MCMURDO STATION
IT&C PRIMARY OPS

CHARRETTE REPORT
JUNE 1ST, 2016

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MCMURDO STATION, ANTARCTICA
New IT&C Primary Ops Facility
New Data Center Wing & BL004 SSC Renovation

CHARRETTE REPORT

Lockheed Martin Corporation IS&GS
Contract No. 4102481765

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ACRONYM LIST

- **AFRTS:** American Forces Radio and Television Service.
- **AGE:** Aircraft Ground Equipment. Department in McMurdo dealing primarily with maintenance activities for aircraft.
- **AHJ:** Authority Having Jurisdiction.
- **ANG:** Air National Guard, United States Air Force Reserve Component.
- **ASC:** Antarctic Support Contract. The primary logistical support contractor to the United States Antarctic Program, managed by Prime Contractor to National Science Foundation.
- **ASHRAE:** American Society of Heating, Refrigerating, and Air-Conditioning Engineers.
- **ATC:** Air Traffic Control
- **ATO:** Antarctic Terminal Operations. Division of Antarctic Support Contract that manages the movement of passengers and cargo.
- **ATS:** Automatic Transfer Switches
- **Bag Drag:** Similar to check-in with commercial airlines. Passengers are weighed and checked for extreme cold weather gear, carry-on bags are approved, and bags are palletized for transport.
- **BICSI:** Building Industry Consulting Service International.
- **BL:** Building.
- **C-17:** A United States Air Force aircraft used for transporting cargo and personnel between New Zealand and McMurdo.
- **C-130:** A wheeled four-engine Lockheed Hercules turboprop airplane. LC-130 indicates a ski-equipped plane like those used in Antarctica.
- **CEP:** Central Energy Plant.
- **CHP:** Combined Heat/Power Microturbine.
- **CONUS:** Continental United States.
- **CRAC:** Computer Room Air Conditioning
- **CRREL:** U.S. Army Corps of Engineers' Cold Regions Research and Engineering Laboratory.
- **CSEC:** Crary Science and Engineering Center. Laboratory at McMurdo Station. Also known as Building 001, or Crary Lab.
- **DC:** Data Center
- **DDC:** Direct Digital Control.
- **DHW:** Domestic Hot Water.
- **DNF:** Do Not Freeze.
- **DV:** Distinguished Visitor.
- **EC:** Electronically Commutated
- **ECM:** Electrically Commutated Motors.
- **ECW:** Extreme Cold Weather
- **EOC:** Emergency Operations Center. A dedicated space to use as an incident command center during emergencies.
- **ESD:** Emergency Shut Down
- **FS&T:** Field Support and Training.
- **GEM:** SPAWAR GPS Embedded Module
- **Grantee:** A scientist who has received a grant from the National Science Foundation.
- **HRV:** Heat Recovery Ventilator
- **HVAC:** Heating, Ventilation, and Air Conditioning.
- **IBC:** International Building Code.
- **Ice Runway:** Runway built on the temporary sea ice; accommodates wheeled airplanes.
- **IECC:** International Energy Conservation Code
- **IFC:** International Fire Code.
- **IGY:** International Geophysical Year.
- **ISP:** Inside Outside Plant
- **IT&C:** Information Technology and Communications. Antarctic Support Contract functional work group overseeing telecommunications and computers.
- **JPSS:** Joint Polar Satellite System; part of National Environmental Satellite, Data and Information Service of the United States.
- **JSOC:** Joint Space Operations Center. Also refers to a building in McMurdo that houses both National Aeronautical and Space Administration as well as Antarctic Support Contract Network Operations Center.
- **JTF-SFA:** Joint Task Force-Support Forces Antarctica, led by Pacific Air Forces at Joint Base Pearl Harbor-Hickam, Hawaii.
- **MAC Ops:** McMurdo Communications Operations
- **MCC:** Movement Control Center, McMurdo Station, Antarctica.
- **MCM or McM:** McMurdo Station.
- **MCI:** Mass Casualty Incident.
- **MEC:** Mechanical Equipment Center, McMurdo Station,

Antarctica.

- **MEP:** Construction industry term standing for mechanical, electrical and plumbing.
- **MERV:** Minimum Efficiency Reporting Value
- **Milvan:** - Military Van. Containers used for shipping and storage of goods.
- **MP 1.0:** Previous McMurdo Master Plan.
- **MP 2.0:** Previous McMurdo Master Plan.
- **MP 2.1:** Current McMurdo Master Plan.
- **MP:** In Master Plan 2.1 refers to Multi-Purpose rooms. Specifically the Multi-Purpose Lecture Hall located in Central Services.
- **MPSM:** McMurdo Palmer South Pole Modernization
- **MV:** Medium Voltage.
- **NASA:** National Aeronautics and Space Administration
- **NFPA:** National Fire Protection Association.
- **NOAA:** National Ocean and Atmospheric Administration
- **NOC:** Network Operations Center
- **NSF:** National Science Foundation, an agency of the U.S. government.
- **NYANG:** New York Air National Guard.
- **OAS:** US Department of the Interior's Office of Aviation Services.
- **O&M:** Operations and Maintenance. Usually refers to cost burdens not construction.
- **ORP:** Oxidation Reduction Potential.
- **OSP:** Outside Plant Cabling
- **PAX:** Vernacular for passenger/s.
- **PDU:** Power Distribution Unit
- **Pegasus:** A prepared runway on permanent ice near McMurdo Station that accommodates wheeled airplanes.
- **PFH:** Plate/Frame Heat Exchangers.
- **PIV:** Post Indicator Valve.
- **POE:** Post Occupancy Evaluation
- **PUE:** Power Usage Effectiveness
- **PV:** Photo Voltaic.
- **Redeployment:** Passenger transport from destination to origin.
- **Retrograde:** To return cargo from the field to McMurdo Station, or from McMurdo to destinations north. Usually in the reverse order of its initial deployment.
- **RO:** Reverse Osmosis. Refers to the water purification system used in McMurdo.
- **SATCOM:** Satellite Communications.
- **SC/APC:** Subscriber Connector/Angled Physical Contact
- **SG:** Smart Grid.
- **SOPP:** SPAWAR Space and Naval Warfare Office of Polar Programs. Agency that provides weather forecasting and air traffic control services for the United States Antarctic Program.
- **SOW:** Scope of Work
- **SPAWAR:** Space and Naval Warfare Systems Command
- **SPoT:** South Pole overland Traverse.
- **SSC:** Science Support Center, legacy building (building 004) in McMurdo currently containing the Mechanical Equipment Center and Field Safety Training Program.
- **STHX:** Shell and Tube Hyrdonic Heat Exchanger.
- **UL:** Underwriters Laboratories.
- **UPS:** Uninterrupted Power Supply.
- **U.S. Antarctic Program (USAP):** United States Antarctic Program. The United States governmental program, administered by the National Science Foundation, for Antarctic research and related activities.
- **VFD:** Variable Frequency Drives.
- **VMF:** Vehicle Maintenance Facility (Building 143).
- **WAN:** Wide Area Network.
- **WTE:** Waste to Energy. Current program initiative that uses cardboard, wood and paper as feedstock to operate a wood chip boiler.
- **WWTP:** Waste Water Treatment Plant.

A/E TEAM

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Architectural

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A. EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This report documents the recent design charrette held in Centennial, Colorado on April 12-13, 2016 to shape the program and scope of work for the IT&C Primary Ops Facility envisioned for McMurdo Station, Antarctica. This facility will serve as the primary data center facility for the station, and will house critical back-up emergency operations and communications functions as well as various shop and other related functions.

Participants in the charrette included the design team (architects and consulting engineers), NSF, NASA, Joint Polar Satellite Systems (JPSS) Operations personnel, Space and Naval Warfare Systems (SPAWAR) personnel, and Lockheed Martin Antarctic Support Contract personnel.

The first charrette day focused on prioritizing critical aspects of the project, confirming IT requirements including data center redundancy and renovated BL004 redundancy, gathering stakeholder needs including the number of personnel, spatial requirements, adjacency, functional, operational & basic equipment requirements (to include future growth) and right-sizing the data center rack count and spatial requirements by stakeholder group.

The second charrette day focused on exploring various alternatives for the data center wing connection to the existing BL004. Efforts focused on data center 2nd floor requirements to optimize space efficiency, Mac Ops/Mac Weather/Raven Ops needs, roof antenna requirements, an unheated storage addition, sustainable design and commissioning. The day concluded with a pre-final draft of the project scope for further subsequent definition and inclusion in the charrette report.

The new IT&C Primary Ops Facility, as envisioned through the charrette process, has the potential to set new operational and facility standards for the NSF in Antarctica. Design strategies include a high performance building with a unified architectural design between the existing BL004 and the new data center, cold storage and skybridge additions, mechanical and electrical systems with an emphasis on redundancy first, energy efficiency second with simplicity of design and ease of maintenance, a right-sized data center with room for future growth, critical facility security and sustainability.

B. CHARRETTE PROCESS

B. CHARRETTE PROCESS

Charrette Purpose

The Design Charrette Scope of Work for the McMurdo Station IT&C Primary Operations called for a two-day design charrette in Centennial, CO, to assist Lockheed Martin ASC and NSF to right size the new data center, right size the new data center wing and finalize the new data center configuration/tie-in to the existing BL004.

The purpose of the charrette is to gather information from the NSF, grantee community and other stakeholders regarding customer/user activities and functional requirements for the new IT Primary Operations Center at McMurdo Station to commence design.

Charrette Objectives

The charrette was held on April 12-13, 2016 at Lockheed Martin's Centennial, CO, offices. It was determined that the primary criterion for charrette success was agreement on the project scope of work by the end of charrette day 2.

The charrette objectives also included:

- Prioritize overall project critical criteria: cost, maintenance, mission, etc.
- Right size the new data center (DC) wing including rack count & spatial requirements
- Finalize the new DC wing orientation relative to existing building
- Determine # of personnel, spatial requirements, adjacency, functional, operational & basic equipment requirements by stakeholder group, to include future growth
- Determine antenna roof platform requirements
- Determine utility requirements for new DC wing & existing building
- Determine conceptual utility point(s) of connection
- Confirm redundancy requirements for DC & existing building: utility, HVAC, UPS, etc.
- Confirm sustainable design goals
- Confirm commissioning intent

Charrette Participant Groups

NASA NEN: The NASA Near Earth Network operates the McMurdo Ground Station, an earth station supporting NASA and NASA partner space missions. NASA staffs and operates the McMurdo Ground Station 24/7/365.

JPSS Operations: Joint Polar Satellite System (JPSS) Operations operates the NOAA JPSS antennas (MC1 and MC2) that are used for data recovery from operational polar orbiting weather satellites and provide off ice communications for all station operations.

SPAWAR Weather and ATC: Space and Naval Warfare Systems (SPAWAR) provides aviation technical support for navigational aids and equipment for daily airfield operations. SPAWAR also maintains meteorology equipment deployed locally and to the deep field camps, as well as, the communication control system throughout Antarctica.

Lockheed Martin (LM): Under contract to the National Science Foundation (NSF), Lockheed Martin provides logistical and base operations support to the United States Antarctic Program (USAP) of the NSF. Lockheed Martin has responsibility for operation and maintenance of facilities, vehicles, and equipment at all United States Antarctic Program stations, as well as two ice-classed research vessels. LM also provides construction and operations support at USAP stations and temporary field camps during the Austral summer field season. Participants for LM included representatives of the Communications Shop, the Telco Shop, IT, the MPSM project and ASC Engineering.

NSF: NSF sponsors research projects in Antarctica at USAP stations as well as at the temporary field camps used during the Austral summer field season. Participants for NSF included the IT Manager and the NSF Facilities Engineering Project Manager for Antarctica.

AE Team: The AE team, led by the architects, conducted the charrette. The team included the electrical, mechanical,

Charrette Participant List

Douglas Brauer - NOAA/JPSS - JPSS External Relations Coordinator

William Munley - NOAA/JPSS - Aerospace Corp, Support to JPSS C3S

Greg Thomas - SPAWAR SOPP

Roy Wendell - NASA NEN - LJT & Associates, Inc.

David Hess - NASA NEN - Harris, Corp.

Jennifer Cox - NASA NEN - LJT & Associates, Inc.

Bruce Thoman - NASA NEN - NASA

Jeff Scharf - ASC IT - IT Manager

Joe Harrigan - ASC IT - IT Operations Manager

Bill Jirsa - ASC IT - McMurdo IT Manager

Dale Abel - ASC IT - Data Center SME

Nathan Hoople - ASC MPSM - Project Manager

John Beccaria - ASC MPSM - Program Manager

Dave Winkler - ASC MPSM - Engineering Manager

Kevin Gibbons - ASC MPSM - Project Manager

JP Murad - ASC MPSM - Telecom Engineer

James Hilden - ASC Engineering - Architect

Ben Roth - NSF - ABM

Pat Smith - NSF - ABM

Joseph Ferraro - Ferraro Choi And Associates Ltd. - Principal-In-Charge

Kim Claucherty - Ferraro Choi And Associates Ltd. - Project Manager

Joseph Cengia - Ferraro Choi And Associates Ltd. - Architect

Reece Bonilla - Ferraro Choi And Associates Ltd. - Intern Architect

Robert Posma - PDC Engineering - Electrical Engineer

Lance Mackie - M. Baker International - IT & Security Systems Specialist

C. PROGRAM PLANNING

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PROJECT BACKGROUND

The IT&C Primary Ops Facility new data center wing location and orientation has evolved several times over the last year as McMurdo Master Planning has evolved.

Initially, as shown in the McMurdo Master Plan 2.1, published March 17, 2015, the new two-story data center infilled the inside building corner along the north elevation of the east wing. The summer 2015 AIMS charrettes used this configuration for concept development/ programming.

A later version of the McMurdo Master Plan 2.1, published October 30, 2015, shifted the new data center wing location to that envisioned as Ph. II during original design. The structural design for the original BL004 incorporates this Ph. II location. While this location appears to allow for a larger building, it causes potential significant snow drifting in the SE inside corner between the new data center wing and the existing BL004 east wing. The CPP Project 8596 Preliminary Snow Modeling Report published in December 2015 documents this snow drifting for this data center wing orientation.

The latest McMurdo Master Plan 2.1, published December 16, 2015, further shifts the new data center wing and rotates it 90 degrees immediately adjacent to the existing BL004 east wing. This orientation, while better for snow drifting, results in costly structural tie-in of the new wing to the existing BL004 due to multiple existing roof elevations and pitch.

A new configuration for the data center wing developed during January, 2016. This new layout included a "skybridge" between the proposed data center wing and the existing BL004, and thereby introduced a pathway for snow scouring within the SE inside corner. Further development of this same plan, more detailed, was issued later that month.

Further exploration and development of this "skybridge" concept occurred during February 2016, during a trip to McMurdo Station by Ferraro Choi and Associates, with informal approval from various stakeholders. It is this concept design, from February 2016, that was used as a "starting point" for the recent design charrette in Centennial, CO.

Included in the project is a 2nd floor skybridge connection for pedestrian access to the future Central Services Building. More information on this skybridge is included in the following pages.

PROJECT SQUARE FOOTAGE PARAMETERS

- Square footage concepts provided in ITCMPlanInputsv4 dated 20 Nov 2014 and Feb16 B004 and DataCenter ITInputs v1 were considered during the charrette discussion and were incorporated as much as possible into the conceptual layouts provided in this report. Approximate square footage for these areas follows.

- Generally, data center wing 2nd floor project square footage (approx. 6600 SF) includes a co-location data center partitioned off for several stakeholders, adjacent network operations center/control room areas, assignable office/meeting areas, 3 separate bench spaces, a broadcast/production studio, as well as support spaces for storage, an electrical closet and a "mud", or make ready, room for extreme cold weather gear (ECW) and toolbags. Other support areas for the data center wing, such as breakrooms, toilets, and copy/print rooms, will be provided by the renovated BL004.

- Mech/elec/fire/telecom systems (including an IT wiring/node room) spaces are located on the data center wing 1st floor to service the new data center and occupy approximately 4200 SF.

- A 2000 SF unheated (cold) storage area is planned in an extension of the existing 1st floor MEC overflow storage. This storage area will be partitioned off for up to 4 different users. Two overhead doors are planned for access and will align with the existing MEC overflow overhead door and a second internal overhead door (to be added). This storage area will be estimated separately as an add alternate.

- The renovated BL004 1st floor (11,400 SF) will house various shop and loading/staging areas including the PC Shop, the Electronic/ Comms Shop and the SPAWAR Electronics Shop and Offices and an associated loading dock/staging area. Additionally, warm storage, battery storage/charging (in existing specially equipped space), mechanical (existing), breakroom, toilets and service desk are provided on this floor.

- The renovated BL004 2nd floor (11,190 SF) will house the back-up Emergency Operations Center (EOC) and mission communications.
- Other 2nd floor spaces include a breakroom, assignable offices, field science laydown space and operations receiving/shipping.
- A second floor skybridge connection to future Central Services Building approximately 160' X 10' (1600 SF)

PROJECT SITE CONDITIONS

- Access

  McMurdo's remote location at the southern tip of Ross Island, Antarctica, 2415 miles south of Christchurch, New Zealand, complicates logistics and access, particularly during winter. Access is by military aircraft from Christchurch, NZ, or by ocean-going vessel for annual resupply from Port Hueneme, CA, USA. Straightforward design using proven materials and equipment is necessary to minimize logistical challenges.

- Site

  Site topography slopes generally east to west from a starting elevation of 106' to an elevation of 100'. A 12' embankment sits immediately east of the existing BL004 east wing, the top of which is connected by a bridge to existing 2nd floor overflow storage for loading/unloading access.

  The existing BL004 SSC (Science Support Center) occupies the site for the new IT Primary Ops Facility. The current building footprint is approximately 11,400 SF. The new IT Primary Ops Facility will include the existing BL004, the new proposed data center wing (approximate footprint of 6600 SF) and a new 2000 SF unheated storage area immediately adjacent to the existing BL004 east wing.

- Climate

  "The mean annual temperature at McMurdo Station is 0 deg F. Temperatures may reach 46 deg F in summer and -58 deg F in winter. The average wind is 12 knots, but winds have exceeded 100 knots."(http://www.usap.gov/videoclipsandmaps/mcmWebCam.cfm accessed on April 23, 2016)

  Humidity at McMurdo Station is extremely low due to very low annual precipitation and snowfall. Such low humidity promotes electrostatic discharge (ESD) resulting in electronic equipment failures. Humidification to control ESD is planned in the data center and limited bench areas to minimize these failures.

- Dust

  Due to the volcanic origin of the surrounding site, fine volcanic dust from basaltic rock infiltrates buildings that lack dust control measures and causes excessive equipment maintenance and frequent failure. Control of this dust through entry vestibules, outside air intake filtration, and other means is necessary.

- Security

  The new IT&C Primary Ops Facility will be a critical facility and requires security consistent with this designation. Controlled access is planned for the new data center wing. Additional controlled access will be included within the 2nd floor of the new data center wing for the various stakeholder groups and data center areas. Similarly, controlled access is desired for the 1st floor mechanical/electrical/telecom system areas. Emergency egress only will be provided from the 1st floor stairway.

PROJECT SCHEDULE

- Refer to the Scope of Work Design Charrette for McMurdo Station IT Primary Operations, Rev. 2 issued March 31, 2016 for the project design schedule (see Appendix – Process).

C. PROGRAM PLANNING

- The proposed project design schedule in the referenced scope of work above sets an aggressive pace for the design phase of the project. Assuming no significant scope or design changes, this deliverable schedule appears to be achievable.

RESEARCH AND DATA GATHERING

- It is recommended that energy analysis for the new IT Primary Ops Facility data center wing be completed. This analysis will compare IT Primary Ops data center performance against baseline data center building performance. Further analysis of relative differences in energy consumption results between the existing BL004 building envelope vs. an upgraded BL004 envelope is strongly recommended but not included in the current scope.

- A hygrothermal study of the building envelope is recommended to analyze the movement of heat and moisture through the envelope. This computer-based study is recommended during design to ensure the dew point is outside the wall assembly. Analysis will ensure the proposed data center humidification does not damage the building envelope.

D. CHARRETTE SESSIONS

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Charrette Day #1 Highlights

- Prioritize critical priorities: Mission was established as the highest priority with cost and maintenance a close second
- Confirm: IT requirements including data center redundancy and renovated BL004 redundancy
- Gather: Stakeholder needs including #personnel, spatial requirements, adjacency, functional, operational & basic equipment requirements, to include future growth
- Right-Size: Data center rack count and spatial requirements by stakeholder

Charrette Day #1 Complete Meeting Notes

General Comments

- Offices adjacent to DC
- Science area not included in scope
- Co-location - need redefine, means “shared”
- BL157, Telco, Fire Alarm equipment, not control room but storage.
- Common offices for other users (assigned)
- 2 DC for redundancies
- BL165 and BL175 nonexistent offices

BL004 First Floor - General Comments

A. Genius bar – to be renamed Service Desk - one stop shop, pick up equipment prior to field work. - IT services only, RFI comms and PC to be in Core Facility
B. Co-location replace with NASA storage - testing, bench and storage space.
C. Common storage - offline warm storage for electronics
D. NASA JPSS - separate controlled storage preferred.

USAP/NSF Requirements

A. Interface should be Co-location located with other DC stakeholders
B. Network engineers - help desk (IT Services), telephone operators (up to 3 people) - Genius Bar (service desk)
C. Field customers, issue gear - gear to remain in BL004 temporarily
D. Training component a concern, when gear is issued - maybe issued in core facilities (CS) but provide training, if reqd, in BL004
E. Tier 1 support (network), computer configuration, genius bar (service desk) does not need to be large - 3 people.
F. Lounge - multipurpose, no dedications
G. Tech library - manage, security access, rails with shelving, move to NOC spaces, no general library space needed, 8› linear wall shelves
H. Divorce breakroom lounge and meeting space (keep separate)
I. Expand BL004 bathrooms
J. Small meeting space wanted in DC wing, shared (collaborative) space - DC specific (6-8 people).
K. Larger meeting room in BL004.
L. Bench space needed in close proximity to DC, pre-installation/ equipment set-up (make-ready) activities, no cardboard in space, cannot be inside DC space due to contamination, place in NOC space, requires humidity control similar to DC space.
M. Fire protection in DC but provide dry sprinklers, Linear (test) bench space - 8’ long with ability to move and use carts (need dimensions), 4’ deep, need to be grounded, dedicated for DC space (frequent access), provide network and power outlets.
N. Accountability, isolation, and security wanted.
O. NASA/JPSS together, no need to be separated.
P. 3 total DC NOC spaces – NOAA/NASA/JPSS, NSF/USAP, and Assignable (flex space) for SPAWAR Weather/SPAWAR ATC/ MacOps/Fire.
Q. Wall space for 2-3 display monitors (40-50» screens or window walls) – security and operations, traffic flow graphics, 1 display for up/down equipment (red/green light)
R. Windows in DC wanted.

USAP NOC Needs for DC

A. 5-6 people interacting with equipment within DC.
B. 7-8 people, occupied 24/7, 7:30-5:30 shifts (includes Telco engineer)
C. Temperature after hours, occupant override buttons
D. Storage at hand 200SF

NASA/JPSS/NOAA Requirements

A. 2 operational consoles (4 rail wide or 8'x8') in DC controlled environment + 3 admin (with work stations)
B. Spaces align with DC for short cable run
C. Overhead cable preferred.
D. Share breakroom
E. Admin work stations (6'/person) with bookshelves and storage, no expansion envisioned for this staff.
F. Controlled ready direct access (day-to-day) 200-300 SF and non-ready access (cold?/long-term) storage 300 SF, currently in milvans
G. Greg - 3+5 racks storage 5' away
H. SPAWAR storage 100-200 SF, direct access within IT&C
I. Staff within NOC – 2 operations consoles

Power Standards (DC)

A. Follow industry standards per DC design
B. USAP specific requirement per AIMS
C. Put together by ASC
D. Cabinet - 2 power, 2 separate UPS, may not be 208v.
E. Cooling 1.5x power for future expansion
F. 30% humidity minimum threshold, 40-60% target
G. Hot/cold aisles, forced air cooling
H. Racks 24x42x7' nominal height (use same dims for CAB size)
I. FE 12-13 systems, not charged sprinklers, dry, no water, oxygen evacuation
J. Prevent dry volcanic dust into DC + air duct or tracked in by feet
K. Tier 1 vs Tier 2 (Tier 1.5 goal)
L. Generator - single appropriately sized, per Uptime requirement
M. Facility UPS in their own room or with racks
N. Non UPS circuit in DC
O. Grounding important
P. Air intake must not clog with snow during condition 1
Q. Mitigation of track in and ambient air (dust)
R. Minimum N+1 of HVAC to allow for maintenance of units.
S. JSOC not a good model for building
T. Cable – CAT 6A, horizontal overhead cable design between racks

Data Center Rack Count

A. 60 racks total - design target
B. NSF confident in #'s
C. Rack units 1.75"H
D. 40% buffer vacant space - DC rack industry standard (included in 60 rack total)
E. Current constraints
    - Various locations/users, power limitations, legacy equipment

MAC Center

A. ATC – acoustical concern to separate sound generated by each operation
B. 4 positions, co-location acoustic partitions full height
C. One-on-one training not in this facility.
D. Backup facility
E. ROF room facility
F. Flight planning (briefing) room next door (not Ops) 5-6 people
G. A lot of network (off continent) out of scope
H. Heavier port density, higher than average work space*****
I. BL004 requires dedicated comms room
J. Linear layout, see programming diagrams for SSC from Joe Harrigan
K. Tech library – linear shelves for manuals
L. Design space allocate as in programming diagrams
M. Critical backup – power + data intensive

Communication Shop

A. Comms help desk to Central Services now, not in IT&C Primary

D. CHARRETTE SESSIONS

B. Telcom - ASC shared
C. Tech control need space to work - network operational facility maintenance activities
D. Sat com in NASA Control Room
E. 6 people with workstations + briefing area.
F. Staging/training area for equipment, grantee instruction – not in this facility (in Central Services)
G. Physical inspection and testing of electronics
H. Issuing equipment not in this facility, no desk on first floor
I. Ground Electronic Maintenance (GEM) - adjacent
J. Rolling cart to truck to helo hangar, provide staging area for readying equipment
K. Brief board + area
L. People not dedicated to work stations, rather place to check in (email, admin), need workstations for each
M. Work benches for dirty work (electronics)
N. Locker room - equipment/clothes/tools
O. AC taps - test bench areas (anti-static)
P. Carts in addition to benches, not dedicated to work benches
Q. Battery charging only for comms, not shared with SPAWAR but in same space.
R. Chalk talk- briefing space
S. Storage secured
T. Exhaust requirements for soldering
U. Horizontal analysis for roof antennas (line of site research needed for various antennas)

Telco

A. 3 people/work stations – 1 supervisor + 2 operators
B. Shared briefing space (9-10 people space with comms group)
C. No separation needed, meetings sometimes separate
D. Battery backup + UPS not needed
E. Indoor cold storage associated with shop, adjacent to loading dock area
F. Engineer space in NSF NOC
G. Tool bag + ECW – same location

PC Shop

A. IT Service desk not in this building
B. 4 people with workbenches for dedicated space, must include workstations, 2 in 1 work space – second floor of BL004 access to Core Facility for PC delivery
C. Service desk for anyone - service desk (manned by 1-2 people max), field or station based, not to issue gear, guest network to reduce service desk need, phone calls to other location.
D. No Tech Library space, put in the NOC's
E. Staging bench to cart across sky bridge for transport to Core Facility
F. Lift required
G. No issues with humidity for storage waste
H. Work stations/benches (email + PC) same/combined desk
I. Space for 4-5 computers on work bench
J. Configuration - flex, one common bench for layout equipment

SPAWAR

A. 3 people + 1 supervisor
B. Test/repair/storage areas access to loading dock, 1 without door access and 1 adjacent to offices
C. Rail storage (3) - 600 SF (warm) - one same space
Cold storage from Milvans - 600 SF
D. Warm storage w/in B004 – 600SF
E. 1 work bench (120v and 220v needed) 6' long with 1200SF of shop space
F. Battery storage + charge, total roughly of 30 batteries
G. Shared battery storage, partitioned, dedicated storage/group
H. Tech library with electronic shop
I. 24 linear feet shelves for manuals

DATA CENTER

A. Outside data plant – node room
    a. 1st floor approx. 150 SF 10x15
    b. Plywood walls for punch down blocks

B. Wiring closet with distribution not DDC + fire alarm

C. Fire suppression room

NASA/JPSS – Non NOC + DC

A. NASA – 2+1 summer time in control room
B. JPSS – 5-6 in all areas (Tech refresh 6 x 3 times)
    - Assignable offices
    - Make ready space
    - Control room
C. Cold storage
D. Outdoor tech repairs – rapid response, access in/out space + equipment tools suit up
E. Antenna maintenance
F. Ready RM, locker, tools, in/out
G. RMs for cabling entry - need dimensions, 2 physical paths into building, 1 room for node + wiring closet (8x10)
H. Office spaces to replicate near entry/exit spaces (staging)
I. Roof Access to 4 Antennas

Data Center Racks (Confirmed by Joe Harrigan) - includes 40% buffer for growth

A. NSF - 24
B. NASA - 22
C. SPAWAR ATC - 2 (opps control, acoustical, network attached)
D. SPAWAR Weather - 4
E. AFRTS - 7 (not included, in a separate space)
F. Fire/Ops - 1 (Fire tech access)
G. Mac Ops - 4

MISC.

A. 42" deep rack, 44.3" unit from NASA, need to accommodate
B. NSF comment - will need lift to get PCs upstairs to go across skybridge to Core Facility
C. "seamless connection"
D. 1st priority – mission
E. 2nd - cost/maintenance
F. Water for fire suppression, no black water
G. Eye wash station requirements (water issue?)
H. Don't plan for generator in space but provide connection for future.
I. Cold storage in south extension as possible AD ALT

Charrette Day #2 Highlights

- Explore Alternatives: The data center wing progressed from a skybridge connection, as envisioned in Feb 2016, to direct data center wing connection to BL 004 (no skybridge), to direct data center wing connection to BL004 with a snow scouring "slot" on the first floor. See physical model photos in Figs. 1-4.

- Strategize: Review data center 2nd floor requirements to optimize space efficiency, Mac Ops/Mac Weather/Raven Ops needs, roof antenna requirements, unheated storage addition, sustainable design and commissioning.

- Finalize Project Scope and seek stakeholder buy-in: Review the data center wing and BL004 1st and 2nd floor layouts, as modified during the charrette, and summarize scope concepts including proposed redundancy. Scope refinement continues past the charrette for a limited time is then firmed for inclusion in charrette report.

Charrette Day #2 Complete Meeting Notes

CONFIGURATION STUDIES AND CONFIRMATION

A. Video production equipment
B. Move in/out equipment through NOC area – not ideal
C. Issues with space planning and access
D. Rack layouts may need reconfiguring (vertical vs horizontal)
E. Partitions + air flow barrier effect
F. Overhead data cabling and power access preferred, no need for raised floors for power/data
G. CRAC unit location a concern – cold/hot air mixing?

D. CHARRETTE SESSIONS

PHYSICAL MODEL

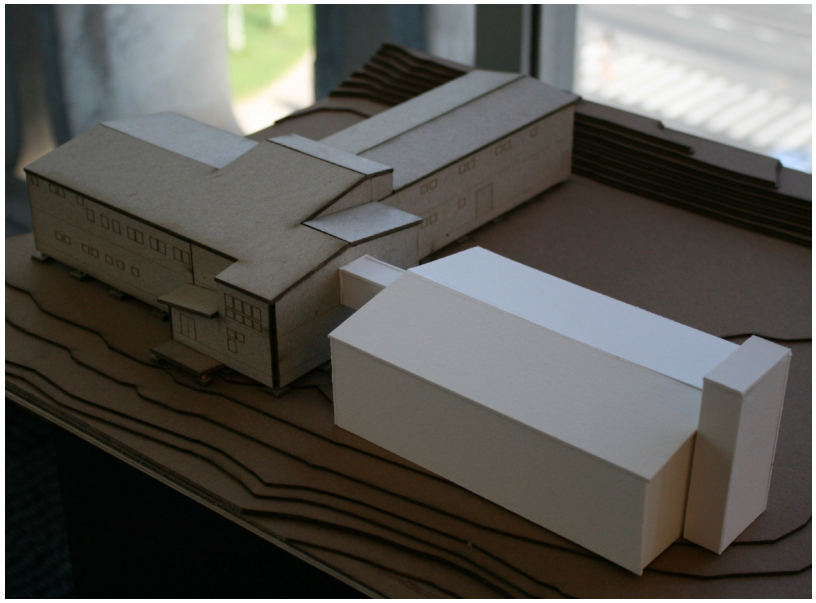


Figure 1 - Skybridge

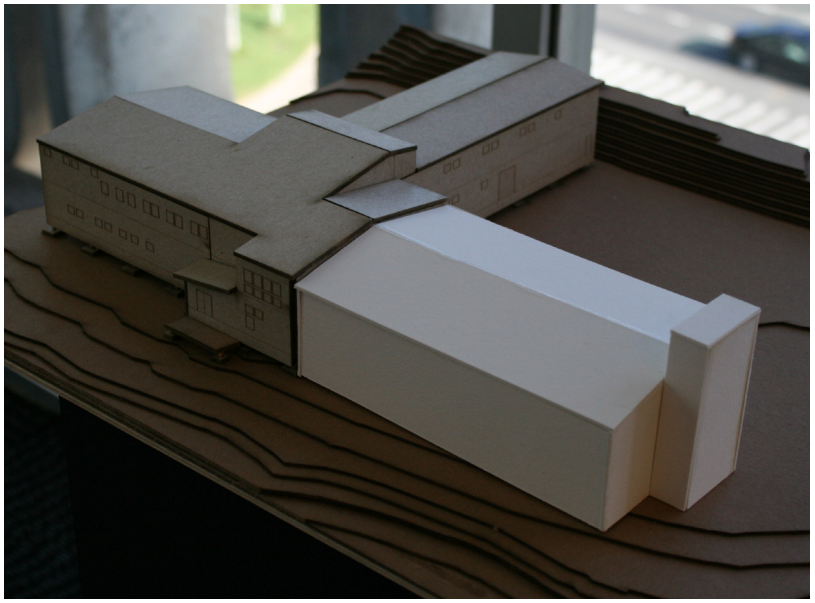


Figure 2 - Direct Connection

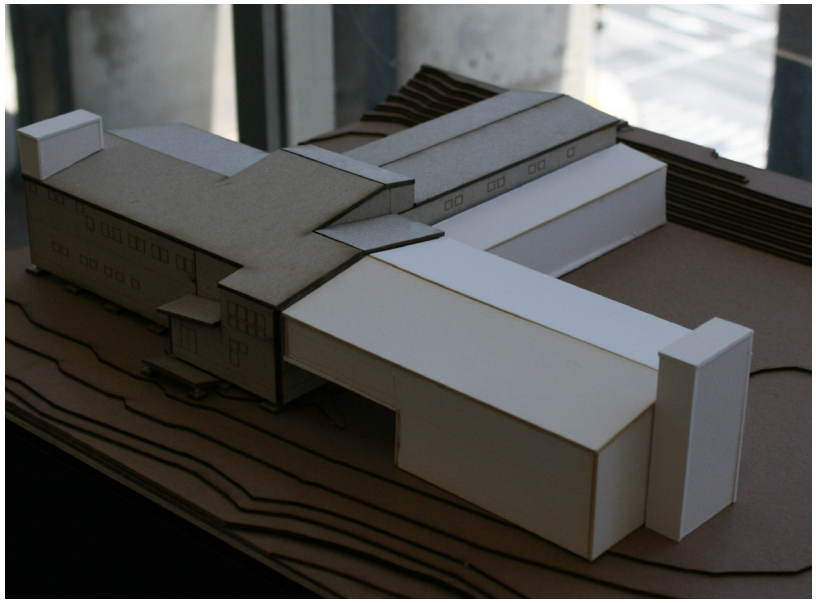


Figure 3 - Snow Scouring “Slot” and New Cold Storage Wing

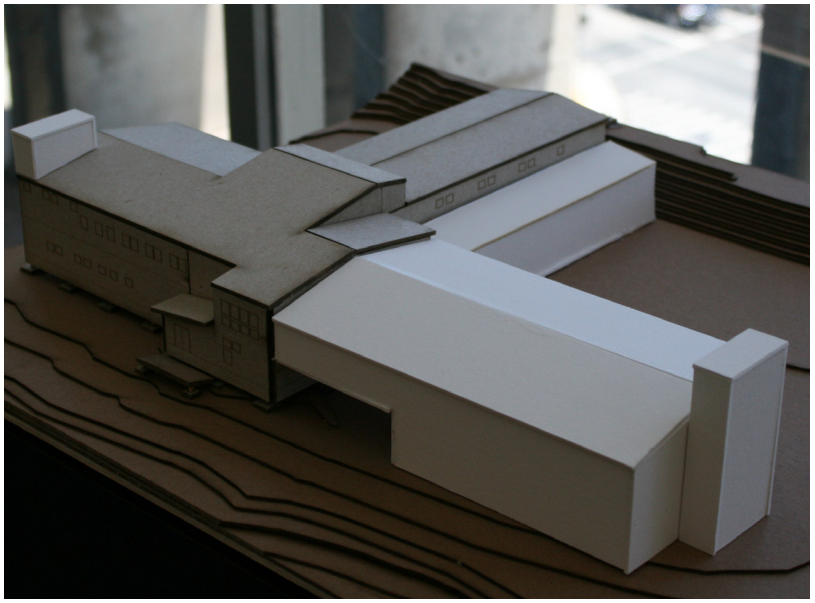


Figure 4 - Extended Data Center Wing (by 10 ft.)

H. Humidification in CRAC units a concern? Requires lots of plumbing?
I. Raised floor not needed with hot/cold aisle configuration.
J. Each tenant have control, need to be secured.
K. UPS circuit
L. Panel board (PDU's) thinner than rack possible
M. Relay rack needed for distribution to racks, can be placed anywhere, could be at end of rack row, used for network distribution (lots of copper), would require underfloor support structure if raised.
N. Structure may be issue for relay rack (heavy), need to be secured.
O. Visibility from NOC/Control rm. not a concern
P. Corridor in between NOC and DC more favorable, provide non-operable windows
Q. Flexibility in DC wanted
R. Research door openings for moving racks (radius)
S. Racks with doors? – During rack servicing – vulnerable (for weeks), some equipment with different cabling needs.
T. NSF DC – 2x/year exercise training starts @ UPS, cannot impact NASA and other servers - electrical distribution to be separated per group
U. JPSS need exclusive access to DC, need security
V. Emergency power disconnect, button to be provided for separate groups (red mushroom button)
W. Infrastructure audits
X. UPS maintenance a concern (new versions require less maintenance), battery additions are heavy and awkward to move into and out of building
Y. UPS model can be separated from DC or included in rack aisles.
Z. UPS requires front/back access
AA. Reliance on waste heat only not resilient for future if server waste heat generation drops off
AB. Electrical space – 200-300 kw UPS, power module 50kw each, battery, 480v transformers – battery capacity unknown at this time.
AC. Mech space conditioned to 40-50 degrees F
AD. Loading dock in Mechanical area
AE. Need WIND TUNNEL STUDY WITH SKYBRIDGE or direct attach ALTERNATIVES

A. Visibility not a large concern, don't need to see.
B. # of aisles a concern
C. Egress both sides of access rows preferred for safety
D. Linear layout of DC more efficient than square
E. ESD in DC is fine but control console still issue - NSF
F. SPAWAR no need such large space for NOC, make-ready spaces only adjacent to DC due to humidification, etc requirements
G. Humidity control no need in admin area
H. Play with corridor width, turning radius for dolly with racks could be an issue, double doors possible solution but may be have issues with sealed room (humidity breach) - 5' opening, usable space preferred, door wide openings in NOC across from DC entries possible solution to turning radius of racks in/out of DC.
I. New layout with DC @ end - square space, allows for flexibility for rack configurations but egress to fire stairs could produce more circulation space than needed.
J. Only NSF and NASA require visual to DC space from NOC space.
K. Desirable DC offices – 6 for JPSS and 8 for NSF
L. Full time manager need office in DC

BL004

A. PC shop = general storage (mainly)
B. Common storage – caged for multi-tenant use
C. Larger staging area on north end to 600 SF for USAP and SPAWAR (in loading area)
D. At least 6' wide hallway on 1st floor
E. Max 400 SF for PC shop, enough

MAC OPS (Back up only, primary in Core Facility)

A. One Operator - turn over field party comms
B. Layout – see Joe Harrigan's layout
C. Staffing of 6 with acoustical separation - 3 seats @ console
D. MAC OPS (24/7) check in/out, science, vehicular support, communication, track movements, ship operations, com HELO schedule
E. MAC Center - air traffic, UAV›s
F. Raven Ops - route chains, airline - same coms rm with acoustical separation, coordinate ground support
G. MAC Weather - Observation and forecast

D. CHARRETTE SESSIONS

H. Fire dispatch - coordinate air field fire

A. Meds back up, not general, can be anywhere
B. Access to showers may need in initial phase if no connection to Central Services. Could be used for initial phasing then go away later.

MAC WEATHER (Back-up facility, primary in Core Facility)

A. Close by IT (in SPAWAR NOC?)
B. Map = MET manager
C. Will act as backup with main facility @ central services
D. Phasing dictate primary function, transition from BL165, existing BL165 to remain for contingency, needs to have same capability of BL165 during transition, act as transition space
E. Assignable office is where equipment will be
F. Finalize # of work stations
G. Shared open area is good, collaborative for 3 groups
H. Replicate radio functions, need line of site - ski runway
I. Need views to NE + NW, if possible, verify (This can be accomodated with cameras, if necessary).
J. Line of site from roof platform to Pegasus and Willy Field
K. Views to weather events to be by camera

Raven Ops (refer to diagram provided by Joe Harrigan) (Backup, primary in Core Facility)

A. 4 people, not key to communications
B. Replicate communication features
C. Assignable offices could be placed in BL004
D. All groups (comms) in one assignable office to view single screen for observations (board, wall monitor
E. Command center adjacent to EOC so screen displays in command center can be shared during an emergency
F. Radio operational console
G. EOC and radio ops should have equal capacities.
H. EOC meeting (assigned) - mission communication + EOC Communications (assigned), both dedicated.
I. 2nd meeting space can convert to assignable office for backup.
J. BL175 common office space adjacent to assigned comms space

---

A. 42 U cabinets - racks provides flexibility and layouts.

Items Left Out

A. Common space for copiers - 4x4 area, check
B. Waste disposal space, recycling, trash
C. Rated IT28 with loaded Fork + contents for east loading dock (2nd floor)(according to ASC and as per signage)

Roof Platforms (dumbbell shape)

A. 30x30 with 3000lbs for terascan radomes (can revisit and refine)
B. 10’ wide walkway - 2000lbs support
C. Obtain dome stats, weight, and power from Joe Harrigan
D. Testing + permanent routing cables
E. Operational all the time - radome on DC building
F. Equipment mounting rails all around for antennas.
G. Mainly receiver (small) antennas
H. Start with a 20’ x 20’ and go from there
I. Future road map for antennas later – this needs to be researched for line of site reqmts., etc.
J. Access and installation important - Ben
K. Operational considerations - platform with railing preferred, less time to train new people (if tie-offs were used instead of platform).
L. Bulkhead wiring preferred in shop areas
M. Static drain for lightning management
N. Electrical power source needed on platforms in cabinets, signal/ antenna cables
O. Terascan has power going to it, require 360 line of sight
P. Several outlet locations along walkway every 10’ okay
Q. Lighting required, J-Poll with intervals, non-RF
R. Accommodate for surveillance camera
S. Wiring closet close enough to run cameras
T. POE for IP address
U. Some cameras may require power.
V. Pat Smith suggested radome for Terascan might be mounted on a separate tower

Sustainability Design Goals

A. Water/Thermal Comfort/Power studies

B. Building fenestration studies
C. Define concept, baseline, standard, target energy intensities
D. Capitalize heat from DC for comfort
E. Capture heat from other buildings
F. Point of diminishing returns - insulation
G. Data Center Energy Metrics – check into
H. Analysis of individual components, energy use, kw/hr.
I. Tradeoffs using equipment to move air rather than artificially

Cold Storage "Shed" Addition
A. 2000SF attached to BL004
B. Comms – 800SF
C. NSF - 600SF, sealed off from elements - includes comm gear, solar panels, etc., closer to comm shop preferred, staging area potential, cage separation
D. SPAWAR – 600-1000 SF
E. NASA - Milvan storage replacement, check SF in existing – 200SF
F. Provide 2 OH Doors in line with current OH doors, allow trucks to back into area.
G. Areas separated with chain-link fences, provide high bay shelving.

Commissioning
A. Operation of systems (sequence of Operation) - HVAC, cooling, fire suppression, failure modes
B. Inside plant cabling, equipment closets, test
C. UPS + backup generator test (load banks)
D. Use heat generators to simulate internal loads - heat line from BL004
E. JSOC - load bank in DC - test
F. Test building envelope - joints sealed, pressurize windows and test leakage, test dehumidification boundary
G. Craig - dry testing recommended to ensure optimal final commissioning report
H. IECC commissioning requirements - verify
I. Inside DC wiring cable, termination points, building electronics, management systems, protocols needed – Pat Smith
J. As-builts will act as active management tool?

MISC.
A. Battery storage and ventilation, check existing storage spaces for reuse
B. BL165 and 175 transitional office - confirm space requirements
C. East (2nd floor) loading dock similar to North (1st floor) loading dock, sized for IT28 loader with loaded fork (according to ASC and posted signage)

Data Center (...again)
A. Not to lock individual racks
B. Channeling instead - flexible
C. Two options to layout
D. (1) NASA and USAP look into DC with flex space behind them connected by corridor.
E. (2) original layout with linear DC layout
F. Access to rooftop through stair towers either new or existing dependent on DC layout.
G. No access from 1st floor (outside) but internal access through stairs allowed.
H. 60 racks
I. PDU used to get off wall (relay panel board)

A. Need snow drifting study of potential building layout options to confirm skybridge or direct connection with cutout below for snow scouring performance.
B. Cold storage with access doors preferred.

Redundancies
A. Robert - electrical
B. 2 sets of power required for each rack (from two different UPSs)
C. Legacy type devices
D. Panel Board in room support for (2-3) different UPS systems
E. BL004 + DC covered by backup source
F. UPS only for DC wing
G. Transformer switches in BL004 if possible
H. 2 power feeds into building
I. Phase matching in grid? Need to be sync, commissioning type activities
J. Command center needs backup, backup dependent on grid - comm consoles EOC
K. Possible generator added at 1st floor of DC wing

D. CHARRETTE SESSIONS

A. Relay rack frame 1 per 15 racks (referencing ASC DC tour). Nathan Hoople email 4/14 confirmed the relay racks are included in the DC rack count.

Out brief

B. Reuse battery storage room in both parts of BL004, confirm capacities.
C. Get info from ASC on assignable space @ McM.
D. Will model work for snow drifting?
E. Backup generator set for DC.

E. CONCEPTUAL PLANS, SYSTEMS & NARRATIVES

E. CONCEPTUAL PLANS, SYSTEMS & NARRATIVES

The conceptual plans, systems and narratives which follow below provide a framework to commence design. These plans, systems and narratives distill down gathered charrette information to right size the data center wing, orient the new wing to the existing BL004, and determine personnel, spatial, adjacency, functional, operational, and basic equipment requirements by stakeholder group.

System info includes the architectural design concepts, mechanical design concepts, the electrical design concepts, the structural design concepts, the telecom design concepts, the antenna roof platforms, utility type and points of connection for both the new wing and renovated BL004, and the required redundancy for the data center and the renovated BL004. System narratives and associated graphics are broken out by discipline Lastly, sustainable design and commissioning are addressed in the appropriate narrative sections by discipline. A cost estimate based on the conceptual design was completed and is included as a separate document. Cost estimating references as applicable, are included with the cost estimate.

ARCHITECTURAL NARRATIVE

A unified architectural design approach between the existing BL004, the new data center wing, the new cold storage wing and the new skybridge to Central Services is desired. To achieve this, similar architectural building and roof lines, fenestration shape and orientation, materials, finishes and colors will be used in the new additions.

Existing BL004 construction type is V-B with a mixed occupancy (refer to Code Analysis in Appendix – Development). Code analysis indicates the same construction type is feasible for the new data center wing, if outfitted with automatic sprinklers. Further, analysis indicates no separation is required between occupancies.

The current scope does not call for upgrade of the existing BL004 building envelope. However, the new data center wing building envelope will meet exterior wall assembly requirements for thermal and moisture performance as denoted by LM ASC and described in various AIMS studies currently underway or recently completed. Further, due to thermal and dust infiltration concerns, building envelope commissioning is planned.

The renovation scope of work for the existing BL004 will be similar to a light tenant improvement project. Because of existing open ceilings, open shop areas, existing mechanical/electrical systems in good condition, extensive demo and upgrade of such systems is not anticipated. Existing infrastructure will remain and terminal units relocated as required. Therefore, limited demolition of the existing BL004 is anticipated.

As per the recent McMurdo Station Campus Power, Water, and Thermal Storage Strategy Report, published April 2015 the “Wall and roof assemblies should be comprised of a high-performance insulated panels of R-60 or greater to minimize heat loss and maximize the use of heat from the hydronic loop. If the campus is converted to 100% wind power, minimum R-100 assemblies are recommended to ensure minimal heat loss because all heat will be generated from electric power. Similarly, high performance glazing with 3 or 4 insulating cavities is recommended to ensure performance efficiency. Entry vestibules are recommended for all building entrances to prevent unrestricted infiltration of outside air.” (Merrick, April 2015, p. 71)

It is anticipated that the new data center wing building envelope will meet the above requirements for thermal performance, or as modified by LM ASC during the design process. Further, consideration will be given to building envelope construction as described in the recent “McMurdo Station Modernization Study, Building Shell & Fenestration Study, March 11, 2016, 65% Submittal” by OZ Architecture, or as subsequently modified by LM ASC during design.

The above Merrick report also recommends humidification of office areas to 35% relative humidity (Merrick, April 2015, p. 92). While the current IT Primary Ops scope describes humidification of the data center and limited other spaces to the target indicated in the upcoming mechanical systems narrative, it is not intended to humidify any other areas at this time for practical reasons.

Based on charrette discussions about various desired adjacencies between and within the new data center wing, the renovated BL004, the new 2nd floor skybridge to the Core Facility, and the proposed unheated storage, an adjacency diagram was developed (refer to Fig. 5). Primary and secondary adjacencies are as indicated as well as secured circulation barriers.

ADJACENCY DIAGRAM

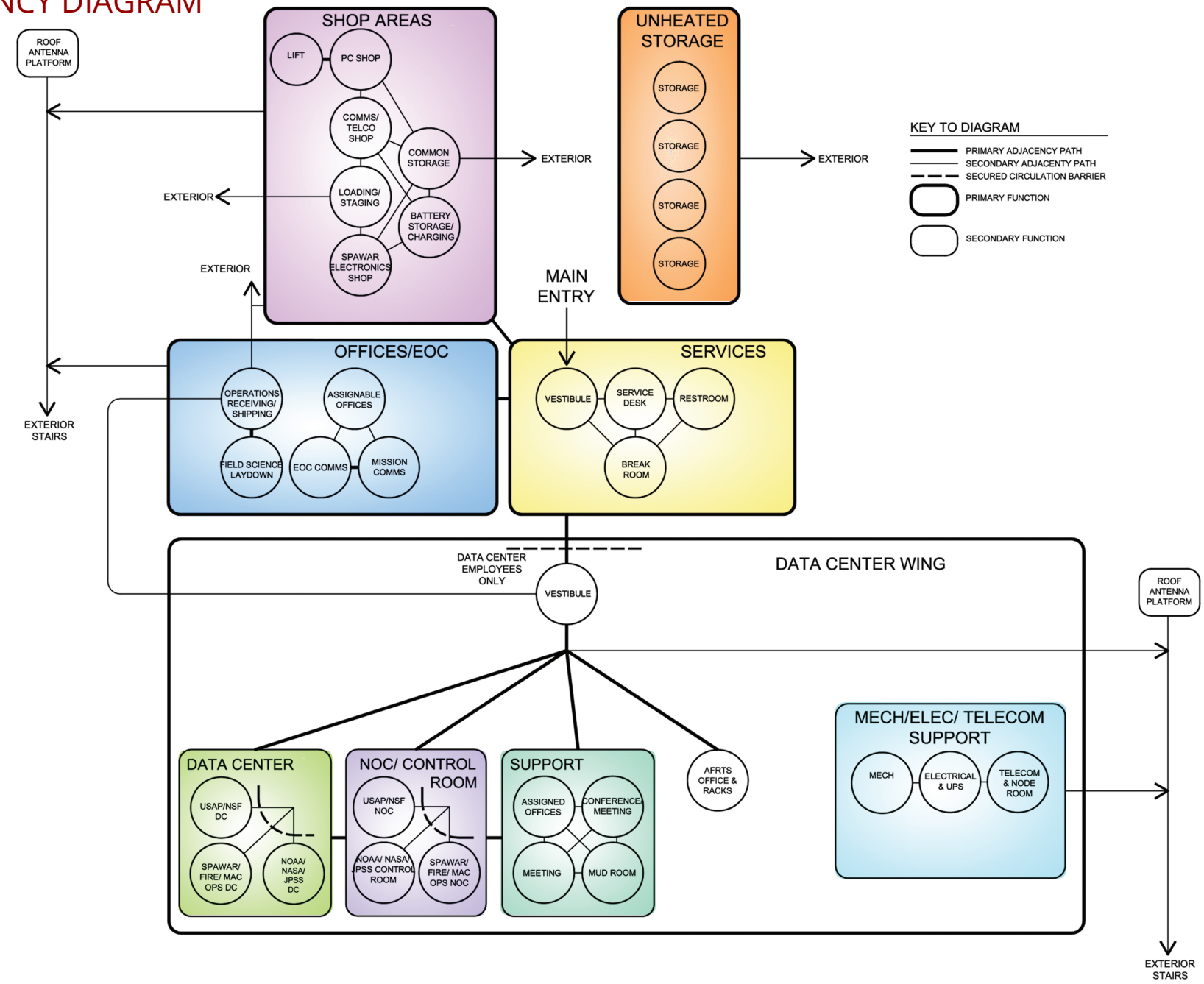


Figure 5

E. CONCEPTUAL PLANS, SYSTEMS & NARRATIVES

ARCHITECTURAL SITE, FLOOR AND ROOF PLANS

- The IT Primary Ops Facililty Site Plan shows the new data center wing footprint on the site (refer to Fig. 6). A dashed line across the data center wing (40' from the existing BL004) indicates the extent of the proposed snow scouring "slot".

- Mech/elec/fire/telecom systems (including a wiring/node room) spaces are located on the data center wing 1st floor to service the new data center and occupy approximately 4200 SF (refer to Figs. 7 and 9).

- Generally, data center wing 2nd floor (refer to Figs. 8 and 10) project square footage (approx. 6600 SF) includes a CO/LO data center partitioned off by chain link for several stakeholders, adjacent network operations center/control room areas, assignable office/meeting areas, 3 separate bench spaces, a broadcast/production studio, as well as support spaces for storage, an electrical closet and a "mud", or make ready, room for extreme cold weather gear and toolbags. Other support areas for the data center wing, such as breakrooms, toilets, and copy/print rooms, will be provided by the renovated BL004. Approximate square footage for these areas:
    - 2000 SF for CO/LO data center
    - 550 SF for AFRTS racks and broadcast/production studio
    - 800 SF for NSF NOC (includes 200 SF for storage)
    - 800 SF for NASA/JPSS Control Room (includes 200 SF for storage)
    - 480 SF for SPAWAR (ATC + Weather), MAC OPS, Fire Dispatch NOC/Offices
    - 145 SF for "Mud" or make-ready room
    - 1040 SF for assignable offices, bench spaces (3 total) and electrical closet

- The renovated BL004 1st floor (11,400 SF)(refer to Fig 7) will house various shop and loading/staging areas including the PC Shop, the Electronic/Comms Shop and the SPAWAR Electronics Shop and Offices and an associated loading dock/staging area. Additionally, warm storage, battery storage/charging (in existing space), mechanical (existing), breakroom, toilets and service desk are provided on this floor. It is anticipated new partitioning for new office spaces will be gyp board, paint, rubber base, and carpet tile. Acoustical ceilings will be needed with a limited amount of ceiling work anticipated. These areas include:
    - 400 SF PC Shop
    - 2500 SF Electronics/Comms Shop
    - 1200 SF SPAWAR Electronics Shop/Offices
    - 600 SF Loading/staging
    - 180 SF Battery storage/charging
    - 1000 SF Warm storage
    - 540 SF Mech (existing)
    - 480 SF Breakroom
    - 400 SF Service desk
    - Enlarged toilet facilities, SF TBD

- The renovated BL004 2nd floor (11,190 SF) (refer to Fig 8) will house the back-up EOC and mission communications. Dedicated spaces for these two functions are:
    - 200 SF for EOC Comms
    - 600 – 1200 SF for EOC/meeting/mission comms

- Other 2nd floor spaces include:
    - 400 SF Breakroom (existing)
    - 2000 SF Assignable offices
    - 4000 SF Field Science Support

- 600 SF Operations Receiving/Shipping
- Enlarged toilet facilities, SF TBD

- Included is a 2nd floor skybridge for pedestrian access to new Core Facility (Central Services)(160' long x 10' wide x 10' high)
  - Skybridge is to include one direction change (kink)
  - Skybridge to include heat, light & power, and fire sprinklers
  - See structural narrative for more details on the skybridge structural system
  - Building envelope to include insulated soffit (below floor), walls and roof
  - To be conditioned to prevent freezing of fire sprinkler system
- A 2000 SF unheated (cold) storage area (refer to Fig. 7) is planned in an extension of the existing 1st floor MEC overflow storage. This storage area will be partitioned off with chain link for up to 4 different users. Two overhead doors are planned for access and will align with the existing MEC overflow overhead door and a second internal overhead door (to be added). This storage area will be estimated separately as an add alternate.

E. CONCEPTUAL PLANS, SYSTEMS & NARRATIVES

SITE PLAN

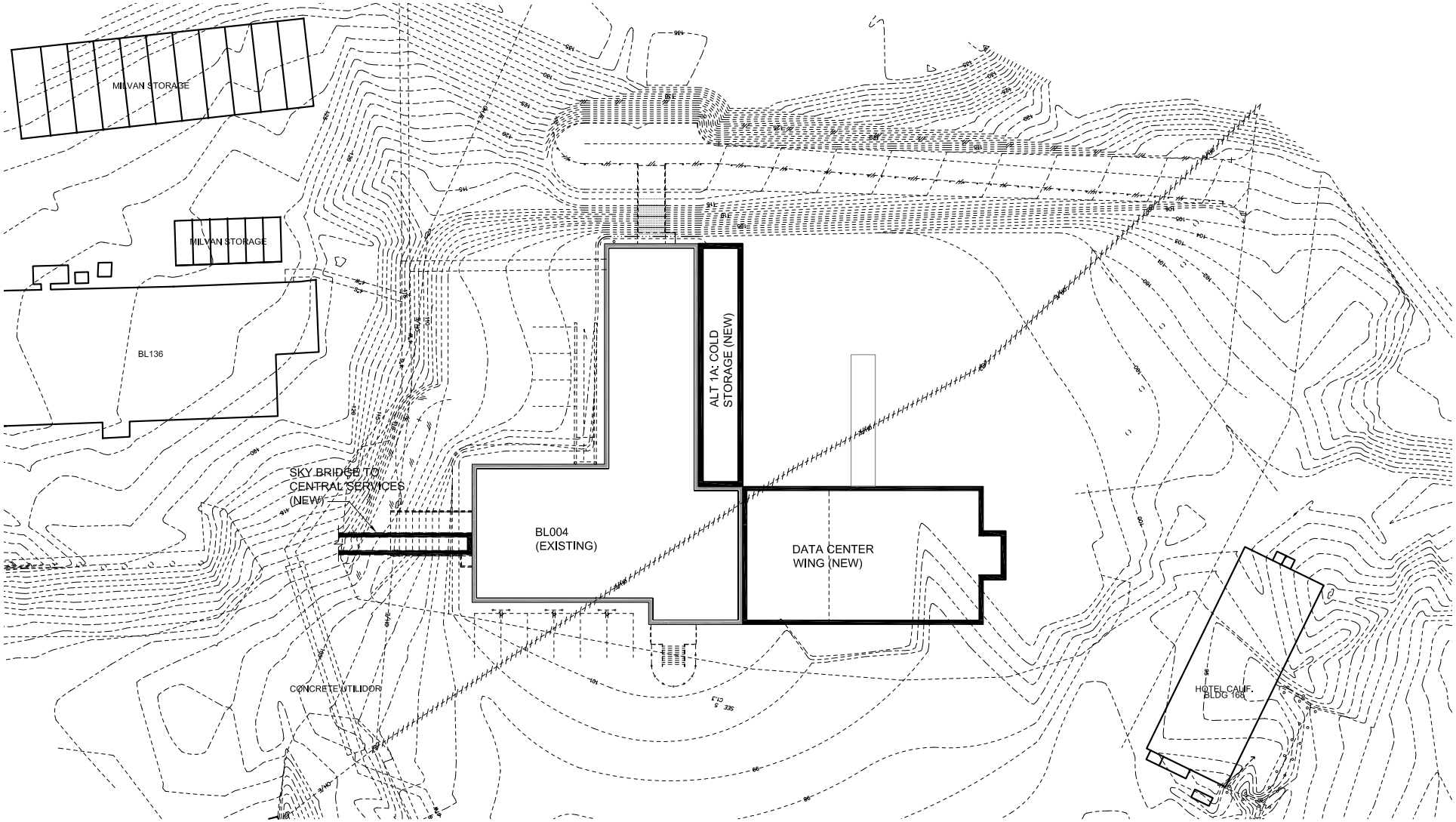


Figure 6

OVERALL FIRST FLOOR

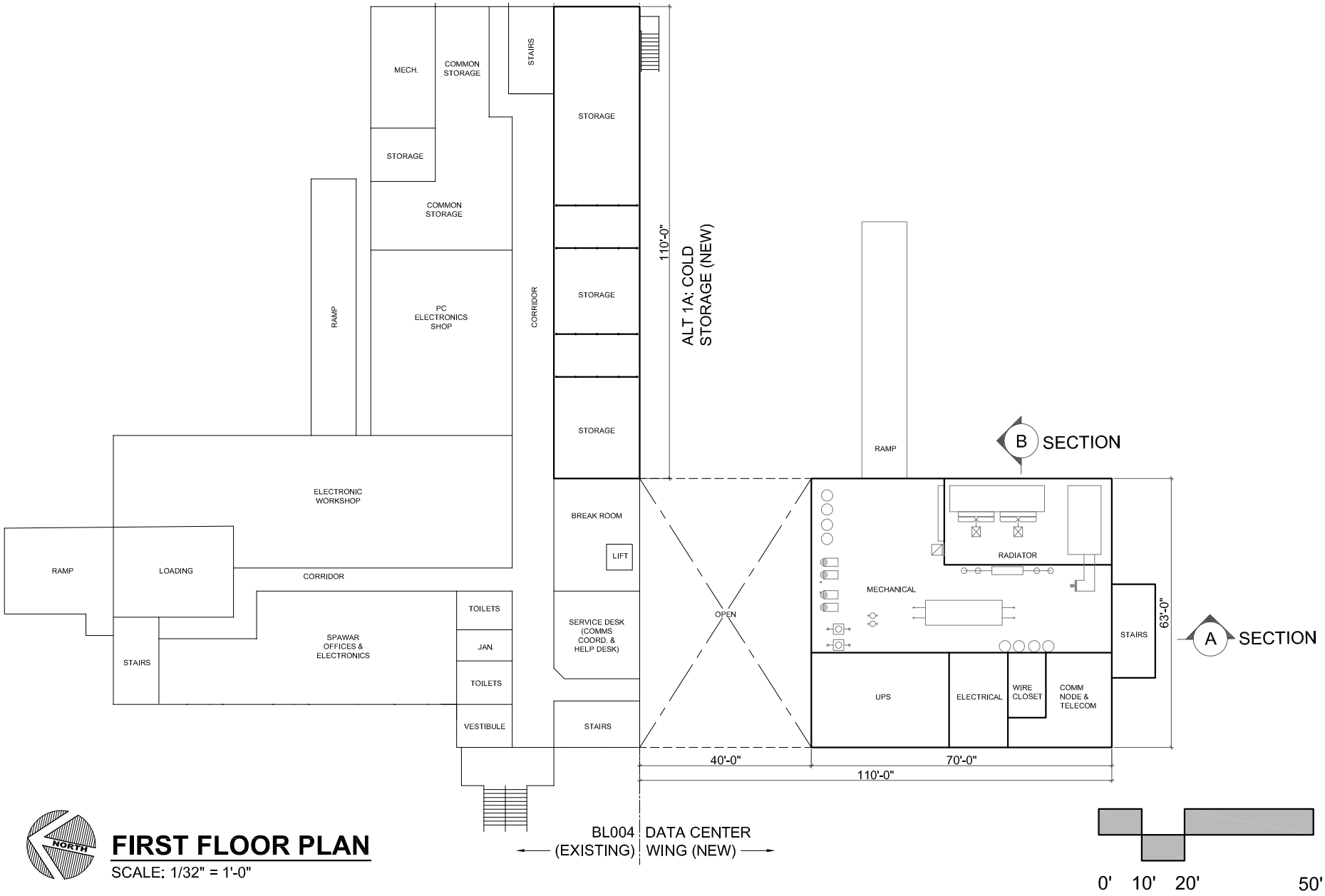
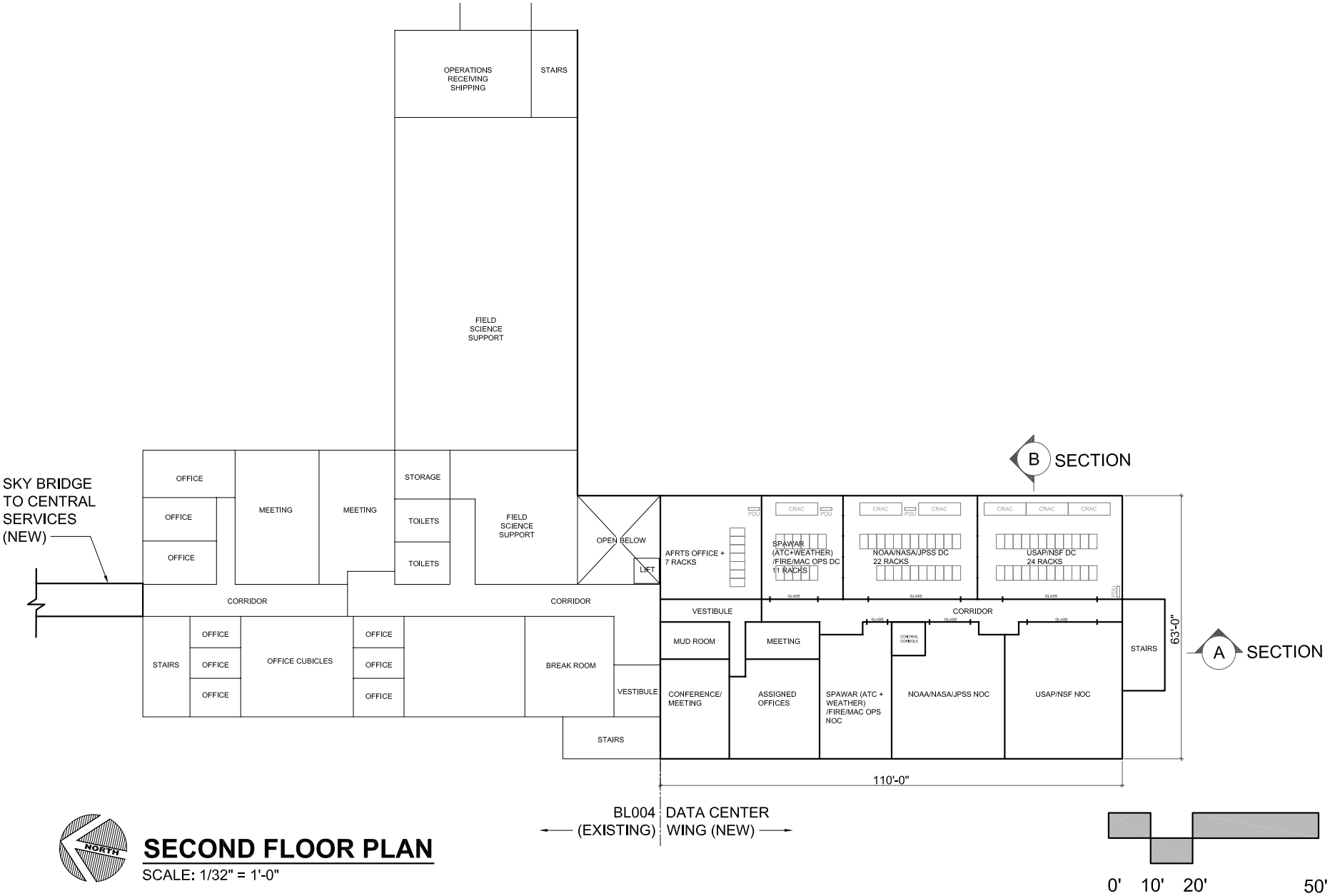


Figure 7

OVERALL SECOND FLOOR



SECOND FLOOR PLAN
SCALE: 1/32" = 1'-0"

Figure 8

ENLARGED FIRST FLOOR PLAN - DATA CENTER WING

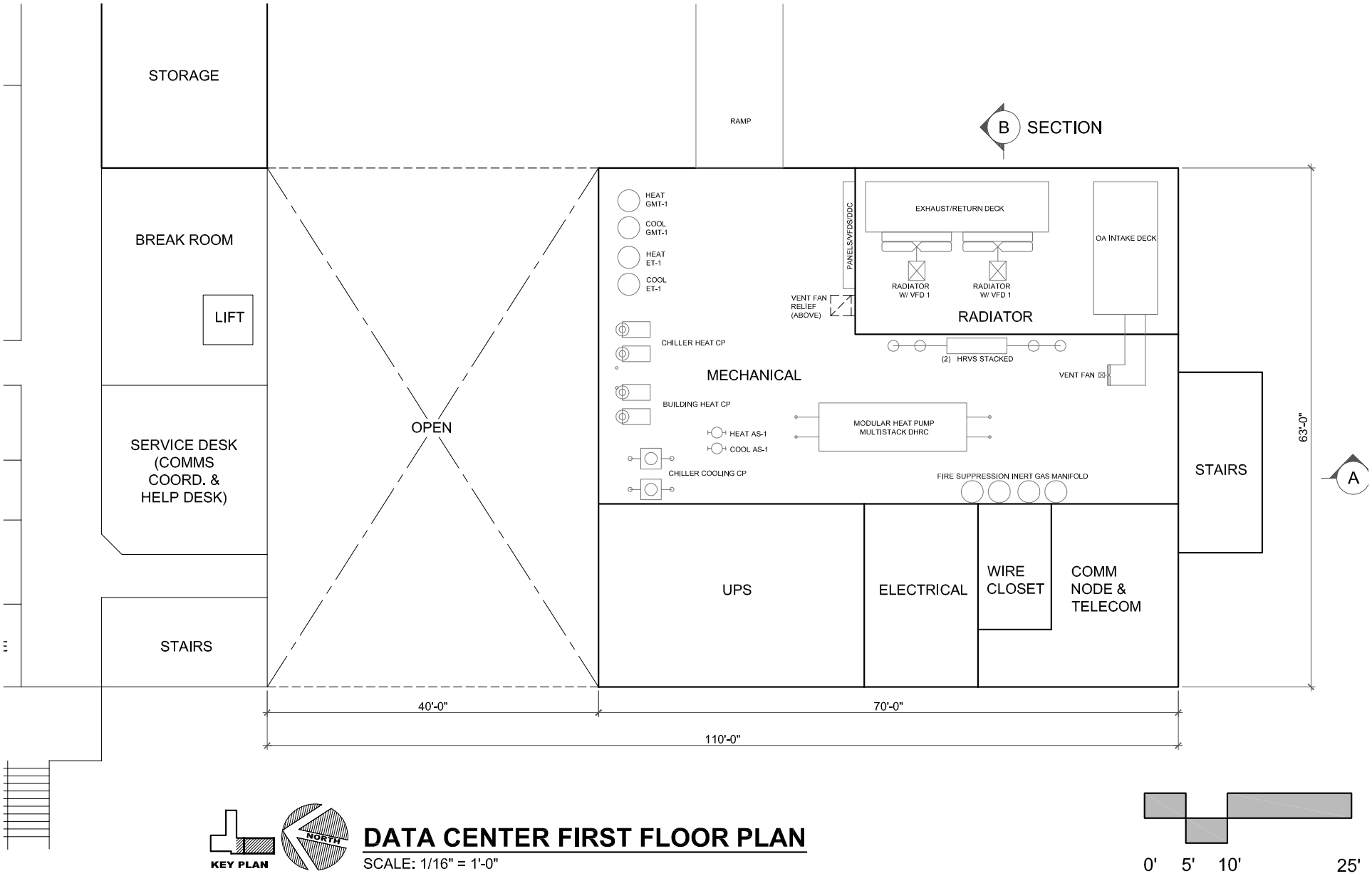


Figure 9

ENLARGED SECOND FLOOR PLAN - DATA CENTER WING

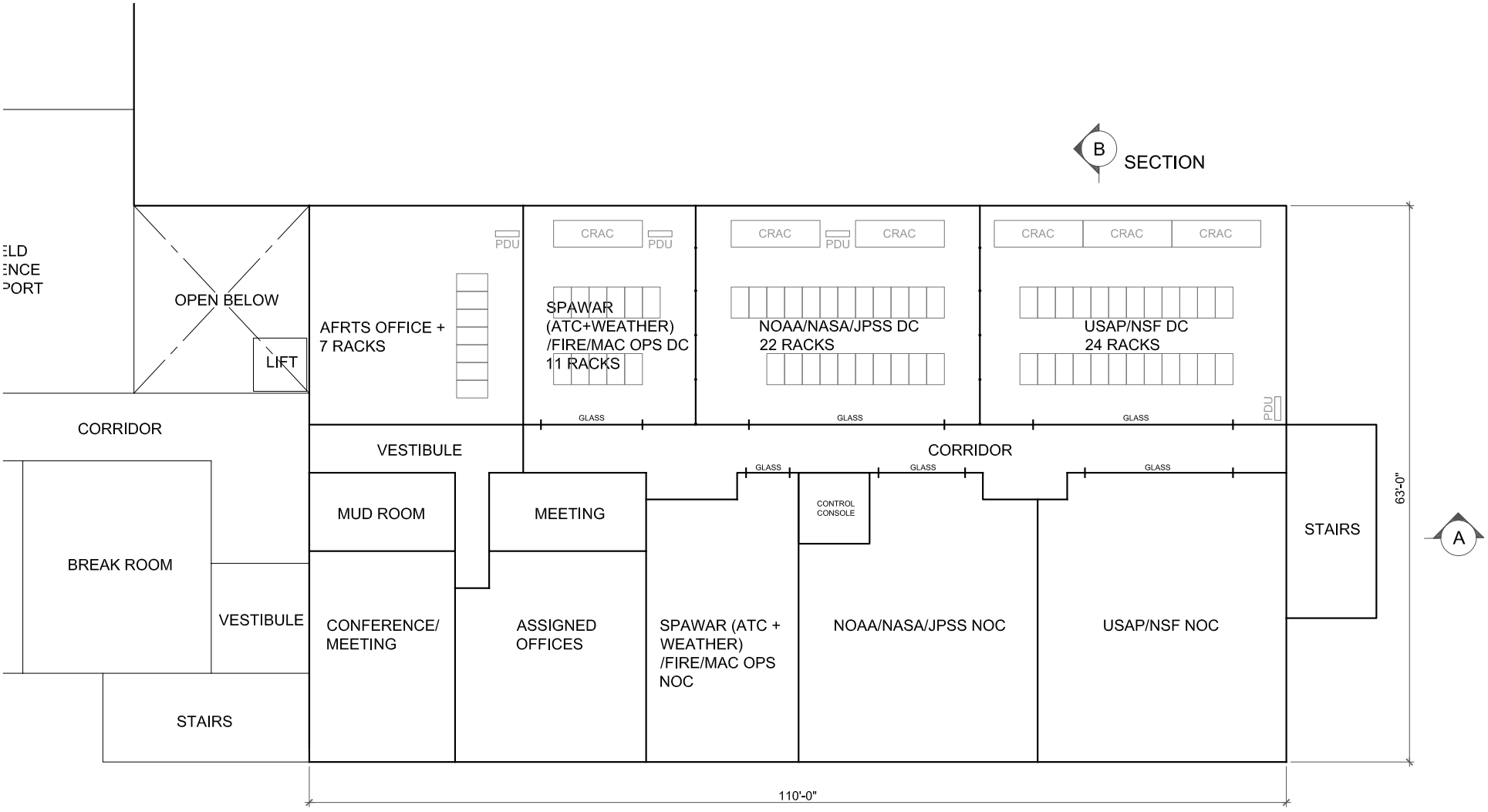


Figure 10

ROOF PLAN

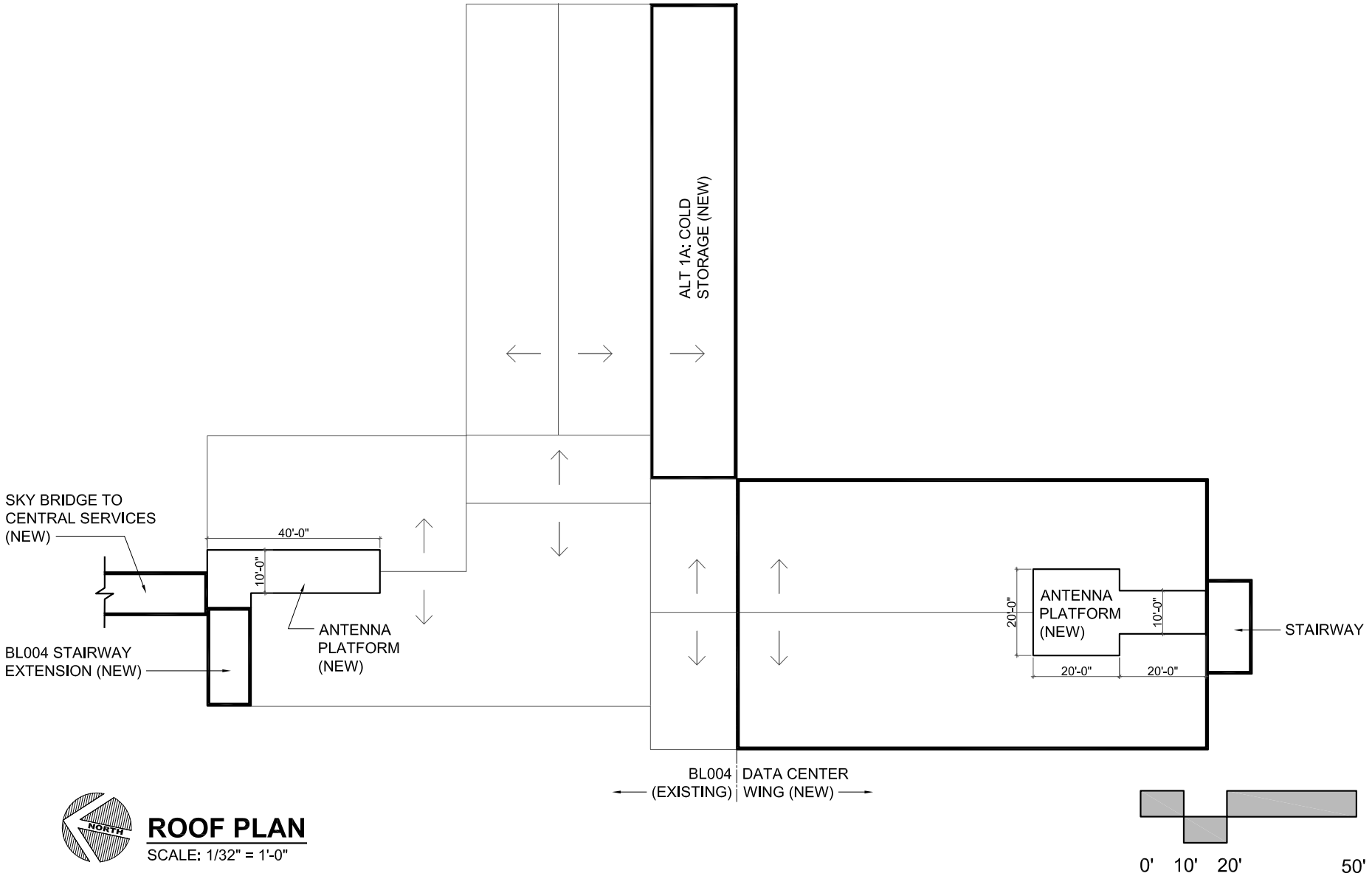
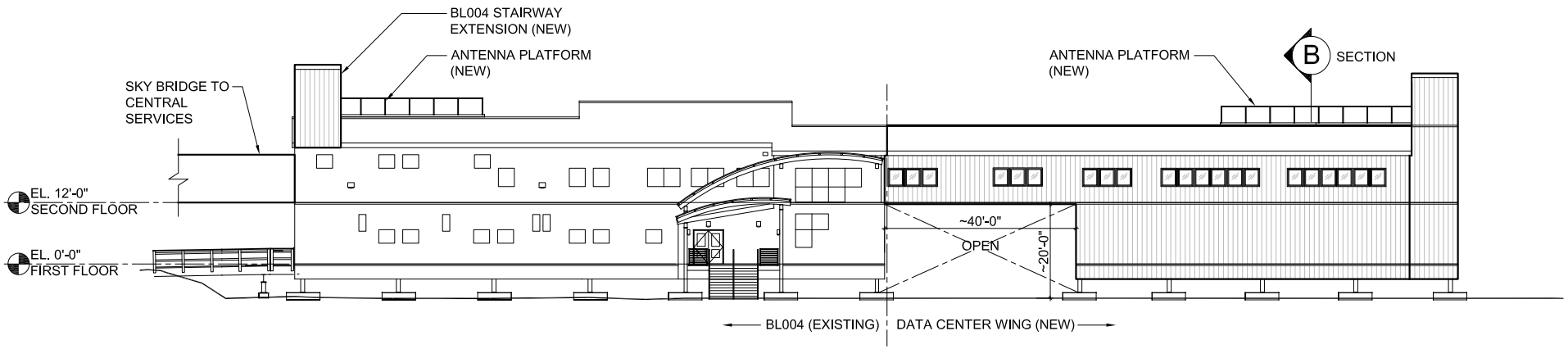


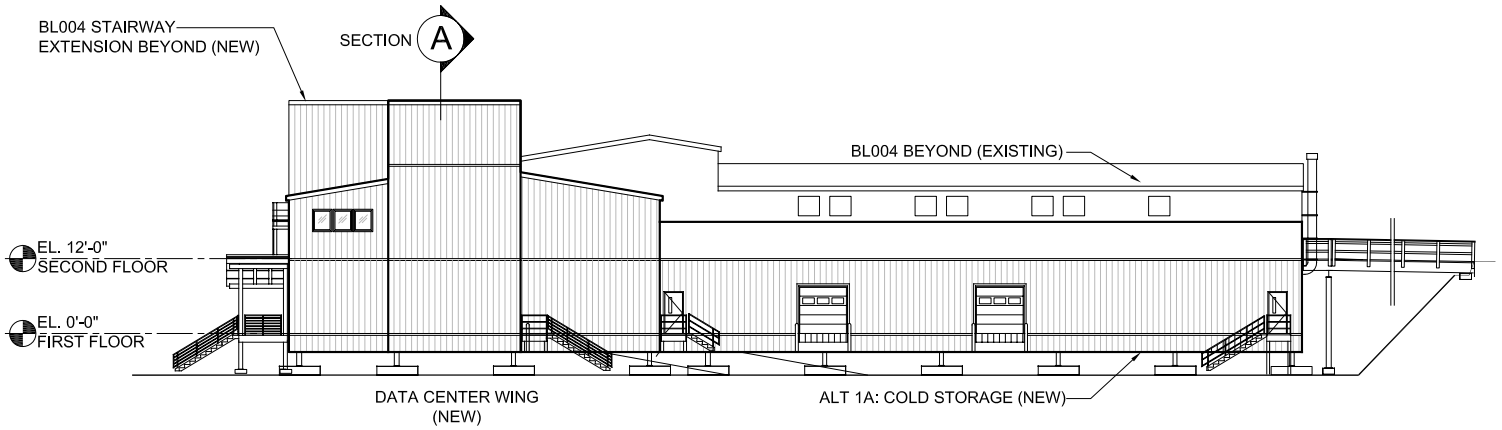
Figure 11

ELEVATIONS



WEST ELEVATION

SCALE: 1/32" = 1'-0"



SOUTH ELEVATION

SCALE: 1/32" = 1'-0"

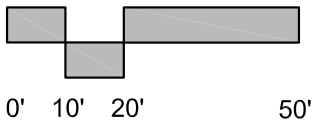
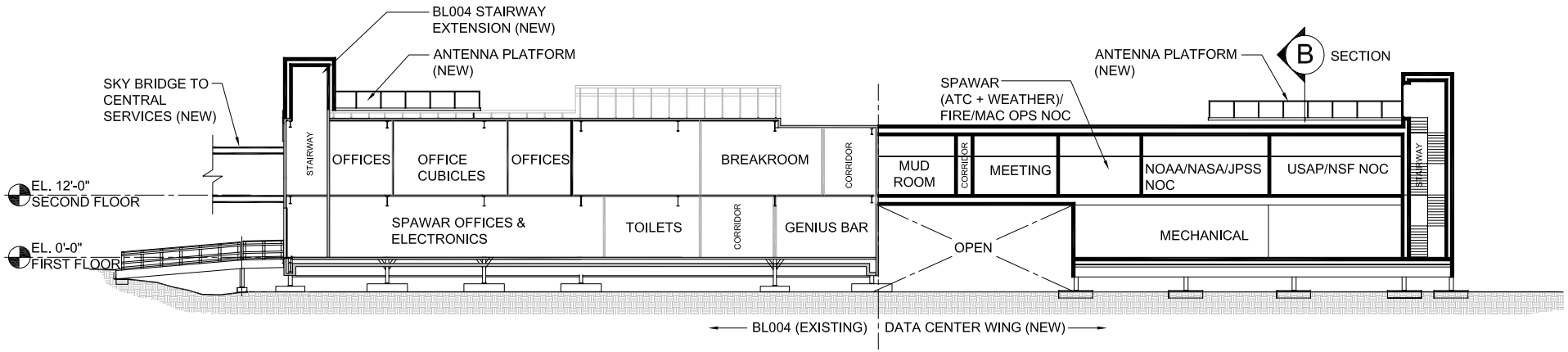
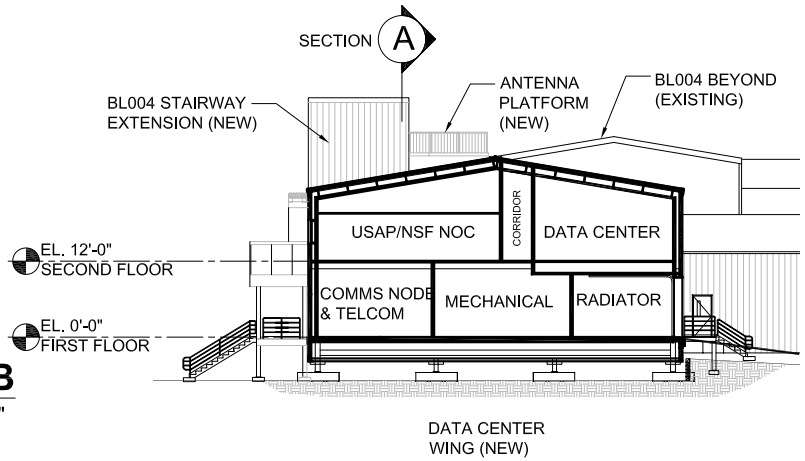


Figure 12

SECTIONS



SECTION A
SCALE: 1/32" = 1'-0"



SECTION B
SCALE: 1/32" = 1'-0"

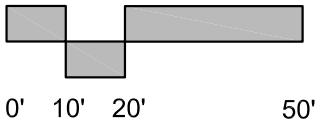


Figure 13

MECHANICAL NARRATIVE

GENERAL

This section provides an overall description of the mechanical design parameters for the mechanical systems serving the addition to BL004 as well as the renovation of the existing facility. Particular emphasis has been given to the design of the Data Center (DC) and its unique requirements.

DESIGN PHILOSOPHIES

The mechanical system components will consist of standard commercial grade equipment and installation techniques, unless noted otherwise. All systems have been designed with the highest emphasis on system redundancy with energy efficiency being the second highest design criteria. To support system redundancy, simplicity of design and ease of maintenance are emphasized to the greatest extent possible.

Our design philosophy also recognizes the unique operational and climactic conditions that this facility will experience over the life of the systems.

Philosophies that guide the design include:

- All systems supporting the Data Center are to have N+1 redundancy.
- Ensure operational environmental parameters are maintained throughout the data center.
- Compliance with code requirements and applicable design standards wherever possible.
- Systems that are standardized, with an emphasis on maintenance and energy efficiency.
- Equipment will be selected to match McMurdo Station standards and when possible to be in compliance with Buy American Act.

CODES AND STANDARDS

- 2015 International Building Code (IBC)
- 2015 International Fire Code (IFC)
- 2015 International Mechanical Code (IMC)
- 2015 International Plumbing Code (IPC)
- ASHRAE 62.1-2010, Ventilation for Acceptable Indoor Air Quality
- ASHRAE Environmental Guidelines for Datacom Equipment - 2008
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbooks and Standards.
- SMACNA Standards

SUSTAINABLE DESIGN

The facility will meet or exceed applicable energy conservation guidelines and building code requirements including

- US Antarctic Energy Checklist.
- 2012 International Energy Conservation Code
- ASHRAE 90.1 (As deemed applicable per Energy Checklist)
- ASHRAE 189.1 (As deemed applicable per Energy Checklist)

The following energy saving systems are being included in the design:

- Capturing the heat from the data center and boosting the temperature through a heat pump system to allow the heat to be used in the addition as well as in the renovated areas of the existing BL004.
- The system is designed to allow all of the heat from the data center to be cooled with drycoolers, requiring no chiller/heat pump operation.

- The occupied spaces will be ventilated with a Heat Recovery Ventilator (HRV) with air-to-air heat recovery on the exhaust air systems to pre-heat the minimum outside air levels.
- Variable frequency drives provided on the heating distribution pumps.
- Variable frequency drives provided on the economizer radiators to minimize fan power usage.
- Consider the use of a Micro-Turbine (MT) Combined Heat and Power (CHP) unit, such as the Capstone C65, strategy to provide base load power operation. Utilize the waste heat to heat IT&C as well as the existing BL004.

Heating and Ventilation Systems

Design Parameters

Outdoor winter design:	-50°F
Outdoor summer design:	45°F
Data Center indoor design:	65°F, 40%-60% RH with a minimum 30% RH threshold
Remaining indoor design:	68°F
Noise Criteria:	Offices and normally occupied spaces, NC-35
	Restrooms and Storage, NC-40
	Data Center, NC 50

Demolition

The existing systems serving BL004 will be demolished as required to support the renovation work. Terminal heating units will be replaced with new units to utilize the 150 degree supply fluid that will be available from the DC waste heat system.

General HVAC Materials

All sheet metal will be galvanized, constructed and installed in accordance with SMACNA Guidelines.

Hydronic heat piping within the building will be insulated Type L copper with brazed fittings or welded steel.

Isolation valves, pressure gauges, temperature gauges, and associated distribution system appurtenances will be provide throughout the system to facilitate maintenance and operations.

All new hydronic piping will be insulated with 2 inches of pre-formed fiberglass insulation with all-service-jacket. Calcium silicate, polyurethane core systems, or other hard block insulation will be provided for inserts at hanger locations with shields. New exposed piping installed within 10 feet of the floor will be provided with aluminium or canvas secondary jacket to provide additional protection. All outside air ductwork and exhaust and relief air ducts 10 feet from the exterior will be insulated with 2 inches of insulation.

Cooling System

The Data Center will have a high density of heat load generation and will need to be actively cooled with a mechanical cooling system. The supporting spaces in the addition will also have varying cooling loads based on computer workstations and occupants.

Data Center Cooling Strategy

There were two main strategies for cooling the Data Center:

1. Reject all of the heat to the outside using drycoolers or radiators. This is a simple system and should be able to be accomplished year round without the use of mechanical cooling equipment such as chillers.
2. Capture the heat from the DC, boost it through a heat pump, and distribute it for space heating in the addition as well as the existing BL004 building. Excess heat not utilized by the building heating system would be discharged to outside.

The concept design and cost estimate are based on Option 2.

In order to best maintain the relative humidity criteria for the DC, the use of direct outside air to cool the space was not pursued. The amount of constant humidification that would be required would create excessive maintenance as well as other issues.

E. CONCEPTUAL PLANS, SYSTEMS & NARRATIVES

Data Center Cooling Load

The cooling load is based on 60 racks, each having 7.5 kW of heat production (5 kW per rack with 1.5 power multiplier at the time of commissioning per NSF). Lights and a couple occupants are also taken into consideration.

Hot Aisle / Cold Aisle Design

The racks in the main three DC areas (NASA, NSF, SPAWAR) are arranged in a hot aisle/cold aisle configuration. Cooling for the racks is proposed to be completed through ventilating a proposed raised floor system. Computer Room Air Conditioning (CRAC) units will discharge supply air under the raised floor, pressurizing it and creating a plenum affect. This will provide N+1 redundancy by having the CRAC units increase their airflow to continue the supply duct plenum pressure to compensate for a down unit. The CRAC units will also have humidifiers that will maintain room relative humidity setpoint.

The DC cooling air distribution system is comprised of the following:

- Six CRAC units (Five+1) are located in the DC area, two per caged area. Each CRAC unit is currently calculated to provide 390 MBH of cooling (113 kW).
- CRAC unit supply air directly into the proposed raised floor plenum.
- Perforated floor grilles will be placed down the cold aisle to allow the cool air to fill the aisle and enter the racks or on the cooling intake side of racks that are not in a hot aisle/cold aisle configuration.
- Hot air from the hot aisles is collected at the ceiling and is ducted into the top (return) of each CRAC unit.

Chilled Glycol System

A liquid hydronic cooling system is provided to remove the heat from the DC and either convert it into usable space heat or discharged to the outside. Reference Figure 14 for a chilled glycol system piping diagram.

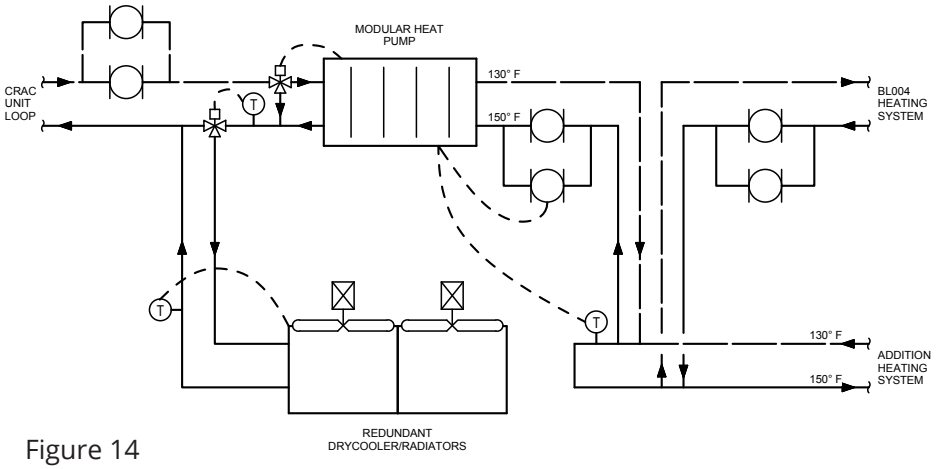


Figure 14

- Chilled glycol will be 50% propylene glycol to match the heating system medium. The design is based on a supply temperature of 45 degrees and return temperature of 55 degrees F. Higher temperatures to provide more system efficiency will be further evaluated during the design phase.
- Chilled glycol is routed from the CRAC units by two circulating pumps, (470 gpm, 90 FT HD, 20 HP) piped in a primary/back-up configuration. Each pump will have a VFD with manual bypass.
- Distribution piping accessories include a 6 inch Spirotherm air/dirt separator, 100 gal ASME bladder-type expansion tank, and a 55 gallon glycol make-up tank.
- A three-way valve will be used to divert the chilled glycol to the heat pump if the heating system loop requires heat.
- The heat pump is a modular waste heat recovery chiller that is utilized as a heat pump to boost the CRAC return fluid of 55 degrees to 150 degrees for distribution to heating terminal units. The heat pump skid is comprised of six (five+1) 415 MBH (35 tons) units. Basis of design is the Multistack DHRC series, model MS085XC1-410A.
- If the heat pump did not remove enough heat from the loop, a three-way valve will divert the chilled glycol to a drycooler/radiator system to discharge the heat to atmosphere.

- At least two drycooler units or radiators will be used to discharge the heat to the outside.
    - The units will be located in a separate plenum room that will be maintained at 40 to 50 degrees to optimize heat transfer while also lengthening the life of the equipment.
    - The equipment exhaust will ducted into an exhaust plenum with return air dampers that will either direct the heat back into the space to maintain room temperature setpoint or outside of the building.
    - Variable frequency drives will be used on the fans, based on return chilled glycol temperature to reduce energy usage.
    - Outside air intake into the space will utilize exterior hoods for the intake.

The chilled glycol loop will also serve terminal cooling units in the UPS storage room as well as the office spaces with high heat loads due to occupants and computers. The terminal cooling units can be a mix of passive chilled beams and/or fan-coil units.

Ventilation System

The ventilation system for the DC area is described under the Cooling System section. The remaining ventilation systems in the addition include occupant ventilation, cooling for the mechanical room, and ventilation for the remodelled spaces of the existing BL004 including upgraded exhaust for the expanded restrooms, loading dock, and process applications such as soldering station. Existing ventilation and exhaust systems in BL004, such as the Battery Storage Room, will be reviewed for compliance with current code.

Office Space Ventilation

The offices and Data Center will be served by two identical Heat Recovery Ventilators (HRV) with an air-to-air heat recovery core. Two units are provided for N+1 redundancy. Because the air at McMurdo is so dry, it will affect the relative humidity ratios in the building so the HRVs will be used primarily for ventilation only.

- Each HRV is currently scheduled at 1,000 cfm, 100% outside air.
    - Each unit will be ducted into a common supply and exhaust ducts, with control dampers used to isolate the primary and back-up unit.
    - The unit will be provided with glycol pre-heat coil with MERV 8 summer and winter filters. A glycol heating coil will be provided downstream of the heat exchanger.
    - The heat exchanger will have a supply bypass to allow for summer economizer mode.
    - ASHRAE book, "Particulate and Gaseous Contamination in Datacom Environments" recommend a final MERV 13 filter be provided to reduce contaminants in a DC. This meets an ISO Class 8 cleanliness. We are proposing to utilize at least a MERV 14 filter due to the silty dust that is prevalent in McMurdo.
    - The supply and exhaust fans will be direct drive, plenum type fans to reduce maintenance. Either VFDs or EC motors will be provided for balancing purposes as well as to provide some protection against power fluctuations.
    - Outside air will be pulled from the Radiator Room outside air plenum.
- Distribution supply and exhaust ductwork will be routed throughout the second floor occupied spaces.
- The DC will be provided with a minimum amount of air, currently anticipated at 200 cfm, equally distributed in the DC, to provide ozone ventilation and occupant ventilation for when someone is in the DC.

Other Ventilation in Addition

A ventilation fan and relief air duct assembly will be used to cool the mechanical room. The ventilation fan assembly will be comprised of a propeller fan with an outside air and return air mixing damper configuration to provide 55 degree cooling air to the space.

Since there is no combustion in the mechanical room, the relief air duct will have a control damper on it.

Existing BL004 Ventilation

New exhaust fan will be provided for the expanded restrooms.

An exhaust and make-up air duct will be provided in the Loading Dock area and be activated based on carbon monoxide sensor.

Existing ventilation distribution system will be relocated for the reconfigured occupied spaces.

Heating System

The addition will be primarily heated by DC waste heat from the modular heat pump system.

- The building heating system will utilize 50% propylene glycol as the heating medium to match other facilities. The system will be sized using 150 degree supply temperature to maximize the waste heat available from the DC.
- A supply and return pipe will be routed from the existing BL004 heating plant to the addition, piped in a primary/secondary loop configuration to provide supplemental heat if needed. The piping will be configured such that heat could also be taken from the addition (230 gpm, 60 FT HD, 7.5 HP)
- The building heat distribution system will utilize two pumps piped in a primary/back-up configuration (100 gpm, 45 FT HD, 5 HP). Each pump will be provided with a VFD with manual bypass.
- Distribution piping accessories include a 3 inch Spirotherm air/dirt separator, 100 gal ASME bladder-type expansion tank, and a 55 gallon glycol make-up tank.
- Heat will be distributed from the modular heat pump package to the building heat loop in a primary/secondary piping configuration. Two pumps will be provided in a primary/back-up configuration (230 gpm, 60 FT HD, 7.5 HP). Each pump will be provided with a VFD with manual bypass.
- If a MT is provided at the facility, the waste heat system will be connected to the heating loop in a primary/secondary piping configuration. Since the MT will not be the primary heat source for the building, a single circulating pump (32 gpm, 16 FT HD, 3/4 HP) is to be provided.

PLUMBING SYSTEM

General

The plumbing for the addition is limited to providing water to the CRAC humidifiers and the removal of condensate from the various CRAC units and terminal cooling units. Water and waste piping mains will be reused in the remodel of the restroom group in the existing BL004.

No new utility connections are anticipated at this time.

Humidification and Condensate

A domestic water line will be routed from the existing BL004 to the new addition for the use in the humidifiers. A Reverse-Osmosis (RO) system will be provided to clean the water before it is distributed to the CRAC unit humidifiers.

Condensate from the CRAC units and the terminal cooling devices will be collected into the first floor mechanical room. A central lift station will be provided on the first floor to pump the condensate to the restroom waste main in the existing BL004. The lift station will be a duplex pump system to provide redundancy.

Water System

The existing domestic water and hot water in BL004 will be modified to serve the renovated restroom area.

Fixtures

Commercial grade plumbing fixtures will be used in the restroom remodel. Fixtures will be virtreous china with low-flow flush valves and faucets to provide water efficiency.

COMMISSIONING AND PERFORMANCE VERIFICATION

Systems installed and modified as part of this project will be commissioned to verify proper operation. Commissioning process will be based on ASHRAE Guideline 0 recommendations.

Systems that are anticipated to be commissioned include:

- Building envelope integrity

ELECTRICAL NARRATIVE

The electrical design for the project includes support for the new Data Center and remodel of the existing Bldg 004 into a support facility related to the users of the Data Center. Building 004 will include back up emergency response control facilities.

Reference Standards

- NFPA 70 - National Electrical Code (2014)
- NFPA 101 – Life Safety Code (Current)
- NEMA Standards
- IESNA Handbook 10th Edition
- ASC Primary and Backup Data Center Requirements (01 Apr 2016)
- Underwriter Laboratories (UL)
- ASHRAE 90.1
- Federal High Performance Buildings Standard

Electrical Service

Data Center: A new main electrical service from the station electrical distribution system will be provided. Estimated service size is 1000 kVA load with a 480Y/277V configuration. This includes 300 kVA of data center cabinet load (5 kVA each rack), 450 kVA of mechanical load primarily cooling and humidification loads, and 25% spare capacity. As service is over 1000 Amps, ground fault protection will be required for the mains and major distribution feeder. Until the new utilidor work is completed, a temporary service with exterior disconnect will be routed through Building 004. A new transformer and service will be required to be installed to supply the Data Center.

Note: This is a potential significant electrical load and might have a large on station's generator capacity if it were all new load and existing facilities were going to remain. The new load is mitigated as:

- *The basis for number of racks is the existing station's infrastructure which will be relocated to this facility, ideally a net "0" increase to the station load.*
- *Existing spaces where equipment is located is using older technology for cooling and computer systems as well as being distributed in smaller units. Estimate that ventilation/chilling load would regularly be less that the total of the other spaces.*
- *CRAC units if they had to be attempting to humidify all outside air, would use approximately ½ of the mechanical load noted above. Use of a recycled humidified air will greatly reduce the demand load by not having to vaporize water.*
- *Exterior envelope, vestibules and other features will reduce/ eliminate vapor loss and therefore electrical humidification load.*

Building 004: Current electrical service is anticipated to meet the new facility configuration loads

Data Center Distribution

Power distribution within the data center is divided between 480V – 3 Wire power for the mechanical equipment loads and 208Y/120V for the data center and other utilization loads within the facility. The 208Y/120V load is estimated to be 500 kVA and will be served by step down transformers (300 and 225 kVA) located within the electrical and UPS rooms on the first floor. A 1600 Amp distribution switchboard will be located load side of the 1600 Amp automatic transfer switch.

Distribution and branch circuit panels located in the UPS and electrical rooms will include an estimated:

- Two 600 Amp 480V for A/B loads
- Two 1000 Amp 208Y/120V A/B
- Twelve 225 Amp Data Center Panels for A/B rack supplies, fed from UPS
- Two 225 Amp 208Y/120V non-redundant, non-UPS

Redundant Power Supply

A backup power supply is required for the Data Center's critical electrical

systems as well as the Bldg 004 backup operation centers. This is a currently anticipated exterior module including up to a 1200 kVA diesel generator. Other alternative backup supplies are outside the current design instructions. Further demand load studies shall be coordinated during the design with intent to bring the generator peak capacity down to approximately 500 kVA (See Generator Module section below).

Options for additional micro-turbines to support base loading and long term standby loads could be made part of the Building 004 design. Offsetting base power distribution load could likely be achieved by using several Capstone C65 or other micro-turbines.

Uninterruptable Power Supplies

UPS units shall be based upon ASC IT Standards and confirmed by attendees of the Design Charrette. Redundant power supplies to the Data Center will be provided from Redundant (N+1) configuration of UPS units. Each collection of UPSs are able to supply the entire Data Center loads if one should fail.

UPS for the emergency (secondary) EOC/MacOps, etc. shall be supplied from a redundant power source. There should be redundant UPS located near the EOC area to power the local equipment racks, consoles and displays for the area. Additional 120V connections will need to be supported for legacy equipment and options considered for supplying single power supply loads from either UPS.

A more costly solution is to parallel UPS and feed to a common bus. Alternative is to have a manual bypass switch which would transfer load between the UPS.

ASC has standardized around the APC line of products allowing them to monitor the health of all the UPS via common software. Joe Harrigan and others indicated a desire for the modular UPS arrangement with sealed batteries. Modules allow easy field replacement. Joe indicated they would provide information on installed units. ***Recommend requesting an inventory of UPS units and current demand loads at McMurdo.***

The following configuration of UPS are under consideration:

- 12 each 60 kW (scalable to 100 kW) Symmetra PX with additional battery module for 30 minutes run time.
- 6 each 125 kW (scalable to 250 kW) Symmetra PX with additional battery module for 30 minutes run time. The additional benefit of these units is they can be parallelled for a common bus arrangement, but require output transformers.
- 3 each 175 kW (scaleable to 250 kW) Symmetra PX with similar features as above.

Lighting

LED lighting is anticipated throughout the new Data Center, skybridge to the core facility and remodeled Building 004. Lighting will be by pendant luminaires mounted within the cold and hot aisles for the data centers. Luminaire placement will be coordinated to permit complete access to the above rack cable tray systems. Cold weather LED will be used in the chiller plenum as well as exterior to the facility.

Lighting controls will be integrated into the fixtures or ceilings to permit energy reductions when spaces are unoccupied.

General Power

Receptacles will be distributed to meet operations facility office requirements. Data Center racks will be served from “A” and “B” 30A, 208/120 single-phase receptacles to supply redundant cabinet mounted PDU units. Equipment test benches will be similarly configured for individual testing. Receptacles will be distributed over the length of the skybridge to the core facility at approximately 60-70’ centers for cleaning.

Grounding

Building service ground bar will be provided in the electrical room. UPS, transformers and neutral at service disconnect point will be interconnected to the building ground bar. Interconnection to station ground and main telecommunications ground bar will also be accommodated.

Generator Module

A self-contained generator module will be provided for the Data Center and BL004 as noted above. This module include genset, engine controls, battery and fuel storage for 12 hours at peak load, but with diversity this is anticipated to provide closer to 18-24 hours of fuel. As

a standby generator, it shall meet Tier 2 emissions criteria. The module will further have ventilation and controls to maintain temperature and combustion air requirements within the module. Additional features of the module will include: output circuit breaker to supply the Data Center's Distribution Systems, panelboards for the module's electrical loads, electric unit heaters, LED internal and exterior entrance lighting, battery charging equipment, generator jacket water heaters. A fire suppression system and emergency shutdown provisions will be required. Module's foundation configuration shall be determined. Conduits between the generator module and data center distribution and transfer switch(es) will be provided with supports to maintain snow removal around the module access door.

The generator module foundations shall be precast concrete footings and piers coordinated with the module supplier.

STRUCTURAL NARRATIVE

The IT & C Data Center and the Cold Storage Area are additions to Building 004. There will be a Skybridge connecting the second floor of the IT Center to the Core Facility.

Building 004 is a two story steel frame building. The 1st floor is 8" precast hollow core concrete slabs supported by wide flange steel beams. The 2nd floor is 3" steel deck overlain with 3/16" steel plate supported by wide flange steel beams. The roof is framed with insulated metal panels supported by open web steel joists and wide flange steel girders. The columns are steel wide flange sections and square tubular steel sections. The building is laterally supported by braced frames with square tubular steel sections. The exterior wall panels are supported by heavy gage Z girts spanning between the columns. The foundations are precast concrete footings sitting on the surface. Rock anchors were installed to resist uplift loads at the braced frame foundations.

The IT Addition is anticipated to be of similar construction. It will align with the existing building where a addition was originally planned. Both floors will be steel deck overlain with steel plate or similar strata, supported by wide flange beams or open web steel joists supported by wide flange girders. The roof will be insulated panels supported by open web steel joists and wide flange girders. The columns will be wide flange sections or square tubular steel sections. The lateral support will be steel braced frames with square tubular steel sections. The foundations will be precast concrete footings sitting on the surface. The second floor may be recessed for a raised access floor at the data equipment.

The Cold Storage is a one story addition directly south of the east wing of Building 004. The floor will be 8" precast hollow core concrete slabs supported on wide flange beams. The roof will be insulated panels supported by open web steel joists and wide flange steel girders. The roof girders will connect to the existing columns on one end so that the roof is below the windows on the second floor. There will be snow drift on the new low roof, and snow clips will need to be added to the existing roof so that sliding snow will not impact on the lower roof of the addition. The columns will be wide flange sections or square tubular steel sections. The lateral support will be steel braced frames with square tubular steel sections. The foundations will be precast concrete footings sitting on the surface. The exterior wall of Building 004 will be modified for another over head door.

The additions will be hard connected to the existing building. At the connection points new columns and footings will be provided in the addition if the existing columns and footings are not adequate for the additional loads. The existing bracing will be evaluated for the added lateral loads and reinforced if necessary.

The Skybridge will be steel frame with intermediate supports and supports at both ends. At each end a seismic joint will be provided so that the Skybridge will be self-supporting vertically and laterally. The floor will be steel deck overlain with steel plate or similar strata, supported by wide flange beams or open web steel joists, and the roof will be insulated panels supported by open web steel joists. Spanning longitudinally between the Skybridge supports will be wide flange girders of one story high steel trusses. The columns will be tubular steel sections. The lateral support between the roof and floor will be steel braced frames with square tubular steel sections or trusses in the longitudinal direction, and moment frames in the transverse direction. The lateral support between the floor and the foundations will be steel braced frames in both directions. The foundations will be precast concrete footings sitting on the surface.

TELECOMMUNICATIONS LAYOUTS & NARRATIVE

The new primary data center will be located on the second floor of this new facility. This data center will contain telecommunication cabinet/rack space for several different stakeholders on McMurdo. These include the National Science Foundation (NSF), NASA/JPSS/NOAA, SPAWAR, AFRTS, MacOps, etc. For the design, Uptime, PUE, and BISCI standards will be followed as applicable.

DATA CENTER WING (NEW)

- The data center cabinets/racks will be co-located in the same general data center area, divided by chain link fence or some other means into separate secure spaces for each stakeholder.
- The cabinet layout configuration would be based upon cold aisle containment.
- Most cabinets will be enclosed and lockable, some open racks will be used in addition to cabinets.
- Working clearances in front of the cabinets will be the depth of the cabinet plus 12". Clearance behind the cabinets will be a minimum of 36". This will actually be adjusted to 40" per Bicsi standards.
- Standard cabinet dimensions will be 24" wide x 42" deep.
- Cabinet capacity would be standardized at 42U for all stakeholders.
- The cabinet/rack quantity was discussed and it was determined that the following counts would be the basis of the initial design. These counts do include 40% spare capacity for growth:
    - NSF – 24
    - NASA/JPSS – 22
    - SPAWAR (Weather) – 4
    - SPAWAR (ATC) – 2
    - AFRTS – 7
    - Fire/Ops – 1
    - MacOps – 4
- The majority of these will be located in the main data center space. However the SPAWAR (ATC), AFRTS and Fire/Ops cabinets may reside in other locations more suitable for their use.
- Two different options for the cabinet/rack layout have been designed for the main data center stakeholders NSF and NASA/JPSS which will have 24 cabinets each (see figures 15 and 16). One consists of (4) rows of six cabinets and the second consists of (2) rows of twelve cabinets. The second option has a slightly smaller square footage and some HVAC advantages due to only having one cold aisle.
- Cable trays would be used for power and data cable management. A minimum of 2" separation is required between power and data. This may be accomplished with separate cable tray or a divided cable tray.
- It is preferred to not have a raised floor in the data center or network operator center (NOC) stations/control consoles, however, this will be finalized during design.
- Adjacent NOC/control room spaces will be needed for NSF and NASA/JPSS.
- Work bench space, approximately 8', will be needed for NSF, NASA and one to be assignable user (total of 3 separate spaces). These will be used to service the sensitive networking equipment in the data center area.
- The NOC/control room and work benches must be adjacent to each stakeholder's data center and in an area conditioned similar to the data center.
- Additional user specific cabling will be required for the radome and various antennas located most likely on the roof.
- Data Center redundancy to meet a combination of Tier 1/Tier 2 Uptime Institute guidelines.
- All 1GB horizontal cabling will be provided via CAT6 and all 10GB

backbone cabling will be provided via CAT6a or CAT7 cabling.

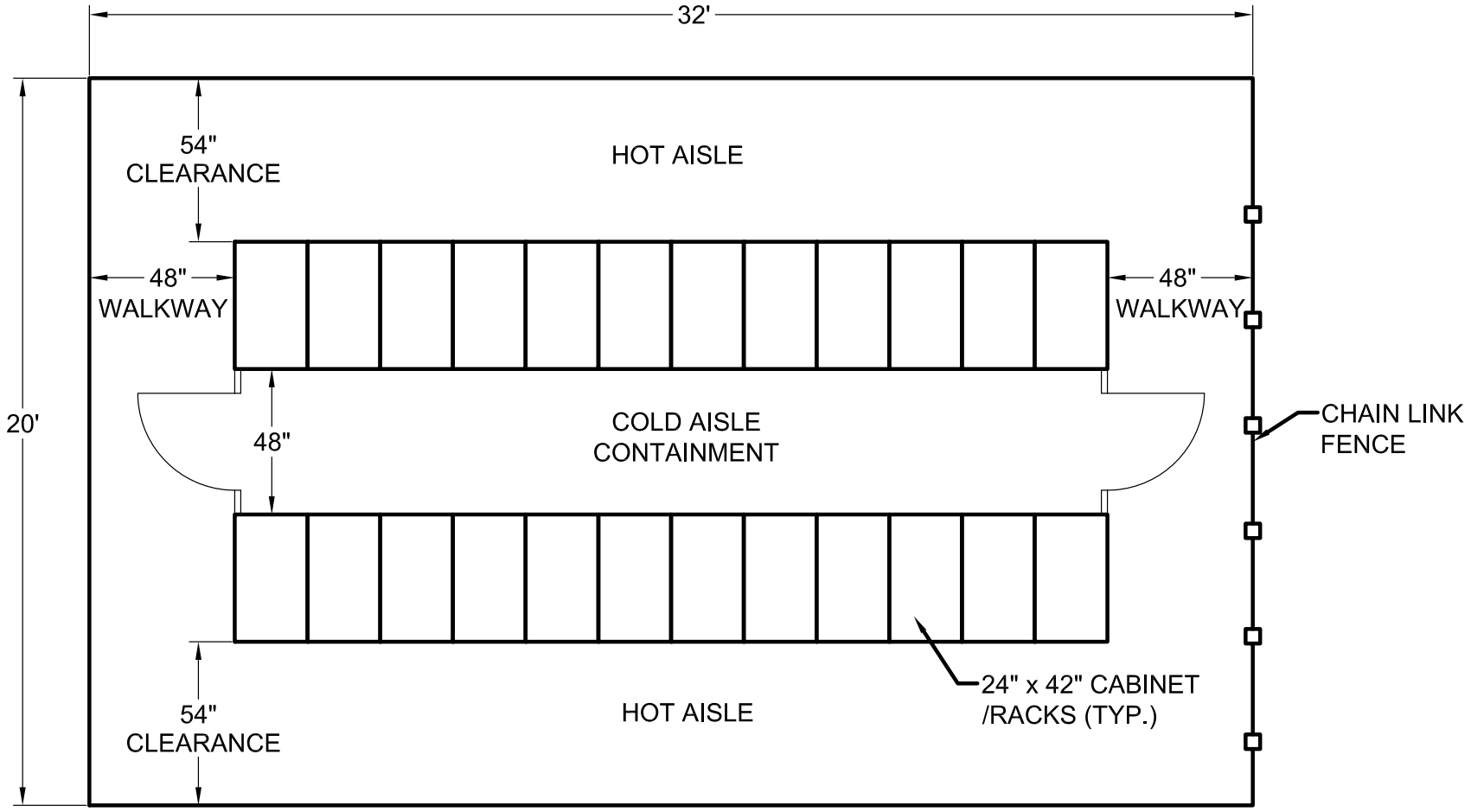
- All data transmission longer than 100m will be via single-mode fiber optic cabling.
- Fiber optic terminations will be done using SC/APC connectors.
- Physical security will be provided for the new data center wing and also between data center sections and NOC/control rooms for each stakeholder.
- Outside plant cabling (OSP) will be provided via the combined utilidor. This will be terminated in the entrance facility "node" located on the first floor of the new addition. This room will contain the necessary racks/cabinets for terminating the OSP cable and also distributing backbone cabling to the new data center addition. Until the new utilidor work is completed, a temporary data feed will be routed through Building 004.
- A Telecommunications room will also be located on the first floor, most likely adjacent to the telecommunications entrance facility "node". This room will contain the necessary racks/cabinets for distribution of horizontal cabling to all telecommunications outlets throughout the new facility.

BL004 (EXISTING TO BE RENOVATED)

- The new secondary Emergency Operations Center (EOC) will be housed in the renovated existing BL004. This will include MacOps, MacWeather, MacCenter, RavenOps and the Fire House. This EOC will be used to in the event that the primary EOC located in the Central Services building cannot function or is not yet operational.
- The existing telecommunications room will be reused, if possible, and contain the necessary racks/cabinets for distribution of horizontal cabling to all telecommunications outlets throughout the renovated BL004 facility.
- The loading dock(s) in the existing BL004 will be used by the new data center addition for shipping/receiving and staging of the telecommunications equipment.

DATA CENTER LAYOUT OPTIONS

NOTE: ALL CLEARANCES SHOWN ARE FOR CABINETS ONLY.
ADDITIONAL SPACE WILL BE REQUIRED FOR ELECTRICAL AND
MECHANICAL EQUIPMENT THAT IS NOT CURRENTLY SHOWN.

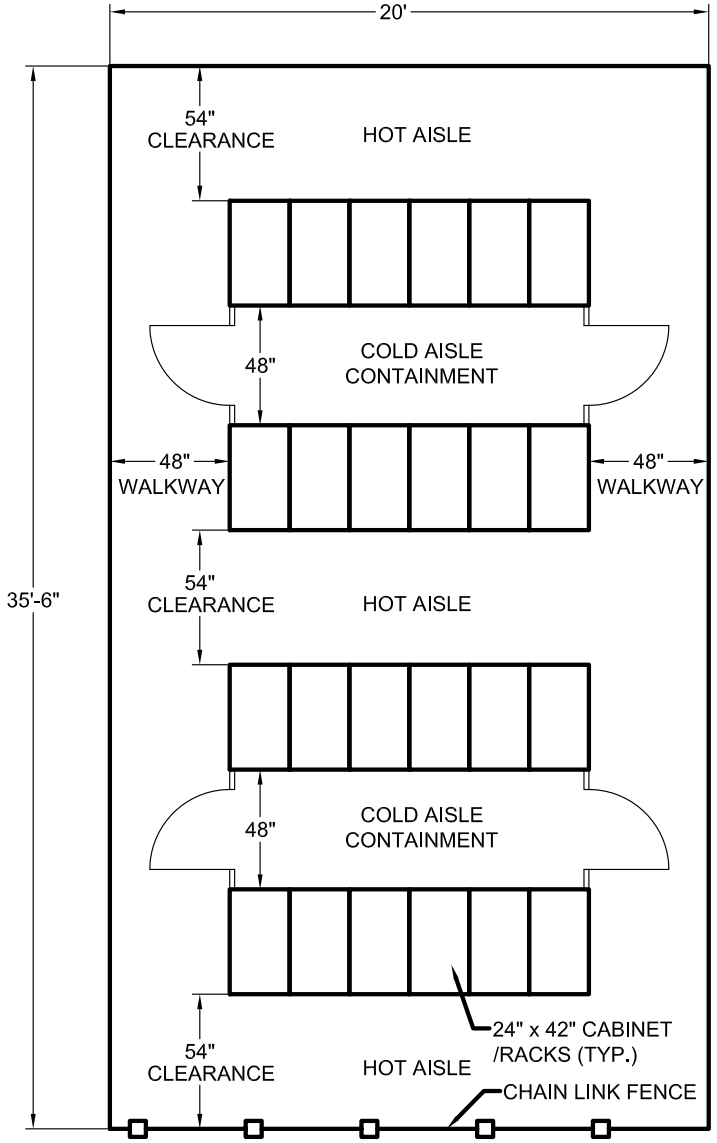


1 (2) ROWS OF (12) CENTERED - 640 SQ. FT. (OPTION 1)

SCALE: NTS

Figure 15

DATA CENTER LAYOUT OPTIONS



NOTE: ALL CLEARANCES SHOWN ARE FOR CABINETS ONLY. ADDITIONAL SPACE WILL BE REQUIRED FOR ELECTRICAL AND MECHANICAL EQUIPMENT THAT IS NOT CURRENTLY SHOWN.

1 (4) ROWS OF (6) CENTERED - 710 SQ. FT. (OPTION 2)

SCALE: NTS

Figure 16

F. CONCLUSION - SCOPE OF WORK

F. CONCLUSION

IT&C Primary Ops Scope of Work

Determination of the design scope of work was a primary charrette objective to facilitate development of a parametric construction cost estimate. The bullets below describe this scope of work (SOW). The SOW resulted from charrette discussions, referenced charrette documents and associated communication with various stakeholders. Buy-in by all stakeholders to this scope of work is sought to move ahead with design.

DATA CENTER WING (NEW)

The new data center (DC) wing will be directly connected to the existing BL004 (no sky bridge), as planned for the original Ph II, and be oriented north-south. The data center wing first floor will be interrupted by a 40' wide snow "slot" at the interface to the existing BL004. Snow modeling will be needed to verify the performance of this "slot" to scour snow and prevent significant drifting in the corner created by the new wing addition. If snow does accumulate, this "slot" provides an easy means for snow removal from the area by pushing it through the drive thru area rather than digging out and risking damage to the building shell.

- First Floor Addition square footage: ~4,200 sq. ft.
- Second Floor Addition Square footage: ~6,600 sq. ft.
- Rack count finalized at a nominal count of 60 (includes 40% industry standard freespace requirement):
    - NASA – 22 racks
    - NSF – 24 racks
    - SPAWAR: Weather – 4 racks
    - SPAWAR: ATC – 2 racks
    - Mac OPS – 4 racks
    - Fire House – 1 rack
    - AFRTS – 7 racks (to be segregated from co/lo DC)
- Adjacent NOC/control room spaces needed for NSF and NASA/ JPSS/NOAA (approx. 800 SF each)
- Adjacent bench space (8') needed (3 total, separate) for NSF, NASA, and one to be assignable
- DC wing to be supported by break rooms, toilets, copy/print, and additional assignable offices in BL004.
- Data center wing to include small collaborative meeting space (6-8 people) and shared ready room for ECW and tool bags (to include lockers)
- DC redundancy to include N+1 for UPS, HVAC, and power ((A & B circuits on racks and point of connection to be provided for exterior backup generator for DC)
- UPS (30 min.) either rack-mounted or DC wide (1st floor electrical room includes space for DC wide UPS). Will proceed with DC wide UPS option as preferred option.
- DC fire protection to include dry sprinklers as well as FE-12 or FE-13 system (located in DC wing, 1st floor)
- Prefer no raised floor in data center or NOC/control rooms. Power and signal cable will be routed overhead in ceiling via a structured cable tray system.
- Limited ready storage provided in DC for NASA and SPAWAR only
- DC humidification target 40 – 60%, minimum threshold 30%. Vestibule separation will be included to prevent migration of moist air and possible condensation.
- Hot aisle/cold aisle rack configuration with forced air cooling
- 42 U racks, 24" x 42" to be the standard
- Roof antenna platform to be approximately 20' x 20' with an extension 10' wide x 20' long (to be further researched by ASC to assess line-of-site requirements) to be reached by new DC wing south stairway

- OSP entry to DC wing at node room on first floor (150 SF, 10' x 15') plus wiring closet (8' x 10) ultimately, temporary data feed through existing BL004 until OSP is built out
- Roof antenna connection to the shop areas via test bench bulkhead(s) with multiple antenna wiring outlets
- New DC wing dedicated power feed into 1st floor electrical room with generator power ATS and point of connection ultimately, temporary power feed through the existing BL004 pending permanent utilidor installation
- Water and waste heat for the new DC wing will be provided from the existing BL004
- Security into the new DC wing, between stakeholder data center sections and for NOC/control room areas will be provided
- Provide copy/print areas as appropriate

BL004 (EXISTING TO BE RENOVATED)

- First Floor Existing Bldg. 004 square footage: 11,400 sq. ft.
- Second Floor Existing Bldg. 004 square footage: 11,190 sq. ft.
- Existing BL004 utility points of connection to remain
- No UPS needed for BL004 other than selected critical loads
- Back – up power connection to be provided for BL004
- 2nd floor skybridge for pedestrian access to new Core Facility (160' long x 10' wide x 10' high)
    - Construction to be full depth truss on the sides or wide flange sections with intermediate supports and transverse bracing
    - Skybridge is to include one direction change (kink)
    - Skybridge floor framing to be steel deck with steel plate
    - Skybridge to include some heat, light & power, fire sprinklers
    - Building envelope to include insulated soffit (below floor), walls and roof
    - To be conditioned to prevent freezing of fire sprinkler system
- 6' x 6' lift to be provided for PC shop delivery to Core Facility via proposed sky bridge
- BL004 second floor to include back up EOC, Mac OPS, Mac Weather, Mac Center, Raven Ops, and Fire House Dispatch.
- Dedicated EOC comms space (~200 SF) and mission comms space (~1232 SF)
- Other BL004 second floor back up services will be in assignable office (~1000 SF) and meeting space (~500 SF)
- BL004 second floor space for field science electronics lay down (~4000 SF) (UNAVCO/PASCAL from Crary)
- 2nd floor bridge/loading dock into partitioned off operations/ receiving/shipping area for DC 2nd floor and BL004 access
- Loading dock/staging area (~600 SF) adjacent the 1st floor shop areas
- BL004 first floor shop areas for:
    - SPAWAR/IT Electronics Shop (~1200 SF)
    - Comms/Telco Shop (~2500 SF)
    - PC Shop (~400 SF)
- Roof antenna connection to the shop areas via test bench bulkhead(s) with multiple antenna wiring outlets
- Roof antenna platform approximately 10' wide x 30' long (to be further researched by ASC for line-of-site requirements) to be reached by extension of existing stairway

- Include waste/recycled materials collection/staging areas
- Provide copy/print areas as appropriate
- Battery storage and charging area (~325 SF) (likely in existing locations)

BL004 UNHEATED (COLD) STORAGE WING (NEW, AS ADD ALTERNATE)

OPTION A:

- 2000 SF of unheated storage for:
    - SPAWAR - ~600 SF
    - NSF - ~600 SF
    - Comms - ~600 SF
    - NASA - ~200 SF
- Caged for multi-tenant use
- Rework existing exits from 1st and 2nd floor impacted by the new unheated storage wing
- Provide two exterior overhead doors at outside wall for access, in line with existing and a new internal overhead door, and high bay shelving
- Building envelope to match existing building envelope on BL004 and include tubular skylights in the roof (every 10' – total of 10 tubular skylights)

OPTION B (AS AN ADD TO OPTION A):

Based on recommendations from the 65% submittal of the "Campus Power, Water and Thermal Storage Strategy Report" for McMurdo Station published in April 2016, a microturbine Proof of Performance noted on p. 32 for Power Generation Options Alternative 2 could be included in this cold storage space.

The new optional cold storage wing for the IT&C Primary Ops Facility can serve as the location for a Capstone C65 test case. This option is worth considering for the following reasons:

- The cold storage wing is separate from the new data center wing and could be constructed at any time prior to, during or after the data center wing construction
- If constructed before the data center wing, it could house a C65 pilot test while the BL004 is still operating as the SSC with the load profile in place currently
- Once the data center is constructed, the C65 pilot could then be tested with a different load profile which, because of its nature as a data center, would be a constant load profile amenable to base load power generation via a microturbine
- If the microturbine pilot test is not considered successful, this cold storage wing could then be converted to cold (as in "unheated") storage as discussed during the charrette last week.
- If considered successful, the C65 could remain in place to serve the new IT&C Primary Ops Facility

REFERENCE INFORMATION

Project will use applicable Uptime institute design standards, BISCI cabling standards, and PUE metrics to be further reviewed and clarified during formal design.

SUSTAINABLE DESIGN

The sustainable design guidelines for the project will include the following:

- Building envelope strategies as noted in the "McMurdo Station Modernization Study – Building Shell & Fenestration Study", 65% Submittal, published March 11, 2016.
- Wall and roof assembly R-values as noted in the "Campus Power, Water and Thermal Storage Strategy Report" published April

2016.

- ASHRAE Environmental Guidelines for Datacom Equipment – 2008
- ASHRAE Handbooks and Standards
- LEED guidelines, as applicable, relating to water efficiency, energy efficiency, materials, and indoor environmental quality
- IECC 2015

COMMISSIONING INTENT

- Systems to be commissioned include:
    - HVAC systems
    - Condensate removal system
    - Fire suppression and detection
    - ISP cabling
    - Electrical to include UPS, backup generator ATS and point of connection, DC controls and management systems, building controls and management systems, lighting controls
    - Building envelope and Data Center envelope

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