Readying Operations for Direct Potable Reuse

Our Team

Troy Walker
Hazen and Sawyer
PI

Debbie Burris
DDB Engineering
Co PI

Jim Vickers
Separation Processes Inc

John Caughlin
Operator Star

Ben Stanford PhD
Hazen and Sawyer
Co PI
Utility and Other Partners

[Logos of various organizations]
Is Operations Ready for DPR?

Convincing a skeptical public

Convincing regulators

Can We Trust Operations?

“Eighty per cent of the failures he recorded were not due to failures of technology … but were due to human error”

Professor Don Bursill, the CEO of the Cooperative Research Centre for Water Quality and Treatment, Australia 2007 (The Age June 5, 2007).
Operations - Striking the Right Balance

OPERATING RISK

- Public Health
- Quality
- Production

OPERATING COST

- Operator Effort
- Chemicals and Energy
- Asset Replacement
Public Health Protection is Paramount

Trace Organic Contaminants (TrOC or TOrC)

Pharmaceutically Active Compounds (PhACs)
- Antidepressants
- X-ray contrasting agents
- Antibiotics
- Steroid estrogens

Personal Care Products
- Sunscreen
- Perfumes/fragrance
- Skin care
- Hair care
- Soaps

Endocrine disrupting compounds
- Steroid estrogens
- Surfactants
- PAHs
- Phthalates
- PCBs
- Pesticides

Nanoparticles

Conjugated Heavy Metals

Antibiotic resistance genes

Microconstituents
Critical Control Points

Integrating Public Health to Operations
Borrowing from the Food Industry – Critical Control Points

- Systematic Approach.
- Integrate elements to O&M for IPR/DPR

Conceived in 1960s by Pillsbury for NASA

Defined in ISO 22000 – Food Safety
CCP Approach Applied to Recycling

1. Identify Hazardous Contaminants
2. Identify Hazardous Events
3. Identify Source of Contaminants
4. Determine and Rank Risks
5. Identify Critical Control Points
6. Water Quality Testing
7. Validation
8. Verification
9. Develop CCP Response Procedures
10. Ongoing Analysis and Assessment

Hazard Analysis

Monitoring

Critical Control Points

Procedures & Corrective Actions
Operational Framework
DPR Operations Management Plan

Risk Management
- Risk Management Process
- Operational Risk Assessment
- Water Quality Risk Assessment

CCP
- Critical Control Point Selection
- Critical Control Point Management

Operations Management
- Roles and Responsibilities
- Operating Procedures
- Managing Incidents and Emergencies
- Non Conformances Corrective/Preventative Actions
- Asset Management and Maintenance
- Operating Interfaces
- Validation and Auditing
- Operator Skills and Training
CCP – Public Health Safety

NDMA Control

Microorganisms

Chemicals of Concern

Critical Control Point Selection

Microorganisms

LEAD/COPPER LEACHING IN DISTRIBUTION SYSTEM.

Microorganisms

Chemicals of Concern

Microorganisms

REVERSE OSMOSIS

CONCENTRATE

UV REACTOR

H₂O₂

STABILIZATION

CHLORINE

Microorganisms

Drinking Water Plant or Distribution

Engineered Storage
How CCP works.

CCP is the process barrier.

Monitor critical limit to validate barrier is intact.

If monitor detects barrier not intact then **control action** and **standard operator response**.
Clear Response Procedure to Aid Ops

Normal Operations

Critical limit triggered?

Y

Alert level response process

N

Operating Procedures

Non Conformances Corrective/Preventative Actions

Complete Investigation Report (<1 week) -> Corrective Actions

Complete Incident Report (<24 hours) -> Preliminary risk assessment

Continue monitoring of trends (including manual testing if required)

Restart process under Supervisor direction

Run PDT on all units - isolate faulty MF unit and restart all units within normal range

Process engineer to carry out investigation (Membrane testing, review trends, fault identification) and implement maintenance/corrective actions

Incident Response Process:
- Verbal notification to authorities and customers
- Initial investigation and risk assessment (potential exposure, process failure analysis)
- Incident report
- Engagement with authorities to agree subsequent steps

Alert response steps (including validation of combined analyser signal)

Automated MF shutdown and supply interruption

Notification to plant manager and supervisors

Critical limit breach is real?

Y

N

Review Alert response steps (including validation of combined analyser signal)

Incident Response Process:
- Verbal notification to authorities and customers
- Initial investigation and risk assessment (potential exposure, process failure analysis)
- Incident report
- Engagement with authorities to agree subsequent steps
What About Other Important Process?

Critical Operating Points

Flow settings. Recovery %

COP Support equipment and plant production

Supports CCP but not the critical monitor.

All supported by SOP

Operate as per CCP. Support plant, production and equipment.
We Rely Heavily on Analyzers

- Calibration and verification of analyzers is critical.
High Automation – Need to Avoid Alarm Flooding

- Alarm systems must be manageable.
- CCP, COP alarms at high priority.

![Weekly Alarm Count Graph]

Operational Monitoring
Anticipate Issues – Reports and Trends

- Effective performance trending.
- Dashboard reports provide good overview.
Managing Across Jurisdictions

Recommend DPR permit cover wastewater, advanced treatment and water treatment.
Looking After The Equipment

- Things wear out.
- Equipment fails.
- Critical to success.

When to replace?

What spares to keep?

How often to maintain?
Certification and Training
Reuse Not Yet Well Covered

Operator Skills and Training

Wastewater

Water Reuse

IPR

DPR

Drinking Water
Existing Curriculum Content
(Membrane Approach)
Existing Curriculum Content (Non-Membrane Approach)
The curriculum exists.

Specialist providers

AWWA/CWEA

Consultants

Membrane Associations

Equipment Vendors
In Addition to Process Knowledge

- Instrument Management (Calibration and Verification)
- Water Sampling and Analysis
- Basic Wastewater Knowledge
- Water Quality Health Risks
- Knowledge of DPR Regulations
- Basic Water Knowledge
- Managing a Risk Register
- Critical Control Points
- Corrective Actions
The Approach for IPR Now.

Always water certified.

Advanced treatment more in common with water treatment processes.

Mostly Drinking water operators

Wastewater knowledge is still important.

Orange County Water District

Santa Clara Valley Water District

Heavy reliance on in house training.
Certification – The Current CA Approach

Wastewater Operator

Grade 5
Grade 4
Grade 3
Grade 2
Grade 1

Also reviewing AZ, NC, FL.

Exam
Exam
Exam
Exam

Experience
Training
Training
Experience

T 5
T 4
T 3
T 2
T 1

Water Operator

Title per 23 CCR, Division 3, Chapter 26

Title 22 CCR, Division 4, Chapter 13

Also reviewing AZ, NC, FL.
A Potential Framework Integrating DPR

Leverage from existing pool of operators.

Append to system – options for operators.
The Right Staff?

Partner Benchmarking

Zero based Assessment
(Actual Plant – Design phase)

Size and Complexity

Specific Roles

Roles and Responsibilities
Build on the Existing Certification Levels

<table>
<thead>
<tr>
<th>Area</th>
<th>Criteria</th>
<th>Points</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundwater and/or purchased treated water meeting primary and secondary drinking water standards, as defined in section 116275 of the Health and Safety Code</td>
<td>2</td>
<td>64413.1.b.1</td>
</tr>
<tr>
<td></td>
<td>Water that includes any surface water or groundwater under the direct influence of surface water</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Source of Water</td>
<td>Microbiological water quality of influent</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MPN less than 1 per 100 mL</td>
<td>0</td>
<td>64413.1.b.2</td>
</tr>
<tr>
<td></td>
<td>MPN 1 through 100 per 100 mL</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MPN greater than 100 through 1,000 per 100 mL</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MPN greater than 1,000 through 10,000 per 100 mL</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MPN greater than 10,000 per 100 mL</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Turbidity of Influent (for facilities treating surface water or groundwater under the direct influence of surface water)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than 15 NTU</td>
<td>0</td>
<td>64413.1.b.3</td>
</tr>
<tr>
<td></td>
<td>15 through 100 NTU</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greater than 100 NTU</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

(Extract)

Process complexity, number of processes and size. Similar approach for DPR.
Specific Roles

- Large plant – key person.
- Smaller plant – part of responsibilities.
- Mix of water and wastewater knowledge.

DPR Water Quality
- Source water quality
- Water quality risk register

Operating Interface
- Wastewater to Advanced
- Advanced to Drinking/Distribution

Instrument Calibration/Verification
- Calibration/Verification Schedules.
- Alarm Management

CCP Manager
- Manage data on CCPs
- Follow up on incident investigations.
Conclusions

- A single permit – wastewater/advanced/water
- Critical Control Point Approach should be integrated into operational planning.
- A solid operational plan will underpin success for DPR operations.
- Certification for DPR can leverage from existing systems.
Thank You

Troy Walker
Senior Associate & Water Practice Leader | Hazen and Sawyer
480 340 3270 (cell)
twalker@hazenandsawyer.com