Sample Functional Performance Test – Central Chiller Plant

Advantage Engineering Technologies, PLLC | Richard Valentine, PE | Sample from a completed commissioning plan, project details removed

This checklist is a condensed sample of the functional performance tests written for a central chiller plant commissioning plan. The plant has three 500-ton York water-cooled chillers, a Johnson Controls Metasys building management system (BMS), variable-flow pumps on variable frequency drives (VFDs), and cooling towers with variable-speed fans. The sequence of operations allows only two chillers to run at a time, stages the lag chiller on at 80% load (400 tons), and rotates the lead chiller by run hours.

Project information

- Equipment: Chiller 1, Chiller 2, Chiller 3 (York 500-ton water-cooled)
- Control system: Johnson Controls Metasys BMS, BACnet communication with the chiller panels
- Sequencing rule: N+1 redundancy; maximum two chillers operating, one locked out on standby
- Staging parameter: lead chiller limit 80% full-load amps / 400 tons

Section 1 – Sensor calibration and communication

Before sequence testing, confirm that BMS points match the local chiller panel readings.

Step	Test procedure	Expected BMS display / result	Pass / Fail	Notes
1.1	Verify BACnet communication mapping from each chiller panel to the BMS network engine.	All data points (tonnage, % FLA, evaporator and condenser pressures) map accurately.	☐ Pass ☐ Fail	
1.2	Verify chilled water supply (CHWS) and return (CHWR) temperature sensors against a certified digital thermometer.	Readings within ±0.2°F of the calibration tool.	☐ Pass ☐ Fail	
1.3	Check cooling tower basin level sensors and condenser water supply/return thermowells.	BMS readings match the physical gauges within ±0.5°F.	☐ Pass ☐ Fail	
1.4	Stroke all motorized evaporator and condenser isolation valves 0% to 100% using BMS manual override.	End-switch feedback matches (open = open, closed = closed).	☐ Pass ☐ Fail	

Section 2 – Flow and VFD interlocks

Step	Test procedure	Expected BMS display / result	Pass / Fail	Notes
2.1	Issue a start command to Chiller 1 from the BMS.	Evaporator and condenser valves open; primary VFD pumps ramp to minimum start speed.	☐ Pass ☐ Fail	
2.2	Simulate a high differential pressure (DP) condition across the building chilled water loop header.	VFD pumps slow to hold the DP setpoint without falling below the chiller's minimum design flow.	☐ Pass ☐ Fail	
2.3	Force the running chiller's flow switch into a no-flow state.	Chiller trips immediately on its local safety interlock; BMS raises a priority-1 critical alarm.	☐ Pass ☐ Fail	

Section 3 – Automated staging (80%) and interlocks

Step	Test procedure	Expected BMS display / result	Pass / Fail	Notes
3.1	Cold plant start: establish a building cooling load with Chiller 1 set as lead.	Chiller 1 starts; the cooling tower fan ramps on its VFD to hold the condenser water setpoint.	☐ Pass ☐ Fail	
3.2	Lag staging on: override the load or lower the chilled water setpoint until Chiller 1 holds 80% (400 tons) for a sustained 15 minutes.	Staging timer starts; lag chiller isolation valves open; lag pump ramps up; Chiller 2 starts and matches the plant load.	☐ Pass ☐ Fail	
3.3	Load balancing: observe the plant once Chillers 1 and 2 are both online.	Both chillers modulate to share the total load evenly (about 50/50).	☐ Pass ☐ Fail	
3.4	Third-chiller lockout: manually command Chiller 3 on while Chillers 1 and 2 are running.	BMS safety lockout blocks the command and displays "Maximum capacity reached – Chiller 3 locked out."	☐ Pass ☐ Fail	Enforces the two-chiller limit
3.5	Lag staging off: reduce the plant load until the combined total stays below 35% for 20 minutes.	BMS ramps the lag chiller down, runs its shutdown cycle, and closes its isolation valves to stop bypass flow.	☐ Pass ☐ Fail	

Section 4 – Run-time equalization and automatic failover

Step	Test procedure	Expected BMS display / result	Pass / Fail	Notes
4.1	Run-time equalization: set Chiller 3 to the lowest accumulated run hours in the BMS logic and force a lead rotation.	Chiller 3 moves to the lead position for the next plant cycle.	☐ Pass ☐ Fail	

Step	Test procedure	Expected BMS display / result	Pass / Fail	Notes
4.2	Emergency failover: with Chiller 1 running as lead and Chiller 2 on standby, simulate a compressor motor fault on Chiller 1.	Chiller 1 shuts down safely; BMS raises an immediate priority alarm; Chiller 2 isolation valves open and its compressor starts automatically to hold the loop.	☐ Pass ☐ Fail	

Section 5 – Field test sign-off

Commissioning authority: _____ Date: _____

Controls contractor: _____ Date: _____

Chiller manufacturer's representative / startup technician: _____ Date: _____