Pumps and Piping

Design, Performance and Commissioning Issues

Testing Pumps and Piping Systems

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Commissioning; a Definition

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the contract documents, the design intent and the Owner's operational needs

- Begins in predesign
- Documents the design intent
- Continues through construction, acceptance, the warranty period, and through the building's life cycle
- Includes functional testing
- Includes training
- Documents performance

Commissioning is about performance and integration

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New Construction versus EBCx Testing

New Construction

- Trying to prove design intent
- Demonstrate all elements of the system meet requirements
- Verification and quality assurance process

EBCx

- Trying to understand design intent
- Focused on certain elements of the system
- Diagnostic and troubleshooting process

Forced vs. Natural Response Testing

Forced Response Testing

I force a change and watch how the system responds

Forced vs. Natural Response Testing

Forced Response Testing

Example

1. With it 50°F outside and the AHU near 100% OA, I over ride the outdoor air sensor and manually enter 100°F as the outdoor temperature
2. I observe that :
   - Outdoor air dampers commanded to MOA
   - Leaving air set point commanded to low end of reset range
   - Chilled water valve opens

Natural Response Testing

Example

1. I pull trend data from the system for a day when the outdoor air temperature swung from 53 – 82°F.
2. I observe
   - Chilled water temperature instability during low outdoor air temperature periods
   - Transition to and from economizer at appropriate temperatures
   - Return fan tracking fails on minimum outdoor air

Forced vs. Natural Response Testing

Forced Response Testing

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Natural Response Testing

I observe how a system responds to the normal course of events

View the video on Youtube at http://tinyurl.com/MR-1-Launch

For the details behind what went wrong, visit:

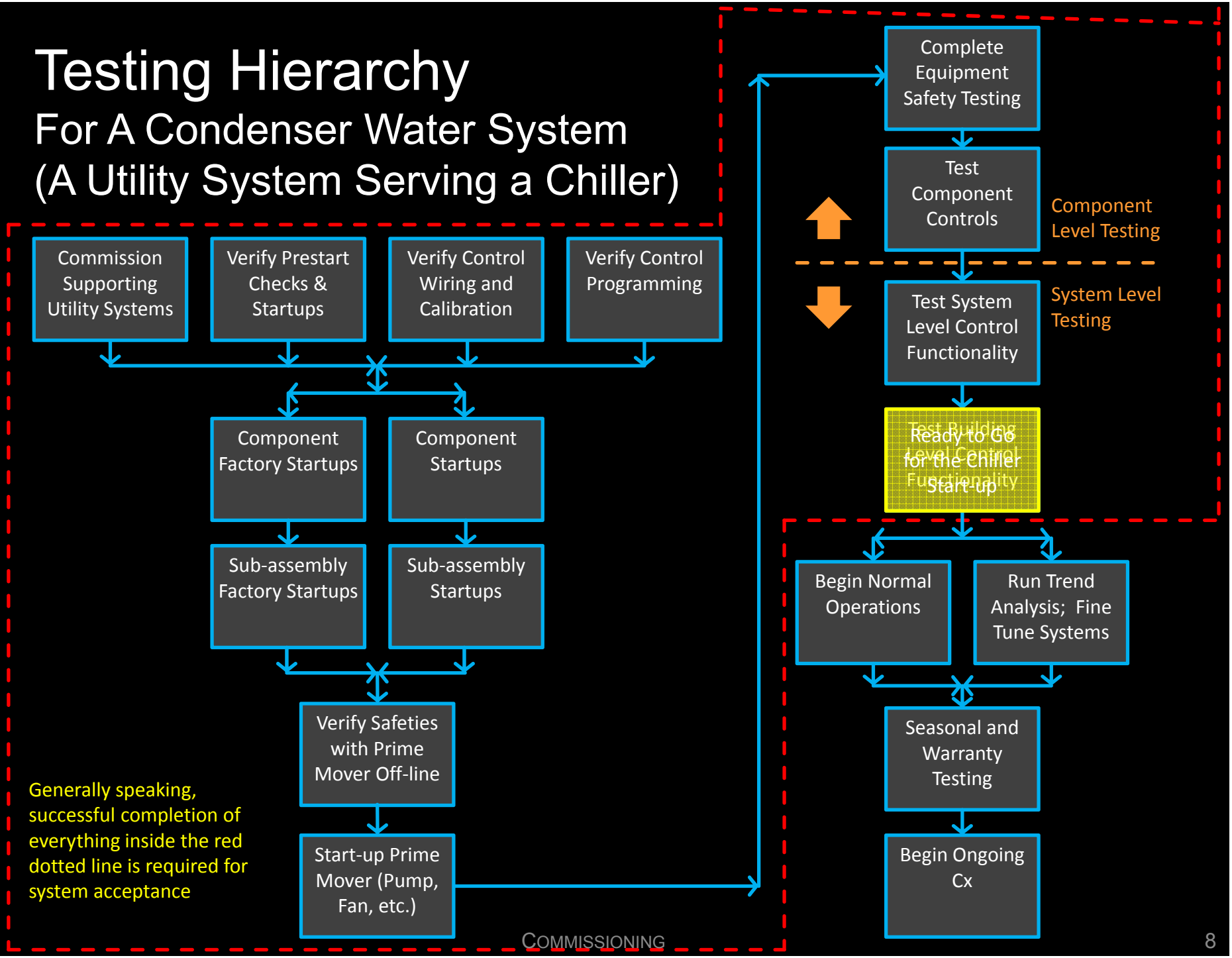
http://tinyurl.com/MR1Flight

… which is a chapter from *This New Ocean, a History of Project Mercury*

http://tinyurl.com/ProjectMercuryHistory

Testing Hierarchy

For A Condenser Water System (A Utility System Serving a Chiller)



Verification Checks/Prestart Checks

- Typically non-dynamic, non-interactive items
- Making sure everything is ready to become dynamic
  - Is all the hardware in place?
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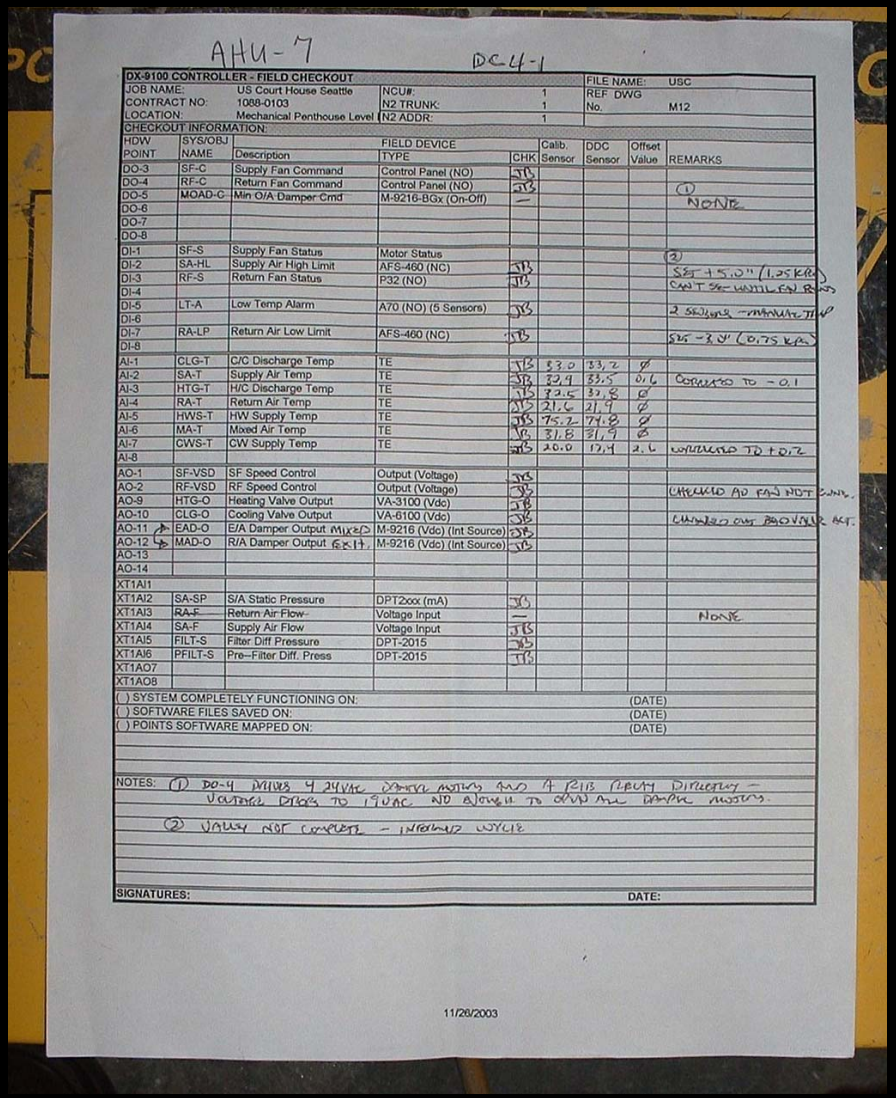

AHU-7 DC4-1

DX-9100 CONTROLLER - FIELD CHECKOUT

JOB NAME:	US Court House Seattle	NCU#:	1	FILE NAME:	USC			
CONTRACT NO:	1088-0103	N2 TRUNK:	1	REF DWG No.	M12			
LOCATION:	Mechanical Penthouse Level	N2 ADDR:	1					
CHECKOUT INFORMATION:								
HDW POINT	SYS/OBJ NAME	Description	FIELD DEVICE TYPE	CHK	Calib. Sensor	DDC Sensor	Offset Value	REMARKS
DO-3	SF-C	Supply Fan Command	Control Panel (NO)	JTB				
DO-4	RF-C	Return Fan Command	Control Panel (NO)	JTB				(1) NONE
DO-5	~~MOAD-C~~	~~Min O/A Damper Cmd~~	M-9216-BGx (On-Off)	—				
DO-6								
DO-7								
DO-8								
DI-1	SF-S	Supply Fan Status	Motor Status					(2)
DI-2	SA-HL	Supply Air High Limit	AFS-460 (NC)	JTB				SET +5.0" (1.25 KPa)
DI-3	RF-S	Return Fan Status	P32 (NO)	JTB				CAN'T SET UNTIL FAN RUNS
DI-4								
DI-5	LT-A	Low Temp Alarm	A70 (NO) (5 Sensors)	JTB				2 SECONDS - MANUAL TO
DI-6								
DI-7	RA-LP	Return Air Low Limit	AFS-460 (NC)	JTB				SET - 3.0" (0.75 KPa)
DI-8								
AI-1	CLG-T	C/C Discharge Temp	TE	JTB	33.0	33.2	0	
AI-2	SA-T	Supply Air Temp	TE	JTB	32.9	33.5	0.6	CORRECTED TO -0.1
AI-3	HTG-T	H/C Discharge Temp	TE	JTB	32.5	32.8	0	
AI-4	RA-T	Return Air Temp	TE	JTB	21.6	21.9	0	
AI-5	HWS-T	HW Supply Temp	TE	JTB	75.2	74.8	0	
AI-6	MA-T	Mixed Air Temp	TE	JTB	31.8	31.9	0	
AI-7	CWS-T	CW Supply Temp	TE	JTB	20.0	17.4	2.6	CORRECTED TO +0.2
AI-8								
AO-1	SF-VSD	SF Speed Control	Output (Voltage)	JTB				
AO-2	RF-VSD	RF Speed Control	Output (Voltage)	JTB				CHECKED AO FAN NOT RUNNING
AO-9	HTG-O	Heating Valve Output	VA-3100 (Vdc)	JTB				
AO-10	CLG-O	Cooling Valve Output	VA-6100 (Vdc)	JTB				CHANGED OUT 3000 VALVE ACT.
AO-11	EAD-O	E/A Damper Output MIXED	M-9216 (Vdc) (Int Source)	JTB				
AO-12	MAD-O	R/A Damper Output EXIT	M-9216 (Vdc) (Int Source)	JTB				
AO-13								
AO-14								
XT1AI1								
XT1AI2	SA-SP	S/A Static Pressure	DPT2xxx (mA)	JTB				
XT1AI3	~~RA-F~~	~~Return Air Flow~~	Voltage Input	—				NONE
XT1AI4	SA-F	Supply Air Flow	Voltage Input	JTB				
XT1AI5	FILT-S	Filter Diff Pressure	DPT-2015	JTB				
XT1AI6	PFILT-S	Pre-Filter Diff. Press	DPT-2015	JTB				
XT1AO7								
XT1AO8								

( ) SYSTEM COMPLETELY FUNCTIONING ON: (DATE)
( ) SOFTWARE FILES SAVED ON: (DATE)
( ) POINTS SOFTWARE MAPPED ON: (DATE)

NOTES: (1) DO-4 DRIVES 4 24VAC DAMPER MOTORS AND 4 R21B RELAY DIRECTLY - VOLTAGE DROPS TO 19VAC AND BOUGHT TO DRIVE ALL DAMPER MOTORS.

(2) VALVE NOT COMPLETE - INTERMED CYCLE

SIGNATURES: DATE:

11/26/2003

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- Pump alignment checks are a good example
  - Angularity
  - Offset
  - Soft foot

Typical Pump Alignment Specifications		
Nominal Speed rpm	Angularity mils	Offset mils
1,200	5.0 - 8.0	2.5 - 4.0
1,800	3.0 - 5.0	2.0 - 3.0
3,600	2.0 - 3.0	1.0 - 1.5

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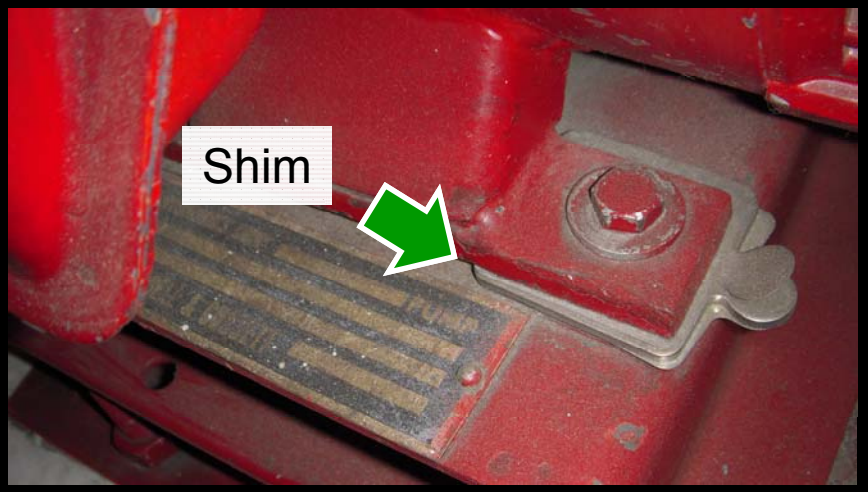

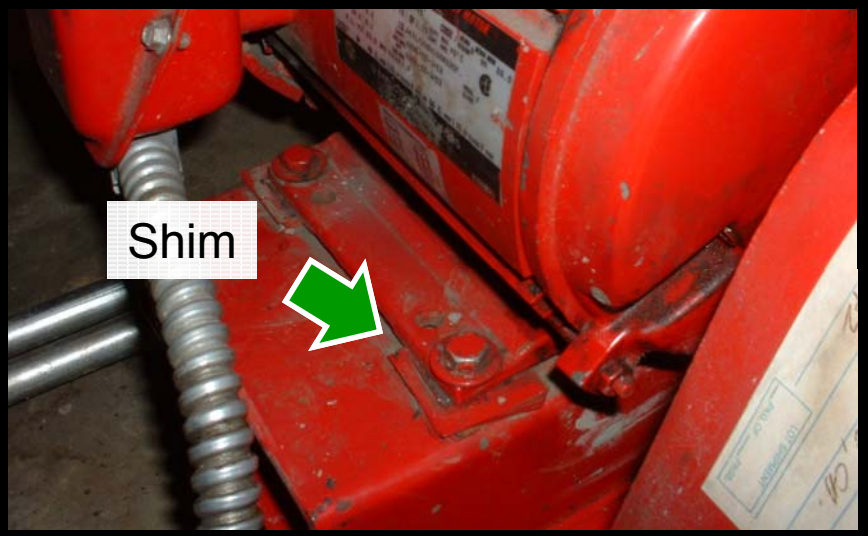

Verifying Pump Alighnment