

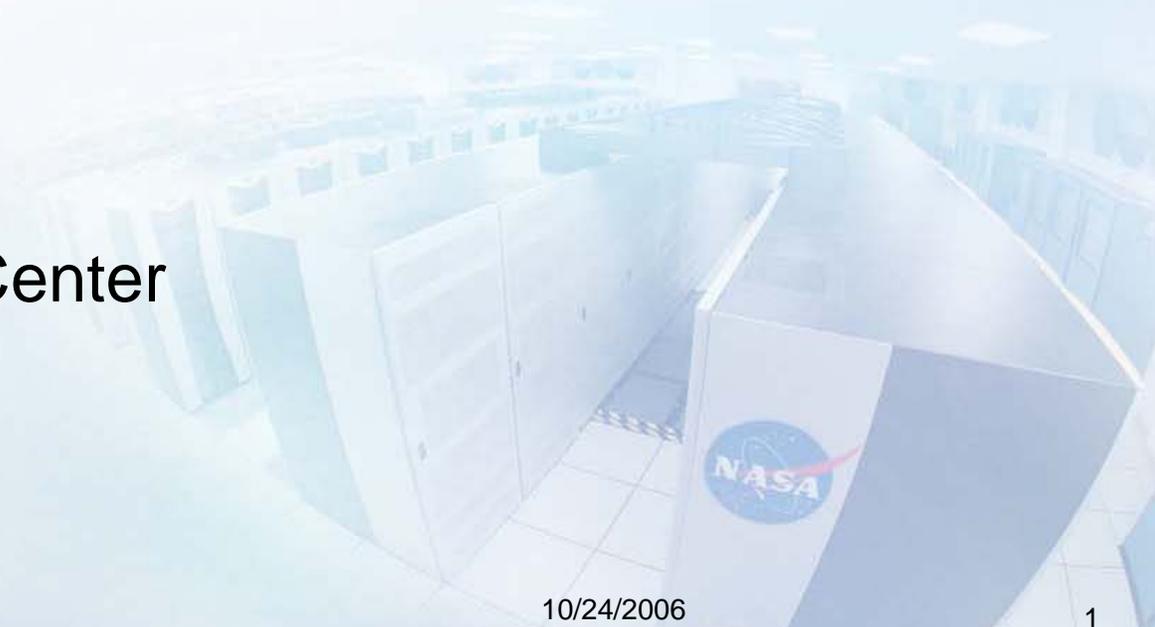


# Beyond Columbia: Enabling NASA's Science and Engineering

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# Challenges for the future

- Existing Facility
- Challenges of Success
- System Targets
- Electrical Upgrades
- Cooling Upgrades



# Existing Facility

- The NAS Facility is located on the NASA Ames Research Center about 10 miles north of San Jose and 40 miles south of San Francisco
- The facility has 90,000 SF divided between 23,450 office, 46,750 common use, and 19,800 lab
- The computer floor is divided into 3 rooms with a common sub-floor providing 14,000 SF for computer systems
- We have about 6,300 SF that can be converted to compute space as required





# Power and Cooling

- Electrical
- Building electrical capacity ~4MW
- Initially designed to house HEC components with huge power and cooling demands
- Peak of ~2.3MW to computer floor
- Peak of ~.8MW to Electro-mechanical room (chillers, pumps, In Space Units, etc)
- No UPS systems beyond “building comfort” and safety
- Backed up by diesel generators brought in if required
- Electro-mechanical
- Chillers
- Four 700T Chillers replaced by three 450T chillers in 2000 to satisfy environmental mandate for conservation (1985-2000 ~2800T of Cooling; 2000-present 1350T of Cooling)
- Static pumps at cooling tower, chillers, and floor distribution (cooling tower and building distribution pumps motors replaced by variable speed motors in 2000 to satisfy environmental mandate for conservation)
- Seventeen 40T ISU on main computer floor



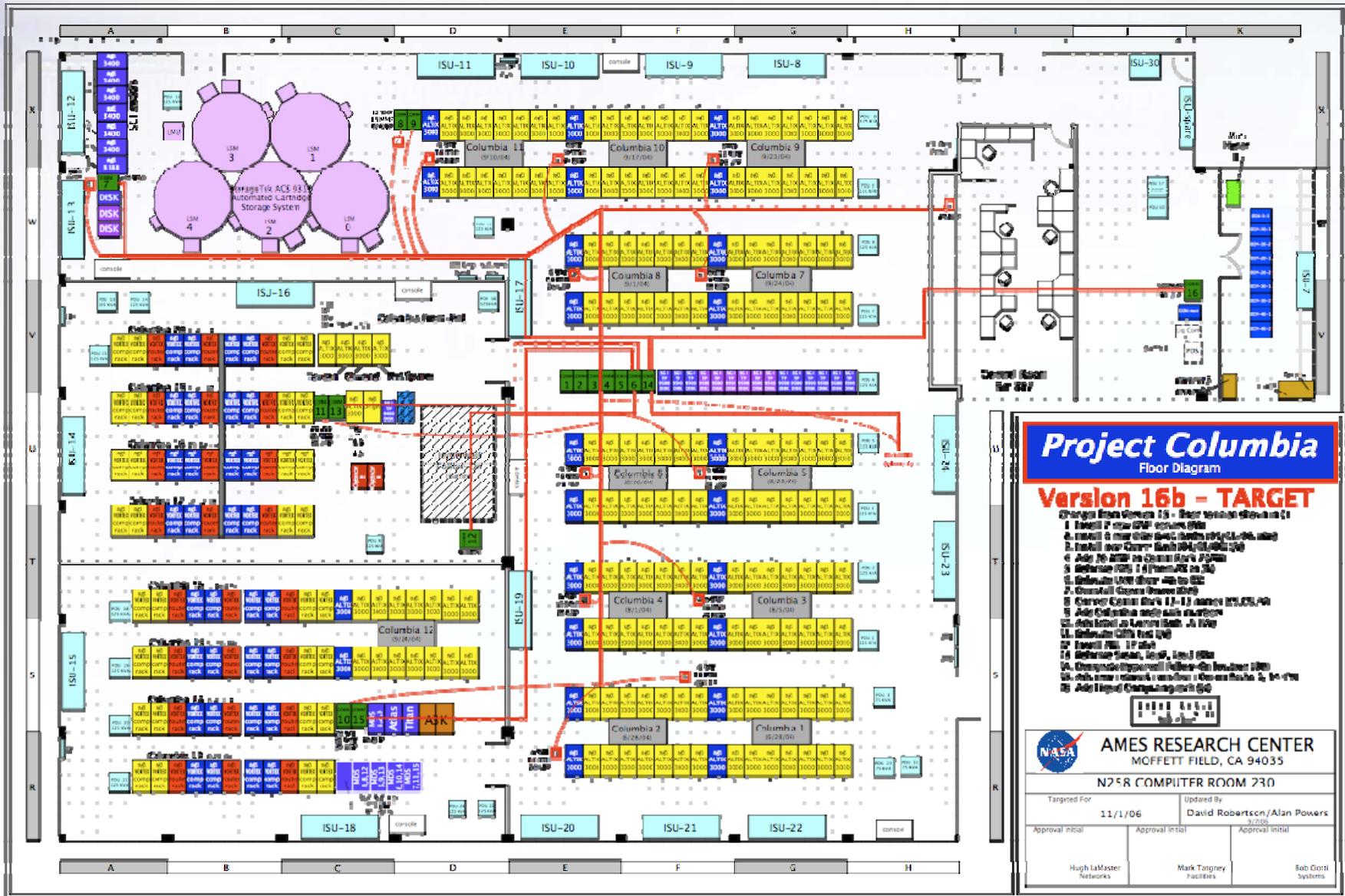
# Columbia Enclave

- 62TF constellation-class SGI Altix Super-cluster
  - 20 512P nodes
    - 1.5/1.6 GHz Intel Itanium2 processors
    - 6/9 MB cache
    - NUMALink intra-node interconnect
      - 4 nodes connected via NUMALink
    - Infiniband inter-node interconnect
    - 3x1 Gbps ethernet
    - 1x10 Gbps ethernet
  - 2 Secure Front Ends
  - 3 Columbia Front Ends
  - Storage Environment
    - 3 CXFS Domains
    - XFS RAID





# Current Floor is Full



**Project Columbia**  
Floor Diagram

**Version 16b - TARGET**

Change from Version 15 - See Version 15 for details

1. Install 17 new 2U server racks
2. Install 8 new 4U server racks (8x1U, 8x2U, 8x3U, 8x4U)
3. Add 20 2U server racks to Column 12
4. Add 20 2U server racks to Column 11
5. Add 20 2U server racks to Column 10
6. Add 20 2U server racks to Column 9
7. Add 20 2U server racks to Column 8
8. Add 20 2U server racks to Column 7
9. Add 20 2U server racks to Column 6
10. Add 20 2U server racks to Column 5
11. Add 20 2U server racks to Column 4
12. Add 20 2U server racks to Column 3
13. Add 20 2U server racks to Column 2
14. Add 20 2U server racks to Column 1
15. Add 20 2U server racks to Column 12
16. Add 20 2U server racks to Column 11
17. Add 20 2U server racks to Column 10
18. Add 20 2U server racks to Column 9
19. Add 20 2U server racks to Column 8
20. Add 20 2U server racks to Column 7
21. Add 20 2U server racks to Column 6
22. Add 20 2U server racks to Column 5
23. Add 20 2U server racks to Column 4
24. Add 20 2U server racks to Column 3
25. Add 20 2U server racks to Column 2
26. Add 20 2U server racks to Column 1

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**AMES RESEARCH CENTER**  
 MOFFETT FIELD, CA 94035  
**N758 COMPUTER ROOM 730**

Targeted For	Updated By
11/1/06	David Robertson/Alan Powers (1/2006)
Approval Initial	Approval Initial
Hugh LaMaster Networks	Mark Tregney Facilities
	Bob Corti Systems



# Challenges Replacing Successful Systems

- Columbia is approaching 100,000,000 hours delivered
- User community is very happy with the environment
- Recent discussions with multiple customer communities have yielded similar feedback
  - They do not have a preference on what we do as a follow-on to the Columbia system as long as we don't impact engineering and scientific productivity
- Replacing a successful system can be very disconcerting to the user base
- There must be a clear "win" to transition to a new environment
- The user community is not interested in petaflops per se, but in what they can get accomplished on the system
- The advantages of the new system must overcome the barriers to change
- The modifications necessary to field the new systems in an existing facility must be made while minimizing impact on the community



## That Being Said...

- Computer systems must be replaced/augmented to enable competitive science and engineering and to meet the Agency and National objectives
- Next System Target:
  - 4x Columbia capability and capacity
  - System provides head-room on both floor space and environmentals to allow 2 - 3 generations of systems to coexist.
  - Facility must support both air cooling and water cooled
  - Estimated system
    - ~250TF
    - 75 cabinets
    - <2MW power
    - Water cooled
- The following system upgrade should be in the PF range



# Electrical Upgrade

- Transition compute floor from 2.8 MW to 4 MW
  - 2007
    - Modify the electrical service loop to 14 MVA
    - Replace two 480V transformers
    - Replace 2 distributions switches
    - Replace 8 instrumentation panels
  - 2008
    - 6 MW to floor (4 MW to compute floor, 1.5 MW to Electro-mechanical room)
    - Prepare site for Rotary UPS (RUPS)
  - 2009 - 2010
    - Install 4 RUPS
  - 2011
    - Install dedicated feeder from substation



# Electro-Mechanical

- Provide the cooling systems to satisfy heat load dissipation requirements for the follow-on systems
- Specifics are dependent on technology selected and capacity available (Multiple studies underway)
  - Potential areas for improvement
    - Infrastructure upgrade to chillers (~450T to ~500T)
    - Additional chiller
    - Plumbing Infrastructure upgrade
    - Computer room redesign



# Questions

