Designing Around New Operation/Maintenance Needs

WEST COAST WATER/WASTEWATER UTILITIES
WORKSHOP ON WORKFORCE DEVELOPMENT

January 29, 2010

Metro Vancouver

- Metro Vancouver is a federation of 22 municipalities, one electoral area, and one treaty First Nation
- Provide regional services such as water, wastewater, solid waste, air quality, parks, etc.
- 1400 employees
- 2.2 million people (2/3 of the population of British Columbia)
- Located in the lower mainland of British Columbia, Canada

metro vancouver


Pemberton
Whistler
Merritt
Campbell River
Powell River
Courtenay
Cumberland
Squamish
Peachland
Princeton
Sechelt
Parksville
Vancouver
Port Coquitlam
Maple Ridge
Nanaimo
Port Alberni
Surrey
Abbotsford
Ladysmith
White Rock
Ucluelet
Lynden
Lake Cowichan
Ferndale
Duncan
Bellingham
Boundary Pass
Victoria
Mt Vernon
Twisp
Sooke
Forks
Marysville
Everett
Monroe
Shoreline
Bothell
Entiat
Seattle
Bellevue
Renton
Wenatchee

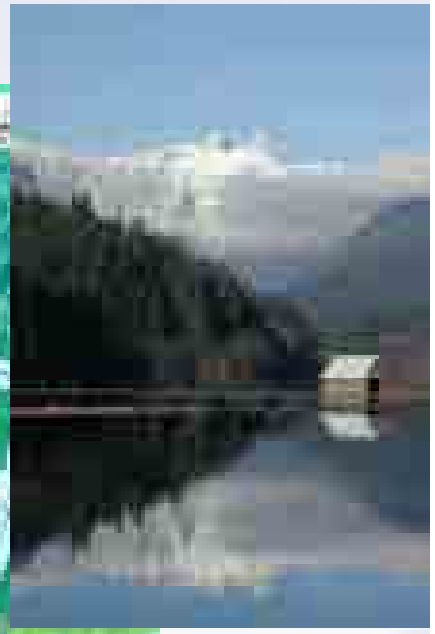
Water Supply and Treatment

Surface water supply from three protected watersheds (Capilano, Seymour and Coquitlam)

Over 310 miles of large diameter transmission mains

22 reservoirs

15 pump stations



Wastewater Collection and Treatment

33 pumping stations

275 miles of trunks and interceptor sewers

3 secondary treatment plants

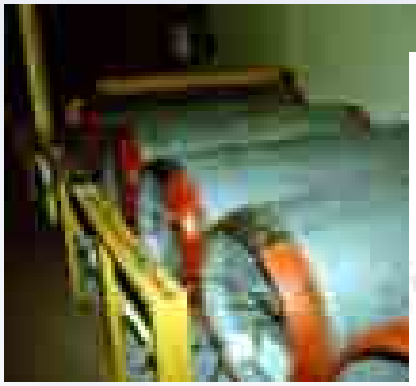
2 primary treatment plants

Trends Driving Metro Vancouver Over the Next 5-10 Years

1. Regulations Proliferate.
2. Financial Climate. Massive funding is required for infrastructure needs.
3. Increased demands for efficiency.
4. **Changing Workforce.** Workforce development is vital, as the work environment will continue to evolve.
5. **Expanding Infrastructure Needs.** Infrastructure management is becoming a critical issue for utilities.
6. High Customer and Stakeholder Expectations.
7. **Extensive Application of Technology.** Information technology and automation expanding rapidly.
8. Increasing Demands on Limited Resources. Growing populations and restrictions on water sources.

Water System Changes

- 1940's: Chlorination at the three sources
- 1980-90's: Rechlorination facilities built in distribution system
- 2000: Ozonation & corrosion control at Coquitlam source




The Vancouver Sun

POLITICIANS WAGING SECRET CHLORINE DRIVE

Undercover Plans To 'Educate' Public On 'Doped' Water

Liberal Letter Bares Secret Chlorine Drive

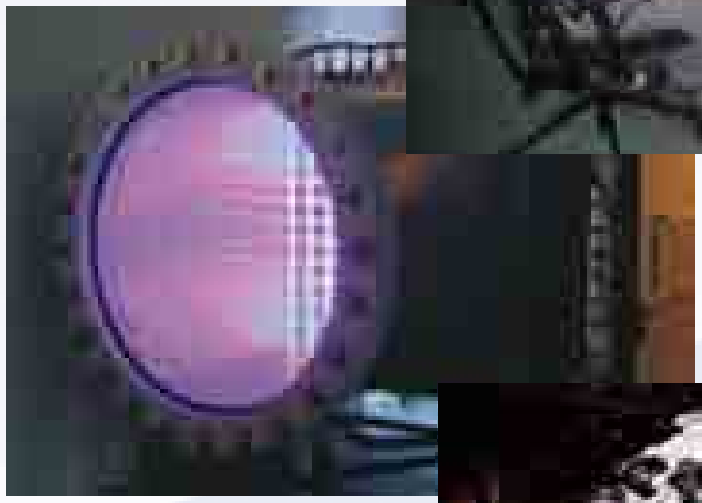
Politicians Plan To 'Educate' Public On 'Doped' Water

Water System Changes

- 2009: 1800MLD Seymour-Capilano Filtration Plant (Seymour source filtered)

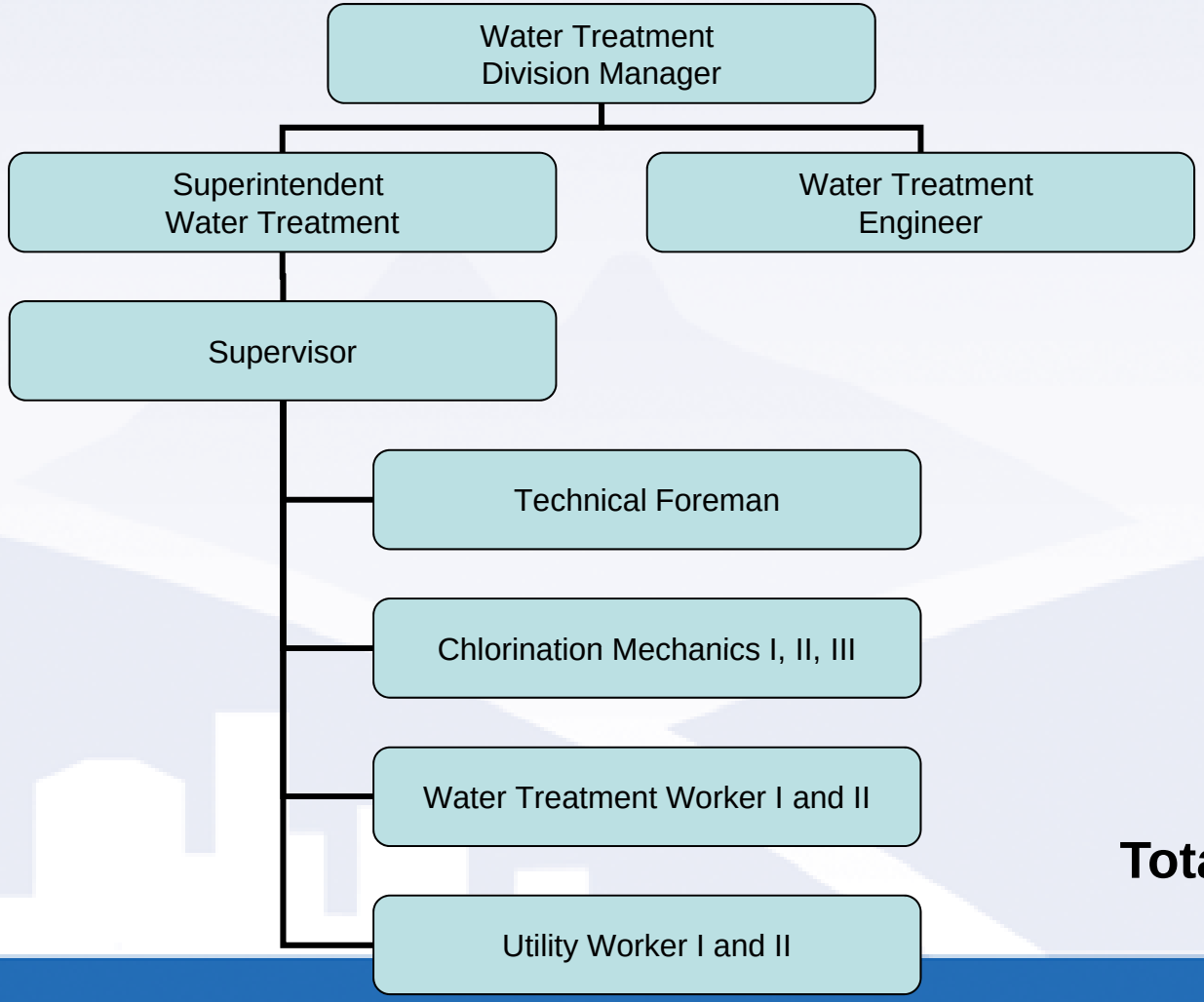
Water System Changes

- 2009: New SCADA system and System Control Centre (@ SCFP)
- 2011: UV Disinfection Facility at Coquitlam source
- 2013: Capilano source filtered (tunnels complete)



Water Treatment Operations - 2005

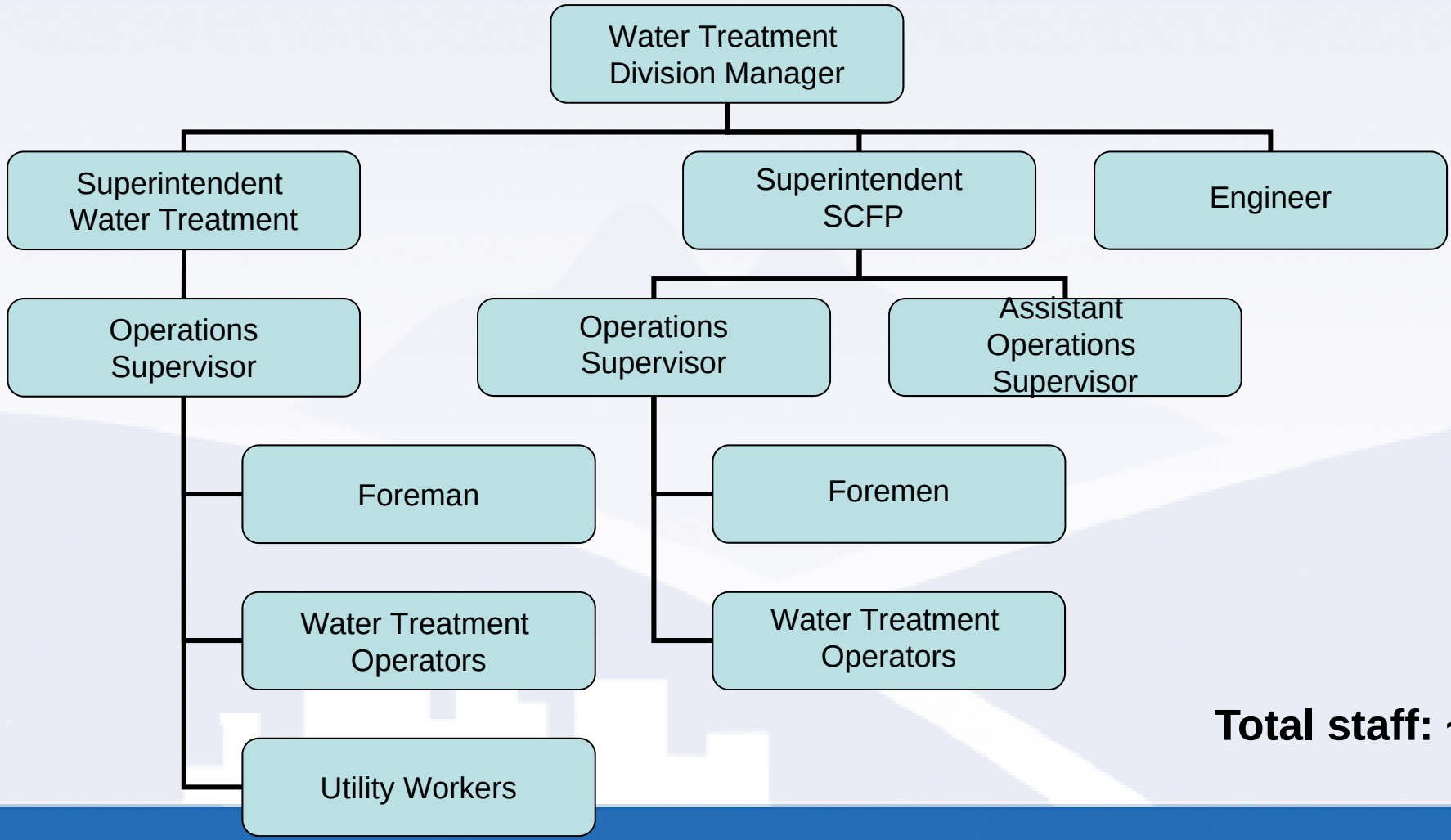
Small group with multiple job descriptions developed over time



Total staff: ~10

Water Treatment Operations - 2007

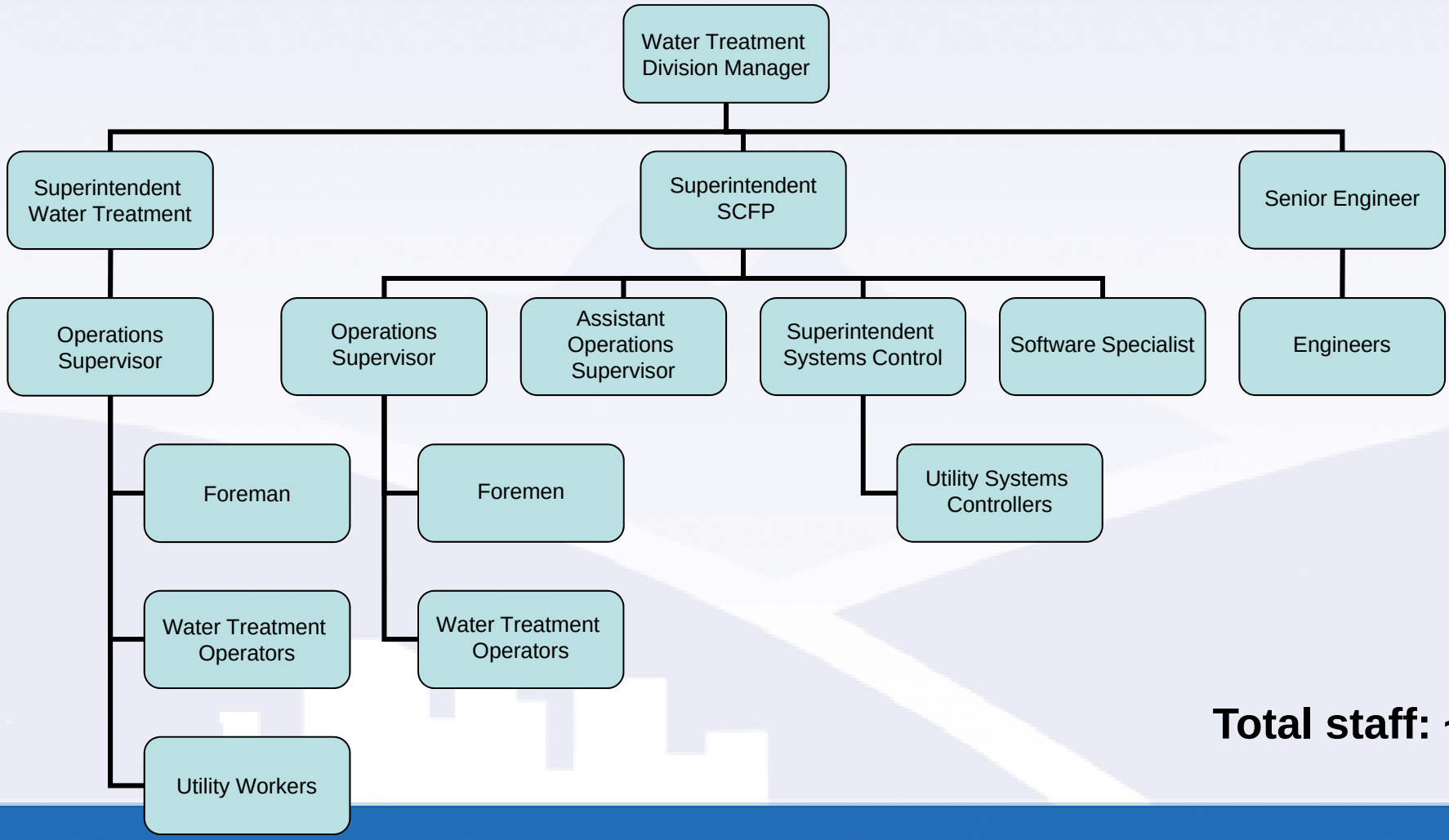
Parallel structure and standardized job descriptions



Total staff: ~40

Water Treatment & Systems Control

Parallel structure and standardized job descriptions



Total staff: ~60

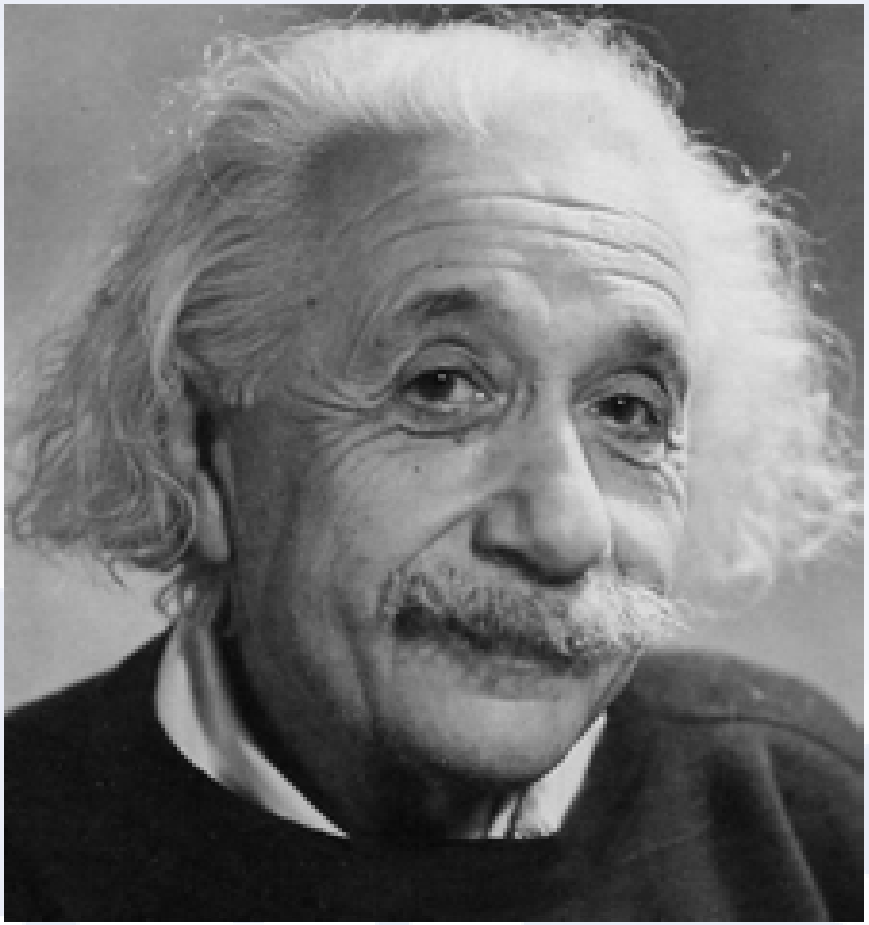
Workforce Change Strategies

- Accelerated succession
- Hire multi-skilled workers
- Onboarding
- Inn ve hiring
- Job redesign

KNOWLEDGE RETENTION AND TRANSFER

Knowledge Retention & Transfer

- Engineering standards
- Project management guidelines
- Technology tools (decision support, asset management, document management)
- Technical (O&M) knowledge and experience
  - Procedures
  - Training Program



“If you do what you’ve always done…you’ll get what you've always got.”

SCFP Procedures Development

- Gather resource materials
  - Design reports
  - Drawings
  - Process/programming narratives
  - Equipment manuals
  - Equipment list (asset identification)
- Task identification workshops
  - 530 Tasks that required procedures ~1,250 procedures
- Prioritization
- Procedure development workshops
- Desk and field verification

Prioritization

Critical Task Inventory Worksheet

Tasks or Activities	Major Loss Exposures	Risk Evaluation			
List all Tasks or Activities normally done or that might be done	Consider Safety, Health Damage, Fire, Quality, Production Problems, Etc. Consider PEME: People, Equipment, Materials and Environment	Severity 0-6	Frequency 1-3	Probability	Criticality
Unload CGT-LM	P E M E – exposure, piping, chemicals, outside catchment, truck connections	6	1	0	6
Collect CGT Sample-LM	P - exposure	5	1	1	7
Check CGT Pump Calibration-LM	P M - exposure, production	4	1	-1	4
Adjust CGT Feed Rate-CRA, CRM, LM	M - production	5	1	0	6
Switch CGT Tanks-CRA, CRM, LM	P E M - exposure, pumps, production	4	1	-1	4
Unload CAP-LM	P E M E - exposure, piping, chemicals, outside catchment, truck connections	3	1	0	4

SEVERITY
(0 – 6)

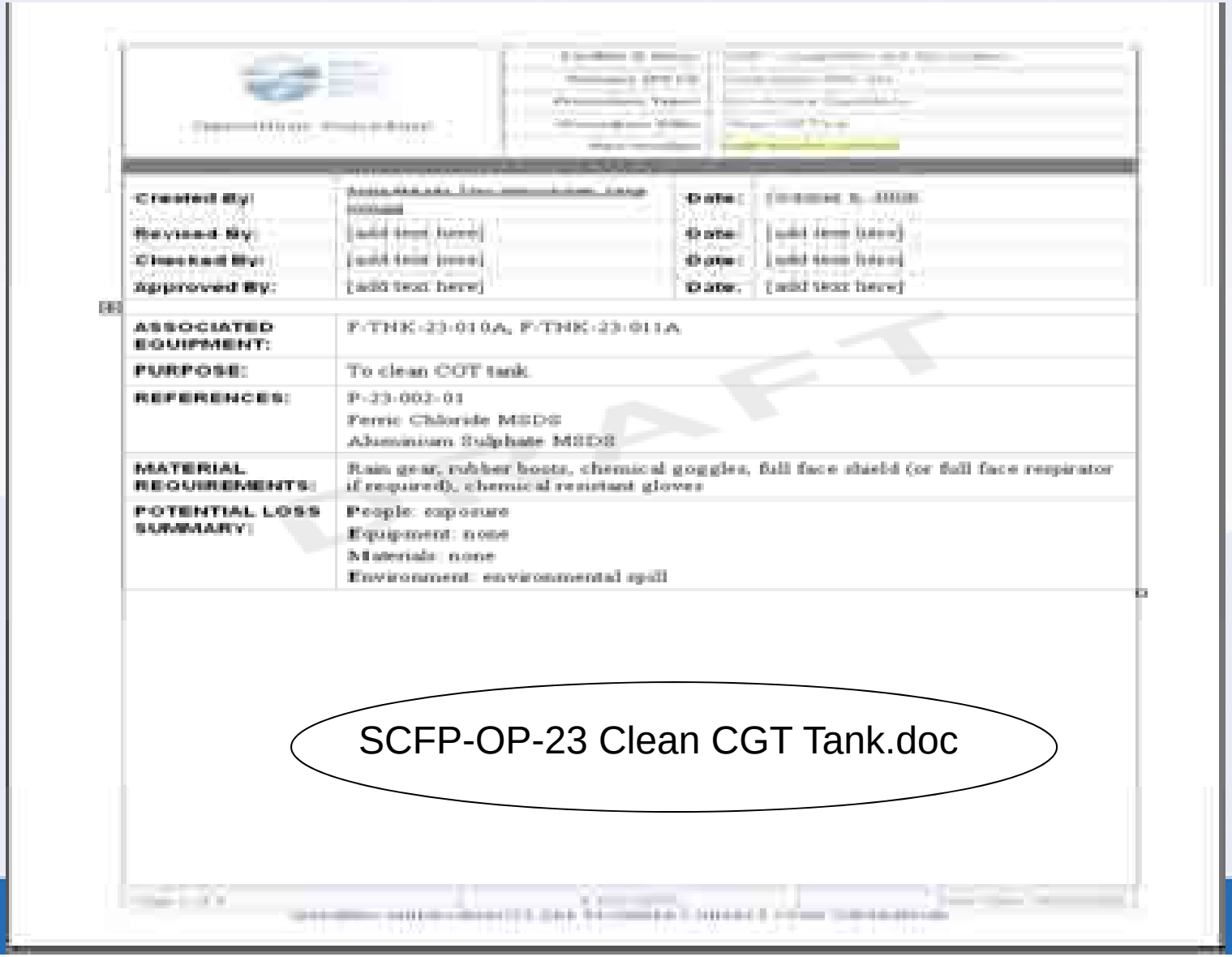
FREQUENCY OF EXPOSURE
(1 – 3)

PROBABILITY OF LOSS
(-1, 0, +1)

CRITICALITY
Sum (S,F,P)

P – People
E – Equipment
M – Materials
E – Environment

Operations Procedures



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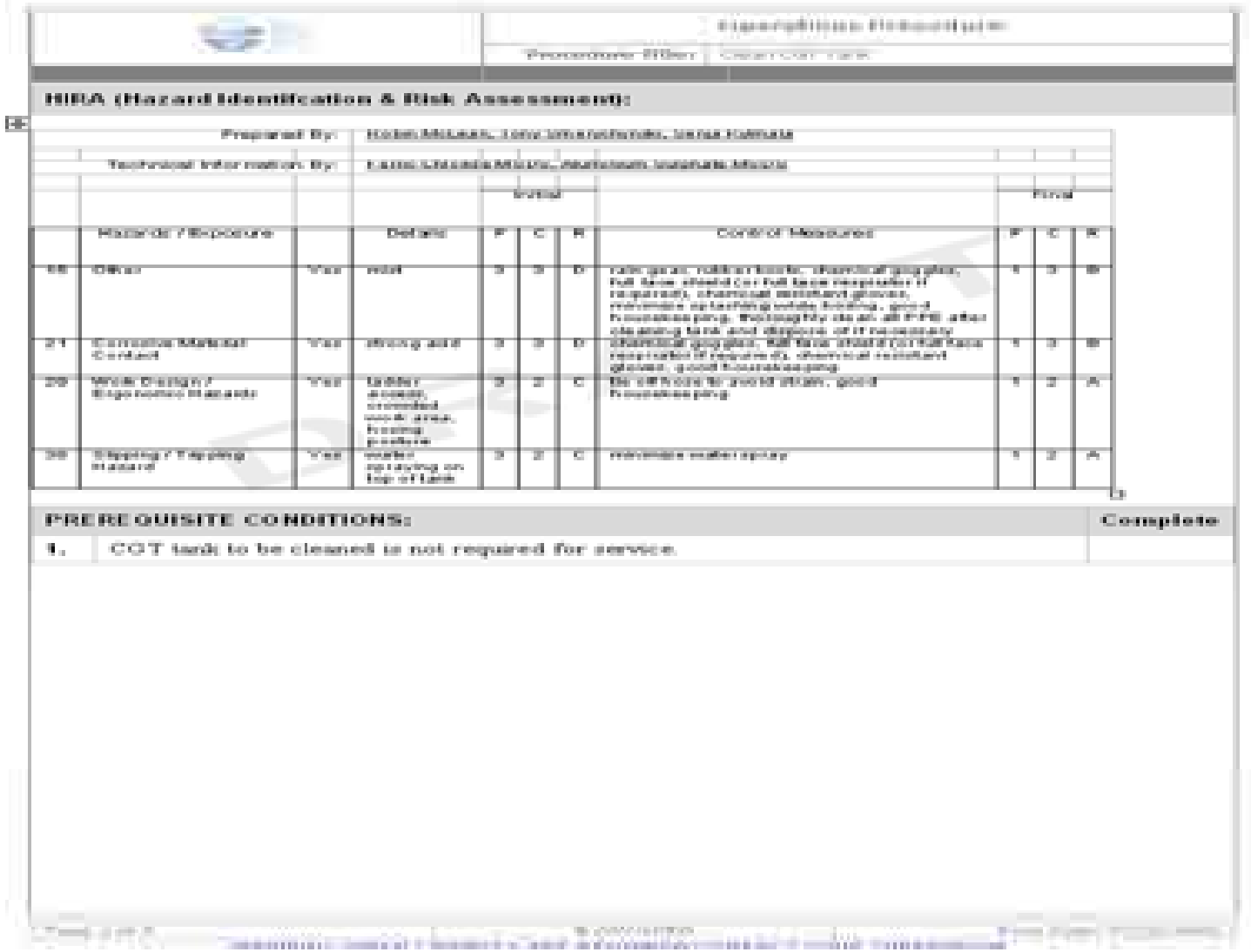
Revised By:	[add text here]	Date:	[add text here]
Checked By:	[add text here]	Date:	[add text here]
Approved By:	[add text here]	Date:	[add text here]

ASSOCIATED EQUIPMENT:	F-THK-23-010A, F-THK-23-011A
PURPOSE:	To clean CGT tank
REFERENCES:	P-23-002-01 Ferric Chloride MSDS Aluminum Sulphate MSDS
MATERIAL REQUIREMENTS:	Rain gear, rubber boots, chemical goggles, full face shield (or full face respirator if required), chemical resistant gloves
POTENTIAL LOSS SUMMARY:	People: exposure Equipment: none Materials: none Environment: environmental spill

SCFP-OP-23 Clean CGT Tank.doc

SCFP-OP-23-Clean CGT tank



HIRA (Hazard Identification & Risk Assessment):

				Initial				Final		
	Hazards / Exposure		Details	P	C	R	Control Measures	P	C	R
18	Odour	Yes	mist	3	3	D		1	3	B
21	Corrosive Material Content	Yes	strong acid	3	3	D		1	3	B
29	Work Design / Ergonomic Hazard	Yes	ladder access, crowded work area, hosing, positive pressure	3	2	C		1	2	A
30	Slipping / Tripping Hazard	Yes	water spraying on top of tank	3	2	C		1	2	A

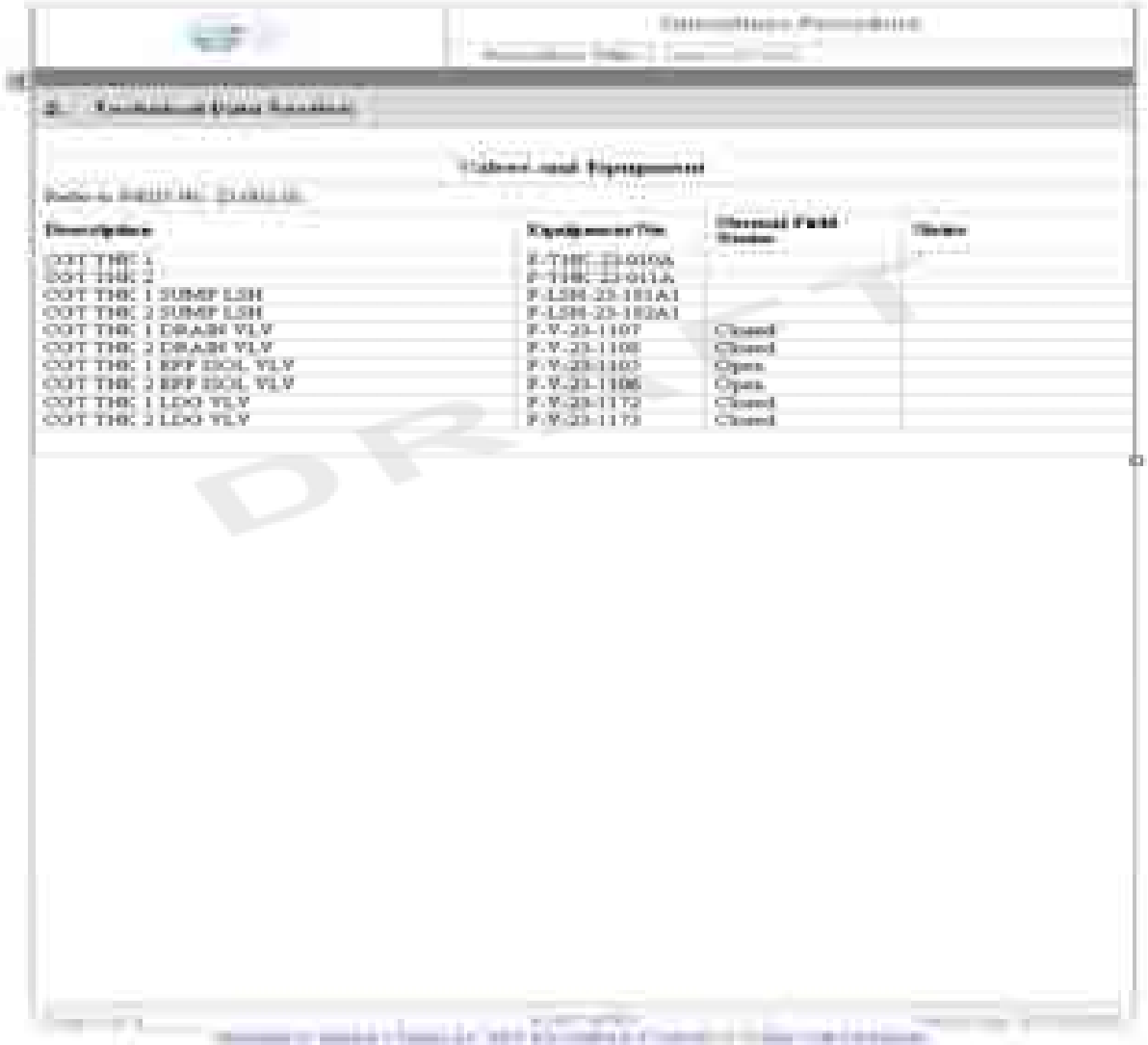
PREREQUISITE CONDITIONS:		Complete
1.	CGT tank to be cleaned is not required for service.	

SCFP-OP-23-Clean CGT tank

Operations Procedure

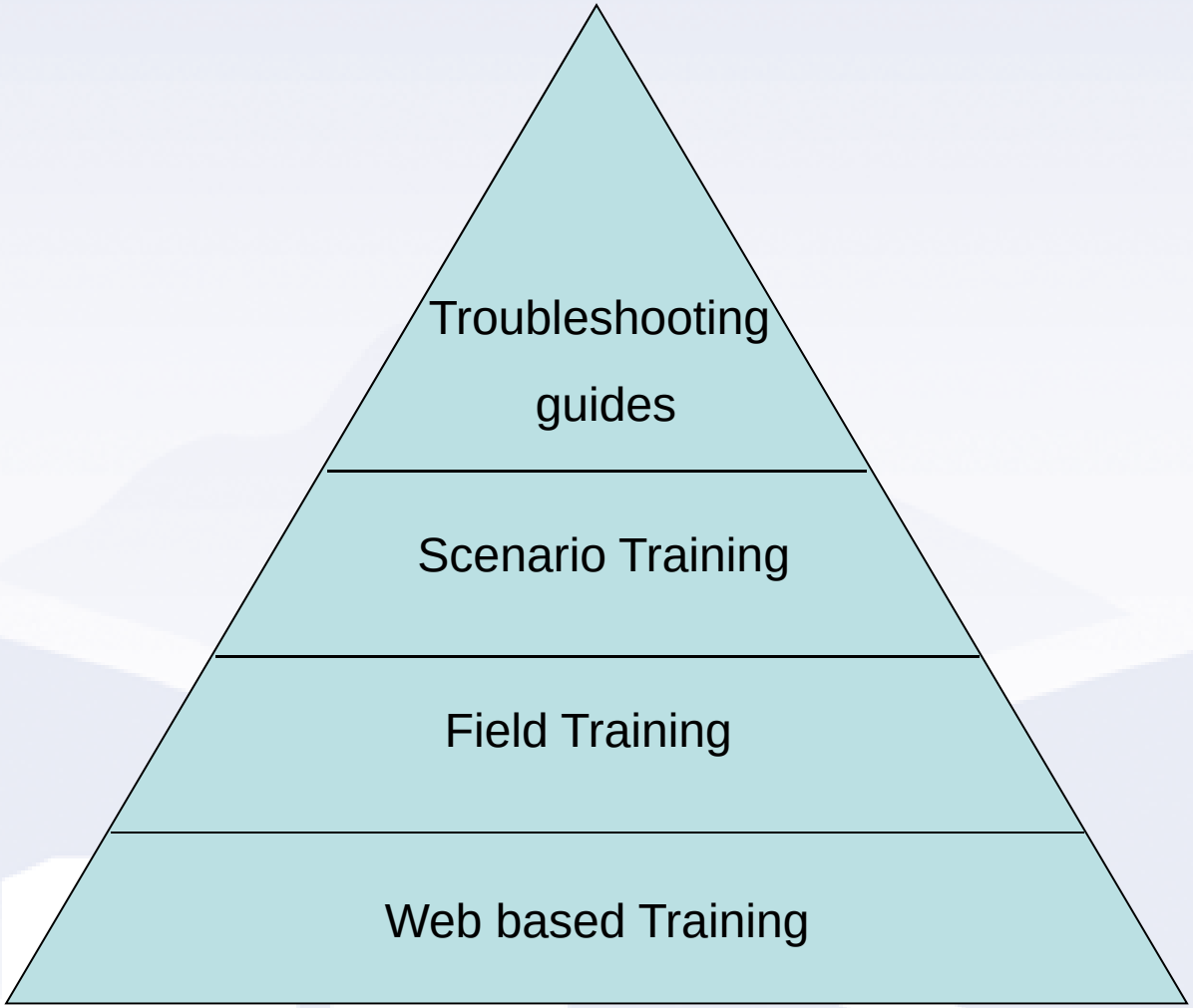
1. Clean CGT Tank	Position	Complete
STATUS: CGT tank is off line.		
1.1 Request CRO to switch CGT tank to GOB	CRO	
1.2 Request CRO to switch HVAC ventilation to High flow mode	CRO	
1.3 Close CGT THK effluent isolation valve and apply operations hold lock.	OP	
1.4 Apply operations hold lock to CGT THK loading valve.	OP	
1.5 Drape plastic over CGT pumps to protect from over-spray.	OP	
1.6 Connect vacuum truck to CGT THK sump vacuum pump connection and provide suction.	OP	
1.7 Open CGT THK drain valve to drain CGT tank.	OP	
Note: ***Ensure water level in containment area does not reach CGT pumps.***		
1.8 Open CGT THK top hatch.	OP	
1.9 Hose CGT tank with water until clean.	OP	
1.10 Close CGT THK drain valve when CGT tank is empty.	OP	
1.11 Hose down containment area and outside of CGT tank.	OP	
1.12 Shut down vacuum truck when CGT THK sump is empty and disconnect.	OP	
1.13 Close CGT THK top hatch.	OP	
1.14 Remove operations hold locks at CGT THK loading and CGT THK effluent isolation valves.	OP	
1.15 Return valve positions to normal field status.	OP	
1.16 Return HVAC ventilation to Normal mode.	CRO	
This procedure is complete when: • CGT tank is clean. • CGT tank is in normal operating condition. • Area is clean and secure.		

SCFP-OP-23-Clean CGT tank

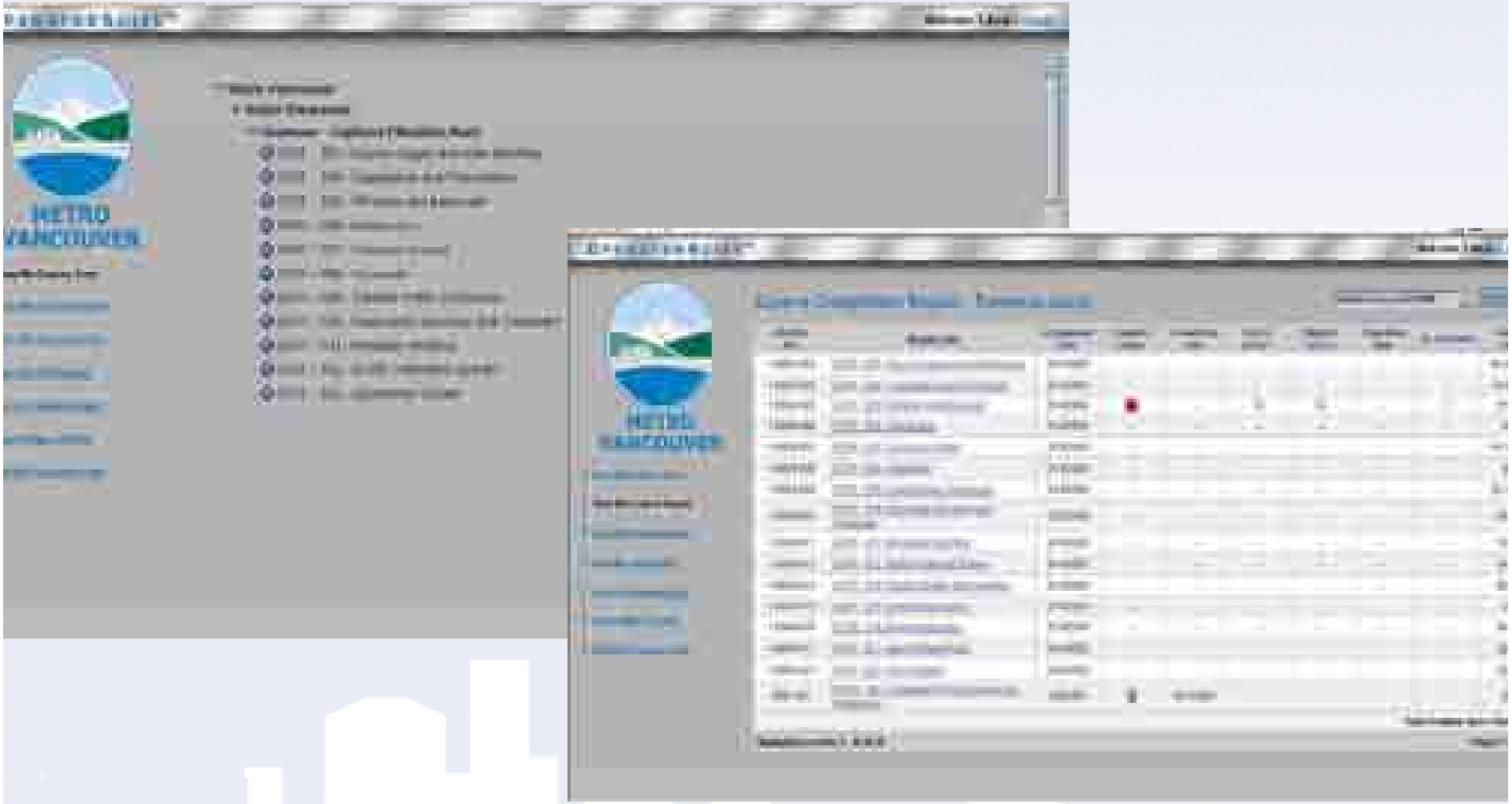


CGT THK 1	F-THK-23-010A		
CGT THK 2	F-THK-23-011A		
CGT THK 1 SUMP LSH	F-LSH-23-181A1		
CGT THK 2 SUMP LSH	F-LSH-23-182A1		
CGT THK 1 DRAIN VLV	F-V-23-1107	Closed	
CGT THK 2 DRAIN VLV	F-V-23-1108	Closed	
CGT THK 1 EFF DIOL VLV	F-V-23-1107	Open	
CGT THK 2 EFF DIOL VLV	F-V-23-1106	Open	
CGT THK 1 LDO VLV	F-V-23-1172	Closed	
CGT THK 2 LDO VLV	F-V-23-1173	Closed	

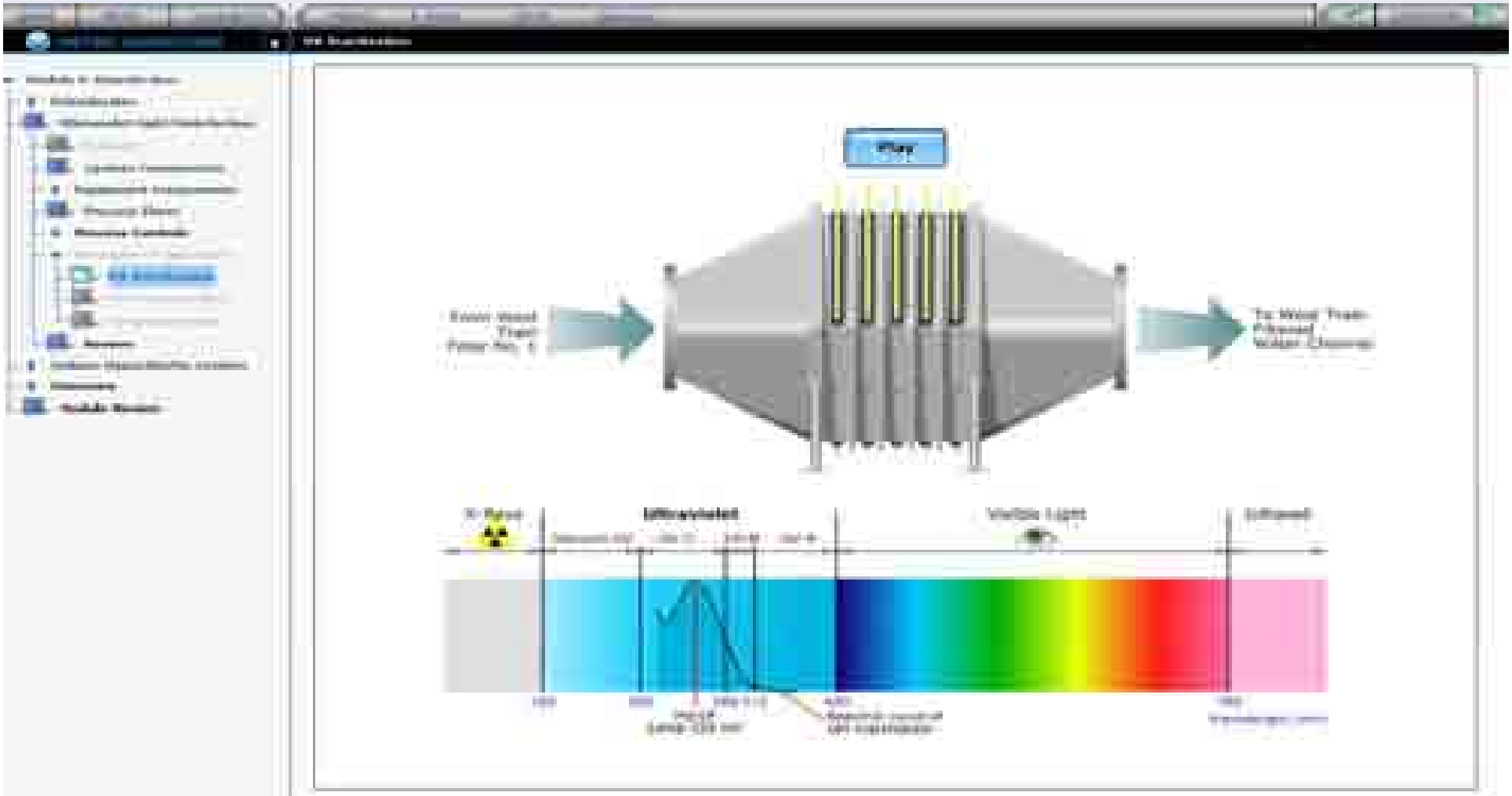
SCFP Blended Training Program



Web Based Training



Web Based Training



The ultraviolet light disinfection system provides primary disinfection of protozoa at the SCFP. UV light inactivates the micro-organisms in the water by causing a molecular rearrangement in the DNA (deoxyribonucleic acid) of the micro-organisms. This DNA disruption prevents the micro-organisms from causing infection by stopping them from reproducing into viable organisms.

Filtered water from the filters flows to the UV reactors for micro-organism inactivation. The UV reactors provide the UV equipment for UV inactivation to occur. The UV reactors are located in the filter gallery at the outlet of each filter. Each UV reactor is equipped with 4 rows of 12 quartz sleeves.

Web Based Training

Field Training

- Walkthrough & Skills Demonstration Guides
  - Provides a structural framework for performance-based training in the field
  - Simulates actual performance under typical working conditions
  - Prioritized similar to procedures

Field Training

LEARNING OBJECTIVES

For successful completion of this walkthrough guide, you must be able to:

- Draw a diagram of the Coagulation and Flocculation system.
- Identify the boundaries of the system.
- Locate, identify and demonstrate how to use all the PPE required for the Coagulation and Flocculation area.
- Identify all hazards in the Coagulation and Flocculation area.
- Locate, identify, and state the purpose of the listed components for the system.
- Trace the process flows to and from all major equipment within the system.
- Describe the operating principles and critical issues of all the major equipment.
- Perform the following procedures correctly and without supervision:
  - Adjust CGT feed rate
  - Calibrate CGT pump
  - Clean up CGT
  - Unload CGT
  - Start up CGT system
  - Shut down CGT system
  - Adjust CAP feed rate
  - Calibrate CAP pump
  - Clean up CAP
  - Unload CAP
  - Start up CAP system
  - Shut down CAP system
  - Start up injection manifold raw water pumps
  - Shut down injection manifold raw water pumps
  - Start up flocculation system
  - Shut down flocculation system

Web Based Training

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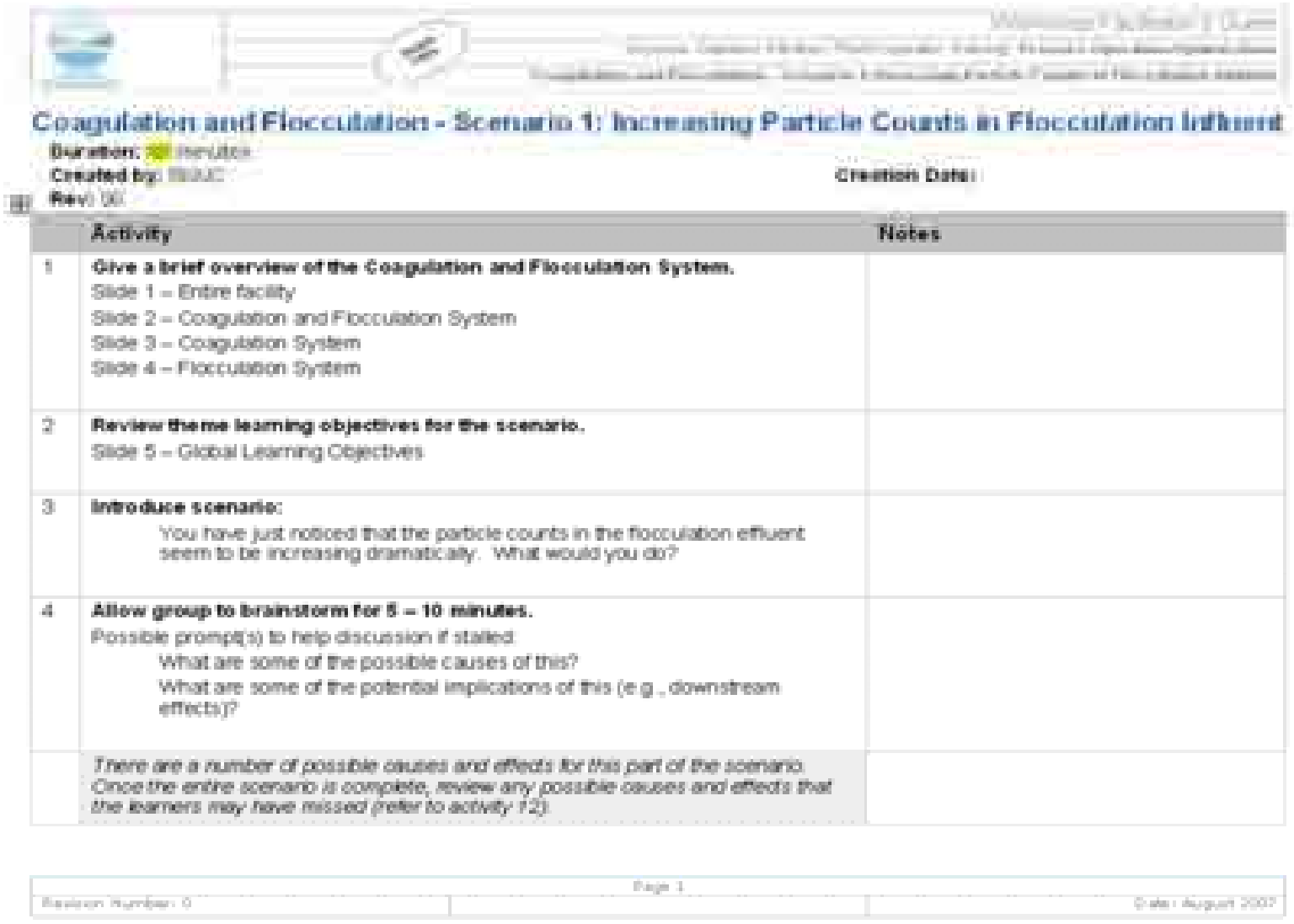
  - Adjust CGT feed rate
  - Calibrate CGT pump
  - Clean up CGT
  - Unload CGT
  - Start up CGT system
  - Shut down CGT system
  - Adjust CAP feed rate
  - Calibrate CAP pump
  - Clean up CAP
  - Unload CAP
  - Start up CAP system
  - Shut down CAP system
  - Start up injection manifold raw water pumps
  - Shut down injection manifold raw water pumps
  - Start up flocculation system
  - Shut down flocculation system

Classroom Training

- Apply knowledge learned in Web Based and Field Training and creative thinking
    - Team learning
    - Team development
    - Very small class size
- Train-the-Trainer Seminars

Dynamic structure allows flexibility to re-initiate course but with new scenarios as the plant continues to operate

Classroom Scenario



Coagulation and Flocculation - Scenario 1: Increasing Particle Counts in Flocculation Influent

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Rev: 00

	Activity	Notes
1	**Give a brief overview of the Coagulation and Flocculation System.** Slide 1 – Entire facility Slide 2 – Coagulation and Flocculation System Slide 3 – Coagulation System Slide 4 – Flocculation System	
2	**Review theme learning objectives for the scenario.** Slide 5 – Global Learning Objectives	
3	**Introduce scenario:** You have just noticed that the particle counts in the flocculation effluent seem to be increasing dramatically. What would you do?	
4	**Allow group to brainstorm for 5 – 10 minutes.** Possible prompt(s) to help discussion if stalled: What are some of the possible causes of this? What are some of the potential implications of this (e.g., downstream effects)?	
	There are a number of possible causes and effects for this part of the scenario. Once the entire scenario is complete, review any possible causes and effects that the learners may have missed (refer to activity 12).	

Troubleshooting Guides

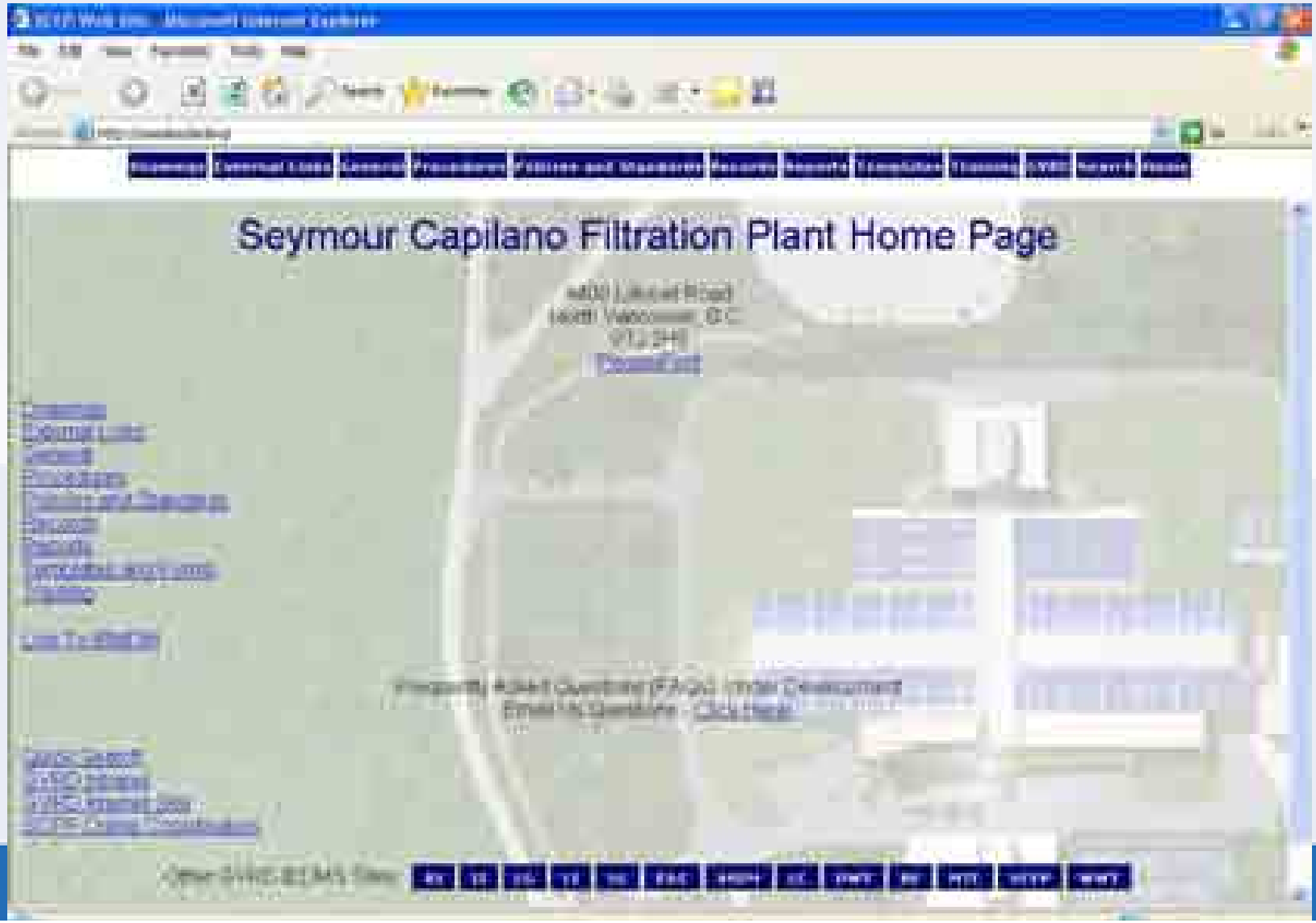
Assessment

- Formal knowledge and skill based reviews for web based training and field training
- Informal assessment for classroom training

Program Administration

- Technical Administration
- Content Administration
- Learning Administration

SCFP Web Portal



Schedule & Resources

- Schedule
  - July 2006 to December 2009
- Resources
  - 1 person full time for project management and technical reviews
  - Equivalent of 2+ subject matter experts (operators, engineers, consultants, etc.) throughout contract duration for content development and review

Budget

"Depending on the size of the project and your staff previous experience, complete operator training and documentation may cost

~ 0. 25% to 0.75 % of the total project cost

– do not use low bid for this part of your project

– you get what you pay for "

- Gerry Stevens, AECOM

- SCFP capital= $300M, therefore $750,000 to $2.25M for training & documentation

- SCFP procedures and training program development project contract ~$1M = 0.33%

Lessons Learned

- Plan, plan, plan
  - Include all stakeholders in scoping
  - Do a gap analysis
  - Budget and resources (Multi-year? Phased approach?)
  - Technical limitations (Platform? Bandwidth?)
- Reference materials availability

Lessons Learned

- Know your audience (“Learners”)
  - Base skills/knowledge
  - Target skills/knowledge
  - Consider different learning styles & needs
  - IT skills? Access?
  - Blended approach
- Document templates

Lessons Learned

- Ongoing management
  - Content
  - Documents
  - Program
  - Software
- Effectiveness Measurement
  - ROI (pre-tests, etc..)
  - Feedback on learning tools and learning content

Results

- “Blended training” program accommodates various learning and teaching styles
- Consistent training to all employees
- Minimized impact on experienced staff during training
- Training documented
- Shortened timeframe to train a new employee
- Enhanced problem-solving and communication skills
- Staff enabled to engage in innovation and optimization
- Customized reference materials (library)
- Program is being replicated for the water distribution system and the wastewater treatment plants

Testimonials

"…a great tool to complement my knowledge about the operation gained previously from the PFSs…"

Tahir Maloku, Water Treatment Plant Operator

"As a new operator here at the SCFP, I found the web-based training to be highly effective at putting the diverse systems into perspective. It allowed me to gain a detailed understanding of the theory and operation of the various systems prior to field work. It would have taken a far greater amount of time to walk the various systems and discover all the feeds and flows. I particularly enjoyed the graphical representations of flows and chemistry…"

Rob Chilton, Water Treatment Plant Operator

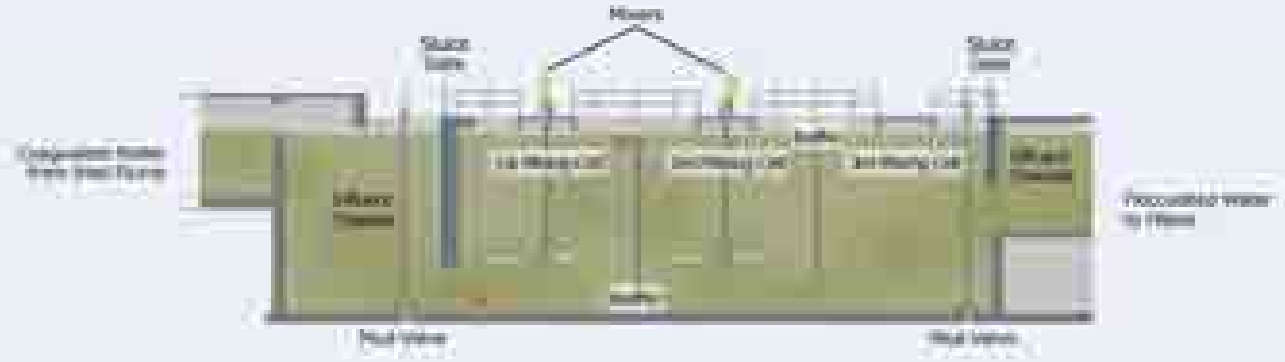
"These courses are very user friendly and I can surf in different parts of them easily. The graphics are very clear and neat, and related notes are in perfect and brief shapes…"

Reza Fereidouni, Water Treatment Plant Operator

"The complete package provided a great foundation for staff to operate equipment during early commissioning in support of the Seymour Tie – in, and media washing. The classroom training provides a great forum for team building and trouble shooting.."

Alistair Wardlaw, Plant Supervisor

Questions?



Jennifer Crosby
Senior Project Engineer
Water Treatment & Systems Control
604.451.6568
jennifer.crosby@metrovancouver.org