

Startup Planning



April 27, 2018

Tina Hastings, P.E.

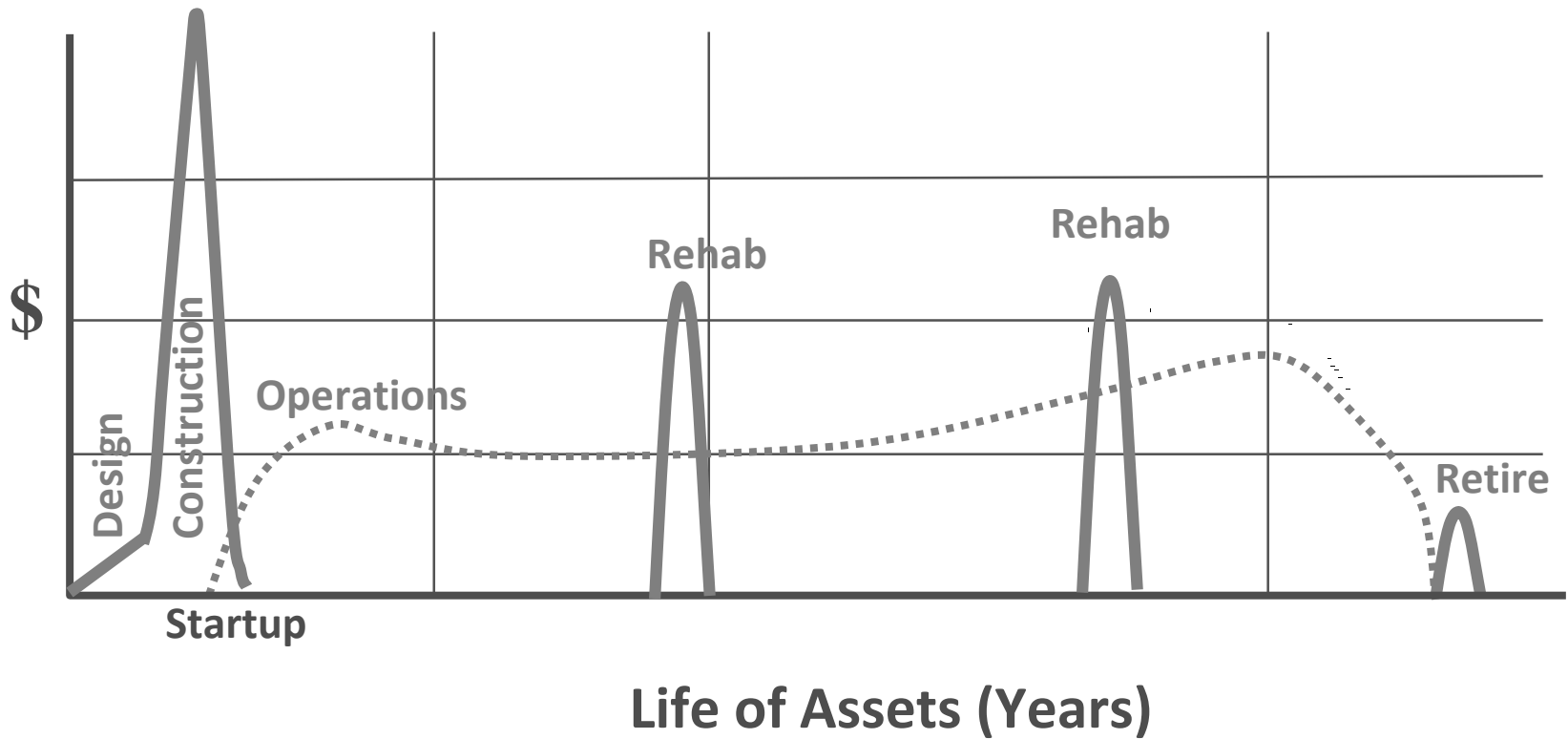
Butch Perry

JACOBS[®]

Agenda

- Asset life Cycle
- Startup Phase Terminology
- Documentation
- Roles and responsibilities by Project Scale
- Planning Case Study

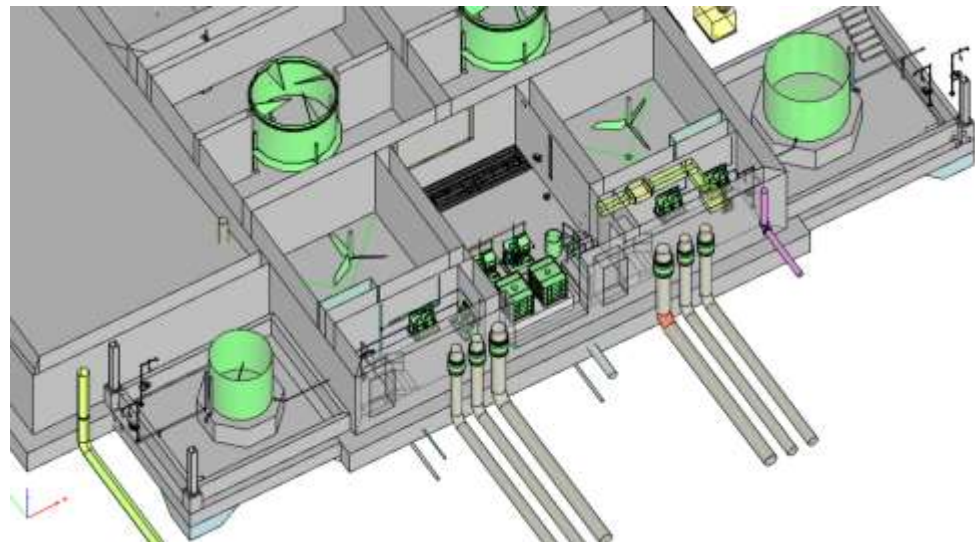
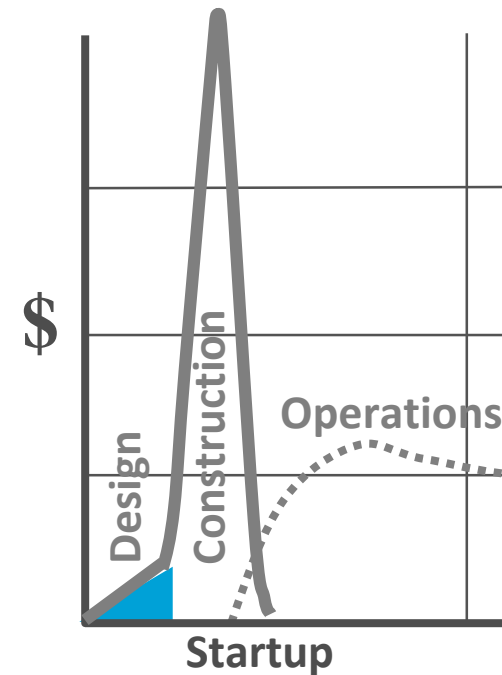
Asset Lifecycle



- Design and Construction
- Startup is transition from construction to operation
- Records
 - Startup Manuals and Test Plans including field notes
 - Record Drawings, O&M manuals, vendor manuals

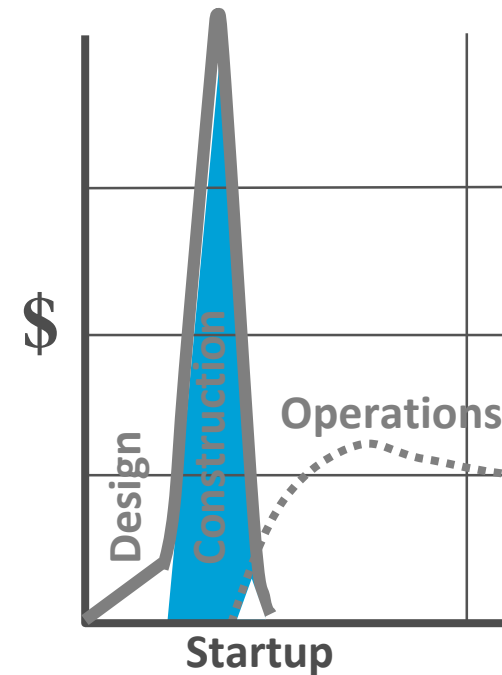
O&M Design Activities to support Startup during Design

- Pre-Design and Design (30, 60, 90)
- Drawing Review
 - Model review
 - 3D pdfs
 - Model walk-thru
 - Virtual or Augmented Reality
- Specification Review
 - Submittals: Review during construction
 - Materials: Spare Parts; Special Tools
 - Execution: Vendor support; Training
 - Warranty: Start dates (events) & duration
- Startup specification can be separate



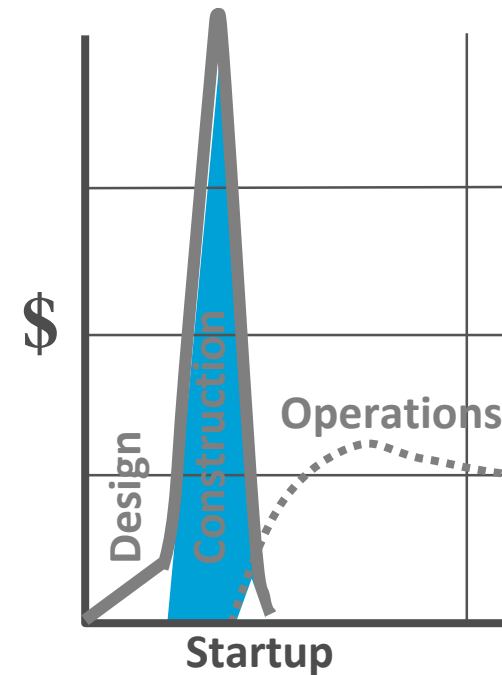
O&M Activities during Construction to support Startup

- Submittal Review
 - Engineer reviews for specification conformance
 - Spare Parts
 - Shop Drawings
 - Quality review
 - Materials check
 - “Or equal”
- Equipment
 - Delivery: Check for damage during shipment
 - Storage: maintenance per Mfr recommendation
 - Installation: alignment; field fit up pieces
- Training: Classroom and Field
- Participate in Startup Phases

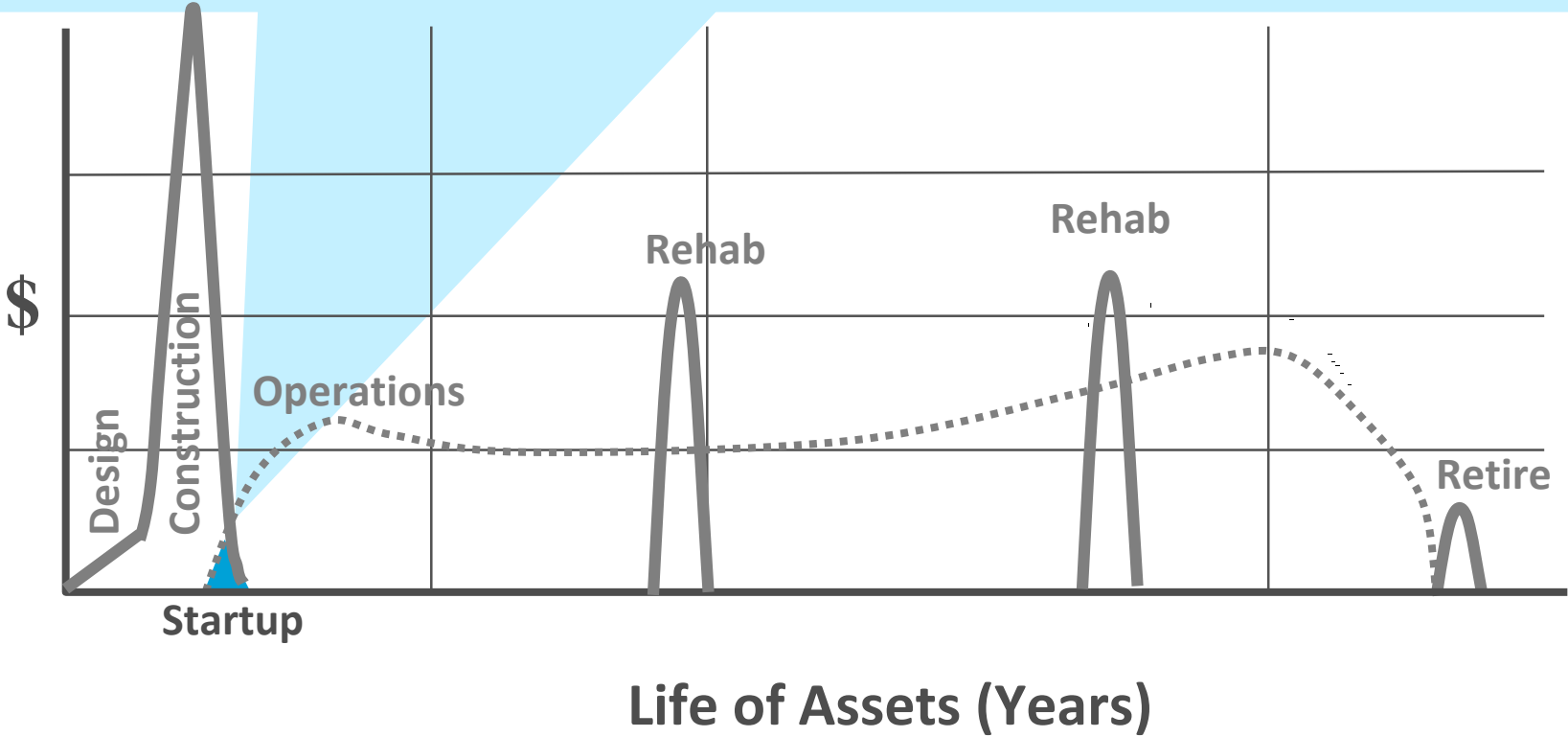
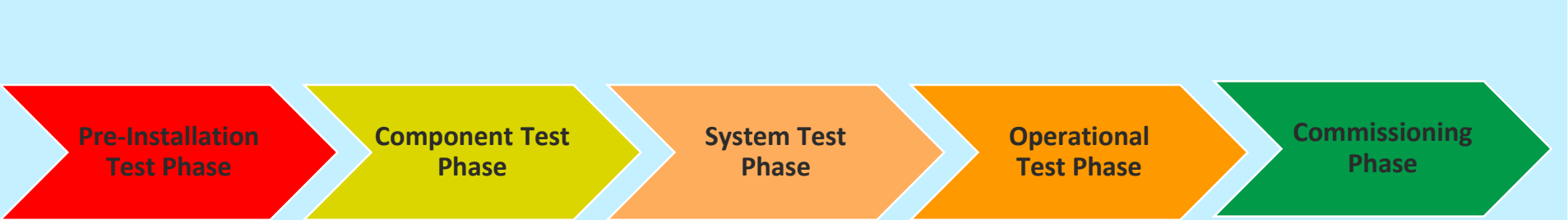


O&M Activities to support Submittal Review

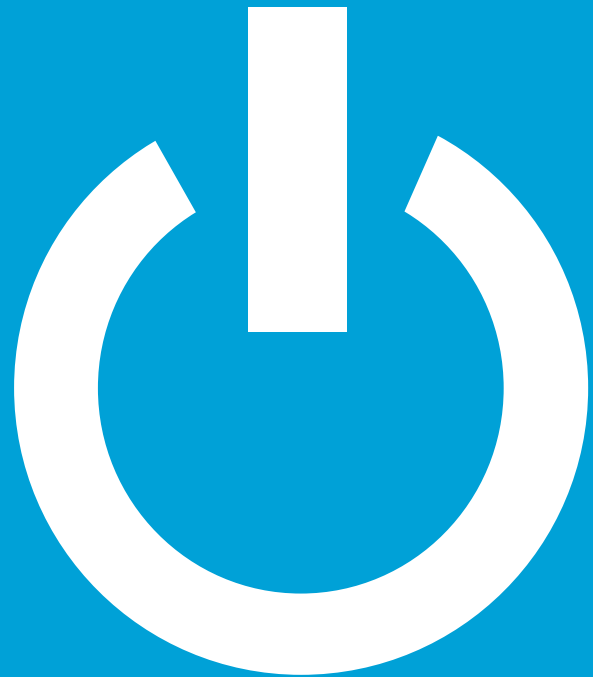
- Review equipment submittals
 - Does the equipment contain everything needed?
 - Equipment materials and/or mounting material compatibility with use environment
 - Equipment manufacturer - spare parts availability
 - Critical spares provided
 - Special tools required
 - Training requirements
 - O&M manual, spare parts list, warranty
- Training content and coordination specific to discipline (Electrical, Mechanical, operations, etc...)
- Review System and Operational test plans
- Operation and Maintenance Manual review
 - Vendor O&M manual
 - Facility O&M Manual



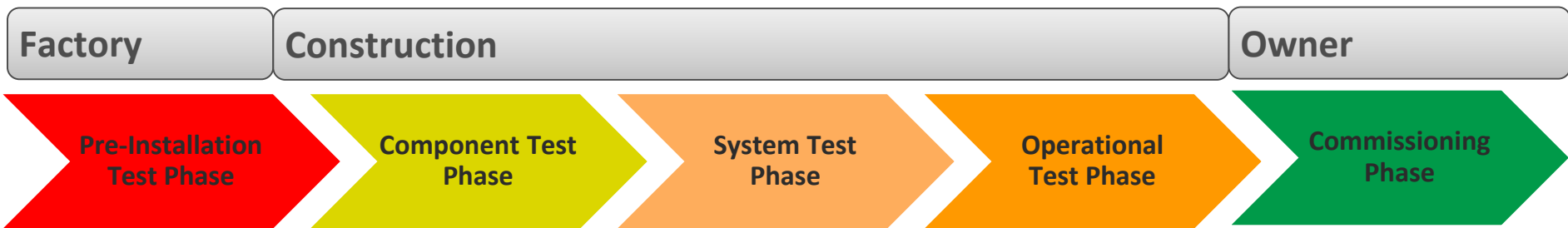
Project Startup Activities



Startup Phases

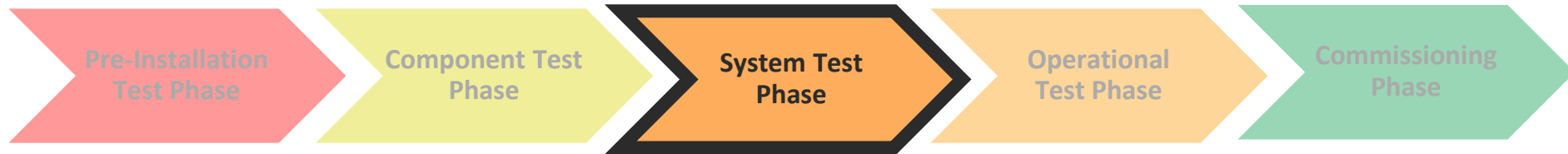


Test Phases



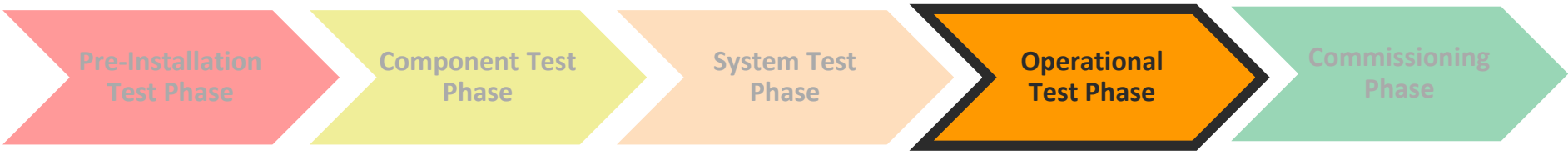
- **Pre-Installation:** Factory Acceptance Test (FAT); Test items at place of manufacture during or on completion of manufacture
- **Component Test:** Test the device (motor, valve actuator, etc...) Verify control signals to PLC and OIT graphics; System pressure testing and cleaning; alignment...
- **System Test:** Completely test equipment specified in Div 11-17 over entire range of operating conditions. Combined components that make up a system.
- **Operational Test Phase:** Water typically used as testing medium; Facility as a unit with Control system operating as designed over a full range of operation.
- **Commissioning:** Owner operates facility. Supported as needed by contractor for immediate assistance on any equipment failures.

System Test Phase



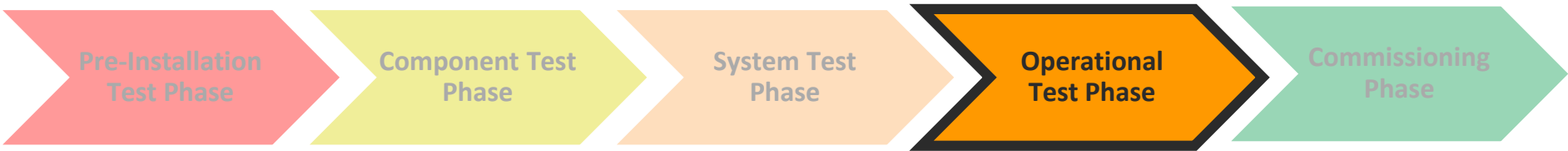
- Closed Loop recycle
 - Test full operational range; set points; alarms
- Consider impacts outside of project boundaries
 - Sufficient volume to start the test and sustain it without cycling
 - Where does the flow discharge
- System isolation done properly for the test
 - Screens/pancakes removed
 - Isolation valves
- Records: set point changes, etc

Operational Test Phase



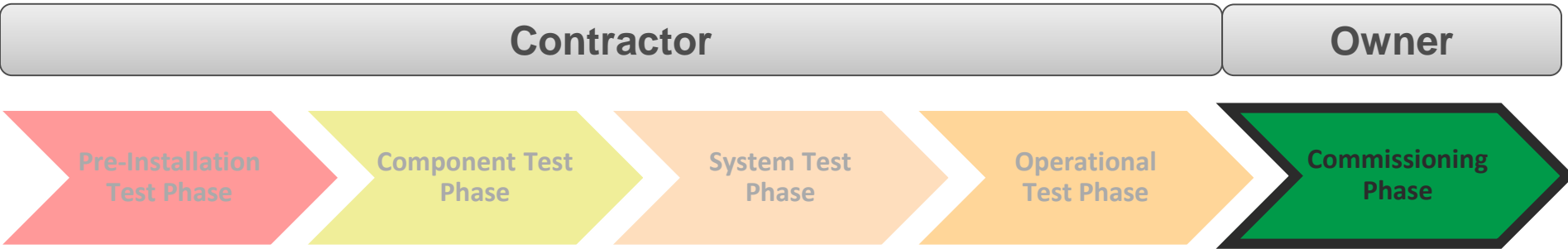
- All Systems working together
- Hydraulically run the facility as one coordinated system.
- Control strategies test interlocks and permissives between systems
 - Test failure scenarios and control system responses
 - Consider impacts outside of project boundaries Conveyance/Distribution system impacts
 - Failure Scenarios: is anything subject to a higher pressure than it was designed for?
 - Testing interlocks between systems

Operational Test Phase - continued



- Failures during test phase
 - Evaluated by startup team
 - May require retest or potential restart of Operational Test Phase
- Control system logs all operational data.
 - Trends used to evaluate operational data; changes typically made during the day with steady state operation at night.

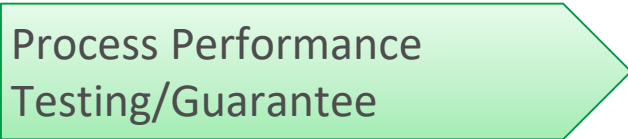
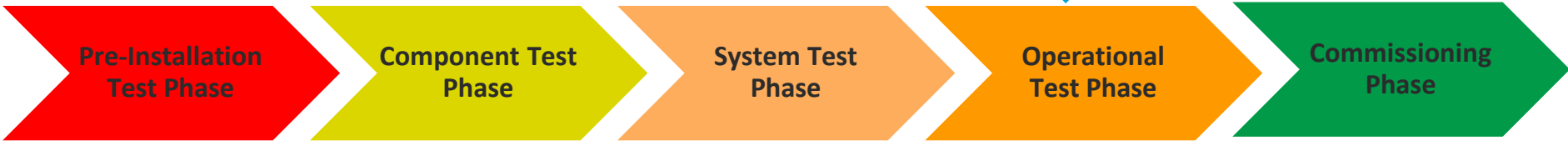
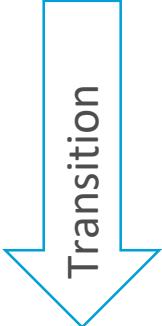
Owner Commissioning



- Previous testing phase documentation and O&M Training complete
- O&M manuals and Spare Parts turned over to Owner
- Transfer fully functional facility to Owner for operation during commissioning period
- Contractor provide required support to Owner to ensure the facility maintains fully operational mode
- (X) (time period) continuous or full operation
- System operates as designed
- Contractor oncall during commissioning phase
- Equipment failures restart commissioning period

Testing Fluid

...but I tested it on water and it was fine



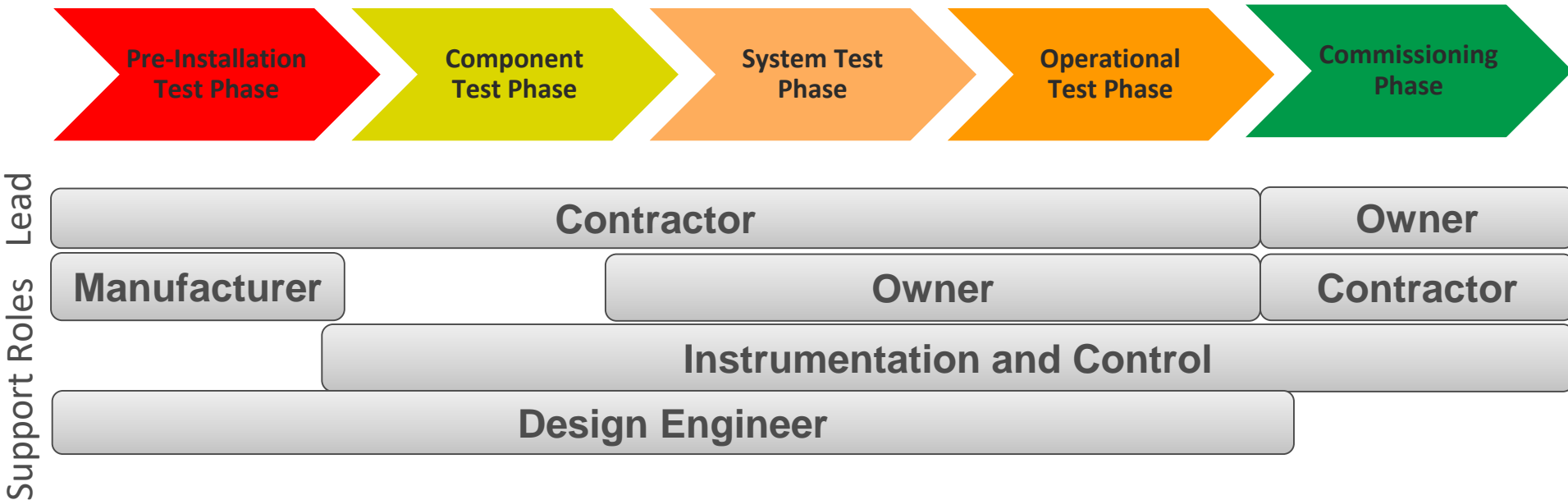
Operational changes can occur when operating with actual process fluid.

Startup considerations

- Safety: LOTO; Job Hazard Analysis
- Hydraulics first; process and biology second
- Temporary accommodations to facilitate testing impacts to existing operations
 - Closed Loop
 - Discharge to storage tank; wet well
 - Simulate headloss (sleeve valve)
- Testing medium
 - Water/Air
 - Switching to actual medium
 - Chemicals
 - Specific Gravity changes
 - Corrosive problems may take time to show up

Start up Roles

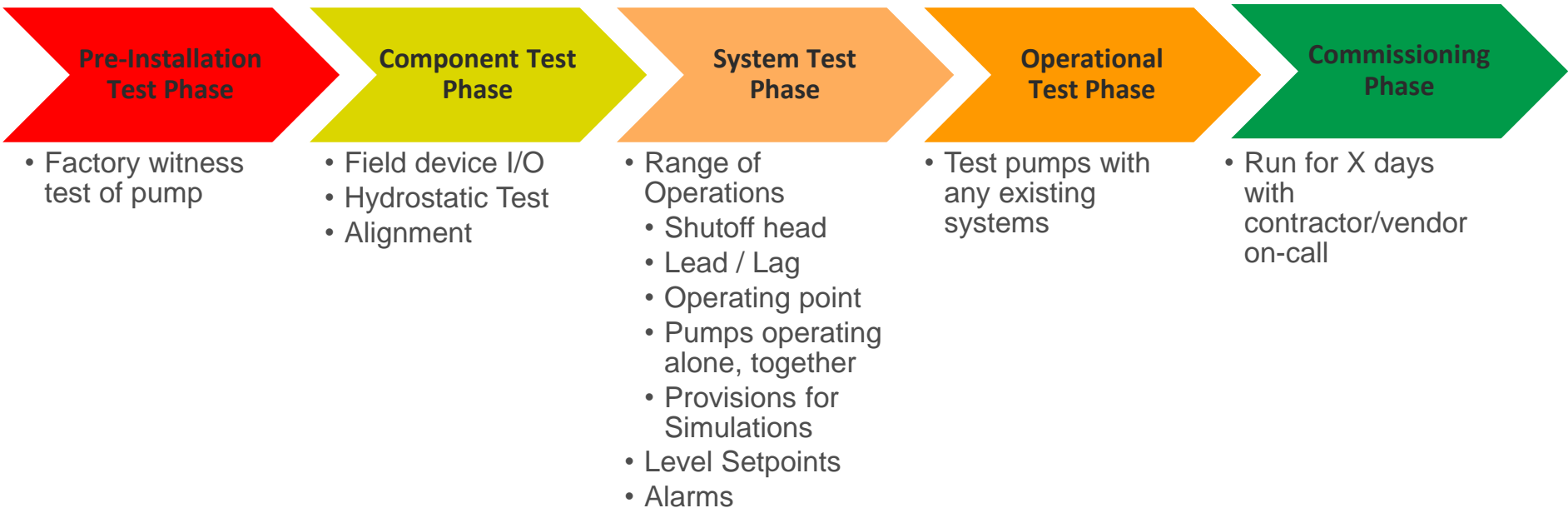
Startup Phase Roles and Responsibilities



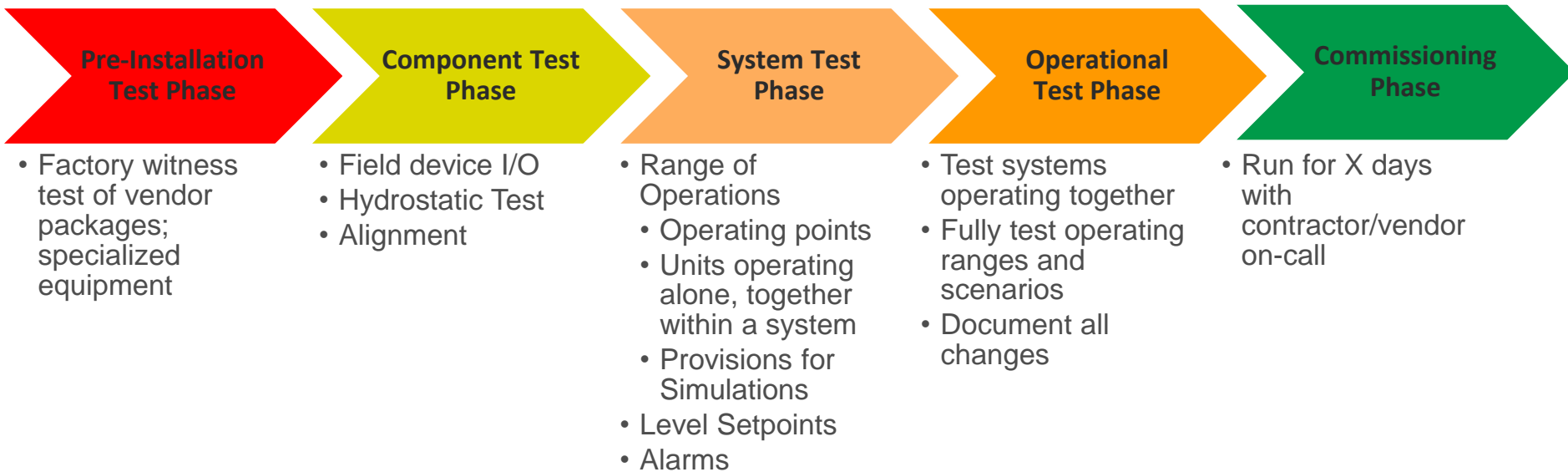
- Roles and responsibilities change by Project Scale
 - PM, PE, CM-PR, CM-Inspector, O&M supervisor, operator, maintenance trade
 - Scale of startup activity (capital project vs in-house project)
 - Type of contracting method - hard bid, GCCM, on call
 - Value of contract – Capital, Contractor Work-Order, in-house Work-Order
 - Capital support for Operating budget projects

Scale of Projects

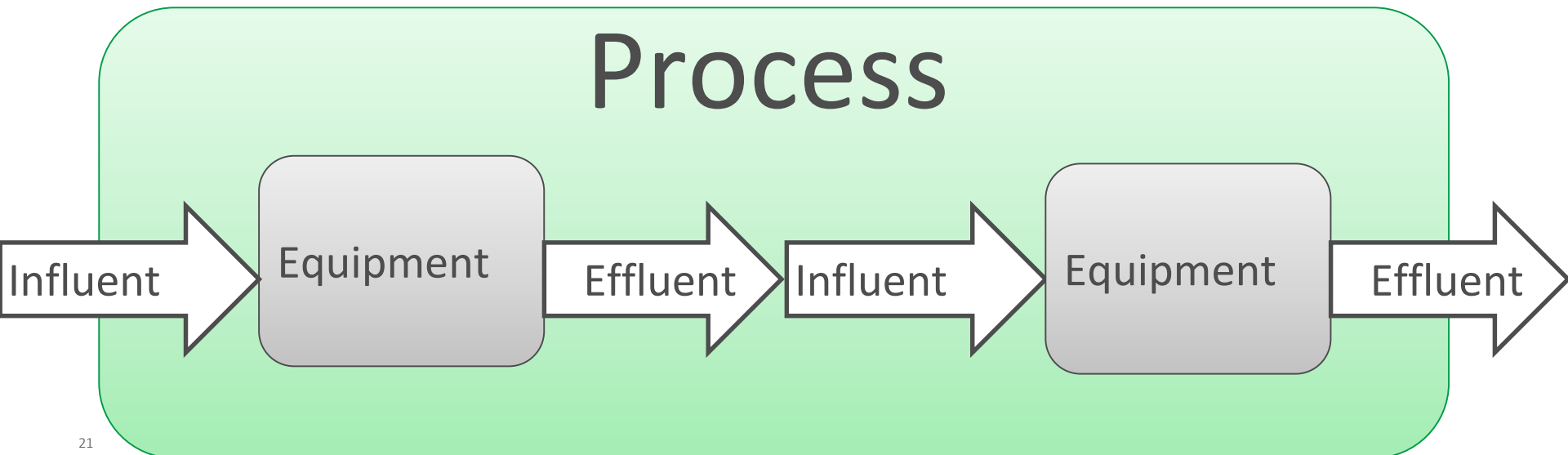
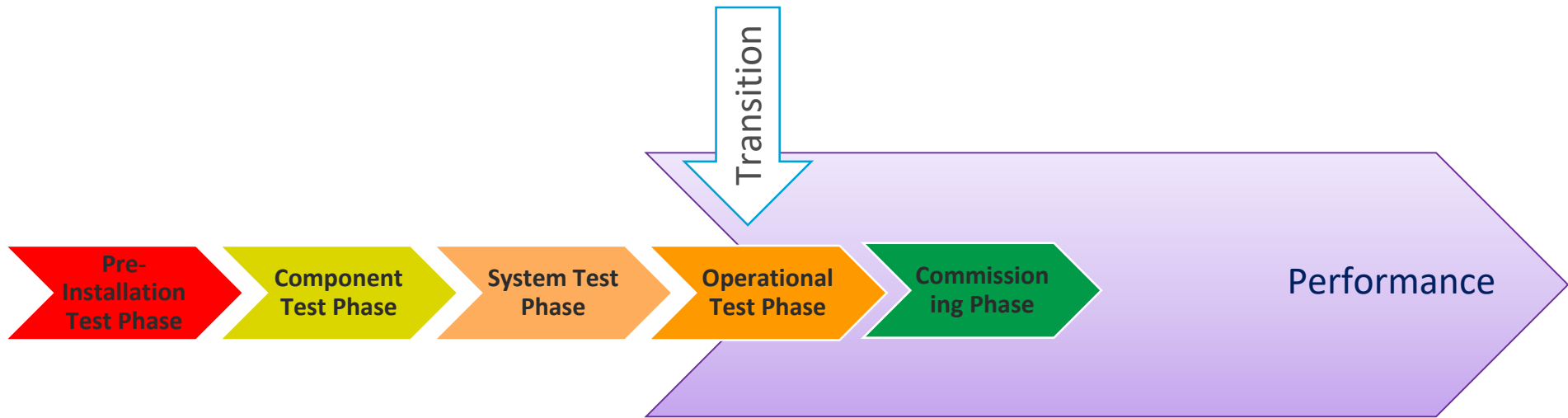
Test Phases: Pump Replacement



Test Phases: Treatment Plant



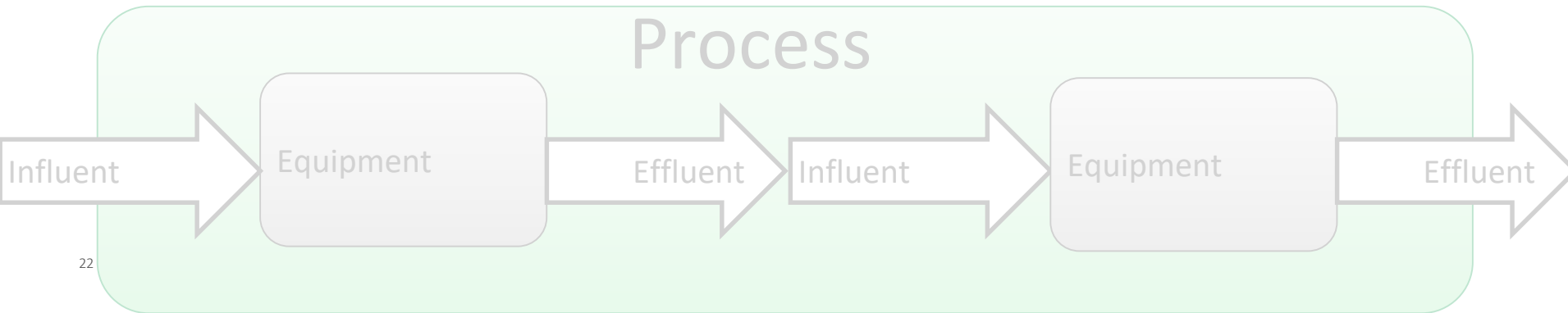
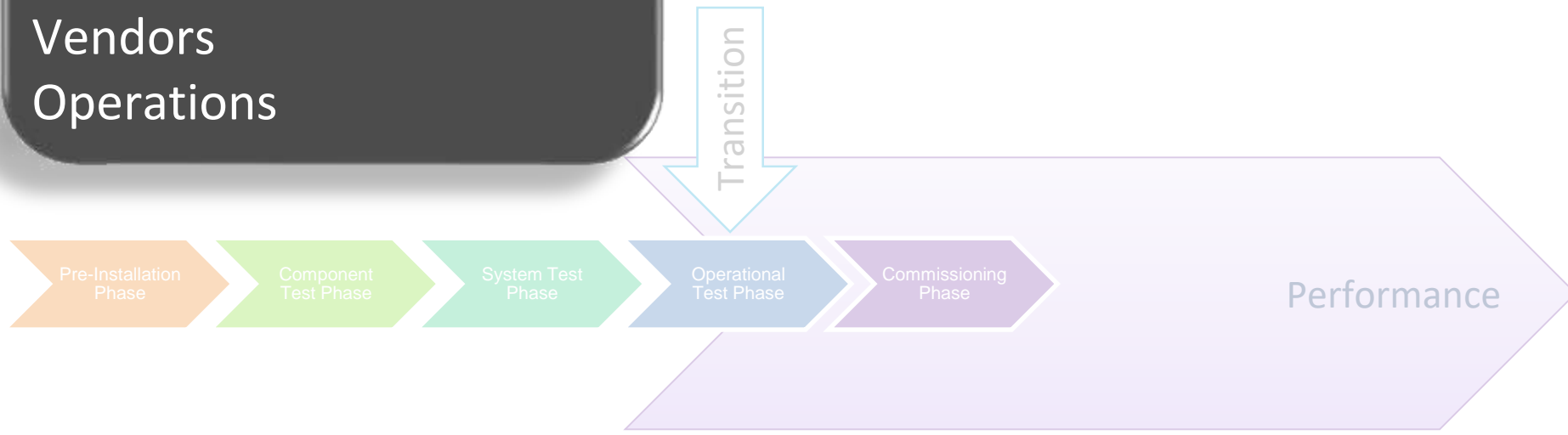
Performance: Process Optimization (Treatment Plant)



Team Collaboration

We're all
in this
together

- Owner
- Design
- Construction Management
- Contractor
- Vendors
- Operations



Startup Plan

Startup Test Plan Content

1. Control Strategy ● ●
2. P&ID Drawings ●
3. Related Specifications ●
4. Manufacturer and Instrument Drawings ●
5. Pressure and Leak Tests ●
6. Electrical Wire and Cable Pre-Component Tests ●
7. I&C Wire and Cable Pre-Component Tests ●
8. Factory Tests and Installation ●
9. Electrical and I&C Component Tests ●
10. Mechanical Equipment Startup and Component Tests ●
11. Equipment Vibration, Sound and Capacity Tests ●
12. Startup Plan and Job Hazard Analyses ●
13. Training Records ●
14. System Tests ●
15. Maintenance Forms and Records ●
16. Deficiencies, Punch lists and Corrections ● ● ● ● ●

Content of final
Startup test plan
documents
everything that
happened during
startup testing

Legend

- Support information
- Pre-installation phase
- Component
- System
- Operational
- Commissioning

Startup Test Plan Content

1. Control Strategy

2. P&ID Drawings

3. Related Specifications

4. Manufacturer and

5. Pressure

6. E

7. I&

8. Fac

9. Elec

10. Mec

11. Equip

12. Startup

13. Training

14. System T

15. Maintena

16. Deficiencie

will run continuously, and if set at 50 percent, it will run for the stop.

3) Grit pumps that serve a common grit cyclone (grit tank 1) will both feed cyclone 5, and grit tank 5 (pump 2 and grit tank 5) will not be allowed to operate simultaneously. These grit pumps will keep from overfeeding the cyclone with grit.

4) Grit pumps that share a cyclone and are out of service will start control strategy and the remaining grit pump shall be allowed to start.

4. Local: None.

D. Interlocks:

1. SPCS/Regional: None
2. SPCS/Field Level Control:
 - a. Before a grit pump is allowed to start, its associated grit tank must be empty.
 - b. If a grit washer stops when an associated grit pump is running, after an initial time period (initially set to 2 minutes) after the motor current exceeds an operator adjustable high current limit (25 percent of set amperage), stop the grit pump.
 - c. After an initial time period (initially set to 2 minutes) after the motor current (25 percent of set amperage) is established on a grit pump that share one cyclone (grit tank 1) through 5, if a grit pump starts, stops, or fails to start, at any time the strategy, send an alarm to the SPCS.
 - d. If a grit pump starts, stops, or fails to start, at any time the gate is open (as confirmed by gate position switch), if the grit tank is operating, send an alarm to the SPCS.
3. Local: (Hardware). When a grit pump's windings temperature is high.

4. Local: (Hardware). When a grit pump's windings temperature is high.

E. Shutdown:

1. SPCS/Regional: None
2. SPCS/Field Level Control:
 - a. CS 100-01 commands the equipment associated with the electrical actuated valves to hold their last position.
 - b. The equipment is prevented from restarting after the CS 100-01 restart command is received.
 - c. CS 100-01 restart command is received.
3. SPCS/Field Level Control:
 - a. The equipment controlled by this control strategy is made at the time of shutdown command.
 - b. Electronic valves remain in the last position.
4. Local: Regardless of a CS 100-01 shutdown command, in hand, the equipment controlled by this control strategy is in hand, the equipment will re-engage as soon as power is present.
 - a. When logged, the equipment will re-engage as soon as power is present.
 - b. When logged, the equipment will re-engage as soon as power is present.

F. Restart After Short-Term Outage:

1. SPCS/Regional: None
2. SPCS/Field Level Control:
 - a. The equipment is prevented from restarting after the CS 100-01 restart command is received.
 - b. Upon receipt of CS 100-01 restart command, the equipment can restart equipment as follows:
 - 1) The operator can manually modulate the equipment.
 - 2) The operator can manually modulate the equipment.
 3. SPCS/Field Level Control:
 - a. Upon receipt of CS 100-01 restart command, the equipment that was running at the time of shutdown and (frequency) driven equipment has the process requirements.

CS 100-01 Supervisory Process Control Strategy
 CS 320-03 Grit Washing and Dewatering System
 D. Supporting Documentation: Core supporting documents are listed in paragraph in Section 17500. Additional supporting documents are as follows:

1. Section 11325

1.03 SYSTEM DESCRIPTION

A. The grit slurry pumping system removes grit from backwash water and scour aeration. There are five grit tanks. The grit flows into the first cell of a grit tank. Because the grit flows into the first cell of a grit tank, the first cell of a grit tank is the largest. The first cell of a grit tank is continuously while the second cell grit pump is running. The first cell of a grit tank is continuously while the second cell grit pump is running from tanks 1 through 3 feed cyclones 1 through 3. The first cell of a grit tank is continuously while the second cell grit pump is running from tanks 4 through 5 feed cyclones 4 through 5. The first cell of a grit tank is continuously while the second cell grit pump is running from tanks 6 through 10.

B. Cyclones 1 through 5 feed grit washer 1 and associated grit washer is not in service, no associated grit washer is allowed to start. After 60 seconds of the grit pump running, the associated grit washer is allowed to start.

1.04 EQUIPMENT

A. Process Equipment:

Equipment No.	Equipment Description
BW-P 310.121	Grit Tank 1 Pump
BW-P 310.131	Grit Tank 1 Pump
BW-P 310.122	Grit Tank 2 Pump
BW-P 310.132	Grit Tank 2 Pump
BW-P 310.123	Grit Tank 3 Pump
BW-P 310.133	Grit Tank 3 Pump
BW-P 310.124	Grit Tank 4 Pump
BW-P 310.134	Grit Tank 4 Pump
BW-P 310.125	Grit Tank 5 Pump
BW-P 310.135	Grit Tank 5 Pump
BW-P 310.126	Grit Tank 6 Pump
BW-P 310.136	Grit Tank 6 Pump

B. Control Valves:

Valve No.	Valve Description
None	

C. Solenoid Valves:

Valve No.	Valve Description
BW-EV 310.111A	Grit Tank 1 Pump 1 Devicenet Motor Control Interconnect
BW-EV 310.111B	Grit Tank 1 Pump 2 Devicenet Motor Control Interconnect
BW-EV 310.111C	Grit Tank 1 Pump 3 Devicenet Motor Control Interconnect
BW-EV 310.111D	Grit Tank 1 Pump 4 Devicenet Motor Control Interconnect
BW-EV 310.111E	Grit Tank 1 Pump 5 Devicenet Motor Control Interconnect
BW-EV 310.111F	Grit Tank 1 Pump 6 Devicenet Motor Control Interconnect
BW-EV 310.112A	Grit Tank 2 Pump 1 Devicenet Motor Control Interconnect
BW-EV 310.112B	Grit Tank 2 Pump 2 Devicenet Motor Control Interconnect
BW-EV 310.112C	Grit Tank 2 Pump 3 Devicenet Motor Control Interconnect
BW-EV 310.112D	Grit Tank 2 Pump 4 Devicenet Motor Control Interconnect
BW-EV 310.112E	Grit Tank 2 Pump 5 Devicenet Motor Control Interconnect
BW-EV 310.112F	Grit Tank 2 Pump 6 Devicenet Motor Control Interconnect

SECTION 17500
 CS 310-01
 CONTROL STRATEGY
 GRIT SLURRY PUMPING SYSTEM

1.01 PURPOSE

A. The grit slurry pumping system removes the settled solids from the aerated grit tanks, transporting them to the grit washing and dewatering system (CS 320-03). The grit slurry pumping control strategy defines the relationship between critical components, and the required control logic and interlocks.

1.02 REFERENCES

A. Process and Instrumentation Diagrams:

Dwg No.	Process and Instrumentation Diagram Description
BW3100-P-501	Grit Tank 1
BW3100-P-502	Grit Tank 2
BW3100-P-503	Grit Tank 3
BW3100-P-504	Grit Tank 4
BW3100-P-505	Grit Tank 5
BW3100-P-506	Grit Tank 6

B. Wiring Diagrams:

Dwg No.	Wiring Diagram Description
BW-EL310.121	Grit Tank 1 Pump 1 Devicenet Motor Control
BW-EL310.121A	Grit Tank 1 Pump 1 Devicenet Motor Control Interconnect
BW-EL310.122	Grit Tank 2 Pump 1 Devicenet Motor Control
BW-EL310.122A	Grit Tank 2 Pump 1 Devicenet Motor Control Interconnect
BW-EL310.123	Grit Tank 3 Pump 1 Devicenet Motor Control
BW-EL310.123A	Grit Tank 3 Pump 1 Devicenet Motor Control Interconnect
BW-EL310.124	Grit Tank 4 Pump 1 Devicenet Motor Control
BW-EL310.124A	Grit Tank 4 Pump 1 Devicenet Motor Control Interconnect
BW-EL310.125	Grit Tank 5 Pump 1 Devicenet Motor Control
BW-EL310.125A	Grit Tank 5 Pump 1 Devicenet Motor Control Interconnect
BW-EL310.126	Grit Tank 6 Pump 1 Devicenet Motor Control
BW-EL310.126A	Grit Tank 6 Pump 1 Devicenet Motor Control Interconnect
BW-EL310.131	Grit Tank 1 Pump 2 Devicenet Motor Control
BW-EL310.131A	Grit Tank 1 Pump 2 Devicenet Motor Control Interconnect
BW-EL310.132	Grit Tank 2 Pump 2 Devicenet Motor Control
BW-EL310.132A	Grit Tank 2 Pump 2 Devicenet Motor Control Interconnect
BW-EL310.133	Grit Tank 3 Pump 2 Devicenet Motor Control
BW-EL310.133A	Grit Tank 3 Pump 2 Devicenet Motor Control Interconnect
BW-EL310.134	Grit Tank 4 Pump 2 Devicenet Motor Control
BW-EL310.134A	Grit Tank 4 Pump 2 Devicenet Motor Control Interconnect
BW-EL310.135	Grit Tank 5 Pump 2 Devicenet Motor Control
BW-EL310.135A	Grit Tank 5 Pump 2 Devicenet Motor Control Interconnect
BW-EL310.136	Grit Tank 6 Pump 2 Devicenet Motor Control
BW-EL310.136A	Grit Tank 6 Pump 2 Devicenet Motor Control Interconnect

C. Control Strategies:

CS No.	Control Strategy Description

Brightwater Treatment Plant
 August 10, 2007

17500 CS 310-01-1

CS3138C-838
 Revision 1

Brightwater Treatment Plant
 August 10, 2007

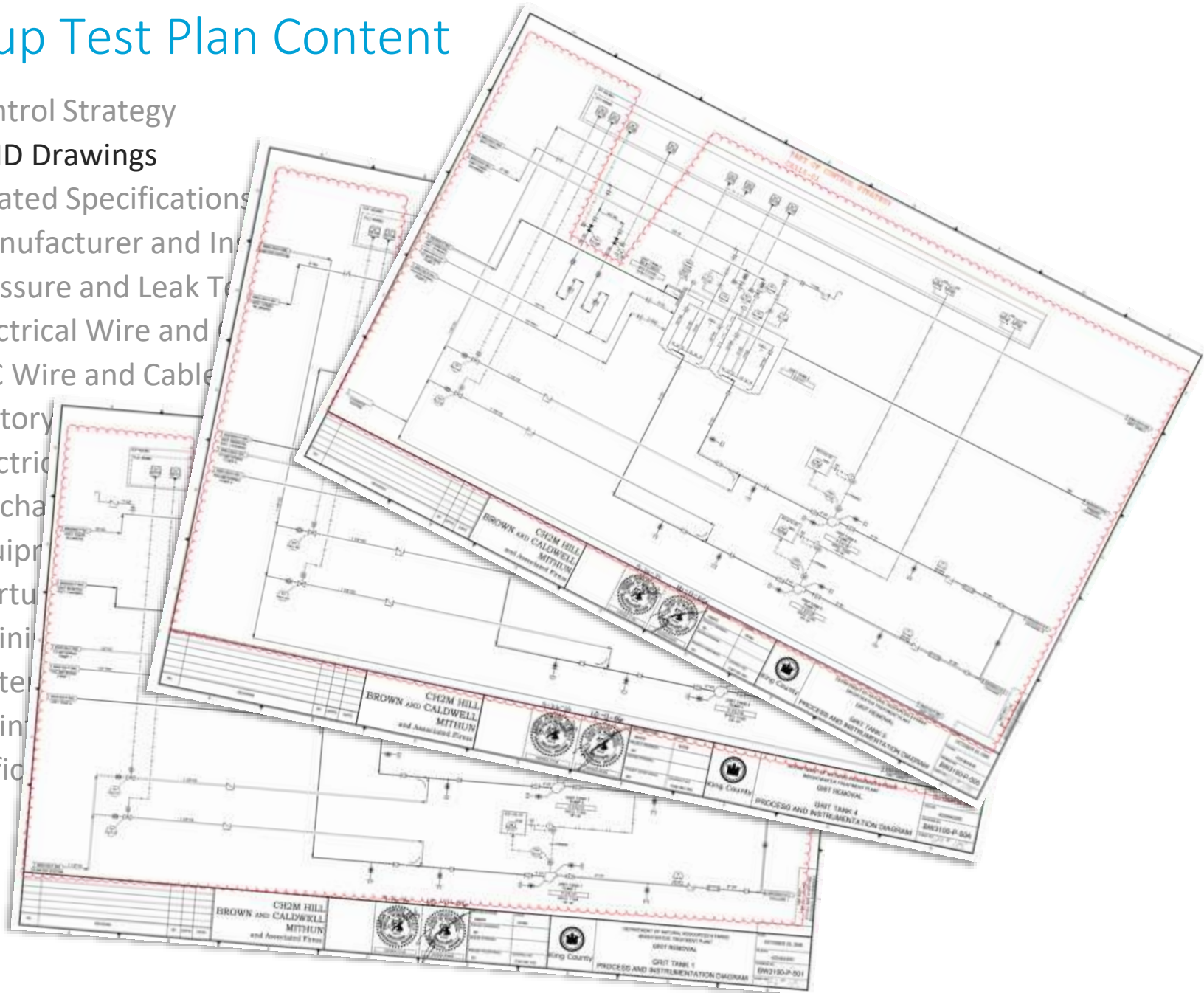
17500 CS 310-01-2

Brightwater Treatment Plant
 August 10, 2007

17500 CS 310-01-4

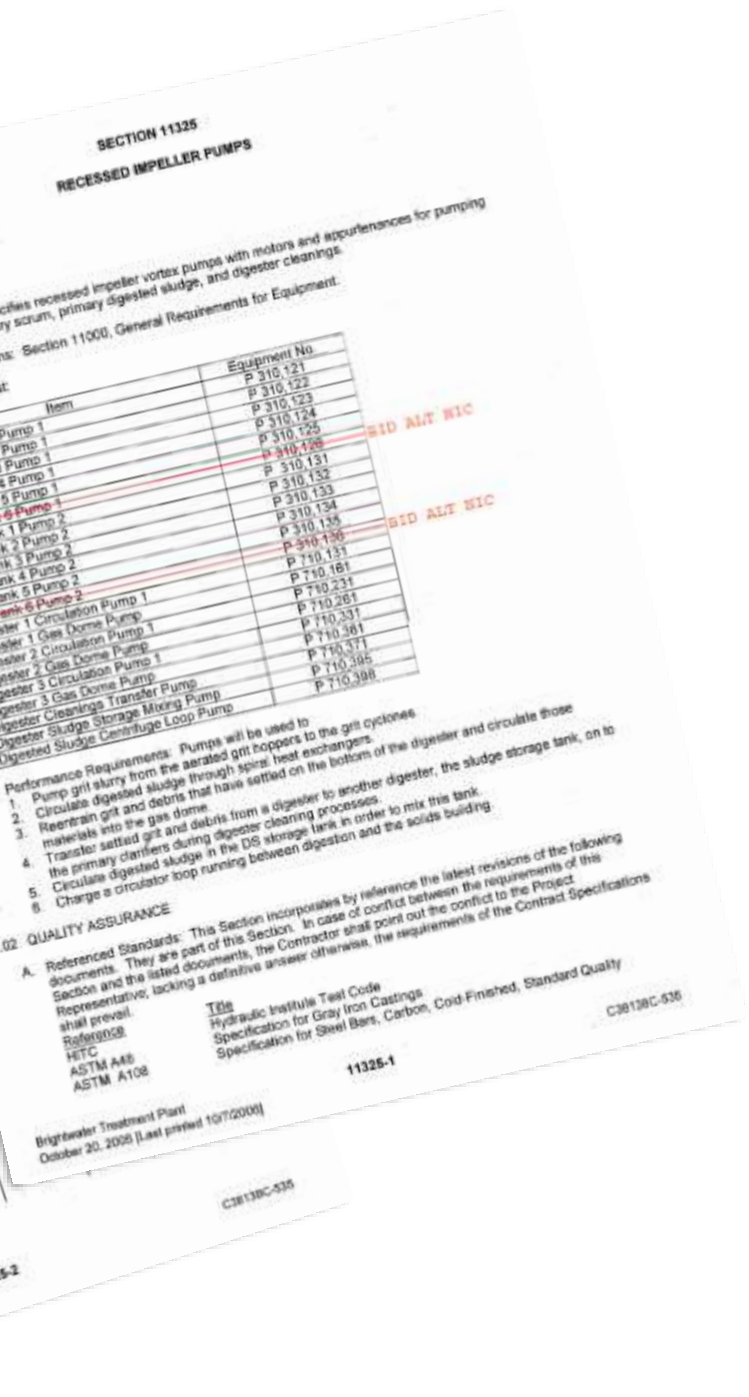
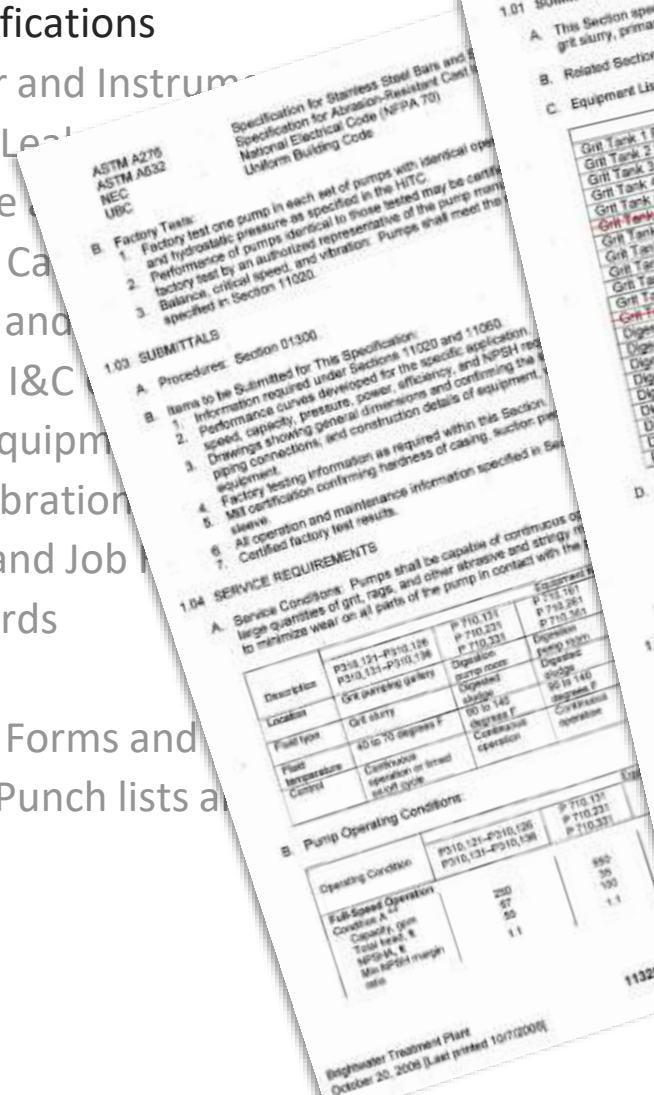
Startup Test Plan Content

1. Control Strategy
2. P&ID Drawings
3. Related Specifications
4. Manufacturer and Installation
5. Pressure and Leak Test
6. Electrical Wire and Cable
7. I&C Wire and Cable
8. Factory
9. Electric
10. Mecha
11. Equipm
12. Startu
13. Traini
14. System
15. Main
16. Defic



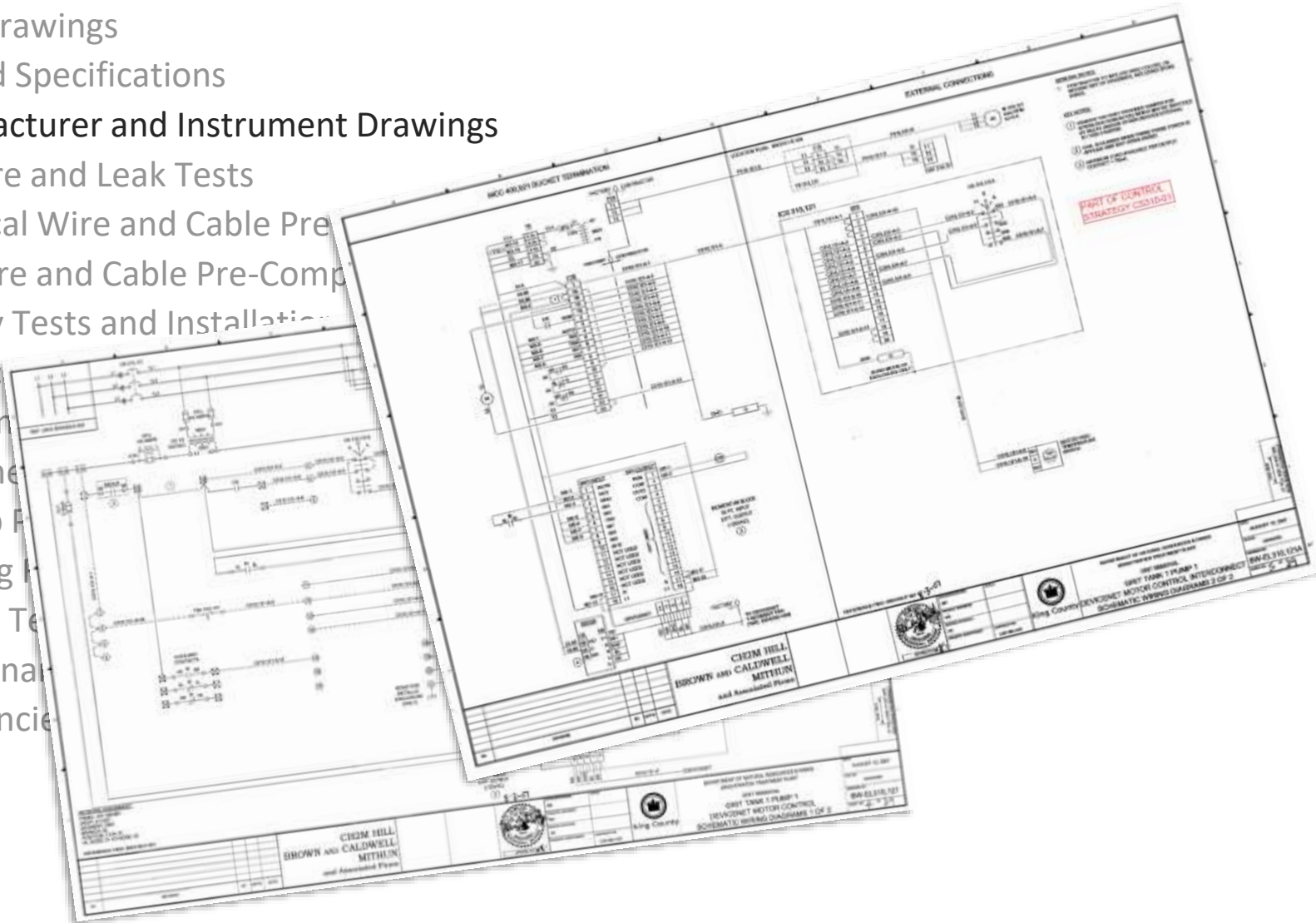
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7. I&C Wire and Cable
8. Factory Tests and
9. Electrical and I&C
10. Mechanical Equipment
11. Equipment Vibration
12. Startup Plan and Job
13. Training Records
14. System Tests
15. Maintenance Forms and
16. Deficiencies, Punch lists and



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HOFFMAN CONSTRUCTION COMPANY OF WASHINGTON
 1301 Woodside Ave. N., Box 200, South, WA 98148
 Phone: (206) 487-7400 Fax: (206) 487-7423
 License Number: B0079462100000

Quality Assurance/Quality Control Plan
 Brightwater Treatment Plant
 King County

HYDROSTATIC/PNEUMATIC PIPING TEST REPORT

WORK INSTALLED BY: SUBCONTRACTOR
 SUBCONTRACTOR: *Boyer*
 DATE OF TEST: *12/18/10*
 SYSTEM TESTED: *SGT # 7002*
 LINE/TEST LOCATION: *2nd # 2 1st # 2*
 REPORT BY: *Bob Jensen*

TEST CONDUCTED BY: SUBCONTRACTOR
 TEST NO.: *356*
 LOCATION: *210 El 200 200 200 El 200*
 SPECIFICATION NO.: *150 50*
 REFERENCE DRAWING NUMBER:
 TO: *220 El 1 2 2*
 DATE OF REPORT: *12/18/10*

TYPE OF TEST: VISUAL HYDROSTATIC PNEUMATIC

Specified	Actual	Test Media	Test Pressure	Test Duration	Allowable Leakage
		Water	50	1	0
		Water	50	1	0
		Water	50	1	0

Test Media: Water
 Test Pressure: 50
 Test Duration: 1
 Allowable Leakage: 0

Date Test Started: *12/18/10*
 Time Test Started: *7:57 AM*
 Starting Pressure: *50*
 Date Test Finished: *12/18/10*
 Time Test Finished: *8:20 AM*
 Finish Pressure: *50*
 Pressure Change: *0*
 Primary Gauge No. *P 311 16 2*
 Secondary Gauge No. *20 2/11*

Remarks:

Test results: Pass Fail
 Re-Test Required: Yes No

Test Performed By: *Bob Jensen*
 Test Performed By: *Bob Jensen (see inside)*
 Test Performed By:

Page 1 of 2
 Company: King County
 Form Q-32

Startup Test Plan Content

1. Control Strategy
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6. Electrical Wire and Cable Pre-Component Tests
7. I&C Wire and Cable Pre-Component Tests
8. Factory Acceptance Tests
9. Electrical System Acceptance Tests
10. Mechanical System Acceptance Tests
11. Equipment Acceptance Tests
12. Startup Acceptance Tests
13. Training Acceptance Tests
14. System Acceptance Tests
15. Maintenance Acceptance Tests
16. Deficiency Acceptance Tests

LOW VOLTAGE CABLE INSPECTION AND TEST REPORT

Project Information: King County, Brightwater Treatment Plant, 7/26/2010, Project Info

Customer: King County, Location: Brightwater Treatment Plant, Date of Test: 7/26/2010

MCC 400.921

Cable Designation	Cable Size	Breaker/Switch Rating	Cable Resistance (Milliohms)			Visual Inspection	Notes
			A	B	C		
P210.122-A	244, 3#120	150 AMP	00	00	00	CM	
P210.122-B	244, 3#120	150 AMP	00	00	00	CM	
P210.122-C	3#10, 3#140	150 AMP	00	00	00	CM	
P210.124-A	244, 3#120	150 AMP	00	00	00	CM	
P210.124-B	244, 3#120	150 AMP	00	00	00	CM	
P210.124-C	244, 3#120	150 AMP	00	00	00	CM	
P210.125-A	244, 3#120	150 AMP	00	00	00	CM	
P210.125-B	244, 3#120	150 AMP	00	00	00	CM	
P210.125-C	244, 3#120	150 AMP	00	00	00	CM	
P210.126-A	244, 3#120	150 AMP	00	00	00	CM	
P210.126-B	244, 3#120	150 AMP	00	00	00	CM	
P210.126-C	244, 3#120	150 AMP	00	00	00	CM	
P210.127-A	244, 3#120	150 AMP	00	00	00	CM	
P210.127-B	244, 3#120	150 AMP	00	00	00	CM	
P210.127-C	244, 3#120	150 AMP	00	00	00	CM	
P210.128-A	244, 3#120	150 AMP	00	00	00	CM	
P210.128-B	244, 3#120	150 AMP	00	00	00	CM	
P210.128-C	244, 3#120	150 AMP	00	00	00	CM	
P210.129-A	244, 3#120	150 AMP	00	00	00	CM	
P210.129-B	244, 3#120	150 AMP	00	00	00	CM	
P210.129-C	244, 3#120	150 AMP	00	00	00	CM	
P210.130-A	244, 3#120	150 AMP	00	00	00	CM	
P210.130-B	244, 3#120	150 AMP	00	00	00	CM	
P210.130-C	244, 3#120	150 AMP	00	00	00	CM	
P210.131-A	244, 3#120	150 AMP	00	00	00	CM	
P210.131-B	244, 3#120	150 AMP	00	00	00	CM	
P210.131-C	244, 3#120	150 AMP	00	00	00	CM	
P210.132-A	244, 3#120	150 AMP	00	00	00	CM	
P210.132-B	244, 3#120	150 AMP	00	00	00	CM	
P210.132-C	244, 3#120	150 AMP	00	00	00	CM	
P210.133-A	244, 3#120	150 AMP	00	00	00	CM	
P210.133-B	244, 3#120	150 AMP	00	00	00	CM	
P210.133-C	244, 3#120	150 AMP	00	00	00	CM	
P210.134-A	244, 3#120	150 AMP	00	00	00	CM	
P210.134-B	244, 3#120	150 AMP	00	00	00	CM	
P210.134-C	244, 3#120	150 AMP	00	00	00	CM	

Notes: **Rating Key: 1-Poor, 2-Marginal, 3-Fair, 4-Good, 5-Excellent, 6-Not Applicable

LOW VOLTAGE CABLE INSPECTION AND TEST REPORT

Project Information: King County, Brightwater Treatment Plant, 7/26/2010, Project Info

Customer: King County, Location: Brightwater Treatment Plant, Date of Test: 7/26/2010

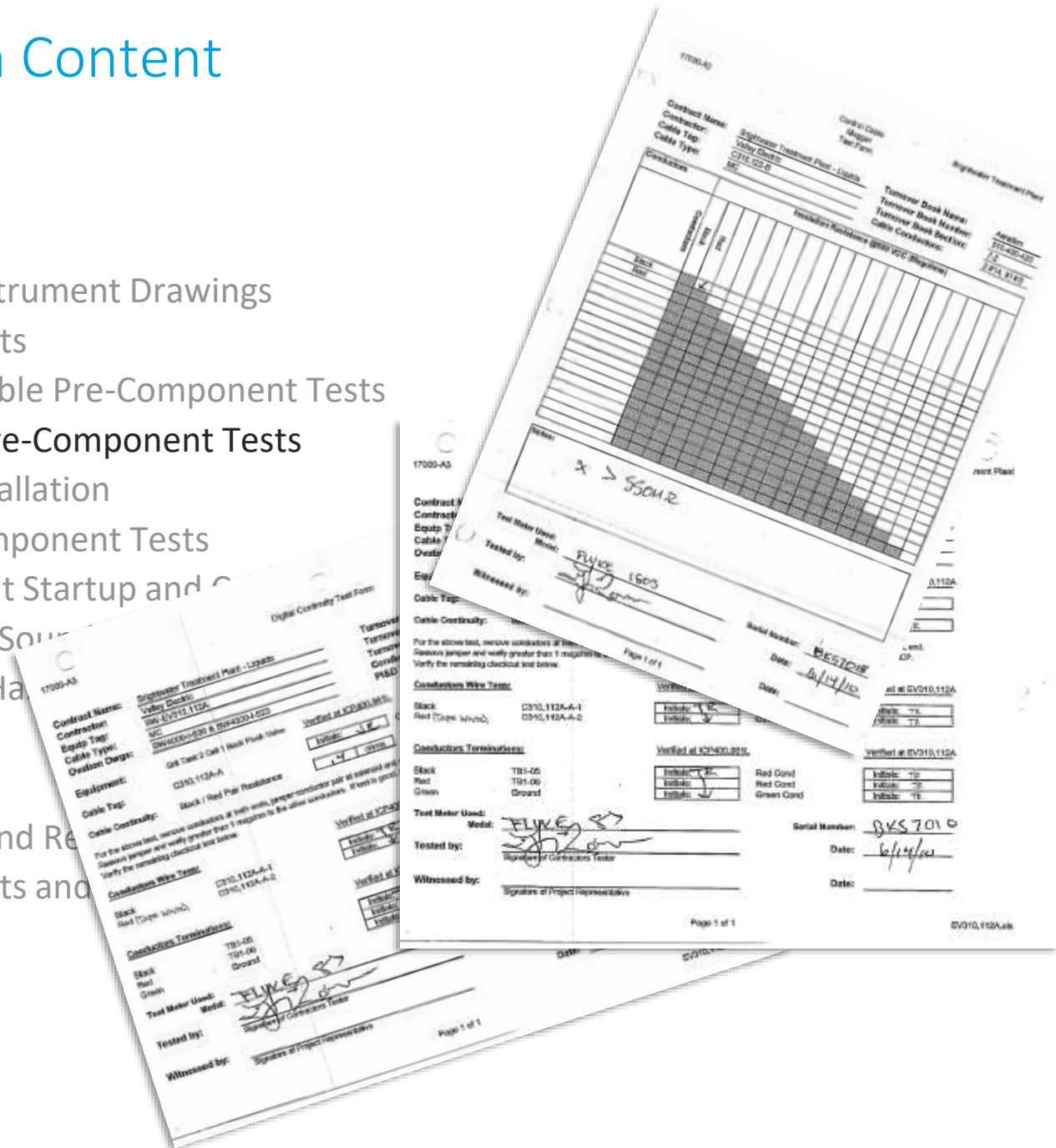
MCC 400.921

Cable Designation	Cable Size	Breaker/Switch Rating	Cable Resistance (Milliohms)			Insulation Resistance @ 1000VDC (Megohms)						Visual Inspection	Notes		
			A	B	C	A-B	B-C	C-A	A-G	B-G	C-G				
P210.121-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.121-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.121-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.122-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.122-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.122-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.123-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.123-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.123-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.124-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.124-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.124-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.125-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.125-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.125-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.126-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.126-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.126-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.127-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.127-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.127-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.128-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.128-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.128-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.129-A	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.129-B	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	
P210.129-C	244, 3#120	150 AMP	00	00	00	00	00	00	00	00	00	00	00	CM	

Notes: **Rating Key: 1-Poor, 2-Marginal, 3-Fair, 4-Good, 5-Excellent, 6-Not Applicable

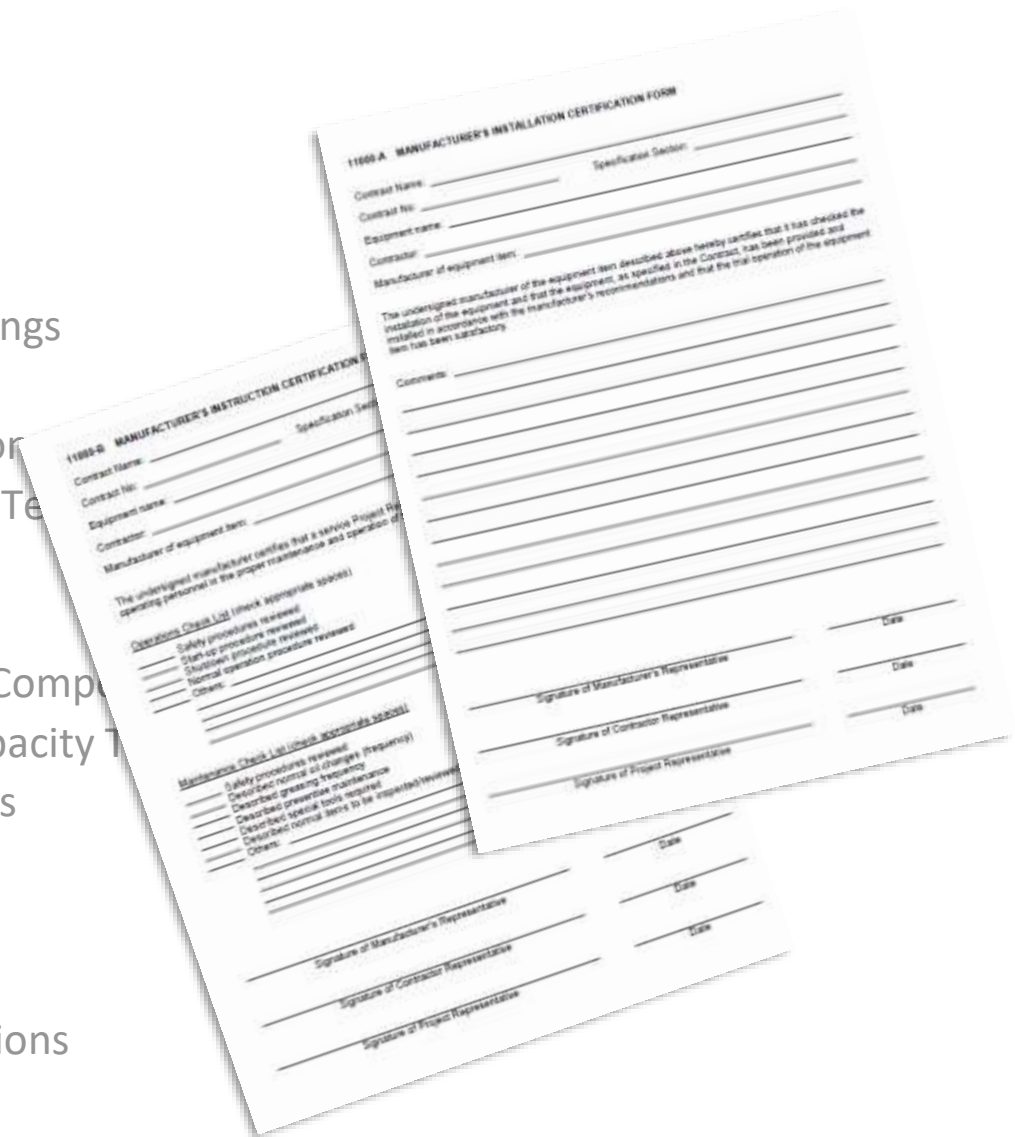
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11. Equipment Vibration, Sound
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Contract Name: Brightwater Treatment Plant
Contractor: Emerson
Equipment Tag: P 310 124
Device Type: Constant Speed DN Starter

0	amps	3	%	hours
27.1	amps	0		

1) Record current read at DCS with the equipment off.
2) Turn the ICS station to auto and verify pump turns on. Record the running amps, current instantaneous percentage, ICS switch status, and run status.
3) Verify that DCS is recording run time on this equipment and record present hours.
4) Turn the ICS station to auto and verify that the equipment stopped. Issue a start command from DCS console and verify that the equipment did not start. Issue stop command from the DCS console.
5) Turn the ICS station to auto and verify that the DCS system indicates the equipment in auto.
6) Turn the ICS station to auto and verify that the equipment starts plus the correct status is indicated at the DCS console.
7) Issue a start command from the DCS console and verify the equipment stops plus trip alarm received at the DCS console.
8) Push the trip test button at the starter and verify the starter resets.
9) Issue a trip reset from the DCS console and verify the starter resets.

Circle DCS Equipment Status Indicator: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A
Circle Test Result: Pass Fail N/A

Comments: _____
Date: 12/3/10
Emerson Technician: _____
Signature of Project Representative: _____
Witnessed By: _____
Rev 1

Comments: _____
Date: 12/3/10
Emerson Technician: _____
Signature of Project Representative: _____
Witnessed By: _____
Rev 1

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FORM-X MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract Name: Digester Treatment Plant - Liquids Stream
 Contract No: CS310-08 Specification Section: 11000
 Equipment name: Grt Tanks 1-4 Pumps 1-4 2 3 4 5 6 7 8 9 10 11 12
 Contractor: H&B Mechanical Contractors
 Manufacturer of equipment name: Mitsui/Apsco

The undersigned manufacturer of the equipment here described above hereby certifies that it has checked the installation of the equipment and that the equipment, as specified in the Contract, has been provided and installed in accordance with the manufacturer's recommendations and that the installation of the equipment has been satisfactory.

Comments: *Pumps installed well and operating to manufacturers specifications.*

 Signature of Manufacturer's Representative 11/12/10 Date

 Signature of Contractor Representative 11/12/10 Date

 Signature of Fieldman Representative 11/12/10 Date

 Signature of Project Representative 11/21/10 Date

Contract Name: 111019 01000-1 C...

CS310-01

Equipment Tag	Description	11/12/2010	01/14/2010	12/30/2010
HW-P 210.121	Grt Tank 1 Pump 1	11/12/2010	01/14/2010	12/30/2010
HW-P 210.131	Grt Tank 2 Pump 2	11/12/2010	01/14/2010	12/30/2010
HW-P 210.122	Grt Tank 2 Pump 3	11/12/2010	01/14/2010	12/30/2010
HW-P 210.132	Grt Tank 3 Pump 2	11/12/2010	01/14/2010	12/30/2010
HW-P 210.123	Grt Tank 3 Pump 3	11/12/2010	01/14/2010	12/30/2010
HW-P 210.133	Grt Tank 4 Pump 1	11/12/2010	01/14/2010	12/30/2010
HW-P 210.134	Grt Tank 4 Pump 2	11/12/2010	01/14/2010	12/30/2010
HW-P 210.124	Grt Tank 5 Pump 1	11/12/2010	01/14/2010	12/30/2010
HW-P 210.125	Grt Tank 5 Pump 2	11/12/2010	01/14/2010	12/30/2010
HW-P 210.126	Grt Tank 5 Pump 3	11/12/2010	01/14/2010	12/30/2010
HW-P 210.135	Grt Tank 5 Pump 2	11/12/2010	01/14/2010	12/30/2010

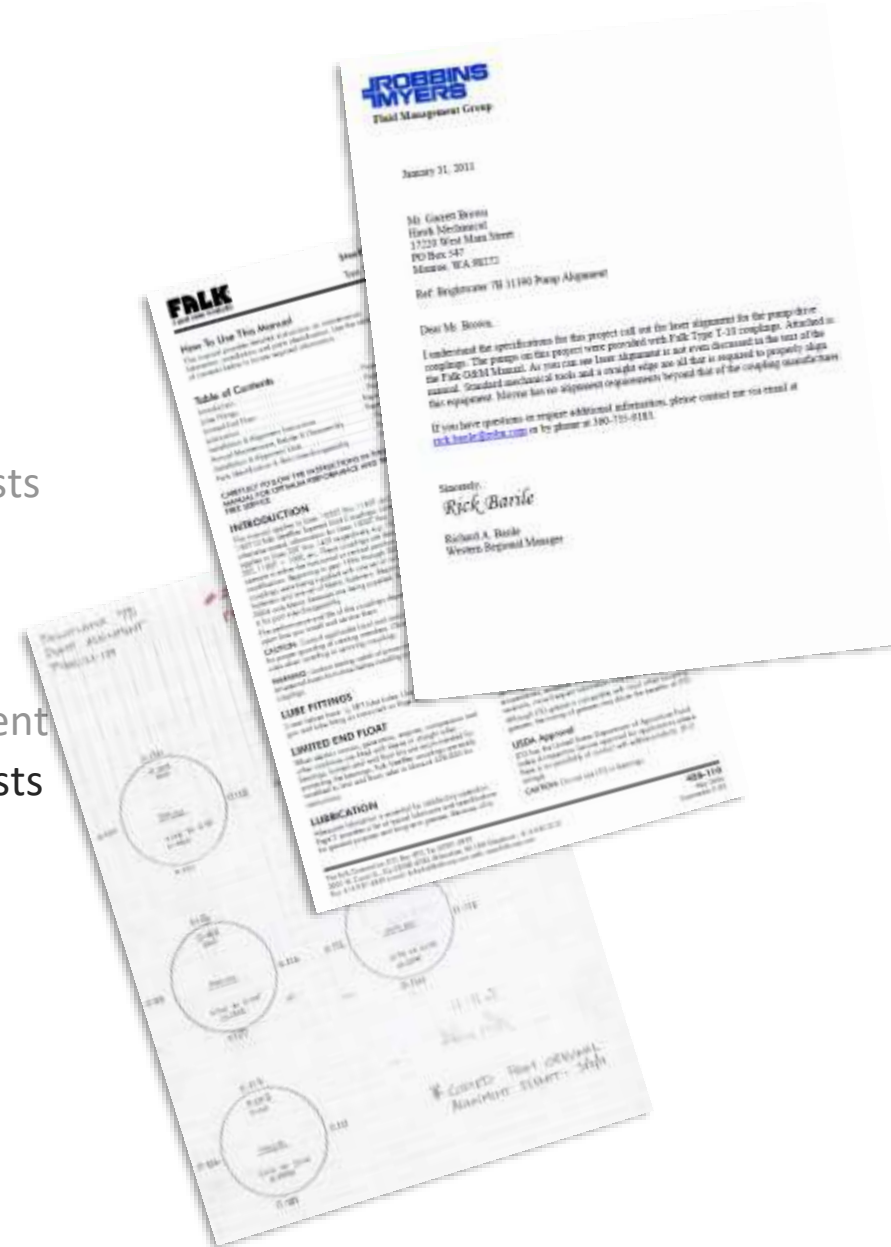
Manual Valve	Description	Manual Stroke Valve Complete	Tight Shutoff Test Complete	Chain Fall Installation Inspection Complete	Comments
0" Plug	Grt Tank 1 Pump 1 Inlet Valve	Yes	Yes	NA	
0" Plug	Grt Tank 1 Pump 2 Inlet Valve	Yes	Yes	NA	
0" Plug	Grt Tank 1 Pump 2 Outlet Valve	Yes	Yes	NA	
0" Plug	Grt Tank 1 Pump 3 Outlet Valve	Yes	Yes	YCS	
0" Plug	Application Air to Grt Tank 1 Pump 1 Valve	Yes	Yes	NA	
0" Butterfly	Application Air to Grt Tank 1 Pump 2 Valve	Yes	Yes	YCS	
0" Butterfly	Grt Tank 2 Pump 2 Inlet Valve	Yes	Yes	NA	
0" Plug	Grt Tank 2 Pump 2 Outlet Valve	Yes	Yes	NA	
0" Plug	Grt Tank 2 Pump 3 Outlet Valve	Yes	Yes	NA	
0" Plug	Application Air to Grt Tank 2 Pump 1 Valve	Yes	Yes	NA	
0" Plug	Application Air to Grt Tank 2 Pump 2 Valve	Yes	Yes	NA	
0" Butterfly	Application Air to Grt Tank 2 Pump 3 Valve	Yes	Yes	NA	
0" Plug	Grt Tank 3 Pump 1 Inlet Valve	Yes	Yes	NA	
0" Plug	Grt Tank 3 Pump 1 Outlet Valve	Yes	Yes	NA	

CS310-01 Mech Component Test Index

Page 1 of 2

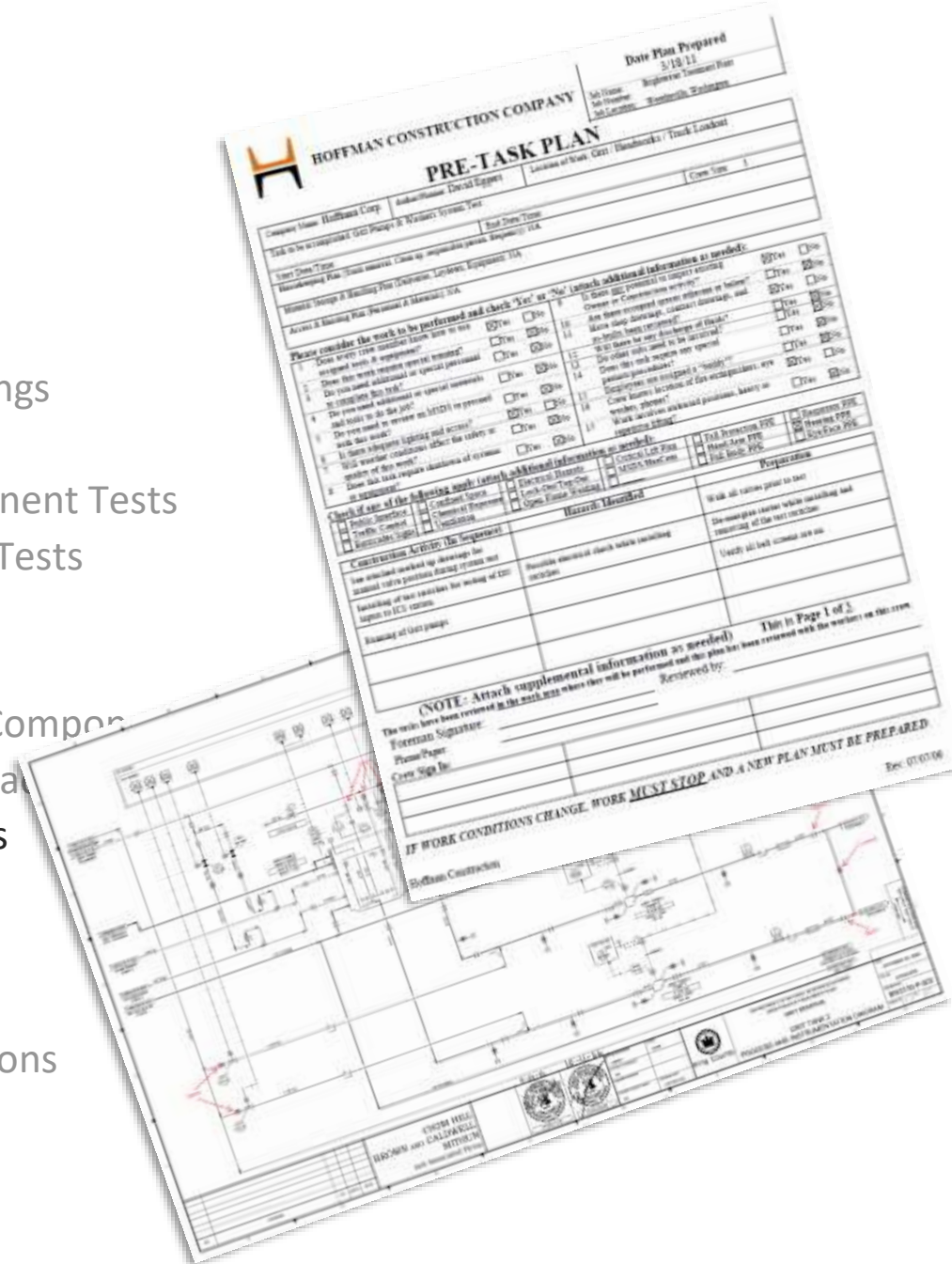
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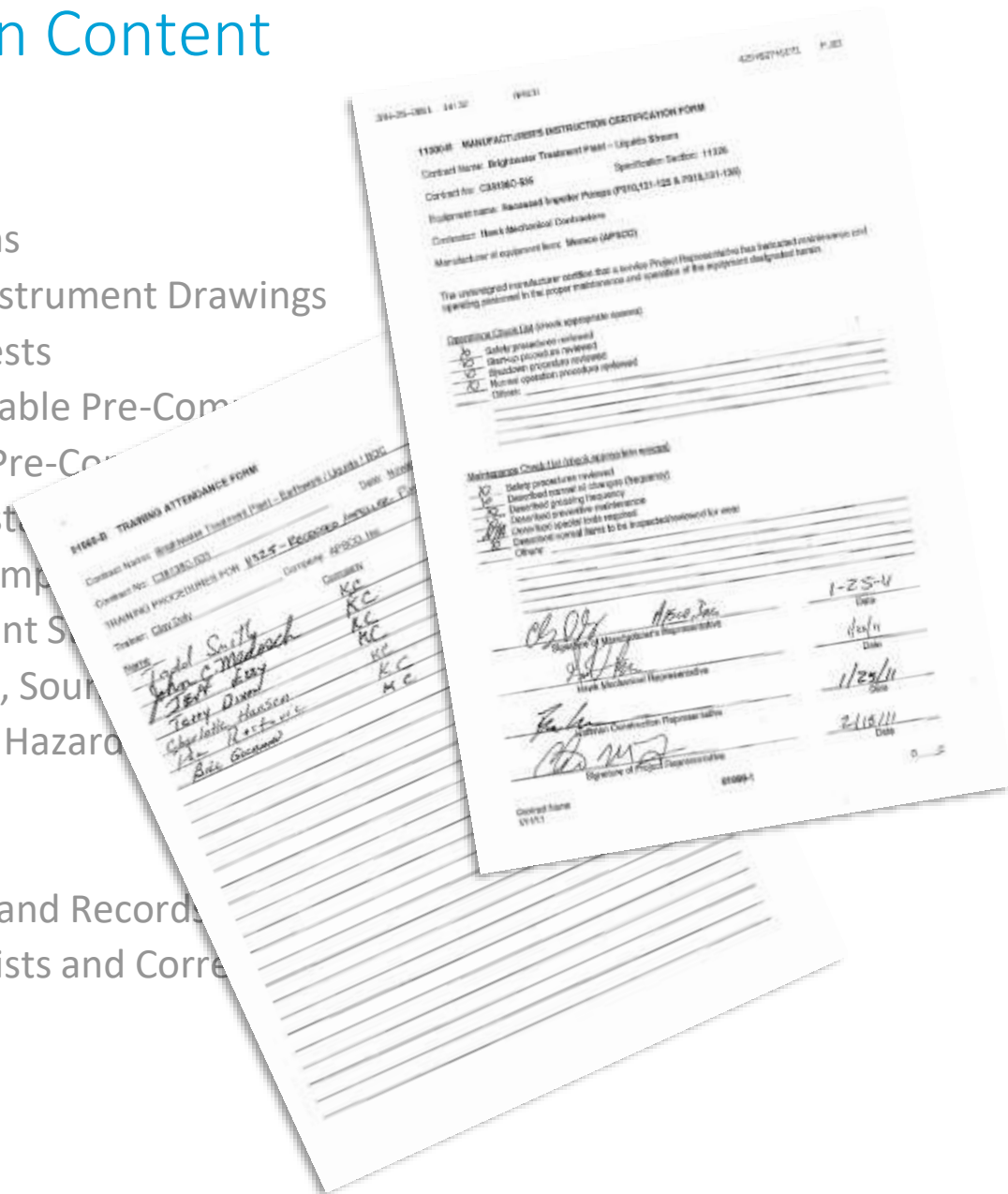
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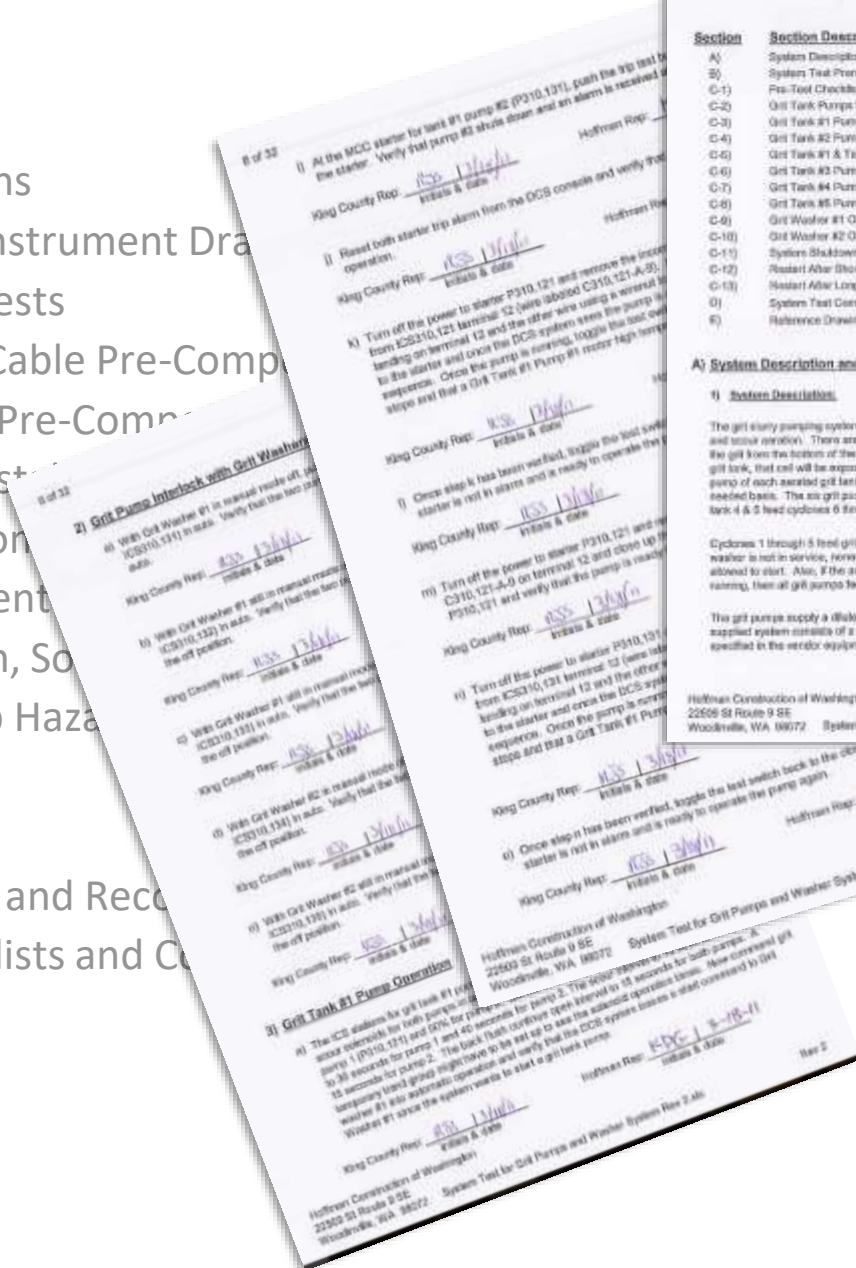
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1 of 32

Grit Pumps and Grit Washer/Dewatering System Test at Brightwater Waste Water Treatment Plant

INDEX

Section	Section Description	Start Page
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B)	System Test Prerequisites	Page 4
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C-2)	Grit Tank Pumps Interlock with Grit Washers	Page 8
C-3)	Grit Tank #1 Pump Operation	Page 8
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C-5)	Grit Tank #1 & Tank #2 Pump #3 Alternating Run Cycle	Page 11
C-6)	Grit Tank #3 Pump Operation	Page 13
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C-8)	Grit Tank #5 Pump Operation	Page 19
C-9)	Grit Washer #1 Operation	Page 21
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A) System Description and Equipment List

1) System Description

The grit slurry pumping system removes grit from the grit tanks after it has been floated with tank flush water and tank rotation. There are two pumps per grit tank and the pumps are operated on fixed intervals, pumping the grit from the bottom of the two grit tank cells to the grit cyclones. Because the grit flows into the first cell of a grit tank, that cell will be exposed to higher concentrations of grit than the second cell. Therefore, the first cell of a pump of each aerated grit tank will operate continuously while the second cell pump will operate on an as-needed basis. The six grit pumps from tanks 1 through 3 feed cyclones 1 through 5 and the 4 grit pumps from tank 4 & 5 feed cyclones 6 through 10.

Cyclones 1 through 5 feed grit waster #1 and cyclones 6 through 10 feed grit waster #2. If the associated grit waster is not in service, none of the grit pumps feeding cyclones that feed the out of service grit waster is allowed to start. Also, if the associated in-service grit waster fails to start within 60 seconds of the grit pump ramping, then all grit pumps feeding that grit waster will be allowed.

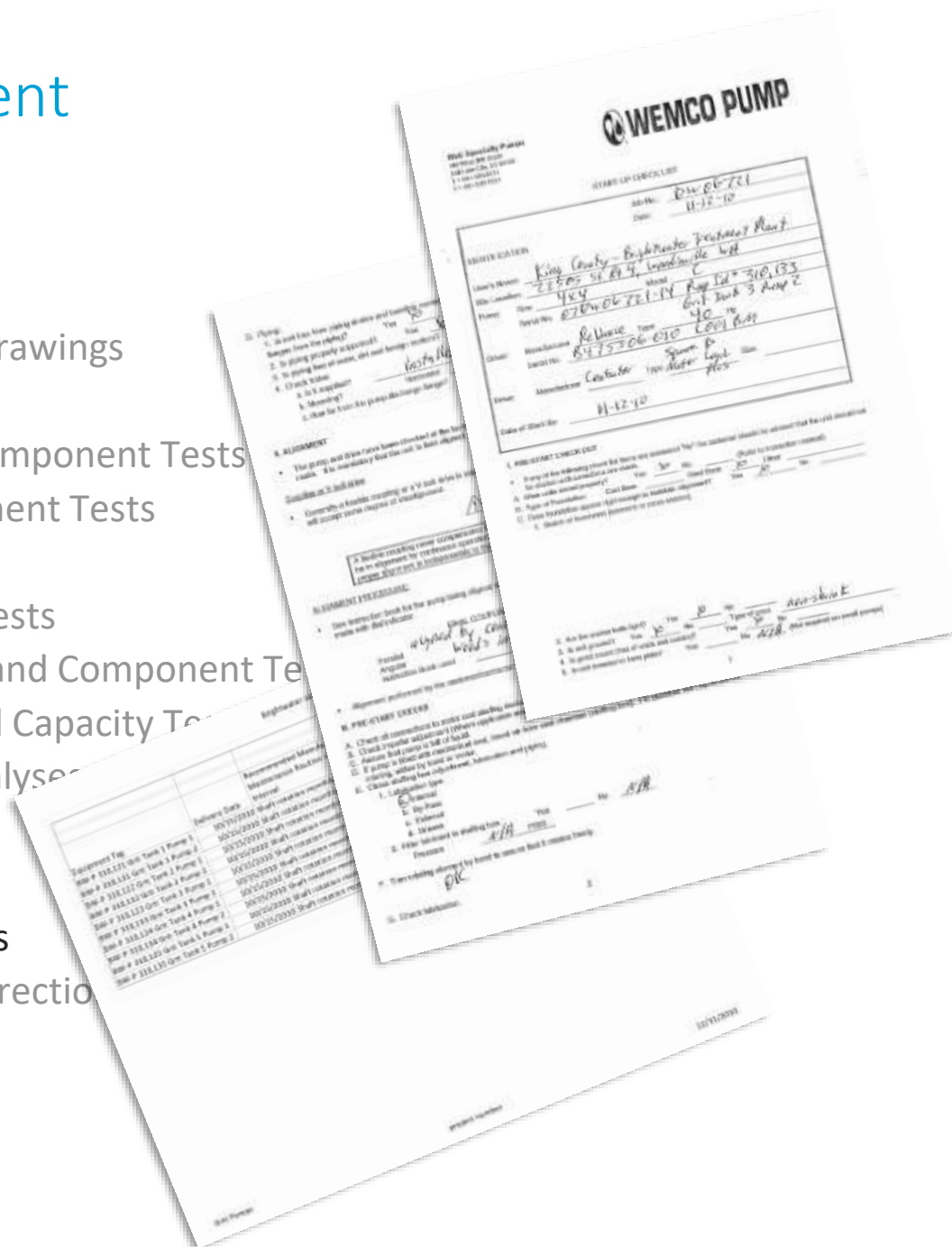
The grit pumps supply a dilute slurry from the grit tanks to cyclones that concentrate the grit slurry. The vendor supplied system consists of a grit waster motor, grit waster conveyor, valves, instrumentation, and switches as specified in the vendor equipment specification, section 11146.

Hoffman Construction of Washington
22509 St Route 9 SE
Woodinville, WA 98072 System Test for Grit Pumps and Washer System Rev 2.0

Rev 2

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The image shows three overlapping forms used for documentation in a startup test plan. The top form is titled 'SYSTEM PUNCHLIST DOCUMENTATION FORM' and includes fields for Contract Name, Contract No., Title, and Date. It features a table with columns for Item No., Date, Location, and Description. The middle form is titled 'SYSTEM TESTING DEFICIENCY DOCUMENTATION FORM' and includes fields for Contract Name, Contract No., System, and Date. It features a table with columns for Item No., Div. or Spec. Reference, and Description/Response. The bottom form is partially visible and appears to be another instance of the 'SYSTEM TESTING DEFICIENCY DOCUMENTATION FORM'.

Case Studies

GWWTS Overview

- 70 MGD treatment capacity
 - Screening – 115 MGD
 - Equalization – 1.1 MG
 - Conveyance storage counted in the model
 - Ballasted Sedimentation – 70 MGD
 - UV disinfection – 70 MGD
 - River outfall – 70 MGD
- Peak event volume – 85 MG
- Average annual treated volume – 67 MG/year
- Average number of events – 20+
- Events are a few hours to a few days long



Intermittent Operations and Startup Challenges

Challenges

Satellite facility (not located at an existing 24/7 WWTP, not staffed full time)

Ready to start – must react quickly as levels rise quickly

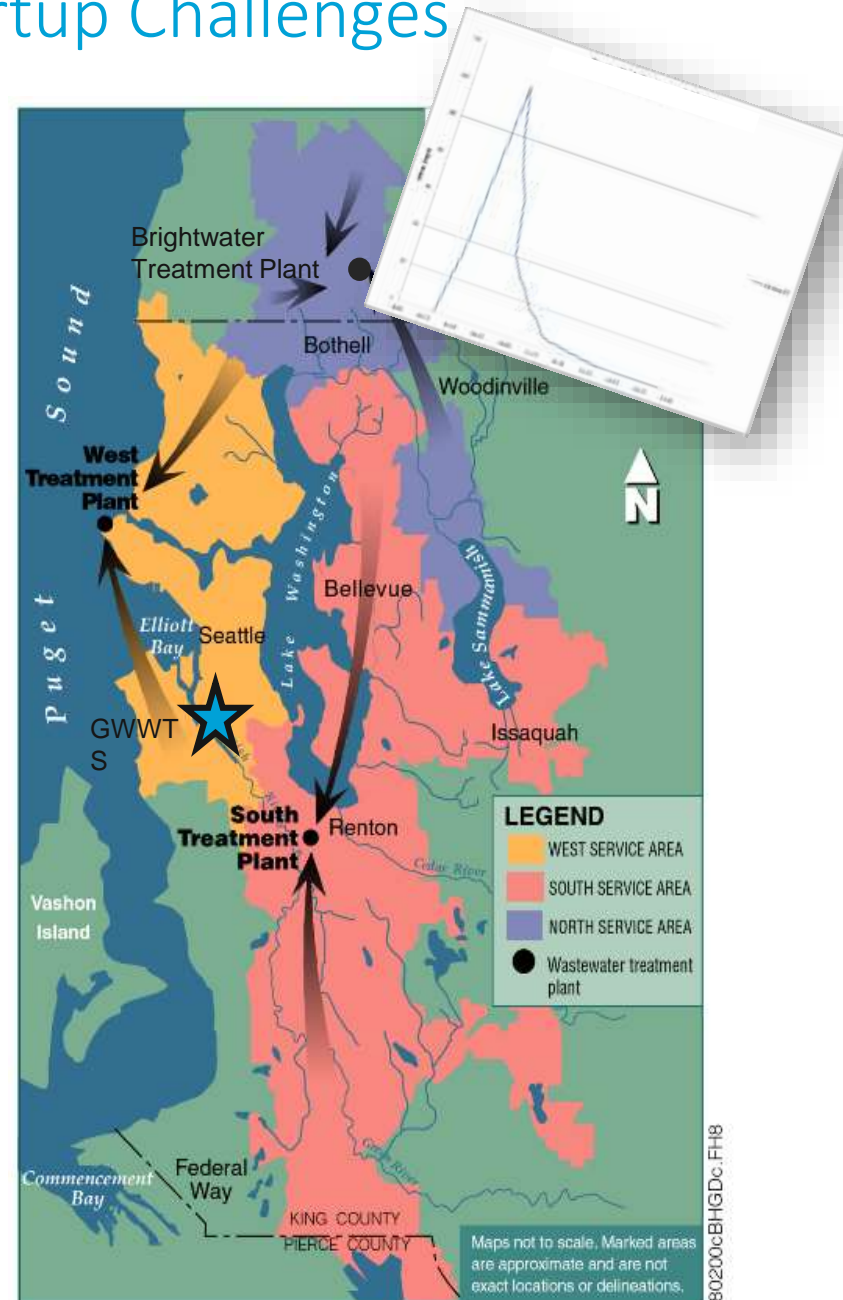
Start and Stop automatically

Shutdown after event

Shutdown after season

Startup Testing – sufficient water to hydraulically test

Performance Testing – achieve a meaningful test, since storms cannot be scheduled.



Georgetown Wet Weather Treatment Station Start-up

Pre-Installation
Test Phase

Component
Test Phase

System Test
Phase

Operational
Test Phase Part
1

Operational
Test Phase Part
2

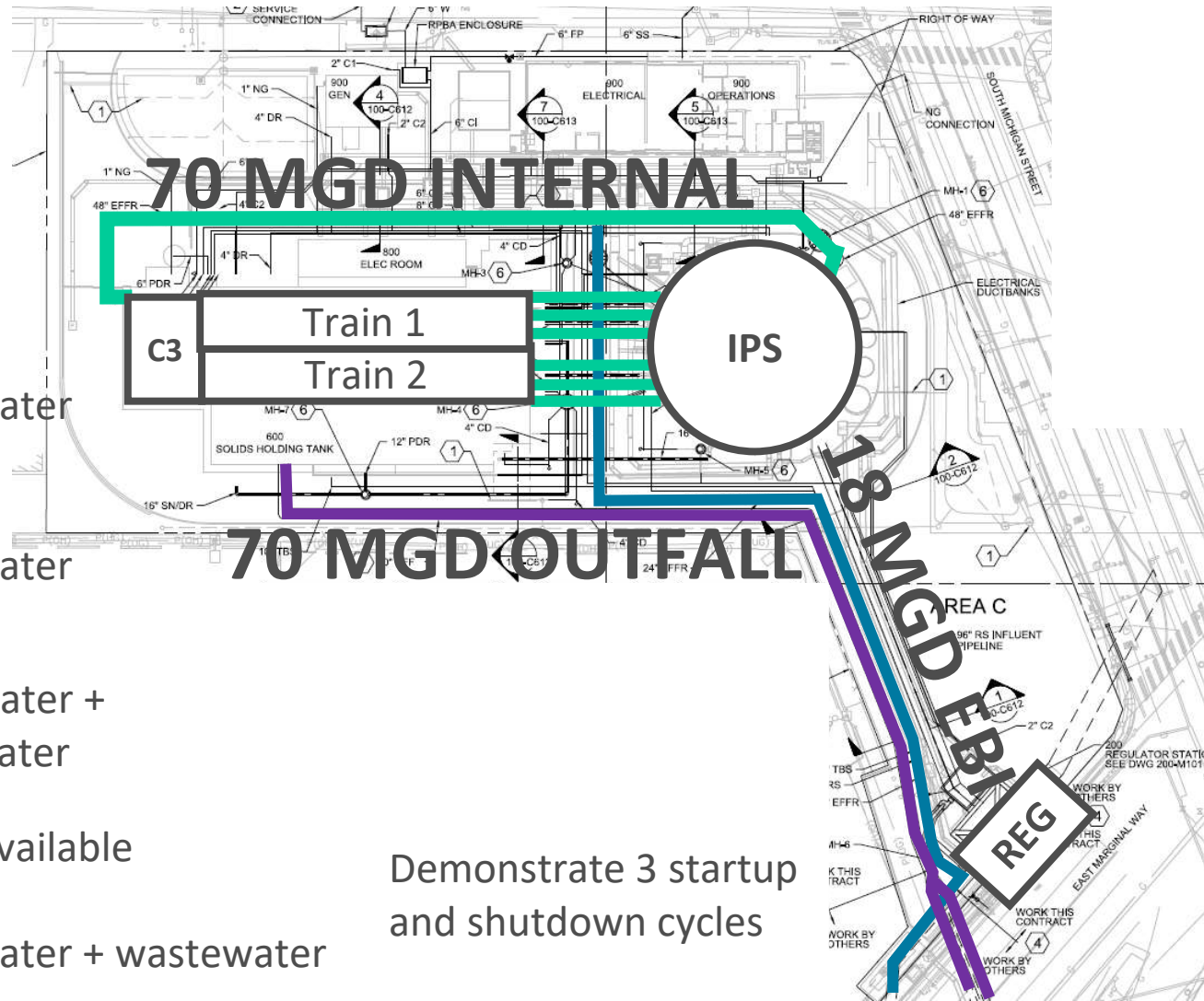
Commissioning
Phase

Clean water

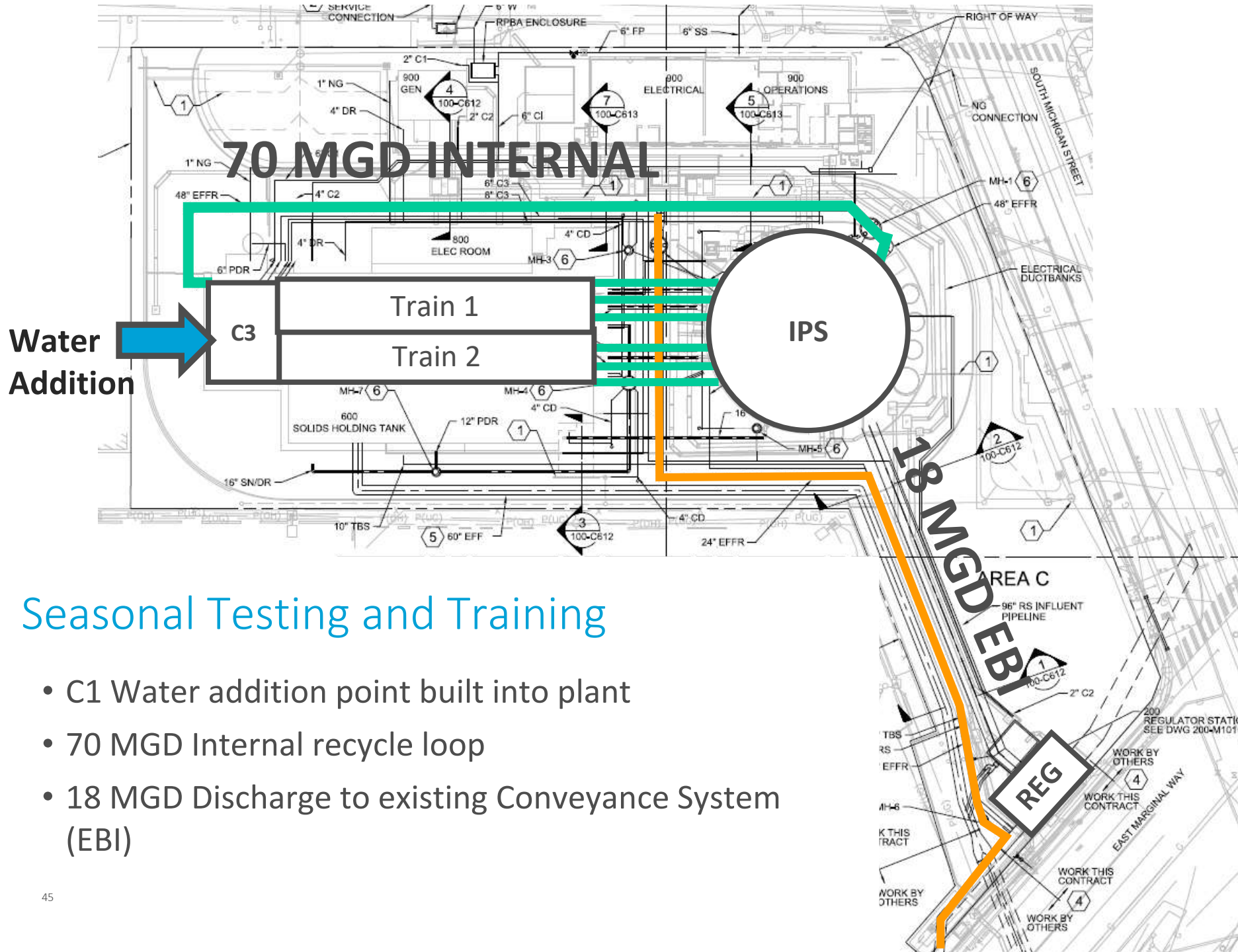
Clean water

Clean water +
wastewater

CSO if available
OR
Clean water + wastewater



Demonstrate 3 startup
and shutdown cycles



70 MGD INTERNAL

Water Addition

Train 1
Train 2

IPS

18 MGD EBI

REG

Seasonal Testing and Training

- C1 Water addition point built into plant
- 70 MGD Internal recycle loop
- 18 MGD Discharge to existing Conveyance System (EBI)

Recurring themes

- Ozone threads leak
- Hypo systems leak
- Diffusers leak
- If process fails, confirm mechanical
 - Valves open/actuator open
 - Pumps delivering specified flow
- Vendor supplied package system may not fully understand process outside of package
- Material compatibility
- Startup screens left in place
- Surge issues during testing
- Nuisance alarms are not always nuisances

Thank you



Tina Hastings, P.E., PMP, ENV SP

Jacobs

Project Manager/Water Engineer

425.233.3058 Desk

Tina.Hastings@jacobs.com

Butch Perry

King County

Infrastructure Coordinator

Harold.Perry@KingCounty.gov

Boston Water Treatment Plant

- Ozone disinfection, storage tank(s) conveyance tunnel
- Design allowed for future filtration facility
- Connecting structure flooded
- Ozone contractor vacuum relief minimal
- Post event forensics

Tolt

- Does the design match upstream and downstream conditions?
- Post construction - are all hatches/covers clean gasketed and secured?
- Control System
 - Alarm criticality assigned?
 - Nuisance alarms cleared?
- Post startup all systems should be visually inspected frequently and monitored for alarm condition continuously
- Unusual activities detected by smell, sound, visually or by the control system should be checked immediately and problem corrected or system disabled until craft is available to investigate.

Cambridge

- Consider failure modes and isolation points
- Access to isolation devices
- Changes allowed during construction - Don't assume, consider impact
- Power failure resulted in surge
- Could not isolate flow into plant
- Flow isolated at tank over a mile away - no vacuum relief