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6 COMMISSIONING OF SYSTEMS

6.1 GENERAL

6.1.1 Scope

- 1 This Part specifies the requirements for identification markings for components of plumbing installations, testing of plumbing installations and disinfection of plumbing installations.
- 2 Related Sections and parts are as follows:

This Section

Part 1..... General

Part 2..... Water Distribution

Part 3..... Cold Water Storage

Part 5..... Hot Water Storage

Section 1 General

6.1.2 System Description

- 1 Where possible and practicable, the parts of all Works covered in this Section shall be split into sections for interim testing purposes. Final testing shall be done when the installation is complete.
- 2 Disinfection shall not be undertaken until all tests and inspections have been completed to the satisfaction of the Engineer.

6.1.3 Submittals

- 1 The Contractor shall prepare a detailed testing and inspection programme, including method statements, and submit it to the Engineer for approval. This programme shall identify each item to be tested, the type of test to be performed and the date and time of the test.
- 2 The Contractor shall prepare test record sheets for all tests undertaken. The format of the test record sheet shall be to the approval of the Engineer. On successful completion of a test, the test record sheet shall be signed and stamped by all parties. The Engineer shall retain the original test record sheet.
- 3 The Contractor shall prepare a detailed disinfection programme, including method statements, and shall submit it to the Engineer for approval. This programme shall identify the date and time at which each item is to be disinfected.
- 4 The Contractor shall prepare disinfection record sheets for all disinfections undertaken. The format of the disinfection record sheet shall be to the approval of the Engineer. On completion of disinfection, the disinfection record sheet shall be signed and stamped by all parties. The Engineer shall retain the original disinfection record sheet.

6.1.4 Connection to Water Supply System

- 1 Connection to the Qatar General Electricity & Water Corporation (QGEWC "KAHRAMAA") water supply system shall not take place until all tests and inspections have been successfully completed and the system has been disinfected.
- 2 The Contractor shall comply with all the requirements of the QGEWC "KAHRAMAA" with respect to making the connection to the water supply system.

6.2 PIPELINE IDENTIFICATION

6.2.1 Tags and Colour Coding System

- 1 Marker tape shall be laid above all underground water mains. The marker tape shall be blue PVC or polyethylene mesh or ribbon at least 50 mm wide (The tape shall be 150mm wide and 200 micron thickness), incorporating a corrosion resistant tracing system. The tape shall be clearly marked "WATER" in both English and Arabic in black print.
- 2 Where aesthetically acceptable, above ground piping shall be clearly and indelibly marked "WATER" in both English and Arabic. Pipes solely for the use of fire fighting purposes shall be distinguishable from other water pipes.
- 3 Every valve in hot and cold water service pipework installed above ground shall be provided with an identification label. The label shall be secured by either non-corroding, incombustible means to the valve or fixed to a permanent structure near the valve. Labels secured to valves shall be of a non-corroding and incombustible material and clearly marked, by stamping or engraving, with a reference number for the valve. The reference numbers for the valves shall be as stated in the Project Documents. Labels fixed near valves shall comply with the requirements for labels secured to valves except that they need not be incombustible.
- 4 Surface boxes shall have "WATER" in both English and Arabic cast on. They shall be painted blue with a durable epoxy paint.

6.3 TESTING AND INSPECTION

6.3.1 General Requirements

- 1 The Contractor shall notify the Engineer at least two clear working days before hand of his intention to test any section of the Works.
- 2 Unless otherwise agreed by the Engineer, both interim and final tests shall be undertaken on each section of the Works.
- 3 The Contractor shall also carry out any further testing or inspections specifically requested by QGEWC "KAHRAMAA".
- 4 Unless otherwise provided in the Project Documentation, the Contractor shall be responsible for providing all equipment and materials for testing purposes and for their removal and proper disposal on completion of testing.

6.3.2 Timing of Tests

- 1 The timing of tests shall be arranged as follows:
 - (a) interim test shall be undertaken as soon as practicable after completion of a particular section; particular attention shall be made to work which will be concealed
 - (a) final tests shall be carried out on completion of all work on items included in this Section and prior to handing over
 - (b) items failing any test shall be corrected immediately and re-tested before further work proceeds.
- 2 The Contractor shall note that satisfactory completion at an interim test does not constitute a final test.

6.3.3 Inspection

- 1 Visual inspection shall be carried out at both interim and final testing in order to detect faults in construction or materials not shown up under testing but which could lead to premature failure. A careful record shall be kept of such inspections.
- 2 On external pipelines, the following shall be visually inspected:
 - (a) pipe bed
 - (b) pipe line and level
 - (c) joints
 - (d) air valves
 - (e) washout valves
 - (f) gate valves
 - (g) thrust blocks
 - (h) pipe protective coating
 - (i) any other pipeline appurtenance.
- 3 Trenches shall be inspected to ensure that excavation is to the correct depth to guard against mechanical damage due to traffic loading.
- 4 No part of the pipe trench shall be backfilled until the above are satisfactory completed and approved by the Engineer.
- 5 All internal pipework shall be inspected to ensure that it has been securely fixed.
- 6 Before testing takes place, all cisterns, tanks, hot water cylinders and water heaters shall be inspected to ensure that they are properly supported and secured, that they are clean and that cisterns are provided with correctly fitting covers.
- 7 Before testing takes place, all electrical and mechanical items shall be inspected in accordance with Section 9, Mechanical and Electrical Equipment.

6.3.4 Leakage Test for Underground Pipelines

- 1 After satisfactory visual inspections have been completed, hydraulic pressure testing shall be carried out on the installation. The testing procedure shall be as follows:
 - (a) gauges used for testing pressure pipelines shall either be of the conventional circular type, not less than 200 mm diameter, calibrated in metres head of water, or shall have a digital indicator capable of reading increments of 0.1m head. Before any gauge is used, the Contractor shall arrange for it to be checked independently and a dated certificate of its accuracy shall be provided
 - (b) before testing, valves shall be checked and sealed, the sections of pipe filled with water and the air released. After having been filled, pipelines shall be left under operating pressure for the period described in the Project Documentation or as directed by the Engineer, so as to achieve conditions as stable as possible for testing

- (c) the pressure in the pipeline shall then be raised steadily by pumping in water until the specified test pressure, as given in the Project Documentation or as directed by the Engineer, is reached in the lowest part of the section. The pressure shall be maintained at this level, by pumping if necessary, for a period of one hour. The pumps shall then be disconnected, and no further water shall be permitted to enter the pipeline for a further period of one hour. After the one hour test period, the pressure in the pipe shall be recorded. At the end of this period the original test pressure shall be restored by pumping in water and the loss measured by drawing off water from the pipeline until the pressure as recorded at the end of the one hour test period is again reached
- (d) the permissible loss shall not exceed 2 litres per metre nominal bore per kilometre length per metre head (calculated as the average head applied to the section) per 24 hours. This relationship in equation format, with the leakage measured in litres, can be written as follows:

$$\text{Permissible leakage per day} = 2 \times D \times P \times L$$

For the one hour test period, this equation can be rewritten as follows:

$$\text{Permissible leakage} = (2 \times D \times P \times L) / 24$$

Where: D = pipe diameter (m)
P = test pressure (m)
L = length of test section (km)

- (e) in addition to the tests on separate sections, the whole pipeline shall be tested on completion to the same pressure and by the same procedures as that outlined for individual sections
 - (f) where a new pipeline is to connect to an operational pipeline the final connection shall be inspected visually under normal operating pressure and there shall be no visible leakage.
- 2 To avoid the risk of contamination, water used for testing shall be obtained from a potable supply.
 - 3 Before accepting a pipeline, a check shall be made that valve boxes are properly aligned, that suitable operating keys are provided which can be easily fitted to the valves and in the case of deep valves, that adequate extension spindles are installed.

6.3.5 Testing of Installation Within Buildings

- 1 When the installation is complete and visual inspection has been satisfactorily completed, it shall be slowly filled with water, with the highest draw-off point open to allow air to be expelled from the system. The installation, including all cisterns, tanks cylinders and water heaters, shall then be inspected for leaks.
- 2 The system shall be hydraulically tested in the following way:
 - (a) subject the pipes, pipe fittings and connected appliances to a test pressure at least 1.5 times the maximum working pressure for a period of at least 24 hours
 - (b) check the installation for leaks; including all cisterns, tanks, cylinders and water heaters.

- 3 Each draw-off tap, shower fitting and float-operated valve shall be checked for flow against specified requirements. Performance tests shall also be carried out on any specialist items to show that they meet the requirements detailed in the Project Documentation.

6.3.6 Back-Siphonage

- 1 It shall be verified that the appropriate back-flow prevention devices have been selected and that they have been installed correctly.

6.3.7 Mechanical and Electrical Equipment

- 1 Mechanical and electrical equipment shall be tested and commissioned in accordance with Section 9, Mechanical and Electrical Equipment.

6.4 DISINFECTION

6.4.1 General Requirements

- 1 All hot water systems and cold water systems installed shall be disinfected before being taken into use.
- 2 Where chlorinated water that has been used to disinfect an installation is to be discharged into a sewer, the Drainage Department shall be informed.
- 3 Unless otherwise stated in the Project Documentation, the Contractor is responsible for providing water for disinfection purposes.

6.4.2 Installations Outside buildings

- 1 At the time of laying, large bore pipes shall be brushed clean and sprayed internally with a strong solution of sodium hypochlorite.
- 2 At the time of laying, small bore pipes shall be swabbed with a polyurethane foam plug soaked in a strong solution of sodium hypochlorite. A water jet may be used to push the plug along the pipe.
- 3 Following the disinfection process, the pipe shall be regarded as operational and the Contractor shall not open or close any valves or take any other action which might interfere with the use of the pipe.

6.4.3 Installation Inside Buildings

- 1 All visible dirt and debris shall be removed from the cistern.
- 2 The cistern and distributing pipework shall be filled with clean water and then drained until empty of all water. The cistern shall be filled again and the supply closed.
- 3 A measured quantity of sodium hypochlorite solution of known strength shall be added to the water in the cistern to give a free residual chlorine concentration of 50 mg/litre in the water.
- 4 The cistern shall be left to stand for 1 hour. Then each draw-off fitting shall be successively opened working progressively away from the cistern. Each tap or draw-off fitting shall be closed when the water discharged begins to smell of chlorine. The cistern shall not be allowed to become empty during the operation; if necessary, it shall be refilled and chlorinated as detailed above. Should refilling be necessary, the cistern and pipes shall be left for a further hour before continuing the disinfection procedure.
- 5 The tap furthest from the cistern shall be opened and the level of free residual chlorine in the water discharged from the tap shall be measured. If the concentration of free residual chlorine is less than 30 mg/l the disinfecting process shall be repeated.

- 6 Finally, the cistern and pipes shall remain charged with chlorinated water for at least 16 hours and then thoroughly flushed out with clean water until the chlorine concentration at the taps is no greater than that present in the clean water from the QGEWC "KAHRAMAA" supply main.
- 7 For installation with more than one cistern, all cisterns shall be cleaned and chlorinated, in accordance with paragraph 1 to 4 above, simultaneously.

END OF PART