

Update on the Status of the APS Storage Ring Temperature Control System

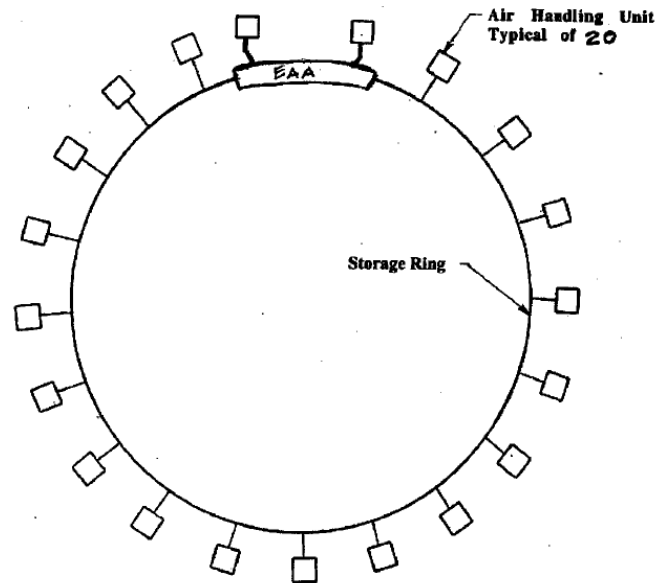
October 2006
By: Marv Kirshenbaum

Background

APS Storage Ring Temperature Control

Background:

- The storage ring is supplied with conditioned air from 20 separate and independent HVAC units.



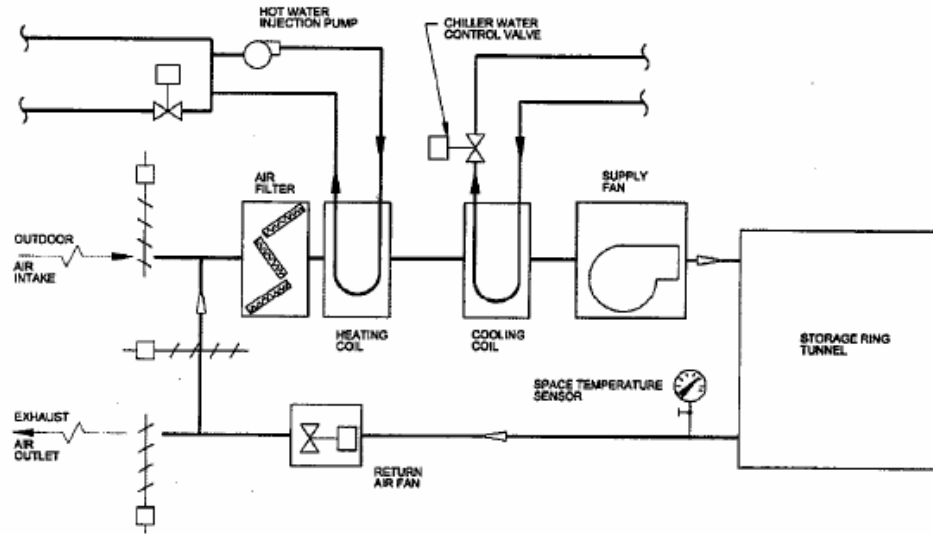
APS Storage Ring Temperature Control

Background:

- Each HVAC unit has the ability to pre heat and cool air circulated into the storage ring tunnel.
- A portion of the air is continuously exhausted and replaced with outside air to meet code requirements.

APS Storage Ring Temperature Control

Background:



Typical Storage Ring HVAC System Arrangement

APS Storage Ring Temperature Control

Background:

- The original construction specification (1990) required a tunnel air temperature tolerance of +/- 2 degrees F.
- Tolerances tighter than the original specification have not been met with consistent reliability.
- An additional challenge to temperature stability resulted from a decrease in storage ring DI water temperature.

APS Storage Ring Temperature Control

Background:

- A study of the temperature control system was conducted in 2005. The goal of this study was:
 - To identify causes of temperature instability and recommend changes to enhance temperature control.

APS Storage Ring Temperature Control

Background:

Study findings included the following:

- The original HVAC system was designed for operating conditions that demanded cooling in excess of that which is now required.
 - The existing cooling system has an order of magnitude more capacity than is required; resulting in a disproportionately large response to small changes in input.
- The existing system is highly sensitive to outdoor air temperature changes.
- Potential changes to the existing system that could result in a significant improvement of performance were identified.
- These changes were implemented in 3 “prototype” systems to gauge the magnitude of improvement in temperature stability.

APS Storage Ring Temperature Control

Background:

- Based on work with the prototype units the study proposed:
 - Decoupling outdoor air temperature influences from the tunnel temperature control loop.
 - Reducing the system gain through replacement of existing large cooling control valves with smaller valves.
 - Relocation of all tunnel space temperature sensors closer to the storage ring.
 - Sensors currently located in the experiment hall mechanical mezzanine will be relocated to the storage ring infield wall.

APS Storage Ring Temperature Control

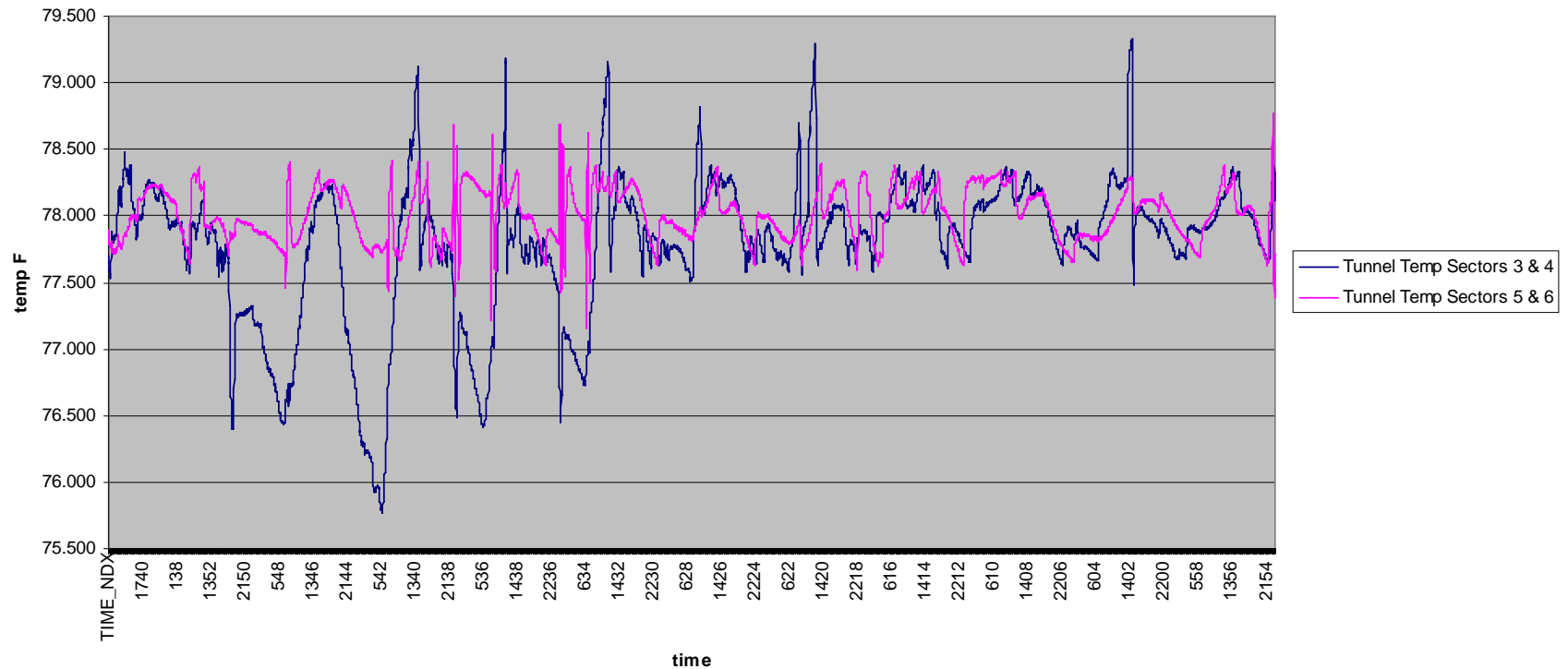
Background:

- Proposed changes continued:
 - Seal all air infiltration paths between the tunnel and the infield service aisle.
 - Investigate site wide chilled water system to further enhance water temperature stability.
 - Initiate a yearly re-commissioning plan for the storage ring HVAC system.
 - Commissioning will occur on a rotating basis during the APS regularly scheduled maintenance periods.
 - Work will include all mechanical equipment and, their associated controls, sensors, and mechanical components.

APS Storage Ring Temperature Control

Background: Performance prior to modification

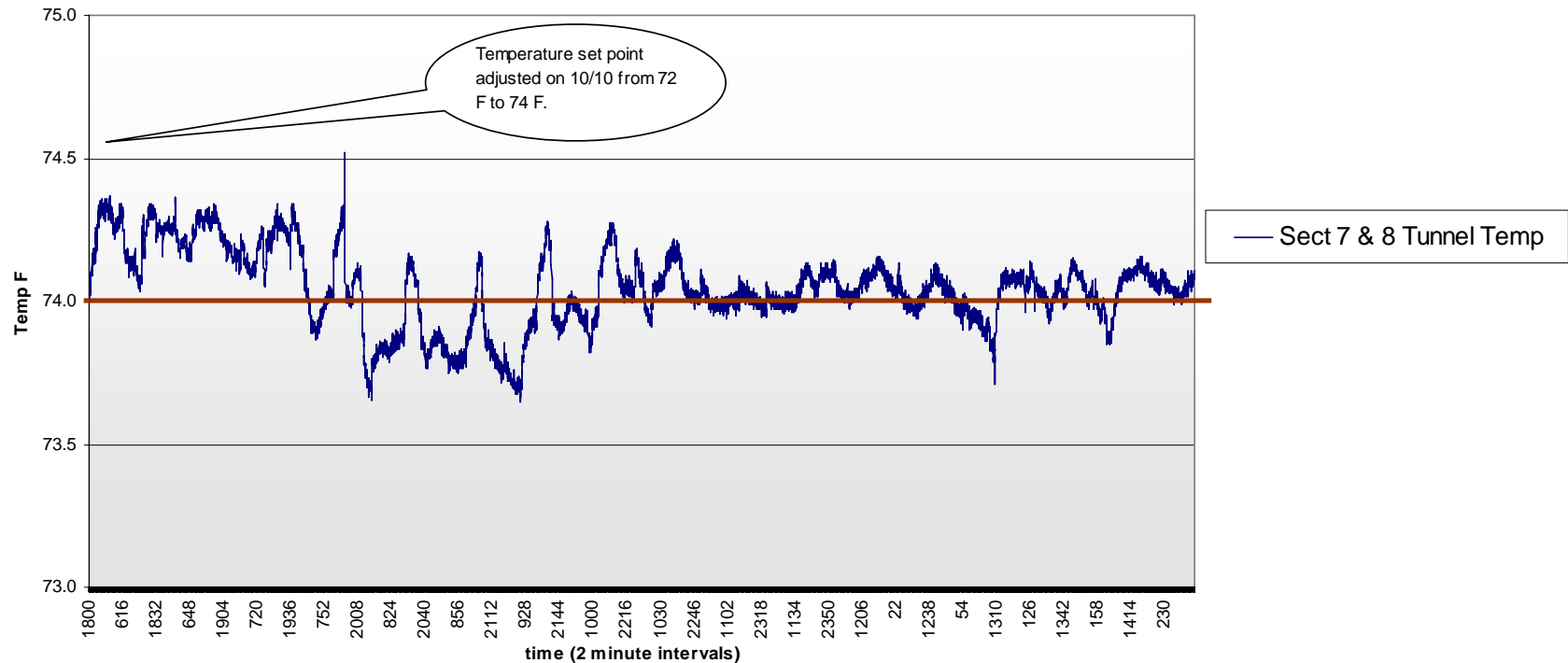
Storage Ring Space Temperature Sectors 3 & 4 From 7-25 to 8-5-2005



APS Storage Ring Temperature Control

Background: Performance after modification

Sect 7 & 8 Tunnel Temp 10/10 to 10/27/2005
Low Gain System
Figure 4



Current Status

APS Storage Ring Temperature Control

Current Status:

- A number of HVAC units were modified at the end of 2005 and data collection has continued in order to verify system long term performance.
- The need to insure administrative control of all critical temperature set points and associated tuning parameters was identified.
 - A temperature control authority (TCA) was established as a single point of contact to authorize any changes deemed necessary or requested.

APS Storage Ring Temperature Control

Current Status:

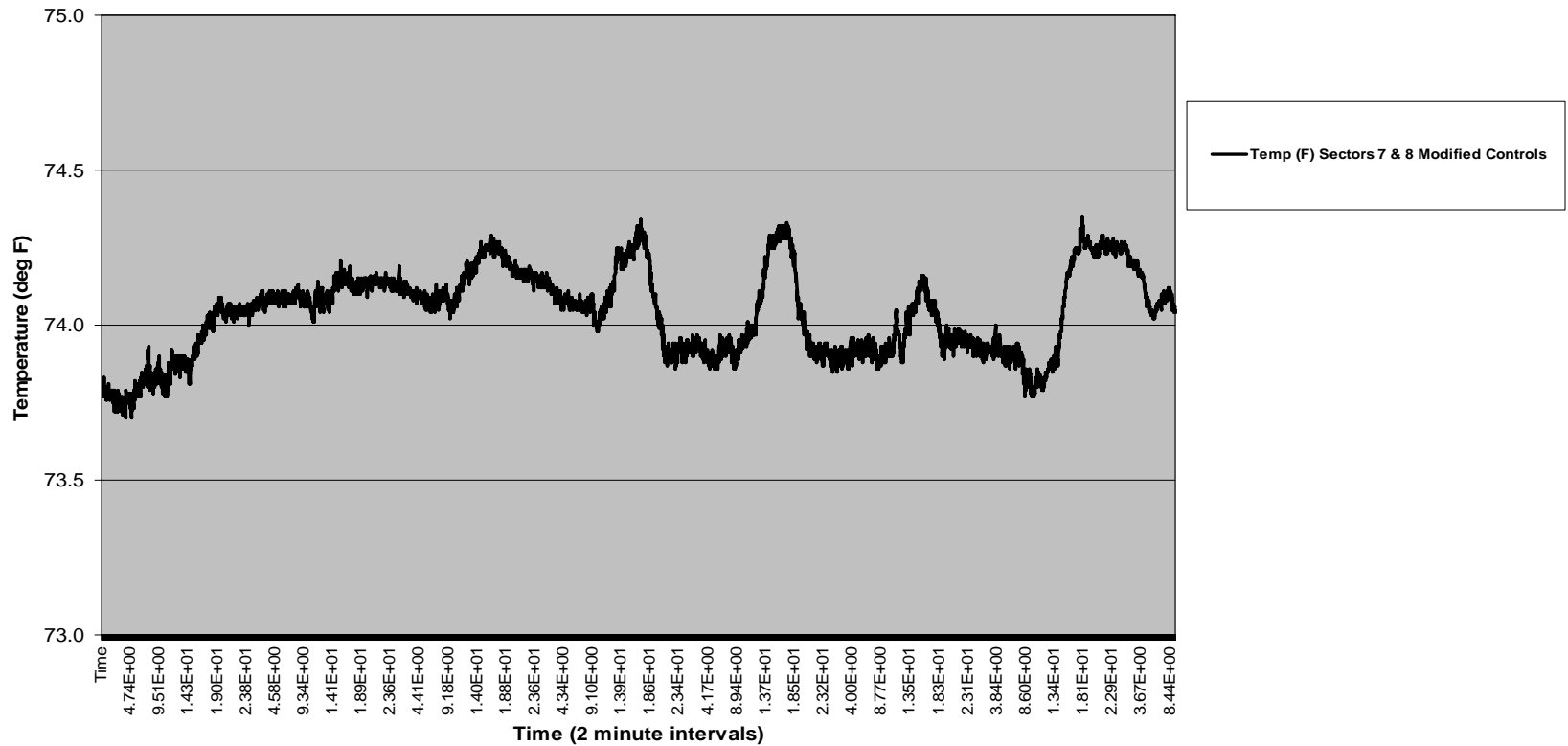
- Temperature specification with a goal of a long term 1 degree F peak to peak temperature variation was set.
 - The intent is to tightened the tolerance as operating experience with the modified system is accumulated.
- Performance monitored at the modified units indicates that.
 - Temperature tolerances within 1 degree F peak to peak have been consistently maintained.

APS Storage Ring Temperature Control

Current Status:

Recent Data

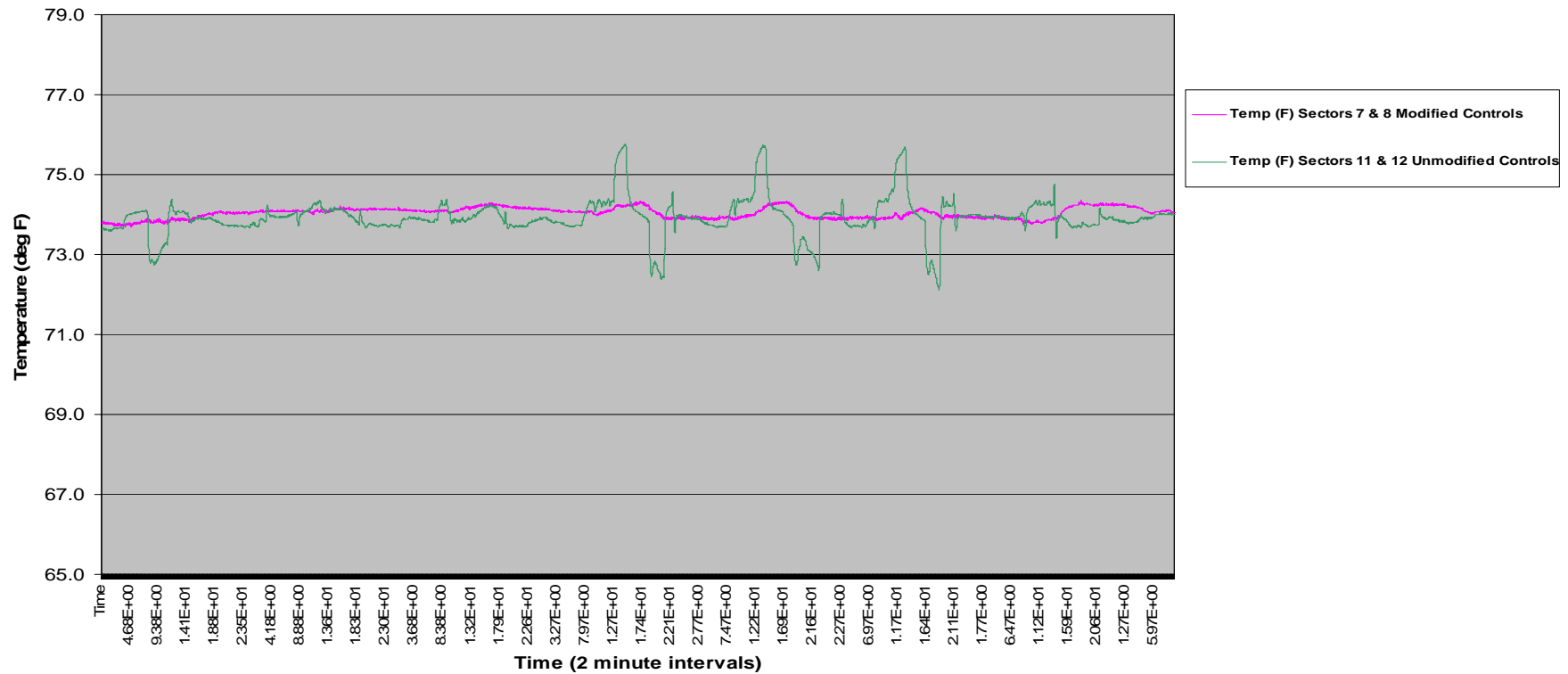
Storage Ring Air Temperature
Oct 4 through 11 2006



APS Storage Ring Temperature Control

Current Status: Comparison of Performance of Modified and Unmodified Units

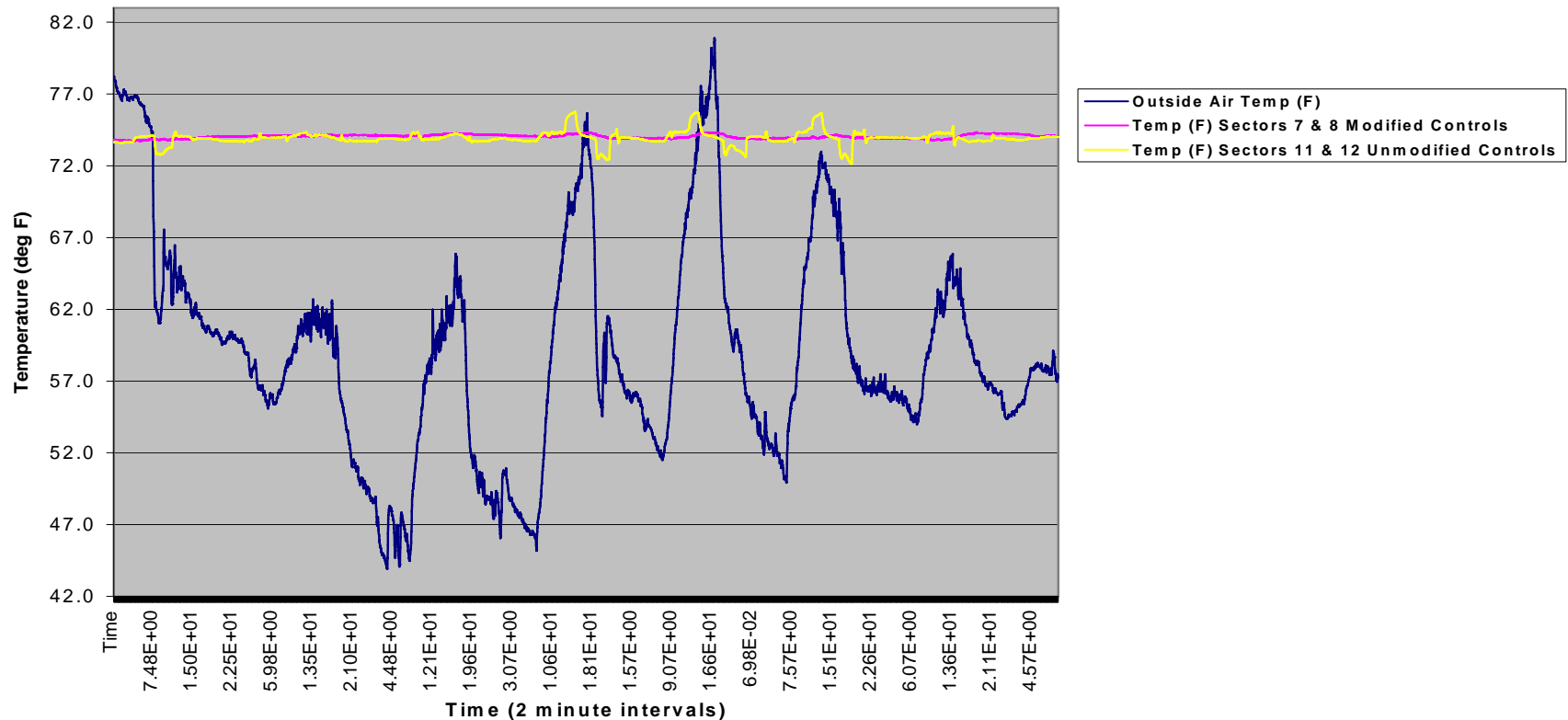
Storage Ring Air Temperature
Oct 4 through 11 2006



APS Storage Ring Temperature Control

Current Status: Comparison of Performance of Units with Variation in Outside Air Temperature

Storage Ring Air Temperature
Oct 4 through 11 2006



APS Storage Ring Temperature Control

Current Status: **Work Under Contract**

- A contract has been awarded by the DOE that included modifying all the remaining HVAC units.
- Construction work is being managed by the ANL FMS division in partnership with the AES division.
 - This work will begin in December of 2006 and be completed at the end of 2007.
 - Work is being phased to address the decoupling of the outdoor air influences first.
 - This will address the most problematic issue first.
 - Completion of the de-coupling work is scheduled for April of 2007.

APS Storage Ring Temperature Control

Current Status: **Project Management**

- The TCA is maintaining a storage ring task list that contains all action items pertinent to the temperature control issues.
 - This list is updated monthly and issued to APS management.
- The TCA is monitoring the progress and actively participating in the construction effort associate with the upgrade of the remaining HVAC units.
 - Progress reports will be included with the updating of the task list.

APS Storage Ring Temperature Control

Current Status: Typical Storage Ring Task List Document

Storage Ring Task List

Number	Item- Description	Action	Status	Estimated Date for Completion	Comments
1	Seal Storage Ring Access Door Openings	MK	COMPLETED		COMPLETED
2	Readjust all set points and tuning parameters to original recommended by Nov 2005 study	PFS	COMPLETED		COMPLETED
3	Establish Space Temperature Set point Authority	APS	COMPLETED		COMPLETED
4	Turn off or stagger auto zero for experiment hall temp zones	PFS	COMPLETED		COMPLETED
5	Continue Closing outdoor air dampers until minimum storage ring negative pressure level is reached	PFS			To be reevaluated with regard to summer/winter switchover
6	Check and verify all heating control valve operation				In Progress
7	Prepare Plan to study chilled water temperature stabilization	MK	To be started		delayed
8	Verify operation of all dampers and chilled water control valves	PFS/MK	In Progress 50% complete	31-Dec-06	In Progress 50% complete
9	Critical Systems Re-Commissioning Plan	MK	Not Started		delayed
10	Critical Systems Re-Commissioning Procedure	MK	Not Started		delayed

APS Storage Ring Temperature Control

Current Status: Documentation

- Documentation of all storage ring work, set points, and control parameter loops will be maintained in the APS ICMS.
- All modifications to the current system and associated technical data will also be maintained in the ICMS.

APS Storage Ring Temperature Control

Summation:

- Dramatic improvement in temperature stability has been achieved in units retrofitted as recommended by the 2005 study.
- A well established re-commissioning program that exceeds normal maintenance procedures is essential to insuring reliable performance of the system.
- Further improvement in temperature stability can be achieved by eliminating abrupt changes in system operating conditions.
 - Explore enhancement of the chilled water temperature control.
 - Mitigate effects of seasonal changes from heating to cooling mode switchover.

Questions ?