WOODS HOLE OCEANOGRAPHIC INSTITUTION

Laboratory for Ocean Sensors and Observing Systems (LOSOS)

Schematic – Basis of Design

March 17, 2011

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Project Overview

The Woods Hole Oceanographic Institution (WHOI) has received funding from the National Institute of Standards and technology (NIST) to construct a Laboratory for Ocean Sensors and Observing Systems (LOSOS). LOSOS will be an interdisciplinary center for scientists and engineers developing the next generation of sensors and supporting technology for ocean observation. It will specifically support two major national programs: the Ocean Observatories Initiative (OOI) and the Ocean Bottom Seismometer Instrument Pool (OBSIP), and also WHOI's Martha's Vineyard Coastal Observatory (MVCO). The development and deployment of interdisciplinary ocean sensors and observing systems is essential to our understanding of the multiple and changing interactions of the ocean with earth, atmosphere, climate and human civilization. These ocean data are increasingly critical to NOAA missions in climate, weather, resource management, and earthquake and tsunami prediction. Coordination of these scientific and engineering efforts at LOSOS will accelerate progress and enhance efficiency in all of these programs. In addition to this relevance to NOAA priorities, the development, testing, calibration and deployment of advanced ocean instrumentation at LOSOS is entirely consistent with the NIST mission.

WHOI is the largest private oceanographic research institution in the world. Established in 1930 in the 'science village' of Woods Hole, Massachusetts, WHOI currently has a staff of over 800 and a 2009 budget of $165M. Research at the Institution covers nearly all aspects of oceanography and ocean engineering in five academic departments, four Ocean Institutes, a Marine Policy Center and several smaller Centers and Cooperative Institutes. WHOI operates three ocean-going research vessels, a coastal ship, and the National Deep Submergence Facility which includes the submersible Alvin and several robotic vehicles for ocean exploration and research. WHOI is the lead institution in the Coastal and Global (CGSN) Implementing Organization of the OOI, funded by the National Science Foundation, is scheduled to start its 5-year design and implementation phase in September 2009 with first deployments in 2013.

The Laboratory building proposed here would be the main facility for engineering, construction, testing, calibration and maintenance of sensors and supporting infrastructure for the OOI CGSN program at WHOI. There is not currently any other space available on the WHOI campus to accommodate this need. The building would include laboratory and operational office space for the Martha's Vineyard Coastal Observatory, a state of the art *in-situ* research facility and test site for a variety of ocean instruments. Finally LOSOS would also provide new and expanded space for the WHOI Ocean Bottom Seismograph Laboratory, currently occupying inadequate space on the WHOI dock.

Design Description of the Research Facility

The site chosen for the Laboratory for Ocean Sensors and Observing Systems (LOSOS) on the Quissett campus is intended to maximize the efficiency of the building and its ability to support the LOSOS program. This is due to the site's proximity to several key features of the campus: the new campus Ring Road; the existing high bay facilities currently utilized for instrument development, including Clark Lab and the Rinehart Coastal Research Lab (CRL); and the Burn-In area shared by these two existing facilities. The access to the Ring Road will allow direct delivery of raw materials to the facility, as well as transportation of the completed instruments to the WHOI Dock once the instruments are in service. The adjacency to Clark South and the CRL will allow the LOSOS to take advantage of several existing technical features in these buildings such as a salt water tank for instrument testing, large paint spray booths, and potting facilities. Access to the existing Burn-In area will allow the staff to confirm the readiness of the instruments prior to being placed in service by direct exposure to the elements. These adjacencies will also foster cross fertilization of technological developments amongst the staff.

In addition to the technical merits of the site regarding the science initiative, the site was selected for the fact that the general area within the Ring Road has been previously permitted for further development by the Cape Cod Commission. As with other development projects recently implemented by WHOI within the Ring Road, this project will make all efforts to retain existing vegetated areas wherever possible, and replace disturbed areas with native tree and ground cover species to match those found and installed elsewhere on the campus. The selected site also offers an existing vegetated low containment basin, which with only minor modification should accommodate all the runoff from the developed areas of this project such as the roof and the pavement, with no impact to other areas of the campus.

Site development will include paved staging areas adjacent to the building to allow for efficient delivery of raw materials, loading and unloading of the instruments, and storage of large buoys and other instrumentation while under servicing. These delivery and staging areas are strategically located to provide access to spaces in the building that house key operations - the Receiving Area and the High Bay - and to instrumentation laboratories flanking these spaces. Staff parking for the facility will also be accommodated in the paved area, in a manner conducive with the staging and delivery activities. The building will make use of existing utilities found along the Ring Road which include the electrical grid, city water, and gas. Sanitary service will be provided by the existing on-site campus treatment facility located nearby. The site development will also include a bridge connection between the LOSOS and Clark Lab where collaborating scientists' labs and offices are housed, and where access to the WHOI shuttle bus is available. The site is also under consideration as one of several locations for a wind turbine to provide electrical service, which can easily coexist with the LOSOS.

The architectural expression of the building will be consistent with existing nearby buildings and the recent additions to the campus. The exterior walls are to be clad predominately in horizontal tongue and groove wood siding which will weather naturally to a light grey, with windows of aluminum construction in a light color to complement the siding. Selected areas of the exterior will be highlighted with the application of natural zinc panels which will also weather to a grey color. Exterior windows will utilize high performance insulating glazing, and all materials in the exterior wall construction will meet or exceed the requirements of the energy code.

The functional organization of the building is centered on the High Bay area and the safe and efficient flow of materials between it and the supporting spaces in the facility. The High Bay itself will include a large overhead door onto the exterior staging area to facilitate the movement of buoys, mooring components and other large hardware in and out by means of electrical forklifts. The High Bay will also feature an overhead bridge crane to move these items once inside the building, where they can be safely positioned for fabrication, repair, and maintenance. From inside the High Bay, the instrumentation can be removed and taken to the laboratories located within the facility via wide interconnecting corridors, a freight elevator, and by a centrally located open stair and open mezzanine walkway. Key non-lab features of the building program include a Conference Room overlooking the High Bay, and an Operations Room where regular Project Team meetings will be held. The facility also includes offices for all research and administrative staff, along with customary support spaces.

Environmental control for all spaces will be provided by mechanical equipment located within the facility. Two rooftop HVAC units will serve the High Bay, and one rooftop unit will serve the remainder of the building. The High Bay and laboratories do not require an enhanced degree of environmental controls for heating and cooling thus the criteria will be consistent throughout the facility. All required life safety features will also be provided, including full sprinklering of all spaces, and an addressable fire alarm system. A natural gas fired emergency generator (with a sound attenuating enclosure) will provide standby power for life safety, laboratory needs, and a reduced setting for environmental conditioning equipment.

The building structure will be a steel frame with concrete floors, which will be designed to a vibration criterion of 4000 micro inches per second to ensure that there is no harmonic interference with instrumentation. The building will also be connected to the Institution's data network, with network connections throughout the facility. The work in the laboratories will not require the use of chemicals and laboratory gases, therefore fume hoods and related exhaust systems will not be required, with the exception of one fume hood in the Electronics Lab for use with various foam injection processes.

LEED Assessment

The project will include an integrated approach to sustainable design in the development of the design of this project. This effort will begin in the Preliminary Design phase when the team will consider a wide range of sustainable building strategies for the project. In the initial LEED assessment, the Project Team will evaluate and articulate the project's goals and the certification level sought currently, planned to be LEED Silver. The following primary elements of sustainable design have been preliminarily identified based on LEED criteria as those that could be incorporated into the building.

A. Sustainable Sites
   The site will meet sustainability goals through:
   1. Selecting a site that is appropriate and reducing the building's impact on the site
   2. Providing access to alternative transportation with access to public transportation and facilitating the use of bicycles
   3. Storm water Design
   4. Reducing light pollution from the building.

B. Water Efficiency
   Increase water efficiency by:
   1. Using water efficient landscaping
   2. Reducing water use overall.

C. Energy and Atmosphere
   1. Optimize energy performance - The building systems and envelope shall be designed to achieve a minimum performance 16% more efficient than required by ASHRAE 90.1-2007, promoting energy efficiency and performance with:
      a. Variable volume air handling systems with variable speed fans
      b. High efficiency filtration systems
      c. Premium efficiency type motors
      d. High-frequency electronic ballasts and T-5 lamps
      e. Light-emitting diode (LED) exit lights
      f. NEMA TP 1-2002 compliant dry-type transformers
   2. Enhanced commissioning will be performed by a third party to verify systems perform in accordance with the Owner's operating requirements
   3. Enhanced refrigerant management - zero use of CFC based refrigerants. Selected refrigerants will have zero or low ozone depleting potential and minimal direct global warming potential

D. Materials and Resources
   1. Construction waste management will be used to divert 75% of waste materials from landfills, incinerators, etc.

2. Materials with recycled content will be used wherever possible
3. Regional materials will be used wherever possible
4. Materials from sustainable sources will be used wherever possible

E. Indoor Environmental Quality

The project will enhance indoor air quality through:

1. Outdoor air delivery monitoring
2. CO2 detection in densely occupied spaces
3. Construction IAQ management plan both during construction and before occupancy
4. Use of low emitting materials
5. Indoor pollutant source control
6. Controllability of lighting systems, including daylighting lighting control systems to minimize use of building lighting systems
7. Thermal comfort – design HVAC systems and exterior wall to comply with ANSI/ASHRAE Standard 55-2004, *Thermal Environmental Conditions for Human Occupancy*,
8. Daylight and Views – design to allow occupants access to outdoor daylight and views

Architectural

The Architectural Basis of Design outlines the various architectural materials and finishes appropriate for the project.

Materials for Exterior Construction

The exterior walls of the addition will be comprised of the following systems: 40% wood siding; 15% composite aluminum panel; 15% zinc panel; and 30% glazed curtain wall. The roof of the building will be a high performance single ply membrane roof. The rooftop mechanical equipment screen will be of prefinished metal panel construction with exposed (to equipment side) galvanized structural steel support structure.

Following is an outline of these systems and their components.

1. Wood Siding System
   a. Wood Siding: Quarter sawn eastern white cedar, clear grade, tongue and groove profile
   b. Furring Space: 1.5" pressure treated vertical wood furring

c. Insulation: 1.5" extruded polystyrene board.
d. Air, Water, and Vapor Barrier Membrane: equal to Perm-A-Barrier by W.R. Grace & Co.
e. Sheathing: "Dens Glass Gold".
f. Structural Backup: 6" light gage metal framing, spacing and gage as required for loads
g. Interior Finish: Painted gypsum wall board, or other as scheduled elsewhere

2. Composite Aluminum Panel System
   a. Metal Panels: Composite aluminum panels, 4 mm thick, equal to Alucobond. Finish to be 70% Kynar two coat custom color.
   b. Insulation: 1.5" inches of extruded polystyrene board.
   c. Air, Vapor, and Water Barrier Membrane: Equal to Perm-A-Barrier by W.R. Grace & Co.
   d. Sheathing: "Dens Glass Gold".
   e. Structural Backup: 6" light gage metal framing, spacing and gage as required for loads
   f. Interior Finish: Painted gypsum wall board, or other as scheduled elsewhere.

3. Zinc Panel System
   a. Zinc Panels: Titanium zinc, 0.8 mm thick, preweathered type, equal to Rheinzink.
   b. Ventilation Mat: Equal to Enkamat by Colbond.
   c. Sheathing: "Dens Glass Gold".
   d. Insulation: 1.5" inches of extruded polystyrene board. (not required at rooftop mechanical equipment screen)
   e. Air, Vapor, and Water Barrier Membrane: equal to Perm-A-Barrier by W.R. Grace & Co. (not required at rooftop mechanical equipment screen)
   f. Sheathing: "Dens Glass Gold". (not required at rooftop mechanical equipment screen)
   g. Structural Backup: 6" light gage metal framing, spacing and gage as required for loads
   h. Interior Finish: Painted gypsum wall board, or other as scheduled elsewhere. (not required at rooftop mechanical equipment screen)

4. Glazed Curtain Wall System
   a. System: Equal to Kawneer 1600 Wall System.
   b. Full engineering services are required from the fabricator.
   c. Air leakage performance: maximum 0.06 cfm/sq. ft. at a static air pressure differential of 6.24 psf.
   d. Water leakage performance: none at 12 psf.
   e. Frame: 2.5 inches wide with glazing at exterior face.

f. Frame finish: Finish on all surfaces, interior and exterior, to be three coat custom color metallic finish, to meet AAMA 2604.
g. Vision Glass: Class A insulting, Viracon VE1-2M, low E coated, clear.
h. Spandrel Glass: Class A insulating, heat strengthened, low E coated.
i. Zero sightline operators
j. Sunshades: Horizontal sunshades equal to Kawneer 1600 Sunshade System

5. Roof
   a. TPO single ply membrane equal to Sure-Weld TPO Sheet Membrane by Carlisle
   b. Flashings: Elastomeric TPO sheet flashing equal to membrane.
   c. Roof Walkway Pads: Heat weldable walkway rolls, 30" wide x 5/16" thick x 200' total length.

6. Exterior Doors, Frames and Hardware
   a. Hollow metal, extra heavy duty, 16 gage galvanized steel sheet construction.
   b. Door Elevation: Stile and rail with full glass.
   c. Glass: 0.25 inch thick, non-insulating, clear tempered safety glass.
   d. Hinges: butts.
   e. Exit device: modern style push bar.
   f. Closer: concealed in head of door or frame.
   g. Weather-stripping: easily replaceable
   h. Threshold: barrier free, thermally broken.

7. Exterior Overhead Coiling Doors
   a. Electrically operated insulated overhead coiling doors.
   b. Structural quality, cold rolled galvanized zinc coated slats formed over expanded polyurethane insulation core.
   c. Galvanized bottom bars, counterbalance barrel, end brackets, hoods, and guides.
   d. Sensing Edge and push button operator controls.
   e. Sizes as follows: 16' x 20' at High Bay (one total required); 8' x 12' at other labs

8. Exterior Ceilings and Soffits
   Integrally colored, polymer modified cement coating with light sand texture over cement board sheathing with fiberglass tape reinforced joints

9. Foundation Wall Waterproofing
   a. Sheet and Liquid Waterproofing: for below grade structure
   b. Cementitous Waterproofing: at interior of elevator pits

10. Joint Sealants and Fillers: silicone, except urethane for walking surfaces

11. Exterior Expansion Joints: concealed extruded aluminum retainers with plastic gasket and redundant inner gasket

12. Foundation Drainage System: PC pipe system, with cleanouts, drainage fills, and filter fabric

13. Exterior Railing at Retaining Wall: Galvanized steel with high performance paint coating.

14. Wood Walkway (supported bridge, 8' wide) to Clark Lab: Cast in place concrete foundation piers (round), 16' on center; 2 x 12 pressure treated southern yellow pine joist floor construction; similar wood guard and hand rail construction with posts at 8' on center, and galvanized steel mesh panel infill below rails; 1 x 6 Ipe deck boards. Provide step lights at all posts.

15. Mock Ups:
Construct composite, on site mock up of all exterior materials and assemblies, including structural backup, sheathing, insulation, air/vapor/ and water barrier membrane, flashing, and each type of joint with specified sealant treatment.

Materials and Equipment for Interior Construction

Finish Schedule

	Space	Floor	Base	Walls				Ceiling	Ceiling Height	Notes
				North	South	East	West			
1	**Research Space**									
1.1	Buoy/Mooring Prep and Maintenance	SC	RB	MRGW-BCDX	MRGW-BCDX	MRGW-BCDX	MRGW-BCDX	Exp. Ptd.	varies	High Bay
1.2	Wet Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.2.1	AUV Integration and Test Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-3	10'-0"	
1.2.2	Glider Integration and Test Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-4	10'-0"	
1.2.3	Profiler Integration and Test Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-5	10'-0"	
1.3	OBS Operations Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-1	10'-0"	
1.3.1	Mechanical Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.3.2	Electronics Assembly/ Disassembly	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.3.3	Clean Electronics	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.4	MVCO Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.5	PI Sensor Integration and Qual Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.6	Instrument Prep Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.7	Electronics Prep Lab	NCT	RB	GWB	GWB	GWB	GWB	ACT-2	10'-0"	
1.8	RF Test Facility									Exterior Space

Research Support Space										
2.1	Q/A and Receiving Area	SC	RB	MRGW-BCDX	MRGW-BCDX	MRGW-BCDX	MRGW-BCDX	Exp. Ptd.	10'-0"	
2.2	High Latitude Environmental Cold Room	SV	ICB	By Manuf.	By Manuf.	By Manuf.	By Manuf.	By Manuf.		
2.3	Operations Room	CPT	RB	GWB	GWB	GWB	GWB	25% GWB/75% ACT-1	9'-0"	
3 Offices/Admin										
3.1-3.6	Offices (General)	CPT	RB	GWB	GWB	GWB	GWB	ACT-1	9'-0"	
4 Admin Support										
4.1	Conference Room (30P)	CPT	RB	GWB	GWB	GWB	GWB	25% GWB/75% ACT-1	9'-0"	
4.2	Copy/Printer/Mail Room	CPT	RB	GWB	GWB	GWB	GWB	ACT-1	9'-0"	
4.3	Kitchen	NCT	RB	GWB	GWB	GWB	GWB	ACT-1	9'-0"	
5 Lobby/Break-out										
5.1	Lobby	PT	PT	GWB	GWB	GWB	GWB	25% GWB/75% ACT-1	10'-0"	
6 Building Support Spaces										
	Toilets	CT	CT	CT	GWB	GWB	GWB	ACT-1	8'-0"	
	Stair	RT		GWB	GWB	GWB	GWB	ACT-1	Varies	
	Corridors	CPT	RB	GWB	GWB	GWB	GWB	ACT-1	9'-0"	
	Normal Electrical Room	SC	SC	CMU	CMU	CMU	CMU	Exp. Ptd.	N/A	
	Emergency Electrical Room	SC	SC	CMU	CMU	CMU	CMU	Exp. Ptd.	N/A	
	Sprinkler Room	SC	SC	CMU	CMU	CMU	CMU	Exp. Ptd.	N/A	

Finish Systems

Following is a description of the above finish systems and an outline of the other required materials and equipment found throughout the building.

1. Monorail in High Bay
   a. Capacity: 10 Ton column supported single girder bridge crane
   b. Hoisting Mechanism: Dual speed, R & M wire rope hoist, variable speed trolley with independent traveling push button controls and soft start feature
   c. Manufacturer: Equal to North American Industries, Woburn, MA

2. Elevators
   a. Hydraulic Class A freight elevator equal to ThyssenKrupp
   b. Capacity: 5000 pounds.
   c. Speed: 45 FPM
   d. Cab Finishes: Plastic laminate with stainless steel trim
   e. Cab Interior Dimensions: 6' x 6'
   f. Number of Stops: 3 - First, Second, and Roof
   g. Use non-petroleum based hydraulic fluid, if possible

3. Stairs
   a. Structure
      1. Egress Stair and Open Stair at High Bay: painted steel stringers and risers, concrete filled pan tread and landing with GWB at underside of stair.
   b. Stair Guard Rails
      1. Painted steel flat stock with painted wire mesh infill panels.
   c. Stair Hand Rails
      1. Clear finished quarter sawn oak
   d. Stair Tread Finish:
      1. Rubber treads, rubber tile at landings.

4. Guard Rail around High Bay
   a. Painted steel flat stock with painted wire mesh infill panels.

5. Partition Assemblies
   a. Gypsum wall board (GWB) on required gage steel framing filled with acoustical insulation, typical at Labs, Offices, Conference Rooms, Operations Rooms, as per Finish Schedule.
   b. Moisture and abuse resistant gypsum board (MRGWB) equal to "Aquatough Interior Panel" system by USG on required gage steel framing at Toilet Rooms, as per Finish Schedule.
   c. Gypsum wall board shaft wall (GWBSW) assemblies at shaft enclosures.

d. Reinforced concrete masonry units (CMU) at Egress Stair, Elevator Shaft, and mechanical areas.
e. Moisture and abuse resistant gypsum board (MRGWBCDX) equal to "Aquatough Interior Panel" system by USG on required gage steel framing with ¾" CDX plywood up to 8' AFF at High Bay

6. Ceiling Assemblies
   a. Gypsum Wall Board (GWB) screwed to manufactured gypsum board ceiling suspension system.
   b. Acoustical ceilings:
      1. ACT-1 (Offices, Conference Room, Operations Room, other administrative areas): 24 x 24 inches, Armstrong Ultima Vector, with Prelude 15/16" exposed tee grid.
      2. ACT-2 (Labs): 24 x 24 inches, Ecophan Focus Ebx with box grid and Connect Shadow Line Trim 8152.

7. Floor Finishes
   a. Sheet Vinyl (SV): Armstrong Medintech, with integral coved base and heat welded seams.
   b. Resilient Tile (NCT): Stonescape by Estrie Division of American Biltrite, Ltd.
   c. Carpet (CPT): Direct adhered, level loop, 28 ounce face weight, solution-dyed, nylon, 20 pound tuft bind, stain-microbe-static treated.
   d. Porcelain Tile (PT): Techno Line by Rondine Group with matte slip resistant, 12" x 12" x $^{5}/_{16}$" nominal thickness, thinset over waterproof antifracture membrane, epoxy grout joint lines.
   e. Ceramic Tile (CT): 2" x 2" unglazed ceramic floor tile; 4 ¼" x 4 ¼" glazed wall tile up to 7' AFF all wet wall.
   f. Sealed Concrete (SC): sealed with transparent dustproofer /hardener.
   g. Entrance Mats (EM): stainless steel grate with polypropylene carpet inserts and integral drain pan.

8. Wall Base
   a. Integral Cove Base (ICB), resilient sheet vinyl: installed integral with sheet vinyl floor finish.
   b. Resilient Tile Base (RB): Rubber, 4 inches high, factory formed corners, coils to minimize seams.
   c. Porcelain Tile Base (PT): 4 inches high, to match porcelain tile flooring.
   d. Ceramic Tile Base (CT): Coved to match ceramic wall tile.

9. Interior Painting
   a. Products: water based, low odor, low VOC architectural coatings.
   b. Coats: Primer and two finish coats for all surfaces.
   c. Sheen for Ceilings: Flat.

d. Sheen for Walls: Satin.
e. Sheen for Painted Doors, Frames and trim: Semi-gloss.

10. Interior Wall Finishes
    a. Acoustical Wall Panels (AWP) in Conference Room and Operations Room: Micore 160 board, with Maharam Tek Wall Syntax fabric covering.

11. Interior doors, frames and hardware
    a. Aluminum doors and frames at Offices, Conference Room, Operations Room, Kitchen, Copy/Printer Room, Storage Rooms: Equal to Wilson Partitions Snap on Trim Profile series with full safety glazing, transparent or translucent.
    b. Wood Doors with Steel Frames at Labs: Stile and rail beech veneer doors, with transparent safety glass; 16-gage welded, shop primed, field painted frames.
    c. Wood Doors with Steel Frames at Toilets: Solid core beech veneer doors; 16-gage welded, shop primed, field painted frames.
    d. Steel doors and Frames at Egress Stair and mechanical areas (rated where required). 18- gage face, flush, seamless shop primed, field painted doors; 16-gage welded, shop primed, field painted frames.

12. Interior Windows and Borrowed Light Assemblies
    a. Frame: to match Wilson Partitions Snap on Trim Profile Series.
    b. Glass: transparent safety glass

13. Millwork and Casework (non-laboratory)
    a. Conference Room: Plain sliced beech veneer plywood, with quarter sawn solid stock beech edge banding.
    b. Operations Room, Copy/Printer Room, and Kitchen: Plastic laminate over MDF core.

14. Counter Tops
    a. Conference Room: to match millwork and casework.
    b. Operations Room, Copy/Printer Room, and Kitchen: Plastic laminate with shop finished beech edge.
    c. Toilets: solid surface material

15. Building Specialties and Equipment
    a. Toilet partitions: phenolic with heavy stainless steel hardware and fittings
    b. Toilet accessories: stainless steel commercial units.
    c. Projection screens: motorized ceiling recessed, 6' wide x 9' high. One each in Conference Room and Operations Room, (two total required)
    d. Projector mount: fixed ceiling mounted, black painted finish. One each in Conference Room and Operations Room. (two total required)
    e. Fire extinguisher cabinets: Recessed units equal to Larsen's Occult Series Model O-2409. (7 total required)
    f. Tackboards: Forbo Bulletin Board cork with aluminum frame.

g. Writing Boards: porcelain steel with aluminum frame and tray.
h. Window Treatment: Manually operated, translucent shades in all offices with exterior windows (12 total required) electrically operated blackout shades at Conference Room and Operations Room.
i. Wall and Corner Guards: Adhered stainless steel, in lab areas. (36 total required)

16. Lab Specialties and Equipment
    a. Lab Casework: Fisher Hamilton "Regency Flush" series or equal.
    b. Fume Hoods: Equal to Air Sentry Model by LabCrafters, six foot wide with vented base cabinets. (one total required)
    c. Controlled Temperature Room: Prefabricated all metal clad, complete self contained unit and system, equal to Minus Eleven.

17. Mock ups
    a. Construct composite, off site mock ups of research lab bench assemblies including casework, frames, shelving, fixtures, and equipment. Mockups approved by the architect can be used in the final construction of the building.

Mechanical Systems

The HVAC, Electrical, Plumbing and Fire Protection Basis of Design outlines the various systems and design criteria required for the project.

Fire Suppression (Division 21)

Fire Protection

- Provide new Building Fire Service by connection to existing 12" campus water main in loop. Assume 400ft run of 6" pipe to foundation. Base cost assumes that recently enhanced city water service to campus provides adequate pressure for sprinkler service.
- Provide alarm valve, pumper truck connection, sprinkler floor control valves, and a wet sprinkler system for complete sprinkler protection of OOI. New sprinklers branch piping, and accessories shall be hydraulically designed to meet the NFPA definition of "fully sprinklered" Ordinary hazard level of sprinkler density is anticipated.

Plumbing (Division 22)

Sanitary, Lab Waste and Storm Systems

- Provide sanitary drainage to meet architectural program, including toilet core facilities, kitchenette, lab hand-washing sinks and any eyewash stations.
- Any new program-driven floor drains to be tied into sanitary or lab waste mains as appropriate.
- It appears that separated lab drainage will be minimal or not needed. Any new wet-bench lab waste piping would connect by gravity sewer to the existing site treatment plant.
- Provide storm drainage from flat roof areas: internal rainwater leaders, site storm sewer to on-site underground infiltration chambers, and roof overflow scuppers.

Supply Systems

- New plumbed systems shall include potable cold & hot water, hot water return, tempered water for safety shower, tempered water return, natural gas for heating appliances, laboratory/shop compressed air.
- No piped specialty gasses, piped pure water or laboratory vacuum are anticipated.

- It appears that a separated non-potable water supply for laboratory purposes is not needed. A piped pure water system (RODI or distilled) is not needed.
- New domestic water service to be connected to existing campus water main in loop road. Assume 400ft run of 6" pipe to foundation. Provide meter station, backflow protection.
- New distribution piping shall include potable cold & hot water for toilet core, kitchenette and lab hand-washing, associated hot water returns, and tempered water for safety stations, tempered water return, laboratory compressed air as required for fixtures and equipment. Supply branches shall include isolation valves at supply mains as well as at the point of outlet.

Plumbing/Laboratory Equipment

- Instrument/shop air compressor station: Allow duplex 5HP with refrigerated dryer.
- Building water heaters: Provide a gas-fired domestic water heater in penthouse mechanical room. Heater shall be storage type with adequate storage volume to serve one safety shower.
- Emergency shower/eyewash stations shall be installed and connected to the building tempered water supply circuit.

Heating, Ventilating and Air Conditioning (Division 23)

Central Air Conditioning Systems

- Design Criteria
    - Instrumentation (dry) labs and related spaces: 12W/sf equipment load, 12 air changes/hour (ACH) design maximum circulation, 2ACH outdoor air.
    - Offices: 5W/sf equipment load, 6ACH design maximum circulation, 1ACH outdoor air.
    - All conditioned spaces: 72F heating setpoint, 74F/50%RH cooling setpoint, no humidification.
    - Outdoor design criteria: 0F winter, 81Fdb/75Fwb summer.
- Provide a variable air volume (VAV) 25,000cfm A/C supply air system to serve approximately 14,000 gsf of conditioned space, including dry labs and offices. Because labs do not use chemicals, the system will re-circulate air from all principal occupied spaces. System will incorporate minimum ventilation rates to meet Code,

and air-side economizer to provide up to 100% outdoor air for cooling. Note that Code ventilation is significantly less than the norms for wet labs using chemicals.

- System will have multiple VAV zone reheat terminals. Terminals will incorporate minimum airflow limits for ventilation and hot water tempering coils. Average terminal size will cover 500sf – one lab, a half of a large lab, or a group of 3-5 offices with similar exposure.
- Supply duct system will be fully insulated. System return air will be fully ducted to finished space, with no above-ceiling air-handling plenum.
- Provide one 25,00cfm, 75 ton packaged VAV rooftop HVAC unit. Air-handling segment will comprise supply and return fans, variable speed drives and tracking controls, outside air/economizer/relief chamber, air blender, filtration, direct expansion cooling coil, and natural gas furnace. Compressorized cooling section will comprise modulating screw compressor and air-cooled condenser with multiple fans.
- Cooling coil and condenser coil shall have copper fins and tubes for corrosion-resistance in the coastal environment.
- Air filtration shall be two –stage with MERV 8 (ASHRAE 30% pre-filters and MERV 14 (ASHRAE 90%) final filters.

Building Heating

- Based on an expectation of moderate window area and good thermal envelope, the building will not have perimeter radiation. Heating for the unoccupied mode will be by cycling of natural gas furnace in the rooftop HVAC unit.
- Tempering of terminal zones during the occupied cycle will be by zone terminal hot water coils.
- Hot water to be generated by a packaged boiler in a mechanical penthouse. Boiler to be fired by natural gas. Anticipated size 350MBtu/hr output, 500MBtu/hr input (500CFH natural gas).

Special Exhaust Systems

- Toilet exhaust via roof-mount fan.
- High-bay cooling exhaust via roof-mount fans.

High-Bay Area

- The high-bay area will be heated and minimally ventilated in winter by two 5000cfm rooftop gas-fired furnaces, and ventilated for summer cooling with roof-mount

exhaust fans and a motorized intake louver adjacent to the overhead doors. Fan capacity of 15,000cfm anticipated. Space will not be de-humidified in summer.

HVAC Piping Systems

- Hot water for Zone Reheat: Duplex pumps (30 GPM) and 2" copper piping circuit.
- Reheat run-out piping and hook-ups to all terminal coils.

Integrated Control (Division 25)

- Direct Digital Control (DDC) and Building Automation System (BAS) controlling all HVAC zones and central equipment.
- New system connected to existing Siemens campus network. No in-building operator station is anticipated.
- Serves all fan systems: Supply and exhaust AHU's, including volume, pressure and temperature control.

Electrical (Division 26)

Normal Power Service

- New utility service from NStar. Construction scope includes high-voltage empty conduit to nearest available manhole, at-grade mounting pad for utility transformer, secondary feeders to main electric room containing 1200A, 120/208V switchboard. Switchboard to be molded-case circuit-breaker type.

Normal Power Distribution

- 208/120V power distribution to separate lighting and receptacle panelboards arrayed along the main corridors

Emergency Power Distribution

- Segregation of life-safety power from on-site research standby power is a required scope component.
- Life-safety needs are assumed to be limited to egress lighting. Because there will be separate egress for each level, the elevator is not required for egress. Emergency exit lighting and signage will be powered by battery-powered ballasts and separate battery lights.
- Research standby power is desired for:
  1. Two receptacles per office and lab bench. Allow 200W per 200sf module, or 1W/sf and 21kW overall.

2. Maintenance of building heat via rooftop furnaces and fans. Allow 60HP to allow for fans operating at minimum airflow.
3. Maintenance of circulating hot water for heating. Allow 1HP.
4. Limited research refrigeration. Allow 5kW
5. Tel/data room A/C system
6. environmental room
7. ESP lab exhaust

- Provide a 150kW natural-gas fired generator service for research standby duty. Service to include pad-mount 150kW, 480/277V packaged engine-generator in a weatherproof sound attenuated enclosure, 600A ATS and distribution panelboard. Provide wiring and panelboards in main corridors.

Mechanical and Plumbing Services

- New mechanical and plumbing equipment to be powered with new branch circuits.
- Rooftop HVAC equipment to have split power feed –standby for air handler/furnace, and normal power only for compressor/condenser segment.

General Purpose Power

- Receptacles shall be 125V, 20A duplex provided throughout the renovation. Offices shall generally contain one double duplex receptacle per desk and one duplex receptacle for every 75 sf. Labs and lab support spaces shall contain single channel aluminum multi-outlet assemblies with duplex receptacles on 24 inch spacing at all wall benches and equipment spaces and dedicated 125V, 20A or special purpose 208V, 20A receptacles for specific equipment. Corridors shall contain receptacles at maximum 50 foot spacing.
- Generally, receptacles shall be circuited such that no more than four duplex receptacles are connected to a circuit.
- Special purpose receptacles shall be circuited such that no more than two receptacles are connected to a circuit. Equipment connected to dedicated circuits shall not exceed 80% of the maximum branch circuit capacity.
- Specific fixed equipment shall be provided with dedicated branch circuits of a voltage and amperage suitable for the type of equipment.

Lighting Systems

- Lighting fixtures within the labs will generally be pendant tubular fluorescent for indirect lighting. New lighting fixtures in ancillary office and support spaces outside of the labs will generally be recessed fluorescent of a type suitable for the space.

- New lighting control in the labs will consist of low voltage, multi-level automatic and manual control. Multi-level lighting shall provide unoccupied cycles, with occupancy-sensed override via a new lighting automation panel. Lab lighting shall be individually controllable by room. New lighting controls in areas other than labs and in ancillary office and support spaces will consist of automatic and manual controls as required by codes.
- Emergency egress illumination will be provided by approximately 25% of the corridor lighting fixtures (with battery ballasts) to provide code-mandated illumination levels. Internally illuminated exit signage will be provided to comply with code requirements.

Communications (Division 27)

Telecommunications

- Telecommunications wiring and devices serving the area will comply with WHOI standards.

Electronic Safety and Security (Division 28)

Fire Alarm System

- Provide a fire alarm system with an addressable network and municipal fire department notification.
- New notification appliances shall be ADA compliant combination horn/strobes located in corridors, all common spaces such as break rooms, rooms with two egress paths, rooms within other rooms.
- New fire alarm initiating devices, including manual pull stations, and water-flow and tamper supervisory monitoring devices shall be provided as necessary to comply with codes.