Component Level Test

HPCBS
High Performance Commercial Building Systems

Project Name

System Pacific Energy Center Chilled Glycol System

Component or function to be tested Pumps P1 and P2

Purpose:

This test is designed to demonstrate how a pump test is performed, how the load placed on a pump extracts more or less power from the pump's motor by changing the slip, and how parallel pumps interact with each other.

Instructions:

This test is for demonstrating purposes only, so it is not necessary to document test results. Space has been provided for the user to document observations and make notes for their own use as they observe the demonstration.

Equipment Required:

1. Differential pressure gauge for measuring pump differential pressure.
2. Strobe tach for measuring pump motor speed.
3. Power meter for measuring pump power.
4. Transient time ultrasonic flow meter for measuring system flow. Note that this meter is not actually required for the test; the pump test itself provides the system flow information based on pump head and the pump curve. The flow meter allows the students to observe what is going on in the system in terms of flow when the interaction of the parallel pumps is demonstrated with out having to perform multiple

Acceptance Criteria:

1. This test is being run for demonstration purposes, thus there is no acceptance criteria associated with it.

Precautions:

1. Exercise care when changing operating modes if a chiller is running.
2. Verify that all components between the pump discharge and the discharge service valve are rated for the peak pressure on the pump curve with the largest impeller size installed prior to performing a shut off test.
3. Avoid sudden flow changes to minimize the potential for water hammer.
4. Exercise proper precaution while working around live wiring and terminals to take amp readings.
5. Exercise proper precaution while working around the rotating parts of the pump.

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References:

1. The Bell and Gossett Engineering Manual is a good reference for most of the items that are demonstrated in the exercise. The Functional Testing Guide also has useful information that is applicable regarding pump testing.

Requirement	**Data** **Include units**	**Completed** **Initials, Date and Time**
Prerequisites:		
1. Pump P1 (closest to the electrical room) is on line and ready for testing.		
2. Pump P2 (closest to the wall) is available for operation when required by the demonstration.		
Preparation:		
1. Document the position of the balancing valve on the discharge of both pumps		
2. Document the system operating status prior to starting the procedure.		
Procedure:		
1. With pump 1 (closest to electrical room) running document the following. Note the engineering units associated with the reading; i.e. psi or ft.w.c., etc. Pressure ahead of the strainer Pump suction pressure Strainer pressure drop (the difference between the two reading just taken)	Note 1	
2. If the pressure drop through the strainer exceeds 3 psi/7 ft.w.c. suspend the test and inspect and clean the strainer. After the strainer is clean, proceed with the		
3. Verify that the discharge throttling valve is fully open.	Note 2	

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4. Document the following via measurement or assessment from the pump curve.		
Pump differential pressure (calculate from to the following readings or measure directly) Pump suction pressure Pump discharge pressure Pump volts Phase A to B Phase B to C Phase C to A Pump amps Phase A Phase B Phase C Pump power factor Pump kW Pump speed Pump flow (from the pump curve) Pump horsepower (from the pump curve)	For Pump 1, the differential pressure will typically run between 93-95 ft.w.c. The flow produced will be in the 135 - 140 gpm range at about 5 hp.	
5. Assess the following: How does the flow measured by the ultrasonic flow meter compare with the flow derived from the pump curve? Is it possible for there to be a difference? If so, why is it possible? If not, why is it not possible? If it is not possible for there to be a difference, which would you believe?	See Note 3	

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6.	How does the pump kW compare with the brake horsepower from the pump curve (there are .746 kW per horse power? Is it possible for there to be a difference? If so, why is it possible? If not, why is it not possible? If it is not possible for there to be a difference, which would you believe?	The pump curve is based on brake horse power; i.e.. Power out of the motor. The kW meter is reading power into the motor and reflects the motor efficiency losses.	
7.	How does the pump speed compare with the nameplate rating on the motor? Is it possible for there to be a difference? If so, why is it possible? If not, why is it not possible? If it is possible for there to be a speed difference between the actual operating pump and the motor nameplate, what are the implications in terms of pump	The pump speed will vary with motor load. The name plate speed is at the rated condition. Less torque is required at low load so the slip between the motor speed and the rotating field created by the utility 3 phase power decreases and the motor	
8.	How does the pump power factor compare with the nameplate rating on the motor? Is it possible for there to be a difference? If so, why is it possible? If not, why is it not possible?	Power factor will also vary with load; the nameplate value is at the rated condition for the motor.	
9.	Perform a pump shut off test by fully closing the discharge service valve, forcing the pump to 0 gpm and documenting the following:		
	Pump differential pressure (calculate from to the following readings or measure directly)		
	Pump suction pressure		
	Pump discharge pressure		
	Pump power factor		
	Pump kW		
	Pump speed		
10.	Return the discharge valve to the fully open position.		

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11. Assess the following: What does the shut off test tell us about the physical characteristics of the pump?	It tells impeller size. Periodic re-testing will show wear ring wear.
12. How does the pump kW compare with the kW with the discharge valve wide open? If there is a difference, why?	The pump is unloaded and the kW drops.
13. How does the pump speed compare with the speed with the pump discharge valve wide open? If there is a difference, why?	As the pump unloads, it speeds up.
14. How does the pump power factor compare with the power factor with the pump discharge valve wide open?	As the pump unloads, the power factor will tend to decay from
15. Start pump P2. How much did the system flow as measured by the ultrasonic flow meter increase? Is the result what you expected? If so, why? If not, why not?	Because the impeller in P2 was trimmed, it can not pump against the head produced by P1.
16. Use the strobe to check the speed of P1 and P2. P1 speed P2 speed	The strobe data will show that P2 is unloaded relative to P1.
17. What does this information tell you about what is going on with the pumps?	Pump speed provides a clue that the pump is dead headed.
18. **Sh**ut down pump P1. What happens to the system flow rate with only pump P2 in operation? What does this tell you about pumps P1 and P2?	P2 can now produce flow and provides the flow targeted by the impeller trim.

Follow up and Return to Normal:

1. Return the discharge balancing valves on both pumps to the original position.		
2. Return the pumps to the operating mode they were in before the demonstration was started.		

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Test Coordinator(s)

Name	Affiliation	Work phone	Work e-mail

Test Team Members

Name	Affiliation	Work phone	Work e-mail

Test Completion Sign Off

This test has been performed to the best of my ability per the requirements of the procedure. Deviations or problems encountered have been noted at the end of the test form.

Test coordinator name (print)	
Signature, date and time	

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Comments and Notes

1. This is a bit of a set up; there is no way to measure pressure ahead of the strainer. So, you have to make a judgment call, a common occurrence in the field. Given that it's a closed system in a reasonably well maintained facility, its probably reasonable to assume the strainer is not plugged. If it was an open system or a poorly maintained facility, that might not be as good of an assumption. If you really needed to know, you could take a pressure on the blow down fitting on the strainer and compare it with the pump suction reading.

Note also that there are actually two strainers; a Y strainer in the down comer to the pump and a suction diffuser on the pump inlet, which typically includes a strainer element.

2. The valve on this system is wide open, but on some systems it has been throttled to place the pump at design flow. If we are running the pump test to see how we should modify the pump so that it can produce design flow with out having to run against a throttled valve (which wastes energy), then we need to test the system with the valve wide open to establish the system curve with out the resistance of the throttling valve. For a system where the valve has been throttled to force the pump up its curve to design flow, opening the valve will cause the pump to move more than design flow, but it will also establish the system curve for the piping circuit with out the added resistance of the throttled discharge valve. Once we know the system curve for the unthrottled pump, we can decide how to modify the pump to shift its performance down the system curve to the desired flow. Typically, this will be accomplished by a speed change or an impeller trim and will save more energy than throttling the pump to design flow. The best approach will vary from system to system and depends on the shape of the pump curve and system curve and where they

3. In a perfect world, the flow meter and pump should provide very similar numbers. The flow meter has the potential to provide greater precision, and once it is installed, instantaneous readings of flow. In contrast, a pump with a known impeller size and valid curve can provide flow information for the system it serves via a pump test. This can be invaluable in situations where there is not a flow meter (the majority of field situations), but can be cumbersome if a number of flow measurements must be taken.

There are a number of things that could cause the flow meter to read differently from the flow obtained by a pump test. On the flow meter side of things, if the meter was not installed properly (good coupling between the transducers and pipe wall) or if there was something that could divert some of the flow before it reached the meter (an open pot feeder, a piping connection to a load between the pump and meter location, etc.), there could be a difference in readings. On the pump side of things, if the pump curve was not actually

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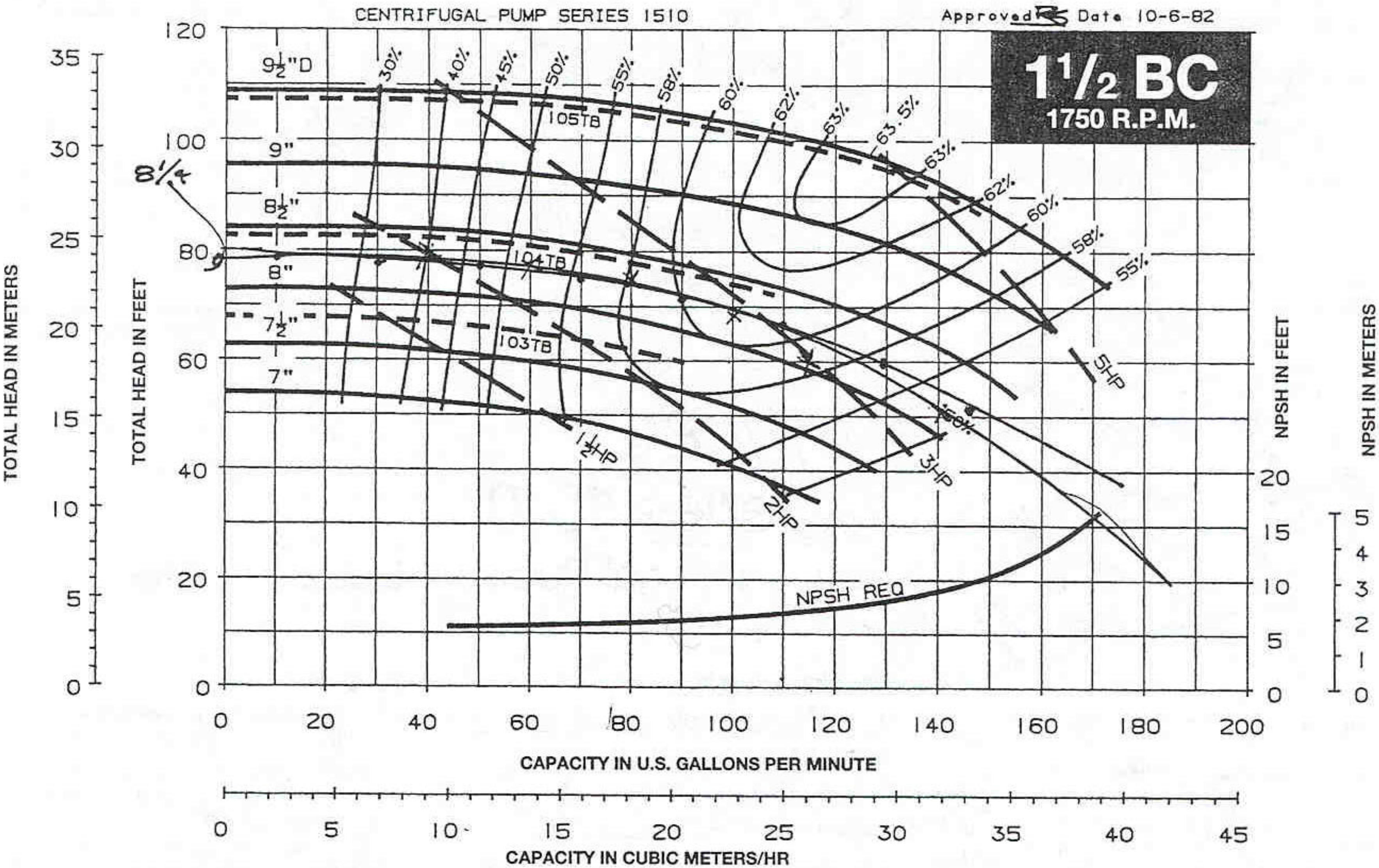
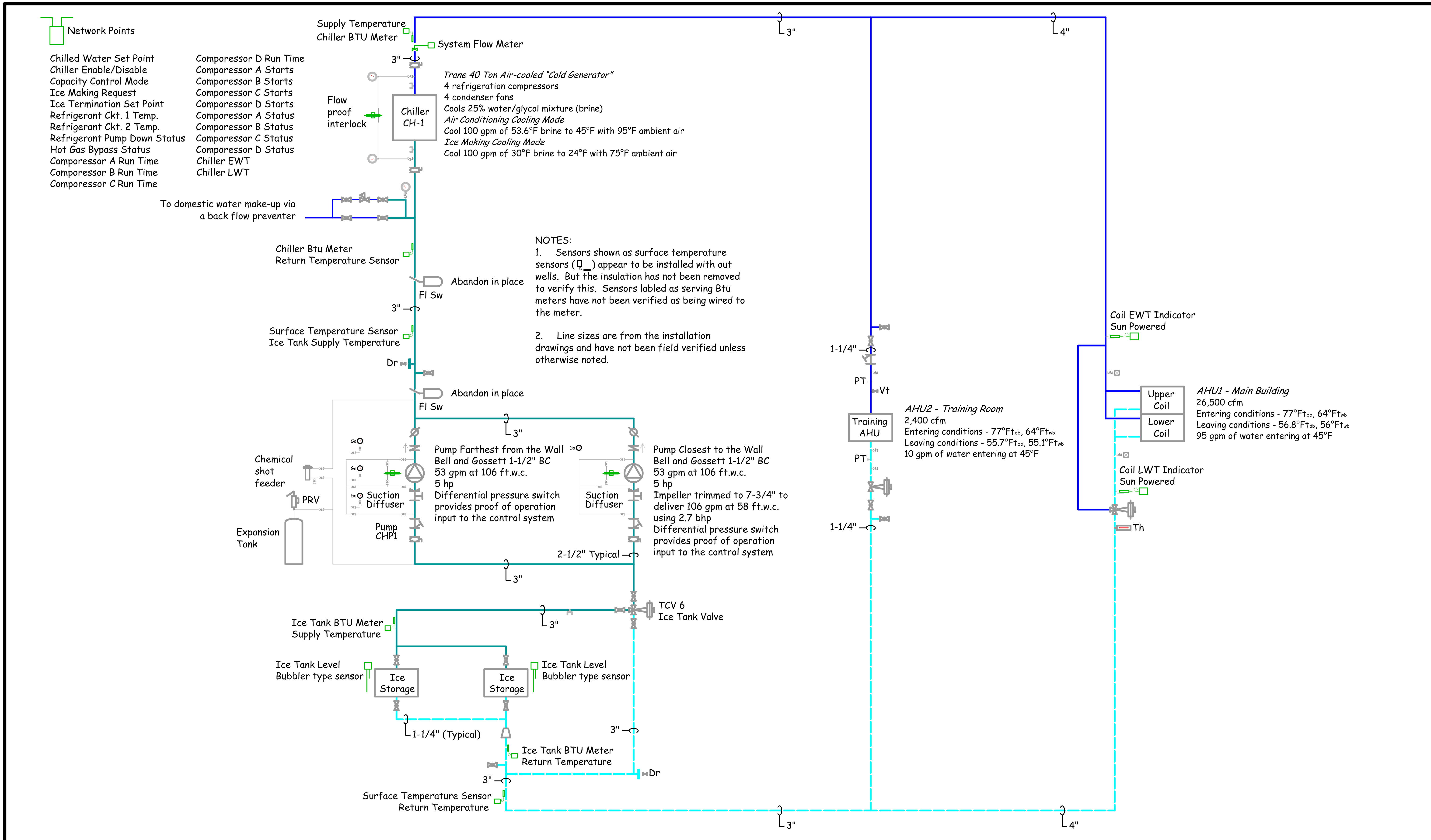
the pump, or if the gauge used to take the reading did not have good resolution, the information generated from the pump curve could be inaccurate.

SERIES 1510 PUMP PERFORMANCE CURVES

PERFORMANCE CHARACTERISTIC CURVE





Pacific Energy Center Ice Storage System

Revisions: 1 - Fixed pump manifold detail, added chillernetwork points 11-16-10
Revisions: 2 -
Revisions: 3 -

Drawn by: DAS	Date: 08-19-10	SD-1
Checked by: DAS	Plot date:	