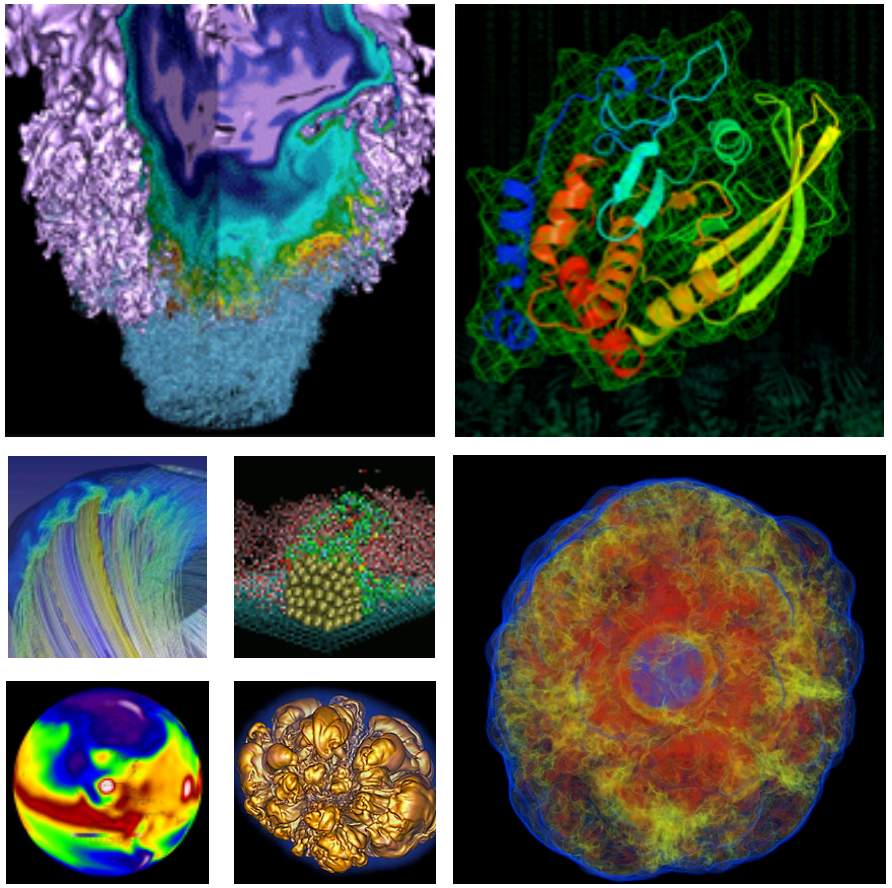
Computational Research and Theory Facility (CRT)



NERSC 40 YEARS at the FOREFRONT

Jeff Broughton
NERSC Deputy for Operations

February 25, 2015

CRT Located at LBNL Main Gate

Computational Research and Theory Building (CRT)

- **Four story, 140,000 GSF facility for scientific computing including:**
  - 20,000+9,870 ASF High Performance Computing Floor
  - 41,000 ASF office and conference area; ~300 offices
- **$143M UC Sponsored Building**
  - No long term commitment or decommissioning costs
  - No major capitalization or appropriations costs
- **$19.8M DOE Funded Data Center**
  - Power and cooling expansion for NERSC systems
- **Notable Features**
  - Free cooling
  - Heat recovery
  - Seismically isolated floor

Power and Cooling Capacity

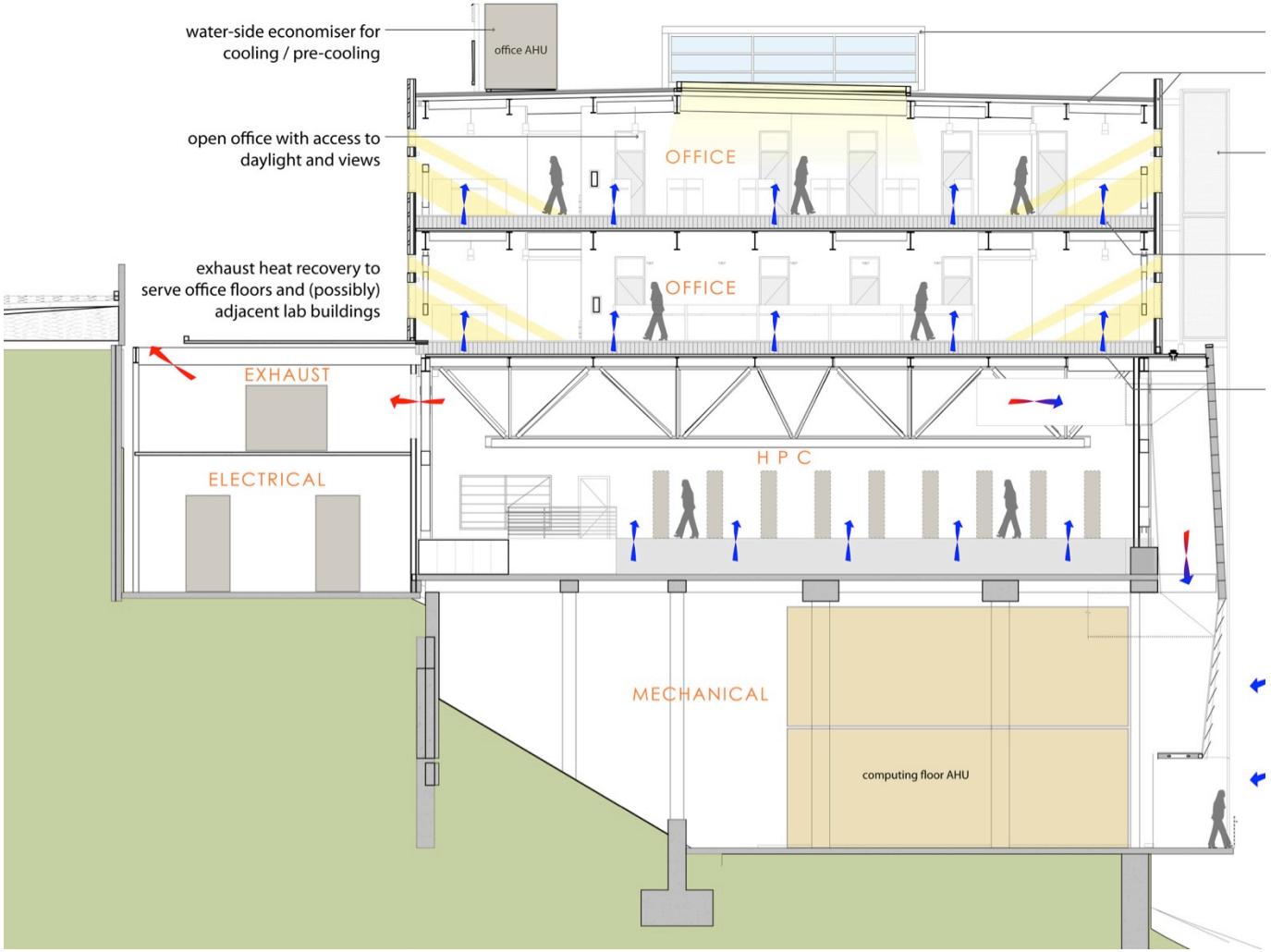
	Move-in	Drop-in Expansion Capability
Power feeders	27MW redundant 42MW non-redundant	Same
Power Substations	5 substations @ 2.5 MW	11 = 27.5 MW
UPS	1.0+0.5 MW	2.0+1.0 MW
Generator	1 @ 1.25 MW	2 = 2.5 MW
AHUs	3+1 redundant @ 60K CFM / 0.5MW = 1.5 MW	30 = 15 MW
Cooling Towers	3+1 @ 3.375MW = 10.25 MW	6+1 = 20.25 MW
Chillers	None	2 x 550 ton

“The coldest winter I ever spent was a summer in San Francisco.”

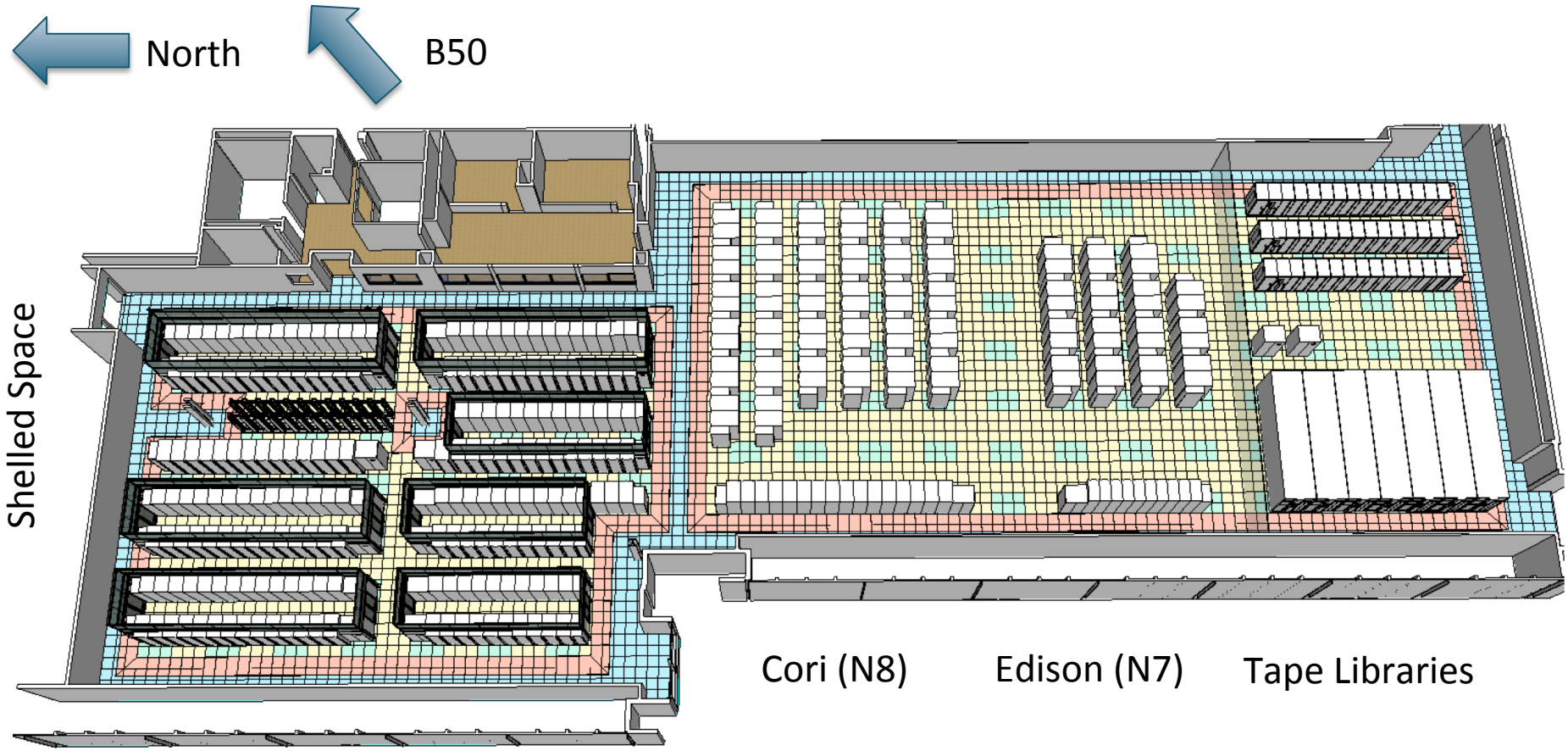
Free cooling provides exceptional energy efficiency

- **LBNL's location and the CRT design enables**
  - Power Usage Effectiveness (PUE): 1.1
  - Data Center infrastructure Efficiency (DCiE): 0.91
- **Air cooling**
  - 75°F air year round without chillers
- **Liquid cooling**
  - 74°F water year round without chillers
- **Computer room exhaust heat used to heat office floors**
- **Save ~50% per year on power costs**
  - Free cooling + WAPA power

Building Cross Section

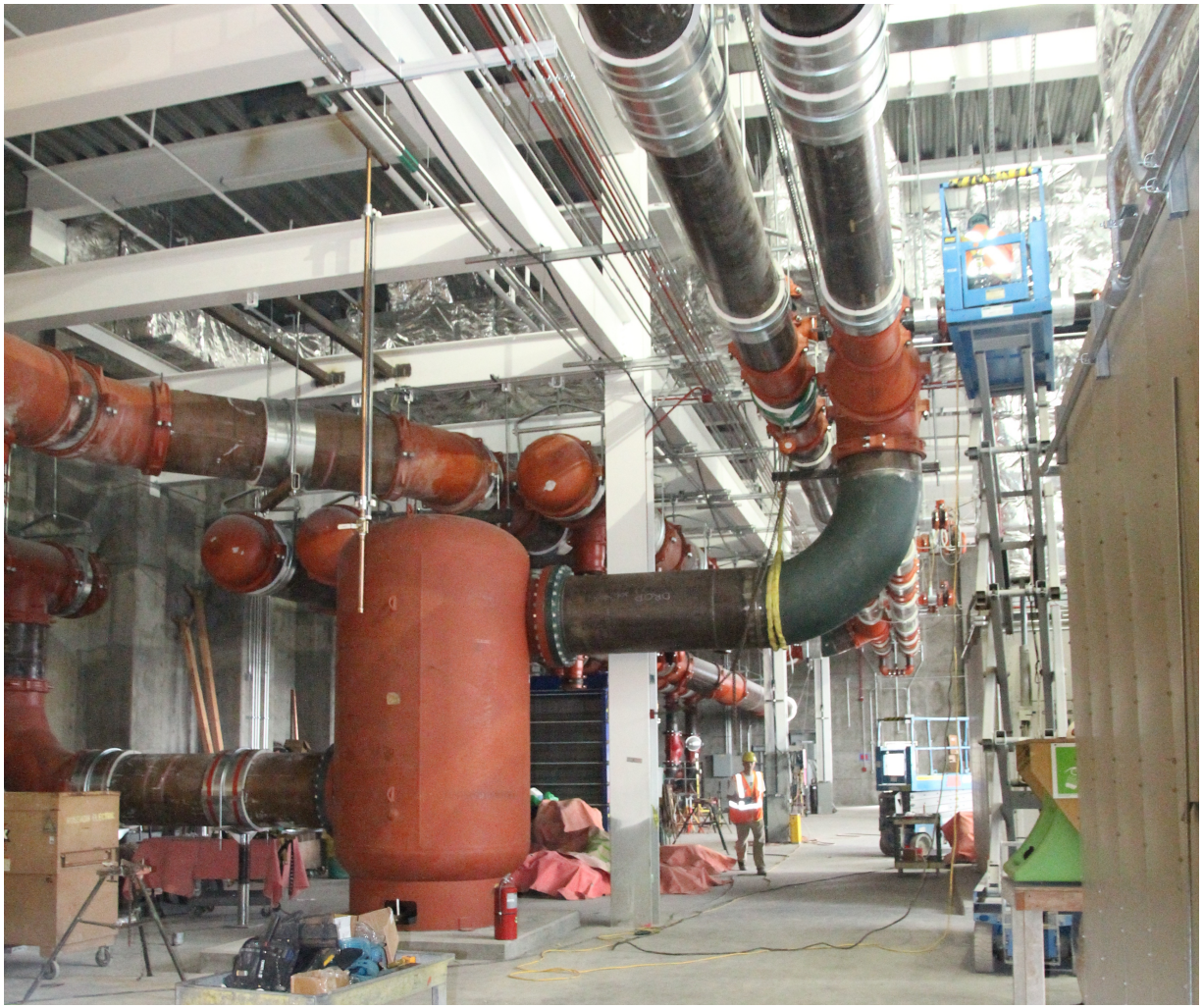


CRT machine room layout

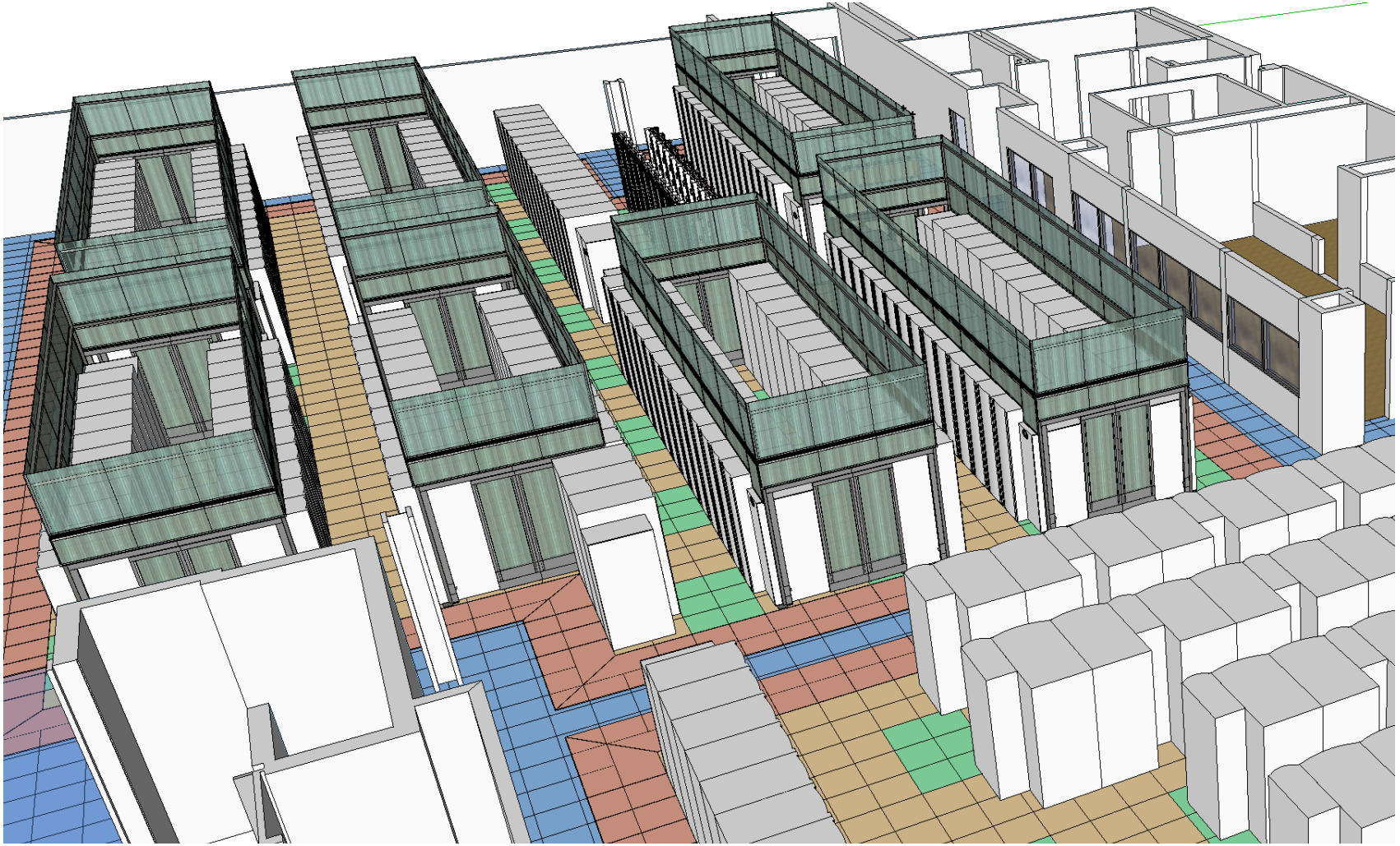


Air handlers

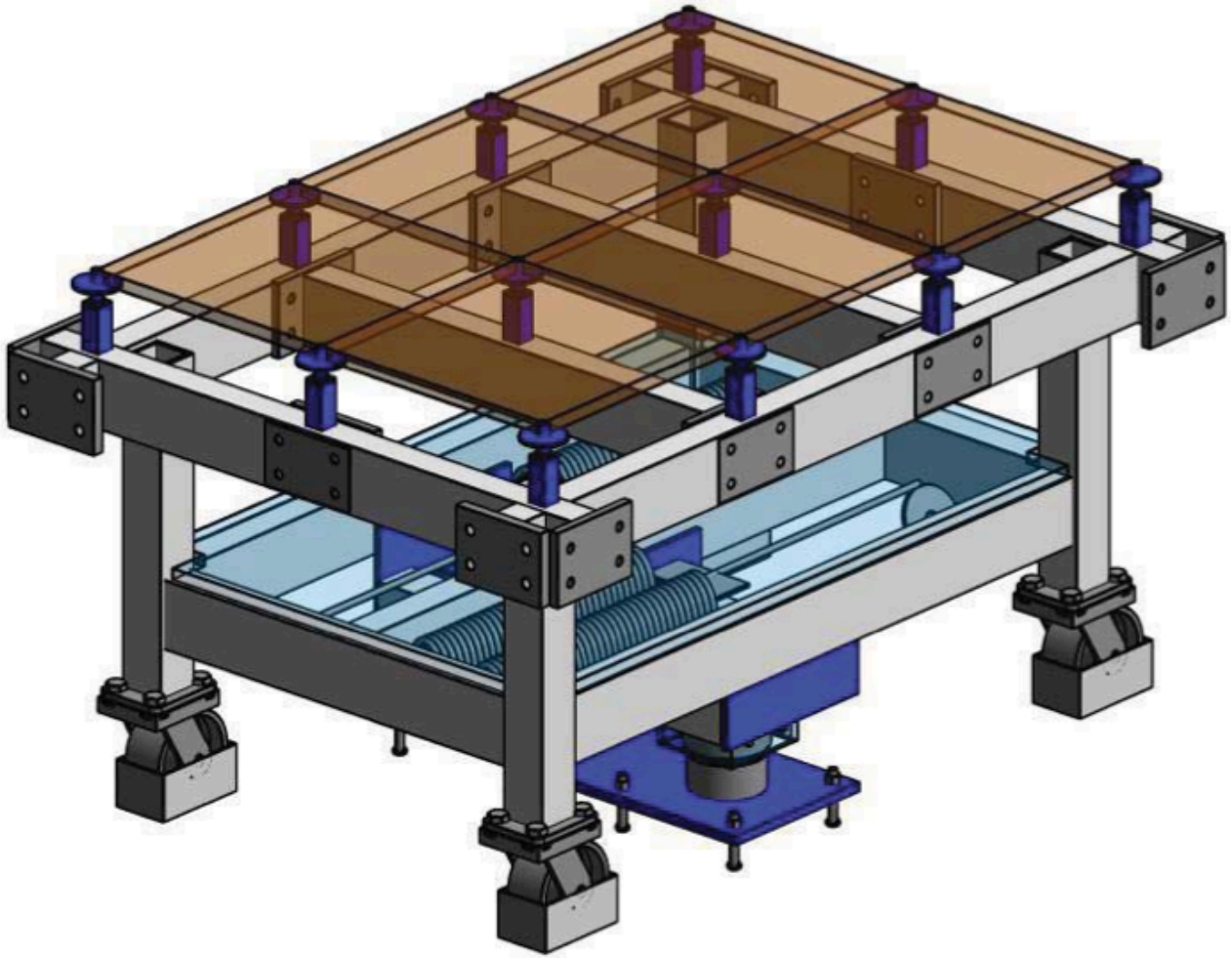
Cooling Pipes



Hot aisle containment with chimneys will facilitate energy recovery



Seismic floor isolates systems from severe earthquakes



Seismic Floor Installation

Testing of Seismic Floor

Key Strategies for the Move

- **Concurrent operation in CRT and OSF**
  - Reduce impact to users by minimizing downtime
  - Move equipment in manageable phases
  - Decouple risk associated with simultaneous moves
  - Reduce impact on staff / need for additional staff
- **Dedicated 400Gb/s inter-site network**
  - ESnet to provide wave gear and link; NERSC the routers
  - Network reduces timing dependencies – systems can access storage at either site (with some BW limits)
- **Duplicate key infrastructure to simplify the transition**
  - Time refresh/upgrade purchases to minimize cost
  - Buy early and test and stage new gear in OSF
  - Retire old gear in OSF

Avoiding a Resource Dip

- **NERSC delivered core-hours could dip in AY15/16**
  - Edison outage over move
  - Hopper & Carver retirement
  - NERSC-8 delay and pre-production time
- **Mitigate with NERSC-8 Phase 1**
  - Plan to buy a 10-cabinet Cray XC Haswell system along with Cori File System and Burst Buffer to bridge resource loss
  - First Cray system to be installed in CRT
  - Make operational before Edison moves to cover Edison's outage
  - Will enable delivered core-hours to stay flat at the AY14 level of ~3 billion throughout the move

Very High Level Plan

- Install power distribution and cooling manifolds [Mar->Aug]
- Install networking and IB SAN infrastructure [May]
- Move file systems (NGF) [Jun->Oct]
- Install NERSC-8 Phase 1 (Hopper+) [Aug-Oct]
- Retire Carver at OSF by 9/30
- Move Edison [Oct-Nov]
- Retire Hopper at OSF [Dec]
- Install NERSC-8 Phase 2 [Spring 2016]
- Tape libraries will not move before late 2016

Thank you!