

A person wearing a white lab coat is holding a large, orange, shield-shaped sign. The sign has a circular logo on the right side with the word "WATER" inside. The background shows a water treatment plant with various pipes and structures.

Creating a Useful

SYSTEM MANUAL

Documenting Standard Operating Procedures Ensures Continuity

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Most people don't relish the idea of documenting everything they do at work. It's time-consuming and not the most exciting thing you'll do in your career. But, a detailed, simply written, standard operating procedures (SOP) manual can be a valuable tool during an emergency or when a new operator comes on board, helping to assure the quality drinking water your community has come to expect.

"One of the most common manuals found at a drinking water plant is the SOP manual," says Zane Satterfield, engineering scientist with the National Environmental Services Center (NESC). "This document is particularly useful when a plant needs to bring in an operator who is unfamiliar with the system. For example, a plant may have two operators, one on vacation and another out because of a family emergency. Without the specific instructions that an SOP manual provides, a temporary operator might not be able to provide uninterrupted service."

Michael Helmick, general manager and chief operator, Hamrick [West Virginia] Public Service District, relates a recent experience he had that supports why written procedures are necessary. "A water system that needed assistance contacted us through our engineering firm. They were having trouble with coagulation, and the operator who had taken care of it for years was no longer employed there. The newly employed operator didn't know how to do the procedure so we helped them through it." A properly written SOP manual could have helped this water system, saving them both time and money.

What's in an SOP manual?

While each drinking water system is unique, there are components and functions that are typical. Some of the information that might be included in a SOP manual are start-up and shut-down procedures, daily routine operations, safety information for handling chemicals, trouble-shooting procedures, water quality tests, forms, and records.

Sanitary Survey Records and Retention Period

Your system's sanitary surveys contain a wealth of information. Consider including copies as appendices in your standard operating procedures manual. You are also required to retain records for various lengths of time.

Microbiological analysis — 5 years



Chemical analysis — 10 years



Actions to correct violations — 3 years



Sanitary survey reports — 10 years



Variance or exemption — 5 years



Turbidity results — 10 years



All lead and copper data — 12 years



Public Notification and CCR — 3 years



Documentation of corrective action — 10 years



Compliance monitoring daily results — 5 years



Source: U.S. Environmental Protection Agency. *Sanitary Survey Guidance Manual for Ground Water Systems*. EPA 815-R-08-015.

Satterfield says a good place to start is your system's sanitary survey, the periodic (every three to five years) onsite review of the water source, facilities, equipment, operation, and maintenance of a public water system required under the federal Safe Drinking Water Act. Designed to ensure that drinking water is safe, the survey involves physically inspecting the water system and how it is operated and maintained. "Because the sanitary survey examines every part of your system, it has, in one place, all the various things you should address in your SOP manual," Satterfield says.

"It is my belief that what an operator does from the minute he walks in to the minute he leaves should be documented," Helmick says. And probably the best person to document these procedures is the operator because he is the person who performs the tasks. (A list of suggested items for an SOP manual can be found on page 30.)

For Bonnie Serrett, executive secretary, Huttonsville [West Virginia] Public Service District, not having written procedures for operating the water and wastewater systems was unacceptable.

"Our main concern was that we have only two operators for our water plant and two for our wastewater plant, so it would not be unheard of to have two operators off sick with no one left who has the knowledge to run the plant," Serrett says. "Our operators ran the systems from memory, but we needed more than that. So we asked our operators to write in simple language what needs to be done on a daily basis from A to Z to operate the plant in their absences. We wanted to know,

for instance, how to read the charts, check the pump stations, and identify a leak. To make the information easier to understand, we had the operators include lots of pictures so we know what we are looking for and where to find it. The procedures were tested and have been proven to work."

Other Considerations

Of course, if your equipment is in disrepair or broken, performing all of the operating procedures is difficult. Therefore, all equipment should be checked regularly. A maintenance manual, along with the manufacturer materials for maintaining and repairing equipment, will help keep equipment in working order.

If your drinking water infrastructure collapses, you aren't going to be able to do business. Water utilities must ensure that our water systems provide an uninterrupted supply of safe drinking water and an adequate supply of water for fire fighting. Threats to water systems include vandalism, computer hackers, disgruntled employees or customers, floods, earthquakes, severe storms, and droughts.

Therefore, security manuals, based on existing vulnerability assessments and emergency response plans, are an important part of any drinking water library. A vulnerability assessment is performed to evaluate weaknesses to potential threats and identify steps that can reduce the consequences of these risks. Based on the vulnerability assessment, the system should develop an emergency response plan, which identifies steps to take to manage the plant during an emergency and to make it resilient.

Keep it Simple

"Regardless of the particulars, documentation should be simple, step-by-step instructions that an operator who has basic knowledge can perform without supervision," says Craig Mains, NESC engineering scientist. "They should be updated as processes change and should be periodically reviewed to ensure steps and information are correctly documented." During an emergency or when your current operators leave, you'll be glad you have all the information about your system in one place.

References

- Association of State Drinking Water Administrators, National Rural Water Association. *Security Vulnerability Self-Assessment Guide for Small Drinking Water Systems*. May, 30, 2002. Download at <http://oregon.gov/DHS/ph/dwp/docs/security/vasa3300.pdf>.
- Environmental Protection Agency. *Sanitary Survey Guidance Manual for Ground Water Systems*. EPA 815-R-08-015. October 2008. Download at www.epa.gov/ogwdw000/disinfection/gwr/pdfs/guide_gwr_sanitarysurvey.pdf.



Standard Operating Procedures Manual Outline

Although the specific content of an SOP manual will vary depending on the size of the system, its characteristics, managerial structure, and regulatory requirements, most elements in the manual should include:

1. Start up Procedures:

- start the raw water flow,
- start the chemicals,
- open filters, and
- start pumps.

2. Shut down Procedures:

- shut down the pumps,
- close filters,
- turn off feed machines,
- turn off the water going into the feed machine,
- stop the chemicals, and
- shut off the service pumps.

3. Daily Routine Operations:

Document the procedure for each shift.

4. Safety Procedures for Handling Chemicals:

Describe how chemicals should be stored and the procedure to follow should there be a chemical spill or should chemicals splash on the operator.

5. Trouble Shooting Procedures:

Normally, these procedures are in the form of a chart of problems and their associated solutions.

6. Water Quality Tests:

- type of tests (e.g., chlorine, fluoride, iron, and manganese),
- monitoring schedules,
- sampling locations, and
- raw and finished water readings for each test.

If an outside laboratory performs tests, record the following information:

- name of the laboratory,
- address,
- phone number,
- contact person,
- samples sent,
- tests conducted, and
- monitoring schedules.

7. Forms:

- daily operational reports,
- precipitation records,
- source water used, and
- compliance forms.

8. Records:

Maintain records of meter readings, tests, equipment, chemical use, sanitary surveys, and customer complaint log.

9. Figures:

- schematic diagrams of flow within the facility,
- line drawings of equipment and process components,
- chemical applications.

10. Appendices might include:

- sanitary surveys,
- design criteria,
- board of certification of drinking water operator regulations,
- definitions,
- required permits and requirements,
- required facility operations, laboratory, and maintenance forms.

Office of Safety and Health Administration safety requirements and facility safety,

calculations for chemical usages and dosages,

Environmental Protection Agency and Department of Environmental Protection water quality, testing, and permit reporting requirements,

lists of lab chemicals,

pipng color codes,

sample forms, and

user rates strategy.

Helmick, Michael, Craig Mains, Zane Satterfield, and Bonnie Serritt. Interviews with author August 2009.

Washington State Department of Health, Division of Environmental Health, Office of Drinking Water. *Preparing for a Sanitary Survey: Information to Help Small Water Systems*. Publication #: 331-238. December 2005. Download at: www.doh.wa.gov/ehp/dw.

Washington State Department of Health, Division of Drinking Water. Evergreen Rural Water of Washington. *Security Vulnerability Self-Assessment Guide for Small Drinking Water Systems Serving Populations Between 3,301 and 9,999*. Download at: www.erwow.org/documents/VulnerabilityAssessmentMediumSystemsNew.pdf.

Additional Resources

NESC's popular *Tech Briefs* provide information that water operators and others might find helpful when constructing an SOP manual:

"Basic Water and Wastewater Formulas," which provides basic examples of complex formulas and conversion factors operators should know. (Item #: DWFSOM103)

"Jar Testing," explains what jar testing is and summarizes its process. (Item #: DWFSOM73)

"Sourcewater Protection" looks at some possible contamination sources and feasible ways to address them. (Item #: DWFSOM125)

Maintenance & Security Manual Outlines

A sample maintenance manual might include:

For distribution operators:

- 1. Exercise the valves.
- 2. Flush fire hydrants.
- 3. Calibrate meters or replace them if necessary.
- 4. Check valve vaults, ensure they are secure and have the proper drainage.
- 5. Inspect:
 - a. interior storage tank for structural soundness and sediment buildup,
 - b. exterior storage tank for rust, condition of screens, and structural soundness,
 - c. booster pump stations,
 - d. security measures to ensure they are in place and in working order,
 - e. pressure reducing valves and air release valves.
- 6. Perform routine maintenance on service vehicles according to the owner's manual, for example, oil change and lubrication.
- 7. Chlorinators should be checked for leaks and to ensure proper operation. Any repairs done to chlorinators should only be done when more than one operator is present.
- 8. Oil should be checked in gear reduction units, and these units should be routinely greased.

For plant operators:

- 1. Check the pumps and electric motors, using the manufacturers' recommended maintenance schedule.
- 2. Exercise valves inside the plant.
- 3. Calibrate chemical injection systems.
- 4. Calibrate test equipment.
- 5. Calibrate all monitoring equipment.
- 6. Check security measures to ensure they are in working order.
- 7. Check chemical inventory storage.
- 8. Inspect filters.

For all operators:

- 1. Review the latest sanitary survey for possible guidance in maintaining equipment.
- 2. Make sure you have access to any special tools you may need but don't have. If you have these tools, make sure they are in good working order and that you know how to use them.
- 3. Maintain cost and budgeting system.
- 4. Record the maintenance schedule of all equipment on a weekly, monthly, and yearly basis.
- 5. Check and maintain your inventory for chemicals and supplies.
- 6. Check warranty provisions, including specific dates when the warranties run out.
- 7. If there is more than one operator, don't assume someone else will take care of routine maintenance.

Security Manual Outline

Information contained in the security manual should include how to:

- 1. secure the site perimeter,
- 2. set up barriers to regulate the avenues of approach to the building,
- 3. secure hardware,
- 4. protect utility systems (indoor and outdoor) from intentional or unintentional damage, tampering, and accidents,
- 5. safeguard communication systems,
- 6. control building access by using barriers such as keys, keypad systems, and access cards,
- 7. protect high-risk spaces within the building such as hazardous material storage rooms, loading docks, and laboratories,
- 8. communicate and outreach during an emergency,
- 9. identify areas of vulnerability,
- 10. enact the emergency preparedness plan.

Maintenance and security issues are listed here as separate manuals. They could also be incorporated as separate sections in the larger SOP manual, as well as other information such as safety procedures.



"Turbidity Control," which examines turbidity control throughout the entire water process. (Item #: DWFSOM89)

"Valve Exercising," which examines typical exercising programs that help maintain the operation and life of water system valves. (Item #: DWFSOM97)

For a complete list of *Tech Briefs*, visit the NESC website at www.nesc.wvu.edu/techbrief.cfm. You may download *Tech Briefs* for free from the site, or you may order them for a nominal cost by calling (800) 624-8301 or by sending an e-mail to info@mail.nesc.wvu.edu.



A member of NESC for more than 10 years, **Caigan McKenzie**, has had her water and wastewater articles reprinted in numerous publications.