CAT6A U/FTP, or fiber optic cable runs.

b. Extend the PDS carrier from the PDS horizontal backbone throughout the facility to areas where Host Nation Classified Secret access is required. Branch off the PDS horizontal backbone with a horizontal run to an area where the UDB is located.

c. Use vertical carrier runs from the horizontal run to the UDB. TIA-569 change in direction standard does not apply.

d. Maintain RED/BLACK cable separation in accordance with CNSSAM TEMPEST/1-13.

e. Remove all burrs from carrier segments prior to installation.

3.3.2 Mounting Location Considerations

a. Route the PDS carrier so that it does not cross windows or doorway openings; does not cross ceiling or wall mounted lighting fixtures; does not obscure EXIT signs or fire alarms; and maintains a minimum 1000 mm separation from fire sprinkler heads.

b. Use manufactured PDF systems as presently in use buy the U.S. military.

c. Use offset raceway to route secure raceway systems around columns and other wall partition obstacles.

d. Route PDS carrier so that it is surface mounted on interior walls

wherever possible. Obtain exceptions from Qatar Emiri Signal Corps (QESC) prior to installation to mount PDS carrier on exterior wall partitions.

e. Route PDS carrier to maximized cable fills in horizontal runs and reduce the number of horizontal runs within the same space.

f. Use all-thread rod to mount the PDS carrier to true ceiling structure when routing across open areas (e.g. large hallways, open office areas, large rooms) that exceed 2400 mm. Mounting the PDS carrier directly from suspended ceiling framework is not acceptable.

3.3.3 Adjacent Infrastructure Considerations

Keep conduit a minimum of 150 mm from parallel runs of flues and steam or hot water pipes. A minimum separation of 150 mm is required between the PDS carrier and water pipes, electrical wires, electrical pipes, plumbing, air conditioning, etc. Minimum of 1 meter from wireless access points.

3.4 INSTALLATION

Strictly comply with manufacturer's installation instructions and recommendations and approved shop drawings. Coordinate installation with adjacent work to ensure proper clearances and compliance with project site manager and Qatar Emiri Signal Corps (QESC).

3.4.1 Mounting PDS Carrier

Surface mount PDS Conduit on the wall using clamps, brackets, or mounts with 12 to 25 mm offset spacer from the wall surface. Mount PDS carrier to a wall partition every 1500 mm and/or within 450 mm of a section or component connection. Do not mount the PDS Carrier directly to the wall surface.

a. Where wall mounting is unavailable, use appropriately sized all thread rods to mount PDS carrier to ceiling structure.

b. Do not mount PDS carrier to acoustical tile ceiling (ATC) framework.

c. Fasten PDS carrier and component items to building wall partitions using appropriate anchor and fastener for wall partition type.

d. Mount PDS carrier so that is is level and plumb along its route. The top edge of the carrier is horizontally level. Whenever possible maintain a minimum of 50 mm below the suspended ceiling line or the true ceiling line, whichever is lower.

e. Use appropriate hanger type to mount PDS Conduit carrier from ceiling structure.

f. Struts are not allowed to be used to mount secure raceway to wall partitions.

g. No more than 6 mm play is allowed on TOP CAP (top cover) and span cut per segment span.

h. Install the PDS carrier to permit visual inspections of its entire run.

i. Do not block doorways or access to emergency exits and do not inhibit the operation of windows.

j. Do not paint or cover the PDS carrier with wallpaper or other covering unless the paint is applied by the carrier manufacturer.

k. Bond PDS carrier to PBB or SBB at point of origin.

3.4.2 Enclosures

Use of enclosures with pre-punched knockouts or external hinges is not acceptable. Fasten UDB, pull boxes, and enclosures to the wall partition using fasteners appropriate for the wall partition type.

3.4.2.1 User Drop Box (UDB)

a. Indicate UDB locations in the PDS Plan and on as-built drawings.

b. Size the UDB to terminate up to 6 cables.

c. Coordinate drop box location with furniture, fixtures and equipment that will be used in the vicinity. Surface mount drop boxes on the wall partition approximately 1.2 to 1.5 m above final floor line depending on room furniture height and layout.

3.4.2.2 Other Enclosures

Indicate enclosure type (user drop box, equipment, or pull-box) on shop and as-built drawings.

3.4.3 Mechanical Security

Comply with site specific epoxy standards obtained from the installation Qatar Emiri Signal Corps (QESC). Apply a continuous bead of epoxy at all component, coupling, and fitting connection joints of PDS carrier system. Seal pull box covers to the pull boxes around the mating surfaces after installation if they cannot be secured with approved changeable combination padlock.

3.4.4 Carrier Support

Support carrier with mounting brackets at intervals in accordance with manufacturer's installation sheets.

3.5 FIELD QUALITY ASSURANCE

3.5.1 Physical Inspection

Physically inspect all interfaces to ensure that they are tight and cannot turn. Also, physically inspect lock covers to ensure that the lock cap is properly sealed inside the locking mechanism.

3.5.2 Magnetic Test

Perform magnet test on all components (e.g. carrier raceway, pull boxes, enclosures, cover plates, etc) and fittings used to construct the carrier. Place a magnet on the carrier component or fitting to verify that construction is from ferrous material. Some alloys will fail the magnet test (e.g. 309 stainless steel) but meet the ferrous material requirements. Provide alloy material property list for components that fail magnet test to the Contracting Officer for approval. Use of

components and fittings that fail the magnet test and are not made from ferrous material is not acceptable.

3.6 CLEANING AND PROTECTION

Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer. Protect raceways and boxes until acceptance.

-- End of Section --

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SECTION 31 00 00.00 06

EARTHWORK
REVISED BY AMENDMENT NO. 0002

PART 1 GENERAL

1.1 ATTACHMENTS

See (Attachment A) of this specification for Geotechnical Reports for previous projects on Al Udeid Air Base.

1.2 REFERENCES

The referenced publications listed below and indicated within the body of this specification constitute a compilation of internationally recognized standards. Contractor is responsible to comply with the most stringent requirement or standard specified herein as well as adhering to all requirements of

QCS 2014. If a conflict is identified, contractor shall generate a Request for Information (RFI) complete with suggested / recommended course of action for approval by the Contracting Officer's Representative prior to commencement of work or procurement of products. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM D1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of

	Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1883	(2016) Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
ASTM D2434	(1968; R 2000) Permeability of Granular Soils (Constant Head)
ASTM D2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2937	(2000e1) Density of Soil in Place by the Drive-Cylinder Method
ASTM D422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D4318	(2017) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, and CL. Satisfactory materials for grading shall be comprised of stones less than 200 mm, except for fill material for pavementswhich shall be comprised of stones less than 75 mm in any dimension.

1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter. The Contracting Officer shall be notified of any contaminated materials.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, and CL. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D4318, ASTM C136, ASTM D422, and ASTM D1140.

1.3.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 9.0 mm sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 9.0 mm sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

1.3.5 Hard/Unyielding Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 75 mm in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.6 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 0.375 cubic meter in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling that is performed merely to increase production.

1.3.7 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.3.8 Select Granular Material

1.3.8.1 General Requirements

Select granular material shall consist of materials classified as GW, GP, SW, or SP, by ASTM D2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D4318. The plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 35 percent by weight shall be finer than 75 micrometers sieve when tested in accordance with ASTM D1140. Coefficient of permeability shall be a minimum of 0.01 mm per second when tested in accordance with ASTM D2434.

1.3.8.2 California Bearing Ratio Values

Bearing Ratio: At 2.5 mm penetration, the bearing ratio shall be at least a minimum of 5 percent at 95 percent ASTM D1557 maximum density as determined in accordance with ASTM D1883 for a laboratory soaking period of not less than 4 days.

1.3.9 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 75 mm or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 50 mm in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.3.10 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 15 when tested in accordance with ASTM D4318.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with LRL Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring; G M/R

Submit 15 days prior to starting work.

SD-03 Product Data

Utilization of Excavated Materials; G M
Opening of any Excavation or Borrow Pit

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Advance notice on the opening of excavation or borrow areas.

SD-06 Test Reports

Testing
Borrow Material Testing

Within 24 hours of conclusion of physical tests, submit copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing; G M

Qualifications of the Corps' validated commercial testing laboratory or the Contractor's validated testing facilities.

1.5 SUBSURFACE DATA

Subsurface soil boring logs within the project limits are not available. The subsoil investigation reports and samples of materials taken from subsurface investigations are from other projects and sites within Al Udeid Airbase. These data represent the best subsurface information available.

Contractor is responsible for providing a geotechnical subsurface investigation report to verify assumed data.

1.6 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.7 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water is not expected to be encountered.

d. Hard materials and rock will be encountered at >1 meter below existing surface elevations.

PART 2 PRODUCTS

2.1 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 75 mm minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems (Foul and Surface Water)
White:	Steam Systems
Gray:	Compressed Air

2.1.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.08 mm. Tape shall have a minimum strength of 10.3 MPa lengthwise, and 8.6 MPa crosswise, with a maximum 350 percent elongation.

2.1.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.10 mm. Tape shall have a minimum strength of 10.3 MPa lengthwise and 8.6 MPa crosswise. Tape shall be manufactured with integral wires, foil backing,

or other means of enabling detection by a metal detector when tape is buried up to 920 mm deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

PART 3 EXECUTION

3.1 GENERAL

In addition to the specific execution requirements contained herein, the execution of all work performed under the direction of this specification section shall also adhere to the technical guidance in connection with the execution of construction in the State of Qatar as contained within the Qatar Construction Specifications 2014 (QCS 2014).

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 1 meter from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to

the final grade level shall not be made until just before the concrete or masonry is to be placed. Where pile foundations are to be used, the excavation of each pit shall be stopped at an elevation 300 mm above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, loose and displaced material shall be removed and excavation completed, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 1.5 meters high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed the dimensions as shown on the drawings. Where recommended trench widths are exceeded a redesign of either stronger pipe, or special installation procedures shall be provided by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.2.3.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 75 mm or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.2.3.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed to 600 mm (max) below the required grade and replaced with suitable material.

3.2.3.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.2.3.4 Excavation for Appurtenances

Excavation for manholes or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When

concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.4 Underground Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within 600 mm of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.5 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas within the limits of the project site. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

The Contractor shall notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

The Contractor shall submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be

removed as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. At the Contracting Officer's discretion, the Geotechnical Engineer shall be available on-site to meet with the Contracting Officer or at any time throughout the contract duration either by written correspondence, telephone communication, or by video conference. ~~The Geotechnical Engineer shall be available to meet with the Contracting Officer at any time throughout the contract duration.~~

3.6 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Stockpiles of satisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and wasted materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 150 mm before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are

less than the specified density, the ground surface shall be broken up to a minimum depth of 150 mm, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 300 mm and compacted as specified for the adjacent fill.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED WARNING IDENTIFICATION TAPE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape as shown on the drawings.

3.11 BACKFILLING AND COMPACTION

Backfill adjacent to any and all types of structures shall be placed and compacted to 90 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph GROUND SURFACE PREPARATION. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs EMBANKMENTS AND STRUCTURAL FILL, and Section 33 40 00 SURFACE WATER UTILITIES. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Trenches shall be backfilled to the grade shown.

3.11.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.11.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

3.11.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least 300 mm above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4. Backfill to top of pipe shall be compacted to 95 percent of ASTM D1557 maximum density.

3.11.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways and parking areas: Backfill shall be placed up to the required elevation as specified. Water flooding or jetting methods of compaction will not be permitted.

b. Footways and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm loose thickness, and compacted to 90 percent maximum density for cohesive soils and 95 percent maximum density for cohesionless soils. This requirement shall also apply to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole or similar structure has been constructed the backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 1 meter from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.12.2 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 900 mm from the finished grade, unless otherwise indicated.

3.13 EMBANKMENTS AND STRUCTURAL FILL

3.13.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm. The material shall be placed in successive horizontal layers of loose

material not more than 200 mm in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.13.2 Structural Fill

All structural fill placed to facilitate desired site grades shall be constructed from satisfactory material free of organic or frozen material and rocks with any dimension greater than 75 mm. The fill shall be placed in maximum 200 mm loose lifts and compacted to the following criteria. Beneath foundations, slabs and roads: at least 95 percent laboratory maximum density as determined by the project geotechnical engineer.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. Proof roll the existing subgrade with six passes of a dump truck loaded with 6 cubic meters of soil or a 13.6 meter tons, pneumatic-tired roller. Operate the vehicle in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer and replaced with select material.

3.14.2 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 150 mm below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. The elevation of the finish subgrade shall not vary more than 15 mm from the established grade and cross section.

3.14.3 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, each layer of the embankment shall be compacted to at least 95 percent of laboratory maximum density.

3.14.3.1 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percent laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, the top 150 mm of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

3.14.3.2 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 95 percent laboratory maximum density for the full depth of the shoulder.

3.15 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.16 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 15 mm of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. Settlement or washing that occurs in graded or backfilled areas prior to acceptance of the work, shall be repaired and grades re-established to the required elevations and slopes.

3.16.1 Subgrade and Embankments

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No base course or pavement shall be laid until the subgrade has been checked and approved, and in no case shall base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade.

3.16.2 Grading Around Structures

Areas within 1.5 m outside of each building and structure line shall be

constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 TESTING

The Contractor's laboratory shall be approved by the Contracting Officer or designated representatives on-site prior to starting any work which requires quality control (QC) testing. The Contractor shall use an approved independent testing laboratory for the required test methods.

The Contractor may elect to establish an on-site laboratory for it's own purposes, but test results from this operation may not be substituted or used for QC purposes.

Field in-place density shall be determined in accordance with ASTM D1556 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D1556. ASTM D6938 results in a wet unit weight of soil and when using this method ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D6938; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D2937, Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.17.1 Fill and Backfill Material Gradation

One test per 200 cubic meters stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM D422.

3.17.2 In-Place Densities

a. One test per 1,000 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines, minimum of one per day.

b. One test per 500 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines, minimum of one per day.

c. One test per 500 linear meters, or fraction thereof, of each lift of embankment or backfill for roads, minimum of one per day.

3.17.3 Check Tests on In-Place Densities

If ASTM D6938 is used, in-place densities shall be checked by ASTM D1556 as follows:

a. One check test per lift for each square 10,000 meters, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines, minimum of one per day.

b. One check test per lift for each square 10,000 meters, of fill or backfill areas compacted by hand-operated machines, minimum of one per day.

c. One check test per lift for each 20,000 linear meters, or fraction thereof, of embankment or backfill for roads, minimum of one per day.

3.17.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.17.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 2000 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.17.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

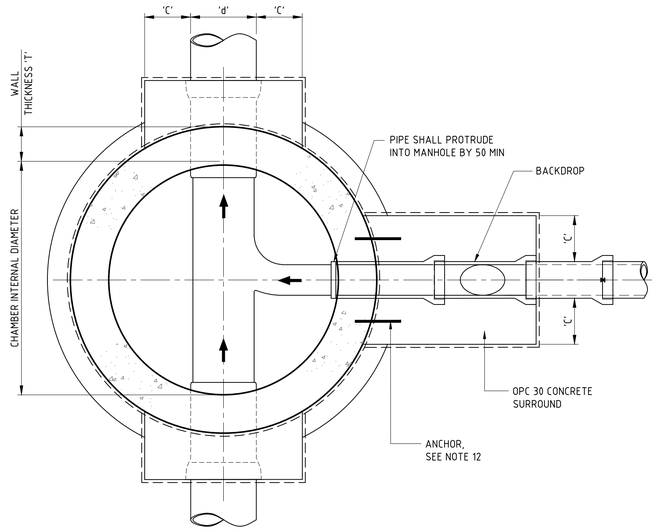
3.17.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 900 mm shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

3.18 DISPOSITION OF SURPLUS MATERIAL

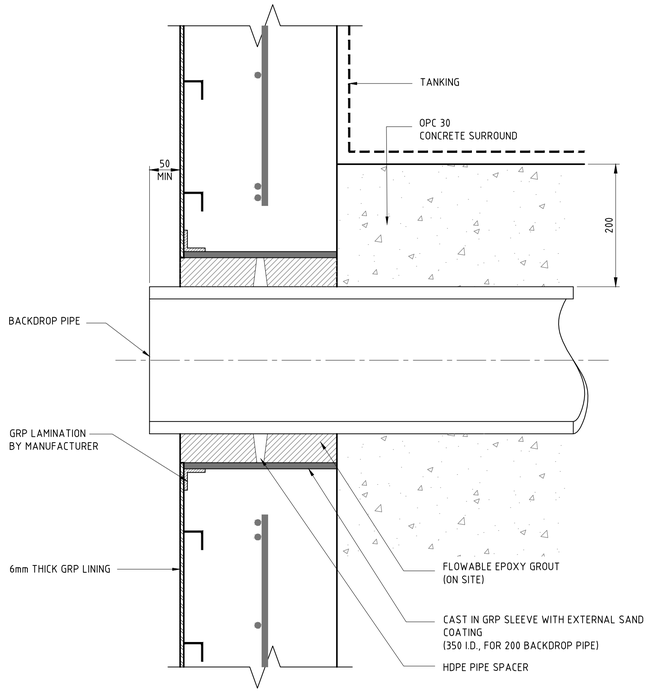
Surplus material or other soil material not required or suitable for filling or backfilling shall be wasted in a Government disposal area as directed by the Contracting Officer.

-- End of Section --

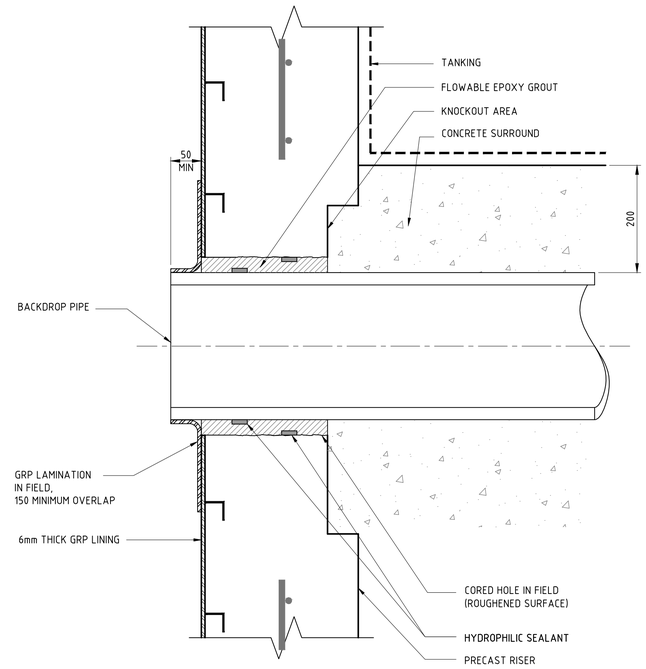


PLAN

NOTE: SEE DRG NO. SD-8-4-207 FOR DIMENSION TABLE

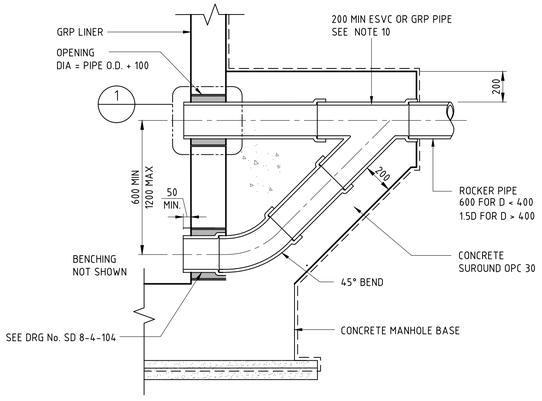


1 CAST OPENING

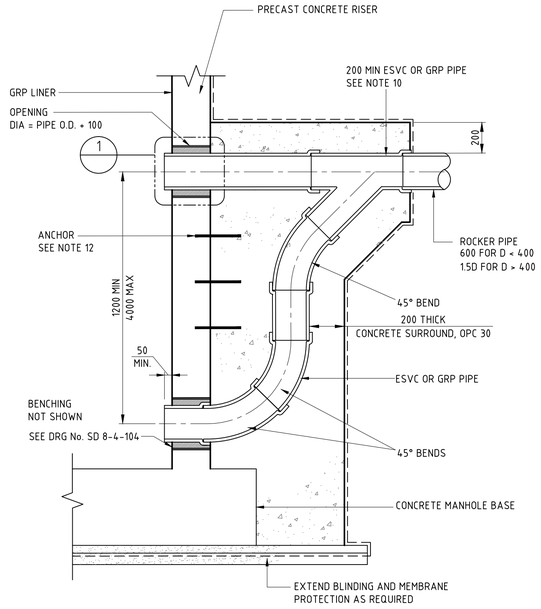


OPTIONAL CORED OPENING

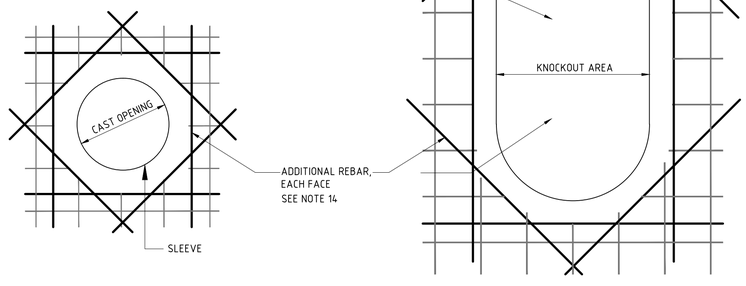
SEE NOTE 14



TYPICAL RAMP BACKDROP CONNECTION DETAIL



TYPICAL VERTICAL BACKDROP CONNECTION DETAIL



CAST OPENING

KNOCKOUT/CORED OPENING

REINFORCEMENT DETAILS

NOTES:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS REFER TO DRG Nos. SD 1-1-101.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
3. ALL MATERIALS, FABRICATION AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS.
4. ALL JOINTS BETWEEN PIPES AND CONCRETE SHALL BE WATERTIGHT.
5. ALL CONCRETE COVER FOR REINFORCEMENT TO BE 75mm MIN.
6. SEE DRAWING No. SD 8-4-103 FOR TANKING DETAILS.
7. BACKDROP PIPES SHALL BE VITRIFIED CLAY OR GRP SPIGOT AND SOCKET JOINT UNLESS OTHERWISE STATED AND SHALL COMPLY WITH THE REQUIREMENTS STATED IN THE SPECIFICATIONS.
8. WHERE THERE IS A DIFFERENCE IN LEVEL BETWEEN THE INVERT LEVEL OF INCOMING AND OUTGOING PIPES THE FOLLOWING RULES APPLY:
   a). WHERE THE DIFFERENCE IN LEVEL IS LESS THAN 600mm THE PIPE CONNECTION MAY BE DIRECT THROUGH THE MANHOLE OR GRADIENT ADJUSTED TO SUIT.
   b). WHERE THE DIFFERENCE IN LEVEL IS GREATER THAN 600mm AND LESS THAN 1200mm A RAMP BACKDROP SHALL BE CONSTRUCTED.
   c). WHERE THE DIFFERENCE IN LEVEL IS 1200mm OR MORE A VERTICAL BACKDROP SHALL BE CONSTRUCTED.
9. WHERE INCOMING AND OUTGOING PIPE DIAMETERS DIFFER A TAPERED CHANNEL IN THE BENCHING SHALL BE PROVIDED.
10. WHERE INCOMING PIPE CONNECTING TO BACKDROP IS 150mm DIA A 150/200mm TAPER SHALL BE PROVIDED. IF INCOMING PIPE IS GREATER THAN 200mm DIA THE BACKDROP SHALL BE OF THE SAME DIAMETER.
11. ANY EXCESS EXCAVATION BELOW BACKDROP TO BE FILLED WITH CONCRETE GRADE SRC 20.
12. 16 DIAMETER REINFORCEMENT BARS, 300mm LONG. EMBEDDED 100mm INTO PRECAST CONCRETE MANHOLE @300 CENTERS VERTICALLY, BOTH SIDES OF BACKDROP.
13. PIPE OPENINGS WILL NOT BE PERMITTED THROUGH PRECAST MANHOLE JOINT. A MINIMUM DISTANCE FROM TOP OR BOTTOM OF ANY OPENING SHALL BE 150 PLUS JOINT DEPTH.
14. 50% OF AREA OF DISPLACED STEEL REPLACED IN EACH ELEVATION IN BOTH FACES, BAR LENGTH = 90xDIA MIN.
15. STRUCTURAL DESIGN OF PRECAST MANHOLES TO BE IN ACCORDANCE WITH BS 5400 AND DESIGN CRITERIA SET FORTH IN THE LRDP DESIGN MANAGEMENT MANUAL, APPENDIX H.
16. MIN STEEL TO BE .0035x1000x'T' IN EACH DIRECTION.

Rev.	Date	Revision Details	Appd.
0	15SEP13	ISSUED FOR USE	

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QCS Section:
Section 8 - Sewerage
Part 4 - Pipeline Installation

Drawing Title:
FOUL SEWER PRECAST MANHOLE TYPE 2

Approved:	Sheet No: 1 OF 1
Date: SEPTEMBER 2013	Scale: 1:20; 1:5 on A1
Drawing Number: SD 8-4-209	Revision: 0

Chapter 1

Water Network Design Guidelines

Water Network Development & Design Standards

PARSONS

Table of Contents

I. GENERAL INFORMATION

I.1 Purpose

These water network design guidelines present the basic criteria and considerations for the design of components for the extensions, upgrades, additions, replacements, or rehabilitation of KM's water network system.

These design guidelines, with the aid of computer modeling of the water distribution system, intend to provide a set of guidelines and minimum criteria for the design of water network in Qatar. It also applies for other public and private development projects that will be constructed and connected to KM water system.

I.2 Scope

These design guidelines summarize the design criteria for elements of the water system reservoir, pumping system, and transmission/delivery system including:

- Service area coverage
- Water demand projections
- Water main pressure requirements
- Pipe velocities
- Typical configuration requirements for network piping design for transmission lines, rising mains, and distribution mains,
- Water main location
- Line valves, fire hydrants, and special valves requirements
- Reservoir and pumping station design criteria,
- Hours of operation
- Paralleling of transmission lines/rising mains, reservoir inlets
- Acceptable commercial size of pipe diameters
- Safety and security

I.3 Responsibilities & Authorities

All KM staff and consultants providing design services to KM are responsible for using the criteria and guidelines provided in this manual. Any deviations from these standards/guidelines outlined in this document must be reviewed and approved by KM.

Any deviation from the standards/guidelines outlined in this document must be reviewed and approved by KM

I.4 Abbreviations, Definition Of Terms

Abbreviations and definition of terms used in this report are consistent with the Standard Terminologies, Abbreviations, Acronyms and Definitions presented in the Glossary of Documents which is located under this Manual.

I.5 Specifications, Guidelines, & References

Water network concept through final design shall conform to the following specifications, guidelines, and references:

1. General Specifications of Main Laying Materials for Waterworks
2. General Specifications for Main Laying Contracts
3. Water Network Standard Drawings
4. Regulations of Internal Water Installations and Connection Works (KM Plumbing By-laws)
5. Qatar Construction Specifications (QCS), 2010
6. Ministry of Municipality and Urban Planning (MMUP) Policy Plan
7. Qatar Highway Design Manual

I.6 Design Conditions

I.6.1 Physical Environment in the State of Qatar

The regional and local physical description of the project area should be discussed including the geophysical and climatic conditions.

I.6.2 Geophysical Conditions

Figure I-1 illustrates that Qatar is a peninsula. It borders Saudi Arabia and the United Arab Emirates to the south with the remaining land mass extending into the Arabian Gulf. The terrain is mostly flat and barren desert covered with loose sand and gravel. There are some small hills and high ground to the northwest and a few scattered sandstone and limestone hills. The higher elevations are generally found to the southwest from Dukhan south where elevations rise to approximately 35 m.

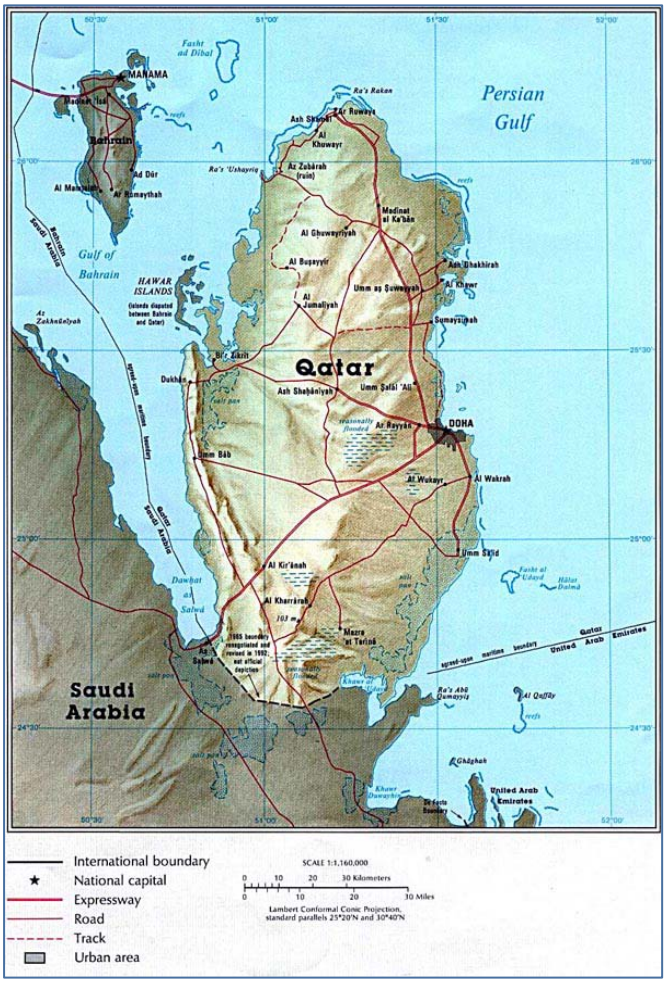

Figure I-1 Map of Qatar

I.6.3 Climatic Conditions

Qatar has a tropical climate. In summer, extreme heat, dust, and humidity are experienced. The design engineer should consider the impact of climatic conditions for both design and construction of the project. Climatic data to be used for planning and design purposes are found in Table I-1.

I.6.4 General Considerations:

- Proximity to the Gulf creates a high salt laden air atmosphere. During periods of high humidity, this results in a severe corrosive atmosphere. Corrosion protection should be considered during design.
- Groundwater may be brackish and/or soils may be corrosive resulting in increased potential for corrosion.
- Distribution and occurrence of rainfall events are very erratic. Rainfall events are generally of a high intensity with a short duration and usually occur between December and March.
- The prevailing wind directions are from the north and west.

Table I-1 Climatic Design Conditions

Description	Design Value
Maximum Temperature	50° C
Minimum Temperature	5° C
Maximum Temperature for enclosures and exposed metal	85° C
Maximum Humidity	100%
Minimum Humidity	20%
Maximum Wind Velocity	150 km/hr
Annual Rainfall	80-150mm

I.7 Design Survey Requirement

It is required to have a vertical profile for the primary mains and existing & finished ground surface profile of the alignment reckoned from the latest Qatar National Datum and tied to at least two(2) official survey benchmarks. Additional semi-permanent benchmarks shall be established every 100m along the route by closed loops of third order accuracy. The existing ground profile shall consist of ground surface elevations along the proposed transmission main centerline at every 25m station and at pronounce grade breaks.

Topographical features within the street or right-of-way and any topographic feature outside the right-of-way, which may interfere with the operation or installation of the primary main shall be accurately surveyed and depicted on the plans. Topographic features may be compiled by aerial photogrammetry or field survey methods. In areas where the ground slope perpendicular to the centerline of the primary main exceeds 5%, cross sectional data shall be surveyed at all 25m station profile points and shall extend at least 10m at each side of the centerline.

I.8 Geotechnical Investigation

When required, a geotechnical investigation shall be performed for the purpose of determining the soil bearing capacity, soil backfill suitability, presence of groundwater, bedrock, corrosion potential and other conditions, which may affect the design, construction and maintenance of the entire water network. Test holes shall be located at maximum spacing

not more than 200m and at highway and canal crossings. The geotechnical investigation shall be carried out in accordance with the guidelines set forth in the latest Qatar Construction Specifications (QCS), Section 3 – Ground Investigations.

II. ENGINEER'S REPORT

Prior to preparation of the Engineer's Report, a planning meeting shall be conducted with Water Planning Department to discuss the project concept and obtain system information required for design.

The Engineer's Report presents the following information where applicable, which shall be submitted to KM for review and approval.

II.1 Introduction

Provide a brief description of the purpose and scope of the project. Identify the Owner, Engineer, and all major stakeholders of the project.

Provide a summary description of the contents of the Report by section, describe the contents of the appendices, and identify supplementary volumes and their contents.

II.2 Overview and Background

Include general project related information and identify the planned objectives. Briefly describe the following:

- existing conditions,
- background data,
- previous studies and recommendations,
- related work done by others,
- special considerations, and
- reasons underlying the need for new or modified facilities.

The major elements of the proposed design should be introduced.

- Acknowledgments. Identify key regulatory agency personnel who provided data, input, review, etc.; and the identities of outside groups that have provided input or review.

II.2.1 General Information

- A description of the project including geographical location.
- Demographics of the existing waterworks facilities.
- Identification of the target service area/s.
- A list of existing studies, reports, surveys and other available information to be used in evaluating the project.
- A list of applicable standards, codes, units, and datum to be utilized.
- Interactions with Owner, governmental, utility, and permitting agencies.
- The schedule for completion.

II.2.2 Extent of Water Works System

- Description of the nature and extent of the area to be served.
- Provisions for extending the water works system to developed/developing uncovered areas.
- Provisions for replacement / upgrading of the waterworks system.
- Appraisal of the future requirements for service, including existing and potential industrial, commercial, institutional, and other water supply needs.

II.2.3 Justification of Project

The proposed project requires to be justified based on the following:

- Extension to uncovered developed/developing areas,
- Improving the existing facilities,
- Future expansions,
- Adapting to new technology and environment.

II.3 Alternative Evaluation

Where two or more solutions exist for providing public water supply facilities, each of which is feasible and practicable, discuss the alternatives.

Prepare multiple conceptual schematic layouts based on discussions with KM. These layouts should be evaluated using:

- Limited hydraulic and hydrologic modeling, and
- Conceptual level engineering calculations of
    - civil,
    - geotechnical,
    - structural,
    - mechanical,
    - communications systems,
    - instrumentation systems, and
    - electrical features.

Each conceptual layout should include:

- A description of the conceptual layout and features.
- A summary of the analysis and results in evaluating the layout and
- A summary of the advantages and disadvantages of each solution. Give reasons for selecting the one recommended, including:
    - potential impacts to:
        - public use,
        - environmental factors,
        - other projects within the region, and
        - Right-of-Way needs.
    - ability to meet the goals and objectives of the project,
    - financial considerations,

- operational requirements,
- operator qualifications,
- reliability, and
- water quality considerations.

- Whole-life-cycle cost analyses to be carried out for all alternatives to demonstrate that the recommended development plan is the least-cost or the most economical option.

II.4 Elements of Design

The Engineer's Report should include the following information to allow proper evaluation and design of the selected solution:

II.4.1 Geotechnical Conditions

- The character of the soil through which water structures and/or pipelines are to be constructed.
- Foundation conditions prevailing at sites of proposed structures and
- The level of ground water in relation to subsurface structures.

II.4.2 Water Demand Data

- Population projection,
- Land use,
- Historical production / forwarding figures,
- Historical water consumption,
- Historical water losses,
- Historical storage volume and pumping discharges,
- Fire flow requirement,
- Historical & updated per capita consumption,
- Bulk demand on commercial, industrial, institutional & irrigation (optional),

II.4.3 Flow and Pressure Requirements

- Hydraulic analyses based on flow demands and pressure requirements,
- Fire flows, when fire protection is provided, meeting the KM and CD recommendations,
- Surge Analysis to determine the required surge protection devices and surge vessels.

II.4.4 Sources of Water Supply

Describe the proposed source or sources of water supply. If one is to be developed include the reasons for selection.

II.4.5 Cost Estimate

- Estimated cost of integral parts of the system,
- Detailed estimated annual cost of operation over the life of the project, to include
  - labor categories and hours
  - material costs
  - equipment costs
  - power costs

- Proposed methods to finance both capital investment cost and operating expenses.

II.4.6 Future Extensions

Summarize planning for future needs and services for the development. Plan the start date to allow new facilities to be on-line when needed based on projected demand. A description of the goals and objectives to be achieved by the pipelined project should be described.

III. ROAD OPENING AND DESIGN APPROVALS

III.1 Road Opening Approvals

Q-PRO (Qatar Permit of Road Opening) is the State of Qatar's on-line RO (Road Opening) permitting, reporting, and analysis web-application. Q-PRO allows agencies to apply for RO permit on-line to carry out any work on public right-of-away in the states of Qatar. Q-PRO allows authorized agencies to approve permits on-line.

KM will coordinate Road Opening permit applications through Q-PRO.

III.2 Design Approvals

The following utility departments and agencies shall review, comment and approve all the designs:

1. KM- Electricity Network Affairs
2. Public Works Authority- Roads Affairs
3. Public Works Authority- Drainage Affairs
4. Ministry of Municipality and Urban Planning (MMUP)
5. Qatar Telecom- Q-Tel
6. Qatar Petroleum
7. Water Producers (If required)
8. Ministry of Environment
9. Municipalities

IV. WATER NETWORK DESIGN STEPS

Table IV-1 presents general design steps to be followed for network design development. Note that these steps are iterative and may need to be revisited during the course of a project in order to complete the design.

Table IV-1 Water Network Design Procedures

Design Step	Description
1. General: Determine Service Area	Define the project service area and identify the pressure zones in which it is located; coordinate this effort with Water Planning Department. For this and the remaining items in this table, utilize Appendix B for checklists relating to hydraulic analysis and transmission and distribution main design.
2. General: Determine Water Demands	For preliminary design, assess the demand required from the new service area based on typical land use categories and ranges of water demands listed in Table V-6 and Table V-7. Refer to Appendix A for detailed guidelines for project requirements and preparation of demands for bulk customers.

Table IV-1 Water Network Design Procedures	
Design Step	**Description**
3. General: Determine Flow Demands	Determine water demands and apply peaking factors listed in Table V-6, Table V-7 and Table V-8 to establish design flow demand values.
4. Pipe Network:	Determine the required project network piping based on the service area map, customer locations and the design standards and guidelines including associated fire hydrants and valving.
5a. System Planning: Determine Requirements Network	Prepare the proposed network hydraulic model analysis based on criteria in Sections V and VIII. If the results of the modeling efforts show that a pump station is necessary, proceed to Step 5b. Otherwise, proceed to Step 6.
5b: RPS Planning: Determine Pumping Requirement	Prepare a preliminary RPS station design based on Section VII and the duty points identified in the hydraulic model. Provide storage facilities as required and incorporate into the piping and pump station networks.
5c: Pump Planning: Refine Booster Pumping Requirement	Based on the results of the initial modeling, modify the design if needed and re-run the model with the revised pump data until a design is created which satisfies the requirements.
5d. System Planning: Determine Surge Protection Configuration	Perform a transient analysis of the network model to determine the extent of surge protection required.
6. General: Determine required monitoring requirements	Determine based on each specific project needs which of the monitoring devices listed in Section VI, Table VI-5 are required.
7. Fire Flow Simulation	Application of fire hydrant criteria as presented in Table VI-9 should be discussed both with CD and KM with respect to the specific requirements of the development projects being designed.
8. Option Analysis & Recommendation	Perform network analysis by setting all criteria and necessary inputs. Consider all options and present recommendations.
9. Prepare Engineer's report	Prepare Engineer's report based on criteria presented in Section II.
10. Seek KM approval	Present the Engineer's Report to Water Planning Department for review and approval before proceeding.

V. DESIGN CRITERIA OF WATER PIPELINES

The design engineer is directed to adhere to the following design criteria unless project conditions require deviation from these standards. If the design engineer determines a deviation is warranted, approval should be obtained from Water Planning Department prior to continuing with design.

V.1 Public and Private Water Mains

All pipelines and appurtenances upstream of the customer's main meter are the responsibility of KM. All pipelines and appurtenances downstream of the customer's meter are the

responsibility of the Owner and should comply with all Qatar and KM standards, guidelines, procedures, processes, and specifications.

All engineering plans shall clearly differentiate between all portions of the public and private water distribution system.

V.2 Easements for Water Mains

The Qatar Highway Design Manual and Ministry of Municipality and Urban Planning (MMUP) designated utility corridor arrangements/reservations should be followed where applicable. In general, deeper utilities are to be installed prior to shallower utilities.

Any deviation from the MMUP standards not located in designated corridor must be approved by Water Planning Department.

Water lines shall be placed on the north and east side where possible except where it is impractical or more expensive to do so, or where there is already an existing line.

V.3 Routing and Layout Requirements

Below are the minimum requirements in routing and layout for pipes:

- All water mains shall be constructed in streets within the water utility reserves as per Road Affairs Road Hierarchy for safe and quick access to all KM water mains at all times for repair of pipe breakages, install service connections and perform preventive maintenance.
- Pipelines should never be laid on private boundaries to ensure accessibility of the line during maintenance and repair of the pipes.
- There maybe some instances where the standards cannot be applied. Hence, adjustments or deviations from the standards for individual special cases will be made through mutual agreement with other utility departments and with the approval of KM Water Planning Department.
- In main highways or wide roads, the economics of laying secondary distribution mains on both sides of the road must be considered to minimize the need for long service pipes across the road. A secondary distribution line should be laid along side a primary distribution line 400mm and larger, except where there are no houses yet. In this case, outlets or stub-outs should be provided for future parallel secondary distribution line.
- Provision (such as Tees) for future extensions should be considered at all road intersections.
- All water lines shall be laid as straight as possible. Avoid excessive number of high points and low points along the line and between cross street connections as they create air pockets.
- Minimum radius of curve and maximum deflection angle of pipe joints will be restricted to 75% of manufacturer's recommendation, after which the use of horizontal or vertical bends will be required.

V.3.1 Continuity of Service

When existing service areas are impacted by new construction, provide continued operation of existing facilities or provide temporary facilities to maintain uninterrupted service to

customers. If disruption of service cannot be avoided, schedule such outages to the least disruptive time of day or night. Notify affected customers and minimize the time period of outage.

V.3.2 Redundancy for System Reliability

For bulk customers, two connection points to the distribution network are recommended. The primary connection point is metered. The secondary point is connected by a normally closed isolation valve that can be opened to allow uninterrupted service in case the primary supply point is shut down for maintenance or repair. An adjacent District Metering Area (DMA) with a connecting main is suitable for a secondary connection point.

V.3.3 Paralleling Piping System

If the system analysis recommends increasing existing pipe sizes for future pipelines, consider installation of parallel mains to minimize disruption of service during construction.

For critical customers such as hospitals, consider parallel mains to provide redundancy for increased reliability of service in case repairs or maintenance require that one main is shut down. Parallel pipelines should also be considered for pipelines critical to system operation such as distillate mains, rising mains, and reservoir inlets.

Parallel mains should be physically separated by a minimum of three (3) meters to allow excavation for maintenance without impacting the second main.

V.4 Water Main Classification for Design

Table V-1 classifies pipelines for design purposes.

Table V-1 Pipeline Classification Chart

Type Main	Size (mm)
Transmission/Rising mains	400mm and larger
Distribution Mains	
Primary	400 mm and larger
Secondary	150 – 300 mm
Tertiary	100 mm
Service Connection Mains	25 – 63 mm

V.5 Pipe Material

Only pipe materials included in the KM Specifications for Main Laying Materials are allowed. These include:

V.5.1 Ductile Iron Pipe (DIP)

Distillate, Distribution Primary, Distribution Secondary Mains and Tertiary Mains; 100 mm to 2600 mm.

V.5.2 High Density Polyethylene (HDPE)

Although HDPE pipe has been allowed in the past and pipelines up to 600 mm are currently in service as of the writing of this document, HDPE is no longer allowed as a suitable material.

V.5.3 Medium Density Polyethylene (MDPE)

Service piping 63 mm and smaller.

V.5.4 Material Specifications and References

All main laying installations should be made under the direct supervision of KM and should conform to the most current versions of the following references and specifications:

1. General Specifications of Main Laying Materials for Waterworks (Latest Edition)
2. General Specifications for Main Laying Contracts (Latest Edition)
3. Water Network Standard Drawings
4. Qatar Construction Specifications
5. Regulations of Internal Water Installations and Connection Works

V.6 Minimum Water System Design Period

Water system elements are designed to meet the demands of its service area over a design period. The economical period of design of water system elements is related to its first cost, service life, present population and present growth rate of its service area, interest rate and the ease and cost of increasing its capacity. Most of the above factors invariably vary from locality to locality, hence resulting in a variable economical period of design.

The ideal design period is based on historical data and projected future events. Experience has shown the design period given in Table V-2 can be used. If information is available to justify variance from these values consult with Water Planning Department for guidance.

Table V-2 Water System Design Period

Type of Works	Design Period (Years)
Tertiary Distribution Mains	20
Secondary Distribution Mains	20
Primary Distribution Mains	30
Source Transmission Mains	50
Pump Station	20
Reservoirs	20

The chosen design period shall be the economic life to be used in carrying whole life-cycle cost analyses of development alternatives.

V.7 Pipe Sizing

V.7.1 Minimum Pressures, Velocities and Head Losses

The pipe network should be designed to deliver safely and economically the required volume of water at the minimum acceptable pressure to consumers within district/pressure zones as provided in Table V-3.

Table V-3 Residual Pressures	
Pipe Size (mm)	**Minimum Residual Pressure (bars)**
Distribution Mains[1]	1.5
Transmission Mains	2.0

Note [1] : The residual pressure shall be met at the critical (highest and farthest) nodes of the system, regardless of whether this node is on a primary or secondary line.

Water systems shall be sized to carry the larger of the designed peak hourly flow or the average daily flow required plus fire flow without exceeding the minimum / maximum pipe velocities and the maximum head loss listed in Table V-4.

Table V-4 Allowable Velocity and Head Losses			
Pipe Size (mm)/Scenario	**Minimum Allowable Velocity (m/s)**	**Maximum Allowable Velocity (m/s)**	**Maximum Allowable Head loss at Peak Domestic Demand (m/km)**
Distribution Mains			
ADD	0.5	1.5	-
ADD+FF	-	2.5	2-5
Transmission Mains			
ADD	0.5	1.0	-
PHD	-	2.0	2-3

V.7.2 Standard Pipe Diameters

Limit pipe selection to nominal pipe sizes that are provided in Table V-5 below.

Table V-5 Standard Pipe Sizes
Pipe Nominal Diameter (mm)
100
150
200
300
400
600
900
1200
1400
1600
2000
2600

Any deviation from the above sizes must be approved by KM.

V.8 Water Demand Projection

V.8.1 Service Area

The design engineer should use the Ministry of Municipality and Urban Planning (MMUP) Policy Plan and other maps to define the project service area, land use and occupancy rates. Also, the design engineer should obtain approval of the service area boundaries from Water Planning Department. Consideration should be given to projected land uses and demand based on phasing and full development of the service area.

V.8.2 Land Use, Population, and Unit Water Demands

Table V-6 and Table V-7 present typical ranges of unit water consumption rates for various land use categories and should be used to establish water demand for development projects. However, it is the sole responsibility of the consultant/developer to accurately determine the demand required with due consideration to the nature and type of the proposed development. Justification for variance from this table should be submitted to KM for concurrence. KM must concur with the water demand forecast prior to project approval.

Table V-6 Unit Water Demands (Domestic Category)

Land Use Category	Unit	Daily Water Consumption (Liters)
Residential Building	(Per Capita)	250-400
Qatari Villas	(Per Capita)	500-800
Worker Labor Accommodation	(Per Capita)	80-150
Mixed Use Residential	(Per Capita)	250-400

(Source: KAHRAMAA Water Development Guidelines for Bulk Customers, April 2012)

Table V-7 Unit Water Demands (Non-domestic Category)

Land Use Category	Unit	Daily Water Consumption (Liters)
Mixed Use Commercial	(Per Capita)	60-80
Commercial Building	(Per Capita)	60-100
Mosque	(Per Capita)	10-50
Restaurant	(Per Meal)	10-20
Hotel	(Per Room)	200-300
Shop	(Per Capita)	60-80
Office	(Per Capita)	60-80
School	(Per Capita)	60-80
University	(Per Capita)	60-80
Medical	(Per Bed)	60-80
Public Amenities	(Per Capita)	20-50
Nursery	(Per Capita)	60-80
Guard House	(Per Capita)	60-80

Table V-7 Unit Water Demands (Non-domestic Category)		
Land Use Category	**Unit**	**Daily Water Consumption (Liters)**
Retail	(Per Capita)	60-80
Theatre	(Per Capita)	10-50
Stadium	(Per Capita)	15-20
Town Centre	(Per Capita)	60-80
Manufacturing	(Per Capita)	60-80
Workshop	(Per Capita)	60-80
Swimming Pool		Pool Volume plus the rate of re-filling/year
Warehouse/ Store/ Showroom	(Per Unit)	2, 889
MEW Electricity Substation	(Per Unit)	509
Clinics	(Per Unit)	26, 458
Gardens/ Parks/ Nurseries	(Per Unit)	85, 106
Car Wash	(Per Unit)	20, 991
Embassies	(Per Unit)	21, 205
Petrol Station (No Car Wash)	(Per Unit)	2, 559
Sports Stadiums	(Per Unit)	109, 712
Industry		
Heavy Water Using	(cum/hectare/day)	120
Light Water Using	(cum/hectare/day)	30
Precast Factory	(cum/hectare/day)	85
Garage for Heavy Truck	(cum/hectare/day)	30
Food Stores	(cum/hectare/day)	30
Industrial Store	(cum/hectare/day)	30
Livestock, (liter/head/day)		
Camel	(liter/head/day)	30-55
Cow	(liter/head/day)	100-126
Sheep	(liter/head/day)	8-20
Goat	(liter/head/day)	7-12
Chicken	(liter/head/day)	13-62
Type of Crops		
Vegetables	(liter/m^2/day)	5.37
Cereals	(liter/m^2/day)	3
Fodder	(liter/m^2/day)	18
Fruits & dates	(liter/m^2/day)	8.8

(Source: KAHRAMAA Water Development Guidelines for Bulk Customers, April 2012)

Future population projections may be used to determine water demand for large developments and projects where development categories are not yet determined. The population forecast used to develop the required demand should be based on the population of Qatar as per MMUP Annual Statistical Abstract. Also, to be considered are the current development of multi-structured facilities that require high end demands and are eventually considered as bulk demands, such as industrial, commercial, institutional and irrigation requirements.

Over the 20-year population period in Qatar from 1986 to 1997, the average population growth rate was 3.20% per year. It increased to 5.15% per year from 1997 to 2004, and from 2005 to 2010, it was projected to 5.6% per year. Thus, for a constant population projection, a growth rate of 5.60 % per year may be used for design purposes.

In the absence of census data for a given area to be served, a rough population estimate may be made based on the number of existing households and the number of persons per household as given below:

Average No. of Persons per Household = 6 persons per household

For bulk customers (including industrial, commercial, institutional and irrigation uses), individual data is required to be surveyed and analyzed.

V.8.3 Peaking Factors

The water demand over a 24 hour period averaged over the period of service is defined as the Average Day Demand (ADD). The 24 hour period of the highest demand during the study period is defined as the Peak Day Demand (PDD). In a 24 hour period, the hour of the highest demand on the PDD is defined as peak hour demand (PHD).

Listed in Table V-8 are the recommended peaking factors for design.

Table V-8 Water Demand Peaking Factors

Type Demand	Peaking Factor	
	Rising Mains	Distribution Mains
Average Daily Demand (ADD)[1]	Determined from Actual Data or Estimated from Unit Demand Values or population projections	Determined from Actual Data or Estimated from Unit Demand Values or population projections
Peak Daily Demand (PDD)[2]	ADD x 1.5	ADD x 1.5
Peak Hour Demand (PHD)[3]	ADD x 2.0	ADD x 2.5

[1]ADD determined by design engineer from worksheets
[2]PDD = ADD x PDD Peak Factor
[3]PHD = ADD x PHD Peak Factor

V.8.4 Water Loss

The design flow calculations should include allowance for losses including regular flushing volume, leakages and etc. referred to as “Unaccounted-for-Water” (UFW) as indicated in Table V-9.

Table V-9 Non-Revenue Water	
Pipe Elements	**Percent UFW**
Proposed Pipe	15%
Existing Pipe	20 to 30%

V.8.5 Fire Flow Demand (FFD)

KM provides aboveground and underground fire hydrants at regular intervals within their distribution network. As part of the hydraulic network modeling, it is required to consider at least two fire hydrants located at the remotest and highest elevation simultaneously flowing during a particular fire event. KM requirement for fire flow demand per hydrant is presented in Table V-10:

Table V-10 Fire Flow Demand Per Hydrant		
FIRE HYDRANT (FH) PARAMETER	**Unit**	**Underground and Aboveground Hydrant**
Fire Flow per FH	Li/min	1,000 (17 lps)

The designer is required to coordinate with KM and CD on the criteria to be applied for a specific project development.

V.8.6 Design Formulas and Calculations

For hydraulic analysis and pipe sizing, Peaking factors are applied to the ADD and used for system development.

Average Water Consumption (AWC)

AWC = P x Per Capita Water Consumption

Where:

P = Design Population

AWC = Average Water Consumption

Average Daily Demand (ADD)

$$ADD = \frac{P \times AWC}{1 - \%UFW}$$

Where:

P = Design Population

AWC = Average Water Consumption

ADD = Average Daily Demand

UFW = Unaccounted-for-Water

Peak Daily Demand (PDD)

PDD = PF x ADD= 1.50 x ADD

Where:

PF = Peaking Factor

PDD = Peak Daily Demand

Peak Hour Demand (PHD)

PHD = PF x ADD= 2.50 x ADD

Where:

PF = Peaking Factor

PHD = Peak Hour Demand

Water network analysis using computer modeling should evaluate the following scenarios in order to obtain the proposed system:

- ADD, Average Daily Demand
- PDD, Peak Daily Demand
- PHD, Peak Hour Demand
- ADD + FFD, Average Day Demand plus Fire Flow Demand
- PHD + FFD with Pump Shut-down Surge Condition (When Pumping is included in design)

Modeling results should include analysis of the pipe network under both new and existing conditions.

V.9 Working and Test Pressure

The distribution mains shall be designed to convey the PHD with a minimum service/residual pressure of 1.50 Bar (15m) at critical (highest and farthest) nodes of the system, regardless of whether this node is on a primary or secondary line except on transmission line with minimum residual pressure of 2.0 bar.

Working and test pressures for the pipeline classifications are provided in Table V-11.

Table V-11 Pipeline Design Pressure Chart

Type Main	Size (mm)	Maximum Working Pressure	Minimum Test Pressure
Transmission/Rising mains	400mm and larger	12 bar	18 bar
Distribution mains:			
Primary	400 mm and larger	6 bar	9 bar
Secondary	150 – 300 mm	6 bar	9 bar
Tertiary	100 mm	6 bar	9 bar
Service Mains	25 – 63 mm	6 bar	6 bar

V.10 Pipe Cover

All pipes shall have a minimum pipe cover of 900 mm from the crown of the pipeline to the finished road level or ground. However, as the primary mains increases in size, the minimum cover requirement may increase.

V.11 Separation of Utilities and Facilities

V.11.1 Separation with Utilities

Water facilities should meet the separation requirements with other utility infrastructure stated in Table V-12.

Table V-12 Separation with Utilities

Utility	Minimum Separation	
	Vertical (m)	Horizontal (m)
Sewerage		
Gravity Sanitary Sewer Mains	0.5	3.0
Sewer Service lines		0.5
Sanitary Sewer and Treated Sewer Effluent Forced Mains	0.5	3.0
Wastewater Structure	-	3.0
Storm Drains and Culverts	0.5	3.0
Electricity, MV / HV	0.5 / 1.0	1.50
Q-Tel	0.5	1.50
QP Oil/Gas	0.6	2.00
Qatar Cooling	0.5	1.50
Existing Water Main	0.1-0.3	0.5

Potable water mains should always pass above sewerage mains. Where separation with sewerage facilities cannot be met, the following modifications may be approved:

- Relay parallel sewer pipes using equivalent water system pipe and provide 0.5 m vertical separation.
- Install crossing pipes using full pipe section lengths centered at the crossing and provide a minimum of 0.25 m vertical separation.

Water main separation from wall structures should comply with setback distances stated in Table V-13.

Table V-13 Setback Distances from Structures

Pipe Size	Centerline of Pipe Set back Distance (m) to the edge/face of Structure
Pipes up to 150mm	1.5
150mm to 900mm	2.0
Greater than 900mm	4.0

V.11.2 Utility Conflicts

Where utility conflicts cannot be resolved through design modifications to the new facilities and relocation of the existing utility is required, resolution of the conflict must be coordinated and approved by both KM and the affected utility owner.

V.12 Connections to Existing Water Mains

V.12.1 General

All connections to existing water mains should be made under the direct supervision of KM and should conform to General Specifications of Main laying Contracts.

V.12.2 Connections to Transmission or Rising Mains

Connections for single connections or distribution systems to any transmission or rising mains are not allowed (Figure V-1). However, in areas where there is no reasonable alternative for providing service, KM may approve a 300 mm diameter minimum size connection and pipeline configured for a future parallel distribution system for additional services. The connection should include a minimum 300 mm tee to allow for expansions, an isolation valve, a pressure reducing valve and a flow meter at the point of connection should be installed. See Figure V-2 for this type of connection.

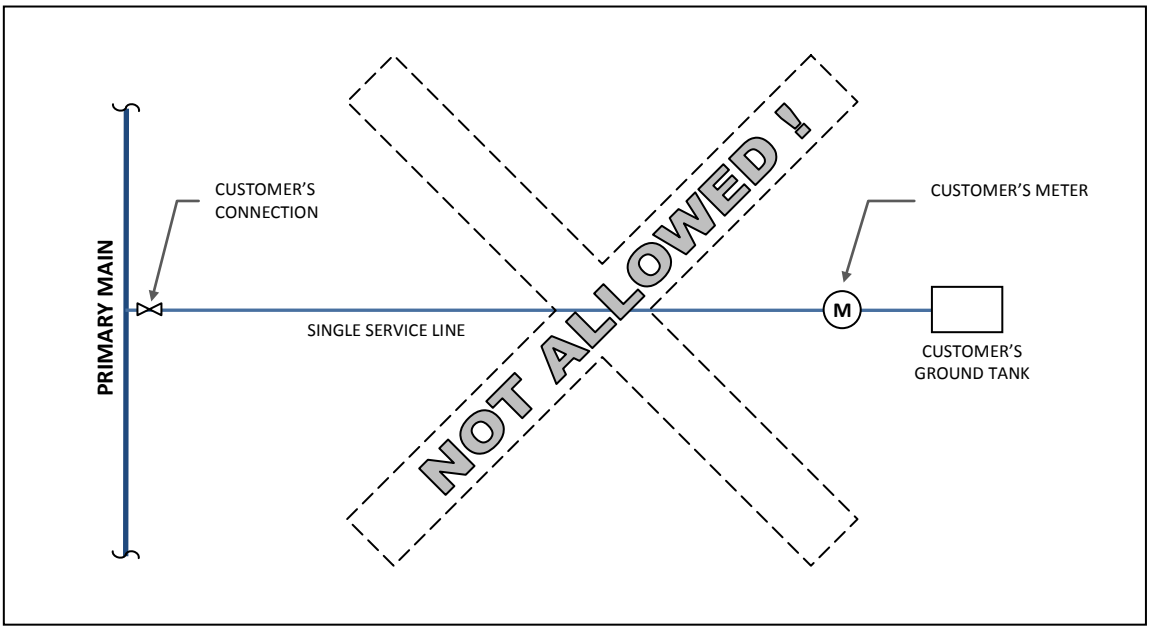

Figure V-1 Single Service Connections to Transmission or Rising Mains (NOT ALLOWED)

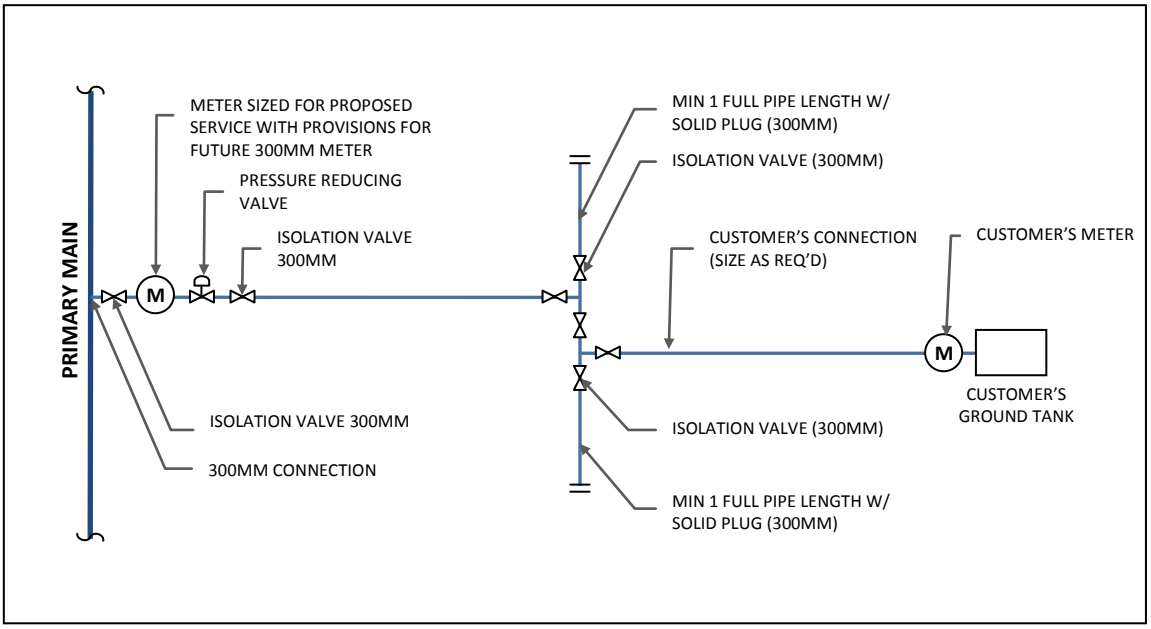

Figure V-2 Connections to Transmission or Rising Mains

V.12.3Connections to Primary Mains (Distribution)

Connections smaller than 150 mm (for single connections or distribution systems) to primary distribution mains 400 mm or larger are not allowed. In areas where there is no reasonable alternative for providing service, KM may approve a 150 mm minimum size connection and pipeline configured for a future parallel distribution system for additional services. The connection should include an isolation valve at the point of connection, a minimum 150 mm tee to allow for expansions, and isolation valves on each extension. See Figure V-3 for diagram of this type of connection.

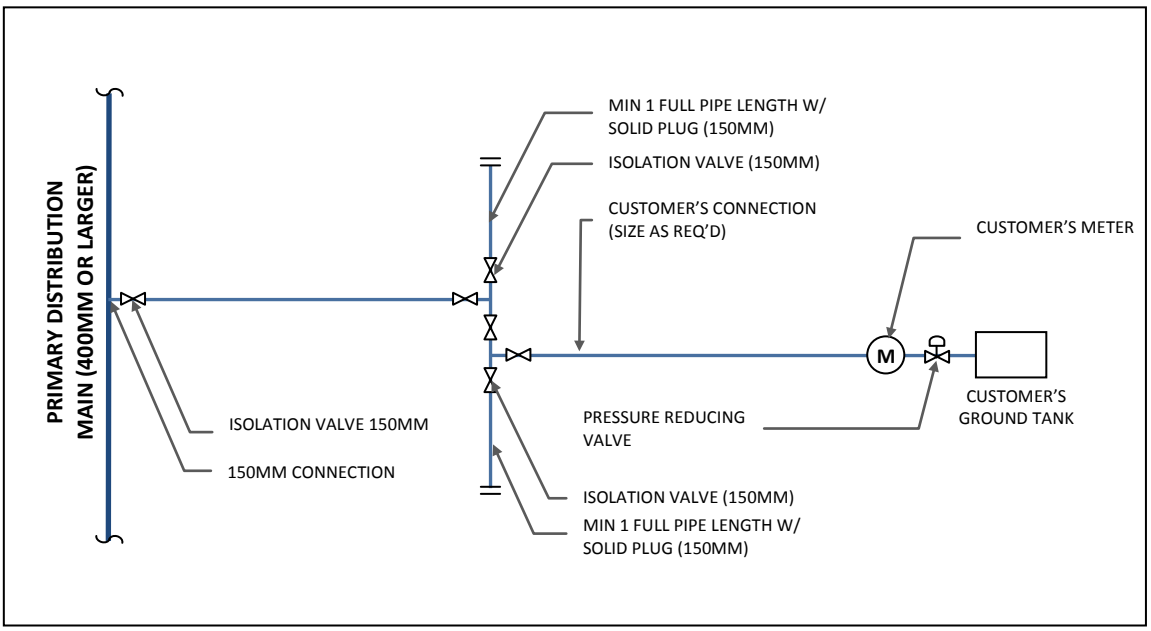

Figure V-3 Connections to Primary Distribution Mains

V.12.4Cross-Connection Control

No physical connection should be allowed between potable and non-potable sources. Install back-flow prevention where connections between any part of the potable water system and any other environment containing other substances can result in reverse flow due to back pressure. The type of protection used should be selected based upon the service conditions as identified in Table V-14.

Table V-14 Back-Flow Prevention Selection Table	
Type Connection	**Type Back-flow Prevention**
Service connection	Air gap at storage tank
Direct connection to potable water system with elevated tank or pressurized pipe network	Double check valve assembly
Direct connection to chemical feed system	Reduced pressure principle non-return valve assembly
Hydrant of other hose station with direct connection to pipe network	Check valve or vacuum breaker (except for emergency firefighting)

V.12.5Seismically Vulnerable Areas

Qatar is considered a Zone 1 classification for seismic design purposes. This is minimal and generally not of concern. One exception is to address seismic risk when designing pipelines supported on a bridge. See KM Standard drawings for details to be incorporated and comply with Public Works Authority.

V.13 Reconnaissance Works

During the design stage, a site investigation should be conducted by the designers to determine if the condition at the site imposes special requirements. Corrosive soil, level of the water table, extreme traffic loading, ground conditions, route/placement of pipe, etc. are among the environmental factors that should be considered in the design.

V.14 Drawings

Pipeline drawings should include existing utilities, existing structures, existing roadways and topographic information that may impact construction. Drawings for all primary distribution and transmission mains (pipelines 400 mm and greater) should include a profile view indicating existing ground surface elevations directly above the pipeline alignment and size and vertical clearance of existing utilities (with elevations, if known) crossing the pipeline alignment. Crossings shall be shown in both plan and profile. Plans should include details of pipe restraints if applicable.

Drawings for water lines shall show stationing, pipe size and material, bearings, and curve data to adequately define the water line location. Water line dimensions including distances to structures, right-of-way, face of curb, edge of pavement, and property lines shall be shown. The drawings shall also show all appurtenances, water service connections and water meters.

V.15 Oversizing Requirements

The water main can be oversized based on the future development as per the policy plan.

Where proposed pipe networks are impacted by future water demand projected by KM, those future demand values should be provided to the consultant and included in the water network design. Pipe sizes larger than those required for the specific development may be considered when including future demands provided by KM.

VI. VALVES AND APPURTENANCES

All the required appurtenances should be laid in accordance with KM General Specification of Main Laying Materials for Water works.

VI.1 Isolation Valves

Mainline valves should be the same diameter as the pipeline. On distribution mains in residential areas valves are placed at street intersections and on each smaller main as it leaves the larger main. In general, valves are placed at the tees in 2 directions. In commercial and industrial areas valves should be placed on each branch of tees (all sides).

Pipe cross fittings are not allowed.

The maximum spacing of valves for long pipe lines shall meet the requirements of Table VI-1. Pipe grid systems shall be along the run at intervals of four blocks and not more than the spacing shown in Table VI-1.

Table VI-1 Valve Types and Spacing

Pipe Size (mm)	Maximum Spacing Between Valves (m)	Valve Type
900 and greater	2000	Butterfly Valve
600	1000	Butterfly Valve
400	600	Butterfly Valve
100 to 300	300	Sluice Valve
Less than 100	300	Sluice Valve

Note : In addition to maximum spacing indentified in the table, valves should be located at critical interconnections and inside pumping stations as required by WTDD.

Where future water main extensions are anticipated valves are placed, where possible, so that customers are not out of service during connection work. In most cases, this calls for a line valve within six (6) meters from the end of the main.

Valves for fire hydrants are perpendicular to the water main and in line with the fire hydrant; no offsets are allowed. Valves in the distribution system should be placed so that pipe sections can be isolated such that no more than 2 fire hydrants are out-of-service at any one time in the event of a main break. Place valves at the connection to the main for all fire services including hydrants.

If KM requires the installation of Electronic Monitoring and remote operation equipment, the line valve must be a butterfly valve with rectangular vault, housing the valve operator and telemetry equipment.

VI.2 Air Valves

Air valves are required at strategic locations along pipelines to prevent air binding during filling operations, allow the continual release of air during normal operations, and to facilitate draining of the main. Design should follow recommended practice as described in AWWA Manual M51 or similar design reference. Types of air valves are described in Table VI-2.

Table VI-2 Air Valve Types	
Type	**Description**
Single Air Valve Small Orifice Type (Air-Release)	Small orifice valves designed to automatically release small pockets of accumulated air while system operates under pressure.
Single Air Valve Large Orifice Type (Air/Vacuum)	Large orifice valves designed to exhaust large quantities of air automatically during pipeline filling and admit large quantities of air when the internal pressure drops below atmospheric pressure. Negative pressure may be caused by column separation, pipeline draining, pump failure, or a pipeline break.
Double Air Valve (Combination)	Both small and large orifice valves designed to provide both functions of air-release valves and air/vacuum valves.

Typical locations for air valves are shown on the sample profile in Figure VI-1 and in Table VI-3.[1]

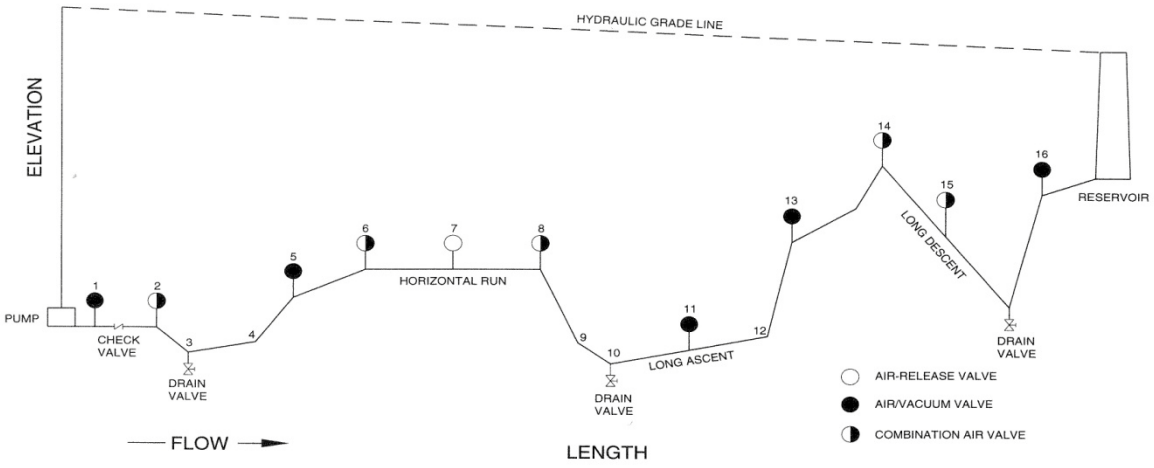

Figure VI-1 Sample Profile

Table VI-3 Typical Air Valve Locations					
No.	**Description**	**Recommended Type**	**No.**	**Description**	**Recommended Type**
1	Pump Discharge	Air/Vac	9	Decreasing Down slope	None required
2	Increasing Down slope	Combination	10	Low Point	None required
3	Low Point	None required	11	Long Ascent	Air/Vac or Combination

[1] AWWA M51: Air-Release, Air/Vacuum, and Combination Air Valves

Table VI-3 Typical Air Valve Locations					
No.	**Description**	**Recommended Type**	**No.**	**Description**	**Recommended Type**
4	Increasing Upslope	None required	12	Increasing Upslope	None required
5	Decreasing Upslope	Air/Vac or Combination	13	Decreasing Upslope	Air/Vac or Combination
6	Beginning Horizontal	Combination	14	High Point	Combination
7	Horizontal	Air Release or Combination	15	Long Descent	Air Release or Combination
8	Ending Horizontal	Combination	16	Decreasing Upslope	Air/Vac or Combination

All air valve design calculations require KM review and approval.

Air inlet and discharge vents for valve chambers should be at least 0.5 m above finished grade when possible. It should have a downward-facing vent opening with insect screen. Where it is not practical to install an air vent above grade the below-grade chamber must be rated for appropriate traffic loading in traffic areas, and the chamber must drain to daylight.

VI.2.1 Air Valve Assemblies

Primary mains between valves shall be treated as an independent unit with provisions for dewatering, filling, removing air and adding air as appropriate for the primary main construction and maintenance. Air valve assemblies shall be installed at all profile high points in the primary mains at locations approved by Water Planning Department with sizes as presented Table VI-4

Table VI-4 Air Valve Sizing	
Main Diameter (mm)	**Washout Size (mm)**
2000	300
1600	250
1400	250
1200	200
900	200
600	150
400	100

VI.3 Control Valves

Hydraulic modeling must verify the need for the control valve function and location, and requires KM approval. A description of the application of each type of valve is included in Table VI-5.

Table VI-5 Application of Control Valves in System Design	
Valve Type	**Application**
Pressure Reducing Valve (PRV)	A control valve that opens to allow flow if the downstream pressure is less than a certain value and that closes when the set pressure is reached. A pressure reducing valve ensures that the downstream pressure does not become too high. It is used between Transmission / Distribution mains where the distribution pressure is lower and in other situations that require reductions from higher-pressure planes to lower-pressure planes.
Pressure Sustaining	A pressure sustaining valve controls the pressure between two zones of high demand maintaining the appropriate pressure on the upstream system while allowing flow to move into the lower pressure demand area. These valves also protect against the demand in the lower pressure area depleting the pressure from the area supplying it. Pressure sustaining valves are fully automatic and are easily adjustable based on system operational parameters.
Pressure/Surge Relief	A pressure/surge relief valve is a fast opening valve used to dissipate excess pressure in a system during events such as pump start up, but slow closing to avoid surge within the system. Pressure/surge relief valves are automatic and easily adjustable based on system operational parameters.
Flow Control	A flow control valve regulates the flow and pressure of a pipe system. Flow control valves respond to signals from separate systems such as flow meters or flow control PLC units.
Level Control Valves (Altitude Valves)	Level control valves are automatic valves that close when a reservoir or other system reaches a predetermined elevation (i.e. tank full) and opens once the tank is depleted to a level requiring filling. Level control valves can be either pressure controlled or electronically controlled. Tank levels can be controlled locally at the tank or remotely via PLC controller.

Design should follow recommended practice as described in design references such as AWWA M44. All control valve design calculations require KM review and approval.

VI.4 Non-Return Valves

Non-return valves should be installed where backflow from a pressurized source can occur should system pressure be lost. This includes vaults that may be flooded, fire hydrants, and any location where a hose may be connected to the water system. Refer to cross-connection control for appropriate non-return valve types and applications.

VI.5 Wash-Out Valves (Flushing)

Install washouts or hydrants at low points and dead-ends. They should be designed to achieve a minimum velocity of 0.5 m/s in the main. Washouts should be sized using Table VI-6.

Table VI-6 Washout Sizing	
Main Diameter (mm)	**Washout Size (mm)**
Greater than 1200	250
1200	250
900	200
600	200

Table VI-6 Washout Sizing	
Main Diameter (mm)	**Washout Size (mm)**
400	100
Less than 400	No less than 2 diameter sizes smaller than the main diameter

VI.6 Flow Metering

Metering and monitoring points are required at strategic locations. Installation requirements vary based upon the meter configuration category. All meter installations should be provided with isolation valves.

VI.6.1 Domestic Meters

Domestic meters can be broken down into small and large configurations. Customer meters are provided for all service connections and should be placed at the property line.

VI.6.1.1 Small Meters

Flows less than 165 m^3/day (6.9 m^3/hr) are considered small meters.

VI.6.1.2 Large Meters

Flows greater than 165 m^3/day (6.9 m^3/hr) but less than 600 m^3/day (25 m^3/hr) are considered large meter customers.

VI.6.2 Service Connections & Water Meter Requirements

All service connections and water mete materials and installations shall be as per KM specifications. Other requirements are given below:

- In new developments where new mains are installed, service connections and electronic water meters shall be installed to each prospective consumer.
- Every separate property or building shall be supplied with a separate service connection and water meter. A single service line and a master meter could be used for two or more buildings located on the same lot or for housing complex or like within one lot/property.
- New service connections, as much as possible, shall be limited in size to 50% of the water main diameter. On looped mains, there shall be a limited number of service connections comparable to the equivalent existing main capacity.
- Electronic water meters shall be used.
- Service connections shall be MDPE.

VI.6.3 Bulk Customer Meters

Flows equal to or in excess of 600 m^3/day (25 m^3/hr) are considered bulk customers. A bulk customer meter will be required to measure flow into the development. Depending upon the nature of the development, such as a housing complex, additional meters inside the customer's property may be required.

In addition to measuring flow, other parameters to be monitored include pressure and water quality. Locations of monitoring facilities will be as directed by KM during project development.

VI.6.4 District Meters

Flow meters should be installed at the points where major supplies enter the network, downstream of main divergence points on the transmission or distribution system main, and at entry points to District Metered Areas (DMAs) and other distribution blocks. A monitoring insertion point should be provided at each meter location.

VI.6.5 Facility Meter

IWPP connection points and inlet and outlet piping to RPS facilities require metering and pressure sensing instruments with SCADA for continuous real-time monitoring.

VI.7 Monitoring Stations

Monitoring stations to allow insertion of instruments to monitor various functions are required for special purposes as identified in the meter classification descriptions above. Quadrina Insertion points at each district and bulk metering point are required. Insertion stations are required in DMAs at high and low points for monitoring system pressures. Insertion points are also required at select locations as determined by KM throughout the distribution network where water quality or system parameters must be determined for reliable operation.

Monitoring stations consist of a ferrule with an isolation valve that provides a minimum of 50 mm clear opening. The station should be located in a straight section of pipe at a minimum of 10 pipe diameters upstream and 5 pipe diameters downstream of any fittings or connections that may influence the water flow pattern. At locations where flow may reverse, the minimum downstream straight pipe length should be increased to 10 pipe diameter.

Examples of typical metering and monitoring appurtenances/applications include:

- Flow Metering – Provide meters at all service connections and elsewhere in the pipeline network as determined by KM.
- Pressure Transmitters – Provide pressure monitoring stations at locations selected by KM.
- Pressure Regulating Valves – Install pressure regulating valves when connecting to higher pressure network system components.
- Water Quality Controls - Analyzer Stations for measuring pH, residual chlorine, conductivity and temperature should be installed at locations identified by KM.
- Water SCADA Requirements - KM requirements for SCADA systems shall be discussed and complied with KM Water Control Section (NWCC), Technical Affairs and Water Planning Department.

Table VI-7 presents water monitoring and sampling location design steps.

Table VI-7 Sampling Point Location Design Steps			
Design Steps	**Type of Sampling Point**		
	Manual	**Quadrina Station**	**Automatic with Telemetry**
1. Review Distribution Network Map Layout and Water Quality Analysis from Computer Modeling (if done).	-	-	-
2. Identify KM required monitoring points:			
A. Standard locations for Distribution Network			
i. Dead end lines	X	-	-
ii. DMA Metering Point	-	X	-
iii. DMA High & Low Points	-	-	X
iv. Upstream and Downstream of Disinfection Points	-	-	X
v. IWP Metering Point	-	-	X
B. RPSs			
i. Inlet Piping from Source	-	-	X
ii. Outlet Piping to Distribution System	-	-	X
C. RO and Wellfield Facilities - as directed by HSE and Water Laboratory	X	X	X
3. Identify KM Project Specific monitoring points: This step requires coordination with network water quality modeling to identify areas of potential poor water quality. In addition, KM may desire to monitor miscellaneous points in the system for other reasons. The location and type of sampling point equipment to be installed will be directed by HSE and Water Laboratory.	X	X	X

Additional monitoring requirements for district metering locations are to be determined by KM during the project development phase which may include the following parameters:

- Pressure
- Water Quality Stations
  - pH
  - residual chlorine
  - conductivity
  - temperature
  - Oxidation-Reduction Potential (ORP)

VI.8 Appurtenance Chambers and Boxes

In-situ concrete chambers shall be provided in primary & transmission pipes 400 mm and larger pipes and pre-cast concrete boxes for 300 and below mains.

All valves assembly, chambers, boxes and covers shall conform to the specifications of main laying materials and specifications of main laying construction.

VI.8.1 Chambers and Access Manholes

For developments that are proposed to be phased, the chamber and piping must be sized for the meter or valves required for the ultimate build out of the development. However, the initial meter installed must be sized to accurately capture the range of flows for the first phase. It is expected that in most cases the water meter size will be at least 1-2 sizes smaller than the water service connection pipeline.

Access manholes shall be provided in 400mm and larger pipes to allow for inspections during construction and to serve later on during repairs.

VI.8.2 Meter Boxes

Consideration should be given for future conditions when sizing the box for meters and instruments. Provide adequate space for future modifications if anticipated. Provide precast structures unless sizes or special conditions require in-situ placed concrete.

VI.9 Corrosion Protection

Engineers should consider protection from external corrosion in areas where corrosive soils are prevalent or when pipelines, for whatever reason, leave the soil environment. This protection is especially true for bridge crossings in salt-water (coastal) environments or other harsh environments. Engineers should also evaluate and, if appropriate, protect metal pipes from corrosion due to stray electrical currents in the soil. This usually occurs when metal pipes are near or cross major oil or natural gas pipelines protected by impressed current.

VI.9.1 Protective Coatings

Install protective tape wrap and coating systems on all ductile iron pipe and appurtenances complying with KM's *General Specifications for Main Laying Materials for Waterworks*.

VI.9.2 Cathodic Protection

In general, cathodic protection in conjunction with highly effective dielectric coatings should be provided if any of the following conditions exist:

- Soil resistivity is 12,000 ohm-cm or less (measured in the field only) or 5,000 ohm-cm or less (measured in a laboratory in saturated condition), or when a wide range of soil resistivities exists regardless of their absolute values.
- Soil with high chloride or sulfate concentrations.
- Waters with high chloride concentrations, high TDS, or high dissolved oxygen concentration
- Areas subject to stray electrical currents.

VI.10 Thrust Restraint

All bends, fittings, isolation valves, and bulkheads should be restrained to counteract joint movement where unbalanced, internal pressures exist.

Design thrust restraint systems shall be based on soil parameters obtained from geotechnical investigations when available or use typical soil values for the type soils anticipated to be encountered plus a minimum factor of safety of 2.

All thrust blocks and anchorage shall be designed to resist the specified field hydrostatic test (minimum of 9 bar or 1.50 times working pressure whichever is higher). Thrust blocks and anchorages for restraint joints or thrust blocks shall be used for all bends (vertical and horizontal) and fittings or where joint devices are required.

When multiple vertical bends are required for utility clearances, all fittings are to be designed with restrained joints or rigid connections in addition to concrete thrust blocking.

VI.10.1 Joints

Use restrained joints where concrete thrust blocks are not practical due to space limitations or where future excavation may disturb the thrust block supporting soils. Restrained joints may be used independently or in combination with concrete thrust blocks.

When multiple vertical bends are required for utility clearances, all fittings are to be designed with restrained joints or rigid connections in addition to concrete thrust blocking.

VI.10.2 Blocking

Concrete thrust blocks may be used where adequate space is available and future excavation adjacent to the installation will not disturb the supporting soils. Blocking must be poured against undisturbed soils.

Refer to the Standard Drawings for typical details of each type of thrust block. Results from geotechnical investigations should be compared with the design parameters used for design of the standard blocking shown on the Standard Drawing.

VI.11 Fire Hydrant Requirements

VI.11.1 Use of Fire Hydrants

KM installs fire hydrants along the water distribution system. However, KM fire hydrants serve multiple purposes as defined in Table VI-8.

Table VI-8 Fire Hydrant Use Descriptions

Use	Location and Description
Firefighting	Located at specified separation distances to provide access to water source for fighting fires
Air Release (Line filling)	Located at high point in line to allow release of air when filling a pipeline only (not for release of accumulated air during normal operations)
Flushing and Draining	Located at low point in line to allow discharge of water when flushing or draining a pipeline
Water Quality Monitoring	All locations provide access to system to obtain water samples for testing purposes.

Table VI-8 Fire Hydrant Use Descriptions	
Use	**Location and Description**
Flow and Pressure Characteristics Monitoring	All locations provide access to system for flow and pressure measurements for system evaluation and modeling calibration

VI.11.2 Fire Hydrant Design Criteria

Several factors contribute to the configurations of fire hydrants. Table VI-9 summarizes the current design criteria and guidelines in the development of fire hydrants for KM. The application of these criteria shall be discussed with KM with respect to the specific requirements of the development projects being designed.

Table VI-9 Fire Hydrant Design Criteria		
FIRE HYDRANT (FH) PARAMETER	**Unit**	**KAHRAMAA (KM)**
		Underground and Aboveground Hydrant
Fire Flow per FH	Li/min	1,000 (17 lps)
Residual Pressure @ FH	Bar	1.50
No. of FH Operating Simultaneously	#	2
Flow Duration	Hours	2[2]
Hydraulic Modeling Scenario	-	ADD + Fire Flow
FH Size	mm	▪ 150mm for 150mm mains and bigger ▪ 100mm for 100mm mains
FH Location	-	All areas
FH Spacing	m	▪ 150m for urban ▪ 250m for rural ▪ 150m for industrial/ commercial ▪ 250m max. for high/low points
Minimum main size	mm	100

Other fire hydrant requirements are as follows:

- Fire hydrants shall be placed on water utility reserves and shall be installed at convenient spots for firefighting such as at street intersections and junctions.
- Where long block lengths require the use of intermediate fire hydrants, they shall be placed in line with the property boundary between adjacent lots or parcels of land.
- Dead end lines shall be provided with hydrants or terminal hydrants, not necessarily for firefighting but for draining off the pipeline from foreign materials.
- Hydrants shall be CD approved aboveground double pillar type with a minimum 100mm nominal diameter barrel.
- Hydrants with more than two outlets shall have appropriately sized larger barrel size.

[2] NFPA 13 Table 11.2.3.1.2

- Each hydrant shall have at least two outlets. Outlets shall be 65mm nominal diameter.
- The minimum size water line used for fire protection shall be 150 mm in size and shall be looped to provide feed from at least two directions. However, for areas having 100 mm diameter distribution pipeline, a 100 mm belowground fire hydrant could be installed.
- Hydrants shall be located such as to maintain a minimum of 6m clearance from any building or hazards.
- Hydrants shall be so located such that they will not be obstructed by parking, loading and unloading of vehicles, landscaping features and other obstructions.
- Consideration shall be given to protection from mechanical damage.

VII. RESERVOIR AND PUMPING STATION

VII.1 Reservoir Basic Function

Adequate storage plays in important role in sustaining KM water distribution network. All pumping stations draw its water from a number storage reservoirs strategically arranged within the confines of a typical RPS. Regardless of the type of construction and material used, a potable water reservoir has the following essential functions:

- To provide adequate storage and emergency reserve in case of outages and interruptions from the production/treatment plan and transmission main.
- To balance or equalize downstream daily variations in demand with relatively constant rates of inflow and to cover peaks in demand.
- Permit high service pumps at desalination plants to operate at a relatively uniform rate.

VII.2 Reservoir Shape and Type of Construction

Reservoirs should be designed and constructed with at least two compartments so that one can be drained for maintenance without having to put the whole reservoir out of service. The tank's shape generally follows the type of construction adopted and materials used for construction:

- A rectangular tank is suitable for a cast in-situ reinforced concrete tank while a circular (cylindrical) tank goes well with a pre-stressed concrete or steel tank.
- For a two-compartment rectangular reservoir, the most economical plan shape is when its length is one and half times its breadth.
- Buried and partially buried tanks minimize heating of the water and have fewer aesthetic issues than tanks at grade, but have poor accessibility for cleaning, maintenance and repairs.
- Concrete tanks generally need coating re-application on a much less frequent basis than do steel tanks.
- Rectangular tanks can be compartmentalized offering more flexibility for the flow paths and outages for maintenance and cleaning.
- Circular tanks, other than a concentric tank design (small tank within a larger tank), do not offer the same flexibility. However, circular tanks are less likely to have dead zones where solids can settle, and they have no corners, making them easier to clean.

VII.3 Storage Sizing

Storage facilities shall have a capacity to meet projected water demand including fire water storage, emergency and standby reserve. It is the design engineer's responsibility to understand the applicability of the requirements stated in this section as it relates to storage reservoirs.

The KM system has several storage reservoirs coupled with pumping stations to provide pressure to the distribution system. There are five storage volume components designers must consider when sizing total storage volume:

1. Operational storage (OS)
2. Equalizing storage (ES)
3. Standby storage (SB)
4. Fire storage (FS)
5. Dead storage (DS)

Figure VII-1 illustrates each of these components. Only effective storage volume, as defined in Section VII.1, can be used to determine the actual available, or design storage volume. In KM context, the minimum effective storage volume should not be less than twice the projected average day demand (ADD) derived at the design year.

If the project is to be phased and two or more storage reservoirs are ultimately required, the initial or first phase storage reservoir shall include the capacity for the total project (all phases) fire flow storage and emergency storage plus the peak hour storage requirement for the first phase water demand.

VII.3.1 Effective Storage Volume

Effective storage volume is equal to the total volume less the dead storage (DS) built into the reservoir (i.e., Effective Storage Volume = OS + ES + SB + FS). Total reservoir volume, as measured between the overflow and the reservoir outlet levels, is typically not equal to the effective volume available to the water distribution system. A minimum storage water level may be needed to provide sufficient suction head for pumps to withdraw water from a reservoir to feed directly into a distribution system. Conversely, the rate and pressure of the water feeding into a reservoir may limit the top water level, making the upper volume of the reservoir unavailable and not a part of the effective storage of the reservoir.

VII.3.2 Operational Storage (OS) Volume

Operational Storage Volume is the volume of the reservoir devoted to supplying the water to the distribution system under normal operating conditions, but with no source water entering the reservoir. When the reservoir is full, OS provides a safety factor beyond that provided by the ES, SB, and FS as shown in Figure VII-1.

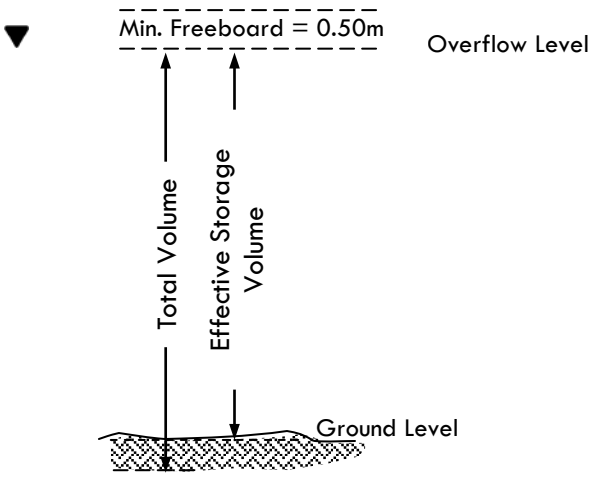

Figure VII-1 Reservoir Storage Components

VII.3.3 Equalization Storage (ES) Volume

When the source flow rate into the reservoir cannot meet the periodic daily (or longer) peak demands placed on the water distribution system, equalization storage (ES) volume must be provided to maintain water supply to all service connections. Several factors influence the ES volume, including peak diurnal variations in water system demand, source production capacity, and the mode of source water operation. The design engineer must consider source water hydraulic capabilities to properly evaluate ES requirements and design of each storage system.

1. ES sizing will require developing a peak day demand (PDD) diurnal curve for the water distribution system demand. Diurnal demand varies due to water system size, season, and type of demand (residential, commercial, industrial, and recreational). After developing the PDD diurnal curve, the design engineer can calculate the required ES by determining the difference between supply and demand over the course of the day. Extended period simulation hydraulic models can be used for this purpose. As a general guideline, the volume of ES needed using constant pumping is about 10 to 25 percent of the PDD.
2. For multiple day demand, the ES volume will increase significantly if the source(s) cannot meet the PDD. In such cases, the design engineer can calculate the difference between supply and demand over multiple days to determine the required ES. This approach requires developing water system-specific diurnal demand curves. Extended period simulation hydraulic modeling may be needed to confirm that system demand can consistently be met.

VII.3.4 Standby Storage (SB) Volume

Standby storage (SB) provides a measure of reliability in case source water systems fail or unusual conditions impose higher demands than anticipated in the distribution system. The SB volume recommended for storage reservoirs with one source of water may differ from storage reservoirs being fed by multiple sources. It is the responsibility of the design engineer to investigate and understand the hydrodynamics and reliability of all sources that will be feeding into a storage reservoir to determine the appropriate SB volume needed.

1. **Water Storage Reservoirs Supplied by a Single Source.** It is recommended that storage reservoirs fed by a single source have a SB volume at least equal to the average daily demand (ADD) or one day of storage as defined by Equation (2).

$$SB_{TSS} = (ADD) \qquad \text{Eq. (2)}$$

Where:

SB_{TSS} = Total standby storage for a single source water system (m^3)

ADD = Average day demand for the design year (m^3/day)

2. **Water Storage Reservoirs Supplied by Multiple Sources.** Water systems supplied by multiple sources should have SB volume based on Equation (3).

$$SB_{TMS} = (ADD) - tm\ (Q_S - Q_L) \qquad \text{Eq. (3)}$$

Where:

SB_{TMS} = Total standby storage component for a multiple source water system (m^3)

ADD = Average day demand for the design year (m^3/day)

Q_S = Sum of all installed and continuously available supply source capacities, except emergency sources (m^3/day)

Q_L = The largest capacity source available to the water system (m^3/day)

tm = Time the remaining sources are pumped on the day when the largest source is not available (minutes). Unless restricted otherwise, assume 1,440 minutes

3. **Reduction in Standby Storage.** SB volume can be reduced if additional water supply sources are available and there is emergency power that starts automatically if power is lost at the primary water source.

VII.3.5 Fire Storage (FS) Volume

When a dedicated fire standpipe system is being supplied from the water reservoir, a fire storage shall be provided.

This fire storage (FS) level depends on the maximum flow rate and duration requirements needed in the supplying distribution system in accordance with KM fire hydrant guidelines. The minimum FS volume for water systems served by single or multiple supply sources is the product of the required flow rate (expressed in liters/min) multiplied by the flow duration (expressed in minutes) as provided in Equation (4).

$$FS = (FF)(\ t_m\ ) \qquad \text{Eq. (4)}$$

Where:

FF = Required fire flow rate (l/min)

t_m = Duration of FF rate (min)

VII.3.6 Dead Storage (DS) Volume

Dead storage (DS) is the volume of stored water not available at all times. It is the total storage below the invert level of the lowest discharge outlet from the reservoir. The dead storage usually contains accumulated silts and suspended solids which should not enter into the distribution system. The dead storage volume should not be more than 5% of the reservoir's volume.

VII.4 Disinfection System Requirements

The treatment of water within the reservoir and pumping station may include the use of chemical disinfection methods including chlorine and chlorine dioxide, or other disinfection methods.

Due to the storage projects, no set design criteria can be maintained for all sites. A general set of criteria has been developed in order to provide guidelines for the design of each site as follows:

- Monitor the chlorine residual in a continuous sample taken from a location that will represent the chlorine level in the reservoir.
- If the chlorine residual falls below the set point of 0.20 ppm, for example, then the chlorine additive system is activated.
- When the chlorine system is activated, a reticulation pump starts and a chlorine solution is added to the water to raise the free chlorine level in the reticulation water to approximately 1 ppm.
- The reticulation pumps will be sized to turn the full volume of the reservoir over in a maximum of 3 days. Each site will have somewhat different point/points from which the reticulation pump will draw its suction. The typical discharge point will be approximately 180 degrees from the inlet/outlet piping. Using this piping system, the chlorinated water will be dispersed into the stored water and eventually turn the volume of the reservoir over with chlorinated water.
- When the chlorine residual in the continuous sample reaches a set point of approximately 0.40 ppm, the reticulation pump, without the chlorination system, will be started. This will help to circulate any newly added water with adequate chlorine residual and a minimum chlorine level in the reservoir.

Chlorination facility maximum design criteria are presented in Table VII-1.

Table VII-1 Chlorination Facilities Maximum Design Criteria

Item	Design Criteria
Low Level Chlorine	0.20 ppm
High Level Chlorine	1 ppm
Design Chlorine Dosage	1 ppm
Volume Turnover Maximum Time Required	3 days
Chlorine Monitoring	Constant, amperometric method

VII.5 Pumping System Planning Criteria

The Pumping Station Design Standards include:

- Pumping unit types and selection criteria.
- Matching pump curves to meet the required system hydraulics characteristics.
- Number of pumps, including stand-by and maintenance pumps.
- Vibration and cavitation considerations.
- Provisions for expansion of the pump station for future flows with minimal disruption of operations.
- Pump station layout and appurtenances to be provided.
- Power requirements including variable frequency drives and motor selection criteria.
- Pump control philosophy and data to be relayed to the NWCC.

The minimum requirements for pumping facilities and booster stations are as follows:

- The pumps shall be selected to provide the minimum required pressure of 1.5 bar (15m) at the farthest and highest node of the distribution network.
- The pumping station shall consist of group of pumps of equal operating capacity and installed in parallel.
- The number of duty and stand-by pumps shall always be n+2, where "n" is the number of duty pumps + 1 (stand-by pumps)+ 1 (maintenance pumps).
- Two (2) numbers of pump slots for future use shall always be included in the design of pump arrangements.
- The pumps total capacity sizing shall be based on a peak hour demand (PHD).

Piping configurations shall include the following:

- All the piping within the pump stations shall be provided with restrained or rigid joints.
- Isolations valves shall be provided for each pump assembly
- Discharge piping shall include:
    - End spools
    - Non-return valves
- Pump discharges shall be joined to a common header, which shall pass through a flow meter as per KM Standard for Meter Assembly.
- Surge protection for the pump shall be installed after the discharge header as well as surge protection devices for the pipes.

VII.6 Number of Pumping Units

The pumping station peak design flow rate should be achieved with all duty pumps operating at the design head condition. A minimum of two duty pumps should be provided in each pump station. As a general guideline, the maximum capacity of any one pump should be limited to approximately 1.0 m^3/s unless this leads to an excessive number of pumps. Table VII-2 provides general guidance for the required number of pumping units.

Table VII-2 Number of Pumping Units				
Rising Main Min. Flow Rate (m^3/s)	Rising Main Peak Flow Rate (m^3/s)	Capacity/ Pump, (m^3/s)	Number of Duty Pumps	Number of Standby and Maintenance Pumps
0.5	1.5	0.5	3	2
1.0	3.0	0.5	6	2
2.0	6.0	1.0	6	2

VII.7 Pump Drives

Water supply and distribution pumps will be driven by electric motors. Power supply is fed from KM Electrical Network. Other power sources such as diesel and other fuel types will be used for emergency power only.

The following characteristics will be included as considerations for the design engineer:

- Motor to be in conformance with Section 4 – Electrical Works, of KM standard specifications.
- Minimum motor efficiency of 93% at the specified operating point.
- Allow a maximum rotational speed of 1500 RPM.
- Limit the starts per hour to motor manufacturer's recommendation.
- Nameplate horsepower shall exceed the maximum required by the pump under all operating conditions. For best efficiency, the motor specified should operate in a range within 90% to 100% of its rated power (avoid over sizing motors since efficiency and power factor drop in motors running below load rating).
- Provide a 1.15 service factor at ambient temperature plus 50 deg C of the nameplate voltage.
- Provide an Underwriter's Laboratory (UL) or Factory Mutual (FM) rating.
- The frame is cast iron.
- Windings are copper, not aluminum.
- Provide heavy-duty 100,000 hour rated bearings. Bearings to be grease lubricated and protected from water ingress by appropriate means. Bearings shall be insulated. The starting code letter/locked rotor kVA shall comply with NEMA code "F" criteria or better.
- Provide an over-temperature safety switch installed on the motor windings and bearing temperature and vibration sensors.
- Provide a heater element installed to reduce condensation. The motor heater element is strip type that automatically disconnects when the motor starts.
- Provide instrumentation for conditions monitoring such as vibration (x,y) at DE and NDE of motor, temperatures of bearings, etc.
- Acceptable valves to be used within the KM pump and booster station piping systems include isolation valves, control valves, air release and vacuum relief valves, drain valves, check valves and relief valves.

VII.8 Surge Analysis

A surge analysis and hydraulic modeling must be performed for all pump stations and then followed by the design of a surge control system that is in accordance with the results of the surge analysis. Even slight velocity and/or pressure changes caused by surges can rupture piping and cause major damage to the pumping system.

Hydraulic surge control is a specialized field and it should be performed by an engineer that has either specialized or extensive experience in the field. A Third Party Specialist shall be engaged during detailed design and construction stages. A detailed surge analysis is recommended for all water system pump stations.

VII.8.1 Surge Control

Surge control methods and devices that may be considered independently or in combination include the following:

- Water pipeline alignment revisions to eliminate potential column separation zones.
- Installation of spring or weight-loaded check valves that are designed to close before the hydraulic wave reverses.
- Installation of a surge anticipator relief valve which senses a loss of power and/or pressure surge wave and opens on set time delay or high pressure respectively. Install piping and valves to provide pressure relief from the pump discharge side to the suction side.
- Installation of a pressure relief valve from discharge manifold to suction manifold for routine pressure rises due to rapid changes in system demand. Cannot rely on mechanical actuator or diaphragm for operation of relief valve.
- Surge tanks are determined if required on discharge pipelines.

VII.9 Pump Station Control Philosophy & Telemetry

Pumps are controlled by pressure designed to maintain a pressure set point at the delivery header. When running under automatic discharge pressure control, the pumps are operated based on the discharge pressure and flow signals from the discharge header pressure in the pump station and the rising main flow meter.

The control philosophy is based on the number of pumps, the flow capacity of each pump, the pump curves, and the system head curve. To meet the pressure requirements at wide flow rate ranges, the pumps' speeds are varied through variable frequency drives (VFDs) or in the case of fixed speed pumps, varying the numbers of pumps operating. Pressure surges caused by the transition from one-pump to two-pump operation, two to three, etc., must be avoided as described in the following control sequence.

It should be possible to control the pump station from either the local control room or from NWCC. The field signals are wired to common marshalling panel in the local control room/instrument room. The signals are then split to the pump station local PLC and to the NWCC RTU. The local control room will have a selector switch for Local/NWCC which will transfer the command from local control room to NWCC and vice versa. The communication between the RTU located in the pump station control room and the NWCC shall be as per the communication section of the Specifications.

Pump station data transmission to the NWCC should include the following data at a minimum:

- Pump running
- Pump speed
- Motor high temperature and vibration alarm
- Pump circuit breaker/motor starter failure
- Control power failure
- Main power phase unbalance/failure
- Distillate inlet pressure and associated alarms
- Rising main flow rate
- Rising main pressures
- Distillate inlet flow control valve position command and feedback
- Distillate inlet flow control valve open/close command with status feedback and trip
- Distillate inlet bypass valve position command and feedback
- Distillate inlet bypass valve open/close command with status feedback and trip
- Distillate direct supply valve to network position command and feedback
- Distillate direct supply valve to network command with status feedback and trip
- Distillate inlet isolation valves open/close command with status feedback and trip
- Individual inlet reservoir valves open/close command with status feedback and trip
- Pump suction/ discharge valves open/close command with status feedback and trip
- Rising main interconnection valves open/close command with status feedback and trip
- Recirculation valves position command and feedback
- Recirculation valves open/close command with status feedback and trip
- Rising main valve position command and feedback
- Rising main valve open/close command with status feedback and trip
- Pump station power supply
- Reservoir or tank level
- Pump room flooding
- Intrusion alarm
- Generator run status and failure
- Ventilator fan failure, etc.
- Pumping station ambient temperature
- Communication failure
- Fire alarm control panel and air conditioning signals
- Water leakage or flooding inside pump station
- Status signal of electrical power distribution equipment
- All signals required for supervising the communication link
- Remote/Local status for the valves should be in series from the field equipment
- All water quality instrument signals with associated alarms including:
    - Residual Chlorine
    - Chlorine Dioxide
    - Turbidity
    - pH

- Conductivity
- Temperature
- Dissolved Oxygen

VIII. HYDRAULIC ANALYSIS AND NETWORK MODELING

Development of the hydraulic models include compilation, review, and analysis of all available information related to the physical system (production, transmission, storage, pumping and distribution facilities) and the distribution of demands (including meter records, water district area mapping, community plans and zoning maps, and aerial or satellite imagery), together with system inspections. These data and information shall be used to generate the computer models, then the production and storage level records together with system pressure recordings shall also be used to calibrate the models. The model is then modified as required to generate results as close as possible to actual system behavior.

VIII.1 Modeling Software Requirements

The hydraulic modeling software selected for network modeling should have the following capabilities:

- Ability to perform a steady-state analysis of pipe conditions to evaluate average day, peak day, peak hour, and fire flows.
- Ability to perform a sequence of analyses with the output from each forming the input to the next one, known as extended-period simulation (EPS). EPS is used to model variations in demand, storage, reservoir operations, water quality, and water transfers through transmission pipes. It requires incorporation of diurnal demand curves for nodes and varying tank configurations, if any.
- Ability to import and export data from and to other applications such as spreadsheets, databases and Geographical Information Systems (GIS) systems.
- Ability to perform automated fire flow calculations.
- Ability to model the water quality within the distribution system, particularly the decay of chlorine residual and water age.

It is noted that while most models can use either the Hazen-Williams or the Darcy-Weisbach equation to compute head losses, the Hazen-Williams is only applicable to a limited range of Reynolds numbers (Re). Thus, it is recommended to use the Darcy-Weisbach equation, which includes all flow regimes.

It should be noted that KM requires all simulations to be carried out using InfoWater hydraulic modeling software.

VIII.2 Analysis Scenarios

VIII.2.1 Steady-State Simulation

A steady-state simulation predicts the response of a water distribution system assuming a hypothetical condition where the effects of all operational and demand changes have stopped. A steady-state analysis should include the following steps (AWWA, 2005):

- Calibrate model to ensure that it predicts distribution system responses with sufficient accuracy.

- Select limiting conditions for design scenarios. These conditions should be the most severe demand conditions to ensure that the system will operate satisfactorily for all other conditions. The most common steady-state scenarios are average day, peak day, peak hour of the maximum day, minimum hour of the maximum day, and average day plus fire flows. The selected condition to model depends on the question that the modeler needs to answer. Table VIII-1 summarizes some typical types of analyses and the recommended steady-state scenarios used to model the network.

Table VIII-1 Typical Model Scenarios

Purpose of the Analysis	Recommended Steady-State Demand Scenario
Studies of normal operation	Peak day
Production and pumping requirements	Peak day
Design-subdivisions	Peak hour of maximum day
Design-large system	Peak hour of maximum day
Tank capabilities	Peak hour of maximum day
Transmission lines	Peak day
Master planning	Peak day
System reliability during emergency or planned shutdown	Condition when the emergency or shutdown is likely to occur
Model calibration	Condition during time when measurements were collected

VIII.2.2 Extended-Period Simulation

During an extended-period simulation (EPS), a series of steady-state simulations at specified intervals (time steps) are performed over a time period to simulate the way the system responds to changing demands and operational conditions. EPS models can refine designed system improvements developed from steady-state simulations. Analyses are typically simulated over a minimum of 24 hours, during average and maximum demand days.

VIII.3Model Applications

VIII.3.1 KM Distribution Network Expansion

The Water Planning Department shall be consulted if modeling is warranted for the expansion of KM water distribution network or addition of new pumping station and rising mains. This hydraulic modeling exercise is performed by KM.

VIII.3.2 Bulk Customer Development

Bulk customers, defined as water customers using flows greater than 600 m^3/day, shall consult with Water Planning Department to determine if computer modeling is required. The modeler should consider:

- The internal network design of the service area,
- Connections to existing system,
- Future downstream development, and
- Fire flows.

The model outlines the details of how the area should grow in a sequential manner. The modeler should consider the effects of staging on system reliability.

VIII.4Modeling Process

The development and application of a water distribution system hydraulic model can be summarized in the following steps presented in Table VIII-2.

Table VIII-2 Hydraulic Modeling Steps

Step	Description
1. Determine model purpose and requirements.	This will dictate the necessary accuracy of the model and the level of detail required.
2. Develop network representation.	This includes determining pipes to be included in the model (skeletonization) and making assumptions for parameters values for pipes.
3. Calibrate model.	Adjust non-measurable model parameters (generally roughness coefficients) so that model results compare well to observed field data. This step cannot be included if the model represents a new development since field data will not be available.
4. Verify model.	Compare model results to a second set of field data (independent of that used for calibration) to confirm that the network and model parameters represent actual conditions adequately.
5. Use model.	Identify the design or operation problem/ alternative to be modeled and incorporate in the model (e.g., higher demands, pipe status, new pipes, operational decisions, etc.).

Table VIII-3 lists typical elements for the KM InfoWater model representation.

Table VIII-3 Network Modeling Elements		
Element	**Type**	**Primary Modeling Purpose**
Reservoir (at desalination plants)	Node	Provides water to the system. Boundary condition.
Storage Tanks (Primary and Secondary)	Node	Stores excess water within the system and releases that water at times of high usage
Junction	Node	Removes (demand) or adds (inflow) water from/to the system
Pipe	Link	Conveys water from one node to another
Pump	Node or link	Raises the hydraulic grade to overcome elevation differences and friction losses
Control Valve	Node or Link	Controls flow or pressure in the system based on specified criteria

VIII.4.1 Hazen-Williams C-factors:

Typical values for Hazen-Williams pipe roughness coefficients are given in Table VIII-4.

Table VIII-4 Typical Hazen-Williams Pipe Roughness Coefficients					
Pipe Material	**C-factor Values for Nominal Pipe Diameters**				
	<150mm	**150-200mm**	**300-400mm**	**600-900mm**	**≥1200mm**
Uncoated cast and ductile iron - smooth and new	121	125	130	132	134
Coated cast iron - smooth and new	129	133	138	140	141
30 years old					
Slight attack	100	106	112	117	120
Moderate attack	83	90	97	102	107
Appreciable attack	59	70	78	83	89
Severe attack	41	50	58	66	73
60 years old					
Slight attack	90	97	102	107	112
Moderate attack	69	79	85	92	96
Appreciable attack	49	58	66	72	78
Severe attack	30	39	48	56	62

Table VIII-4 Typical Hazen-Williams Pipe Roughness Coefficients					
Pipe Material	**C-factor Values for Nominal Pipe Diameters**				
	<150mm	**150-200mm**	**300-400mm**	**600-900mm**	**≥1200mm**
Galvanized iron - smooth and new	129	133			
Lined steel - smooth and new	137	142			
Uncoated steel - smooth and new	142	145	147	150	150
Smooth pipe (lead, brass, copper, polyethylene, and PVC) – clean	147	149	150	152	153
PVC wavy – clean	142	145	147	150	150
HDPE	155				
Fiberglass (smooth)	150				
Cement lined ductile iron	120-140				
Concrete					
Class 1 - Cs=0.27, clean	69	79	84	90	95
Class 2 - Cs=0.31, clean	95	102	106	110	113
Class 3 - Cs=0.345, clean	109	116	121	125	127
Class 4 - Cs=0.37, clean	121	125	130	132	134
Best - Cs=0.40, clean	129	133	138	140	141
Prestressed concrete – clean			147	150	150

Sources: Walski et al. 2003 and Lindeburg, 2003

VIII.4.2 Darcy-Weisbach frictions:

Typical values for Darcy-Weisbach pipe roughness values are given in Table VIII-5.

Table VIII-5 Typical Darcy-Weisbach Pipe Roughness (ε)			
Pipe Material	**Equivalent Sand Grain Roughness, ε (mm)**		
	New	**Average**	**Old**
Uncoated cast iron		0.226	
Coated cast iron		0.102	
Galvanized iron	0.15		
Coated steel		0.005-0.05	
Uncoated steel		0.028	
Smooth pipe (glass, brass)	0.0015		
PVC	0.002	0.013	
HDPE		0.021	
Fiberglass		0.000017	
Cement lined ductile iron		0.1	0.3

Table VIII-5 Typical Darcy-Weisbach Pipe Roughness (ε)			
Pipe Material	**Equivalent Sand Grain Roughness, ε (mm)**		
	New	**Average**	**Old**
Concrete			
Smooth with small joints	0.015-0.2	0.3	
Wood-floated or brushed	0.2-0.4		
Unusually rough/rough joints	0.6-1.0	0.3	3
Butt-welded steel			
New	0.04		
Light rust	0.15	0.2	0.37
Heavy brush-coated enamels	0.37		0.95
Incrustation/tuberculation		0.95-2.5	2.6-6

Sources: Allen, 1996, Walski et al., 2003 and Driscopipe Polyethylene Piping Systems Manual, 1998.

VIII.5Design and Analysis Criteria

Criteria factors to be used for network hydraulic analysis and development of a network computer model are presented in the following tables:

VIII.5.1 Allowable Velocity and Head Losses

Pipe size shall be selected to meet the minimum/maximum pipe velocities and the maximum head loss per kilometer (km) listed in Table V-4.

VIII.5.2 System Pressures

The minimum residual pressures shall be maintained at the furthest and highest point in the network. Design values are presented in Table V-3.

VIII.5.3 Pump Station Modeling

Pumps should be selected following the steps below:

- Determine design flow
- Develop system head curve
- Check agreement of:
    - Design flow
    - Operating point(s)
    - Best efficiency point
- Check pump combinations and select pump operating criteria including number of working and stand-by pumps and pump duty points (flow/pressure).
- Verify operation in model. Evaluate pump capacity against required flow/pressure in the network.
- Check combinations of pumps and resulting hydraulic parameters of pressure, velocity and pressure drop in the network.

VIII.5.4 Water Quality Modeling

Water quality does not stay constant during its passage from the treatment plant through the transmission and distribution systems to its ultimate point of use. Water quality in storage and distribution networks may be highly variable.

The key data requirements for water quality modeling of distribution systems include the properties and chemical composition of the source water(s), hydraulic properties of the system, and reaction rate constants for the processes of interest.

VIII.5.5 Hydraulic Transient and Surge

A surge protection analysis study shall be performed to confirm that the surge protection equipment design requirements are met. The study should include the complete system consisting of piping, reservoirs and pumping station(s) and future pipeline systems connected or to be connected to the system being designed. The study should include recommendation of suitable equipment (surge vessels, anti-surge valves, bypass lines, etc.) to be installed in the piping system to protect against surge effects. The surge analysis shall also include analysis and recommendations for surge protection measures for the ultimate system.

Surge Analysis of the system shall be based on water demand plans and pipeline design with proposed pump characteristics and pumping station design (pump performance curve).

VIII.5.6 Pipe Network Analysis

Pipe flows and pressures throughout the pipe network are determined by hydraulic analysis by employing the relevant hydraulic parameters:

- Water demand scenarios (peaking factors),
- Allowable velocities,
- Allowable headlosses,
- Required system pressures,
- Pipe material and etc.

IX. LIST OF TABLES

X. LIST OF FIGURES

XI. APPENDICES

IX.1 Appendix A – KM Project Guidelines for Bulk Customers

WATER DEVELOPMENT GUIDELINES FOR BULK CUSTOMER

April 2012

Contents

Issue Record		
Issue No.	**Date**	**Reason for Re-Issue**
0	August 2012	First issue
1	April 2012	Updated Water Demand Table
2		
3		
4		
5		

1. Introduction

The aim of this guideline is to provide more detailed provision to bulk customer and the consultant while preparing bulk customer application submission for approval by Kahramaa.

For each new development project, the customer or consultant shall submit to Kahramaa with the estimated water demand planned for the project from its inception through to its completion and full occupancy.

Depending on the scope, the work involved will be to install a service connection and the incidental requirement of laying or building associated water facilities (such as requirements to upgrade/replace existing reservoir & pumping Stations or existing pipelines and/or constructing new reservoir & pumping stations and/or laying/reinforcing of new pipelines) necessary in order to efficiently deliver the water services to the bulk customer by taking into consideration the available information on the development in areas covered by the required water facilities development and in turn the customer will be required to bear the "shared" cost proportionate with its requested full demand against the capacities of the facilities involved.

This document may be updated or amended as deemed necessary.

2. Water Demand

As the customer demand and its staging represent the most crucial element for identification and/or determination of their internal water system facilities during the planning process, customers are advised to submit the following list of information available for Kahramaa review ahead of time in order to cater for different lead times needed for each type of development:

a) Reasonably Projected Demand Figures along with yearly phasing up to its ultimate build-out, occupancy phasing until 100% is achieved and phasing wise percentage of land used;

b) Reasonable Demand Phasing throughout the Project Development Period. The Customer must give emphasis on each phase that will be represented by expected occupancy commissioning dates and occupancy saturation date, rather than construction starting and completion dates. For Multi Structure, Complex and Mega Projects categories, information for each phase should include similar information on the relevant individual projects and their demands;

c) The following demand categories are recognized by Kahramaa:

   i. Residential;
   ii. Commercial;
   iii. Government;

d) The developer shall prepare Project Demand Mapping by Phases and by Demand Categories. This is required to facilitate in the demand forecast process and later in the performance of hydraulic analysis.

e) Base information and calculations used to determine the water demands, such as population, land use, district cooling, even the liters of water demand per area categories, liters per capita consumption, etc.

f) Kahramaa emphasizes that it does not supply potable water for Construction purposes when there is no existing developed network at the Project Area and in such cases may be opted to resort in Tanker Supply.

3. Customer Requirements

a) The customer shall sign MoU with Kahramaa prior to execute water connection.

b) The customer shall allocate during the development stage on the property side, a site and water pipeline route corridor within the Project area that the parties agree is sufficient for that purpose. This allocation shall continue for the entire life of the project. The property of allocated site beyond the customer meter shall remain as the property of the customer.

c) The meter will be installed in the identified area outside of the premises which shall be an accessible area for interconnection of Kahramaa mainline and its service connection provision to the customer water facilities, and shall be accessible for inspection and maintenance.

d) A separate house connection pipes for each premise should be metered. In case of buildings, a main meter is installed on the main inlet pipe before the underground storage tank and sub-meters are installed on the roof of the building on the discharge side of the elevated storage tanks. The customer shall cover all internal water facilities related inside the project premises being covered by the Bulk Selling and may or may not be subjected for review by Kahramaa;

e) The customer shall be required to provide an area and water facilities sufficient enough to accommodate their own terminal water reservoir equivalent to 2-days storage of customer highest forecasted daily demand requirement. This area shall normally be to accommodate the required associated pumping facilities to effectively and efficiently deliver water internal to the customer's water system facilities that can reach to their highest and farthest location.

f) The customer, developer and consultant shall be required to comply the design submissions with existing standards and guidelines, which are recommended by Kahramaa, in executing the planning and design works for the customer Internal Water Systems Facilities.

4. Network Design Criteria

The following Network Design Criteria for water network modeling shall be taken into account by customer's consultant during network design stage.

a) Maximum applied Pipeline Velocity is 1.5 m/s for Distribution lines.
b) Height of storage reservoir shall not be greater than 3 meters from the ground level.

c) Minimum expected Pressure is 1.5 bar at highest and farthest point within the developer (distribution) network.
d) A minimum number of connections should be adopted for better network management. Pressures assumed at connection points should satisfy the design criteria above for the adopted network layout. However, these pressures will be reviewed by Kahramaa and changes if necessary will be recommended as appropriate, including additional pumping or pressure reduction requirements.
e) Zoning by District Metered Area (DMA) and network pressure control as applicable should be considered in the design.
f) Hydraulic Model demands should correspond to the Demand figures submitted in the demand calculation sheets.
g) The developer or their consultant should submit the minimum, average and peak demand and Fire Flow Network Models for each main phase of the development as applicable.
h) Models should be created using Kahramaa adopted software or any compatible software.
i) Network Models should be geo-referenced to the actual physical Geographic location's coordinates using the standard Qatar National Datum.
j) If the development expands through major phases, it is required to submit separate models representing each phase. As well as one overall network model as appropriate.
k) Kahramaa will review the models in contrast with its requirements and planning information, and as required, recommendations for changes will be made accordingly.
l) The network design layout should consider looping the system wherever possible, for better water circulation and system reliability.

5. Demand Requirements

The following Table presents typical ranges of water consumption rates as a guide and may be used as a reference to establish various land use water demand for development projects. However, it is the sole responsibility of the consultant/developer to accurately determine the demand required with due consideration to the nature and type of the proposed development, which would later be submitted to Kahramaa for concurrence. The water demand categories have been reviewed in light of the Kahramaa Waterworks Planning and Design Manual and the revised water demand figures are presented below.

KAHRAMAA Unit Daily Water Demand (Domestic Category)		
Land Use Category	**Unit**	**Daily Water Consumption (Liters)**
Residential Building	(Per Capita)	250-400
Qatari Villas	(Per Capita)	500-800
Worker Labor Accommodation	(Per Capita)	80-150
Mixed Use Residential	(Per Capita)	250-400

KAHRAMAA Unit Daily Water Demand (Non-domestic Category)		
Land Use Category	**Unit**	**Daily Water Consumption (Liters)**
Mixed Use Commercial	(Per Capita)	60-80
Commercial Building	(Per Capita)	60-100
Mosque	(Per Capita)	10-50
Restaurant	(Per Meal)	10-20
Hotel	(Per Room)	200-300
Shop	(Per Capita)	60-80
Office	(Per Capita)	60-80
School	(Per Capita)	60-80
University	(Per Capita)	60-80
Medical	(Per Bed)	60-80
Public Amenities	(Per Capita)	20-50
Nursery	(Per Capita)	60-80
Guard House	(Per Capita)	60-80
Retail	(Per Capita)	60-80
Theatre	(Per Capita)	10-50
Stadium	(Per Capita)	15-20
Town Centre	(Per Capita)	60-80
Manufacturing	(Per Capita)	60-80
Workshop	(Per Capita)	60-80
Swimming Pool		Pool Volume plus the rate of re-filling/year
Warehouse/ Store/ Showroom	(Per Unit)	2, 889
MEW Electricity Substation	(Per Unit)	509
Clinics	(Per Unit)	26, 458
Gardens/ Parks/ Nurseries	(Per Unit)	85, 106
Car Wash	(Per Unit)	20, 991
Embassies	(Per Unit)	21, 205
Petrol Station (No Car Wash)	(Per Unit)	2, 559
Sports Stadiums	(Per Unit)	109, 712
Industry		
Heavy Water Using	(cum/hectare/day)	120
Light Water Using	(cum/hectare/day)	30
Precast Factory	(cum/hectare/day)	85
Garage for Heavy Truck	(cum/hectare/day)	30
Food Stores	(cum/hectare/day)	30
Industrial Store	(cum/hectare/day)	30

KAHRAMAA Unit Daily Water Demand (Non-domestic Category)		
Land Use Category	**Unit**	**Daily Water Consumption (Liters)**
Livestock, (liter/head/day)		
Camel	(liter/head/day)	30-55
Cow	(liter/head/day)	100-126
Sheep	(liter/head/day)	8-20
Goat	(liter/head/day)	7-12
Chicken	(liter/head/day)	13-62
Type of Crops		
Vegetables	(liter/m^2/day)	5.37
Cereals	(liter/m^2/day)	3
Fodder	(liter/m^2/day)	18
Fruits & dates	(liter/m^2/day)	8.8

1: *Sourced from Best Standard Practices from submitted Master Plans & recent Kahramaa Investigative Study.*

2: *Bulk Customer Demand to be estimated from Total Number of Persons from each Land Use Category Multiplied by the corresponding Demand Figure in Litre/Cap/Day.*

6. System Monitoring

Depending on the nature and the size of the Project Network, monitoring devices at main connection locations will be installed by Kahramaa. These devices are outlined as follows.

a) Bulk Flow Metering - is essential for measurement and flow monitoring along the distribution systems. Bulk flow meters shall be proposed at selected locations and implemented by Kahramaa.

b) Pressure Transmitters - Pressure gauges and transmitters may be required as per Kahramaa specifications to monitor pressures at locations selected by Kahramaa.

c) Pressure Regulating Valve - Pressure regulating valve will be installed in case the customer is supplied from water transmission line in order to reduce pressure at the storage facility inlet.

d) Water Quality Controls - Analyzer Stations consisting of transmitters and sensor assemblies for measuring pH, residual chlorine, conductivity and temperature shall be installed at specified locations as per Kahramaa specifications.

e) Water SCADA Requirements - Kahramaa requirements for integrating newly developed network for major projects into Kahramaa SCADA system should be discussed and agreed by Kahramaa Water Control Section and Water Planning Department.

7. Project Requirements

During the Inception and/or development stage of the project, the customer shall be required to submit to Kahramaa in full details of all the above requirement and information to facilitate in parallel the early delivery of Kahramaa services to the customer. Kahramaa requires a normal minimum lead time to deliver the required Services under the following categories as follows:

a) For direct connection to the existing mainline = 3 months minimum to 12 months maximum.

b) For connections requiring associated incidental facilities = 1 year minimum and can reach even up to 3 years from the time of initial coordination with the customer.

c) It is important that customer, developer and consultant must agree with Kahramaa for the lead time of development of the Project. It is usual to take lead time of 2 - 3 years due to planning, engineering and construction prior to commissioning but again this will entirely depend on the nature of the Project. Thus, the customer is required to submit ahead of time the project information in order for Kahramaa to deliver the required services on time.

d) In some instances, Kahramaa may decide, where it is more advantageous for customer to supply and construct under their Project, the required water facilities services that is supposed to be provided by Kahramaa, of which cost will born out fully by the customer, subject to Kahramaa approval of its design and construction.

e) Conduct regular progress review meeting with Kahramaa wherever is required.

f) Close coordination with Kahramaa during commissioning and testing phase of the project.

g) Both parties shall provide necessary advises in resolving any technical issues.

8. Applicable Documents

1. General Specification for Mainlaying Materials for Waterworks - 2005
2. General Specification for Mainlaying Contracts - June 2005
3. Regulations of Internal Water Installations and Connections Works - May 2009
4. Water Network Design Guidelines
5. Water Network Standard Drawings

9. Required Information

Developer or consultant of the customer is required to lodge the submission for assessment to Water Planning Department and shall be addressed to:

Head, Planning and Bulk Customer Section
Customer Service Department

The submission consists (as a minimum) of the following documents:

i. Complete Bulk Customer Application Form
ii. Colored hard copy of the location map and layout of the project as well as soft copy in CAD or GIS system shape file format system.
iii. Complete Master Plan study for the project.
iv. Project water demand calculation sheets, year wise phased total demand, plot / zone or phase wise demands “all calculations should be provided in MS Excel spreadsheet format including all formulas used along with supporting data files”.
v. Land use wise demand calculations including percentage of land use types and year wise percentage of occupancy envisaged by the developer.
vi. Factors used to calculate Average Demands and Peak Demands along with justifications of the same.
vii. Availability statements for plots/corridors required for the development proposal as per Kahramaa requirements.
viii. Existing and proposed site topography based on actual survey data, to support network hydraulic analysis and parameters for proposed pumping facilities.
ix. Digital as well as hard copies of internal network design indicating proposed take off points and expected pressure at each of them.
x. All hydraulic modeling file(s) developed for the network study geo-referenced to the actual coordinate system.
xi. Updated submittals for the above-mentioned documents are required in case of any changes in the demand requirements or network design.
xii. Prior to submission of proposed Internal Water Network Design, the customer will submit water demands, meter & service main location connections for concurrence.
xiii. Upon receipt and stamping of the agreed Demand Forecast and meter and service main location connections, the customer will then submit project specific & detailed drawings for Internal Water Network Design to Water Planning Department’s for approval.
xiv. Kahramaa through Water Planning Department will approve and stamp the final design drawings.

IX.2 Appendix B – Water Network Development Procedure Summary and Checklists

- Initiate project and present concept to KM for concurrence.
  - Evaluate service area limits and use categories
  - Layout pipe network and develop layout of hydraulic model with nodes and demands
  - Assign demand values and calculate flows for ADD, PDD, PHD, ADD+FF
- Proceed with Hydraulic Analysis and present to KM for review and approval (See checklist below).
- Proceed with pipe network planning with valve, hydrant, system monitoring requirements, and service location layout and present to KM for review and approval (See Transmission and Distribution Main Checklist below).

IX.2.1 Hydraulic Analysis Summary

Provide a narrative along with the hydraulic model printouts and data. The narrative should discuss low and high-pressure areas in each pressure zone, identify whether the system has adequate equalizing and firefighting storage, and propose corrective measures. If submitted as part of a water system plan, the narrative and corrective measures should be in the body of the plan. The hydraulic analysis should clearly identify how the model was developed and calibrated, and summarize the output. The following items should be in the hydraulic model discussion. These items are also in the hydraulic analysis checklist below.

- Develop a diagram showing all nodes (junctions) used and a corresponding written summary of assumed supply and demand flows for each condition that must be evaluated. Larger scale diagram sheets may be necessary to accurately show proper location and functions of all control valves and pump station facilities.
- Explain all assumptions used for the model, including friction factors for the pipes and operating conditions of sources, storage reservoirs, booster pumps, and valves. For additions to existing water systems, also provide evidence that the computer model results were compared to actual field measurements, and that the model was calibrated accordingly.
- Using a system contour map, identify the minimum pressure results found at the highest elevations and other critical areas in each pressure zone of the system under flow conditions.
- Enter pump curves for the proposed source and booster pumps into the program to indicate how the system will respond to varying flow conditions.
- Steady-state flow conditions to evaluate should include each of the following:
  - PHD in each pressure zone and throughout the water system, under conditions that deplete all equalizing storage volume and assume all sources are operating. The resulting pressures should meet the minimum requirements.
  - Highest demand firefighting flows during PHD. The engineer should evaluate the water system and each pressure zone under conditions that deplete designed firefighting volume and equalizing storage. Again, the resulting pressures must conform to Table V-3 with respect to values and locations. The

system or zone must also be evaluated with the largest capacity pump out of service.

IX.2.2 Hydraulic Analysis Checklist

A hydraulic analysis should be used to size and evaluate new or existing distribution systems. An acceptable hydraulic analysis includes:

- Description of model whether steady state, or extended period simulation.
- Assumptions are described including:
  - Allocation of demands
  - Friction coefficients, which will vary with pipe materials and age
  - Pipe network skeletonization, as appropriate
  - Operating conditions (source, storage booster pumps, valves)
- Minimum design criteria are met under all scenarios, including:
  - ADD – Average Daily Demand
  - PDD – Maximum Daily Demand
  - PHD – Peak Hourly Demand
  - ADD + FFD – Average Day Demand plus Fire Flow Demand
  - PHD + FFD with Pump Shut-down Surge Condition (When Pumping is included in design)
- Demand scenarios are described, including:
  - Current demand
  - Projected 6 year demand
  - Projected build-out demand of small water systems
- Provide copies of input and output, including:
  - Input data, (demands, elevations, friction losses, and pump curves)
  - Hydraulic profile
  - Node diagram
  - Printout of significant runs
- Summary of results, deficiencies and conclusions including:
  - Identification of deficiencies
  - Locations in distribution system where pressures do not comply with KM guidelines
  - Hydrant flow and placement on undersized mains
  - Fire flow reliability per CD guidelines

IX.2.3 Transmission and Distribution Main Design Checklist

Transmission and distribution main project reports and construction documents should include:

- Water system sizing analysis documenting availability of adequate source and storage to supply the proposed service area.
- Hydraulic analysis used to size mains and determine that required pressures can be maintained and hydraulic transient analysis for transmission mains and distribution

mains where warranted by high pressures or high velocities (see Checklist for Hydraulic)

- Analysis for additional details).
- Identification and description of proposed land use within project area.
- Service area map designating specific properties to be served.
- Distribution system map showing location of water lines, pipe sizes, type of pipe, pressure zones, easements, and location of control valves, hydrants, meters, and blow-off valves.
- Specifications for materials, construction, depth of pipe bury, pressure and leakage testing.
- Adequate separation from sewer mains, non-potable conveyance systems, and other buried utilities.
- Details for pipeline trench, service connections, air and vacuum relief valves, pressure reducing valves, thrust blocking, backflow assemblies, fire hydrants, and other system appurtenances.