NWSC Facility Overview

Michael Kercher, NWSC-3 Facility Infrastructure Lead

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NWSC - Tier-II Data Center

Tier II - Data Center

- Redundant capacity components
- Single, non-redundant distribution paths serving the site's computer equipment.

Benefits of a Tier 2 facility include:

- 99.749% Uptime
- Partial redundancy in power and cooling
- 22 hours of downtime per year

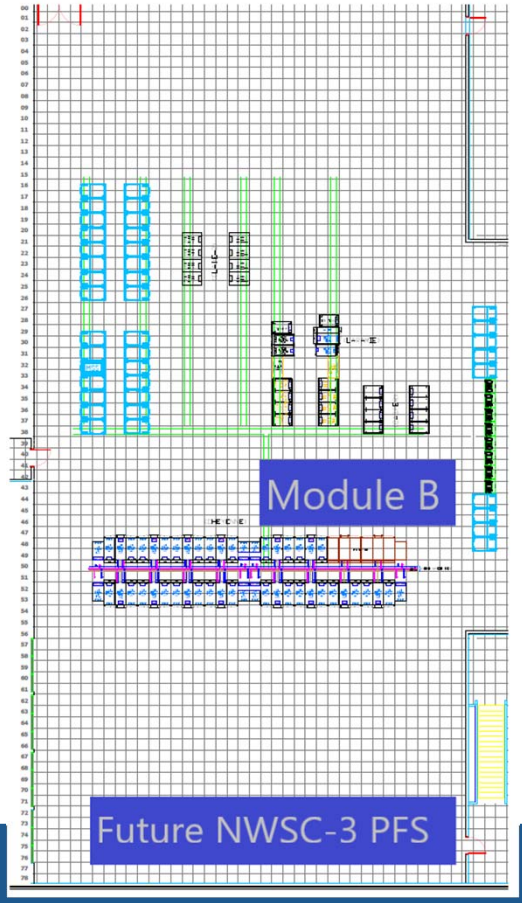
Module B Computer Room

Originally housed all IT equipment for NCAR / UCAR, including HPC compute systems

UPS and Utility power sources available 3MW from source

Module B – Change of mission for NWSC-3 system

- Storage Systems
- HPC Test Systems
- Critical Network Infrastructure



NWSC Module A Computer Room

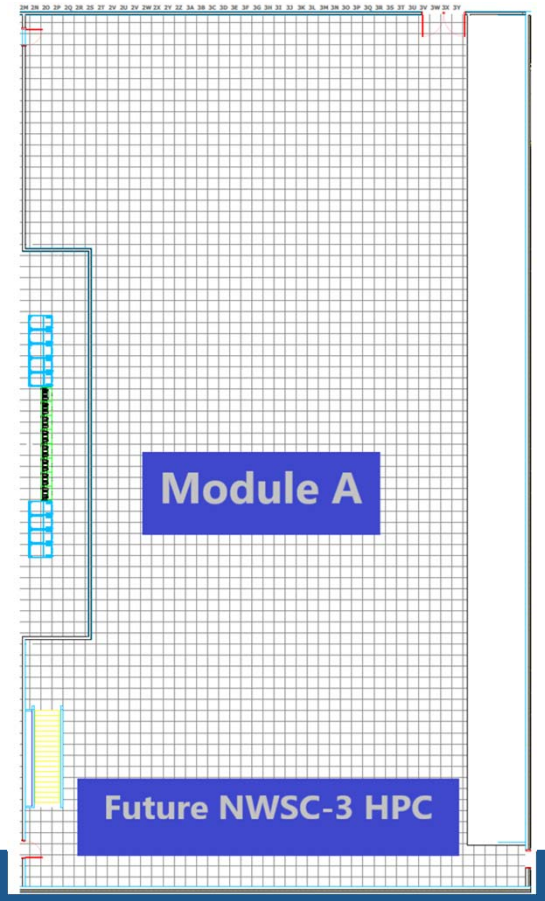
Module A layout is for HPC specific high density loads

NWSC-3 project one new 3MW transformer planned

Design is prepped for up to 12MW in Module A alone

Direct Utility Power is Primary,

- Small UPS systems possible for critical nodes and / or network gear with cable length limitations



NWSC Power Approach to HPC

Critical Equip / Storage / Network

- UPS / Gen backup N+1 Fully Redundant

Compute Nodes fed by Utility - A/B Configuration

- 50% of HPC can still run while other 50% is down for maintenance

Utility Provider, Black Hills Energy

One of the top 10 utilities for system reliability in each of the last five years, rated by

- The Edison Electric Institute (EEI)
- The Institute of Electrical and Electronics Engineers (IEEE)

Resource: https://www.blackhillsenergy.com/services/data-centers/advantages-building-wyoming

NWSC UPS Configuration

(2) UPS Sources with Independent Medium Voltage Transformers

Both UPS sources provided at rack level

- Requires dual tailed N+1 fully redundant power supplies and PDUs for all critical equipment
- Allows for one UPS system to be maintained while in production

UPS Powered Equipment

- Networking Equip
  - NCAR owned
  - Cluster possibilities
- HPC head-end nodes / critical equip
- OOB switches
- Test Systems
- CDUs / Mechanical equip associated with HPC provided by vendor
- 4 MW of Generator Backup

Redundant Power Feeds for Critical Resources

Equipment identified as critical and needing to remain powered through UPS shall have the following:

- N+1 power supplies at the component level (dual tailed)
- N+1 power distribution units at rack level (dual tailed)

Power Test for Critical Equipment:

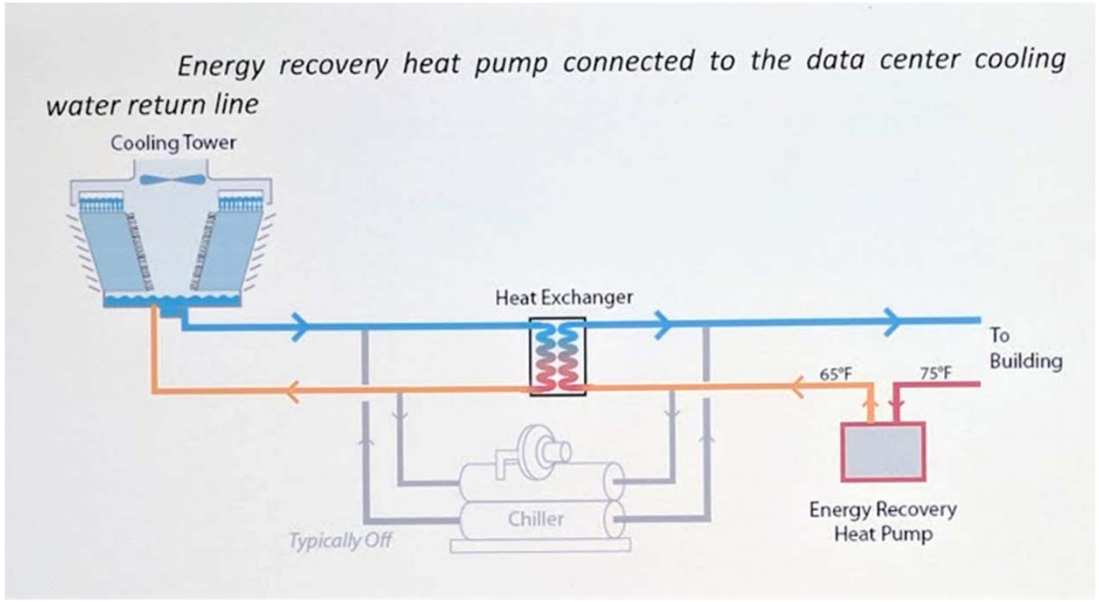
- Each UPS source will be completely shut down, one at a time, and all equipment shall continue operating in full production capacity

HPC Equipment Electrical Protections

- Sag shunt – 5% adj.
- Surge suppression support
- ATO scheme for UPS systems
- Wrap Around
- Vendor Input
  - What voltage tolerances are allowable for equipment

NWSC-3 Mechanical Systems Overview

- Open Loop – Condensing
  - Floating Setpoints
    - Outdoor Wet Bulb
    - Current Loads
- 65 Deg F Closed Loop – Chilled
  - HX Free Cooling (Primary)
  - 1000T Chiller (Secondary)



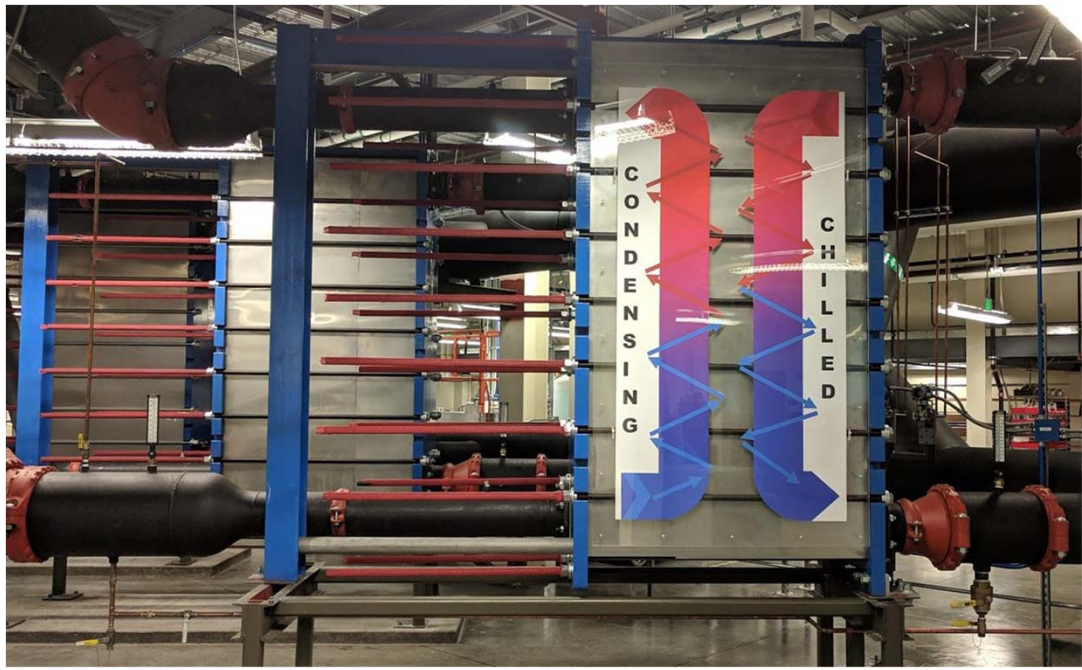
IT Equipment - Free Cooling System

Heat Exchangers

- (3) 750 Ton Plate and Frame
- Chilled Water Closed Loop
- Condensing Water Open Loop
- 1000T York Centrifugal Chiller - Backup

Chilled Tank

- 135,000 Gallons 65 Deg F Water
- Mechanical UPS
- Approx 30 minutes cooling at 4 MW

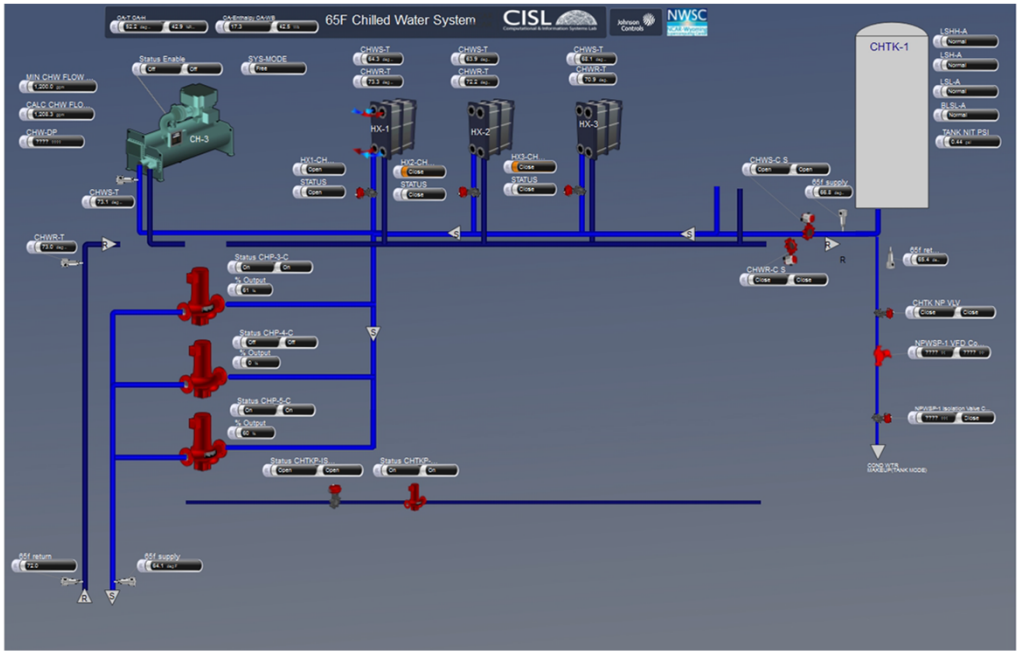


Chilled Water Setpoint - HPS

Currently IT chilled loop is 65 deg F (18 deg C)

ASHRAE Class A1

Mixing valves or sub-loops w/ HX possible for higher temps if needed



Mechanical System Redundancies

N+1 on all critical components

- UPS Air Handlers
- Cooling Towers
- Heat Exchangers
- Generator Backup
- Chilled Tank Reserve

HPC / PFS main 65 Deg F Chilled Water Pumps - Always Moving Water

- UPS Backup
- Gen backup

QUESTIONS??