Development of a Comprehensive Operator Training Program

MICHELLE BERENS
HELIX WATER DISTRICT
PLANT OPERATIONS SUPERVISOR
R.M. Levy Water Treatment Plant

- San Diego area using mostly Colorado River water
- 106 MGD conventional surface water treatment plant with intermediate ozone
- 6 operators – 4 on rotating shifts, 2 day shift
- 2 trainee positions
- 2 full time maintenance technicians
Prior Practices and the Need for Change

- Long time operators with little turnover
- New operators trained by seasoned operators
- Training sometimes inconsistent
- Looming retirements of 20+ year operators
- Not enough objective measurements of progress
The Starting Point – Checklist and Scattered Documentation

- Checklist of Skills and Knowledge
  - 5 Page Word document
  - Included 18 major areas

- Scattered Documentation
  - SOPs
  - SWTR Operations Plan
  - Tables, charts, and cheat sheets developed by various staff to address specific issues

- One of my most common questions was “Where is this document?”

<table>
<thead>
<tr>
<th>12 Filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform manual backwash/ Observe automatic backwash (Piping from WW tanks to filters)</td>
</tr>
<tr>
<td>Identify key events in backwash sequence</td>
</tr>
<tr>
<td>Identify key components to filter operation</td>
</tr>
<tr>
<td>Surface wash</td>
</tr>
<tr>
<td>Individual b/w valve</td>
</tr>
<tr>
<td>Master b/w valve</td>
</tr>
<tr>
<td>Plug valve</td>
</tr>
<tr>
<td>Drain Gate</td>
</tr>
<tr>
<td>Influent valve</td>
</tr>
<tr>
<td>Effluent valve</td>
</tr>
<tr>
<td>Filter to waste valve</td>
</tr>
<tr>
<td>Filter level control (level controls what?)</td>
</tr>
<tr>
<td>Filter Ripening / Cleanliness of filter after B/W</td>
</tr>
<tr>
<td>Regulation of backwash flow (describe what valve)</td>
</tr>
<tr>
<td>Filter Design Criteria (be able name all structures)</td>
</tr>
<tr>
<td>Sqft/ media type / underdrain</td>
</tr>
<tr>
<td>Gpm/ sqft (max flow)</td>
</tr>
<tr>
<td>Operation of filter-to-waste system</td>
</tr>
<tr>
<td>Wash down and clean filter</td>
</tr>
<tr>
<td>Filter analysis procedures</td>
</tr>
<tr>
<td>Regulation and water quality parameter review</td>
</tr>
<tr>
<td>Enhanced Surface Water Treatment Rule</td>
</tr>
<tr>
<td>Filtration calculations/Turbidity requirements</td>
</tr>
<tr>
<td>Unit Filter run Volume (UFRV)</td>
</tr>
<tr>
<td>Backwash rate</td>
</tr>
<tr>
<td>Filtration rate</td>
</tr>
<tr>
<td>Filter volume/ detention time</td>
</tr>
<tr>
<td>Operational parameters</td>
</tr>
</tbody>
</table>
The Approach

- Used existing checklist to develop an outline of major sections
- Started at the front of the plant and worked through each process
- Used development of the Manual as my own training program
- Asked a lot of “How do you do this?” questions
- Played to strengths of individual operators
- Asked for input along the way as to content
- Gave each section to operators to review, edit, and comment
The Product – Trainee Manual with 13 Sections

- Water In/Water Out (Hydraulics) and Plant Process Overview
- Flocculation and Sedimentation
- Filtration
- Chemical Feed Systems
- Chlorination
- Lab Procedures
- Plant Utility Systems (PW/UW, Electrical, Compressed Air)
- Ozonation
- Operator Duties
- PLCs, Plant Security, and Miscellaneous SCADA
- Sample Pumps and Analyzers
- Regulations
- Chlorine PSM
Section Contents

- Background Information
- “How To” Instructions
- SCADA Screenshots
- Labeled Pictures
- Engineering Drawings

FTW Valve
BW Supply Valve
Filter Effluent Valve
Operation of Los Coches Pump Station

After determining the needed Flume flows based on the Total Flume Demand screen, the plant operator will need to adjust the flows at the Los Coches PS as appropriate. Below is SCADA Screen 6, the Los Coches PS control screen.

**SCADA Screen 6: Los Coches Pump Station Controls**

The Auto, Off, Hand indication above the pumps reflect the current position of the HOA switch for each pump in the field. This will need to be in “Auto” in order to run the pump from the control room. In the center of the screen is the Control Mode switch, which also needs to be in “Auto”. To increase or decrease the flow, click on the “Common Speed Setpoint” box and input the desired pump speed. Then push the “Start” button below the pump or pumps to be run. All pumps will run at the same speed setting. Once the pumps are on and have had a bit of time to settle out, look at the pump curve in the bottom right side of the screen. There will be a black dot indicating the current running conditions. You need to keep the black dot within the yellow (optimal) or red (acceptable) areas of the curve, which you do by adjusting the number of pumps running and the speed of the pumps. The maximum flow from a single pump is ~12 MGD.
Water In/Water Out

- Raw water sources
- Treated water transmission
- Process overview
Rapid Mix, Flocculation, Sedimentation

- Rapid mix process
- Flocculation
- Sedimentation
Filtration

- Overview
- Filter valves
- Filter operation
- Filter backwash and modifications
Chemical Feed

- Operational modes for chemical feed systems
- Details for each chemical
- Chemical safety
Chlorination

- Chlorine chemistry and breakpoint curve
- Chlorine feed equipment
- Leak detection and scrubber
- SCADA control
- Disinfection regulations
- Emergency shutdown due to chlorination failure
- Free chlorine versus total chlorine
Laboratory Procedures

- 4 Hour operational labs
- Jar testing
- SUVA
- Indigo testing
- Coliform testing
Plant Utility Systems

- Potable and Utility Water systems
- Electrical systems
- Compressed air
Ozonation

- LOX and nitrogen generation
- Ozone generation
- Ozone cooling system
- Ozone contactors
- Ozone destruct units
- Startup and shutdown procedures
Operator Duties

- Log book
- Paper and electronic documents
- Data entry duties
Sample Pumps and Analyzers

- Maintenance, troubleshooting, and calibration of online analyzers
- How and when to flush instrument manifolds
SCADA and PLCs

- PLC Table
- Types of controllers
- Security systems
Regulations

- Filtration rate
- Turbidity - CFE and IFE
- Disinfection
- Operator certification
Chlorine PSM

- Components of document
- SDS, PPE, and first aid overview
- SDS document
- Chlorine Institute Pamphlet 1
- SOPs
The Product – Written Quizzes

- Questions cover major points of each section
- Written answer questions, not multiple choice
- Quizzes were taken by existing operators to ensure wording was clear and all areas were covered
  - This process was valuable for the operators who took the quizzes
  - Mistakes and misunderstandings were discovered and addressed

- Example Question:
  - What is the purpose of the FTW cycle? What is the minimum time it must run and what determines when the filter can be returned to normal service?
Each section includes a list of hands-on skills demonstrations that must be performed in the presence of an operator or supervisor.

Based on tasks operators are expected to perform independently in normal or emergency operations.

Example:

Demonstrate a manual filter backwash including manual operation of the filter to waste pumps with no notes or stopwatch. Drain the filter to below the media before starting. Discuss visual observations as backwash progresses.
The Product – Scenario Discussions

- Meant to make the operator in training think about multiple processes or areas of knowledge
- Based on issues that have happened or are likely to happen
- Written scenario followed by discussion with an experienced operator
- Example:
  - As you are completing your midnight labs on a Wednesday, you see ozone log removal climb. A grab sample of settled water shows free chlorine of 0.4 mg/L. All source water is from CWA and you have a taste and odor event due to high geosmin. What do you do?
Implementation

► Developed a training schedule to give all trainees variety of experience

► As experience is gained, trainees follow operators on shift for 2 week periods

► Areas of work include:
  ► Operating with an Operator
  ► Operating Independently
  ► Maintenance
  ► Plant Focus
  ► Independent Study
  ► Other/Outside Training
Implementation

- Each person in training given their own copy of the Manual
- Develop a target schedule for completion of written quizzes based on each trainee’s prior experience level
  - Use results to identify any weak areas
- Assign hands-on skills demonstrations and scenario discussions as a trainee gains more experience
Keeping the Manual Updated

- Upon completion, all sections were reviewed a final time.
- Developed a simple Revision History Log included in each copy of the Manual.
- A footer is added to each section showing the Date Last Reviewed and Date Last Revised.
- Operators are given the responsibility of keeping several sections updated as part of their performance review goals.
- Asked to review their sections at least every 6 months or when they are aware of changes affecting their sections.
- After reviewing, they update the Date Last Reviewed and/or Date Last Revised as appropriate and reissue any pages necessary.
Results

- Five people have used the program – two trainees, two operators, one supervisor
  - One certified operator candidate covered first shift independently after only 3.5 months at the plant and is now on a dedicated shift
  - Second certified operator candidate is working his way through program and covered his first shift independently after 5 months
  - Program development was an excellent learning opportunity for supervisor
  - Quizzes, hands-on skills demonstrations, and scenarios give objective measurement of progress and quickly pinpoint areas for improvement
  - Program demonstrates retention and ability to make connections to new situations

- All documentation in one place

- Manual is used regularly by all personnel involved in operation, including seasoned operators
Suggestions for Development

- Assign new operators to author sections
- Allow time for personnel to work on this
- Utilize seasoned operators to give input and information
- Use this as a knowledge transfer opportunity
- Take the opportunity to review and update existing SOPs and other documentation
- Use the manual to consolidate knowledge and documentation
Some Statistics

- ~9 months to develop from start to finish
- 360 pages
- 316 questions in section quizzes
- 99 hands-on skills demonstrations
- 22 scenario questions
Questions?

MICHELLE BERENS
MICHELLE.BERENS@HELIXWATER.ORG