Drinking Water Operator Certification Training
Instructor Guide

Module 11:
Administration of Water Treatment Plants

This course includes content developed by the Pennsylvania Department of Environmental Protection (Pa. DEP) in cooperation with the following contractors, subcontractors, or grantees:
The Pennsylvania State Association of Township Supervisors (PSATS)
Gannett Fleming, Inc.
Dering Consulting Group
Penn State Harrisburg Environmental Training Center

A Note to the Instructor

Dear Instructor:

The primary purpose of this course, *Administration of Water Treatment Plants*, is to introduce participants to the basics of plant administration. This module has been designed to be completed in approximately 4 hours, but the actual course length will depend upon content and/or delivery modifications and results of course dry runs performed by the DEP-approved sponsor. The number of contact hours of credit assigned to this course is based upon the contact hours approved under the DEP course approval process. To help you prepare a personal lesson plan, timeframes have been included in the instructor guide at the Unit level and at the Roman numeral level of the topical outline. You may need to adjust these timeframes as necessary to match course content and delivery modifications made by the sponsor. Please make sure that all teaching points are covered and that the course is delivered as approved by DEP.

Web site URLs and other references are subject to change, and it is the training sponsor's responsibility to keep such references up to date.

Delivery methods to be used for this course include:

• Lecture • Discussion Questions • Calculations	• PowerPoint slides • Class Activities • Exercises

To present this module, you will need the following materials:

• One workbook per participant • Extra pencils • Flip Chart • Markers	• Laptop (loaded with PowerPoint) and an LCD projector **or** overheads of presentation and an overhead projector • Screen

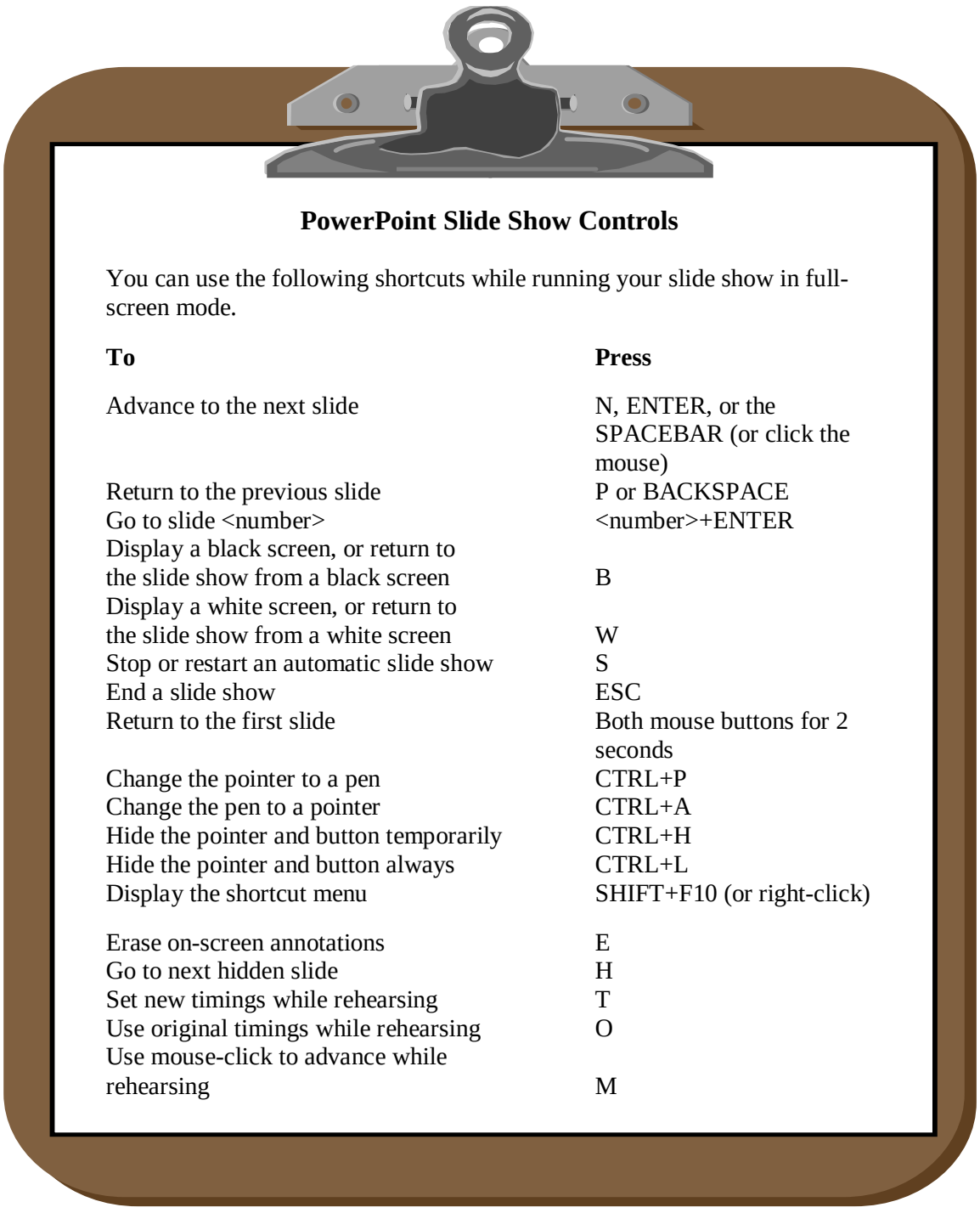
Icons to become familiar with include:

Participant Workbook	Instructor Guide
 Exercise/Activity	Same icons for Participant Workbook apply to the Instructor Guide.
 Case Study	**Ans:** Answer to exercise, case study, discussion, question, etc.
 Discussion Question	 PowerPoint Slide
 Calculation(s)	 Overhead
 Exercise	 Flip Chart
 Key Definition(s)	 Suggested "Script""
 Key Point(s)	

Instructor text that is meant to be general instructions for the instructor are designated by being written in script font and enclosed in brackets. For example:

[*Ask participants if they have any questions on how to read the table. Answer any questions participants may have about how to read the table.]*

If your module includes the use of a PowerPoint presentation, below are some helpful controls that you may use within the Slide Show.



PowerPoint Slide Show Controls

You can use the following shortcuts while running your slide show in full-screen mode.

To	**Press**
Advance to the next slide	N, ENTER, or the SPACEBAR (or click the mouse)
Return to the previous slide	P or BACKSPACE
Go to slide <number>	<number>+ENTER
Display a black screen, or return to the slide show from a black screen	B
Display a white screen, or return to the slide show from a white screen	W
Stop or restart an automatic slide show	S
End a slide show	ESC
Return to the first slide	Both mouse buttons for 2 seconds
Change the pointer to a pen	CTRL+P
Change the pen to a pointer	CTRL+A
Hide the pointer and button temporarily	CTRL+H
Hide the pointer and button always	CTRL+L
Display the shortcut menu	SHIFT+F10 (or right-click)
Erase on-screen annotations	E
Go to next hidden slide	H
Set new timings while rehearsing	T
Use original timings while rehearsing	O
Use mouse-click to advance while rehearsing	M

INTRODUCTION OF MODULE 11: 5 minutes

[Display Slide 1—Module 11: Administration of Water Treatment Plants.]

[Welcome participants. Indicate the primary purpose of this course is to familiarize them with the basics of Water Treatment Plant administration.]

[Introduce yourself.]

[Provide a brief overview of the module.]

This module contains 9 units. On page i, you will see the topical outline for **Unit 1 – Regulatory Monitoring and Reporting** and **Unit 2 – Developing Standard Operating Procedures.**

[Briefly review outline.]

If you turn the page, you will see the topical outline for **Unit 3 – Budget** and **Unit 4 – Personnel.**

[Continue to briefly review outline.]

Turn the page once more and you will see the outline for **Unit 5 – Water Production, Unit 6 – Chemical Inventory**, and **Unit 7 – Electrical Power**.

[Continue to briefly review outline.]

Turn the page again to see the outline for **Unit 8 – Fuel** and **Unit 9 – SCADA and Instrumentation**.

[Continue to briefly review the outline.]

UNIT 1: 75 minutes

[Display Slide 2 – Unit 1: Regulatory Monitoring and Reporting.]

At the end of this unit, you should be able to:

- Describe how water treatment plants comply with their minimum federal and state monitoring requirements.
- List the three ways in which management ensures that the staff complies with monitoring requirements.
- Discuss reporting requirements when complying with federal and state regulations.

MONITORING OF TREATMENT PLANT OPERATIONS: 55 minutes

We will begin the module and this unit with the discussion of minimum monitoring and sampling requirements. We will address sampling methods, sampling types, permits, and management's role in the monitoring aspect of operations.

Water Treatment Plant (WTP) Federal and State Regulatory Requirements

Minimum Requirements

[Review the Information in the workbook.]

Some parameters require an increase in sampling frequency, depending on the number of customers or entry points. The differences in WTP systems require the development of specific schedules. As time progresses, parameters and schedules may change.

[Refer class to Table 1-1.]

As you can see from Table 1-1, an ***abbreviated*** list of monitoring and sampling minimum requirements, your challenge as an operator is to remain current and knowledgeable.

Let's turn to Appendix 1 (page A-2) in this workbook and review Table A, classes of contaminants. Each has a defined frequency (monthly, quarterly, annually, etc.). Based on the contaminant, a different sampling location is defined.

Tables B-D provide additional information about which you should be aware, but due to time limitations we will not review them in depth at this time. Please look them over during a break or after class.

Table E demonstrates that as the size of your customer base increases, the frequency of samples taken will increase. The example used in this table is Coliform.

Tables F and G show that more specific guidelines have been developed and greater emphasis is placed on potential Contaminants of Concern (COC). As an example, lead and copper are common COC and these tables address them.

Tables H and I provide information about when either DEP or the public must be notified of problems. As a water system operator, you should have previously prepared "boiler plate" statements that can be readily customized and used when necessary. These statements should present important information without unnecessary technical data that could confuse non-professionals.

Sample Types

[Review definitions in the workbook.]

Sample Methods – Defined by the DEP

[Review Grab Sample.]

Some samples, such as fecal or chlorine residual (free), *must* be taken as a grab.

[Review Continuous Sample.]

All continuous monitoring should be cross-referenced and calibrated on a regular schedule. Typically this is accomplished by a grab sample or quality assurance sample. Chlorine (if in-situ analyzer) or pH may be monitored continuously. If accomplished by an in-situ analyzer, the results are telemetered to a recording chart. Although not an analyzer, the actual chart records results from the continuous measuring devices.

[Review Composite Sample.]

Either the volume of each sample is proportional to flow rate or the sampling interval (for a constant volume sample) is proportional to flow rate over the time period used to produce the composite. The maximum time period between individual samples for any "composite sample" shall not exceed two hours. Except for wastes of a uniform nature the samples may be collected on a frequency of at least twice a working shift and shall be equally spaced over a 24 hour period or over an operating day of a shorter duration.

Composite sample examples include the taking of feed water source (if you are trying to evaluate the system) or the taking of the solids residual discharge flow.

What is an example of the use of a grab sample to cross calibrate a continuous sample?

Let's take a minute to try to come up with an example.

[If participants cannot come up with any examples:]

Ans: One example might be that the continuous chlorine residual analyzer should be calibrated on a regular basis with the manufacturer's calibration standard and a grab sample. By

collecting a grab sample, the accuracy and confidence that the continuous analyzer is generating a valid representation of the flow stream can be confirmed.

Supplemental Sampling and Monitoring Requirements

[Review information in workbook. Refer participants to Appendix 2 (page A-11).]

Which of the problems in Appendix 2 have you come across? How were they resolved?

Take 2 minutes to write down a few answers to this question and then we'll share our answers with the class.

[List problems and solutions on flip chart for up to 3 minutes.]

Permits

Water Allocation Permit (WAP)

[Refer participants to Appendix 3 (page A-14) ***for reference purposes only****.]*

[Continue to review information in the workbook.]

National Pollutant Discharge Elimination System (NPDES) Discharge Permit

[Refer participants to Appendix 4 (page A-21) ***for reference purposes only****.]*

[Continue to review information in workbook.]

An example of the use of Part C in the permit would be when a facility is applying to construct new processes.

Water Supply Permit (WSP)

[Refer participants to Appendix 5 (page A-41) ***for reference purposes only****.]*

[Review Bullet 1 ("A WSP is issued…") in the workbook.]

[Review Bullet 2 ("A water system…").]

As an example, a new residual storage lagoon may have been constructed which requires an additional WSP.

[Review Bullet 3 (A WSP is normally…").]

[Review Bullet 4 ("Obtaining…") and refer the participant to Appendix 6 (page A-46).]

Appendix 6 lists the various application modules used to obtain the PWS permit. We will only review them briefly during our class. They are for your reference.

[Review Bullet 5 ("Water Resource…").]

Role of Management in Monitoring

This module provides us with a brief introduction to the management of a water system. Additional management training courses and seminars are available and highly recommended.

Let's take a quick look now at the four functions of management.

Establish Policies

The first function of management is to establish policies.

[Review information in the workbook.]

Communicate the Policies

Second, management is responsible for communicating these policies. Putting them in writing is a good idea.

[Review information in the workbook.]

Observe and Modify

The third function of management is to observe behaviors and tasks and modify these behaviors and tasks to ensure adherence to policies.

Describe a simple operating procedure at a WTP and develop a policy statement to address an issue.

Can anyone describe a simple operating procedure and an issue for which a policy statement would have to be developed?

[List any issues on the flipchart. Ask for consensus on which issue they would like to develop a policy statement for.]

[Spend 5 minutes listing class policy statement items on flipchart.]

Continued

[If no operating procedures or issues come forth:]

Let's discuss ways in which a taste and odor complaint can be dealt with in a professional manner. This qualifies as a simple operating procedure. Any ideas?

[List ideas from class.]

[If no concrete ideas come from class:]

For example, when a complaint is received, the water system representative receiving the phone call should record the name, address, and phone number of the customer. In addition, type and severity of problem, length of time noticed and previous similar problems must be documented. A follow up procedure should also be developed.

Provide Training and/or Educational Resources

Finally, as managers we should participate in additional training and employ educational resources and encourage staff to do the same. Both training and educational resources are found at the EPA website and DEP website.

[Review information in workbook.]

REPORTING: 20 minutes

Federal and State Regulations

Federal and State reporting requirements are covered in this module. In-depth information regarding the Safe Drinking Water Act, Primary and Secondary Drinking Water Standards, and Water Supply Manuals are discussed in Module 1, General Overview.

We will be discussing the Annual Water Quality Consumer Confidence Report (CCR), Sanitary Surveys, and Operation and Maintenance Plans.

Annual Water Quality CCR

[Review information in workbook.]

Sanitary Surveys

Appendix 7 (page A-47) includes sample pages from the *Manual for Conducting Sanitary Surveys* for your review and reference. On page A-52 you will find a useful list of frequently used acronyms.

[Continue reviewing information in workbook.]

Operation and Maintenance Plan

Appendix 8 (page A-55) is excerpted from the DEP training workshop, *Public Water System,* for your review. Let's just take a quick look at it to get a feel for the depth of information required.

[Let participants take a minute or two to review Appendix 8.]

In addition to state and federal reporting requirements, let's look at how supplemental reporting can act to educate the local community.

Supplemental Reporting (Local Community Education)

[Review bullets.]

How else might we communicate (report to) the local community?

[Entertain answers from the class.]

Ans: There are many possibilities such as interviews in press, press releases to radio and TV, appearances in public forums, etc.

Backup Information and Files

All of the reports issued to the Federal, State, or local community must be maintained for certain periods of time. Typically this data is stored on a computer system. Let's look at some aspects of maintaining the report data electronically.

[Review Bullet 1 ("Store…").]

Fire damage to one building could result in the loss of all your files.

[Review remaining bullets.]

Submission and Retention of Data

Creating reports and backing up either hard copies or computer data files are step one and two in the submission and retention of report data. Let's look now at submission and retention requirements.

Content

The submission and retention of a number of reports, such as the NPDES permit, are predefined by the appropriate government entities.

Does anyone know which reports must be available for public review?

Ans: Sanitary Survey, CCRs, NPDES, meeting minutes in the case of municipalities, budgets, etc.

Monthly Operating Reports

[Review Bullets 1 and 2.]

As of November 1, 2002, PASS was available in 10 states with many other states to be included in the future. Specific hardware and software requirements are defined. Encryption information must be coordinated between EPA and the facility sending the NPDES permit.

Record Retention Time Categories

Various records must be kept on file for specified time periods.

[Review Bullet 1.]

[Review Bullet 2 ("3 years").]

This code requires documentation of actions taken to correct MCL violations and satisfy treatment requirements.

[Review Bullet 3 and 4.]

[Review Bullet 5 ("Life of facility").]

This is a very partial list. Local issues or conditions as well as pending legal actions may require longer storage time periods.

Unit 1 Exercise

1. List three sample types.

Ans: Raw, Plant Effluent, Entry Point, Distribution, Maximum Residence, Check, or Special

2. List three Sample Methods.

Ans: Grab, Continuous, or Composite

3. (T or F) A Water Allocation Permit is a master plan for any given water service area.

Ans: T

4. List two occurrences that require a Water Supply Permit.

Ans: Construction of new facilities and additions to previously constructed facilities

5. For how many years are Monthly Operating Reports kept?

Ans: 2 years.

6. For how many years are Risk Management Plans kept?

Ans: 5 years.

[Refer class to Unit 1 References on page 1-11.]

UNIT 2: 35 minutes

[Display Slide 3 – Unit 2: Developing Standard Operating Procedures (SOP).]

At the end of this unit, you should be able to:

- State why Standard Operating Procedures are important.
- Develop an SOP.
- State when it is necessary to modify an SOP.

DEFINITION OF A STANDARD OPERATING PROCEDURE: 5 minutes

In Unit 2 we will discuss the definition of a Standard Operating Procedure, when it is used, and how it is developed.

Intent of Standard Operating Procedures During Normal Operations

[Review Bullet 1.]

[Review Bullet 2 ("Provides…").]

For example, the disinfecting of a filter and returning it to service after rehabilitation is an infrequent action requiring multiple steps.

[Review Bullet 3 ("Is useful…").]

Although new employees usually view an SOP as an important learning tool, over time less reliance is placed on the SOP. This can become a concern if, for example, an experienced employee transfers to a different facility where the SOPs may be dissimilar.

[Review Bullet 4 ("May be…").]

Hands-on instruction should not be considered a replacement for an SOP since presentation formats may differ.

[Review Bullet 5 ("May serve…").]

For example, the SOP can demonstrate that specific steps were performed. This documentation may be beneficial in the event of litigation involving the system owner or operator.

[Review Bullet 6.]

This allows management to verify that the SOP steps are complete and in sequence.

Sample SOP

[Review Sample SOP. Suggest the class go around the room reading one item each.]

List three reasons it is important to create and follow SOPs. Indicate the participants should take 2 minutes or less.

Ans: Provides a consistent method to insure that a defined event is always handled similarly. Written SOPs prevent the exclusion of any steps which can occur when a task is not performed frequently.

Is useful in transferring information from senior staff to entry-level individuals. As an employee's experience increases, however, less reliance on the SOP may occur.

May serve as legal documentation.

UNDERSTANDABLE: 5 minutes

[Review information in workbook.]

Use of a Checklist

[Review Bullets 1 and 2.]

[Review Bullet 3.]

This prevents skipping a step or completing tasks out of sequence.

[Review Bullet 4.]

The entry of times of actions taken is often a part of a checklist. We can see in the sample checklist the date and time entries.

Common Terminology

[Review Bullet 1.]

We must avoid using terms such as the "new slurry line." At some time it will no longer be the "new slurry line." A correct term would be the "powdered activated carbon slurry feed line."

[Review Bullets 2 and 3.]

[Review Bullet 4 in workbook.]

UPDATED FREQUENTLY: 5 minutes

There are a number of changes that should require the SOP to be updated regularly. We'll start with the category of process changes.

Process Change

[Review Bullet 1.]

[Review Bullet 2.]

For example, when a booster pump is installed, the manufacturer will have operational and maintenance procedures that must be followed. If this information is not summarized into an SOP by the vendor, engineer, or superintendent, senior staff will need to generate the SOP.

Operational Change (Regulation Driven)

[Review information in workbook.]

[Review Bullet 1. Refer class to Appendix 1, Table F (page A-7).]

As each time milestone is passed, the SOP guiding testing and reporting will need to be rewritten or enacted. If a new phase is completed, the SOP may need to be revised to include any features of the process.

[Review Bullet 2.]

There are 34 different classifications of sample size based on population. Subtle changes may impact operation and should be reflected in the SOP. For example, a customer size of 2500 requires a minimum number of coliform samples of two a month. The addition of one or more customers will then require three samples a month.

History of Problems

[Review information in workbook.]

In either case, an updated version of the SOP would need to be created

ACCESSIBLE: 10 minutes

Common Library or Central Storage

[Review information in workbook.]

Staff Awareness of SOPs

[Review information in workbook.]

☑ **Class Activity – Developing an SOP**

[If time allows: Ask class to spend 5-8 minutes developing the testing SOP for acquiring a coliform sample for a site tap. List suggestions from class on flip chart. Refer class to Appendix 9 (page A-75) as sample SOP to be reviewed outside class.]

[If time does not allow for above: Review Appendix 9 (page A-75) as a sample SOP addressing the coliform testing procedure.]

EMERGENCY RESPONSE PLANS (ERP): 10 minutes

Emergency Response Plan (Non Terrorist Related)

[Review definition in workbook.]

Appendix 10 (page A-76) includes instructions for the ERP template and a Quick Reference Guide to the plan form. Appendix 11 (page A-80) is an example of the ERP template form. Depending on the complexity of the WTS, it may need to be expanded. The template is available in electronic form that allows modification. Each hard copy revision should be stamped with the date it was last reviewed to prevent use of an outdated ERP.

Instructions for ERP Plan Template

[Review Bullet 1.]

For example, the authorizing entity may be listed last or close to last on a call out list.

[Review Bullets 2 and 3.]

[Review Bullet 4 ("Section 4…").]

As the importance or criticality of an individual increases, the ways to contact them should also increase.

[Review remaining bullets.]

Usage During Emergency Conditions (EC)

[Review Bullet 1 ("Recognition…"), sub bullet 1.]

[Review Bullet 1, sub bullet 2.]

For example, if the staff reacts to nighttime EC by implementing the ERP and is successful in stabilizing and returning to normal conditions, there would not be a need to notify management until the next working day.

[Review Table 2.2 which provides some examples of EC.]

[Ask class how each example might be recognized.]

Ans: For example, booster pump failure might be recognized by the loss of water pressure, loud noise from pump motor, pump not running, smell of overheated equipment, or complaints from customers about low water pressure. All possible ECs should be listed in the ERP.

[Review Bullet 2.]

[Review Bullet 3 in workbook.]

Identify Hazards and Access Vulnerability

Although the Drinking Water Module 13 (Security) addresses security issues in depth, we will look briefly at hazards and vulnerability of plant conditions.

[Review information in workbook.]

When questioning yourself, you might ask what would happen if there were no power to the pump? What would happen if the pump would not shut down at high pressure? What would happen if the pump breaks and the area floods? How do I stop the flooding? Etc.

UNIT 3: 20 minutes

[Display Slide 4—Unit 3: Budget]

At the end of this unit, you should be able to:

- List three typical expense categories seen in water plant budgets.
- Describe three cost trends that can be discerned from careful comparisons of monthly budgets.
- Explain the difference between short-term and long-term budgets.

INCURRED COSTS: 5 minutes

In Unit 3, we will explore the topic of budgeting, the categories of costs at a WTP, and procurement. Let's begin with the categories of costs.

Categories

Chemical Expense

Chemical usage may exhibit seasonal variations causing a monthly budget to fluctuate. Can you think of some examples?

Ans: Many examples. One might be the use of Powdered Activated Carbon (PAC). Only used in the summer, it is therefore not an expense in the first few months of the year.

[Review bullets in the workbook.]

Power Expense

[Review information in the workbook.]

It is important to know your plant's power peak demand. Some plants have a 30 second peak demand, others a 15 minute peak demand. To reduce peak demand, it may be advantageous to turn off one pump prior to turning on another. If multiple pumps are required, evaluate whether they may be used at night when peak demand may be lower.

Equipment Expense

The acquiring of equipment is typically a part of a plant's budget. Also, if no expense is shown for equipment maintenance, perhaps it indicates equipment negligence. Is equipment replacement being considered in the budget? Are emergency funds used on a frequent basis? These are examples of important questions that an operator must think through.

Miscellaneous or Unidentified Expenses

[Review bullets in workbook.]

PROJECTED BUDGET: 3 minutes

As we move from the categories of expenses to actual projected budgets, we will look at the three budgetary time frames: short, mid and long term.

Short-Term (Annual)

[Review information in the workbook.]

Mid-Term (5 Years)

[Review information in workbook.]

Replacement of non-critical items is often postponed until a major upgrade is available. A Capital Improvement Project (CIP) fund should be developed for items such as utility vehicles, painting projects, pumps, or chemical feed systems.

Regular review of annual maintenance costs for equipment helps to determine if replacing equipment is more cost effective than repairing.

Long-Term (10+ Years)

[Review Information in the workbook.]

PROCUREMENT: 3 minutes

Procurement begins with budgeting.

Development of a Budget

[Review information in workbook.]

Emergency

Occasionally it becomes necessary to procure items, in an emergency situation, for which there is no budget allowance.

[Review information in the workbook.]

Bid Requirements

When procuring items, bidding requirements may apply.

[Review information in workbook.]

For your reference, Appendix 12 (page A-86) clarifies the municipal requirement to solicit bids prior to purchasing items. We will not review this in class.

State "Piggyback"

Another and often easier way to procure was established by Act 57 of May 1998, which creates the "Piggyback" ability of public procurement units to participate in contracts for supplies, services, or construction already entered into by the Department of General Services (DGS).

[Review information in workbook.]

The state piggyback program is available only for municipalities. There are three advantages to the use of state contracts:

- No bidding, since contracts have already been developed through the Commonwealth's competitive bidding system.
- Saving money, since there are less administrative costs.
- Saving time by not advertising, preparing proposals, and making awards.

☑ **CLASS ACTIVITY: 9 minutes**

[Instruct the participants to review the Example Budget for a few minutes and to search for items that raise concern. Entertain concern items from the class and list on flipchart for 1 minute.]

Ans: Refer class to Appendix 13 (page A-87) for a thorough analysis of the budget. If nothing is mentioned by class, review only items 1 and 3 from the sample budget with the class.

Appendix 13
Sample Budget Analysis

1. If any category exceeds a change by more than an anticipated percentage change, it must be justified. The first note about T & O problem is an example. Realization that it may be a long term problem should initiate an inquiry to determine possible solutions.

2. The explanation for the changes in chemicals and water analysis appears acceptable.

3. The deviation in fuel oil is not accounted for and should be investigated. It may have been a one time event because the percentage change for the current time period returns to a more normal value.

4. The increase in supplies and expenses is significant. This item should be broken into multiple expense categories since it is approximately 21% of the total plant budget. It is possible that someone is putting expenses into an incorrect budget item. Another possibility is that funds are being used from another account.

5. If the miscellaneous category becomes too large, it must be broken down into smaller items. Do not lump expenses more into miscellaneous than necessary.

6. The electric costs for waste water distribution show a constant increase. It is more than the electric for the main WTP. It should be determined if higher water distribution costs are due to ineffective water booster stations or possible water leaks in mains.

7. Normally, it is not necessary to show pennies in a budget breakdown. Depending upon the intent of the budget, rounding off to the nearest one hundred dollars for proposed budgets is often acceptable.

8. The overall percentage increases are consistent but are greater than typical values for inflation. Determine if income can support this type if increase. Determine cost savings measures.

9. The labor for water collection is showing a declining trend.

UNIT 4: 10 minutes

[Display Slide 5 – Unit 4: Personnel.]

At the end of this unit, you should be able to:

- Describe when and why operators are required to submit a copy of their criminal history record.

HIRING AND MANAGING STAFF: 5 minutes

In Unit 4 we will briefly examine some personnel issues. We begin by focusing on some hiring issues. First we will look at the criminal history check. Required by PA Act 11, 2002 it is an important addition to operator certification requirements.

Criminal History Check

Review the key point in workbook.

[Review Bullet 1.]

[Review Bullet 2 and refer class to Appendix 14 (page A-88). Review Form SP4-1642 and sub bullets under Bullet 2.]

Union Contracts

Awareness of labor union contracts can be important during the hiring process. Let's look at three basic reasons that an operator must be educated in the specifics of any operative contracts.

[Review information in workbook.]

Occupational Safety and Health Administration (OSHA)

Occupational Safety and Health Act (OSHA) of 1970

Employees are often aware of the positive impact of OSHA guidelines. Although OSHA may not always govern pre-accident regulations at some municipalities; generally such guidelines will be used in an accident investigation.

[Review information in workbook.]

UTILIZATION OF STAFF: 2 minutes

Effective use of full time, part time and temporary staff requires an understanding of aspects of each staff category.

Full Time

Emergency and Overtime Operations

[Review information in workbook.]

Part Time

[Review information in workbook.]

Temporary Staff and Special Projects

[Review information in workbook.]

STAFF IMPROVEMENT: 2 minutes

Part of any manager's responsibility is to effect improvement of the workforce. We begin with working with each staff member to set sound development and improvement goals.

Setting Goals

SMART Goals

SMART is an acronym for a management methodology. Using these 5 simple guidelines can help you help your staff to become more productive.

[Review information in workbook.]

S = Goals must be specifically defined.

M = If the goal is not measurable, how will we know when we reach it?

A = A goal should encourage improvement in the employee's worth as well as the organization itself.

R = Is the goal realistic and reachable?

T = The time frame should not be so long that it is difficult to maintain enthusiasm.

Training Requirements

[Review information in the workbook.]

Disciplinary Action

When a staff member is exhibiting unwanted behavior, it is helpful to employ the 4 basic tenets listed in the workbook.

[Review information in workbook.]

Everyone appreciates advance warning of a potential discipline issue and the warning should be issued as soon as possible, following the offending behavior. Management reaction to behavior must be uniform for all of the staff and consistently applied overtime.

SAFETY: 1 minute

While safety is mentioned, this module does not deal specifically with safety issues; a brief introduction to safety can be found in Module 12.

[Review information in workbook.]

UNIT 5: 20 minutes

[Display Slide 6 – Unit 5: Water Production.]

At the end of this unit, you should be able to:

- Define water plant flow balance.
- Describe volume conveyed and volume billed.
- Discuss seasonal water usage.
- Calculate water fire demand in gallons per minute.

PRODUCTION AT WATER TREATMENT PLANTS: 15 minutes

In Unit 5 we will look at actual water production at the treatment plant including flow balance, volume conveyed and billed, seasonal usage and fire demand. We'll begin with production per day.

Production

Production Based Per Day

[Review information in workbook and refer class to Figure 5-1.]

As you can see in Figure 5-1, the average day demand is less than the maximum day demand. Maximum demand may be a result of recovering from maintenance activities on the system or water requirements during fire events.

The system may not be able to produce water at maximum fire demand if that time period coincides with normal consumption demand. This results in the need for water storage capability.

If maximum hourly demand extrapolates to exceed a maximum daily production, (as in the case of a fire event, recovery from a water main break, or providing assistance to another community) plant staff may be required to maximize water production for several hours. Some in house recycle flows may be temporarily stopped for a time period. Contingencies to deal with such events should be outlined in the ERP.

Water Plant Flow Balance

As water moves through each treatment phase, the amount of waste products generated vs the actual water flow needs to be monitored.

[Review Bullet 1.]

[Review Bullet 2.]

Each WTP has a method to handle solids such as filter backwash, sedimentation basins, and collection areas.

[Review Bullet 3.]

Remember that as solids increase by 2X, the volume of material will be cut in half. For example, the dry pounds of material are the same if the flow were 50,000 gallons at 1% solids concentration or if the flow were 25,000 gallons at 2% solids concentration.

Volume Conveyed Compared to Volume Billed

Although difficult to calculate, there is always some unbilled water volume at the WTP.

[Review Bullet 1.]

Revenue not realized, or water volume that we are unable to account for and bill, can result from a number of issues.

[Review remaining bullets.]

[Refer to and review Table 5-1.]

The Water Leak Reference Table shows leak size and volume lost per day if main pressure is either 60 PSI or 80 PSI. Generally system operators will be able to detect leaks of holes of ¾" and above. As pipe size doubles the volume of water increases by a factor of four. Generally, therefore, as the hole size doubles, the rate of loss will increase by the factor of four.

[Refer to and review Figure 5-2.]

The nomograph shows an example of water pumped with a water loss of 20% and a cost of water of $0.50/1000 gallons. Take a minute to calculate the cost of water loss.

[Display calculation on flip chart and explain calculation.]

Ans: 4,000,000 gallons per day x 20 % water loss = 800,000 gallons lost
800,000 gallons /1000 = 800 Units
800 Units x $.50/Unit = $ 400 per day
$400 x 365 days = $146,000

Daily and Seasonal Variable Usage

Daily and seasonal usage will vary in every WTP.

[Review information in workbook.]

Diurnal is defined as a daily phenomenon.

[Review Bullet 1 in workbook.]

Winter usage is less than summer usage. Can you think of any reasons for this?

[Entertain answers from the class.]

Ans: Summer usage increases due to many outside activities such as swimming pools, car washing, gardening, etc.

In un-metered areas winter usage may increase in cold weather. What could cause this?

[Entertain answers from the class.]

Ans: Winter usage in un-metered areas may increase in cold weather because home dwellers may allow the water to drip to avoid pipe freezing.

Emergency Production Requirements

Emergency production of water volume is often a result of fire support. Let's look at the recommendations below in preparation for the next exercises.

Fire Support

[Review National Board of Fire Underwriters production recommendations.]

[Review The Insurance Office Guide Recommendations and Table 5-2 in preparation for the upcoming calculation.]

[Review first problem in workbook.]

Take a minute to calculate the water fire demand in the first problem. Please note that the number 18 in the formula below Table 5-2 is a static factor from National Board of Fire Underwriters.

[Display calculation on the flipchart.]

Ans: Use the formula under Table 5–2 ($F = 18 \times C \times \sqrt{A}$)
Multiply 2 stories x 6000 sq. ft. to get the total square feet of 12,000
Find the C value of ordinary construction in Table 5–2, which is 1.0
$F = 18 \times (1.0 \times \sqrt{12{,}000})$
F = 18 x 109.5445
F = 1971.801
Round up to next 100 gpm; F = 2,000 gpm

[Review second problem in workbook.]

Using the 2,000 gpm answer from the first problem, calculate the total gallons required based on the hour requirement and a town of over 2,500 people.

Ans: At 10 hours duration required by National Board of Insurance Underwriters (NBFU), we start with the 2,000 gpm from the above exercise and multiply that by 60 minutes/hour and then by 10 hours to get 1,200,000 gallons.

Shared System – Intercommunity Support

[Review information in workbook.]

WASTE GENERATED AND DISPOSAL: 5 minutes

Clean drinking water production generates waste as a result of water treatment. Let's look at some typical methods used to handle these wastes.

Solids Generated as a Result of Water Treatment

Typical Methods to Handle Solids Generated as a Result of Water Treatment

[Review bullets in workbook.]

*[Refer class to Appendix 15, Form 20R (page A-89) **for reference only**. Do not discuss in class.]*

UNIT 6: 20 minutes

[Display Slide 7 – Unit 6: Chemical Inventory.]

At the end of this unit, you should be able to:

- Define a Chemical Abstract Number.
- State the chlorine condition that requires a chemical Risk Management Plan.

VARIATIONS ON OPERATIONAL REQUIREMENTS: 10 minutes

The chemical inventory of a WTP is an integral and, at times, dangerous aspect of the water treatment process. Careful monitoring of the inventory, understanding of the need for dosage variation, chemical compatibility, and Risk Management Plan requirements are critical to the successful management of chemical inventory.

Seasonal

[Review information in workbook.]

Class Activity — Dosage Variation

Please take 1 or 2 minutes to work on these two PAC dosage calculations.

Calculate the monthly supply for winter operation if dosage is at 2 mg/L to a water production flow of 2.5 mgd.

[Display answers on flipchart and review.]

Ans: We first convert the metric 2 mg/L to pounds by multiplying by 8.34 (conversion factor). (2mg/L x 8.34 = 16.68 pounds).
Next, we multiply 16.68 x 2.5 mgd = 41.7 pounds per day
Finally, 41.7 pounds/day x 30 days = 1,251 pounds per month

Calculate the monthly supply for summer dosage at 10 mg/L with water production increased to 2.7 mgd.

[Display answers on flipchart and review.]

Ans: Both the dosage and the water production increases.
First we convert the 10 mg/L by multiplying by 8.34 (conversion factor).
(10 mg/L x 8.34 = 83.40)
Next, we multiply 83.40 x 2.7 = 225.2 pounds per day
Finally, 225 pounds/day x 30 days = 6,750 pounds per month

[Review information in workbook.]

We've seen how the chemical inventory can be affected by dosage variations; now let's look at a few other issues that may also impact chemical supply requirements as well as costs.

Other Variations

[Review bullets in workbook and refer class to Threshold Planning Level regulation in the Code of Federal Regulations, 40 CFR 68. Indicate that the CFR is not included in this workbook due to its size.]

SAFETY: 8 minutes

Although safety is addressed in greater detail in the Safety Module, we will look at a few aspects of safety management, beginning with the Material Safety Data Sheet.

Material Safety Data Sheet (MSDS)

Chemical manufacturers and importers must evaluate the hazards of the chemicals they produce or import. Using that information, they must then prepare labels for containers, and more detailed technical bulletins called material safety data sheets (MSDS). Every container of hazardous chemicals you receive must be labeled, tagged, or marked with the required information. Your suppliers must also send you a properly completed material safety data sheet (MSDS) at the time of the first shipment of the chemical, and with the next shipment after the MSDS is updated with new and significant information about the hazards.[1]

Refer class to the first reference in Unit 6 References on page 6-8.

[Review information in workbook.]

Chemical Compatibility

[Review information in workbook.]

Risk Management Plan (RMP)

An RMP plan is required if certain toxic or flammable substances in defined quantities are stored on site at the WTP.

[Review information and bullets in workbook.]

The Risk Management Program is about reducing chemical risk at the local level. This information helps local fire, police, and emergency response personnel (who must prepare for and respond to chemical accidents), and is useful to citizens in understanding the chemical hazards in communities. EPA anticipates that making the RMPs available to the public stimulates communication between industry and the public to improve accident prevention and emergency response practices at the local level.

[Review Chemical Abstract Number Service definition.]

Table of Threshold Planning Levels for Mandatory RMP

[Review the excerpt from the Table of Threshold Planning Levels for mandatory RMP in preparation for the next activity.]

Each of these chemicals has listed the amount on site above which an RMP is required. Please not the Chemical Abstract number used for each.

Class Activity – Determine if RMP Is Required

Chlorine usage at the WTP site is 11 pounds per day. Annual shipment is received at one time. Is an RMP required?

Ans: 11 pounds per day x 365 days = 4,015 pounds
Based on the Table for Threshold Planning excerpt, if all chlorine is received at one time, an RMP is required.

Please take a minute to work on the second problem.

The water system consists of a well and intake from surface water. Several miles separate the two locations. Water from the well is conveyed to the WTP before being processed and pumped into the distribution system. Chlorine usage at the well is 4 pounds per day for 365 days per year. The WTP uses 5 pounds per day for 365 days per year. All shipments are in one ton containers. Is an RMP required?

[Display calculation on flipchart and review.]

Ans: Well usage (4 lbs/day) x 365 days/year = 1,460 pounds
WTP usage (5 lbs/day) x 365 days/year = 1,825 pounds

The total amount on site is the received 3,285 pounds plus whatever was already there. Total chlorine on site is over 2,500 pounds so an RMP is required.

If the two amounts were delivered to the separate locations, an RMP *may* not be required.

We say "may" because if either of the locations has existing chlorine on site and the amount delivered to those sites make the total chlorine over 2,500 pounds, an RMP would be required.

If only 4 lbs/day is being used, should a smaller feed system be evaluated? Three 150 lb cylinders of chlorine would last 90 days and result in a smaller risk in the event of a leak. Since the 3,285 lbs is above the 2,500 planning level, better management of inventory can avoid the RMP requirement.

SOURCES/VENDORS: 2 minutes

Our last topic relates to where we purchase chemicals.

Sources

[Review information in workbook.]

Feed Systems

Feed systems are those devices which move the chemicals into the water treatment processes.

[Review information in workbook.]

[Refer the class to Unit 6 References on page 6-8.]

UNIT 7: 15 minutes

[Display Slide 8 – Unit 7: Electrical Power.]

At the end of this unit, you should be able to:

- Describe the level of expertise required to work with High, Medium, and Low Voltage, respectively.
- Define Gen-Set.

PLANT DISTRIBUTION SYSTEM: 7 minutes

A WTP has an electrical distribution system to address normal and emergency conditions. In Unit 7 we will discuss the various levels of electrical voltage, recommended isolation distances and on site generators. We begin with the three levels of voltage.

High Voltage

[Review information in workbook. Indicate that Figure 7-1 is an illustration a high voltage system.]

Emphasize the key point.

Medium Voltage

[Review information in workbook.]

Emphasize the key point.

Low Voltage

[Review information in workbook.]

Emphasize the key point.

Class Activity – Isolation Distance

Table 7-1 taken from the Nation Electrical Code 2002 Handbook shows us sample isolation distance based on voltage to ground and conditions 1, 2, or 3.

[Review information in workbook and refer the class to table 7-1 to answer the word problem.]

[Request an answer from the class on the word problem.]

If a plant addition includes possible installation of new equipment in a space in a motor control center room, with service of 12,000 volt, what would be the isolation distance under the best conditions (Condition 1)?

Ans: A minimum of 5 feet per Table 7-1.

EMERGENCY BACKUP SYSTEM: 8 minutes

Electrical service at the WTP is critical to maintaining water supply. A well maintained emergency backup system is, therefore, an absolute necessity.

Secondary Utility Feeder

[Review information in workbook.]

Emergency On-Site Generator

The maintenance and use of the on-site generator is an important part of plant management. The emergency power source is the last line of defense before water supply is terminated.

[Review information in workbook.]

An automatic cut off to the supplemental power source is preferable since staff is not required to take any action to bring the generator on line

On page 7-6, Figure 7-2 is an example of a typical WTP Gen-Set (a term used to mean an engine driven electrical generator).

[Review bullets and the key point.]

Portable or Trailer Units

From time to time portable or trailer Gen-Set units will be required for use at the WTP. While the portability of these units offers certain convenience, they can be more complicated to use safely.

[Review information in workbook.]

Either a throw switch or an emergency pigtail connection cord should be employed with portable or trailer units.

Portable or trailer units can be rented for short term projects. Since they typically do not have automatic switches, the manual switching and isolation of the generator from the incoming feeder is a more complicated procedure.

Uninterruptible Power Supply (UPS) – Computer Application

In the event of a power outage and prior to the switch over to the Gen-Set, critical computer data may be at risk with the use of a UPS.

[Review information in workbook.]

Evaluation of Key Equipment Electrical Requirements

The best preparation for an electrical outage emergency is a complete understanding of the electrical requirements of the WTP. Three important steps to take to that end are:

[Review information in workbook.]

Electrical Budget Management

Power usage and the controlling of its cost is another important aspect of operator management. Let's look at a few issues to consider.

[Review information in workbook.]

We just talked about the possibility of reducing electrical costs with newer more efficient equipment. Increased efficiency vs cost must be justified by a payback calculation.

Class Activity – Cost Justification of New Equipment

[If time allows, ask class to try the three calculations designed to determine if the purchase of new equipment can be cost justified.]

[Display the three calculations on the flipchart.]

An old pump, estimated to be only 50% efficient, consumes 5,500 kW/hr/month with a power cost of $ 0.11/kW/hr. Calculate the annual cost of this pump.

Ans: 5,500 kW/hr/month x $ 0.11kW/hr = $605/ month or $7,260/year

A new pump will cost $9,500. It is approximately 78% efficient and will consume 3,500 kW/hr/month with a power cost of $0.11 kW/hr. Calculate the annual cost of this pump.

Ans: 3,500 kw/hr/month x $ 0.11 kW/hr = $385/month or $4,629/year

Calculate how long before the new pump will be paid for by the annual cost savings?

Ans: $7,260 - $4,620 = $2,640 savings per year

$9,500/ $2640 = 3.6 years until new pump is paid off.

[If time does not allow, suggest that the class work on problems outside of class and refer the class to Appendix 16 (Page A-98) in this workbook for answers to the three calculations.]

[Refer class to Unit 7 References on page 7-10.]

UNIT 8: 10 minutes

[Display Slide 9 – Unit 8: Fuel]

At the end of this unit, you should be able to:

- Identify three fuel types and their typical uses.
- List four criteria an operator should understand and be able to describe about each fuel consuming unit in the water system.

SOURCES: 5 minutes

In Unit 8 we will explore the topic of fuel for the WTP including suppliers, types, uses, efficiencies, staggered and non- staggered start up, and electrical load calculation. We'll begin with local suppliers.

Local Suppliers

Can you think of some reasons why?

Ans: Many answers including price comparison, fuel delivery schedules, procedures, storage capacity, emergency conditions, etc.

[Review bullets in workbook.]

Emergency Supply

The possibility always exists that we may be required to obtain additional fuel on an emergency basis.

[Review information in workbook.]

FUEL CONSUMPTION: 5 minutes

In order to plan fuel purchases and deliveries efficiently we need to closely approximate our normal and emergency fuel consumption. We'll begin by looking at normal consumption and how best to evaluate our normal fuel needs.

Normal Usage

Approximate Fuel Consumption

[Review information in workbook.]

Emergency or High Output Operation Usage

Now we will look at the emergency or high output operation usage.

[Review information in workbook.]

Class Activity – Fuel Consumption of Staggered vs Non-Staggered Start Up of the Emergency Generator

In this class activity we will learn how to calculate electrical load and the difference between staggered and non-staggered star up of an emergency generator.

[Review information in workbook.]

[Review the definition of wet stacking.]

Load Estimation Procedure

*[Review bullets in preparation for **Calculation Examples**.]*

Calculation Examples

Take 1 or 2 minutes to calculate the first problem.

Calculate Normal Load.

[Display answer on flipchart.]

Ans: 145 hp of motors x 0.75 (conversion factor) = 108.75 kW.
110 kW (rounded) + 25 kW (lighting) = 135 kW normal load

Take a minute to calculate the second problem.

Calculate Maximum Load.

[Display answer on flipchart.]

Ans: 500 hp of motors x 0.75 (conversion factor) = 375 kW
375 kW + 25 kW (lighting) = 400 kW maximum load

Option A: Non-Staggered Start Up

[Review information in workbook.]

[If time allows, request the class try the Option A calculations.]

Calculate what kW load the generator would need to handle.

[Display answers on flipchart.]

Ans: First we multiply 375 hp by 60% to determine the surge factor of 225 hp
Then we add 375 hp to 225 hp to get total horsepower
Convert 600 hp to kW with the 0.75 (conversion factor)
600 X 0.74 = 450 kW
Adding the 450 kW to the 25 kW for lighting, our grand total is 475 kW Gen-Set

Calculate a rough estimate on fuel consumption.

Ans: 475 kW x 0.04 gal/hr = 19 gallons/hour

[Review key point in workbook.]

Option B: Staggered Start Up

[Review information in workbook.]

[Refer class to Table 8-1.]

Let's look at Row 1 Column 1. It represents the 400 kW load (375 = motor, 25 = lighting) that *could* be connected. With a staggered start up only a portion will be initially connected.

Row 1 Column 2 represents 145 kW (120 = motor, 25 = lighting) to be initially connected.

Row 1 Column 3 represents the 120 kW plus 60% rush factor plus 25kW of lighting connected. A total of 217 kW.

Row 1 Column 4 represents the load on the generator after the 60% in rush is satisfied.

Row 2 Column 2 represents the remaining potential load to be connected.

And so on.

Additional Considerations

[Review information in workbook.]

[Refer class to Unit 8 References on page 8-7.]

UNIT 9: 15 minutes

[Display Slide 10 — Unit 9: SCADA and Instrumentation]

At the end of this unit, you should be able to:

- Define Systems Control and Data Acquisition (SCADA).

SUPERVISORY CONTROL AND DATA ACQUISITION: 7 minutes

Computerized systems play a growing role in the operation of a WTP. In this last unit we will explore the concept and operation of a SCADA.

[Review definition of SCADA.]

Usage

[Review information in workbook].

Feed Forward vs Feedback Control Logic

A SCADA system may be programmed in either feed forward or feedback logic.

[Review bullets.]

[Refer participants to Figure 9-1, Generic Control Loops.]

In Figure 9-1 we can see the difference between the two kinds of logic. At the top of the figure, diagram A shows us a feed forward logic control loop. We see that input B will enter into the reaction directly. Input A is variable and its value is measured. Depending on input A's value an automatic adjustment to input B occurs at the Final Control Element (FCE).

The bottom diagram B explains the feedback logic control loop. Again we have input B entering the reaction directly but this time input A is not being measured. It enters directly also. Only after the reaction occurs is the total output measured. Based on that actual measurement compared to the required measurement, an appropriate adjustment is made to input B by the FCE.

Would a critical parameter be more efficiently controlled by the feedback method? Why?

[Entertain ideas from class.]

Ans: Feedback control is preferable to prevent unacceptable results continuing for a prolonged period. If preprogrammed correctly, a SCADA will take necessary action to correct detected problems.

A feed back installation of SCADA will include more components since actual data must be obtained and monitored, mandating the installation of probes or similar devices. The need for probes requires that a calibration schedule be developed to insure that the probes are generating an accurate and precise determination of the parameter of concern. As an example, a chlorine residual analyzer may need to be calibrated every two weeks.

SCADA vs LAN

[Review information in workbook.]

A SCAD system is an operation preprogrammed system. A LAN may be a small part of that system, allowing more than one user access the same computer data and programs.

Master Terminal Unit

[Review information in workbook.]

The MTU is the core then of the SCADA.

Remote Terminal Unit (RTU) or Programmable Logic Controller (PLC)

Both the RTU and PLC are segments of a SCADA system.

[Review information in workbook.]

NORMAL OPERATION: 5 minutes

In the normal operation of a SCADA, almost any aspect of the WTP operation may be monitored and/or controlled. Let's look at some of the aspects and examples of a SCADA in normal operations, beginning with flow.

Flow

[Review Bullet 1.]

For example, the air backwash cycle of filter beds may be governed by using a "mass flow meter" and a desired set point so that a specific amount of air is supplied during the backwash cycle.

[Review Bullet 2.]

Process Parameters

Process parameters may be monitored by a SCADA, resulting in process adjustments.

[Review Bullet 1.]

If turbidity measures above a set point, the SCADA may send filters into a backwash cycle.

[Review Bullet 2.]

If chlorine residual is not within a desired range, chlorine feed output may either increase or decrease.

[Review Bullet 3.]

Similar to turbidity, an alarm may be triggered to alert an operator of a potential problem. The operator may then be able to modify operations without relocating to the equipment location.

[Review Bullet 4.]

A majority of chemical feed systems are designed with at least a minimal amount of automatic operation. Depending upon the design intent or sophistication level, the system may not be able to be adjusted from a remote location.

Continued

Remote Locations Monitoring

A SCADA can also be involved in the monitoring of processes and data from an off-site location, whether a few meters or hundreds of miles away.

[Review information in workbook.]

Monitoring of System from Remote Location (Laptop/Modem)

We should be careful not to confuse Remote locations monitoring described above with the ability to monitor the system from a remote location using a laptop and modem connection.

[Review information in workbook.]

EMERGENCY OPERATIONS: 2 minutes

A SCAD can be critical in an emergency operations situation as well. Let's look at 3 examples of a SCADA handling an emergency situation.

Cross Connection Control

[Review information in workbook.]

Water Main Break

[Review information in workbook.]

Fire Support

[Review information in workbook.]

In what other ways could a SCADA be important to fire support?

Ans: Many answers are possible. For example:

Monitor the level in a water tower.

Inform the operator of a major water demand.

Activate pumps to satisfy water demand.

WHEN SHOULD A SCADA BE CONSIDERED?: 1 minute

There are many justifications for implementing a SCADA system. Let's take a look at just two.

Less Staffing

[Review information in workbook.]

Possible Process Optimization

[Review information in workbook.]

[Refer class to Unit 9 References.]

This concludes Unit 9 and Module 11 – Administration of Water Treatment Plants. Remember, this module was intended to provide you with the basics of water treatment plant administration. Additional information on some of the topics covered in this module may be found in other modules.

[Thank the participants for attending the class and encourage them to use their workbook as a reference when needed.]