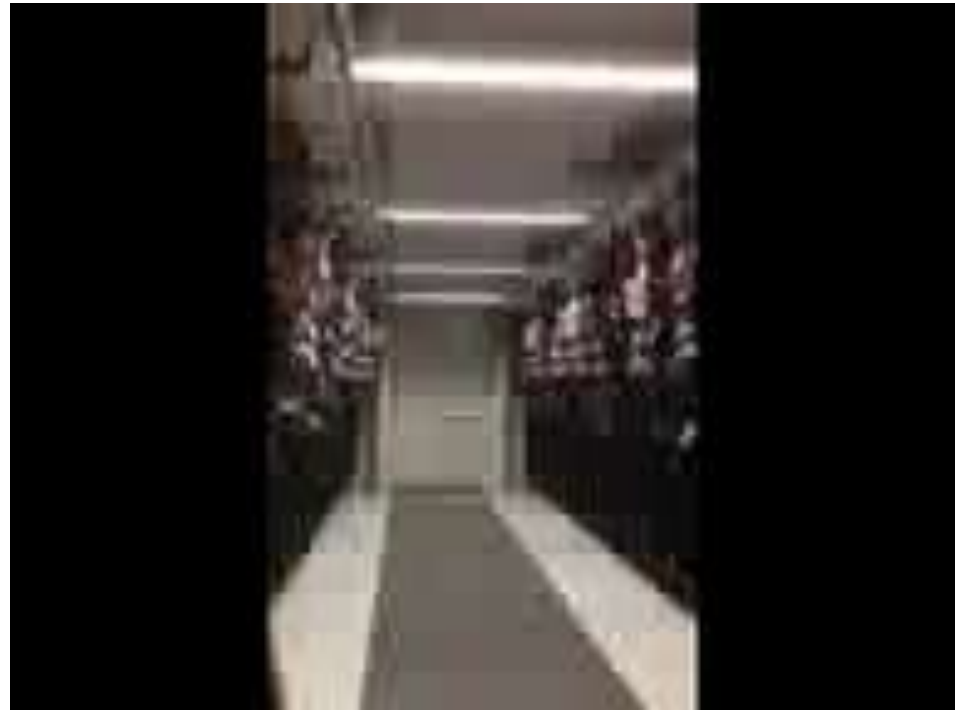


A Modular Data Center Solution for Research HPC



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September 19, 2012

Agenda

- Current Situation
- The Need
- The Right Fit
- Alternatives Considered
- Modular Data Center
- HP EcoPOD
- The Business Case
- MDC Challenges

Current Situation – Apps and DCs by Tier

Tier	Facility Reliability	Application Examples	U-M Data Centers
1	99.0%	<ul style="list-style-type: none"> • Computing clusters for research • Backup • Disaster recovery location • Administrative applications • E-mail 	<ul style="list-style-type: none"> • School of Ed (SEB) • Admin Svcs Bldg (ASB) • Arbor Lakes – (Hosp) • Arbor Lakes - ITS • Many unit server rooms
2	99.75%	<ul style="list-style-type: none"> • Compute & Storage for research computing clusters • Wolverine Access(Peoplesoft) • Administrative applications • E-mail & Directory services 	<ul style="list-style-type: none"> • Michigan Academic Computing Center (MACC)
3	99.98%	<ul style="list-style-type: none"> • Patient information • Hospital applications 	<ul style="list-style-type: none"> • North Campus Data Center (Hospital) (NCDC)
4	99.999%	<ul style="list-style-type: none"> • No known U-M applications • Financial institution applications 	<ul style="list-style-type: none"> • none

Current Situation - Power Avail. for Computing

	ASB (kW)	Arbor Lakes & MAIS – AL MCIT (kW)	MACC (kW)	SEB (kW)	Total (kW)
Power Available	96 240	192	1800	36	2124 2268
Power Used/ allocated	81 110	180	1370	31	1662 1691
Power Reserved	0	0	430*	0	430*
Power Available	130	12	0	5	32 147 (1.5% 6.4%)

* Provost reserved space at MACC for HPC

The Need

- Major campus data centers near capacity
 - Server room consolidation
 - **High Performance Clusters (HPC) for Research**
 - **Computing and Information Resources for Research as a Utility Service (CIRRUS)**
 - ITS provision of new services
- Growth expected to taper off
 - Researchers, and others, sharing clusters
 - Virtualization
 - More rapid upgrade of servers
 - Cloud?

The Right Fit

Appropriate security, redundancy and cost

- Data Center Tier and Application requirements are not matched
 - **Some research compute clusters are in the the MACC when they could be in lower tier, less expensive space**
 - **Research communiity has indicated they would rather pay for additional compute versus more redundancy.**
 - **“give me 5 minutes to shut down my cluster”**
 - Some mission critical applications are running in Tier 1 server rooms that should be in a Tier 2 data center like the MACC
 - IT Rationalization project will further define this

Additional Capacity Needed

Alternatives Considered

~~Existing data centers~~

- NCDC – Highly reliable (Tier 3) but may not be cost effective for research
- MACC - Medium reliable (Tier 2+) but may not be cost effective for research
- ASB, ALDF, NCRC Bldg 14, others – Power constrained, require build out, can't provide high density

~~Bricks & Mortar~~

- Long lead time (5 yrs?)
- High CapEx
- Operational efficiency?

~~Leased data center floorspace~~

- High OpEx
- Location – not likely in AA
- May not meet specs of HPC
- Networking

Containerized solution

- **Moderate CapEx**
- **Low OpEx (1.2 PUE?)**
- **Short Lead time (3-6mos)**
- **Flexibility/Portable (???)**
- **HPC friendly**

Modular Data Center RFP – November 2010

- IBM Portable Modular Data Center (PMDC)
- HP Performance Optimized Data Center (POD)



- High Density
- Excellent Power Effectiveness
- Requires power and chilled water

HP EcoPod

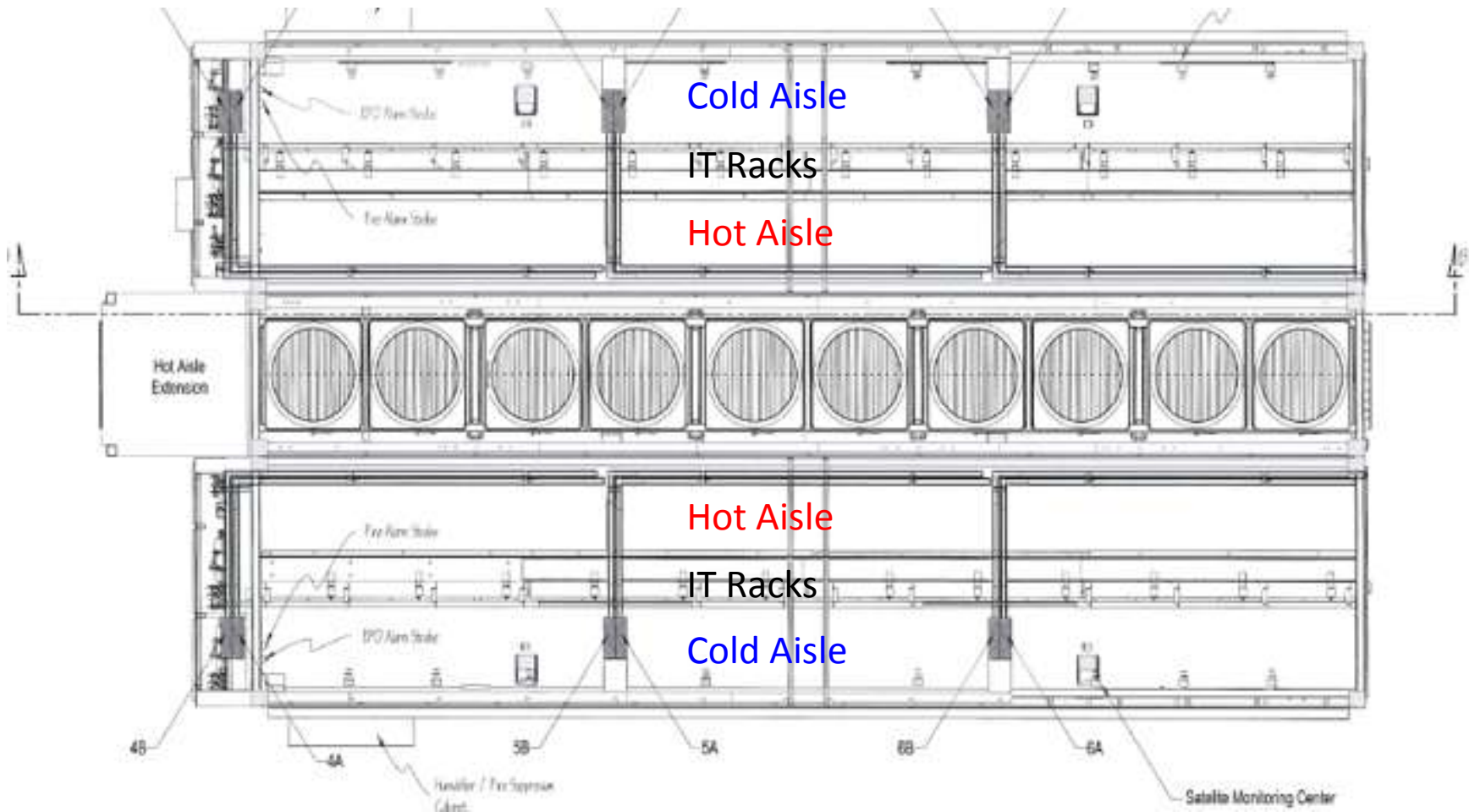
(Announced June 2011)



EcoPod Specifics

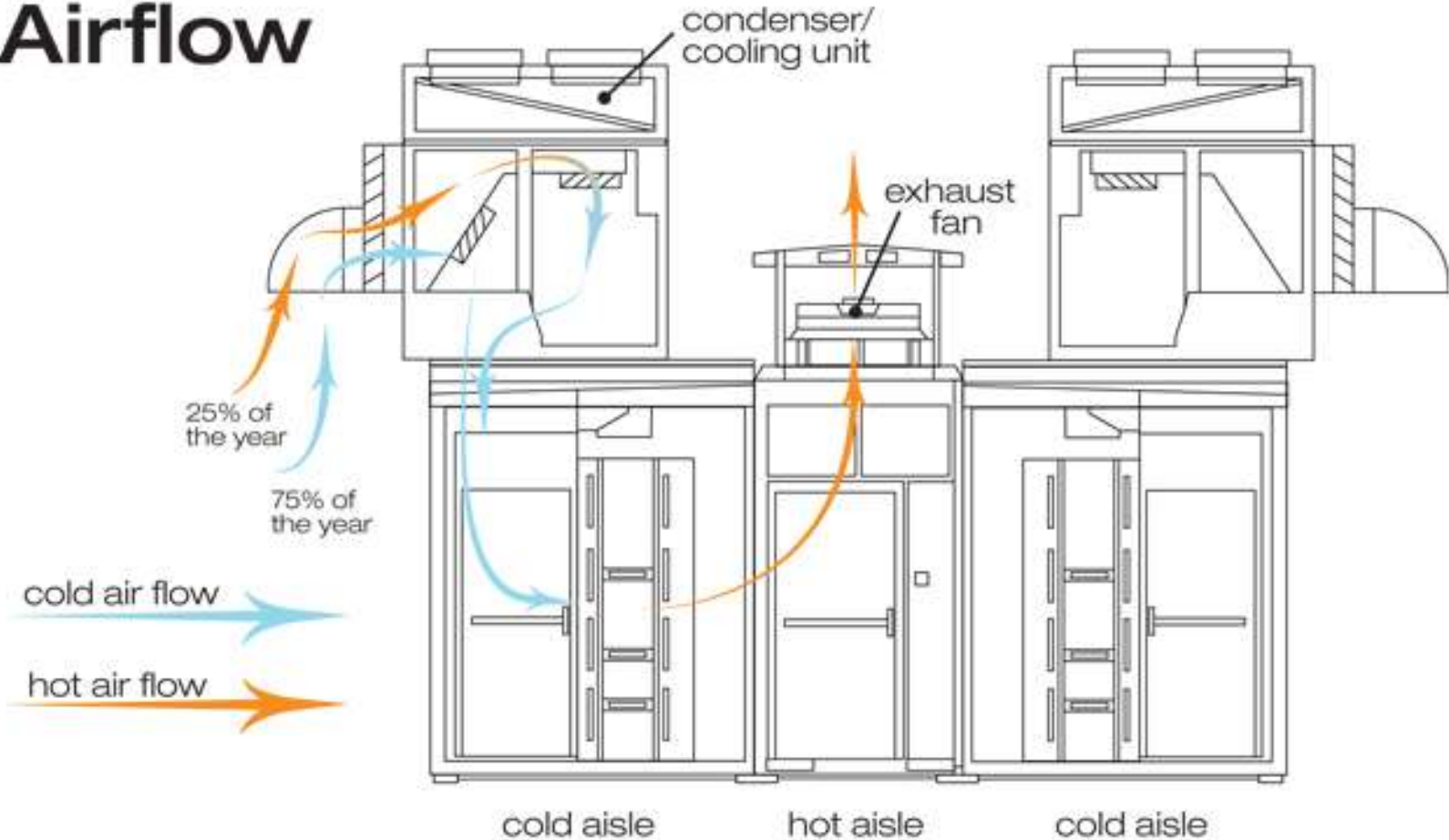
- Double 40ft units connected by shared hot aisle
- 44 50U Racks with 5 min battery UPS in each rack
- Up to 24kw per rack (6kw max @ MACC)
- Free air cooling (75%+) backed up by DX (<25%)
- Single power feed from campus
 - Redundant North campus substation
- 27ft X 48ft support building
- Manufacturer guarantee of 1.23 PUE for ASHRAE recommended equipment temperatures

What We're getting- MDC (EcoPOD) Layout



MDC- EcoPOD – Free Air Cooling

Airflow



Modular Data Center (MDC) – what we're building



University of Michigan
Research Center

Modular Data Center
11106-1000

05 April 2011

Perspective



MODULAR DATA CENTER

Cost Efficient

Building Costs

The cost to build MDC was \$6.2 million, half as much as a brick and mortar data center.



Typical brick and mortar data center



MDC



MDC future expansion*

*Double the capacity for much less

MODULAR DATA CENTER

Innovative

Expandable Capacity, When We Need It

MACC

10,000 sq. feet
1.8 MW compute
300 racks



MDC (EcoPOD)

1,000 sq. feet
1 MW compute
44 racks

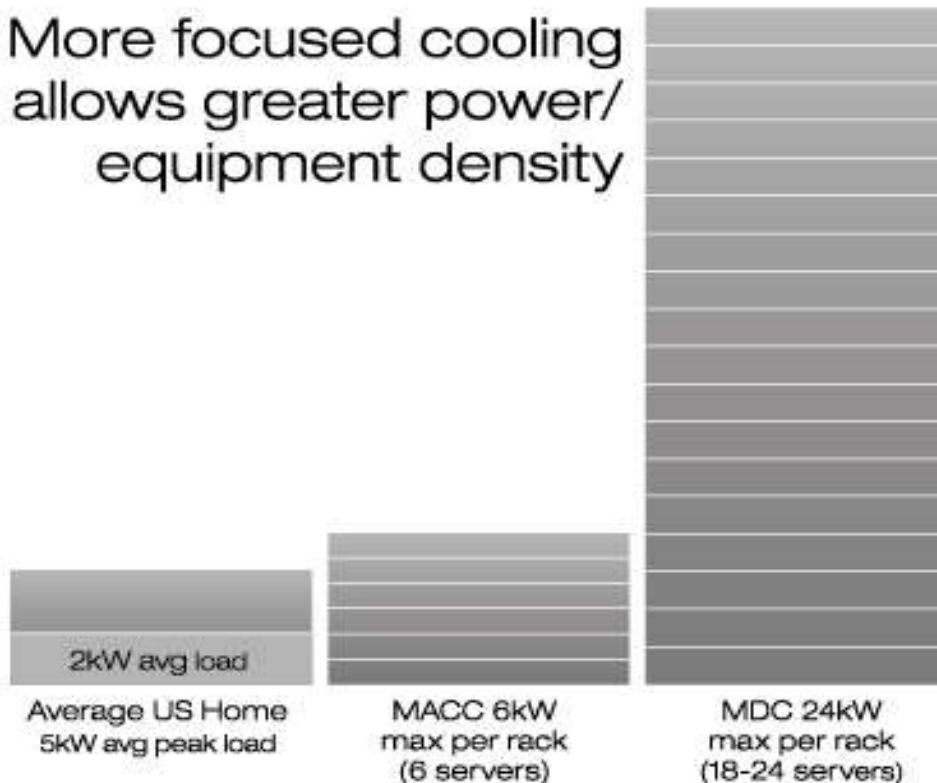


Additional EcoPOD (future)

1,000 sq. feet
1 MW compute
44 racks

**Higher Density,
Smaller Footprint**

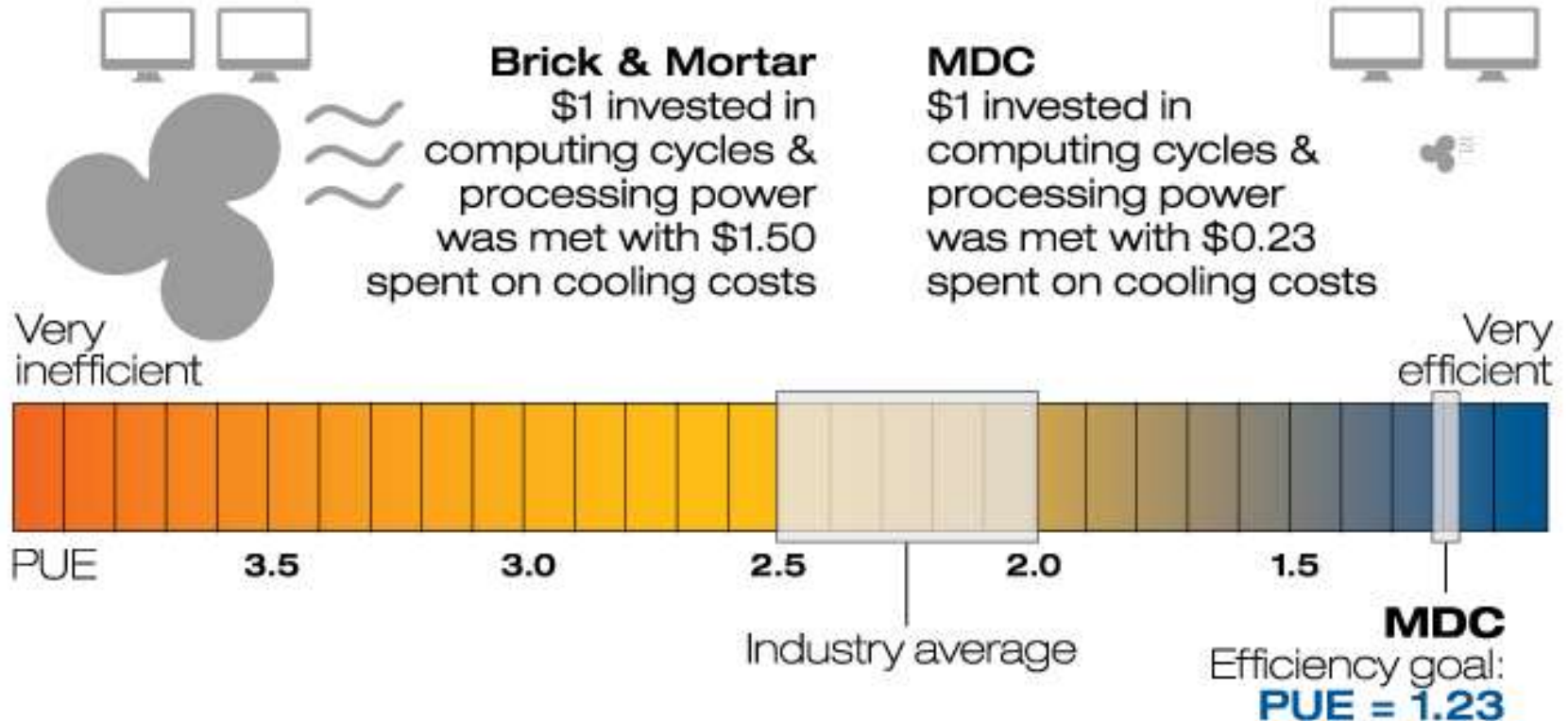
More focused cooling allows greater power/equipment density



High Performance Research Computing
25,000-Core HPC Cluster

	MACC*	MDC
# of Racks Necessary (Based on Expected Core Density)	95	24

Power Usage Effectiveness (PUE)



Cooling Costs



For 75% of the year
outdoor air cools
computing equipment

Saving \$600,000
per year*

*Compared to running a
typical data center

MDC Challenges

- Vestibule was off by 8”
- “Shop Drawings”
 - UM AEC builds buildings
 - HP sees EcoPOD as a product
- Sub Station ground fault
 - 300+ amps on the ground
 - Reverse polarity on sub station CT
- Fire Suppression
 - Novec 1230
 - Did not support required concentration for 10 minutes
- Card readers, Exit signs, monitoring, etc
- Cramped quarters
 - Move from Infiniband to fiber



Questions?



Thank You



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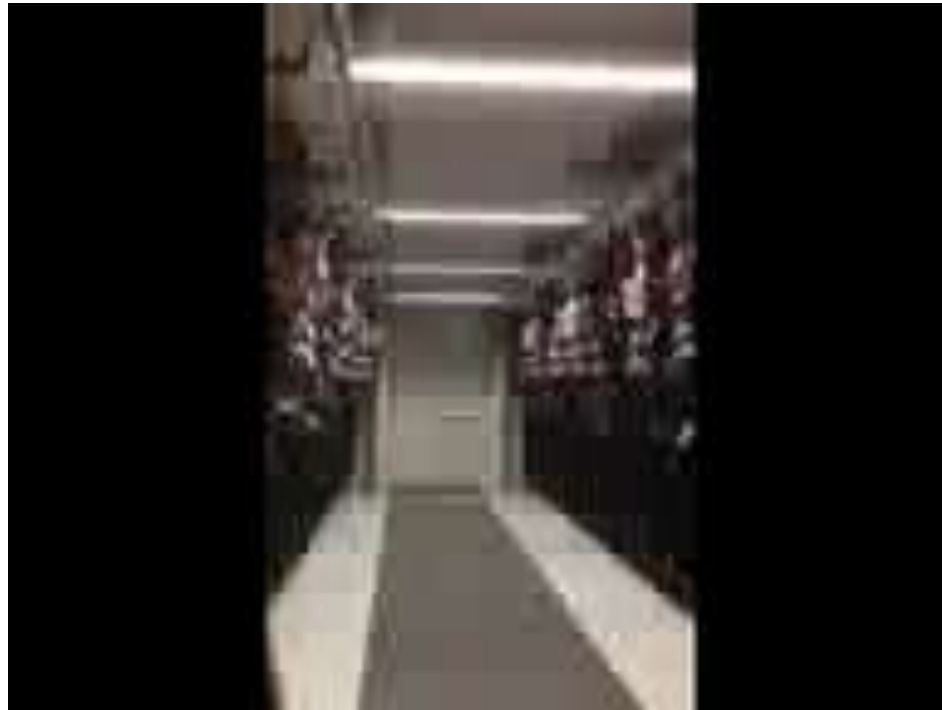


MDC Extra Slides



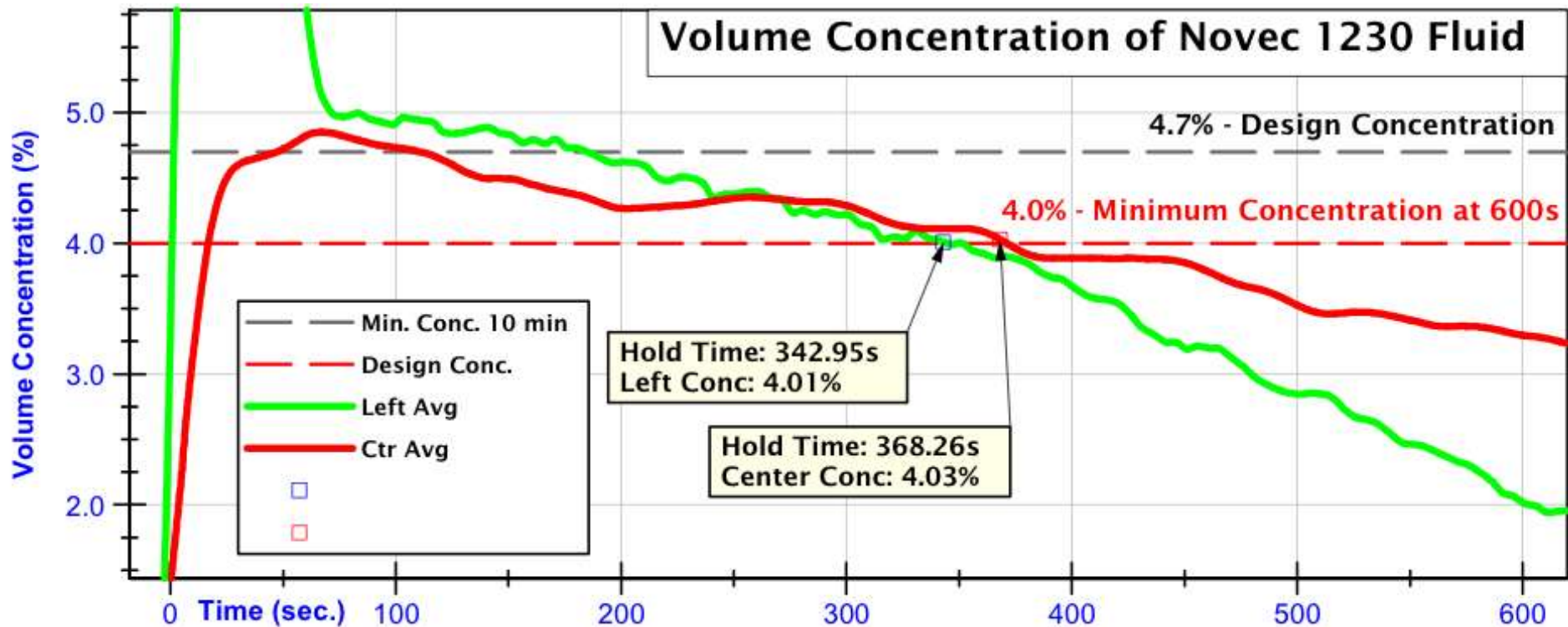
MDC Fire Suppression Test

8/14/2012



Fire Suppression Test Results

8/14/2012



MDC movie links