

# UNIFIED FACILITIES CRITERIA (UFC)

---

## WATER TREATMENT



APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

**UNIFIED FACILITIES CRITERIA (UFC)**

**WATER TREATMENT**

Any copyrighted material included in this UFC is identified at its point of use. Use of the copyrighted material apart from this UFC must have the permission of the copyright holder.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

<b>Change No.</b>	<b>Date</b>	<b>Location</b>

## FOREWORD

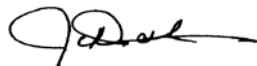
The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD \(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Center for Engineering and the Environment (AFCEE) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: [Criteria Change Request](#). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site <http://dod.wbdg.org/>.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.



---

JAMES C. DALTON, P.E.  
Chief, Engineering and Construction  
U.S. Army Corps of Engineers



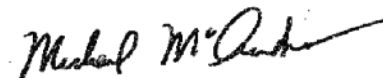
---

JOSEPH E. GOTT, P.E.  
Chief Engineer  
Naval Facilities Engineering Command



---

TERRY G. EDWARDS, P.E.  
Director, Air Force Center for Engineering and  
the Environment  
Department of the Air Force



---

MICHAEL McANDREW  
Director, Facilities Investment and Management  
Office of the Deputy Under Secretary of Defense  
(Installations and Environment)

**UNIFIED FACILITIES CRITERIA (UFC)**  
**NEW REVISION SUMMARY SHEET**

**Title:** UFC 3-230-03, *Water Treatment*

**Superseding:** UFC 3-230-08A and UFC 3-230-12A.

**Description:** This new UFC 3-230-03 consolidates into one Tri-Service document the civil engineering criteria applicable to water treatment that were formerly in the superseded documents. This UFC – through succinct reference to industry and government standards, codes and references – makes possible the replacement and/or consolidation of numerous criteria documents.

The complete list of water engineering documents referenced in this UFC can be found in Appendices A and B.

**Reasons for Document:**

- The new UFC updates the guidance and requirements for water treatment contained in several existing engineering documents and efficiently consolidates them into a single UFC.
- The superseded UFC documents included requirements that were not consistent with industry standards or utilized different industry standards.

**Impact:**

This unification effort will result in the more effective use of DoD funds in the following ways:

- By significantly improving the design process for DoD projects and facilities, through a more efficient application of facilities criteria and enabling more efficient maintenance of facilities criteria.
- The consolidation of the UFC 3-230-03 will positively impact the project costs incurred, as a result of the following direct benefits:
  - Reduction in the number of civil references used for military construction provides more clear and efficient guidance for the design and construction of DoD facilities.
  - Improved clarity and convenience results in reduced time required for execution of project designs.
  - Reduction in ambiguity and the need for interpretation reduces the potential for design and construction conflicts.
  - The reduction in the number of documents and the use of industry standards improves the ease of updating and revising this reference document as better information becomes available.

**Non Unified Issues:** No major unification issues.

TABLE CONTENTS

<b>TABLES.....</b>	<b>II</b>
<b>CHAPTER 1 INTRODUCTION .....</b>	<b>1</b>
<b>1-1    PURPOSE AND SCOPE.....</b>	<b>1</b>
<b>1-2    APPLICABILITY.....</b>	<b>1</b>
<b>1-3    OTHER CRITERIA.....</b>	<b>1</b>
1-3.1    General Building Requirements.....	1
1-3.2    Safety.....	1
1-3.3    Antiterrorism and Security.....	1
<b>1-4    REFERENCES.....</b>	<b>2</b>
<b>1-5    BEST PRACTICES.....</b>	<b>2</b>
<b>CHAPTER 2 GENERAL DESIGN REQUIREMENTS.....</b>	<b>3</b>
<b>2-1    DESIGN.....</b>	<b>3</b>
2-1.1    Design Criteria.....	3
2-1.2    Design Approval.....	4
2-1.3    Planning for Non-War Emergencies.....	4
<b>CHAPTER 3 WATERWORKS SUPPLY SOURCES AND FLOWS.....</b>	<b>5</b>
<b>3-1    WATERWORKS SUPPLY SOURCES.....</b>	<b>5</b>
<b>3-2    DESIGN POPULATION.....</b>	<b>5</b>
<b>3-3    WATERWORKS FLOWS.....</b>	<b>5</b>
3-3.1    Domestic Flows.....	5
3-3.1.1    Per Capita Requirements.....	5
3-3.1.2    Controlling Demands.....	6
3-3.2    Industrial Flows.....	7
<b>3-4    DESIGN FLOWS.....</b>	<b>7</b>
<b>3-5    MATERIALS SELECTION.....</b>	<b>7</b>
<b>CHAPTER 4 SITE SELECTION .....</b>	<b>9</b>
<b>4-1    LOCATION.....</b>	<b>9</b>
<b>4-2    ACCESS.....</b>	<b>9</b>
<b>4-3    FIELD INVESTIGATION.....</b>	<b>9</b>
4-3.1    Existing and Proposed Service Areas.....	9
4-3.2    Topographic Survey.....	9
4-3.3    Soils.....	9

4-3.4	Environmental Considerations.....	10
<b>CHAPTER 5 TREATMENT PROCESS SELECTION.....</b>		<b>11</b>
5-1	<b>PROCESS SELECTION FACTOR.....</b>	<b>11</b>
5-2	<b>FLUORIDATION.....</b>	<b>11</b>
5-3	<b>CORROSION CONTROL TREATMENT.....</b>	<b>11</b>
<b>CHAPTER 6 SMALL WATER TREATMENT SYSTEMS .....</b>		<b>13</b>
6-1	<b>GENERAL DESIGN CRITERIA.....</b>	<b>13</b>
6-2	<b>TYPICAL MILITARY APPLICATIONS.....</b>	<b>13</b>
6-3	<b>PACKAGED TREATMENT PLANTS.....</b>	<b>13</b>
6-4	<b>DISINFECTION.....</b>	<b>13</b>
6-5	<b>RELIABILITY.....</b>	<b>13</b>
6-6	<b>OPERATING CONSIDERATIONS.....</b>	<b>14</b>
6-7	<b>ALTERNATIVE TECHNOLOGIES.....</b>	<b>14</b>
<b>CHAPTER 7 MEASUREMENT AND CONTROL .....</b>		<b>15</b>
7-1	<b>MEASUREMENT OF PROCESS VARIABLES.....</b>	<b>15</b>
7-1.1	Minimum Analyses for Military Water Treatment Plants.....	15
7-2	<b>INSTRUMENTATION AND CONTROLS.....</b>	<b>15</b>
<b>CHAPTER 8 CHEMICAL TREATMENT .....</b>		<b>17</b>
8-1	<b>CHEMICAL PROPERTIES AND STANDARDS.....</b>	<b>17</b>
8-2	<b>CHEMICAL HANDLING, STORAGE AND APPLICATION.....</b>	<b>17</b>
<b>CHAPTER 9 WATER TREATMENT WASTE RESIDUALS .....</b>		<b>19</b>
9-1	<b>QUANTITIES AND CHARACTERISTICS OF WASTE RESIDUALS.....</b>	<b>19</b>
9-2	<b>WASTE MANAGEMENT.....</b>	<b>19</b>
APPENDIX A REFERENCES.....		21
APPENDIX B BEST PRACTICES .....		23
B-1	WHOLE BUILDING DESIGN GUIDE.....	23
B-2	CIVIL ENGINEERING RELATED GUIDANCE.....	23
B-3	ADDITIONAL BEST PRACTICES.....	24

## TABLES

<b>TABLE 3-1: DAILY DOMESTIC CONSUMPTION RATES .....</b>	<b>6</b>
<b>TABLE 3-2: DEMAND VARIATIONS (COEFFICIENT K) .....</b>	<b>6</b>

## CHAPTER 1 INTRODUCTION

### 1-1 PURPOSE AND SCOPE.

This Unified Facilities Criteria (UFC) provides requirements for typical water treatment systems for the Department of Defense (DoD). These minimum technical requirements are based on UFC 1-200-01. Where other statutory or regulatory requirements are referenced in the contract, the more stringent requirement must be met.

### 1-2 APPLICABILITY.

This UFC applies to service elements and contractors involved in the planning, design and construction of DoD facilities worldwide. It is applicable to all methods of project delivery and levels of construction, but is not applicable to public-private ventures (PPV).

All design and construction outside of the United States and United States territories is governed by international agreements, such as the Status of Forces Agreements (SOFA), Host Nation-Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA), and country-specific Final Environmental Governing Standards (FGS) or the DoD *Overseas Environmental Baseline Guidance Document*, DoD 4715.05G. The OEBGD applies when there are no FGSs in place. Therefore, in foreign countries this UFC will be used for DoD projects to the extent that it is allowed by and does not conflict with the applicable international agreements and the applicable FGS or OEBGD.

### 1-3 OTHER CRITERIA.

#### 1-3.1 General Building Requirements.

UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, low impact development (LID) and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

#### 1-3.2 Safety.

All DoD facilities must comply with DODINST 6055.1 and applicable Occupational Safety and Health Administration (OSHA) safety and health standards.

#### 1-3.3 Antiterrorism and Security.

Specific security concerns for Water Treatment Facilities are addressed in the “Policy Statement on Infrastructure Security for Public Water Supplies” of the *Ten State Standards*. Use Best Practices document, ASCE/AWWA Draft American National Standard for Trial Use, *Guidelines for the Physical Security of Water Utilities*, for latest guidelines for protection of water utility systems.

**1-4 REFERENCES.**

Appendix A contains the list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

**1-5 BEST PRACTICES.**

Appendix B identifies background information and practices for accomplishing certain water treatment design and engineering services. The Designer of Record (DoR) is expected to review and interpret this guidance as it conforms to criteria and contract requirements, and apply the information according to the needs of the project. If a Best Practices document has guidelines or requirements that differ from the Unified Facilities Guide Specifications (UFGS) or UFC, the UFGS and the UFC must prevail. If a Best Practices document has guidelines or requirements that are not discussed in the Unified Facilities Guide specification (UFGS) or UFC, the DoR must submit a list of the guidelines or requirements being used for the project with sufficient documentation to the Government Project Manager for review and approval prior to completing design.



## CHAPTER 2 GENERAL DESIGN REQUIREMENTS

### 2-1 DESIGN.

#### 2-1.1 Design Criteria.

Design water treatment systems to meet the drinking water quality requirements of applicable federal, state and local government agencies or overseas equivalent.

The U.S. Environmental Protection Agency (EPA) Safe Drinking Water Act primary and secondary drinking water regulations and State and local water quality regulations typically serve as the drinking water quality standards for a water treatment facility.

Design the water treatment system in accordance with the following criteria precedence:

1. State waterworks regulations for the project location, including State-approved products and treatment systems;
2. Utility provider's requirements;
3. *Recommended Standards for Water Works*, latest edition, Policies for the Review and Approval of Plans and Specifications for Public Water Supplies, A Report of the Water Supply committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (known hereafter as the *Ten State Standards*).
4. Conservation: Consider water and energy conservation alternatives to meet current DoD conservation policy such as the Energy Policy Act of 1992/2006: Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*; and Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*. ASHRAE 90.1 and Federal Energy Management Plan (FEMP) websites have guides for conservation.

Exceptions or additions to the above criteria noted herein. Refer to all applicable standards and Manuals of Practice (MOPs) prepared by the American Water Works Association (AWWA) for additional design criteria not indicated above, as applicable to the project.

Use the following References and Best Practices documents for design guidance:

- AWWA's *Water Treatment Plant Design and Water Quality and Treatment*.
- AWWA's *Water Treatment* in the five part series Principles and Practices of Water Supply Operations.
- Water Environment Federation's (WEF) MOP 28, *Upgrading and Retrofitting Water and Wastewater Treatment Plants*.

- AWWA's *Desalination of Seawater and Brackish Water and Solar Distillation Practice for Water Desalination Systems*.
- HDR's *Handbook of Public Water Systems*.
- MHW's *Water Treatment: Principles and Design*.
- White's *Handbook of Chlorination and Alternative Disinfectants*.

### **2-1.2 Design Approval.**

The Designer of Record must identify and obtain all permits required by federal, state, and local regulatory agencies or overseas equivalent. The Civil Engineering Designer of Record must be a Professional Civil Engineer experienced and licensed; licensure in the location of the project may be required to obtain permits and approvals. Recommend coordination with SDWA primacy agency on any construction and/or modification to public water systems as applicable under primacy agency requirements. In CONUS locations the Government will review for acceptability plans for new water treatment systems or rehabilitation/replacement of existing water treatment systems. In OCONUS locations with Host nation agreements, follow design approval procedure as directed in project scope and by Government Project Manager. In OCONUS locations without Host nation agreements, the Government will review and approve plans for new water treatment systems or rehabilitation/replacement of existing water treatment systems.

### **2-1.3 Planning for Non-War Emergencies.**

Refer to Best Practices document AWWA Manual M19, *Emergency Planning for Water Utility Management*, for non-war emergencies such as earthquakes, hurricanes, tornadoes, floods and vandalism.

## CHAPTER 3 WATERWORKS SUPPLY SOURCES AND FLOWS

### 3-1 WATERWORKS SUPPLY SOURCES.

Unless otherwise directed by the Government Project Manager, obtain potable water supply from a nearby public system. If this is not practical, sources must be developed for the Military activity.

The selection of a water supply source involves a review of the alternative sources available and their respective characteristics. Consider water quality and quantity data for the supply source over a significant period of time to sufficiently assess seasonal and long-term variability. Consider the following factors when selecting a water supply source:

- Safe yield
- Water quality
- Collection requirements (intake structure, wells, etc.)
- Treatment requirements (including the cost and feasibility of residue disposal)
- Transmission and distribution requirements

A complete discussion of water source selection and development is beyond the scope of this document. Refer to state waterworks regulations or overseas equivalent for the project location. For OCONUS locations, evaluate all possible alternative sources, including cost, relations with the Host Nation, and antiterrorism considerations. Brackish or salt water must be used only when other sources are unavailable and must be converted to fresh water by a suitable process. Refer to AWWA's *Water Quality and Treatment*.

### 3-2 DESIGN POPULATION.

Refer to UFC 3-240-02, paragraph entitled "*Design Population*".

### 3-3 WATERWORKS FLOWS.

#### 3-3.1 Domestic Flows.

Domestic uses include drinking water, household uses and household lawn irrigation.

##### 3-3.1.1 Per Capita Requirements.

Actual annual water demand data must be used to determine design flows. If historical water demand data is not available that meets requirements of state regulations or overseas equivalent, base design flows on daily water consumption rates for the types of facilities included in state regulations or overseas equivalent. In locations where state regulations or overseas equivalent do not address types of facilities, obtain typical water demand from Table 3-1.

**Table 3-1: Daily Domestic Consumption Rates<sup>1</sup>**

<b>Use Category<sup>2</sup></b>	<b>Flow Requirement (gpcd) (m<sup>3</sup>/cap/s)</b>
Unaccompanied Personnel Housing <sup>2</sup>	110 (4.82 x 10 <sup>-6</sup> )
Family Housing <sup>2,3</sup>	125 (5.48 x 10 <sup>-6</sup> )
Nonresident Personnel and Civilian Employees (per 8 hr. shift)	30 (1.31 x 10 <sup>-6</sup> )
Military Training Camps <sup>2</sup>	50 (2.19 x 10 <sup>-6</sup> )

<sup>1</sup> Allowances do not include industrial or process wastes.

<sup>2</sup> These values represent domestic waste quantities for resident personnel averaged over the entire installation for a 24-hour period.

<sup>3</sup> In family housing areas, each housing unit must be assigned 3.6 residents for the purpose of calculating populations.

In addition to Table 3-1, other buildings and establishments normally found on military installations must be assigned typical daily water consumption rates obtained from the latest edition of Best Practices document, MHW's *Water Treatment: Principles and Design*. Do not use these typical daily water consumption rates for contingency operations.

### 3-3.1.2 Controlling Demands.

The average day demand must be calculated as follows:

$$\text{Average Day Demand (gpd) (m}^3\text{/s)} = (\text{gpcd) (m}^3\text{/cap/s)} \times \text{Design Population}$$

Demand variations must be evaluated by the following:

$$\text{Demand} = \text{Avg Demand} \times K$$

Base maximum day or maximum hour ratios to average day on historical water demand data unless values in Table 3-2 are greater.

**Table 3-2: Demand Variations (Coefficient K)**

<b>Demand</b>	<b>Units of Demand</b>	<b>Coefficient K</b>	
		<b>Population &lt; 5000</b>	<b>Population &gt; 5000</b>
Maximum Day Demand*	gpd (m <sup>3</sup> /s)	2.25	2
Maximum Hour Flow	gpm (m <sup>3</sup> /s)	4.0	3.5

The designer may make allowances in per capita demand, as deemed necessary, for small activities where all or nearly all demand occurs during working hours. Also account for a planned buildup or population decrease.

**3-3.2 Industrial Flows.**

Industrial flows include cooling, issues to ships, irrigation, swimming pools, shops, laundries, dining, processing, flushing, air conditioning, wash racks, rinse racks, and boiler makeup. Base water demand for Industrial flows on actual meter measurements. Also refer to actual water meter data at other activities having similar uses to those anticipated. Confirm water characteristics required for industrial processes to determine appropriate treatment.

**3-4 DESIGN FLOWS.**

The design capacity of the water treatment plant must be able to meet maximum day domestic demand plus industrial use demand, assuming adequate equalizing storage following treatment. Without equalizing storage, the water treatment plant must be able to meet maximum hour flow plus industrial use demand.

**3-5 MATERIALS SELECTION.**

Approach selection of equipment, piping, materials and coatings for water treatment systems in accordance with current AWWA standards. Ensure compliance with NSF Standard 60 and NSF Standard 61. For corrosive soils, select materials, coatings, and/or a positive corrosion protection system to protect from external corrosion. Use AWWA Manual M27, *External Corrosion – Introduction to Chemistry and Control*; however, explicit approval by the Government is required prior to providing a cathodic protection system on a buried pipeline.

*This Page Intentionally Left Blank*

## CHAPTER 4 SITE SELECTION

### 4-1 LOCATION.

Water treatment plants must be located above the projected 100 year flood elevation according to UFC 3-201-01. Government approval is required for lower elevations to be considered even if it can be adequately shown that the proposed treatment plant can be protected from flooding.

- Consider the following for a treatment plant site:
- Proximity to the source of raw water.
- Proximity to the area to be served.
- Potential for flooding of the site.
- Availability and reliability of electric power from more than one source of outside power.
- Geology and topography of the site.
- Size of the site, both for original and for anticipated expansions.
- Legal obligations or restrictions.
- Environmental considerations.
- Antiterrorism integrity.

### 4-2 ACCESS.

The site must be selected so that an all-weather road is available or can be provided for access to the plant. Consideration must be given, during layout of buildings, roads, fencing and appurtenances, to winter conditions, especially of snow drifting and removal.

### 4-3 FIELD INVESTIGATION.

#### 4-3.1 Existing and Proposed Service Areas.

Utilize Installation's existing utility maps and proposed planning documents to develop existing and proposed service areas for present and future (minimum 5 year) conditions. Where adequate planning documents are not available, estimate future growth as described in Chapter 3.

#### 4-3.2 Topographic Survey.

Provide a topographic survey of project area including locations of existing utilities in accordance with UFC 3-201-01.

#### 4-3.3 Soils.

Evaluate geotechnical data on existing soils, including corrosivity, if existing operating records, visual observations, inspections or testing indicates a need for corrosion control. If recommended by the Government Civil or Geotechnical Reviewer, provide an evaluation of existing soils at the proposed depths and locations of the water system

components in accordance with AWWA Manual M27, *External Corrosion – Introduction to Chemistry and Control* (Chapter 3 entitled “Evaluating the Potential for Corrosion”) and provide recommendations on materials and positive corrosion protection systems.

**4-3.4 Environmental Considerations.**

Contact the Installation’s Environmental Reviewer prior to design and evaluate site for environmental concerns and known contamination. Notify Government Project Manager of known environmental contamination to ensure adequate funding in current project.



## CHAPTER 5 TREATMENT PROCESS SELECTION

The selection of treatment facilities must be determined by feasibility studies, considering all engineering, economic, energy and environmental factors. All legitimate alternatives must be identified and evaluated by life cycle cost analyses. Additionally, energy use between candidate processes must be considered. For the purpose of energy consumption, only the energy purchased or procured will be included in the usage evaluation. All treatment process systems must be compared with a basic treatment process system, which is that system accomplishing the required treatment at the lowest first cost. Pilot or laboratory analysis must be used in conjunction with published design data of similar existing plants to assure the optimal treatment. It is the responsibility of the Civil Engineering Designer of Record to insure that the selected water treatment plant process complies with the National Primary Drinking Water Standards of the Safe Drinking Water Act or overseas equivalent, State and local regulations, whichever is more stringent.

### 5-1 PROCESS SELECTION FACTOR.

Consider the following factors in the choice of a water treatment process:

- Water supply source quality
- Desired finished water quality
- Reliability of process equipment
- Operational requirements and personnel capabilities
- Flexibility in dealing with changing water quality and equipment malfunctions
- Available space for construction and future expansion of treatment facilities
- Waste disposal constraints
- Capital and operating costs (including chemical availability)
- Process susceptibility to intentional contamination or disruption of operation

### 5-2 FLUORIDATION.

All designs of new DoD water treatment systems serving 3300 people or greater must include the ability to treat drinking water to the optimally adjusted concentrations of fluoride indicated in the latest Center for Disease Control's (CDC) National Guidelines For Fluoride Use found in *Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States*. All treatment systems serving less than 3300 people will be determined on a case by case basis.

### 5-3 CORROSION CONTROL TREATMENT.

Provide corrosion control treatment in accordance with AWWA M58, *Internal Corrosion of Water Distribution Systems* if there is evidence of internal corrosion of distribution system piping and building plumbing.

*This Page Intentionally Left Blank*

## CHAPTER 6 SMALL WATER TREATMENT SYSTEMS

### 6-1 GENERAL DESIGN CRITERIA.

Design upgrades to existing treatment facilities and construction of new treatment facilities based on the criteria indicated in paragraph entitled "*Design Criteria*".

Design potable water systems treating less than 100,000 gallons per day ( $4.38 \times 10^{-3}$  m<sup>3</sup>/s) in accordance with EM 1110-2-503. Use Best Practices document, AWWA's *Design and Construction of Small Water Systems*, for design guidance.

If the Civil Engineering Designer of Record utilizes a particular water treatment system, technology, component or device, more than one manufacturer must be listed in the construction documents in accordance with the latest FAR regulations. The manufacturers' systems or components indicated must be currently approved for commercial use for the proposed application and project conditions in the State where the project is located. If the State does not maintain an approved water treatment system or components list or the project is in a location not subject to state water works regulations, then documentation must be provided to the Government indicating that each manufacturer's proposed water system or component is approved in at least one other state for commercial use for a similar application.

### 6-2 TYPICAL MILITARY APPLICATIONS.

Most small potable water systems on military installations that do not obtain water from a municipality use a groundwater source with limited or specialized treatment systems.

### 6-3 PACKAGED TREATMENT PLANTS.

Many small treatment systems on military installations are packaged treatment plants. These systems combine processes such as flocculation, aeration, sedimentation, and filtration in a single multicompartament tank. Typical types include demineralization, reverse osmosis, electrodeionization, and sea water desalination. Various processes may include proprietary components.

### 6-4 DISINFECTION.

Disinfection of the effluent must be provided as necessary to meet applicable drinking water quality standards.

Chlorine gas must not be used for disinfection for a small water treatment system.

### 6-5 RELIABILITY.

Multiple process units capable of independent operation must be provided for redundancy at all plants.

Provide for emergency power operation, such as a dedicated standby emergency generator or a portable generator, in conformance with applicable regulatory and utility provider requirements.

If the delivery of crucial chemical supplies is uncertain, larger than normal stores of these chemicals must be kept on hand, which will necessitate larger than normal chemical storage areas. Caution on the size of selected vessels and storage of chemicals must be exercised. The expected “shelf life” of chemicals and the operating environment must be taken into account. In addition, the procurement process for the facility must be understood before the finalization of any design project that requires ordering and storage of chemicals.

#### **6-6 OPERATING CONSIDERATIONS.**

To simplify plant operations, consider the following during the design stage:

Locate operations requiring frequent attention from plant operators reasonably close together. The most attention is generally required for operation of filters, flocculators and chemical feeding equipment.

Simplify chemical handling and feeding as much as possible. Locate unloading and storage areas for chemicals to be easily maintained and readily accessible and be close to the point of application of chemicals. Care must be exercised in the design of storage area ventilation system to ensure that normal and emergency discharges do not affect other areas or personnel.

Plants treating river water must provide the flexibility in treatment processes needed to cope with raw water quality changes such as high turbidity during rain/flood season.

Typically Operation and Maintenance Support Information (OMSI) manuals are required for treatment plants. OMSI manuals include preparation of the plant operating procedures and controls including a complete description of the treatment process flow.

#### **6-7 ALTERNATIVE TECHNOLOGIES.**

Consider technologies that can pre-condition water such that subsequent processing may be able to eliminate unit processes such that only simple technology or conventional treatment is required. Pilot testing to “prove” these assertions must be performed as appropriate.

## CHAPTER 7 MEASUREMENT AND CONTROL

The primary purpose for instrumentation and control is to produce high quality aesthetic acceptable water compliant with regulatory primary drinking water standards and provide proactive alarms to treatment process malfunction.

### 7-1 MEASUREMENT OF PROCESS VARIABLES.

In order to determine the degree of effectiveness of the different treatment processes, several physical and chemical parameters associated with water treatment must be measured. After they are measured, the information must be evaluated so that necessary adjustments can be made in the treatment processes.

#### 7-1.1 Minimum Analyses for Military Water Treatment Plants.

The type of water quality parameters and frequency of analysis to ensure drinking water is compliant with the National Primary Drinking Water Standards of the Safe Drinking Water Act or overseas equivalent are determined by the size of the system, treatment required, and water quality regulations. These requirements are typically set by state and local regulations. The frequency of analyses must also be adjusted locally to meet changing raw water characteristics. Minimum analyses frequencies and laboratory equipment requirements must comply with the more stringent requirements of individual state and local requirements. For locations outside the United States and United States territories refer to paragraph entitled "*Design Criteria*", for applicable requirements. Analyses conducted to determine compliance with drinking water regulations must be performed in an appropriately certified laboratory in accordance with the *Standard Methods for the Examination of Water and Wastewater* or approved alternative methods. Physical and chemical testing must be performed by trained and certified treatment plant operators or local laboratory personnel. Provide equipment to ensure proper process control must be required to be provided by the construction contractor or other suitable means prior to the plant coming online.

### 7-2 INSTRUMENTATION AND CONTROLS.

Provide for remote monitoring, such as telemetry, in conformance with applicable regulatory and utility provider requirements. If required, provide off site operation capability from a central location. Remote monitoring and control systems must meet the Installation's IT security requirements and standards.

Refer to AWWA's *Water Treatment Plant Design* for a detailed discussion of Process Instrumentation and Controls.

*This Page Intentionally Left Blank*

## CHAPTER 8 CHEMICAL TREATMENT

### 8-1 CHEMICAL PROPERTIES AND STANDARDS.

All chemicals used in water treatment operation must meet the purity requirements of the AWWA standard specifications and comply with NSF Standard 60. Design must be based on the assumption that chemicals will be purchased in normal shipping containers (such as bags, drums, cylinders, or carboys) rather than bulk car or truckloads. Functions of various chemicals and chemical strengths are provided in AWWA's *Water Treatment Plant Design*. For remote locations where delivery is difficult, give priority to chemicals that are stable in storage and slow to degrade or lose potency.

### 8-2 CHEMICAL HANDLING, STORAGE AND APPLICATION.

Refer to AWWA's *Water Treatment Plant Design* and *Ten State Standards, Part 5* for discussions of chemical handling, storage and application procedures.

*This Page Intentionally Left Blank*



## CHAPTER 9 WATER TREATMENT WASTE RESIDUALS

### 9-1 QUANTITIES AND CHARACTERISTICS OF WASTE RESIDUALS.

In connection with water treatment plant location and design, the disposal of the wastes generated during the various treatment processes must receive careful consideration. Among these wastes are sludge from pre-sedimentation basins, coagulation and/or softening sludge, filter wash water, spent regenerant and rinse water from ion-exchange softeners, diatomite filter sludge and mineral wastes from desalination facilities. Ensure acceptable point of discharge for brine (mineral wastes) from desalination plants. Quantities of materials contained in the waste stream will be dependent on the type of treatment processes utilized and the quantity of water treated. A determination of the expected quantity of the various types of waste must be made and proper disposal methods identified during the design process.

### 9-2 WASTE MANAGEMENT.

For information regarding management and disposal of wastes generated by water treatment plants refer to AWWA's *Water Treatment Design*; AWWA's *Water Quality and Treatment*, and *Ten State Standards*, Part 9.

*This Page Intentionally Left Blank*

## APPENDIX A REFERENCES

### GOVERNMENT PUBLICATIONS

#### UNIFIED FACILITIES CRITERIA (UFC), DEPARTMENT OF DEFENSE (DoD)

<http://dod.wbdg.org/>

UFC 1-200-01, *General Building Requirements*

UFC 3-201-01, *Civil Engineering*, target publication date, October 2012. Use UFC 3-210-01A and UFC 3-200-10N as interim criteria until publication of UFC 3-201-01.

UFC 3-240-02, *Domestic Wastewater Treatment*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-020-01, *DoD Security Engineering: Facilities Planning Manual*

#### DEPARTMENT OF DEFENSE (DoD)

[http://www.wbdg.org/ccb/browse\\_cat.php?o=29&c=76](http://www.wbdg.org/ccb/browse_cat.php?o=29&c=76)

DoD 4715.5-G, *Overseas Environmental Baseline Guidance Document*

DODINST 6055.1, *DoD Safety and Occupational Health (SOH) Program*

### UNITED STATES ARMY

EM 1110-2-503, *Design of Small Water Systems*

### NON-GOVERNMENT PUBLICATIONS

#### AMERICAN WATER WORKS ASSOCIATION, 6666 W. QUINCY AVENUE, DENVER, CO 80235

AWWA M27, *External Corrosion: Introduction to Chemistry and Control*

*Standard Methods for the Examination of Water and Wastewater*, latest edition

*Water Quality and Treatment*, latest edition

*Water Treatment Plant Design*, latest edition

#### CENTER FOR DISEASE CONTROL AND PREVENTION (CDC), 1600 CLIFTON ROAD, ATLANTA, GA 30333, [cdcinfo@cdc.gov](mailto:cdcinfo@cdc.gov)

*Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States*

**GREAT LAKES – UPPER MISSISSIPPI RIVER BOARD OF STATE AND  
PROVINCIAL PUBLIC HEALTH AND ENVIRONMENTAL MANAGERS**

*Recommended Standards for Water Works*, latest edition

## APPENDIX B BEST PRACTICES

Appendix B identifies background information and practices for accomplishing certain water treatment design and engineering services. The Civil Engineering Designer of Record (DoR) is expected to review and interpret this guidance and apply the information according to the needs of the project. If a Best Practices document has guidelines or requirements that differ from the UFGS or Unified Facilities Criteria, the UFGS and the UFC must prevail. If a Best Practices document has guidelines or requirements that are not discussed in the Unified Facilities Guide specification (UFGS) or UFC, the DoR must submit a list of the guidelines or requirements being used for the project with sufficient documentation to the Government Project Manager for review and approval prior to completing design.

### **B-1 WHOLE BUILDING DESIGN GUIDE.**

The [Whole Building Design Guide](#) provides additional information and discussion on practice and facility design, including a holistic approach to integrated design of facilities.

The WBDG provides access to all Construction Criteria Base (CCB) criteria, standards and codes for the DoD Military Departments, National Aeronautics and Space Administration (NASA), and others. These include, Unified Facilities Criteria (UFC), Unified Facilities Guide Specifications (UFGS), Performance Technical Specifications (PTS), design manuals, and specifications. For approved Government employees, it also provides access to non-government standards.

### **B-2 CIVIL ENGINEERING RELATED GUIDANCE.**

#### **GOVERNMENT PUBLICATIONS**

#### **NON-GOVERNMENT PUBLICATIONS**

#### **AMERICAN WATER WORKS ASSOCIATION, 6666 W. QUINCY AVENUE, DENVER, CO 80235**

*AWWA Manual M19, Emergency Planning for Water Utility Management*

*Desalination of Seawater and Brackish Water, latest edition*

*Design and Construction of Small Water Systems, latest edition*

*Guidelines for the Physical Security of Water Utilities, latest edition*

*Solar Distillation Practice for Water Desalination Systems, latest edition*

*Water Treatment* in the five part series *Principles and Practices of Water Supply Operations*, latest edition

**HDR ENGINEERING, INC., 660 HAWTHORNE AVENUE, SE #220, SALEM, OR,  
97301-6683**

*Handbook of Public Water Systems*, latest edition

**NSF INTERNATIONAL, P.O. BOX 130140, 789 N. DIXBORO ROAD, ANN ARBOR,  
MICHIGAN 48113-0140**

NSF Standard 60, *Drinking Water Treatment Chemicals*, latest edition

NSF Standard 61, *Drinking Water System Components*, latest edition

**WATER ENVIRONMENT FEDERATION (WEF), 601 WYTHE STREET,  
ALEXANDRIA, VA 22314-1994**

*Upgrading and Retrofitting Water and Wastewater Treatment Plants*, Manual of Practice (MOP) 28, latest edition

**WILEY, JOHN & SONS, INC., 111 RIVER STREET MS 4-02, HOBOKEN, NJ, 07030-  
5774**

MHW's *Water Treatment: Principles and Design*, latest edition

White's *Handbook of Chlorination and Alternative Disinfectants*, latest edition

**B-3                      ADDITIONAL BEST PRACTICES.**