



HARVARD UNIVERSITY

University Operations Services

# Owner Services Program Proposal

Harvard Radcliffe Institute for Advanced Study

Byerly Hall Renovations Project

**Revised October 31, 2007**

# Purpose of OSP

- To fill the gaps between design review and final turnover of the building by ensuring proper operation of all primary building systems; establishment of comprehensive preventive maintenance plans for all MEP equipment; and full training of maintenance staff in building operating protocols.



# Program Objectives

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- Ensure Radcliffe receives the full value from the MEP scope of the project, including quality of installation work as well as system performance/functionality.
- Ensure ongoing engagement of the design team throughout the project, including equipment start-up, problem-solving, commissioning, and final acceptance.
- Create a successful transition from the end of construction to post-occupancy operations including establishment of an ongoing preventive maintenance program (PM) and operating procedures for critical building equipment.

# OSP Key Program Activities

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- OSP Program Manager: establishes specific verification protocols; coordinates schedules with contractor, consultants and internal OSP staff for the successful start-up and testing of all primary building systems installed as part of the Project.
- FMO Facilities Engineer: field monitors start-up sequences for all MEP equipment; identify and track all deficiencies through to resolution.
- OSP Program Manager: serves as the owner's day-to-day representative during equipment installation, start-up and testing; tracks and manages identified deficiencies through to resolution.
- FMO Maintenance Team Supervisor: organizes and oversees development of Preventive Maintenance Program and post-occupancy operations training for FMO maintenance staff.

OSP does not change any of the contractual or technical responsibilities for the Architect, Engineers, Consultants, or Contractors.

# Roles & Responsibilities

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- **General Contractor** - Installs all primary MEP systems in accordance with design plans and specifications.
- **Design Engineer** – Responsible for routine inspections and observations throughout the project. Must certify that all systems have been installed as designed prior to conclusion of the project.
- **Commissioning Agent** – Responsible for performance testing of primary building systems to ensure compliance with design and
- **UOS Owner Services Team** – Oversees testing, start-up, and commissioning of all MEP equipment. Documents all results; identifies deficiencies or changes needed; oversees retests as required. Acts on behalf of the owner to accept equipment following observation of successful testing, start-up, and commissioning. Develops and implements PM plans; develops post-occupancy operating procedures; trains FMO maintenance staff to ensure compliance with established protocols.

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# Procedures

- OSP Acceptance Procedures
  - Acceptance Labels
  - Systems to be Tested
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# OSP Acceptance Procedures

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- No functional testing of MEP equipment or systems shall be conducted prior to contractor's delivery of completed *Pre-functional Test Requirements* (included in Appendix) and without a UOS representative present; it shall be Harvard's responsibility to make maintenance and engineering staff available for these tests in accordance with agreed upon schedules.
- UOS personnel will witness all equipment and system functional tests performed by the Contractor; record testing results, including identification of deficiencies or non-compliance.
- Following successful equipment testing, UOS will attach a label to indicate preliminary acceptance.
- Following successful system testing and certification by engineers and commissioning agent, UOS will issue the final acceptance label for the system and assume operating responsibility (as agreed by Radcliffe and FMO).

# Acceptance Labels

- Successfully tested and commissioned equipment will be accepted and labeled in the field.
- Once accepted, equipment will be locked out to prevent unauthorized operation.



This equipment has been turned over and accepted by Harvard University Operations Services (UOS). This equipment shall not be operated or worked on without UOS permission.

Date Accepted:

Accepted By:

Warranty End Date:

**From this point forward the Harvard Lockout/Tagout program is in effect.**

# Systems to be Tested \*

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- Geothermal Wells and Heat Pumps
- Chilled/Heating Hot Water
- Building Control System
- Electrical
- Plumbing
- Utility Metering (water, electric, chilled water and steam)
- Fire Protection
- Elevator
- Locks, Doors and Hardware

\* *A detailed inventory of Equipment to be tested is included in the Appendix*

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# Team Organization

- Project Team Members
- Team Communication Protocol
- Responsibilities of Key Team Members
  - OSP Program Manager
  - FMO Maintenance Supervisor
  - Electrical Inspection/Compliance Coordinator
  - Plumbing Inspection/Compliance Coordinator

# Project Team Members

- **Client/Owner**
  - John Horst (Radcliffe)
- **Project Manager**
  - Kate Loosian / HRES (*through October 2007*)
  - Peter Riley / HRES
  - Bob Stanley /
- **Architect**
  - Goody Clancy Architects
- **Design Engineer**
  - Cosentini and Associates (*through Stephen Feige, Goody Clancy Architects*)
- **Commissioning Agent**
  - Tim Scruby (Facility Dynamics)
  - Kevin Shortt (Facility Dynamics)
- **OSP Program Managers**
  - Tony Ragucci / Bob Phillos
- **Maintenance Team Supervisor**
  - Bob Phillos (FMO)
- **Engineering Support**
  - Mechanical - Bill Thurley (FMO),  
Electrical Joe Migliosi (E&U)
- **Fire Safety System Testing**
  - John Boucher (FMO)
- **Electrical Distribution Infrastructure**
  - James Callahan (E&U)
- **E&U Inspection/Compliance Coordination**
  - Paul Dunphy Electrical, Fire Dept.
  - Bill Endres, Plumbing, Water Dept.
  - Mark Burley, Elevators
- **Safety and Compliance Coordinator**
  - Josh Girard (EH&S)
- **Locks, Doors and Hardware**
  - Fred Steidle (FMO)

# Team Communication Protocol

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- Throughout start-up and testing period, the OSP Program Manager or his designee will conduct daily meetings with the Design Engineer, the Contractor, and other OSP team members, as required.
- The daily plan will include the following group activities:
  - Confirm Testing Schedule for the Day
  - Review Equipment Acceptance Log \*
  - Review Deficiency Log and Discuss Open Issues \*
  - Review Remaining Turnover Packages
  - Establish Future Testing Schedule

\* Documents distributed to the Client/Owner, Project Manager, GC, sub-contractors and Commissioning Agent.

# OSP Program Manager Responsibilities

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- Serve as liaison between the Project Manager, the Design Engineers, Contractors, Commissioning Agent, and OSP staff throughout the period of equipment start-up and testing.
- Actively participate in Project Meetings to ensure that the daily and weekly work schedules for MEP system installation, start-up and testing are effectively established and communicated to OSP staff.
- Following the successful start-up and commissioning, formally accept MEP equipment and systems on behalf of Radcliffe.

# FMO Maintenance Supervisor's Responsibilities

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- Inventory all installed equipment and attach Avantis® entity label to equipment prior to performance of any testing (includes unique tracking number and bar code).
- Organize maintenance staff to attend all manufacturer or contractor-provided equipment start-up training.
- Oversee performance of manufacturer's recommended start-up maintenance procedure.
- Ensure appropriate maintenance staff witness and participate in the testing of all HVAC equipment, including automated control systems.
- Oversee the auxiliary labeling of all equipment, including panel and valve tagging (bar code/labels).
- Develop Standard Operating Procedures for the operation of all primary building mechanical systems

# Electrical Inspection/Compliance Coordinator's Responsibilities

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- Assist electrical subcontractor with required paperwork for Cambridge Inspectional Services Department (ISD).
- Coordinate and accompany the ISD during rough and finish inspections; assist project team in resolving identified issues.
- Coordinate Harvard Fire Safety Services for required 3<sup>rd</sup> Party Testing and Cambridge Fire Department (CFD) for final acceptance testing and signoffs.
- Assist project team on any electrical or fire code issues or City relations.
- Coordinate integrated system test of building electrical and life safety systems.

# Plumbing Inspection/Compliance Coordinator's Responsibilities

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- Assist plumbing subcontractor with required paperwork for Cambridge ISD and Cambridge Water Department (CWD).
- Coordinate and accompany the ISD during rough and finish plumbing inspections; assist project team in resolving identified issues.
- Confirm Avantis<sup>®</sup> entity records and labels for all Backflow Preventers.
- Inspect and witness test operation of Backflow Preventers.
- Assist project team on any plumbing code issues or CWD relations.

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# Documents

- Documents to be Reviewed by OSP
- O&M Documents
- Final Report Deliverables

# Documents to be Reviewed by OSP

(as assigned by OSP Project Manager)

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- Testing, Adjustment and Balancing (TAB) Report
- Building Automation and Sequence of Operation
- Operation and Maintenance Manuals
- Record Drawings and project documentation
- Training Programs offered by the Vendors

# O&M Documentation

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The following will be reviewed by OSP Team for completeness:

- Permits
- Final As-Built drawings
- Manufacturers' Warranties
- Equipment O&M Manuals (including start-up requirements)
- Manufacturers' / Contractor's Training Plans
- Verification of Equipment Identification and Bar Coding
- Identification of Spare Parts and Special Tools for Maintenance

# OSP Final Report Deliverables

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- Construction Observation Reports
- Deficiency and Issue Tracking Logs
- Start-Up and Verification Checklist Reports
- Preliminary Test Reports (factory, contractor)
- Final OSP Test Reports
- Employee Training Verification Log
- HVAC Preventive Maintenance Program
  - Equipment Inventory
  - Maintenance Routines
  - Proposed Work Schedules and Cost
- Fire Safety Annual Maintenance Program
  - 3<sup>rd</sup> Party Inspection and Certification for CFD
  - Proposed Inspection / Testing Schedules and Cost
- Occupant Readiness Report
  - Locks, Doors, Hardware Inspections
  - Post Occupancy Building Operator Tour Protocols
  - Operations Center Protocols: EMS monitoring, emergency response and notifications

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# Price Proposal and Schedule

- Professional Services
- Hourly Maintenance and Testing Service
- Project Schedule Milestones

# Revised OSP Pricing Proposal for Byerly Hall Project

		Hours	Billable Hours	\$/hour	Cost of Service
<b>Program Manager:</b>	Develop OSP Testing Protocols	32	32	\$110	\$3,520
	Document Review (e.g., submittals, change orders)	30	30	\$110	\$3,300
	Project Management	60	60	\$110	\$6,600
<b>Mechanical Engineer:</b>	E&U Design Review	10	<i>No Charge</i>		
	Develop Equipment Testing Protocols	20	20	\$110	\$2,200
	Field Testing and Project Mtgs.	40	40	\$110	\$4,400
	Progress Reports	12	12	\$110	\$1,320
<b>Electrical Engineer:</b>	E&U Design Review	10	<i>No Charge</i>		
	Develop Equipment Testing Protocols	20	20	\$110	\$2,200
	Field Testing and Project Mtgs.	8	8	\$110	\$880
	Progress Reports	4	4	\$110	\$440
<b>Electrical Inspection:</b>	E&U Design Review	10	<i>No Charge</i>		
	Develop Electrical Ground & Service Entrance Testing	10	10	\$110	\$1,100
	Field Testing Support	12	12	\$110	\$1,320
<b>Elevator Testing:</b>	E&U Design Review	10	NC		
	Develop Pre-Inspection Plans for State Testing	4	4	\$110	\$440
	Field Testing Support	12	12	\$110	\$1,320
<b>Plumbing Inspection:</b>	E&U Design Review	10	NC		
	Field Inspections	4	4	\$110	\$440
	Equipment Testing Support	4	4	\$110	\$440
<b>Totals</b>		<b>322</b>	<b>272</b>		<b>\$29,920</b>

# Revised FMO Pricing Proposal for Byerly Hall Project

		Hours	Billable Hours	\$/hour	Cost of Service
<b>Fire Protection:</b>	Review Maintainability of Equipment	20		<i>No Charge</i>	
	Inspection and Testing Program Development	20		<i>No Charge</i>	
	3rd Party Alarm Testing & Certification for CFD		60	\$70	\$4,200
<b>FMO Maint. Support:</b>	Review Maintainability of Equipment	16		<i>No Charge</i>	
	Equipment Start-Up & Testing		120	\$70	\$8,400
	Bar Code all Equipment for PM Program		40	\$70	\$2,800
	Manufacturer's Training on all Equipment		30	\$70	\$2,100
	Development of Controls Logic Testing Protocols	8	8	\$70	\$560
<b>Totals</b>		<b>64</b>	<b>258</b>		<b>\$18,060</b>

# Project Schedule Milestones

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- Project Started May 2007
- OSP Start Date Sept. 2007
- Construction Completion Date \* May 2008
- OSP Completion Date June 2008
- Building Occupancy July 2008

\* Per Shawmut Construction

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# Appendix

- Pre-functional Test Requirements
- Equipment to be Inspected
- Automation Controls Verifications
- Doors and Hardware Inspection Check List

# Contractor Provided Pre-Functional Performance Test Requirements

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- TAB (testing, adjusting, and balancing) performance report
- Equipment Performance reports
- Performance report for automatic control in all seasonal modes
- Integrated system performance reports
- Performance report for all life safety devices
- Electrical system performance report
- Mechanical system performance report

# Equipment to Be Inspected /Tested

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- **Geothermal Wells:**
  - Casing Installation
  - Inner pump casing (Porter Shroud) installation
  - Pump and wiring installation
  - Supply/return piping from the well to the heat pumps
- **Air Handler Unit AHU-1:** 5200 CFM (chilled & hot water coils)
- **Hot Water Heat Exchanger** (steam to water, 4 pass, 70 GPM)
- **Compressor** (General Air Products  $\frac{3}{4}$  HP Tank and Lubricated Compressor)
- **Control System Computer, Network and Hardware** (Johnson Controls or equivalent)

# Equipment to Be Inspected /Tested

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## ■ Pumps:

- (5) P-HP-1 Geothermal Well pumps: 70 gpm/each
- P-1 Primary Hot Water Pump: 280 gpm
- P-2 Primary Chilled Water Pump: 280 gpm
- P-3 Swing Pump: 280 GPM
- P-4&5 Well Water Pumps: 450 GPM's each
- P-6 Heat Exchanger Pump: 70 GPM's
- P-7 Freeze Protection AHU-1: 60 GPM's
- CP-1 Duplex Condensate Pump: 9 GPM
- PE-1&2 Duplex Ejector Pumps Set
- PS-1&2 Duplex Submersible Pump Set
- CP-1&2 Hot Water Circulation Pumps

# Equipment to Be Inspected /Tested

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- **Accumulation and Expansion Tanks:**
  - T-1 Hot Water 360 Gal. Basement
  - T-2 Chilled Water 360 Gal. Basement
  - T-3 Geothermal 360 Gal. Basement
  - T-4 Hot Water Expansion Tank Basement
  - T-5 Chilled Water Expansion Tank Basement
  - T-6 Geothermal Expansion Tank Basement
- **Variable Frequency Drives – operating the following:**
  - Hot Water Pump
  - Chilled Water Pump
  - Swing Pump
  - Well Pumps
  - AHU-1

# Equipment to Be Inspected /Tested

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## ■ **Supply Fans:**

- SF-1 Supply Fan 1500 CFM Electric Room
- SF-2 Supply Fan 1500 CFM Mech. Room
- SF-3 Supply Fan 750 CFM Steam Room
- SF-4 Supply Fan 4500 CFM Attic Room

## ■ **Exhaust Fans:**

- EF -1 Exhaust Fan 1500 CFM Electric Room
- EF -2 Exhaust Fan 1500 CFM Mech. Room
- EF -3 Exhaust Fan 750 CFM Steam Room
- EF -4 Exhaust Fan 4500 CFM Attic Room
- EF -5 Exhaust Fan 600 CFM Toilet Room
- EF -6 Exhaust Fan 1600 CFM General
- EF -7 Exhaust Fan 450 CFM 3<sup>rd</sup> Floor Attic

# Equipment to Be Inspected /Tested

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## ■ **Cabinet Unit Heaters:**

- CUH-1 Floor Type 430 CFM Stairways
- CUH-2 Floor Type 630 CFM Vestibule
- CUH-3 Ceiling Type 1060 CFM Vestibule
- CUH-4 Wall Type 430 CFM Stairways

## ■ **Unit Heaters:**

- UH-1 Misc. Spaces 700 CFM Hot Water
- UH-2 Misc. Spaces 630 CFM Hot Water

## ■ **Electric Heater:**

- EUH-1 Misc. Spaces 350 CFM Electric

## ■ **Finned Tube Radiation System:**

- FTR-1 Wall Mount 900 BTU/HR/Linear ft.
- FTR-2 Pedestal Floor Mount 700 BTU/HR/Linear ft.

# Equipment to Be Inspected /Tested

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## ■ **Fan Coils Units Horizontal Concealed:**

- (14) FC -2 Chilled/Hot Water Airtherm Units
- (22) FC -3 Chilled/Hot Water Airtherm Units
- (27) FC -4 Chilled/Hot Water Airtherm Units
- (1) FC -5 Chilled/Hot Water Airtherm Units
- (1) FC -6 Chilled/Hot Water Airtherm Units
- (6) FC -7 Chilled/Hot Water Airtherm Units

## ■ **Fan Coils Units Vertical Cabinet:**

- (3) FC -2V Chilled/Hot Water Airtherm Units
- (4) FC -3V Chilled/Hot Water Airtherm Units
- (32) FC -4V Chilled/Hot Water Airtherm Units
- (3) FC -5V Chilled/Hot Water Airtherm Units

# Equipment to Be Inspected /Tested

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- **Fire Protection System** (Simplex or equivalent)
- **Elevator and Control System**
- **Electrical Infrastructure:**
  - Service Entrance Equipment, Feeders and Metering
  - Bonding and Grounding System
  - Electrical Distribution Equipment
- **Controls Logic:**
  - Geothermal Well Pumps
  - Heat Pumps
  - Hot Water Pumps
  - Chilled Water Pumps and Bypass Valve

# Automation Controls Verification

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## ■ **Heat Pump Control Logic Tests:**

- Enable/Disable based on outside air Temperature and Occupancy
- Verify boiler water and makeup water metering
- Verify Supply temp. will be controlled by the heat pump controls, including outdoor temperature reset function
- Verify full Alarm functionality

## ■ **Geothermal Well System Control Logic Tests:**

- Enable/Disable based on Heat Pump requirements
- Verify well water temperature set point
- Verify well water supply/return temperatures metering
- Verify well water flow rate
- Verify full alarm functionality

# Automation Controls Verification

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- **Hot Water Pump Control Logic Tests:**
  - Enable/Disable with Controls
  - Verify control speed to maintain designed differential pressure
  - Verify control of Frequency Drive
- **Chilled Water Pump Control Logic Tests:**
  - Enable/Disable
  - Verify control speed to maintain design differential pressure
  - Verify control of Frequency Drive

# Locks, Doors and Hardware Inspection Check List

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- All interior and exterior doors and hardware installations completed per project plans and specifications.
- All approved panic hardware and emergency exit devices in place and confirmed to be functioning properly at all locations.
- All low voltage electrical wiring required for remote access control or alarm monitoring points has been installed in accordance with plans as well as applicable codes and standards.
- Contractor has presented a set of marked-up plans to Harvard University Locksmith Services reflecting any changes made to the door or hardware schedules. (As-built drawings must be submitted by the contractor at a later date as part of the project close out materials.)

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