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Avoiding Startup Nightmares - How Plant Staff Can Control New Facility Commissioning

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Presentation Objective

1. Startup - what is it ?
2. Describe startup in the construction management environment
3. How a “Prepare – Schedule – Protocol” Method can help you bring new facilities on-line easily

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Startup – The Word May Mean Different Things to Different People

Contractor – everything is installed, no rework required

Vendor – check rotation, complete paperwork

Owner – everything works, we hope ?!

Startup should mean:

The unit process is operating properly under full automatic control and the O&M staff understand the design intent, are comfortable with operating the equipment, and can maintain the equipment properly.

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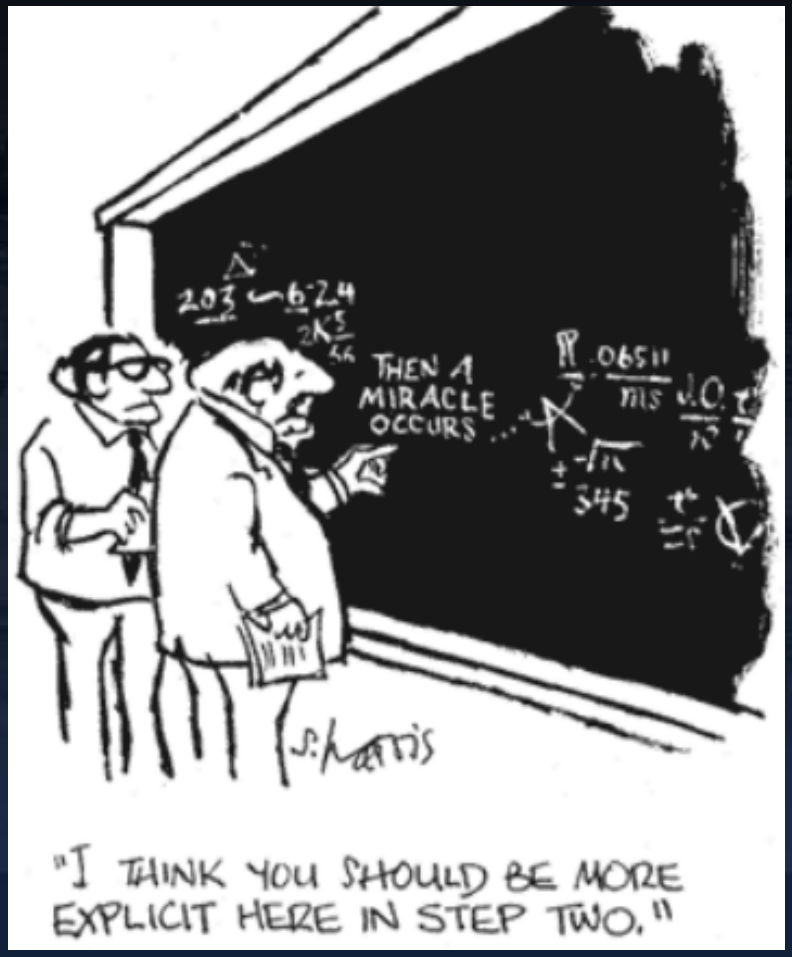
Who is Responsible for Startup ?

- Facility startup is typically addressed by the:
  - Construction Manager
  - Contractor
  - Equipment Suppliers

But you as the Owner have to live through it !



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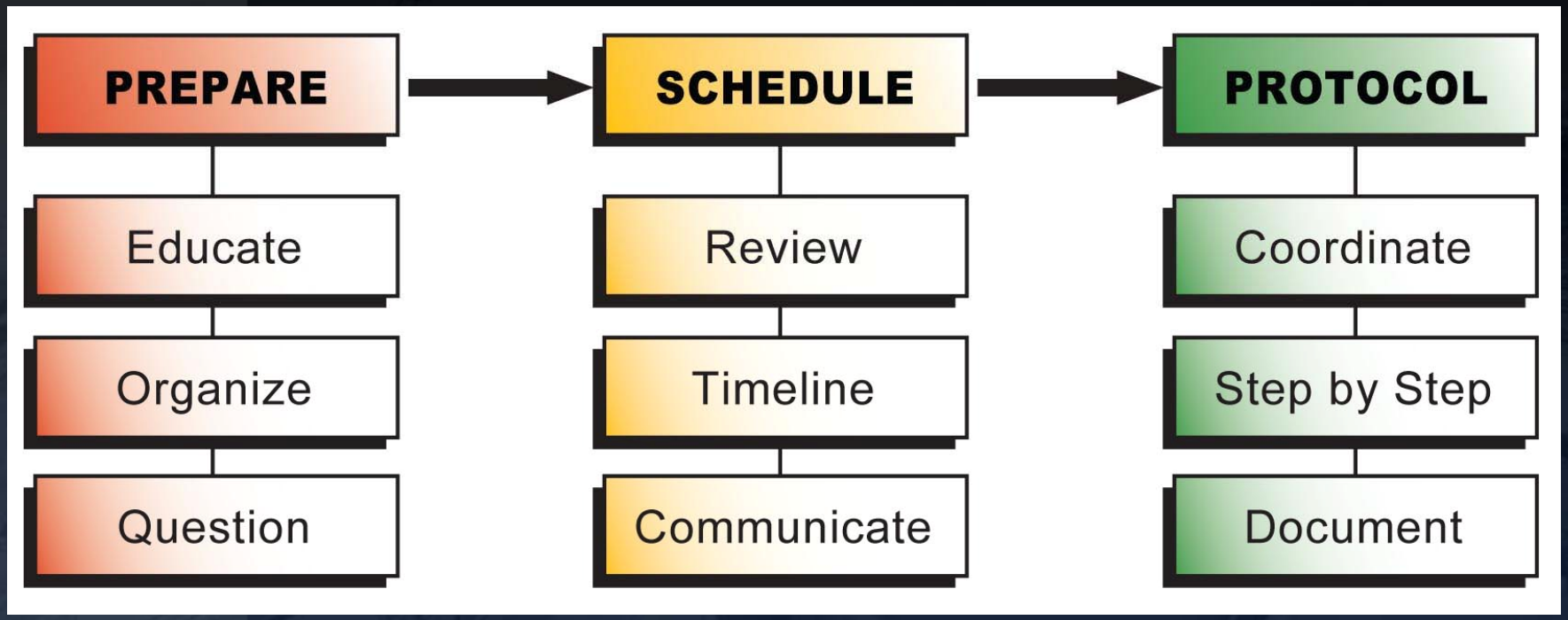
Typical Design-Bid-Build-Commission Sequence

- Pre-design
- Design
- Issue Bid Package
- Award to General Contractor
- Construction
- Startup
- “Here are the keys – good luck ! ”

How Can You Be Ready for Startup ?

Use the PSP Method !



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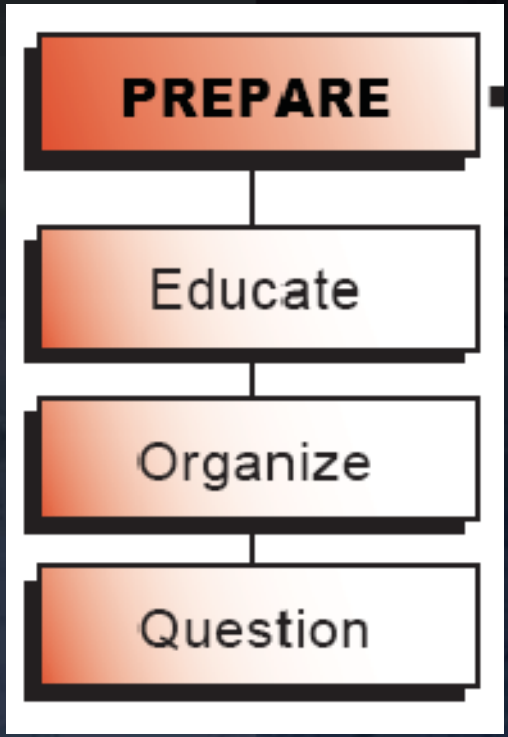
Prepare – Time to Get Educated



In the Preparation element, operators need to find specific information on future equipment, which is buried in . . . .

- Design specifications
- Equipment submittals
- Shop drawings
- Equipment O&M Manual submittals

. . . . and then organize the information so it is easier to understand.

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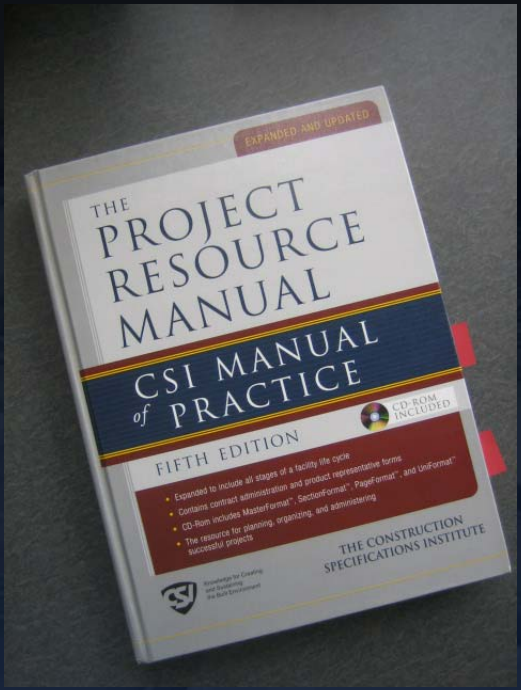
Prepare – Specifications & Drawings

- Specifications are grouped into Divisions 0 - 17
  - Division 1 General Requirements
  - Division 11 Equipment
  - Division 13 Special Construction
- Drawings are grouped by Civil, Structural, Mechanical, Instrumentation and Electrical disciplines:
  - General Abbreviation and Symbols
  - Liquids Schematic
  - Solids Schematic
  - Hydraulic Profile
  - Mechanical Plans
  - Electrical One-Line Diagrams
  - Process and Instrumentation Diagrams



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Prepare – Organize the Information

- "Engineers live by specifications"
- "Contractors live by drawings"
- "Operators live in their plant"

- To be ready for startup, you have to put it all together in a format that makes sense to your staff

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Information Organization Tips

- Create a list of applicable drawings and specifications
- Copy and paste electronic text from specifications into files organized to reflect your process
- Request a copy of equipment O&M Manual submittals
- Post a “working set” of construction drawings. Add notes and red line sketches to assist in interpreting new plant processes
- Create your own version of the liquids and/or solids schematics and show major equipment capacities

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Preparation - Questions

- After reviewing specifications, drawings, and equipment O&M manual submittals:
  - Create a list of equipment and design related questions
  - Organize per process, equipment type, or by division
  - Consider the proper time, place and medium to present your questions
  - Plan ahead - after reviewing the schedule you will have even more questions
- Remember to Document
  - Who did you ask, when did you ask, and what was the response?

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PSP - Scheduling Element

Scheduling startup includes the activities required to:

- complete equipment installation
- complete functional testing
- perform operator training
- commence startup tasks

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Scheduling - Review

- Construction managers, contractors, and project managers provide typical construction scheduling
- The construction schedule is not the “Startup Plan”
- In the PSP Scheduling element, operators learn how to:
  - Communicate in the “construction management” environment
  - Follow transmittal procedures
  - Adjust for construction progression

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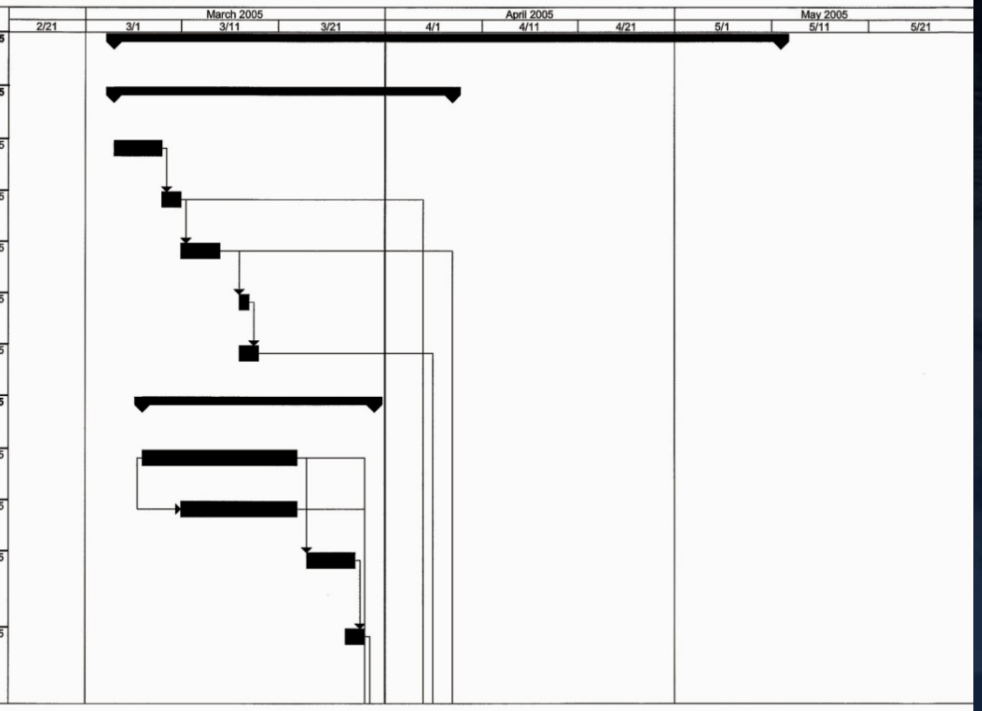
Scheduling - Timeline

- A Gantt Chart is usually found in the contractor's office
- All complex projects have a grouping of activities called the "Critical Path" to completion.

USFilter - Memcor CMF-S Membrane Filtration System
Start-Up Schedule & Activity Sequencing
Kennewick Water Filtration Plant Improvements Project
Membrane Filter Procurement Contract No. P0302

ID	Task Name	Start	Finish
1	**USFilter Membrane Filtration System Start-Up & Commissioning Schedule and Activity Sequencing**	**Fri 3/4/05**	**Wed 5/11/05**
2	**Membrane Installation & Rack Loading Into Filter Cells and Pre-Plant Start-Up**	**Fri 3/4/05**	**Thu 4/7/05**
3	Membrane Loading and Rack Installation for Cell No. 1 (Includes Membrane Loading Into Racks, Racks Installed Into Cells, Filling Cells With Raw Water to Keep Membranes Wet)	Fri 3/4/05	Tue 3/8/05
4	Membrane Loading and Rack Installation for Cell No. 2 (Includes Membrane Loading Into Racks, Racks Installed Into Cells, Filling Cells With Raw Water to Keep Membranes Wet)	Wed 3/9/05	Thu 3/10/05
5	Membrane Loading and Rack Installation for Cell No. 3 (Includes Membrane Loading Into Racks, Racks Installed Into Cells, Filling Cells With Raw Water to Keep Membranes Wet)	Fri 3/11/05	Mon 3/14/05
6	Fill Filter Cells No. 1 - 3 With Clearwell Water Utilizing a Hose to Fill the Cells and Dose 1000 ppm (mg/l) Chlorine Solution for Disinfection with Hypochlorite Chemical Solution Furnished	Thu 3/17/05	Thu 3/17/05
7	Soak Membrane Modules in Filled Filter Cells Nos. 1 -3 With 1000 ppm Chlorine Solution for Required 48 Hours	Thu 3/17/05	Fri 3/18/05
8	**Backwash Pump Repairs and Testing (Tag Nos. P-2513 & P-2518)**	**Mon 3/7/05**	**Wed 3/30/05**
9	Removal and Coating Repair of Fairbanks Morse Backwash Pump No. 1 & Re-Setting Pump In-Place (Coordinated By Apollo) Ensuring Proper Dry Time for Coating	Mon 3/7/05	Tue 3/22/05
10	Removal and Coating Repair of Fairbanks Morse Backwash Pump No. 2 & Re-Setting Pump In-Place (Coordinated By Apollo) Ensuring Proper Dry Time for Coating	Fri 3/11/05	Tue 3/22/05
11	Both Backwash Pumps Sent to Beckwith & Kuffel in Seattle for Re-Work to Remove Grit & Debris From Pumps Caused by Poor Caution Used in Sandblasting and Re-Coating of Pumps	Thu 3/24/05	Mon 3/28/05
12	Both Backwash Pumps Shipped Back to the Jobsite in Kennewick and Re-Set In-Place By Apollo (Bakwash Cans Cleaned of Grit & Debris By Apollo Prior to Re-Setting Pumps)	Mon 3/28/05	Tue 3/29/05



USFilter

Task | Split | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Split | Rolled Up Milestone | Rolled Up Progress | External Tasks | Project Summary | External Milestone | Deadline

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Scheduling - Communicate

Coupled with the knowledge and questions from the Preparation element, pose the following questions internally:

- Staffing
  - What impacts does the schedule have on staffing levels ?
  - Will overtime be needed ?
  - Who is coordinating the contractor, vendor, and plant staff activities ?

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Scheduling - Communicate

- Effluent Compliance / Finished Water Quality
  - Are there any compliance or regulatory deadlines ?
  - If construction involves multiple processes, does the startup sequence make sense?
  - How is effluent or finished water quality monitored?
  - Do sampling collection, analysis, and reporting meet applicable regulations?
  - Are on-line monitors and analyzers appropriate for the sampling stream?
  - Can adverse startup affects be prevented?

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Scheduling - Communicate

- Training and Safety
  - When is equipment vendor training scheduled?
  - Will equipment be operational before or after training?
  - Who is coordinating lock out / tag out activities?
  - Are any safety monitoring devices required?
  - Who is coordinating communication?
- Request a workshop to discuss and review the contractor's schedule

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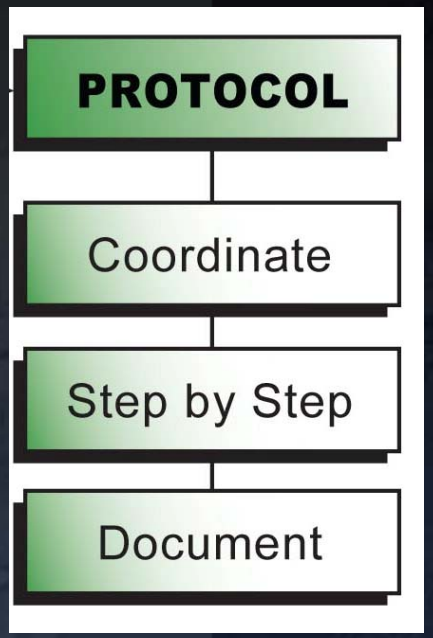
PSP – Startup Protocol Development



Provides a detailed plan to the operators, contractor, and construction management staff of the steps necessary to:

- Startup the process
- Prove performance
- Have the Owner accept the equipment

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Startup Protocol - Coordinate

- Startup plan does not supersede any specification or contractor / engineer / owner obligations
- General contractors may not be well prepared to deal with:
  - Integrating new unit processes with existing plant systems
  - Starting up pumping stations with existing conveyance and distribution systems
  - Control system sophistication
- Requires Coordination of:
  - Systems Integrator
  - Plant Staff
  - Construction Management staff
  - Contractor

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Startup Protocol – 10 Basic Elements

1. State startup goals
2. Define acronyms and abbreviations
3. Define equipment and processes covered
4. Identify constraints or roadblocks
5. Provide contact information for vendors, contractors, key plant staff, construction management personnel
6. List significant startup milestones
7. Reference equipment specific installation checklists
8. Reference equipment specifications including performance requirements
9. Provide safety and communication guidelines
10. Provide bottom-up sequence of events

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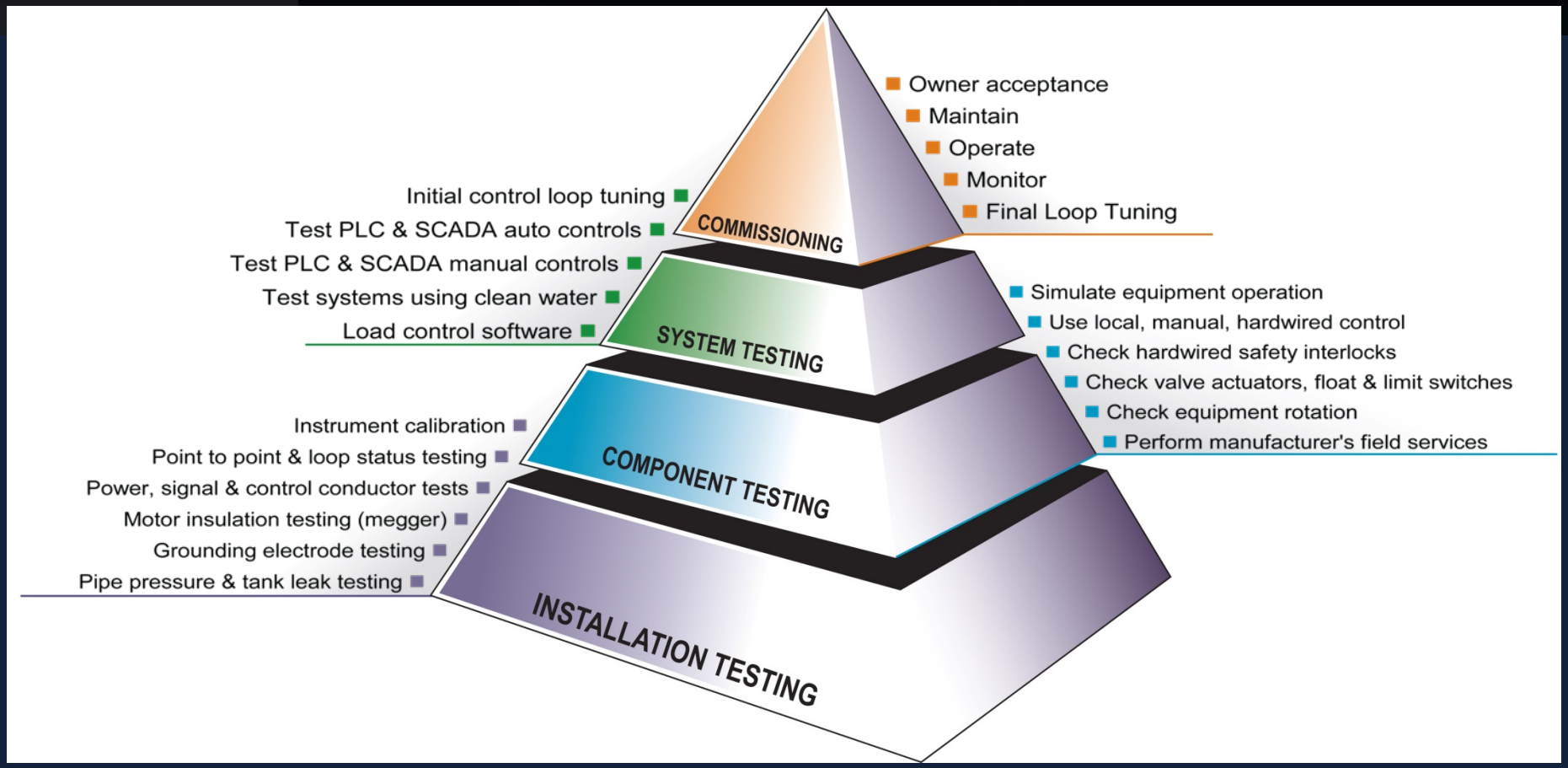
Step by Step – "Bottom Up" Approach



Startup Protocol - Component Testing

- Equipment started and stopped using local controls
- “Clean” water is used. Attempt to isolate from other systems
- Goal is to demonstrate basic functionality and prove protective interlocks work.
- Manufacturers field service may be performed concurrently

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Startup - System Testing

- A system is typically defined as a number of individual components that work together
- For example: raw water pumps, VFDs, and control systems.
- Goal is to demonstrate PLC/SCADA controls and alarms:
  - Typically process setpoints are changed
  - Analog inputs are forced to demonstrate PLC logic is functional

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Startup - Commissioning

- Final decision to place new systems into service discussed and documented in a “GO / NO GO” meeting
- Still may need to meet contractual obligations such as:
  - Performance Testing
  - Acceptance Testing
- Make sure the duration and timing is clearly spelled out in contract documents

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Example Startup Protocol

ATTACHMENT 1
EXAMPLE STARTUP PROTOCOL

Startup - Sequence of Events

System start-up checks will be performed with clean water where available. The following tests activities assume that the sludge feed pumps are aligned to the centrate holding tank. Refer to Attachment A – Dewatering Process Alignment for proper system pre-start setup.

Table 1 – Preliminary Contractual Issues

Preliminary Centrifuge checks	Date Done	Initials	Performed by
1. Provide minimum 7-day notice of targeted demonstration period per 01650-1.3.B.3			Contractor
2. Complete and deliver Instrumentation Suppliers instrumentation installation certificate per 01650-1.3.A.2			Contractor
3. Deliver final approved equipment O&M manuals per 01650-1.3.A.2			Contractor
4. Verify all equipment training has been submitted for review per 01650-1.3.A.1			Contractor
5. Verify electrical inspector has completed final inspection.			Contractor
6. Verify all other City inspections are complete.			Contractor

Table 2 - Centrifuge Component Tests

Preliminary Centrifuge checks	Date Done	Initials	Performed by
1. Perform manufacturer's field service.			Vendor
2. Submit Installation Inspection Report.			Contractor
3. Hearing protection provided.			City
4. Secure flush water.			City
5. Coordinate with plant staff on required belt press operation to maintain plant operations.			Contractor
7. Verify liquid sludge and centrate storage tank levels			City

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Example Startup Protocol

Table 2 - Centrifuge Component Tests, continued			
Verify Alarms & Shutdown (SD indicates a centrifuge shutdown)	**Date Done**	**Initials**	**Performed by**
1. Verify main drive motor over temperature alarm – SD1			Vendor
2. Verify main drive overload alarm – SD1			Vendor
3. Verify main drive 1M, 1S, 2M feedback alarm – SD1			Vendor
4. Verify main drive transition watchdog alarm – SD1			Vendor
5. Verify main drive speed module fault – SD2			Vendor
6. Verify back drive motor over temp alarm – SD1			Vendor
7. Verify back drive feedback alarm – SD2			Vendor
8. Verify back drive VFD run enable fault alarm – SD2			Vendor
9. Verify back drive over speed alarm – SD2			Vendor
10. Verify back drive speed module fault – SD2			Vendor
11. Verify back drive blower motor feedback alarm – SD1			Vendor
12. Verify diverter gate feedback alarm			Vendor
13. Verify diverter gate overload alarm			Vendor
14. Verify high vibration shutdown alarm – SD1			Vendor
15. Verify decanter cover open alarm – SD2			Vendor
16. Verify torque warning			Vendor
17. Verify torque overload alarm – SD2			Vendor
18. Verify low differential speed alarm			Vendor
19. Can all alarms be acknowledged at local panel?			Vendor
20. Can all alarms be acknowledged at plant SCADA?			Vendor
21. Demonstrate Emergency Stop, Sludge Feed Pump fail, Polymer fail, alarm and shutdowns.			Vendor

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Example Startup Protocol

Table 2 - Centrifuge Component Tests, continued			
Test Local Manual Control	**Date Done**	**Initials**	**Performed by**
1. Release EMERGENCY STOP			Vendor
2. Start the Decanter motor			Vendor
3. Open the diverter gate			Vendor
4. Open the feed valve			Vendor
5. Start the sludge feed pump (clean water)			Vendor
6. Monitor for operation for vibration, back drive control, noise levels, motor amps, feed flow monitoring, and back drive/bowl/differential speeds.			Vendor
7. Demonstrate EMERGENCY STOP function.			Vendor

Table 2 - Centrifuge Component Tests, continued			
Test Control Panel (PNL7556) Manual Control	**Date Done**	**Initials**	**Performed by**
The centrifuge feed pump suction is aligned to the centrate holding tank. The centrate holding tank contains 3W Plant Water. The centrifuge will be started in manual mode at PNL7556 to test the DLM Operator Interface Panel. The polymer system will be run with water only, and flushed with mineral oil before polymer is used. The diverter gate position will be closed and aligned to centrate. No cake will be produced. The centrate system should previously have been commissioned and able to operate in automatic.			
1. Ensure no active alarms			Vendor
2. All manual valve aligned for proper operation			City
3. Place system in Manual Run Up mode			Vendor
4. Start centrifuge, allow machine to ramp up to speed.			Vendor
5. Press function key "Decanter Detail"			Vendor
6. Close diverter gate			Vendor
7. Press function key "Input Devices"			Vendor
8. Press function key "Manual"			Vendor
9. Hand symbol should appear over feed pump on screen			Vendor
10. Press function key "Start" sludge feed pump (right hand local pushbutton)			Vendor
11. Adjust feed setpoint and/or monitor flow.			Vendor
12. Select primary polymer and press "Manual" function key			Vendor
13. Hand symbol should appear over polymer on screen			Vendor

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Example Startup Protocol

Table 2 - Centrifuge Component Tests, continued			
14. Change dose setpoint and verify change. (Note: polymer system in "clean" water operation, not pumping polymer)			Vendor
15. Return to the DLM Main Screen			Vendor
16. Toggle back drive mode Differential / Load control (On the local pushbutton located @ right-hand side of screen)			Vendor
17. Enter differing setpoints at back drive and verify change			Vendor
18. Press function key "Input Devices"			Vendor
19. Select active sludge feed pump			Vendor
20. Press the function key "Stop" to stop sludge feed pump			Vendor
21. Select the primary polymer device			Vendor
22. Press the function key "Stop" to stop the polymer system			Vendor
23. Press function key "Decanter Detail"			Vendor
24. Press the function key "Flush Water" to activate			Vendor
25. Press function key "Manual"			Vendor
26. Press function key "Start" to open valve.			Vendor
27. Allow centrifuge to flush for several minutes.			Vendor
28. Press the function key "Stop" to close valve			Vendor
29. Stop decanter at PN7556			Vendor
30. Allow unit to coast down.			Vendor

Table 3 - Centrifuge System Tests			
Test Control Panel (PNL7556) Auto Sequence	Date Done	Initials	Performed by
1. Ensure no active alarms			Vendor
2. All manual valve aligned for proper operation			Vendor
3. Select "Auto Start" from Decanter Logic Manager (OIT)			Vendor
4. Follow System Sequence Steps (0, 2, 3A) as defined in ABB / Alfa Laval DLM Manual.			Vendor
5. Verify systems go to "Production Mode"			Vendor
6. Select "Auto Stop" from DLM			Vendor
7. Verify System Sequence Steps (4 – 8).			Vendor
8. Make sure machine is fully stopped and no active alarms			Vendor
9. Select "CIP Start" from DLM			Vendor
10. Verify CIP System Sequences (0,1,2)			Vendor

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Example Startup Protocol

Table 3 - Centrifuge System Tests, continued			
Test Plant SCADA Monitoring	**Date Done**	**Initials**	**Performed by**
1. Repeat all tasks in Step 4			Vendor
2. Verify Plant SCADA Monitoring corresponds with all status indicators and readouts on DLM screen and PNL7556			I&C Sub-contractor
3. Coordinate alarm checks to verify alarm monitoring on Plant SCADA			I&C Sub-contractor

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Summary

- Armed with knowledge and a few simple tools, plant staff can avoid or at least minimize some of the most common startup problems by focusing on a structured approach to planning, organizing, controlling and documenting commissioning activities.

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QUESTIONS?

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