

Water Treatment Plant Operation and Management

Operational Guide to AWWA Standard G100



G100

Sarah C. Clark, PE



**American Water Works
Association**

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Contents

SECTION 1: ACKNOWLEDGMENTS.....	1
SECTION 2: FOREWORD	2
SECTION 3: INTRODUCTION.....	2
SECTION 4: REQUIREMENTS	4
Sec. 4.1 Compliance With Regulatory Requirements, 5	
Sec. 4.2 Operational Management Practices, 8	
4.2.1 Business Practices, 8	
4.2.2 Treatment Plant Production Limits, 17	
4.2.3 Treatment Plant Adequacy of Treated Supply, 20	
4.2.4 Housekeeping Procedures and Cleanliness, 23	
4.2.5 Operating Permits and Licenses, 24	
4.2.6 Plant Management, 26	
4.2.7 Quality Assurance Practices, 27	
4.2.8 Environmental Impact Management, 40	
4.2.9 Emergency Preparedness and Response, 42	
4.2.10 Security Planning and Implementation, 46	
4.2.11 Health and Safety Management, 53	
4.2.12 Customer Inquiry Tracking and Response, 55	
4.2.13 Process Reliability, 58	
4.2.14 Power, 59	
4.2.15 Unattended Operation, 60	
4.2.16 Human Resources, 64	
Sec. 4.3 Plant–Real Property Management and Maintenance, 68	
4.3.1 Maintenance Management, 68	
4.3.2 Plant Cross-Connection Control, 74	
4.3.3 Disinfection of Water Treatment Facilities, 77	
4.3.4 Operation and Maintenance of Mechanical Equipment, 79	
4.3.5 Materials in Contact With Water, 81	
Sec. 4.4 Water Quality Management, 82	
4.4.1 Performance Goals, 82	
4.4.2 Operational Goals and Objectives, 82	
4.4.3 Monitoring Performance, 87	
4.4.4 Control Measures, 89	
4.4.5 Corrective Responses, 90	

SECTION 5: VERIFICATION	94
Sec. 5.1 Documentation Required, 94	
5.1.1 General, 94	
5.1.2 Control of Documents, 95	
5.1.3 Control of Records, 95	
Sec. 5.2 Examples of Documentation, 97	
SECTION 6: REFERENCES AND RESOURCES	98
SECTION 7: AUDIT CHECKLIST	100
APPENDIX A: TOXIC CHEMICAL RELEASE RESPONSE PLAN FOR CHARLESTON, S.C., WATER SYSTEM	112
About the Author	125



American Water Works
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G100 Operational Guide

Water Treatment Plant Operation and Management

SECTION 1: ACKNOWLEDGMENTS

Writing this guidance document has been a cooperative effort that involves the contributions of many people and utilities who are willing to share their knowledge with the water industry. The Water Treatment Plant Standard Committee members contributed significant time just to develop the approach to the standard and subsequently to write and refine the language. I am grateful to have had the experience in working with a terrific group of people to create the standard itself.

This operational guide is based on a format that was originally developed by James Ginley and Todd Humphrey, who created the first operational guide for Standard G400, Utility Management System, with input from Kanwal Oberoi. Oberoi provided the questions for the checklist at the end of this guide.

The following people kindly provided information and examples for this document:

Christine Owen, Tampa Bay Water, Tampa, Fla.

Jeff Boles, Town of Estes Park, Colo.

Mehrdad Morabbi, Austin Water, Austin, Texas

Charles Maddox, Austin Water, Austin, Texas

Kanwal Oberoi, Charleston Water System, Charleston, S.C.

Greg Moore, City of Golden, Colo.

Steve Hubbs, University of Louisville, Louisville, Ky.

Reid Campbell, Halifax Water, Halifax, N.S.

SECTION 2: FOREWORD

This operational guide has been written as a guidance tool for the implementation of water treatment plant operation and management best practices, as set forth in ANSI/AWWA Standard G100, Water Treatment Plant Operation and Management (AWWA G100; 2011b). AWWA G100 is part of the voluntary management standards for water utilities, initially established in 2004.

The original idea for the operational guide series to accompany the utility management standards came from utility managers who participated in a two-year pilot project that was conducted and supported by the American Water Works Association (AWWA) Utility Quality Programs Committee, the AWWA Accreditation Committee, and nearly 30 utility professionals from more than 10 North American utilities. The pilot project assessed the applicability and practicality of the series of AWWA utility management standards by working with two utilities—Birmingham (Ala.) Water Works and Sewer Board and Washington County (Va.) Service Authority—and a team of volunteers from utilities, consulting firms, and other organizations.

During the pilot process, the utility managers requested that AWWA develop some type of guidance or how-to documents to go along with the management standards. These guidance documents would serve two purposes: one, help utility managers understand the purpose and function of these new standards, and two, help them implement and incorporate the standards into everyday operations. From this suggestion the series of operational guides was conceived.

SECTION 3: INTRODUCTION

In order to consistently supply high-quality water drinking water to customers, the effective operation and management of drinking water treatment plants is essential. Critical requirements for the effective operation and management of drinking water plants are the subject of this guide, which provides suggestions and examples to assist water treatment plants in using AWWA G100.

The US Environmental Protection Agency's (USEPA's) Safe Drinking Water Act ensures public safety by setting extensive regulatory requirements for public water suppliers. However, progressive utilities may voluntarily subscribe to additional requirements, such as the AWWA utility management standards, in order to take a more proactive approach to guarantee that a high-quality product, which exceeds regulatory requirements, reaches the consumers' taps.

ANSI/AWWA Standard G100, Water Treatment Plant Operation and Management, is based on water treatment plant operation and management best practices, developed by consensus of the AWWA Standards Committee. AWWA G100 also calls for quality operation and maintenance of water treatment plants through the appropriate expertise of those operating and managing the system. This guidance document has been established to assist any water treatment plant, large or small, in adopting those practices set forth in AWWA G100.

This guide breaks AWWA G100 down into the following components:

Standard Language—The Standard Language is each section of AWWA G100, as written in the latest standard document.

Rationale—The Rationale gives background on the topic in each section of the standard and discusses why the requirements are important for water treatment plants.

Examples—The Examples given do not cover every aspect of the standard and will not apply to every utility's situation. They are not intended to be a complete instruction guide for the implementation of AWWA G100, rather they are intended to point interested parties in the right direction and give insight on how processes and procedures may be properly implemented in accordance with parts of the standard. In order to keep this publication to a reasonable size, only a handful of examples per topic were included, and most point to a secondary publication with current standard operating procedures and practices used by utilities in a standardized format. There are also many sources of additional information listed in the References and Resources section.

Questions to Check Progress—The Questions are listed as a tool to self-assess the status of a utility's compliance with AWWA G100. If a utility can confirm that it has all items in the questions in place, management may wish to consider applying for recognition, or the utility may be able to leverage that information when negotiating a bond rating.

The Audit Checklist is included to further assist utilities in performing an initial gap analysis or assessing their progress in implementing AWWA G100. This tool will help identify any gaps that may exist in current procedures and those required to meet the standard. It asks specific questions and looks for proof and documentation that procedures are indeed in place where called for by the standard. Just as the examples are not an instruction manual for implementing all of AWWA G100, neither is the checklist a blueprint. However, a utility that has all the components represented in the checklist is likely to have a majority of the AWWA G100 standard well covered in its operating and management procedures and practices.

SECTION 4: REQUIREMENTS

The minimum requirements for the operation of drinking water treatment plants can be divided into four major categories: regulatory compliance requirements, operational management practices, plant–real property management and maintenance, and water quality management. This standard requires that the utility establish measurable goals for each category, implement a monitoring system to measure performance against the goals, employ an optimization strategy to identify opportunities for improvement, and maintain consistent operation that satisfies the goals under conditions. Goals must be set with the concept of protecting public health foremost in mind, and shall include water quality and quantity targets.

Many relationships and linkages exist among the major elements of water treatment plant operation and maintenance. The requirements listed in this standard are meant to apply to water treatment plants. However, the system operator is cautioned to consider the effect of one requirement upon another based on site-specific conditions.

Sec. 4.1 Compliance With Regulatory Requirements

The plant shall satisfy the requirements of all applicable federal, state or provincial, and local regulations that apply to the operation of the plant. Plants shall demonstrate that as a minimum they meet the applicable drinking water regulations for their own jurisdiction.

Rationale

Customers expect their utility to meet or exceed all applicable regulations. In fact, maintaining consumer confidence demands that the utility maintain compliance. Protection of public health requires that water treatment plants produce water that meets all local, state, provincial, federal, or other regulatory requirements. The list of requirements that apply may be different for different treatment plants as some requirements are tied to the type of source water or treatment processes utilized. Responsibility for tasks that maintain compliance with the regulations applying to treatment plants might fall to personnel outside the plant staff, so coordination within the utility is essential to ensure that compliance requirements are met and documented. Plants that are initiating efforts to meet AWWA G100 and require coordination across the utility to meet regulations would profit from parallel application of ANSI/AWWA Standard G400, Utility Management System, and its companion *Operational Guide to AWWA Standard G400* (Ginley and Humphrey 2009).

One approach to managing regulatory requirements is to simply make a list of them, keep it up to date, and identify where the regulation can be found (e.g., a URL on the Internet or a book of codes). To make this list even more useful, identify the person(s) or staff position(s) responsible for ensuring compliance.

Example of Methods or Procedures

Example 1

Example 4.1 is an example Regulatory and Other Requirements Form from the Charleston (S.C.) Water System that can be used by a plant to identify and maintain a list of the most up-to-date versions of all regulations and other requirements that apply to the plant.

Regulatory and Other Requirements Form

Purpose/Scope: This document is used to identify and record legal and other requirements to which the utility subscribes, which have been identified as being directly applicable to the utility's activities, products, and services. Completion of this document will aid overall management of the water quality.

Instructions: This document is to be updated as regulatory and other requirements are modified, added, or removed. List the title of the requirement and provide a brief description in the column titled General Subject Covered. Rules, regulations, and laws must be periodically reviewed for current version and updates; therefore, identify which part of the utility will perform this review in the column titled Responsibility for Current Version. Establish electronic links in the column titled Document Format/Location. This ensures that the most current requirements are available for reference. With hard-copy requirements, list the location(s) of the hard copy.

All utility departments are required to ensure that regulatory and other requirements are interpreted and applied to their operations. Those listed as "Responsible" are required to periodically ensure that the most recent legal and other requirements are identified and listed.

NOTE: This form may be replicated on a computer or duplicated on a photocopier. The computer copy must look similar to this document and contain the same information.

Prepared By/Date:

Title of Rule, Regulation, or Law	General Subject Covered	Responsibility for Current Version	Document Format/ Location (if electronic, provide Web address)

Source: Kanwal Oberoi, Charleston Water System, Charleston, S.C.

Example 4.1 Regulatory and Other Requirements Form

Example 2

Table 4.1 is an example list of permits with ongoing obligations from Tampa Bay Water (Tampa, Fla.) that is maintained to keep track of permits and the frequency of inspection in reporting. All regulatory requirements can be tracked on a spreadsheet that includes appropriate categories for the permits required within a specific jurisdiction. The utility also maintains a list of permits that have close-out obligations and are generally project specific, such as construction permits.

Table 4.1 Table of Permits With Continued Obligations

Permit or Permit Component	Inspection Frequency	Report Frequency	Renewal Frequency
Environmental Resources Mitigation			N/A*
Stormwater	Every 24 months	Every 24 months	N/A
Comprehensive Annual Reservoir Report		Annual	N/A
National Pollution Discharge Elimination System	Annual	Monthly	Every 5 years
Public Water Systems			
Monthly Operations Reports	Monthly	Monthly	
Comprehensive Regional Water Quality Monitoring Program	N/A	Monthly/quarterly/3-year/7-year/9-year	N/A
Hillsborough County Industrial Wastewater Discharge Permit		Monthly/summary report per discharge	Every 2 years
Underground Storage Tanks	Yearly		
Aboveground Storage Tanks			
Air Pollution Permit			
Development and Mitigation Approval			N/A
Aboveground Chemical Storage Tanks			

*N/A = not applicable.

Source: Christine Owen, Tampa Bay Water, Tampa, Fla.

Questions to Check Progress

1. Does the utility maintain and update regularly a list of legal and regulatory requirements?
2. Has the utility communicated this information to all the stakeholders?
3. Has the utility established programs to ensure that regulatory requirements are met?
4. Has the utility established a system of monitoring and evaluation to ensure compliance with the legal and regulatory requirements?

Sec. 4.2 Operational Management Practices

4.2.1

Business Practices

Each plant shall have a mission statement or purpose that includes optimizing water quality and that is communicated to individuals participating in the treatment of raw water for potable use. The treatment plant shall have, as part of its management goals, the review frequency of its performance goals. The management system shall keep records regarding the accomplishment of the goals, have a periodic review, and take documented action if goals are not being achieved. The following requirements apply to the portion of the utility's programs that pertain to the water treatment plant. Plant personnel shall be involved in the accomplishment of the utility's programs.

4.2.1.1

Budget and financial management. The plant shall assess the cost of operation at least annually and provide input regarding estimated expenses to accomplish the requirements of this standard. Plant personnel shall provide recommendations for equipment purchase and other plant-specific expenditures. Actual expenses shall be evaluated against estimates at least quarterly. The plant shall demonstrate adequate funds to incorporate aspects of the standard.

4.2.1.2

Treatment plant capital improvement planning. The plant shall have a current forward-looking assessment of the need for capital improvements consistent with master or facility plans. Master or facility planning should occur on a regular basis.

4.2.1.3

Energy management program. The plant shall review and optimize electrical energy usage at regular intervals, including review of energy use trends and costs, and shall consider energy costs in the evaluation of new or replacement treatment system components.

Rationale

To consistently produce high-quality water, a water treatment plant must set goals, and the plant personnel must understand the goals and how to meet them. Goal setting is part of the planning process and includes financial plans and budgeting. When plant personnel are involved in goal setting, including the budget and recommendations for equipment replacement and capital projects, the staff is more likely to take ownership of the goals and the budget and work toward meeting them.

Progress toward the goals should be reviewed and documented regularly in a framework that allows all personnel to participate in reaching the goals. Annual budgeting with at least quarterly checking of expenditures against the budget provides control of spending and the ability to make changes in spending as needed to meet changing conditions. A budget can be developed as a single spreadsheet, or it can be a fairly complex and long budget document. The size and complexity of the utility often impacts the amount of information normally included in an annual budget.

Capital improvement planning is often combined with a plant evaluation to determine what improvements are necessary to meet future demands, regulatory changes, or to replace aging infrastructure. The plant capital improvement plan, along with other financial information, is typically used to develop utility rate structures that cover current and planned improvements.

Energy management can be a cost savings program because energy costs continue to rise faster than inflation. Optimizing energy usage in a treatment plant requires an energy/sustainability team that will champion energy conservation. Access to energy billing information and benchmarking data for major pieces of equipment allows the team to plot monthly energy consumption costs and demand, which helps reveal where energy is being used. An orderly approach to optimization includes asking “what if” for each piece of equipment:

- What if the piece of equipment is turned off?
- What if the equipment ran at a lower capacity?
- What if more efficient equipment could be found?

The implementation program for energy conservation will be different for each plant, but each program should include a look at renewable sources, pursuit of grants and rebates for funding, and recognition that the program is a continuous improvement project.

Examples of Methods or Procedures

Example 1

Example 4.2-1 is an example of a utility vision, mission, values, and goals statement from Austin Water in Austin, Texas. This particular document is formatted into a wall poster so that it can be displayed in all areas of the utility.

Austin Water Vision, Mission, Values

Vision
To be recognized as the best water utility in the nation

Mission
To provide safe, reliable and high-quality water services to our customers

Values

Integrity
We adhere to the highest standards of ethics and will be accountable for all our actions.

Innovative
We continuously work toward and create new ways to improve our work processes and customer services.

Collaborative
We work as an organization to share information and help one another to achieve our goals.

Safe
We work in a way to minimize risk to ourselves and others.

Green
We implement ways to reduce our impact on our environment.

Diverse
We solicit and respectfully consider different perspectives from individuals with different backgrounds, ideas, and viewpoints.

Inspired
We promote a workforce that is motivated, positive, optimistic, and enjoys the work they do.

Goals

Workforce Development
Promote a workforce that is efficient, effective, inspired and accountable

Customer Value
Strengthen customer value and stakeholder relationships

Environmental Sustainability
Protect the environment through sustainable practices

Public Health and Safety
Protect the public health and safety by providing high-quality water service

Financial Management
Maintain strong financial position to ensure improved cost structure and competitive rates

Asset Management
Optimize life cycle cost of existing and future assets

Source: Austin Water, Austin, Texas.

Example 4.2-1 Vision, Mission, Values, and Goals for Austin Water, Texas

Example 2

Example 4.2-2 shows an example of the table of contents from a large utility annual budget. This document is issued annually not only for internal use, but also is available to the public and to other utilities that purchase water from Tampa Bay Water. In a smaller utility, only a subset of this information would normally be included in an annual treatment plant budget document, and it may all be done on a spreadsheet.

Tampa Bay Water 2011 Annual Budget Table of Contents	
Organizational Information	
Board of Directors and Tampa Bay Water Executives	
Organizational Chart	
Agency Profile	
• Map—Tampa Bay Water Service Areas	
• Map—Tampa Bay Water Facilities Locations	
Agency Update	
General Manager's Budget Message	
Policy Goals Used in Budget Development	
Key Factors Affecting the 2011 Budget	
Water Demand Used in the 2011 Budget	
Operational Highlights of the 2011 Budget	
Analysis of Costs in the 2011 Budget	
Future Supply	
Reserve Funds	
In Summary	
Budget Schedule	
Annual Budget Development	
Budget Format	
Budget Basis	
Annual Budget Requirements	
Annual Budget Process	
Major Responsibilities	
Budget Implementation	
Budget Amendments	
Financial Management Policies	
Utility Reserve Fund (Fund Balance) Policy	
Rate Stabilization Account Policy	
Fixed Asset Policy	
Debt Policy	
Investment Policy	
Accounting, Auditing and Financial Reporting Policies	
• Auditing	
• Basis of Accounting and Accounting Systems	
• Performance Audit	
Example 4.2-2 Table of Contents for Annual Budget for Tampa Bay Water, Tampa, Fla. (continues)	

Financial Plan

Funds Structure Overview

- Fund and Accounts Flowchart

Reserves and Restricted Funds

Projected Changes in Fund Equity Schedule

Financial Planning and Trends

Revenues

Expenditures

Sources and Uses of Funds—2009 Actual, 2010 Approved, 2011 Approved

Sources and Uses of Funds—Budget Projections 2012 through 2016

Explanation of Variances

Capital Improvements Planning and Financing

Capital Improvement Program Definition

Impact of Capital Improvement Program on the 2011 Operating Budget

Routine Capital Purchases

Annual Rate Setting and Member Costs

Overview

Rate Setting

Uniform Rate Elements

- Fixed Costs
- Variable Costs
- Rate for City of Tampa From Tampa Bypass Canal

Other Budget Factors

Uniform Water Rates—2011 Approved, 2012 Through 2016 Projections

Projected Water Demand for Fiscal Year 2011—Chart

Estimated Annual Member Costs Fiscal Year 2011—Detail

Estimated Net Member Costs Fiscal Year 2011—Chart

Estimated Member Costs—Hillsborough County

Estimated Member Costs—City of Tampa

Estimated Member Costs—Pasco County

Estimated Member Costs—City of New Port Richey

Estimated Member Costs—Pinellas County

Estimated Member Costs—City of St. Petersburg

Debt Service

Bonds

Rate Covenant

Facility Acquisition Credits

Summary of 2011 Debt Service

Rating Agency Analysis

Future Borrowing

Example 4.2-2 Table of Contents for Annual Budget for Tampa Bay Water, Tampa, Fla.
(continued)

Capital Improvement Program

- Capital Improvement Program Background
- Goals
- 2011 Capital Improvement Program Funding
- Capital Improvement Financing
- Capital Project List for FY 2011
- Capital Project Detail for FY 2011

Divisional Operating Budget Detail

- Tampa Bay Water's Divisional Organization
- Staffing
- Staffing Comparison by Department in Full Time Equivalents
- Positions for Fiscal Year 2011
- Total Operations—2011 Approved Budget
- Projected Operating Expenses for Fiscal Year 2011—Chart
- Office of General Manager/Public Affairs—2011 Approved Budget
- General Counsel—2011 Approved Budget
- Operations & Facilities Division—2011 Approved Budget
- Science & Engineering Division—2011 Approved Budget
- Finance & Human Resources Departments—2011 Approved Budget
- Information Services & Board Records Departments—2011 Approved Budget

Summary of Contracts and Resolutions

- Amended and Restated Interlocal Agreement
- Master Water Supply Contract
- Master Bond Resolution

Appendix

- Service Area Demographics and Statistical Information
- Annual True Up of Fixed Costs to Members for Fiscal Year 2010
- Uniform Rates 1999–2011
- Budget Development Schedule for Fiscal Year 2012

Source: Christine Owen, Tampa Bay Water, Tampa, Fla.

Example 4.2-2 Table of Contents for Annual Budget for Tampa Bay Water, Tampa, Fla. (continued)

Example 3

A system water plant budget is shown in Table 4.2-1 for a water system serving about 12,000 people. This budget covers the treatment costs for the Town of Estes Park, Colo. Source water, distribution, and billing costs are separate items in this budget and are not shown here.

Table 4.2-1 Town of Estes Park Purification Budget

	Budget		Projected			
	2010	2011	2012	2013	2014	2015
Personnel	\$291,638	\$277,998	\$290,091	\$302,710	\$315,878	\$329,618
Insurance Premiums	1,933	1,366	1,380	1,393	1,407	1,421
Professional Fees/Service-Lab Testing	20,900	22,480	22,705	22,932	23,161	23,393
Publishing	1,000	1,000	1,010	1,020	1,030	1,041
Repairs and Maintenance						
Building Repair and Maintenance	7,000	32,000	32,960	33,949	34,967	36,016
Machinery/Tools	150	150	155	159	164	169
Laboratory	3,000	14,000	14,420	14,853	15,298	15,757
Pump Treatment	2,050	2,050	2,112	2,175	2,240	2,307
Storage Tank	8,500	13,000	8,755	9,018	9,288	9,567
Maintenance/Sample Stations	17,000	17,000	17,510	18,035	18,576	19,134
Materials and Supplies						
Office Supplies	200	225	232	239	246	253
Postage	3,500	3,100	3,193	3,289	3,387	3,489
Printing/Forms	2,950	3,100	3,193	3,289	3,387	3,489
Janitorial Supplies	300	300	309	318	328	338
Small Tools	350	650	670	690	710	732
Small Hardware	2,800	2,850	2,936	3,024	3,114	3,208
Chemicals	150,000	150,000	154,500	159,135	163,909	168,826
Laboratory/Purification	21,850	26,850	27,656	28,485	29,340	30,220
Utility Expenditures						
Telephone	4,866	4,900	5,096	5,249	5,406	5,569
Natural Gas	25,000	25,000	26,000	26,780	27,583	28,411
Electric	43,679	60,000	62,400	64,896	67,492	70,192
Sewer	37,500	37,500	39,000	40,170	41,375	42,616
Propane Gas	5,000	5,100	5,304	5,463	5,627	5,796
Total Purification	\$651,166	\$700,619	\$721,584	\$747,269	\$773,916	\$801,561

Source: Jeff Boles, Town of Estes Park, Colo.

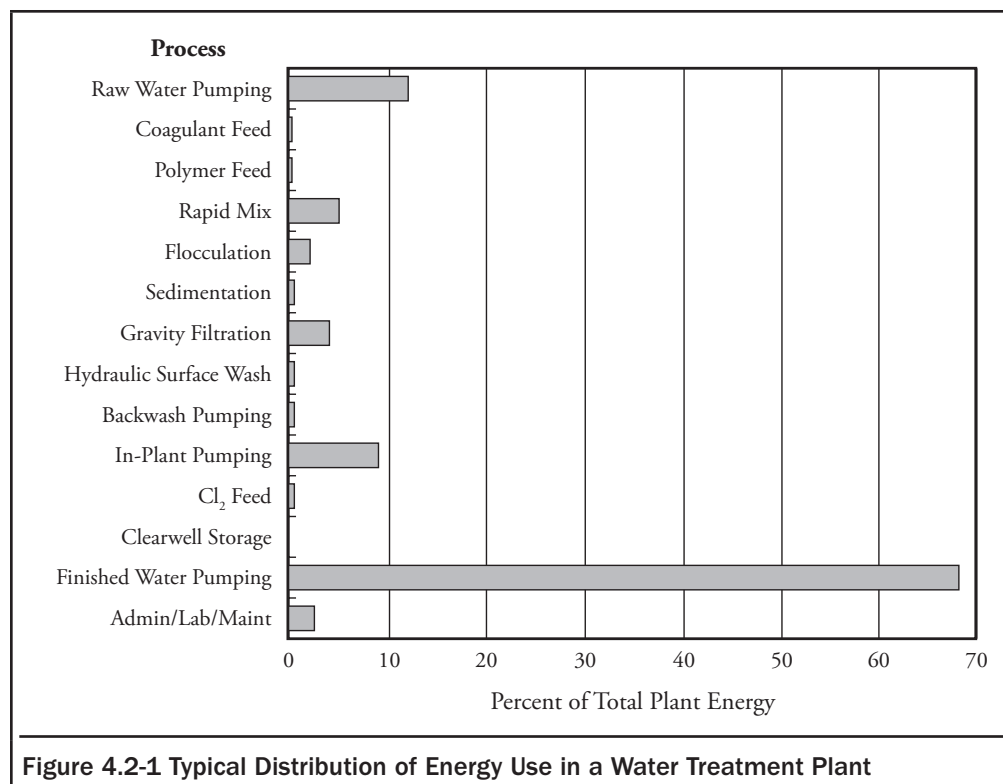
Example 4

A portion of the plant capital improvement plan (CIP) for the Sheridan Water Treatment Plant in Sheridan, Wyo., is shown in Table 4.2-2. This plan was developed from a plant and regulatory compliance evaluation with the goal of ensuring compliance and high-quality water well into the future. Total cost for each year is normally shown at the bottom of each column so that those cost numbers can be used for financial planning. More detailed project descriptions may accompany this type of a tabular listing as part of a larger CIP development document.

Table 4.2-2 Portion of Sheridan Water Treatment Plant Capital Improvement Plan

Project No.	Project Name	Year Project Completed									
		2010	2011	2012	2013	2014	2015	2016	2017	2018	
S-1	Influent chemical feed & mixing improvements				\$600–\$700K						
S-2	Floc/sed basin flow management improvements				\$500–\$600K						
S-3	Floc/sed basin settling improvements				\$1,400–\$1,500K						
S-4	Polymer dose distribution upgrade				\$50–\$60K						
S-5	Floc/sed building roof replacement				\$200–\$300K						
S-6	Chemical feeders replacement									\$250–\$300K	
S-7	Filter media replacement			\$200–\$300K							
S-8	Backwash water supply improvements			\$400–\$500K							
S-9	Clearwell flow monitoring improvements			\$200–\$300K							
S-10	Chlorine feed system improvements			\$200–\$300K							
S-11	<i>Cryptosporidium</i> disinfection improvements						\$4,000–\$5,000K				
S-12	Treated water quality control upgrade			\$100–\$200K							

Source: City of Sheridan, Wyo.



Example 5

Figure 4.2-1 shows the distribution of and percentage of energy use in a typical water treatment plant. Pumping uses the major portion of energy in a plant, which suggests that initiating an energy optimization program by reducing power usage in pumping is an obvious place to begin saving energy and related costs.

Questions to Check Progress

1. Does the plant have a stated mission or purpose and performance goals that are updated regularly and communicated to the staff?
2. Does the plant develop a budget annually that is evaluated against expenditures each quarter?
3. Does the plant have a current capital improvement plan?
4. Does the plant have a systematic method for recording energy usage?
Is energy consumption reviewed regularly and evaluated to determine whether reductions are feasible?

4.2.2

Treatment Plant Production Limits

The plant shall have a written policy that establishes the plant production limits for each unit process, sets process objectives, and compares the plant to permitted, approved, established production limits or design capacity appropriate for the raw water conditions.

Rationale

All water treatment processes are designed to operate within a set maximum flow rate to meet water quality targets set at the time of design. Production limits are important to ensure adequate treatment by all types of processes, including those that are more plant flow dependent (settling) and those that require adequate chemical dosing and mixing. Production capacity of unit processes is one of the measures used by the Partnership for Safe Water Phase III reviews. With a written document that establishes the production limits for each process, operators can easily check to make sure that limits are not exceeded and the plant protects against operating beyond the design limit and the attendant risk that water quality targets cannot be met.

Example of Methods or Procedures**Example 1**

As is often done, Austin Water (Austin, Texas) incorporates process descriptions and capacities into its operation and maintenance (O&M) manual. These same descriptions could be part of a standard operating procedure (SOP), or they might be individual documents stored in a central location for reference by operators. In Austin, the O&M manual is in electronic form, but the same information could easily be included in a paper document. Example 4.2-3 is an extract from the Austin Water O&M manual which defines the process flow limits for rapid mixing and clarification at the Ullrich Water Treatment Plant.

Rapid Mixing, Flocculation, and Sedimentation

Description

There are seven up-flow solids contact reactor-type clarifiers at the Ullrich Water Treatment Plant (WTP). Basin size and capacity are shown below:

Basin Number	Size, ft	Q Rated, mgd	Q Max, mgd
1	150	35	37.5
2	150	35	37.5
3	110	20	22.5
4	110	20	22.5
5	110	20	22.5
6	110	20	22.5
7	110	20	22.5
8	110	20	22.5

Additional Design Criteria for Basin Nos. 1 and 2:

Design Treatment Flow Rate per Unit	35 mgd
Maximum Treatment Flow Rate per Unit	37.5 mgd
Maximum Hydraulic Flow Rate per Unit	45.0 mgd
Rise Rate at Design Flow	1.19 gpm/ft ²
Rise Rate at Maximum Treatment Flow	1.28 gpm/ft ²
Rise Rate at Maximum Hydraulic Flow	1.53 gpm/ft ²
Reaction Zone Detention Time at Design Flow	22.7 min
Maximum Recirculation Rate	187,400 gpm
Rake Drive Duty Rated Torque	400,000 ft-lb
Rake Mechanism Steel Design Torque	400,000 ft-lb

Source: Austin Water, Austin, Texas.

Example 4.2-3 Excerpt From Austin Water O&M Manual Defining Flow Limits for Rapid Mixing and Clarification

Example 2

Example 4.2-4 is a description of the filtration and backwashing processes that includes process objectives and turbidity limits from Austin Water's O&M manual. A simple daily comparison of these design limits and measured flow data allows the utility to ensure that operational flows are always within appropriate boundaries.

Filtration and Backwashing

Description

The purpose of filtration is the removal of particulate impurities and floc from water by passing it through a filter media for both aesthetic and public health reasons. The impurities typically consist of suspended particles (fine silts and clays), colloids, biological forms (bacteria, viruses, and plankton), and chemical precipitates from the lime-softening process. Filtration is both a physical and chemical process. Removal of turbidity in a filter is affected by the following factors: chemical characteristics of the water being treated, nature of suspension (physical and chemical characteristics and particulates suspended in the water), types and degree of pretreatment (coagulation, flocculation, and sedimentation), and filter type and operation.

The filters at the Ullrich Water Treatment Plant (WTP) are dual-media, high-rate, gravity-type filters. There are 18 filters arranged in two parallel rows. Each filter has a surface area of approximately 1232 ft². Each filter was designed to have 6 inches of sand, and 36 inches of anthracite. The coarsest material, the anthracite, also has the lowest specific gravity so that it remains the top layer. Each filter has a low profile Leopold Underdrain and integral media support cap. The underdrain system is designed to collect the filtered water evenly along the bottom of the filter and, similarly, distribute the backwash water uniformly. The maximum loading rate is 7.6 gpm/ft². Since all the valves are activated by the same control point, changes in flow are spread evenly over all the filters in service. As a result, hydraulic surges through the filters are minimized. Additional filters are brought into service as necessary to maintain the filtration rate at or below the target loading rate per filter of 13.4 mgd. The loading rate of 7.6 gpm/ft² allows the plant to achieve 175 mgd firm filtered water production capacity with 5 filters out-of-service (maximum loading of 13.4 mgd per filter). Dirty filters are never returned to service without first being backwashed.

When a filter is brought online, the filter produces water with a higher turbidity for several minutes. This period is called the ripening period of the filter run and generally lasts approximately 15 minutes. Peak filter ripening turbidities are negligible at Ullrich. The ripening algorithm executed by the Plant's Distributed Acquisition and Control System limits the ripening spike to a peak of approximately 0.12 ntu with a recovery back below 0.1 within 15 minutes or less. As a filter run proceeds, foreign material collects in the media, causing turbidities to drop and stabilize before rising again at the end of the filter run. A filter is backwashed to remove the accumulated material from the media after a designated time period. Before a filter is removed from service, another filter is slowly brought online to minimize flow changes and optimize filter performance.

The filter is taken out of service during the backwash process. The backwash system at the Ullrich WTP utilizes both air scour and water to clean the media and flush out the impurities and floc. Centrifugal pumps supply filtered water for backwashing. The backwash pumps are located at the High Service Pump Station. The blowers are located in the lower level of the Administration Building. One of the backwash pumps acts as a standby pump. The filters are backwashed using the high service pumps and water from the clearwell.

Example 4.2-4 Description of Filtration Process, Flow Limits, and Objectives (continues)

A functional description of the normal operation of one of the Ullrich WTP's filters follows:

1. During normal operation, settled water from the basins enters the filter through an inlet valve.
2. The water enters the filter gullet, flows over the washwater troughs (which are submerged during normal operation), and flows by gravity through the filter media.
3. The filtered water is collected in the underdrain system, conveyed to the filtered water collection conduit, and passes into the filter outlet piping in the pipe gallery.
4. The filtered water then passes through the outlet control valve into the filtered water pipe. This filtered water pipe collects the outlet flow from all filters and flows to the finished water clearwells.

Filters are backwashed automatically after a specified run time. For a general description of the backwash process, see the Process Assistance System. A functional description of the backwash process follows:

1. Washwater is supplied from the backwash pumps through the backwash header, flows through the backwash inlet valve, into the filtered water collection conduit, into the filter underdrain system, and up through the media.
2. The dirty washwater rises up into the washwater troughs, drops into the filter gullet, and flows out through the backwash outlet valve into the waste washwater conduit. The waste washwater is conveyed from the conduit to the waste backwash water pipeline, which flows by gravity to the washwater recycle basin. After backwashing, the filter may be returned to service.

Source: Austin Water, Austin, Texas.

Example 4.2-4 Description of Filtration Process, Flow Limits, and Objectives (continued)

Questions to Check Progress

1. Does the plant have defined production limits that are documented?
2. Does the plant have written descriptions of how each treatment process works and are these easily accessible to operators?

4.2.3

Treatment Plant Adequacy of Treated Supply

Plant production capacity should be adequate to meet system demands, taking into account the availability of system storage. The plant shall identify and meet system demands, have a plan to meet those demands, and have a process to implement the plan. The process shall include a method for reviewing the implementation progress for adequacy.

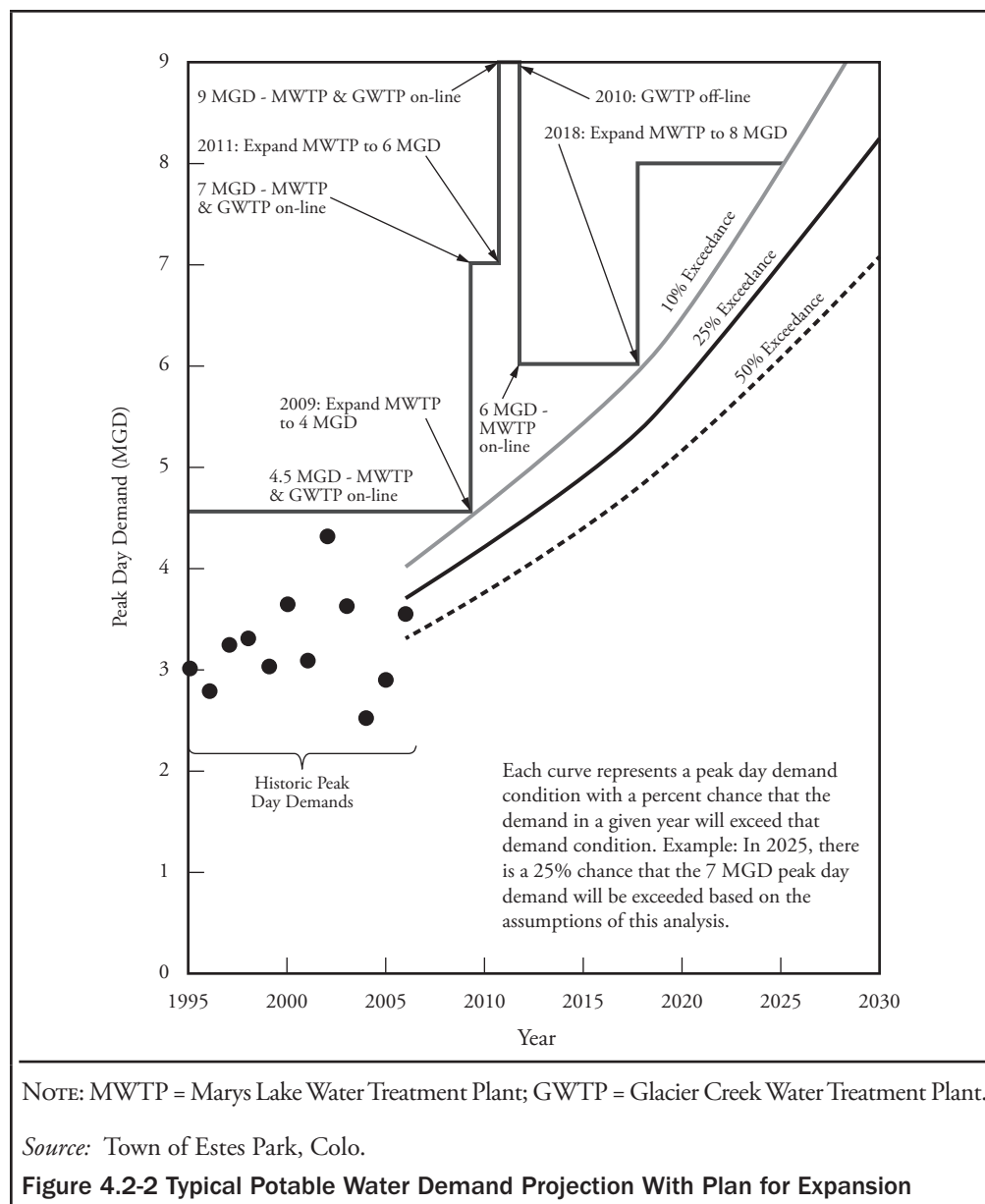
Rationale

Periodic evaluation of system demands and projection of demand increases for a reasonable planning period into the future allows a water system to ensure that sufficient production capacity is available to meet customer needs. A demand projection is typically used to plan for plant expansions and to set up capital improvement plans and rate structures that will accommodate improvements required to meet expected increased demands. Once system demands are determined and a plan is in place to meet the demands, the water plant or system must have a process in place to implement the plan. The plan and its implementation should be reviewed regularly to ensure that timing and progress are adequate to have treatment capacity in place to meet demands.

Documentation of a demand projection is generally provided in a demand study or evaluation, which can be completed by the utility or plant or by contract. A demand evaluation typically includes an analysis of the service population and growth rate, an evaluation of current demands and usage rates, an evaluation of land use and build-out conditions, and a projection of water demand into the future, which is tied back to each of these parameters. Demand projections always contain some uncertainty as there are a number of assumptions made in the process of completing the analysis.

Example of Methods or Procedures

Potable water demand projection can be illustrated graphically. Figure 4.2-2 is an example of a projection for a Colorado utility that includes projected dates for plant expansion and replacement to meet the build-out demand for the system.



Questions to Check Progress

1. Has the plant identified current system demands and projected future demands?
2. Is there a plan in place for making required changes to meet future demands?
3. Is a process in place for implementing the plan and checking up on the progress of implementation?

4.2.4

Housekeeping Procedures and Cleanliness

Areas of the plant shall be maintained in a neat and orderly condition. Operation and maintenance functions should be conducted in such a manner that plant site safety and water quality are not compromised.

Rationale

Drinking water plants are producing water for public consumption that must meet regulatory health standards, so water plant facilities should be kept neat and clean to prevent accidental contamination of the treated water. In the same fashion that operators develop a commitment to making high-quality water, the plant staff should be encouraged to take ownership in the way the plant looks so that housekeeping becomes a habit, not a chore.

Orderly facilities contribute to efficient maintenance of equipment by allowing easy access to make repairs and a work environment that is conducive to getting the work done. Housekeeping procedures are closely related to safety in the prevention of accidents on the plant site. Particularly in plants that do not have excess free space, the work areas for making repairs must be clean and free of clutter to allow optimal working conditions for maintenance staff.

Example of Methods or Procedures

Figure 4.2-3 illustrates a treatment plant in Estes Park (Colo.) that has minimal spare space for working on equipment. Anything left in the walkways creates tripping hazards, and in some areas may compromise the functionality of the jib crane, jeopardizing the ability to remove and repair membrane cassettes. Housekeeping in this sort of environment is not only a safety necessity but also essential for an operator's ability to work on individual pieces of equipment without interference.



Source: Jeff Boles, Town of Estes Park, Colo.

Figure 4.2-3 Submerged Membrane Tanks With Jib Crane Tracks and Control Cabinets at the Marys Lake Water Treatment Plant

4.2.5

Operating Permits and Licenses

The plant shall obtain necessary operating permits and licenses in accordance with regulatory requirements. The record-keeping system shall be used to maintain current documents.

Rationale

All water treatment plants meeting this standard should be in compliance with applicable regulatory requirements. This includes obtaining and updating permits and licenses as necessary to meet the regulations. Utilities have many ways to track their regulatory permitting obligations, but most of them are simplified to a tabular or spreadsheet framework that is assigned to a particular staff member for updating. This information must be easily available to the groups responsible for reporting and renewal to prevent mishaps such as missing deadlines for renewal.

Example of Methods or Procedures

Example 1

Table 4.2-3 lists required permits and identifies the group or person within the utility who is responsible for inspections, reporting, compliance, and renewal of the permit. Organizing the requirements in this manner facilitates the process of ensuring that all reports and permits are kept up to date.

Table 4.2-3 Permits With Continued Obligations

Permit or Permit Component	Section Responsible for Inspection	Report	Renewal
Environmental Resources			
Mitigation	Evaluations & Permits	Evaluations & Permits	N/A*
Stormwater	Planning & Projects	Planning & Projects	N/A
Comprehensive Annual Reservoir Report	Source Rotation	Source Rotation	N/A
National Pollution Discharge Elimination System	Operations	Operations	Planning & Projects
Public Water Systems			
Monthly Operations Reports	Operations	Operations	Operations
Comprehensive Regional Water Quality Monitoring Program	N/A	Laboratory	N/A
Hillsborough County Industrial Wastewater Discharge Permit	Operations	Operations	Planning & Projects
Underground Storage Tanks	Yearly		
Aboveground Storage Tanks		Operations	
Air Pollution Permit		Operations	
Development and Mitigation Approval		Evaluations & Permits	N/A
Aboveground Chemical Storage Tanks		Operations	

*N/A = not applicable.

Source: Christine Owen, Tampa Bay Water, Tampa, Fla.

4.2.6

Plant Management

Management practices and policies shall support the accomplishment of requirements of this standard.

Rationale

Water treatment plants expecting to meet AWWA G100 must have support from plant management as demonstrated through daily management practices. A wide range of management issues play into successful implementation of the standard, including provision of sufficient and appropriately trained staff, ensuring that treatment equipment and facilities are adequate and maintained in good operating condition, and development and implementation of financial plans that allow for appropriate improvements.

A major national program often used to evaluate treatment plants is the Comprehensive Performance Evaluation (CPE) developed by the USEPA. This program has been used in all parts of the country for some time, and summary results from many of the evaluations show that management factors are the most frequent issues that impact water treatment plant performance. To commit to optimized performance, administrators must be willing to pursue actions aimed at improving plant performance. To avoid even momentary lapses in treatment that can increase the public health risk, an understanding of the public health implications of operating a water treatment plant should guide the management approach. Managers need to guard against complacency and develop an environment that encourages an empowered staff that can respond to all kinds of water conditions.

Refer to *Operational Guide to AWWA Standard G400, Utility Management System* (Ginley and Humphrey 2009), for a wealth of ideas regarding management improvement.

Questions to Check Progress

1. Is the plant maintained in a neat and orderly fashion?
2. Does the plant hold all required permits for operations, and are all permits tracked and updated as required?
3. Do management practices support the activities required to meet this standard?

4.2.7 **Quality Assurance Practices**

The plant shall have written operational practices and procedures for the operation and maintenance of the plant.

4.2.7.1 Record keeping and data review. Refer to ANSI/AWWA G400, Utility Management System (AWWA 2009b), for details on record keeping and data review.

4.2.7.2 Record review. A review cycle shall be established for operation and maintenance of the plant to verify that the limits of the operational control policy are satisfied, including, for example, water quality, laboratory operations, and mechanical equipment.

4.2.7.3 Regulatory reporting. The plant shall have a protocol to comply with the reporting requirements of applicable regulations. The protocol shall designate who is responsible for the reports and the timing of submittal. The protocol shall include enough lead time to acquire necessary approvals and still satisfy the deadline for submitting the reports.

4.2.7.4 Standard operating procedures. The plant shall have a system to develop and update standard operating procedures (SOPs) for equipment and plant production processes, and a system to develop and update operation and maintenance manuals. These procedures may be developed specifically for the plant or may be taken from manufacturers' literature or other appropriate sources.

Rationale

Most water treatment plants regularly collect significant amounts of operating and process control data that is used to operate the plant on a daily basis. This data, over a historical timeframe, can also be used to evaluate progress toward meeting goals and to identify weaknesses that would benefit from setting new goals and implementing activities to reach them. A program for analyzing and reviewing the data with respect to plant operations allows plant staff to verify progress toward operational goals and ensure that operating and maintenance procedures are met.

Water treatment plants are typically required to file regular monthly reports to a regulatory agency. Data for regulatory reports are generally collected daily and must be accumulated for inclusion in monthly submittals. Often this is accomplished electronically, but some plants still collect daily data on paper. Each plant should have a written standardized approach to gathering the appropriate information and completing regulatory reports.

For smaller plants where the staff functions for operations and data collection are centrally located and interdepartmental staff can easily communicate, the organization required for ensuring that monthly reports are completed, reviewed, and signed by the appropriate person and submitted to the regulatory agency on time may not require significant preplanning or organization. However, for larger utilities where the functions for plant operations may be completely separate from laboratory functions, the collection of regulatory reporting data may require a standard procedure to ensure that all the correct data is collected and combined into monthly reports for regulators. In either case, all water treatment plants should have a designated person who is responsible for ensuring that the data are entered into reports appropriately and that reports are delivered on time.

SOPs bring consistency to plant operations when operating teams change regularly and have differing views on how a water plant should be operated. Most water treatment processes are more efficient and produce higher quality water with consistent operations, as long as the process has been optimized to treat the raw water quality entering the plant. When raw water quality changes, a standard approach to deal with that change provides multiple operating teams with a similar understanding of the necessary treatment shifts. By extension, the finished water quality is generally more consistent.

Example of Methods or Procedures

Example 1

Development of SOPs in a water plant should be accomplished by a team effort that involves the appropriate staff members who have an understanding of the particular subject of the SOP. This is true of both operational and maintenance SOPs, because no single person knows everything that is needed for a specific procedure. Discussion and agreement about the content of an SOP brings a sense of team effort and ownership to the process that is invaluable in the long-term operation of a plant. Example 4.2-5 is a standard template for development of an SOP.

Example 2

Example 4.2-6 is part of an SOP for the filters at a treatment plant in Austin, Texas. This particular plant is controlled by a supervisory control and data acquisition (SCADA) system, so regular filter operations are controlled according to the control loop descriptions in the SCADA system. However, every operator must understand how to operate the plant manually, without electronic controls, because events can occur that require manual operation to keep the plant online.

Standard Operating Instruction Form

Purpose/Scope: This form is used to prepare Standard Operating Procedures (SOPs) for use by associates who perform operational control and maintenance management tasks. The department head (or designee) is responsible for the approval, revision, and issuance of SOPs and ensuring that associates have the necessary training to perform the job.

Instructions: Complete each section below prior to placing new or modified monitoring or control equipment in service. The department head (or designee) shall ensure that maintenance documents are available and controlled at all appropriate locations. **NOTE:** This form may be replicated on a computer or duplicated on a photocopier. The computer copy must look similar to this document and contain the same information.

Prepared by:

Approved by/Date:

Title:

1. Purpose:

2. Scope:

3. Responsibility:

4. Work Preparation:

4.1 Labor:

4.2 Equipment:

4.3 Materials:

5. Work Step(s):

6. Related Documents:

Source: Kanwal Oberoi, Charleston Water System, Charleston, S.C.

Example 4.2-5 Standard Operating Instruction Form

Filtration and Backwashing

Operation

- Operation Procedures
- Operation Modes
- Control Description

Operation Procedures

- Standard Operating Procedures
- Process Considerations
- Turbidity Monitoring
- Manufacturer's Operations Do's and Don'ts for the Media and Underdrain
- Manufacturer's Operations Do's and Don'ts for the Blower
- Routine Operating Checklist

Standard Operating Procedures

- Standard Operating Procedure: Taking a Filter Out-of-Service and Bringing a Filter Online.
- Standard Operating Procedure: Backwashing a Filter

Process Considerations

In order for the filtration process to be optimal, the operator must ensure that the coagulation and sedimentation processes are also optimized. The operator should strive for turbidity levels in the filter influent to be less than 2 ntu.

All filters in operation should be loaded at the same rate. This ensures that no one filter will become overloaded. The filter control system automatically provides an equal flow split between the operating filters.

Filter effluent turbidity is monitored continuously at each filter and at the computer control room. For additional information see the Process Assistance System.

Turbidity Monitoring

The filters at Ullrich WTP typically produce an effluent with turbidities of less than 0.07 ntu. It is the goal of the Utility to maintain turbidities of less than 0.1 ntu 95 percent of the time.

Turbidity from each filter is continuously monitored by in-line turbidimeters. An analog signal from each of the turbidimeters is sent to its respective filter control console where that signal is compared with turbidity setpoint values corresponding to the call for backwash and high turbidity alarm. Turbidity values are also displayed at any Plant Distributed Acquisition and Control System Human Interface/Machine Interface. In the event of a failure in the automated turbidity monitoring of any filter, operations personnel must collect and analyze samples from the filter and record the data to meet regulatory requirements. For more information see the Process Assistance System.

Example 4.2-6 Filter operating Procedure for the Ullrich Water Treatment Plant (continues)

Manufacturer's Operations Do's and Don'ts for the Media and Underdrain System

Leopold includes a list of Operation Do's and Don'ts in the Manufacturer's O&M Manual to protect the underdrain and the media:

Don't

- Backwash the filters with dirty water
- Backwash the system without adequate flow measurement and flow control devices operational. It is important that the backwash rate be limited to a rate that will not generate a differential pressure across the underdrain greater than 5.2 psi. This rate is typically about 40 gpm/ft², which is significantly greater than the design backwash rate.
- Subject the underdrain to hydraulic surges (water hammer) caused by turning pumps on with the valves open or opening valves too quickly. Valves should be set to open and closed smoothly in a minimum of 60 seconds.
- Increase the water backwash rate to a high value before purging air from the underdrain and media.
- Fill any dry filter, at any time, from the top.
- Subject to filter, during filtration, to frequent major changes in flow rate.

Do

- Subject the filter to periodic disinfection to reduce biological or algal growth.
- Provide and maintain flow monitoring and control equipment for the water and air backwash systems.

Manufacturer's Operations Do's and Don'ts for the Blowers

The air scour blower system supplies air to scour/backwash the filter media. The blowers are centrifugal blowers manufactured by Continental. For more information consult the manufacturer's O&M manuals.

Don't start the blower motor more than 3 times in one hour. And those starts should be spaced equally apart with a minimum of 20 minutes between starts. More frequent starts may result in severe damage to the motors.

Do

- Rotate the machine shaft as indicated by the arrow on the outlet or discharge head.
- Check all valves in the system and appropriately set valves to prevent the machine from surge operation.

Routine Operating Checklist

- Once a day, check the operation of the mechanical equipment and instruments in the filter gallery.
- Once a week, check the operation of the motor-actuated filter valves.
- Check that the valves which are supposed to be open are fully opened and the valves that are supposed to be closed are fully closed.

Example 4.2-6 Filter operating Procedure for the Ullrich Water Treatment Plant (continued)

- Monthly, lower the water level to the top of the filter media and visually inspect the filter bed for the following:
 - Unlevel surface (mounds),
 - Cracks,
 - Unwashed areas,
 - Color change of media, and
 - Mud ball formation.

Normal procedure will be to initiate an automatic backwash sequence at the filter control panel. While backwashing look for the following:

- Uniformity of flow into the backwash troughs, and
- Excessive amounts of media being carried out by backwash flow.

Control Description

Overview

The major components of the Filter System are (18) filters, (2) air scour blowers, and (2) backwash pumps.

Associated Loops

Settled Water Still Well Levels
 Filter Influent Valve
 Filter Effluent Valve
 Filter Drain Valve
 Filter Washwater (Backwash) Valve
 Filter Air Scour Isolation Valve
 Filter Headloss
 Filter Level Switches
 Filter Effluent Turbidity
 Main Backwash Header Pressure

Source: Austin Water, Austin, Texas.

Example 4.2-6 Filter operating Procedure for the Ullrich Water Treatment Plant (continued)

Example 3

Table 4.2-4 is a control document for the list of SOPs for the Bennery Lake Water Supply Plant near Halifax, Nova Scotia. When a new SOP is developed for this plant, the document is added to this master record of all the SOPs for this plant.

Table 4.2-4 Registry of Standard Operating Procedures for the Bennery Lake Water Supply Plant

Halifax Water	Environmental Management System Manual	Page 1 of 2
OPERATIONAL CONTROL ISO 14001: 4.4.6		HW-EMS-12-04 September 2010
Bennery Lake Water Supply Plant REGISTRY OF STANDARD OPERATING PROCEDURES (SOPs)		
SOP-01	Handling, Storage, Use of Sodium Hypochlorite	
SOP-02	Handling, Storage, Use of Potassium Permanganate	
SOP-03	Handling, Storage, Use of Hydrated Lime	
SOP-04	Handling, Storage, Use of Carbon Dioxide	
SOP-05-01	Content Data Sheet	
SOP-07	Handling, Storage, Use of Sodium Hydroxide	
SOP-08	Handling, Storage, Use of Polyphosphate	
SOP-09	Handling, Storage, Use of Alum	
SOP-11	Refilling Sodium Hypochlorite, Drum Changeover	
SOP-12	Refilling Potassium Permanganate, Drum Changeover	
SOP-13	Refilling Lime Bulk Storage	
SOP-14	Refilling Carbon Dioxide Bulk Storage	
SOP-15	Refilling Sodium Hydroxide Bulk Storage	
SOP-17	Spill Response—Polymer	
SOP-18	Refilling Alum Bulk Storage	
SOP-19	Filter Backwashing	
SOP-21	Refilling Polyphosphate Bulk Storage	
SOP-23	Spill Response—Sodium Hypochlorite	
SOP-24	Spill Response—Potassium Permanganate	
SOP-25	Spill Response—Carbon Dioxide	
SOP-26	Spill Response—Petroleum Product (Bennery Lake)	
SOP-27	Spill Response—Polyphosphate	
SOP-28	Spill Response—Sodium Hydroxide	
SOP-29	Spill Response—Alum	
SOP-30	Operator Continuous Monitoring (Rounds)	
SOP-31	Reporting Disruptions in Water Quality	
SOP-33	Operation of Diesel Generator in Case of Emergency	
SOP-34	Setting a Grundfos Pump to Manual Control	
SOP-35	Handling, Storage, Use of Polymer	
SOP-36	Refilling Polymer Bulk Storage	
SOP-37	Response: Threatened or Confirmed Contamination of Raw Water	
SOP-38	Response: Threatened or Confirmed Contamination of Treated Water	
SOP-39	Refilling Petroleum Storage	
SOP-40	Spill Response—Petroleum (Land)	
SOP-41	Procedure: Petroleum Product Inventory Control	

Source: Reid Campbell, Halifax Water, Halifax, N.S.

- 4.2.7.5 Treatment chemicals quality assurance. Chemicals added to water in the treatment process shall meet NSF/ANSI 60 standards for use in potable water or be approved by the applicable regulatory agency.

Rationale

Chemicals used for treating drinking water have the potential for adding contaminants to the drinking water if they do not meet appropriate standards. To avoid the risk of contamination from treatment chemicals, plants should require that all chemical products used in the treatment process meet NSF/ANSI 60 standards, Drinking Water Treatment Chemicals—Health Effects. Normally, this requirement is set at the time of procurement in the specifications for bidding chemicals.

Example of Methods or Procedures

Example 1

Example 4.2-7 is Charleston, S.C., water system's standard procedure for procuring chemicals and checking them on delivery.

AWWA standards provide guidance into specifying chemicals. In addition, the utility may require NSF and Department of Health and Environmental Control certification where applicable for all chemicals that may come in contact with water during the entire treatment process. Food-grade lubricants are used where appropriate as certain lubricant manufacturers may not have pursued NSF certification.

Aside from specifying the properties of the chemical, utility may also evaluate:

- Delivery capabilities and packaging where applicable
- Whether a supplier has multiple sources and/or manufacturing facilities
- Vendor's inventory and emergency assignment of inventory during disasters
- Compliance with ISO 14001 program
- Secondary suppliers
- Safety record, security information on drivers
- Delivery times to ensure that a full staff is available when hazardous materials are being unloaded

Standard Operating Instructions for Chemical Specifications

Safety Requirements:

Follow all requirements of the safety manual and the applicable safety program or procedure. This may include but is not limited to Lock-Out Tag-Out, Confined Space Entry, Hazard Communications (Material Safety Data Sheets [MSDSs]), Process Safety Management, Excavation and Shoring, Respiratory Protection, Electrical Safety, or Lab Safety.

Example 4.2-7 Standard Procedure for Procuring Chemicals (continues)

Use personal protective equipment (PPE) predicated by the work environment and material handling requirements. This may include but is not limited to eye protection, face protection, hardhat, foot protection, welder's equipment, life preservers, respirators, gas masks, SCBA, gas detection equipment, seat belts, hearing protection, or traffic vest. (Indicate location of safety manual and MSDSs.)

Specification for (Chemical):

The (chemical) must meet or surpass current (applicable AWWA standard). The chemical must also meet chemical/physical specification as stated in the most recent version of DHEC State Primary Drinking Water Regulations and/or have NSF/ANSI standard approval for use in potable water.

Additional Specifications:

The chemical must be commercially available in the form of (named chemical).

Basis for Rejection of Chemical:

If the material or its transporting container does not meet the chemical, physical, or safety requirements of the standard and the purchaser's specifications. The chemical meeting the requirements of this standard shall not introduce levels of contaminants into the water that exceed maximum contaminant levels (MCLs) as set forth by the Safe Drinking Water Act and its amendments when the water has been properly treated with the chemical.

The chemical meeting the requirements of this standard shall contain no substances in quantities capable of producing deleterious or injurious effects on the health of those consuming water that has been treated properly with the chemical. The chemical must meet a specified composition.

Packing and Shipping:

The chemical shall be transported by an approved carrier in a tank truck clean and free from contaminants and meet the requirements of the AWWA standard and/or be NSF approved. An affidavit of compliance meeting the requirements of the AWWA standard and/or NSF approval will be required by the purchaser and must be supplied with the bid quote in order to qualify for consideration. Each invoice should display a statement indication that the chemical meets the AWWA standard and/or NSF approval. (Delivery times should also be specified.)

All associates shall be made aware of the consequences of deviating from the task. Failure to follow task instructions may result in additional training and/or disciplinary action at the supervisor's discretion. The positive significant aspect for following this instruction is the maintaining of water quality thus protecting the health of the public consuming the potable water. The negative significant aspect for not following this instruction is loss of water quality and endangering the health of the public consuming the potable water.

Chemical Receiving:

It is imperative that shipment manifests are checked for every delivery to ensure that the correct chemical is received and unloaded into the assigned storage tank. Use an electronic log to record delivery information. Note acceptable delivery times.

- When a chemical truck arrives at the front gate, the guard will contact the control room operator that a chemical shipment has arrived.
- The guard will then log in the truck (time, registration, manifest) and direct him to the Designated Chemical Receiving Parking Zone as signposted.

Example 4.2-7 Standard Procedure for Procuring Chemicals (continued)