SECTION 33 14 20

DISINFECTION OF WATER PIPELINES, FACILITIES AND APPURTENANCES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Essential procedures for disinfecting new and repaired water mains. All new water mains, services, and appurtenances shall be disinfected before they are placed in service. All water mains taken out of service for inspection, repair, or other activities shall be disinfected before they are returned to service.
   2. Testing and reporting of results.

B. Each unit of constructed water main, services, and appurtenances shall be disinfected with chlorine upon successful completion of the hydrostatic test. The disinfection procedure shall be performed in strict conformance with Cape Fear Public Utility Authority (CFPUA) procedures for disinfecting water mains, as outlined in paragraphs 3.2 and 3.3 of this Section.

C. Related Requirements:
   1. CFPUA Material Specification Manual (MSM).
   2. Section 33 14 13 – Water Distribution Piping and Appurtenances.
   3. Section 33 14 14 – Public Water Service Connections.
   4. Section 33 14 13 – Water Distribution Valves and Fire Hydrants.

1.2 REFERENCE STANDARDS

A. American Water Works Association:
   1. AWWA B300 – Hypochlorites.
   2. AWWA C651 – Disinfecting Water Mains.
   3. AWWA M12 – Simplified Procedures for Water Examination.
   4. APHA, AWWA, WEF – Standard Methods for the Examination of Water and Wastewater.

B. North Carolina Public Water Supply:
   1. NCPWS Rules Governing Public Water Systems Section .1000 – Disinfection of Water Supply Systems.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Any event requiring a CFPUA representative to be present will require a two-business day notice to schedule the event.

B. No valves are to be operated unless a CFPUA representative is present. Any valves operated without a CFPUA representative present, or a directive may be subject to penalties in accordance with CFPUA's Ordinance.

C. The Contractor shall pay particular attention to the scheduling requirements outlined in the procedures. The Contractor shall be responsible for furnishing and installing all required chlorine injection and monitoring ports at no additional cost to CFPUA.

D. The mains will in no case be accepted by CFPUA for public use until the CFPUA Engineer approves the mains as having been properly disinfected.

1.4 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures.

B. Submittals:
   1. Product Data: Submit manufacturer information for proposed chemicals and treatment doses.
   2. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
   3. Disinfection Procedure: Submit description of procedure, including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration.
   4. Certify that final water complies with disinfectant quality standards of CFPUA.
   5. Test and Evaluation Reports: Indicate testing results comparative to specified requirements. All lab reports shall be from certified lab and submitted to CFPUA representative.
   6. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Execution and Closeout Requirements.

B. Disinfection Report:
   1. Type and form of disinfectant used.
   2. Date and time of disinfectant injection start and completion.
   3. Test locations.
   4. Name of person collecting samples.
   5. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
   6. Date and time of flushing start and completion.
   7. Disinfectant residual after flushing in ppm for each outlet tested.

1.6 QUALITY ASSURANCE

A. Perform Work according to AWWA C651.

B. QUALIFICATIONS
   1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
   2. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals:
   1. Calcium hypochlorite: Comply with AWWA B300.
   2. Sodium hypochlorite: Comply with AWWA B300.

2.2 CHLORINE RESIDUAL TEST KITS

1. Test kits shall use methodology conforming with *Standard Methods for the Examination of Water and Wastewater* or AWWA Manual M12.
2. Manufacturers:
   a. Hach Company.
   b. LaMotte.
   c. Fisher Scientific.
   d. Hellige.
   e. Or equal.

PART 3 EXECUTION

3.1 PREVENTIVE AND CORRECTIVE MEASURES DURING CONSTRUCTION

Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is, therefore, essential that the procedures of this section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination. Also, any connection of a new water main to the active distribution system prior to receipt of satisfactory samples may constitute a cross-connection. Therefore, the new main must be isolated until all bacteriological and other tests are satisfactorily completed.

A. KEEPING PIPE CLEAN AND DRY: Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material. All openings in the pipeline shall be closed with watertight plugs when work is stopped at the end of the day or for other reasons.

B. JOINTS: Joints of all pipes in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

C. PACKING MATERIAL: All packing material shall consist of molded or tubular rubber rings, or other approved material. Lead or asbestos material in any form shall not be permitted.

D. SEALING MATERIALS: No contaminated material or any material capable of supporting prolific growth of microorganisms shall be used for sealing or lubricating joints. Sealing and lubricating material or gaskets shall be handled in a manner that avoids

contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in closed containers and shall be kept clean. Soil conditions could warrant the upgrade of gasket material to a volatile resistant material.

E. CLEANING OF PIPE AND APPURTENANCES: If dirt enters the pipe, it shall be removed, and the interior pipe surface cleaned. If, in the opinion of the CFPUA representative, the dirt remaining in the pipe will not be removed by the flushing operation, then the interior shall be cleaned by mechanical means such as a hydraulically propelled foam pig or another suitable device. The cleaning method used shall not force mud or debris into the interior pipe joint spaces and shall be acceptable to CFPUA.

F. FLOODING BY STORM OR ACCIDENT DURING CONSTRUCTION: If the main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section of pipeline shall be flushed until water from the pipe runs clear.

3.2 EXAMINATION

A. Section 01 70 00 – Execution and Closeout Requirements.

B. Chlorination Planning:
   1. Before calling the CFPUA office for a time to be set up for disinfection, all of the following shall be installed or supplied by the Contractor at no cost to CFPUA. This list shall be checked and/or assembled before the CFPUA Engineering personnel arrive.
      a. A valve may be required to be installed in the line to be disinfected near the CFPUA water main connection.
      b. A blowoff of a brass or approved material faucet may be required to be installed at the dead end of the line, at all closed valves, and every 1,200 feet to be disinfected for flushing purposes and bacteria sampling. The opening to this blowoff should point downward, and there should be at least twenty-four inches clearance between the opening and the ground for proper sampling.
      c. Mains connecting other mains with open valves within the system to be disinfected may cause “short circuits” resulting in improper disinfection. Valves on these connecting mains shall be checked to see if they should be closed to eliminate this problem. Blowoffs should be at both sides of valves closed to prevent “short circuits”.
      d. Successful hydrostatic testing and CFPUA acceptance of said testing of the line is required before disinfection procedures.
      e. A clean container shall be used to mix and/or dissolve the hypochlorite.
      f. A clean, new wooden mixer shall be present for mixing and dissolving the hypochlorite.
      g. A pump for pumping the chlorine solution into the line shall be present. This pump shall be gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump, for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pres-

sures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

h. All temporary blowoffs and injection points shall be properly abandoned and physically disconnected when directed by CFPUA prior to the line being placed into service.

C. Verify that access fittings have been installed under Section 33 14 13 – Water Distribution Piping and Appurtenances.

D. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting, and balancing, and demonstration procedures, including coordination with related systems.

3.3 DISINFECTION PROCEDURE FOR NEW WATER MAINS AND FIRELINES

A. Provide required equipment to perform Work of this Section.

B. Method of Chlorination:

1. Use the continuous feed method for disinfection of all new water mains. This method must give a minimum of 10 mg/L of chlorine residual at the end of the 24-hr period.
    a. Continuous-Feed Method**:** The continuous-feed method is the process in which a concentrated solution of chlorine is injected into the water main. Caution shall be observed during the handling and injection of the chlorine solution as chlorine in any form is very toxic and any error could be harmful to the employees and to the public.
    b. Preliminary Flushing: Before chlorine solutions are injected, the main shall be filled with potable water to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 3.0 ft/sec (preferably 3.5 ft/sec) unless the CFPUA representative determines that conditions do not permit the required flow or that the flow will cause undue problems when discharged to waste. An acceptable flushing velocity shall then be determined and used.
    c. Procedure for Chlorinating the Main:
        1) Water supplied from the existing distribution system or other Approved public water supply shall be made to flow at a constant, measured rate into the newly installed water main. In the absence of a meter, the rate may be approximated by Approved method.
        2) At a point, not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 50 mg/L and not greater than 100 mg/L free chlorine residual. To ensure that this concentration is provided, measure the chlorine concentration at regular intervals of distance and time in accordance with the procedures described in the current edition of *Standard Methods for the Examination of Water and Wastewater* or AWWA Manual M12, or by using Approved chlorine test kits.
        3) During the application of the chlorine, valves shall be adjusted by or under the supervision of the CFPUA representative to prevent the chlorine solution from entering the existing water system. The chlorine injection

shall not cease until the entire water main is filled with a chlorine concentration of not less than 50 mg/L. All appurtenances and valves shall be operated to ensure that the chlorine solution has contact with them. The chlorinated water shall be allowed to remain for a period of not less than 24-hours.

4) At the end of the 24-hour period, the chlorine residual shall be measured and shall not be less than 10 mg/L in any samples collected along the water main and at the end of said water main.

C. Final Flushing:
   1. Clearing the Main of Highly Chlorinated Water: Highly chlorinated water shall not remain in prolonged contact with pipe. At the end of the 24-hour contact period, the water shall be removed in order to prevent damage to the pipe lining or corrosion damage to the pipe itself. The highly chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system.
   2. Disposing of Highly Chlorinated Water: A neutralizing chemical shall be applied to the chlorinated water to be discharged to neutralize thoroughly the chlorine residual. Chlorine residual of water being disposed shall be neutralized by treating with one of the chemicals listed below:
      a. Ascorbic Acid
      b. Sodium Ascorbate
      c. Sulfur Dioxide
      d. Sodium Bisulfate
      e. Sodium Sulfite
      f. Sodium Thiosulfate

D. Bacteriological and Other Tests:
   1. Standard Conditions: After final flushing and before the new main is opened to the distribution system, two consecutive sets of acceptable samples, taken at least 24-hours apart, shall be collected from the new main. Samples shall be collected from every 1,200-ft of new water main, from the end of the water line, and from each branch. All samples shall be tested in accordance with *Standard Methods for the Examination of Water and Wastewater*. All samples shall show the absence of coliform organisms, and a free chlorine residual equal to the level present in the existing system and shall have no visible color or particulate matter. **Must be submitted in the form of an official report by a certified lab.**
   2. Special Conditions: If in the opinion of CFPUA, excess contamination has been allowed to enter the water main during construction or other events, bacteriological samples shall be taken at intervals of approximately 400 to 500 ft and shall be identified by location. Samples shall be taken of water that has stood in the new main for at least 16 hours after final flushing has been completed.
   3. Sampling Procedures: Sample collection shall be in accordance with *Standard Methods for the Examination of Water and Wastewater*. A copper or PVC assembly or a combination blowoff and sampling tap may be used for mains up to 8-inches diameter. Fire hydrants may not be used for sampling purposes. After samples have been collected, analyzed, and accepted, the sampling assemblies may be removed and retained for future use. All bacteriological analysis must be completed by a N.C. certified Drinking Water laboratory. The utility contractor

shall be responsible for all costs associated with the sampling and analysis of all samples required for acceptance. **All Lab Reports shall be delivered to the CFPUA Representative before any activation can proceed.**

E. Replace permanent system devices that were removed for disinfection.

3.4 DISINFECTION PROCEDURE FOR REPAIRED WATER MAINS

A. The following procedures apply primarily when mains are wholly or partially dewatered. After the appropriate repair procedures have been completed, the existing main may be returned to service prior to completion of the bacteriological testing to minimize the time customers are out of water. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.

B. The following procedure is considered as a minimum that may be used.
   1. Swabbing with Hypochlorite Solution: The interior of all pipe and fittings used in making repair (particularly couplings and tapping sleeves) shall be swabbed with a five (5) percent hypochlorite solution (300 mg/l concentration) before they are installed.
   2. Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions independently is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water and particulate matter are eliminated.
   3. Slug Chlorination: When practical, in addition to the procedures above, the section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated with a high concentration of chlorine (as much as 300 mg/L), and the concentration allowed to stay in contact with the main for a minimum of 15 minutes. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the water is free of noticeable high chlorine odor. A chlorine residual of no greater than 3.0 mg/L shall be acceptable.
   4. Sampling: Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedure's effectiveness. If the direction of flow is known, sample locations shall be determined. If the direction of flow is unknown, then samples shall be taken on each side of the main break. If bacteriological samples are unacceptable, the CFPUA representative shall determine corrective action. Daily sampling shall be continued until two successive daily samples are acceptable.

3.5 REPEAT DISINFECTION OF WATER MAIN

A. If the initial disinfection fails to produce satisfactory results as per specifications, the new main shall be reflushed, rechlorinated and resampled; CFPUA may also require further cleaning methods (i.e., pigging the line) if the disinfection fails twice. If check samples also fail to produce acceptable results, the new main shall be reflushed and rechlorinated by the continuous-feed method of chlorination until satisfactory results are obtained.

B. High velocities in the existing system, resulting from flushing the new main may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to also sample water entering the new main.

3.6 CONNECTION TO EXISTING SYSTEM

A. The NCPWS certifications, final acceptance, opening of valves and activation of the existing water system will only be allowed after satisfactory samples and chlorine levels have been produced. All sampling devices and blowoffs must be removed from the water main by the contractor prior to acceptance by CFPUA. The CFPUA Operations Department will activate the system when their procedures are completed.

3.7 FIELD QUALITY CONTROL

A. Section 01 70 00 – Execution and Closeout Requirements.

END OF SECTION