EXHIBIT A

RE-COMMISSIONING CHECKLIST

Commissioning team members shall be designated as follows:

Designation	**Function**
Q	**Contractors Chief Quality Control Rep**
M	**Contractors Mechanical Rep**
E	**Contractor's Electrical Rep**
T	**Contractor's Testing, Adjusting, and Balancing Rep**
C	**Contractor's Controls Rep**

Contractor shall check individuals present during performance of commissioning checklist items.

Chilled Water Piping to AHU-1

Checklist Item	Q	M	E	T	C
Piping installed per Asbuilts.	__	__	__	__	__
Piping and Components Inspected for Leaks and Damage	__	__	__	__	__
Strainers cleaned.	__	__	__	__	__
Valves installed per Asbuilts.	__	__	__	__	__
Piping insulated as required.	__	__	__	__	__
Thermometers and gauges Operational.	__	__	__	__	__
Verify operation of valves.	__	__	__	__	__
Air vents operational.	__	__	__	__	__
Verify that piping has been labeled and valves identified as specified.	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)					
Hydrostatic test complete.	__	__	__	__	__
Verify flow and pressure data with TAB Report.	__	__	__	__	__

Hot Water Piping System

Checklist Item	Q	M	E	T	C
Piping installed per Asbuilts.	__	__	__	__	__
Piping and Components Inspected for Leaks and Damage	__	__	__	__	__
Strainers cleaned.	__	__	__	__	__
Valves installed per Asbuilts.	__	__	__	__	__
Piping insulated as required.	__	__	__	__	__
Thermometers and gauges Operational.	__	__	__	__	__
Verify operation of valves.	__	__	__	__	__
Air vents operational.	__	__	__	__	__
Verify that piping has been labeled and valves identified as specified.	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)					
Hydrostatic test complete.	__	__	__	__	__

EXHIBIT B

FUNCTIONAL TEST CHECKLIST

Chilled Water Pumps – Prior to performing this checklist, ensure that system is pressurized and the make-up water system is operational.

1. Activate pump start using control system commands (all possible combination, on/auto, etc.).

   ON_____ AUTO_____ OFF_____

   a. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, pump design conditions, and pump manufacturer's performance.

	DESIGN	TAB	ACTUAL
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

   b. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

   c. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

   a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

   b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Chief Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Rep.	_____
Contractor's Controls Representative	_____

EXHIBIT B

FUNCTIONAL TEST CHECKLIST

AHU-1 – Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

   a. Control sensors for the unit shall be calibrated by making a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading compared to the test instrument – measured value is within +/- 2 degrees. If not, install offset in the control system, calibrate sensor or replace sensor.

		init. sensor reading	calibration reading	sensor setpoint
(1)	Discharge Air Temp	_____	_____	_____
(2)	Return Air Temp	_____	_____	_____
(3)	Outdoor Air Temp	_____	_____	_____
(4)	Discharge Static Pr.	_____	_____	_____

   b. The following shall be verified when the supply and return fans operating mode is initiated:

      (1) All dampers in normal position and fan speed modulates to maintain the required static pressure. _____

      (2) All valves in normal position. _____

      (3) System safeties allow start if safety conditions are met. _____

      (4) VAV fan controller shall "soft-start" fan. _____

      (5) Modulate all VAV boxes to minimum air flow and verify that the static pressure does not exceed the design static pressure Class shown. _____

      (6) Verify that VFD's modulate as required to maintain static pressure setpoint without hunting or overshooting setpoint. _____

      (7) Using a squeeze bulb, simulate an increase in discharge air pressure. Verify that an alarm condition is indicated at 3.6 inches WG and the fan shuts down at 4 inches WG. _____

   c. Occupied mode of operation - economizer de-energized.

      (1) Outside air damper at minimum position. _____

      (2) Return air damper open. _____

      (3) Relief air damper at minimum position. _____

(4) Chilled water control valve modulates to maintain leaving air temperature set point. _____

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point. _____

d. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Chilled water control valve modulating to maintain leaving air temperature set point. _____

(4) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point. _____

e. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

f. The following shall be verified when the supply and return fans off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

g. Verify the chilled water coil control valve operation by setting all VAV's to maximum and minimum cooling.

	Max cooling	Min cooling
Supply air volume (_____ cfm)	_____	_____
Supply air temp. (_____ degrees F)	_____	_____

h. Verify safety shut down initiated by smoke detectors. _____

i. Verify safety shut down initiated by low temperature protection thermostat. _____

j. Document building pressurization at each economizer damper position. _____

	Building Pressurization
OA / relief dampers open to maximum position	_____
OA / relief dampers open to minimum position	_____

OA / relief dampers closed (unoccupied mode) _____

k. The following economizer operations shall be verified

(1) With the AHU turned off, verify that OA and relief dampers are completely shut and the return damper is at maximum open . _____

(2) With the AHU in on status and the cooling coil valve and economizer off, turn the cooling setpoint to 85 deg. F. Verify that OA and relief dampers are at the minimum open position and the return air damper is at maximum open. _____
_____

(3) Adjust economizer setpoint so economizer will turn on with call for cooling. Simulate OA temperature as require to force economizer on. Adjust cooling setpoint 1 degree F below space temperature.

a. Cooling setpoint _____

b. OA temperature (DB/WB) _____

c. Space temperature (DB/WB) _____

d. Verify that dampers open properly and that the return air damper is closing proportionately _____

e. Lower cooling setpoint 2 degrees F at a time until cooling coil valve opens. Verify OA and relief dampers stay open and not at minimum and that return air dampers close proportionately _____

(4) Return economizer settings to the original setpoints. Raise outside air temperature setpoint until outside air dampers modulate closed.

a. Verify OA and relief dampers close to minimum _____

b. Verify return dampers open to maximum _____

c. Verify outside air temperature setpoint used _____

d. Verify that outside air temperature is within 2 degrees F of the econimizer setpoint _____

e. Verify that outside air temperature is between 2 – 5 degrees F below space temperature _____

(5) Simulate mixed air temperature until it is below the mixed air temperature setpoint.

a. Verify that OA and relief dampers close to a minimum and the return air damper is fully open _____

b. Verify mixed air temperature used to cause damper closure _____

c. Verify that mixed air temperature is within 2 degrees F of what the setpoint temperature should be _____

(6) Permanently mark all settings on local controllers showing the appropriate setpoint locations.

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Chief Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Rep.	_____
Contractor's Controls Representative	_____

EXHIBIT B

FUNCTIONAL TEST CHECKLIST

Packaged Air Cooled Chiller –

1. Functional Performance Test: Contractor shall demonstrate operation of chilled water system as per specifications including the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.

   a. Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. _____

   b. Verify control system energizes chiller start sequence. _____

   c. Verify chiller senses chilled water temperature above set point and control system activates chiller start. _____

   d. Verify functioning of "soft start" sequence. _____

   e. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____

   f. Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence. _____

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Chiller inlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____

3. Record the following information:

   Ambient dry bulb temperature _____ degrees F
   Ambient wet bulb temperature _____ degrees F
   Entering chilled water temperature _____ degrees F

4. Verify chiller amperage each phase and voltage phase-to-phase and phase-to-ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

5. Unusual vibration, noise, etc.

   _____

   _____

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Chief Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Rep.	_____
Contractor's Controls Representative	_____

EXHIBIT B

FUNCTIONAL TEST CHECKLIST

VAV Terminals –

1. Functional Performance Test: Contractor shall demonstrate operation of VAV boxes as per specifications including the following:

   a. Space sensors for terminal units shall be calibrated by making a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading compared to the test instrument – measured value is within +/- 2 degrees. If not, install offset in the control system, calibrate sensor or replace sensor.

	init. sensor reading	calibration reading	sensor setpoint
(1) Space Temp	_____	_____	_____

   b. Record the following information:

   Temperature adjustment range by tenants _____ degrees F
   Cooling occupied zone temp setpoint _____ degrees F
   Unoccupied zone temp setpoint _____ degrees F
   Occupied zone temp bias (deadband) _____ degrees F
   Unoccupied zone temp bias (deadband) _____ degrees F
   Cooling space setpoint proportional band _____ degrees F
   Cooling cfm proportional band _____ cfm

   c. Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

   Maximum flow [_____] cfm
   Minimum flow [_____] cfm

   d. Check damper maximum/minimum flow settings.

   Maximum flow setting [_____] cfm
   Minimum flow setting [_____] cfm

   e. Observe actual cfm and temperature readings to setpoints and to record drawings.

      (1) Verify that there is little to no overshoot of space temperature. _____

      (2) Verify that there is little or no hunting of the damper. _____

      (3) Verify that the cfm is within its deadband. _____

      (4) Verify that the cfm modulates as the space temperature goes outside deadbands. _____

   f. With the duct SP being met, lower the space temperature setpoint by 20 degrees F. Verify that the specified maximum cfm is achieved (within deadband). _____

g. With the duct SP being met, raise the space temperature setpoint by 20 degrees F. Verify that the specified minimum cfm is achieved (within deadband). _____

h. Adjust the schedule or time so the unit will be in warmup mode. Adjust the space setpoint to be 5 degree F below the space. Verify that the damper goes to cooling maximum. _____

i. Adjust the schedule or time so the unit will be in warmup mode. Adjust the space setpoint to be 5 degree F above the space. Verify that the damper goes to cooling minimum. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Chief Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Rep.	_____
Contractor's Controls Representative	_____

EXHIBIT B

FUNCTIONAL TEST CHECKLIST

Controls System –

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the following tests:

   a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, sling psychrometer, inclined manometer, etc. _____

   b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings. _____

      Sensor _____

      Manual measurement _____

      Panel reading value _____

   c. Verify system stability by changing the controller set point as follows:

      (1) Air temperature - 10 degrees F _____

      (2) Water temperature - 10 degrees F _____

      (3) Static pressure - 10 percent of set point _____

      (4) Relative humidity - percent (RH) _____

      The control system shall be observed for 10 minutes after the change in set point. Instability or excessive hunting will be unacceptable.

      a. Verify interlock with other HVAC controls. _____

      b. Verify interlock with fire alarm control panel. _____

      c. Verify interlock with EMCS. _____

      d. Change controller set point 10 percent with EMCS and verify correct response.

      _____

2. Verify that operation of control system conforms to that specified in the sequence of operation. ___

   _____

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Chief Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Rep.	_____
Contractor's Controls Representative	_____

EXHIBIT B

FUNCTIONAL TEST CHECKLIST

Boiler System-

1. Function Performance Test: Contractor shall verify operation of the Boiler by performing the following tests:
   Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence.

   a. Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation._____
   _____

   b. Verify control system energizes boiler start sequence._____
   _____

   c. Verify boiler senses hot water temperature below set point and control system activates boiler start._____
   _____

   d. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed._____
   _____

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Boiler inlet pressure (psig)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Boiler flow rate (gpm)	_____	_____	_____
Flue-gas temperature at boiler outlet	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants	_____	_____	_____
Concentration	_____	_____	_____
Fuel Type	_____	_____	_____
Combustion Efficiency	_____	_____	_____

3. Record the following information:

Ambient temperature	_____degrees F
Entering hot water temperature	_____degrees F
Leaving hot water temperature	_____degrees F

4. Verify temperatures in item 3 are in accordance with the reset schedule._____

5. Verify proper operation of boiler safeties and alarms._____

_____

6. Unusual vibration, noise, etc._____

_____

7. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement.___

_____

_____

8. Certification: We the undersigned have witnessed the above functional performances tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Chief Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Rep.	_____
Contractor's Controls Representative	_____

Verify flow and pressure data with TAB Report.	__	__	__	__	__

Supply / Return Ductwork Serving AHU-1

Checklist Item	Q	M	E	T	C
Ductwork installed per Asbuilts.	__	__	__	__	__
Ductwork leak test complete.	__	__	__	__	__
Fire dampers, smoke dampers, and access doors operational.	__	__	__	__	__
Ductwork insulated as required.	__	__	__	__	__
Thermometers and gauges Operational.	__	__	__	__	__
Verify open/closed status of dampers.	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)					
Verify cfm and pressure data with TAB report.	__	__	__	__	__

AHU-1

Checklist Item	Q	M	E	T	C
Inspection and access doors are operable and sealed.	__	__	__	__	__
Casing undamaged.	__	__	__	__	__
Insulation undamaged.	__	__	__	__	__
Condensate drainage is unobstructed and operational.	__	__	__	__	__
Fan belt adjusted.	__	__	__	__	__
Filters are properly installed and cleaned.	__	__	__	__	__
Electrical					
Power available to unit disconnect.	__	__	__	__	__
Power available to unit control panel.	__	__	__	__	__
Proper motor rotation verified.	__	__	__	__	__
Verify proper location, installation and calibration of static Pressure sensor.	__	__	__	__	__
Coils					
Chilled water piping properly connected and undamaged.	__	__	__	__	__
Hot water piping properly connected and undamaged.	__	__	__	__	__
Inspect for damage to coil fins.	__	__	__	__	__
Controls					
Control valves/actuators properly installed.	__	__	__	__	__
Control valves/actuators operable.	__	__	__	__	__
Air handler controls system operational.	__	__	__	__	__
Economizer /OA/RA/EA dampers are properly installed and operable.	__	__	__	__	__
Fan air volume controller operable.	__	__	__	__	__
Supply and return fan VFD's are Operational.	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)					
TAB report submitted.	__	__	__	__	__

VAV Terminals

Checklist Item	Q	M	E	T	C
VAV terminal in place and operational.	__	__	__	__	__
VAV terminal ducted.	__	__	__	__	__
VAV terminal connected to controls and operational.	__	__	__	__	__
Reheat coil connected to hot water pipe.	__	__	__	__	__
Controls					
Reheat VAV terminal controls set.	__	__	__	__	__
Reheat terminal/coil controls verified and allowing Unobstructed airflow.	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)					
Verify terminal maximum air flow set.	__	__	__	__	__
Verify terminal minimum air flow set.	__	__	__	__	__
TAB report completed.	__	__	__	__	__

Hot Water Pumps

Checklist Item	Q	M	E	T	C
Pumps grouted in place.	__	__	__	__	__
Pump/motor coupling alignment verified.	__	__	__	__	__
Piping system installed.	__	__	__	__	__
Piping system pressure tested.	__	__	__	__	__
Pump not leaking.	__	__	__	__	__
Electrical					
Power available to pump disconnect.	__	__	__	__	__
Pump rotation verified.	__	__	__	__	__
Control system interlocks functional.	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)					
Pressure/temperature gauges operational.	__	__	__	__	__
Verify cfm and pressure data.	__	__	__	__	__
TAB Report completed.	__	__	__	__	__

Chilled Water Pumps

Checklist Item	Q	M	E	T	C
Pumps grouted in place.	__	__	__	__	__
Pump/motor coupling alignment verified.	__	__	__	__	__
Piping system installed.	__	__	__	__	__
Piping system pressure tested.	__	__	__	__	__
Pump not leaking.	__	__	__	__	__

Electrical

Power available to pump disconnect.	__	__	__	__	__
Pump rotation verified.	__	__	__	__	__
Control system interlocks functional.	__	__	__	__	__

Testing, Adjusting, and Balancing (TAB)

Pressure/temperature gauges operational.	__	__	__	__	__
Verify cfm and pressure data.	__	__	__	__	__
TAB Report completed.	__	__	__	__	__

Packaged Air Cooled Chiller

Checklist Item	Q	M	E	T	C
Chiller properly piped.	__	__	__	__	__
Chilled water pipe leak tested.	__	__	__	__	__
Verify no damage to coil fins.	__	__	__	__	__
Manufacturer's required maintenance clearance provided.	__	__	__	__	__
Electrical					
Power available to unit disconnect.	__	__	__	__	__
Power available to unit control panel.	__	__	__	__	__
Controls					
Factory startup and checkout complete.	__	__	__	__	__
Chiller safety/protection devices tested.	__	__	__	__	__
Chilled water flow switch installed.	__	__	__	__	__
Chilled water flow switch tested.	__	__	__	__	__
Chilled water pump interlock installed.	__	__	__	__	__
Chilled water pump interlock tested.	__	__	__	__	__

Boiler

Checklist Item	Q	M	E	T	C
Boiler flue installed and operational.	__	__	__	__	__
Boiler hot water piping installed.	__	__	__	__	__
Boiler hot water piping tested for leaks.	__	__	__	__	__
Boiler gas piping installed.	__	__	__	__	__
Boiler gas piping tested for leaks.	__	__	__	__	__
Manufacturer's required maintenance clearance provided.	__	__	__	__	__
Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	__	__	__	__	__
Verify that PRV rating conforms to boiler rating.	__	__	__	__	__
Boiler water treatment system functional.	__	__	__	__	__
Combustion efficiency demonstrated.	__	__	__	__	__

Electrical

Verify that power disconnect is located within sight of the unit served.	__	__	__	__	__

Controls

Hot water pump interlock installed.	__	__	__	__	__
Hot water pump interlock tested.	__	__	__	__	__
Hot water heating system balanced.	__	__	__	__	__
Hot water heating controls operational.	__	__	__	__	__

Controls System

Checklist Item	Q	M	E	T	C
Control sequences perform per Asbuilts	__	__	__	__	__
Components properly labeled	__	__	__	__	__
Control components wired to each labeled terminal strip	__	__	__	__	__
Control wiring labeled at all terminations, splices, junctions	__	__	__	__	__
Shield wiring used on electronic sensors	__	__	__	__	__
Verify DDC Controls PC properly set up based on installed building systems	__	__	__	__	__
Verify DDC controls PC allows monitoring and control of control points	__	__	__	__	__

Humidifier

Checklist Item	Q	M	E	T	C
Humidifier installed and operational.	__	__	__	__	__
Evaporating media or atomizer operating	__	__	__	__	__
Piping tested for leaks.	__	__	__	__	__
Water flow, check for proper flow rate	__	__	__	__	__
Humidistat, check for proper operation	__	__	__	__	__
Controls and Logic operating	__	__	__	__	__
Humidifier operating in accordance with manufacturers specifications	__	__	__	__	__
Fan, check for deterioration and balance	__	__	__	__	__