BY ORDER OF THE COMMANDER PACIFIC AIR FORCES

PACIFIC AIR FORCES MANUAL 32-1067

13 APRIL 2026

Civil Engineering

WATER TREATMENT OPERATOR TRAINING AND CERTIFICATION PROGRAM FOR OVERSEAS LOCATIONS AND WATER SYSTEM OPERATION AND MAINTENANCE REQUIREMENTS

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RELEASABILITY: There are no releasability restrictions on this publication.

OPR: PACAF/A4C — Certified by: PACAF/A4C

Supersedes: PACAFMAN32-1067, 1 July 2020 — Pages: 347

This manual implements Air Force Policy Directive (AFPD) 32-10, *Installation and Facilities* and is consistent with Department of the Air Force Manual (DAFMAN) 32-1067, Water and Fuel Systems. This publication defines the DAFMAN 32-1067 requirements for training and certification by water system operations personnel before taking responsibility for water treatment plant operations, maintenance, or repair. This guideline establishes required certification levels and recurring training frequencies for treatment system operators to increase public health protection of Pacific Air Forces (PACAF) drinking water systems that are not regulated by state or local agencies. This manual also includes wellhead protection program and storage tank inspection requirements for overseas locations and establishes an official electronic system of record for backflow prevention and fire hydrant maintenance programs. This publication applies to all PACAF Air Force units. It is not applicable to Air Force Reserve, Air National Guard or United States Space Force. Refer recommended changes and questions about this publication to the office of primary responsibility (OPR) using the Department of the Air Force (DAF) Form 847, *Recommendation for Change of Publication*; route DAF Forms 847 from the field through the appropriate functional chain of command. Ensure that any local policy/guidance, publications, instructions or supplements are created in accordance with DAFMAN 90-161, *Publishing Processes and Procedures*. (Standard for tiered publication) The authorities to waive wing, and unit level requirements in this publication are identified with a tier number ("T-0, T-2, T-3") following the compliance statement. See DAFMAN 90-161, *Publishing Processes and Procedures*, for a description of the authorities associated with the Tier numbers. Submit requests

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SUMMARY OF CHANGES

This document has been revised and should be completely reviewed. Changes include consolidation of training and certification requirements into one chapter; revisions to the minimum number of certified operators at each installation/location to include one certified operator in charge (OC) and one assistant operator in charge (AOC), regardless of water system configuration; and the addition of water storage tank inspection requirements, wellhead protection plan requirements for bases that utilize groundwater for their supply, and the use of GeoBase applications as the official system of record for recurring fire hydrant and backflow prevention device maintenance.

Chapter 1

OVERVIEW

1.1. Introduction. This manual clarifies the requirements of DAFMAN 32-1067 for training and certification of drinking water treatment system operators at overseas locations by establishing required certification levels and recurring training requirements for operators to increase public health protection of PACAF overseas drinking water systems. It also clarifies various drinking water system operation and maintenance requirements of DAFMAN 32-1067 and host nation Final Governing Standards (FGS).

1.2. Background. Consumption of improperly treated drinking water poses a significant threat to Airmen health and safety. Widespread, rapid transmission of waterborne illnesses occur when the drinking water supply becomes contaminated. The ownership and operation of a water treatment and supply system constitutes a force protection, health and safety responsibility.

1.2.1. The 1996 Amendments to the Safe Drinking Water Act (SDWA) directed the United States Environmental Protection Agency (EPA) to develop information on recommended operator certification requirements. In February 1999, EPA published Final Guidelines for the Certification and Recertification of Operators of Community and Non-Transient Non-Community Public Water Systems, which provided baseline standards for state operator certification programs.

1.2.2. The SDWA regulations promulgated by the EPA include provisions that require non-contingency Air Force drinking water systems to be certified by competent authorities. To operate water systems within US jurisdictions, Air Force water system operators must comply with all federal and state drinking water regulations including maintaining applicable permits and operators' certifications in good standing. However, overseas Air Force installations are subject to a blend of US and Host Nation (HN) regulations that do not specifically address operator or system certification.

1.2.3. While DAFMAN 32-1067 requires Air Force drinking water systems to have competent operators, it relies on the ability of the BCE to leverage state and local entities to establish these standards. Additionally, the Environmental Governing Standards at HN locations do not provide any details as to what a qualified and trained operator is. That leaves the BCE without specific provisions for formal Air Force drinking water systems Operator Training and Certification (OT&C) program similar to US-established systems.

1.3. Purpose. The intent of this document is to establish a standard OT&C program for PACAF drinking water systems to meet the SDWA set forth by the USEPA, along with other water system operation and maintenance requirements. This document establishes an overseas operator in charge (OC) and assistant operator in charge (AOC) OT&C program to ensure operators satisfy requirements of an equivalent stateside, USEPA-approved program modified to include overseas requirements set by the Overseas Environmental Baseline Guidance Document (OEBGD) and the country specific Final Governing Standards (FGS), that require that the "U.S. Department of Defense (DoD) installations will ensure that personnel are appropriately trained to operate DoD water systems."

1.3.1. This program accomplishes the following:

1.3.1.1. Provides a system for classifying water treatment facilities.

1.3.1.2. Requires examination of water treatment facility operators and certification for their competency to operate the water treatment facilities according to the classification.

1.3.1.3. Establishes procedures for such classification and certification.

1.3.1.4. Provides requirements for recurring inspections for potable water tanks.

1.3.1.5. Requires installations to develop, implement, and maintain a wellhead protection plan for drinking water systems that utilize groundwater sources.

1.3.1.6. Requires installations to utilize GeoBase applications to record and track fire hydrant flow testing and backflow prevention device inspection, testing and survey activities.

1.3.1.7. Improves and achieves environmental compliance and protect public health.

Chapter 2

ROLES AND RESPONSIBILITIES

2.1. PACAF A4C.

2.1.1. As functional certifier for publication of this document reviews and coordinates on all actions, guidance and directives proposed by AFIMSC Det 2.

2.2. PACAF Bioenvironmental Engineer (BEE).

2.2.1. Supports installation to ensure drinking water surveillance meets requirements.

2.3. AFIMSC Detachment 2.

2.3.1. Provides technical support and guidance to address certification requirements.

2.3.2. Oversees the drinking water treatment operator certification program to meet applicable local laws and/or country-specific Final Governing Standards (FGS), and Overseas Environmental Baseline Guidance Document (OEBGD).

2.3.3. Reviews all drinking water operator certifications and certification renewals. Provides concurrence on certifications and renewals or identifies outstanding requirements.

2.3.4. Coordinates all actions taken with PACAF A4C and performs all intermediate level functional requirements (program oversight roles: staffing, reporting, resource advocacy, budget oversight, issue resolution) to include initiating and performing staffing actions with PACAF A-staff /Special Staff, and senior leadership in addition to other AF agencies as required to support the certification program**.**

2.3.5. Supports water project funding validation and advocacy through participation in the PACAF Facilities Working Group for large project prioritization.

2.3.6. Performs all management and readiness oversight, reporting and tracking activities such as those required by the Management Inspection Compliance Tool (MICT) in coordination with PACAF/IG to ensure compliance with this document.

2.3.7. Approves all training courses related to initial certification.

2.3.8. Approves all reciprocity certifications.

2.3.9. Reviews Environmental Quality funding eligibility for wellhead protection plan requests and provides advocacy where requests meet the requirements of this manual, OEBGD, FGS, and any other applicable standards.

2.3.10. Recalculates the water treatment facility classification score for locations with significant modifications to the existing water system and notifies the BCE of any changes to the classification level.

2.4. Base Civil Engineer.

2.4.1. Certifies all OCs and AOCs, ensuring all operators are qualified, properly trained, and certified at the appropriate level. This includes operators at locations with contractor-operated water treatment facilities.

2.4.2. Assigns the appropriate number of OCs and AOCs to drinking water treatment systems, and ensures the minimum number of OCs and/or AOCs are overseeing treatment facility operations at all times.

2.4.3. Ensures certifications are renewed prior to expiration and all training requirements are maintained.

2.4.4. Requests for funding in their execution plan and submits requests through the Budget Execution Analysis Strategy Tool (BEAST) to support compliance with all applicable requirements of this manual.

2.4.5. Ensures a transition plan is in place that minimizes the duration an installation is without an OC and AOC when a certified operator leaves his or her position.

2.4.6. Notifies AFIMSC Det 2 of any significant changes made to the existing water system.

Chapter 3

OVERSEAS TREATMENT PLANT OPERATOR TRAINING AND CERTIFICATION PROGRAM

3.1. Operator Certification.

3.1.1. All PACAF overseas installations with drinking water treatment facilities must have an Air Force-certified OC and AOC assigned. This includes any treatment facility that alters the physical, chemical, and/or microbiological characteristics of drinking water. The Base Civil Engineer (BCE) is responsible for assigning the appropriate number of OCs and AOCs but each installation with water treatment must have at least one OC and one AOC. OCs and AOCs may be assigned to multiple treatment facilities that are within their area of responsibility. Locations operated by Base Operating Support (BOS) contracts shall have these requirements incorporated into the contract.

3.1.2. For locations with certification requirements that have increased due to changes made to this publication, the additional certifications shall be obtained within 18 months of the publication date. This includes an additional AOC and/or a higher certification level for OCs and AOCs.

3.1.3. Each OC and AOC must have a copy of his or her PACAF Certification, as shown in **Attachment 2**, posted in the water treatment facility and available for review. The BCE shall keep records for certified individuals and ensure the OCs and AOCs are getting the appropriate level of continuing education for renewal of the certification. **(T-2)**

3.2. Operator Certification Requirements. The PACAF operator certification program includes the following five basic requirements:

3.2.1. Education;

3.2.2. Experience;

3.2.3. Approved training at the requisite certification level;

3.2.4. Examination; and

3.2.5. Triennial professional development for renewals.

3.2.6. Each OC and AOC must meet all requirements regardless of employment status (i.e., Civilian, Contractor, Local National, Military, etc.). In addition, all applicants shall be of legal working age, in accordance with the U.S. Air Force and Host Nation labor agreements. Detailed requirements for each level of certification are summarized in **Attachment 3**.

3.3. Operator Certification Levels. Each installation with water treatment shall have operators certified to the level that corresponds with the water treatment facility classification. **(T-2)** For example, an OC and AOC assigned to a Class 2 treatment facility shall at least have obtained Level 2 certification. Operator certification levels prescribe the highest class of treatment facility the operator may be assigned to. For example, a Level 2 certified OC or AOC may be assigned to a Class 1 or Class 2 treatment facility.

3.4. Treatment Facility Classification. Water treatment facility classifications and corresponding certification levels range from 1 to 3, increasing in order of complexity and

population served. Treatment facilities are assigned a total score based on the criteria included in **Attachment 4** and then classified based on the scoring ranges shown in **Table 3.1**. Water systems at locations that purchase treated water from a utility provider and then conduct supplemental treatment (i.e., chlorine disinfection boosting) are Class 1 facilities. The resulting facility classification at each applicable location is shown in **Table 3.2**.

Table 3.1. Water Treatment Facility Classification System.

Total Score	System Classification	System Complexity
1-50	Class 1	Basic-Intermediate
51-110	Class 2	Advanced Intermediate
Over 110	Class 3	Advanced

Table 3.2. PACAF Treatment Facility Ratings.

Location	Classification
Osan	Class 1
Kunsan	Class 2
Kadena (Okuma)	Class 1
Yokota	Class 2
Misawa	Class 2
Suwon	Class 1
Gimhae	Class 1
Daegu	Class 1
Gwangju	Class 1
Wake Island	Class 2
Note: See **Attachment 4** for scoring criteria	

3.5. Training and Examination.

3.5.1. The training and examination requirements for Air Force certification primarily rely on the Navy Overseas Drinking Water Program, which has developed an Expected Range of Knowledge (ERK) for each level of certification. The ERKs are based on industry-accepted publications and standards, and several available training manuals that are widely accepted and used in certification programs throughout the U.S. Additional training materials can be found through various industry providers, including the Water Professionals International (WPI) Associated Boards of Certification (ABC) Testing service. The WPI ABC Testing website has an extensive list of "Need-to-Know" criteria, which can be used as a guideline for drinking water operators. ABC Testing covers most requirements, except for OEBGD and FGS requirements that are unique to overseas locations.

3.5.2. Exams may be taken after completion of a training course and require a Navy-approved proctor to administer the exam. Where an approved proctor is not available, a Proctor Designation Form will need to be completed and submitted to AFIMSC Det 2 for approval by the Navy Operator Certification Authority (NOCA) Board. An operator who does not pass the exam at the end of the training will receive two additional opportunities to retake the test. Any applicant who fails an exam three times must complete the same training class again prior to re-testing.

3.5.3. Alternate training courses that include an exam and demonstrate equivalency with the Navy training program may be substituted. The Navy's Treatment Level 1 (T1) and Level 2 (T2) course agenda are provided in **Attachment 5**. Alternate training course agenda/syllabus must be submitted to AFIMSC Det 2 for approval.

3.5.4. For any questions on Navy training, proctor approval, or alternative course approval, please contact the AFIMSC Det 2/CEO Civil Engineer subject matter specialist (SMS), at DSN 315-447-7380.

3.6. Reciprocity. Certification may be obtained through reciprocity with an operator's valid, current U.S. Drinking Water Treatment license, WPI/ABC certification, Navy certification, or other DoD certification that utilizes the Navy Overseas Drinking Water Program. The education and experience requirements in **Attachment 3** need to be met regardless of licensure or certification by an outside agency. Certification via reciprocity will be approved on a case-by-case basis by AFIMSC Det 2.

3.7. Certification Renewal.

3.7.1. Certifications shall be renewed every three (3) years. **(T-2)** Renewal requires certified operators to complete 36 training hours every three years from the time of certification or prior renewal. No more than 25 percent of the training hours shall be related to operator safety.

3.7.2. Certification cards shall be submitted along with training and professional development records to AFIMSC Det 2 at least 60 days prior to the certificate's expiration date. If the operator fails to meet the continuing education requirements prior to or by the expiration date, the certification will expire. An operator whose certification has expired may seek reinstatement within two years of expiration; otherwise, the operator must complete training and exam requirements again for recertification. It is the responsibility of the operator and the BCE to monitor the expiration status of their operator's certifications.

3.7.3. Drinking water operators shall obtain a certificate or other proof of completion from the organization providing the professional development training that includes the name of the provider, the provider's address and a point of contact with telephone number and email address. The proof of completion shall further identify the name of the participant, the number of contact hours completed, the course name, the instructor's name and the date of the training received.

3.7.4. Training records, including operator certificates and professional development contact hours and course completion, must be maintained by the supervisor IAW DAFI 36-129. It is the responsibility of the drinking water operator and the BCE to maintain accurate training records. AFIMSC Det 2 will not maintain copies of operator training records.

3.8. Suspension and Revocation. If an operator fails to maintain the requirements of their position as detailed herein, his or her certificate may be suspended or revoked. If deemed appropriate, the BCE or AFIMSC Det 2 shall work through the chain of command to suspend or revoke the certification of an operator to address any of the following:

3.8.1. The operator has practiced fraud or deception;

3.8.2. The operator failed to use reasonable care, judgment, knowledge or ability in the performance of his or her duties;

3.8.3. The operator is otherwise incompetent or unable to properly perform his or her duties; or

3.8.4. The operator has failed to comply with the requirements for certification or renewal of certification.

3.8.5. Any operator whose certification has been suspended or revoked must apply through the BCE for consideration and approval for reinstatement.

Chapter 4

WATER SYSTEM OPERATION AND MAINTENANCE REQUIREMENTS

4.1. General.

4.1.1. This chapter establishes detailed wellhead protection program and water storage tank inspection requirements for overseas locations that would otherwise be regulated by a State or local agency. It also requires all PACAF locations to utilize GeoBase applications as the official system of record for backflow prevention device and fire hydrant flow testing maintenance activities.

4.2. Overseas Wellhead Protection Program.

4.2.1. Background.

4.2.1.1. The 1986 Amendments to the Safe Drinking Water Act (SDWA) established a new Wellhead Protection Program to protect groundwater sources utilized by public water systems. The 1996 Amendments to the SDWA established a related program for states, called the Source Water Assessment Program (SWAP). Key elements of the SWAP apply to the Wellhead Protection Program, including protection area and zone delineation, inventory of possible contaminating activities (PCAs), and vulnerability analysis.

4.2.1.2. The country-specific FGS and OEBGD require protection of groundwater sources through a wellhead protection (WHP) program, but do not provide guidance or specific elements to be included in the program. This section establishes general requirements to be included in the WHP program for overseas drinking water systems that utilize wells for source water. Requirements were developed from EPA guidance and approved State programs.

4.2.2. Wellhead Protection Plan.

4.2.2.1. To protect groundwater sources, each installation that utilizes groundwater for its drinking water system shall develop and maintain a wellhead protection plan (WHPP). **(T-2)** The WHPP must be prepared by a professional engineer or hydrogeologist with knowledge of the local groundwater conditions. The key elements of the WHPP include the following:

4.2.2.1.1. Delineating a wellhead protection area (WHPA);

4.2.2.1.2. Inventorying all potential sources of contamination (PSOC) to the well or well field located within the WHPA;

4.2.2.1.3. Assessing the susceptibility of the drinking water system to contamination;

4.2.2.1.4. Developing a management plan to protect the well or well field from the PSOCs; and

4.2.2.1.5. Creating a contingency plan to provide drinking water in the event the well or well field becomes contaminated.

4.2.2.2. Stakeholder engagement throughout the WHPP development process is critical to ensure the plan is accurate and practicable. Public outreach is also a critical component in successfully implementing the management plan. The WHPP shall be reviewed

periodically and updated on an as-needed basis when there are changes to land uses to include new PSOCs within the WHPA, existing wells are decommissioned, new supply wells are drilled, or any other changes arise that could impact the applicability and effectiveness of the plan.

4.2.2.3. Central funding for the creation of or update to a WHPP may be available via the Environmental Quality (EQ) Program. Coordinate with the base water quality program manager and AFIMSC Det 2/CEV for eligibility and availability.

4.2.2.4. Wellhead protection areas.

4.2.2.4.1. The following methods may be used to delineate a wellhead protection area (WHPA), in order of increasing accuracy and complexity. The appropriate method (or combination of methods) will depend on a range of site-specific conditions, including access to technical resources, availability of data (e.g., hydrogeologic data), or the appropriate level of accuracy based on the hydrogeological setting (e.g., Karst formations) and/or presence of high-risk potential contaminant sources.

4.2.2.4.1.1. Arbitrary Radial Distance;

4.2.2.4.1.2. Calculated Fixed Radius;

4.2.2.4.1.3. Analytical Methods;

4.2.2.4.1.4. Hydrogeologic Mapping; or

4.2.2.4.1.5. Numerical Flow or Flow-and-Transport Computer Modeling.

4.2.2.4.2. All WHPAs shall be recorded in GeoBase to ensure planners and engineers conform to the management and protection plan when siting future facilities or activities. The WHPAs shall be added to the G-1, Water Supply System map within GeoBase.

4.2.2.5. Potential sources of contamination.

4.2.2.5.1. All documented and potential contaminant sources or activities of concern within a WHPA that could pose a threat to the groundwater supply shall be identified. Any facility or activity that stores, uses, or produces contaminants of concern that could find their way into a WHPA is a potential source of contamination (PSOC). PSOCs may be identified by reviewing base environmental records, aerial photography, installation development maps, and sanitary surveys; conducting on-site field surveys; interviewing facility managers; and other appropriate methods. Contaminants to consider include, but are not limited to, National Primary Drinking Water regulations, unregulated contaminants, and unregulated contaminants of emerging concern.

4.2.2.6. Susceptibility to Contamination.

4.2.2.6.1. The final step in a groundwater source assessment is to perform a risk analysis to determine the susceptibility of the drinking water system to current and potential sources of contamination. The risk analysis shall include a ranking of the threats and then be used to develop protection measures that address the riskiest threats. Criteria used to rank the groundwater threats and determine susceptibility to contamination include: 1) the likelihood of contamination, 2) the vulnerability of the drinking water system and probability that it would be impacted by groundwater

contamination, and 3) the potential consequences of groundwater contamination for the water system and its customers.

4.2.2.6.2. Susceptibility determinations shall be based on a variety of information such as distance from the PSOC to the well, quantities of the PSOC stored, potential discharge rates from a PSOC, characteristics and properties of the PSOCs, contaminant fate and transport within the WHPA, existing risk mitigation measures in place for the PSOC, and physical integrity of the well.

4.2.2.7. Management and protection plan.

4.2.2.7.1. Results from the three elements above shall be used to develop a groundwater management and protection plan that includes measures to protect and/or enhance source water, such as public education, land conservation, application of best management practices, hazard mitigation, or land use restrictions. The management and protection plan identifies activities or projects needed to mitigate existing and future threats to source water quality and to improve the resilience of the water supply. The plan should include the following:

4.2.2.7.1.1. A list of priorities;

4.2.2.7.1.2. Protection strategies;

4.2.2.7.1.3. Implementation steps and milestones;

4.2.2.7.1.4. Necessary resources and a plan to obtain those resources;

4.2.2.7.1.5. Timeline for achieving the plan goals; and

4.2.2.7.1.6. A process to periodically evaluate progress towards these goals, to include a monitoring program.

4.2.2.8. Contingency Plan.

4.2.2.8.1. Another element of an effective WHP program is emergency preparedness and response planning in the event of wellhead contamination. A Water Contingency Response Plan or Contingency Plan is required by DAFMAN 32-1067, country-specific FGS, and the OEBGD. The Water Contingency Response Plan and/or Contingency Plan should be reviewed to ensure it includes response planning for source water contamination.

4.2.3. Well construction standards.

4.2.3.1. All new well construction shall follow the requirements of AWWA A100 and any other applicable standards. **(T-2)** As part of the WHP program, any existing wells that do not meet current construction standards that protect against aboveground contamination shall be upgraded. **(T-2)** Applicable retroactive standards include the minimum height of the well casing extending at least 24 inches above the ground-level elevation or the 100-year flood plain, whichever is higher, grading the surrounding ground away from the wellhead, and properly sealing and screening all potential contaminant pathways into the well.

4.2.4. Cathodic protection.

4.2.4.1. For new well construction, provide cathodic protection for metal casings in accordance with AFMAN 32-1072. For cathodic protection system operation and maintenance (O&M), follow UFM 3-570-06 and DAFI 32-1001.

4.2.5. Well operation and maintenance.

4.2.5.1. Follow the requirements and guidance in UFM 3-230-02, AWWA M21, and any equipment manufacturer O&M manuals. **(T-2)** For locations in Korea with source wells, also follow the maintenance requirements prescribed in the Korea Environmental Governing Standards (KEGS).

4.2.6. Well closure requirements.

4.2.6.1. To protect groundwater sources, wells no longer used for drinking water purposes shall be permanently closed in accordance with UFM 3-230-02, AWWA A100, and any other applicable standards. **(T-2)** For locations in Korea with unused wells that shall be closed, requirements in the KEGS shall also be met. Unused wells may also be converted into monitoring wells to support the WHP program.

4.3. Overseas Potable Water Storage Tank Inspections.

4.3.1. Background.

4.3.1.1. Three types of inspections are required throughout the life of a potable water storage tank, including an initial inspection performed during construction, regular cursory inspections by operators, and comprehensive recurring inspections. Both interior and exterior inspections are required to assure the tank's physical integrity, security, and water quality. DAFMAN 32-1067 requires systems to be operated and maintained in accordance with UFM 3-230-02, as well as state and federal laws. In the U.S., state or local programs regulate the tank inspection frequency and items inspected. For overseas locations, this section provides these requirements.

4.3.2. Initial inspections.

4.3.2.1. These are one-time inspections carried out during construction of a new water storage tank. The key inspection items include the tank's structural, sanitary, safety and coating condition. Construction related inspections shall follow UFGS 33 16 13.16 or UFGS 33 16 15 and applicable AWWA Storage standards, depending on construction type, and the BCE shall retain all required "G" or "S" submittals.

4.3.3. Regular operator inspections.

4.3.3.1. These are cursory evaluations of the tank's condition by the operators on a semi-annual, annual, or as-needed basis in accordance with UFM 3-230-02, Section 10-8. For water towers, the work should be scheduled in the NexGen IT system utilizing the master Preventive Maintenance Task List (PMTL) G3015108195001, Storage Tank, Water Tower. AF enterprise-level PMTLs for other types of storage tanks have not been approved.

4.3.3.2. In conjunction with UFM 3-230-02, the following items should also be periodically inspected by operators where applicable:

4.3.3.2.1. Site access, including signs of unauthorized access and vandalism;

4.3.3.2.2. Site maintenance, including any vegetation touching any part of the tank or its foundation and soil conditions around the base of the tank to include saturation and erosion;

4.3.3.2.3. Foundations, including adequate grading and drainage away from the foundations, signs of settlement, and concrete conditions to include any signs of cracking, spalling or exposed steel reinforcement;

4.3.3.2.4. The condition of any grout, fiberboard, or sealant located at the foundation and base of the tank;

4.3.3.2.5. Any anchor bolts and chairs for signs of corrosion or metal loss;

4.3.3.2.6. Manholes and doors to ensure secured access;

4.3.3.2.7. Overflow pipes for any potential cross connections to include proper operation of any flap gates or duckbill check valves and the condition of screens;

4.3.3.2.8. Vents, including the condition of any vent screens and shielding over any vertical screens, and the proper operation of any clog-resistant vent and its pallets before and after freezing weather;

4.3.3.2.9. Ladders, including any deteriorated members, any missing or deteriorated hardware securing the ladder to the tank or itself, and any metal loss on rungs;

4.3.3.2.10. Any balcony and/or platform for ponding water, closable covers for any floor openings or protective chains or bars for any safety railing access openings;

4.3.3.2.11. Interior lighting, including the proper operation of fixtures and condition of any protective cages, fixture globes, and wiring conduits; and

4.3.3.2.12. Any obstruction lighting to ensure it is operating properly and is adequately supported.

4.3.3.3. Any repairs that can be conducted by the operators should be completed as soon as possible; otherwise, a work request AF Form 332 should be submitted immediately after the inspections.

4.3.4. Comprehensive recurring inspections.

4.3.4.1. Comprehensive inspections are performed to evaluate the current condition of the tank interior, exterior, foundation, and accessories. These inspections often require the facility to be removed from service and drained, unless robotic devices or divers are used. Dry inspections are the preferred method for interior inspections based on UFM 3-230-02 recommendations and general industry consensus. All necessary interior and exterior surfaces of the tank should be inspected and may require rigging and rappelling, depending on the condition and design of each tank. Where tanks are taken out of service for an extended duration, operators shall adjust water system operations as necessary to provide continuous water service and notify all affected customers if temporary water conservation measures are required.

4.3.4.2. Inspection frequency.

4.3.4.2.1. In accordance with UFM 3-230-02 guidance and industry standards, a comprehensive inspection must be completed a minimum of once every 5 years from the date of the initial inspection or last comprehensive inspection. **(T-2)**

4.3.4.3. Inspection items.

4.3.4.3.1. The following items are the minimum areas that must be covered under a professional inspection contract. Standards for inspection items below are found in UFM 3-230-02, AWWA M42 (Chapter 9, Pre-bid Inspection) for steel tanks and appurtenances for all types of tanks, AWWA D110 for circular, prestressed concrete tanks, and AWWA D115 for tendon-prestressed concrete tanks.

4.3.4.3.1.1. Foundations;

4.3.4.3.1.2. Supporting tower, if applicable;

4.3.4.3.1.3. Exterior condition to include applicable coating or concrete condition;

4.3.4.3.1.4. Interior condition to include cleaning the tank interior to remove dirt and debris;

4.3.4.3.1.5. Vent and overflow;

4.3.4.3.1.6. Access hatches;

4.3.4.3.1.7. Cathodic protection system, if applicable;

4.3.4.3.1.8. Miscellaneous appurtenances to include any level indicating devices, altitude valves, lighting, antennas, exterior and interior ladders, safety railings, platforms, and all other safety- and sanitary-related conditions;

4.3.4.3.1.9. Site conditions;

4.3.4.3.1.10. Security conditions;

4.3.4.3.1.11. Watertightness test for concrete tanks;

4.3.4.3.1.12. Cracks and joints on concrete tanks for signs of leakage; and

4.3.4.3.1.13. Steel reinforcement on concrete tanks if exterior inspection reveals any rusting, staining, cracking (other than minor shrinkage cracking), or signs of leakage.

4.3.4.3.2. Any tanks with coatings that contain lead, chromium, or any other regulated heavy metals shall be carefully inspected and maintained in accordance with all applicable environmental regulations.

4.3.4.4. Inspector Qualifications.

4.3.4.4.1. Comprehensive inspections must be performed by a qualified inspection team, led by a registered professional engineer with at least five years of specialized experience inspecting steel or concrete water tanks, whichever applies. As noted in AWWA M42, the inspection team should have knowledge of the traditional engineering disciplines and have specialized training and practical experience in the design, fabrication, erection, inspection, sanitary integrity, coating (as applicable), and maintenance of water storage tanks. Where applicable, the inspector shall have a working knowledge of corrosion and coating observation techniques, including

certification from a well-known organization such as the Association for Materials Protection and Performance (AMPP), which merged SSPC and NACE International standards.

4.3.4.4.2. Additionally, the inspection team must be experienced in the safe use of specialized rigging and other equipment required to investigate the tank surfaces, which often includes climbing high structures. Where underwater inspections are necessary, all divers shall be certified commercial divers, meet OSHA 29 CFR, Part 1910 Subpart T Diving Standards (including being certified in CPR and first aid) and be experienced in potable water tank inspections. And where remotely operated vehicle (ROV) inspections are necessary, a specially trained field technician shall operate and monitor the ROV to videotape the tank interior. The video should then be reviewed by a registered professional engineer experienced in water tank inspections to determine the interior condition.

4.3.4.5. Inspection Report.

4.3.4.5.1. An inspection report documenting the condition, observations, and recommendations must be completed and certified by a registered professional engineer familiar with the design, construction, and maintenance of potable water storage tanks. The report should cover all tank elements and components, including structural, coating, corrosion control, safety, operational and sanitary conditions, and compliance with applicable standards. Color photographs should be included to properly document the condition and inspection findings. The report should also include rough order of magnitude estimates to execute the corrective actions, anticipated remaining life of the coatings and structure, and, where appropriate, the estimated tank replacement cost. Recommendations should include short-term and long-term repairs so the BCE can budget for and forecast the work effectively.

4.3.4.6. Return to service.

4.3.4.6.1. Once the inspection is completed, the storage facility must be disinfected in accordance with the latest revision of AWWA C652 prior to returning it to service.

4.4. Distribution System Maintenance Records Management.

4.4.1. Compliance with this section is required for all PACAF locations in the U.S., U.S. territories, and overseas.

4.4.2. Backflow Prevention Device Maintenance

4.4.2.1. All squadrons that manage an installation Backflow Prevention Program (BFPP) shall utilize the Pacific Geospatial Engineering Office (GEO) BFPP application in GeoBase. **(T-2)** Backflow Program Managers (BPM) will manage all device inventory, maintenance records, and description data in the application. This system is monitored for compliance purposes and provides program oversight at AFIMSC Det 2/CEO allowing the SMS to monitor program health and for funds advocacy for identified deficiencies.

4.4.2.2. This application fully meets the requirements in DAFMAN 32-1067, Water and Fuel Systems, as a computerized maintenance management system (CMMS) for cross-connection survey results and annual testing and inspection results. For inspection and compliance purposes, the GeoBase application will be recognized as the authoritative

program of record for BFPP management. Using and maintaining documentation on hard copy forms is not required.

4.4.2.3. Each squadron should assign the base BPM as the GeoBase BFPP System Administrator with full access to the application. Trained and certified backflow technicians may then be granted limited privileges by the BPM, including viewing and editing backflow device status, information and reports.

4.4.3. Fire Hydrant Flow Testing

4.4.3.1. All squadrons that manage an installation Fire Hydrant Program shall utilize the Pacific GEO Fire Hydrant Inspection Tracker (FHIT) application in GeoBase to record flow test results. **(T-2)** Fire Hydrant Program Managers (FHPM) will manage all inventory, maintenance records, and description data in the GeoBase FHIT application. This system is monitored for program oversight by the installation Fire Chief and all other levels for inspection and compliance purposes while also being used to monitor program health for funds advocacy for identified deficiencies.

4.4.3.2. The FHPM is responsible for ensuring all hydrant flow testing is accomplished in accordance with NFPA 291 and AWWA M17. The frequency of required flow testing is once every five years, which corresponds to testing approximately 20 percent of an installation's hydrants each year. If there are variations in the flow test from previous readings that pass thresholds listed in UFM 3-601-02, section 2-2.6, the FHPM shall work with the installation Water Sub-AMP Manager to determine the probable cause(s) and address any issues through operational changes or capital improvements.

4.4.3.3. Each squadron should assign the base FHPM as the GeoBase FHIT System Administrator with full access to the application. Trained fire hydrant technicians may then be granted limited privileges by the FHPM, including viewing and editing fire hydrant status, information and reports.

ANDREW B. HUNTOON, GS-15, DAF
Dep Dir/Logistics, Engineering & Force Protection

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

US EPA 625/R-94/001, *Handbook, Ground Water and Wellhead Protection*, September 1994

US EPA Source Water Protection, *Assess, Plan, and Protect Source Water,* Updated August 8, 2024, **https://www.epa.gov/sourcewaterprotection/assess-plan-and-protect-source-water**

DAFI 48-144, *Drinking Water Surveillance Program*, June 21, 2023

DAFMAN 32-1067, *Water and Fuel Systems*, April 11, 2025

UFC 3-230-01, *Water Storage and Distribution*, with Change 3, July 1, 2021

UFM 3-230-02, *Operation and Maintenance: Water Supply Systems*, February 5, 2026

UFC 3-230-03, *Water Treatment*, with Change 2, May 1, 2020

UFM 3-570-06, *Operation and Maintenance: Cathodic Protection Systems*, March 13, 2026

UFM 3-601-02, *Fire Protection Systems Inspection, Testing, and Maintenance,* March 13, 2026Commander, Navy Installations Command (CNIC) Manual M-5090.1A, *Navy Overseas Drinking Water Program Ashore Manual*, March 15, 2021

AWWA Standard A100-20, *Water Wells*, July 1, 2020

AWWA Standard C652-19, *Disinfection of Water-Storage Facilities*, April 1, 2020

AWWA Standard D100-21, *Welded Carbon Steel Tanks for Water Storage*, November 1, 2021

AWWA Standard D101-24, *Evaluation of Steel Water Tanks and Related Facilities*, October 1, 2024

AWWA Standard D107-16, *Composite Elevated Tanks for Water Storage,* January 1, 2017

AWWA Standard D110-13 (R18), *Wire- and Strand-Wound Circular, Prestressed Concrete Water Tanks*, August 1, 2018

AWWA Standard D115-20, *Tendon-Prestressed Concrete Water Tanks*, July 1, 2020

AWWA Standard G100-17, *Water Treatment Plant Operation and Management*, August 1, 2017

AWWA Standard G200-21, *Distribution Systems Operation and Management*, November 1, 2021

AWWA Standard G300-22, *Source Water Protection*, August 1, 2022

AWWA Manual M14, *Backflow Prevention and Cross-Connection Control: Recommended Practices,* Fifth Edition, 2024

AWWA Manual M17, *Fire Hydrants: Installation, Field Testing, and Maintenance*, Fifth Edition, 2016

AWWA Manual M21, *Groundwater Operations*, Fifth Edition, 2025

AWWA Manual M42, *Steel Water-Storage Tanks*, Revised Edition, 2013

AWWA, *Steel Water Storage Tanks, Design Construction Maintenance, and Repair,* 2010

NFPA 291, *Recommended Practice for Water Flow Testing and Marking of Hydrants*, 2025 Edition

Water Professionals International, *The Associated Boards of Certification Examination Resources*, Accessed May 12, 2025, **https://www.gowpi.org/services/abc-testing/examination-resources/**

Prescribed Forms

None.

Adopted Forms

AF Form 332, *Base Civil Engineer Work Request*

DAF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

ABC—Associated Boards of Certification

AFIMSC Det 2—Air Force Installation and Mission Support Center, Detachment 2

AFPD—Air Force Policy Directive

AFRIMS—Air Force Records Information Management System

AMPP—Association for Materials Protection and Performance

AOC—Assistant Operator in Charge

AOR—Area of Responsibility

AWWA—American Water Works Association

BCE—Base Civil Engineer

BEAST—Budget Execution Analysis Strategy Tool

BEE—Bioenvironmental Engineering

BFP—Backflow Prevention

BFP—Backflow Program Manager

BFPP—Backflow Prevention Program

BOS—Base Operating Support

BPM—Backflow Program Manager

CEO—Civil Engineering Operations

CFR—Code of Federal Regulations

CMMS—Computerized Maintenance Management System

COB—Co-Located Operating Base

CPR—Cardiopulmonary Resuscitation

DAFI—Department of the Air Force Instruction

DAFMAN—Department of the Air Force Manual

DoD—U.S. Department of Defense

EQ—Environmental Quality

ERK—Expected Range of Knowledge

FGS—Final Governing Standards

FH—Fire Hydrant

FHIT—Fire Hydrant Inspection Tracker

FHPM—Fire Hydrant Program Manager

GEO—Geospatial Engineering Office

HN—Host Nation

IAW—In Accordance With

KEGS—Korea Environmental Governing Standards

MICT—Management Inspection Compliance Tool

NFPA—National Fire Protection Association

NOCA—Navy Operator Certification Program

O&M—Operation and Maintenance

OC—Operator in Charge

OEBGD—Overseas Environmental Baseline Guidance Document

OIC—Officer in Charge

OPR—Office of Primary Responsibility

OSHA—Occupational Safety and Health Act

OT&C—Operator Training and Certification

PACAF—Pacific Air Forces

PCA—Possible Contaminating Activity

PMTL—Preventative Maintenance Task List

PSOC—Potential Source of Contamination

ROV—Remotely Operated Vehicle

SDWA—Safe Drinking Water Act

SMS—Subject Matter Specialist

SRM—Sustainment Restoration and Modernization

SWAP—Source Water Assessment Program

U.S.—United States

UFC—Unified Facilities Criteria

UFGS—Unified Facilities Guide Specifications

WHPA—Wellhead Protection Area

WHPP—Wellhead Protection Plan

WHP—Wellhead Protection

WPI—Water Professionals International

Attachment 2

PACIFIC AIR FORCES CERTIFICATION CARD

A2.1. Certification Card.

Figure A2.1. Example Certification Card.

US Pacific Air Forces Overseas Drinking Water Treatment Certification					
Name:	John Doe	**Installation:**	Pacific AB	**Treatment Classification Level** *(Table 3.2, PACAFMAN 32-1067)*	2
Select one:	**Operator In Charge:**	✓		**Assistant Operator In Charge:**	
Personnel Training *(Training courses shall meet requirements of sect 3.5 of PACAFMAN 32-1067)*					
Level 1 Training Examination Completion Date:	01/01/22	**Level 2 Training Examination Completion Date:** *If required*	01/01/23		
Operator Education and Experience *(Ref. Table A3.1, PACAFMAN 32-1067, for Level 1 and Level 2 requirements)*					
Education: High school graduate					
Experience/Employment Status: 17 years of experience at current Class 2 facility.					
Certificate Renewal *(Ref. Sect. 3.7, PACAFMAN 32-1067)*		**Operations Flight Chief Certification** I certify the above information to be true and correct			
Professional Development Training Hours Completed:	36	Digitally signed by Smith.James.Maj. 1234567890 Date:20260101 12:00:00 - 00'00'			
Expiration Date: *Not to exceed 3 years*	12/31/28	**AFIMSC Det 2 Concurrence**	Digitally signed by Carter.Michael.D.2345678901 Date:20260101 12:05:00 - 00'00'		

PACAF Form WTC-1 20260324

Attachment 3

OPERATOR CERTIFICATION REQUIREMENTS

Table A3.1. Water Treatment Facility Operator Certification Requirements.

OC and AOC Certification Requirements			
Certification Level	Education	Experience	Training and Examination
1	College graduate with a bachelor's degree or equivalent in the physical, engineering, or natural sciences program; **OR** Graduate of a two-year technical program with a diploma in water technology	Three months of relevant experience at a water treatment facility; AND an existing employee at the assigned treatment facility	Completed an approved Level 1 training course and passed the associated exam
	High school graduate, General Education Development (GED) certificate, or equivalent	One year of relevant experience at a water treatment facility; AND an existing employee at the assigned treatment facility	Completed an approved Level 1 training course and passed the associated exam
2	College graduate with a bachelor's degree or equivalent in the physical, engineering, or natural sciences program; **OR** Graduate of a two-year technical program with a diploma in water technology	One year of relevant experience at a Class 2 or higher water treatment facility; AND an existing employee at the assigned treatment facility	Completed an approved Level 2 training course and passed the associated exam
	High school graduate, General Education Development (GED) certificate, or equivalent	Three years of relevant experience at a Class 2 or higher water treatment facility; AND an existing employee at the assigned treatment facility	Completed an approved Level 2 training course and passed the associated exam
3 (currently not used)	College graduate with a bachelor's degree or equivalent in the physical, engineering, or natural sciences program; **OR**	One year of relevant experience at a Class 3 or higher water treatment facility; AND an existing employee at the assigned treatment facility	Completed an approved Level 3 training course and passed the associated exam

OC and AOC Certification Requirements			
Certification Level	Education	Experience	Training and Examination
	Graduate of a two-year technical program with a diploma in water technology		
	High school graduate, General Education Development (GED) certificate, or equivalent	Ten years of relevant experience at a Class 3 or higher water treatment facility; AND an existing employee at the assigned treatment facility	Completed an approved Level 3 training course and passed the associated exam

Attachment 4

WATER TREATMENT FACILITY CLASSIFICATION SCORING CRITERIA

A4.1. WATER TREATMENT FACILITY CLASSIFICATION SCORING CRITERIA. Table A4.1 gives the rating value for parameters found in a water treatment facility. The total sum of each parameter is used to determine the water treatment facility classification level.

Table A4.1. Water Treatment Facility Scoring Criteria.

Parameter	Sub-Parameter 1	Sub-Parameter 2	Rating Value
Surface Water Source			
	flowing stream		5
	flowing stream w/ impoundment		7
	raw water treatment		3
Ground Water Source			
	first five wells		5
	add 1 point per 5 wells or fraction thereof		1
Coagulation			
	aluminum or ferric based		10
	polymer		5
Mixing			
	baffle		2
	mechanical		4
	air		3
Oxidation (pre- treatment)			
	ClO_2		5
	ozone		5
	$KMnO_4$		3
	Cl_2		3

Parameter	Sub-Parameter 1	Sub-Parameter 2	Rating Value
Carbon Treatment			2
Aeration			
	mechanical draft		3
	coke tray / splash tray		2
	diffused		3
	packed tower (VOC reduction)		10
pH Adjustment (primary)			
	caustic (NaOH)		10
	lime / soda ash		3
	acid		10
Sedimentation			
	standard rate		5
	tube settlers		3
	upflow		8
	pulsators and plates		5
Contact Tank			1
Filtration			
	pressure		
		sand / anthracite	8
		synthetic media	8
		granular activated carbon (GAC)	10
	gravity		
		sand	10
		anthracite (mixed) / GAC	12
		with surface wash or air scour	2
	membrane (micro or Ultra-filtration)		10

Parameter	Sub-Parameter 1	Sub-Parameter 2	Rating Value
Ion Exchange			
	softener, Na cycle		5
	softener, H cycle		7
	Fe and Mn (greensand)		10
	mixed bed or split stream		12
Lime Softening			
	spiractors		10
	clarifier with coagulation		12
	fuel burner		5
Phosphate (sequestering agent)			5
Stabilization			
	acid feed		10
	phosphate		2
	caustic (NaOH)		10
	lime / soda ash		3
	powder activated carbon (PAC)		3
	contact units		5
Nanofiltration, Reverse Osmosis, or Electrodialysis			51
Disinfection			
	gas Cl2		10
	hypochlorite solution		7
	ClO2		13
	ozone		13
	ammonia and Cl2		12
	ultraviolet light (UV)		5
Fluoridation			

Parameter	Sub-Parameter 1	Sub-Parameter 2	Rating Value
	saturator		8
	dry feed		8
	solution (acid)		10
Pumping (each station)			
	raw		3
	intermediate (at plant)		1
	finished (at plant)		3
	distribution system booster		2
Storage Tank (each)			
	raw		1
	treated ground level at plant or in dist. system		1
	elevated at plant or in dist. system		2
	hydropneumatic at plant or in dist. system		2
Population Served (1 point per1,000 persons served or fraction thereof)			1 min. to 50 max.
Plant Capacity (1 point per 1 MGD capacity or fraction thereof)			1 min. to 25 max.
On-Site Quality Control			
	bacteriological		
		MPN/MF	5
		HPC	2
		MMO-MUG (Colilert)	2
	pH		

Parameter	Sub-Parameter 1	Sub-Parameter 2	Rating Value
		meter	2
		test kit	1
	fluoride		
		meter	3
		colorimetric	3
	chlorine		
		titrator	3
		colorimeter / spec.	2
		test kit	1
	iron		1
	hardness		1
	alkalinity		1
	turbidity		1
	manganese		1
	others (1 pt. each)		1

Attachment 5

NAVY DRINKING WATER OPERATOR TREATMENT COURSE AGENDA

A5.1. Navy Drinking Water Operator Treatment Level 1 Course Agenda.

A5.1.1. Operator roles and responsibilities

A5.1.2. Math (basic arithmetic, order of calculation, ratios, proportions, fractions, percentages, unit conversions, geometry, detention time, chemical solutions and dosage, CT value, softening, fluid properties, pressure/head, velocity and flow rate)

A5.1.3. Water quality factors (physical, chemical, biological, radiological)

A5.1.4. Regulations (Safe Drinking Water Act, DoD regulations, monitoring, tank inspections, backflow prevention)

A5.1.5. Basic chemistry (concentration, temperature, common compounds and ions, pH, alkalinity, hardness, oxidation/reduction, conductivity, total dissolved solids)

A5.1.6. Groundwater and wells (drawdown, overwithdrawal, saltwater intrusion, groundwater pollution, well construction, well pumps and appurtenances, common problems, maintenance, well closure)

A5.1.7. Disinfection and disinfection by-products (methods, chlorine chemicals, CT requirement, breakpoint chlorination, chloramines, chlorine residuals, pipeline disinfection, chlorine equipment and safety, total trihalomethanes, Stage 1 and Stage 2 DBP Rules, DBP control and treatment)

A5.1.8. Laboratory procedures and testing (data records, lab safety, sampling and water collection, alkalinity, chlorine residual and demand, pH, temperature, turbidity)

A5.1.9. Small water treatment plants (storage, coagulation, sedimentation, filtration, disinfection corrosion control, iron and manganese, chemical feed pumps)

A5.1.10. Softening (hardness, chemical precipitation, ion exchange, membrane filtration, reverse osmosis)

A5.1.11. Safety (chlorine, chlorine gas, ammonia, potassium permanganate, fluoride, electrical safety, lockout/tagout, ladders, confined space, noise)

A5.1.12. Advanced treatment (disinfection by-product control, ion exchange, granular activated carbon, membrane filtration)

A5.1.13. Maintenance (air compressors, valves, combustion engines, lubrication, fuel storage, chemical storage, chemical feeders, tanks)

A5.1.14. Process wastes (sludge, backwash water, membrane concentrate, brine residuals, spent carbon, off gasses, residuals treatment and disposal)

A5.1.15. Distribution system (isolation valves, pressure reducing valves, altitude valves, air and vacuum relief valves, check valves, hydrants, water meters, pumps)

A5.1.16. Process controls (coagulation, flocculation, settling, filtration, backwash, disinfection, recordkeeping)

A5.1.17. Sanitary survey (Operator roles, types of deficiencies, source deficiencies, treatment deficiencies, storage deficiencies, pump deficiencies, distribution system deficiencies, common deficiencies)

A5.2. Navy Drinking Water Operator Treatment Level 2 Course Agenda.

A5.2.1. Operator roles and responsibilities

A5.2.2. Math (metric system units of measure, unit conversions, percentages, ratio, proportions, fractions, decimal, volumetric calculations, basic treatment formulas, chemical strength and concentration, CT calculations, UV disinfection formulas, velocity and flow rate, pump calculations)

A5.2.3. Coagulation, flocculation and sedimentation (basics, troubleshooting, process control)

A5.2.4. Filtration (mechanisms, media, equipment, operation, backwash, startup, turbidity monitoring, problems, filter types, process calculations)

A5.2.5. Fluoride (compounds, feeders, startup, process calculations, safety)

A5.2.6. Disinfection (performance factors, methods, chlorine chemistry, chlorine chemicals, breakpoint chlorination, chloramines, chlorine residuals, equipment, safety, CT requirements, UV basics)

A5.2.7. Disinfection by-products (trihalomethanes (THM), DBP MCLs, monitoring, control measures, alternative disinfectants, THM treatment, DBP treatment,

A5.2.8. Regulations (Safe Drinking Water Act, DoD regulations, monitoring, Revised Total Coliform Rule, Surface Water Treatment Rule, Lead and Copper Rule, inorganic chemicals, synthetic organic chemicals, Stage 1 and Stage 2 DBP Rules, Ground Water Rule, radionuclides, turbidity, disinfection profiling, reporting and notifications, analytical methods and performance indicators, tank inspections, backflow prevention)

A5.2.9. Bacteriology (reproduction and growth, pathogens, coliforms, heterotrophic plate count, microorganisms affecting aesthetic quality, controlling microbial growth)

A5.2.10. Laboratory procedures (equipment, recording and recordkeeping, quality control, safety, sampling, representative sampling, supplies, collection, instrument calibration, alkalinity, chlorine residual and demand, pH, temperature, turbidity

A5.2.11. Softening (hardness, ion exchange, blending, process by-products)

A5.2.12. Iron and manganese removal (ion exchange, manganese greensand, iron removal filter, greensand and anthracite filters, oxidation-filtration, filter backwashing)

A5.2.13. Corrosion control (electrolysis, galvanic corrosion, protection, factors, chemical factors, biological factors, Langelier Index, corrosion related complaints, control chemicals, cathodic protection)

A5.2.14. Pumps (split case, vertical turbine, velocity pumps, terminology, head, impellers, wet end parts, motors, power and efficiency, pump performance curves, system performance curves, best efficiency point, NPSH, maintenance, operations, pump selection, chemical metering pumps and output math)

A5.2.15. Membranes (treatment applications, feedwater pressure requirements, pretreatment requirements, microfiltration and ultrafiltration configurations and operations, nanofiltration and reverse osmosis configurations and operations, waste disposal)

A5.2.16. Safety (hydrofluosilicic acid, sodium hydroxide, gases, chlorine, chlorine gas, ammonia, salts and powders, potassium permanganate, tank inspections, fire protection, electrical safety, lockout/tagout, ladders, confined space, noise, safety inspections)

A5.2.17. Maintenance (DoD regulations, recordkeeping, tools and supply inventory, asset management, operator and management responsibilities)

A5.2.18. Backflow prevention (cross connections and hazard levels, air gap, reduced pressure zone backflow preventer, double check valve assemblies, vacuum breakers, cross connection control, inspections, installation and maintenance)

A5.2.19. Distribution system (storage and potential water quality problems, age-related water quality problems, flushing program, fire hydrants, safety during flushing)

A5.2.20. Instrumentation (monitoring functions, sensing methods, equipment, terminology, control systems, computer control system, motor control station)

A5.2.21. Sanitary survey (Operator roles, types of deficiencies, source deficiencies, treatment deficiencies, storage deficiencies, pump deficiencies, distribution system deficiencies, common deficiencies)