Gene Swetin

Cooling Water Systems
User and Facilities Support

About myself

- With APS since 1991
- *1991-1996* Conventional Facilities
  - Design, supervision of consultants, construction, commissioning of process water, HVAC, compressed air systems
- *1996 - present* ASD-ME Group

Responsibilities

- Secondary water systems
- Water systems for RF
- Vacuum chamber cooling skids
- Front-end water systems
- User beamline support
- Facilities support

Water Systems

- Tasks, ongoing and recent projects
- Plans
- Challenges

Secondary Water Systems

36 Pumping systems supplying pressure and temperature controlled water to most storage ring, booster, Linac, LEUTL and beamline equipment.

- 59 pumps
- 75 and 100 HP pump motors
- 350-500 GPM
- Supply pressure 135-150 psig
- Supply temperature 78 ± 0.2 deg F
- Filtration 0.5 micron

Storage Ring Secondary Pump System

Secondary Water Systems

Monitor, maintain, improve

- **Monitor**
  - Daily Rounds
  - Johnson Controls, Allen-Bradley, EPICS
  - Vibration monitoring
  - ME Web Page
- **Maintain**
  - Oil changes
  - Pump and motor rebuilding
  - Control valves and sensor calibration
  - Filter changes
- **Ongoing and Recent Improvements**
  - Refurbish all system LCP pump controllers.
  - Replace failing pumps prior actual failure. (25% of storage ring pumps replaced).
  - Replace flexible connectors.
  - Began replacing bypass valves.
  - Began refurbishing temperature control valves.

Secondary Water Systems
Plans

- Replace pumps
- Install new bypass valves
- Refurbish temperature control valves
- Define future of temperature control system
- Continue improving web content

Water Systems for RF

- 6 RF systems
  - Klystrons
  - Circulators
  - Anode Tanks
  - SCR Cabinets
  - Multiple RF Loads
- SR & Booster Cavities
- All components interlocked for water flow and temperature

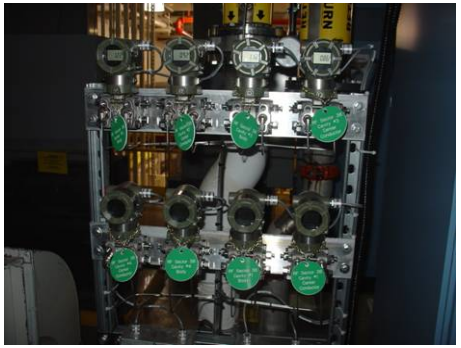
Water Systems for RF

Monitor, maintain, improve

Monitor and maintain

- Similar to secondary systems *plus RF system specific tasks* (griswold valve replacement, solenoid valve rebuilding)
- Support RF group

New P-RFTS water system



Flow meters for HOM Dampers

SCR Cabinet Flow Metering

RF Loads Flow Metering

Recent Upgrades

- Design and install dedicated water system for Test Stand RF equipment
- Design and install water system for sector 38 RF HOM dampers

Water Systems for RF
Plans

- Replace Booster cavities flow meters
- Upgrade temperature measurement
- Service SR cavities flow control valves
- Address temperature control valves' obsolescence

Vacuum Chambers Cooling Skids

- 20 2-pump systems installed around the ring
- 50 GPM / system
- Supply temperature 78 ± 0.1 deg F
- 0.5 micron filtration
- 12 Mohm - cm resistivity
- UV lights for bacterial control

Vacuum Chamber Cooling Skids

Monitor, maintain, improve

Monitor and maintain

- Similar to secondary systems *plus system specific tasks* (system fill level maintenance, UV lights replacement, polishing system)

Recent Upgrades

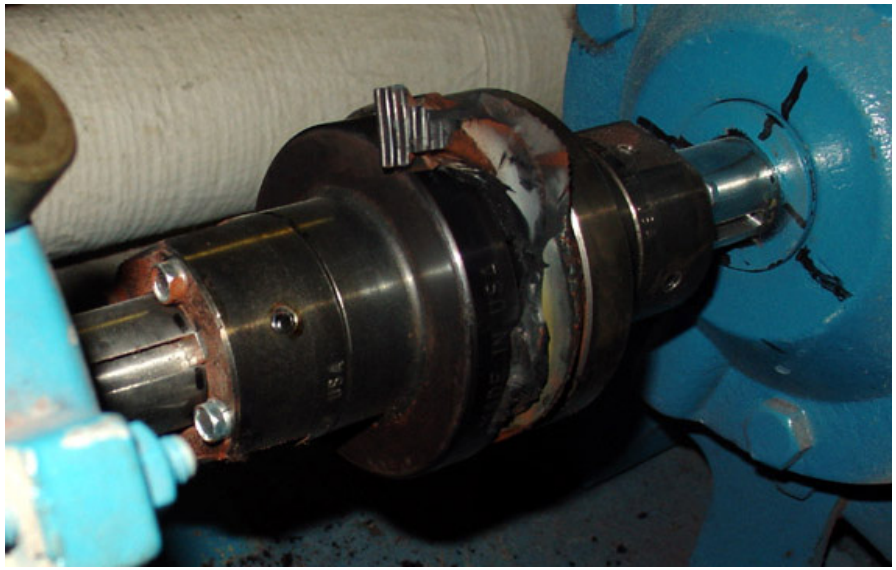
- Refurbish aging system controllers (17 of 20 complete)
- Design and construct new system fill carts

New vacuum chamber cooling skid mobile fill cart

Refurbished DX-9100 system controller

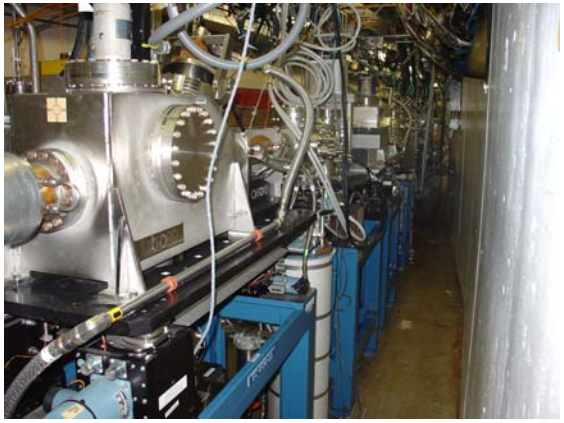
Vacuum Chamber Cooling Skids
Plans

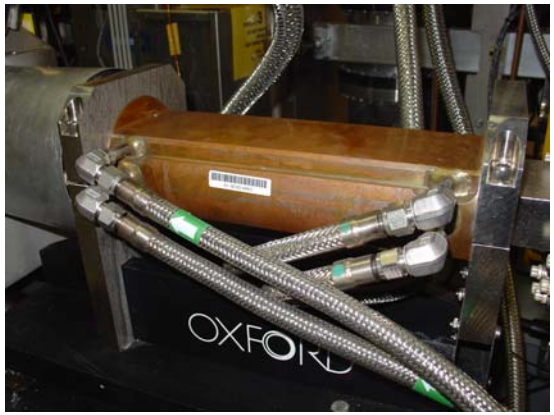
- Replace pump/motor couplings
- Redesign layout to allow for standby pump servicing



Front-end Water Systems

About 500 flow circuits. Each containing flow measuring device, differential pressure transmitter and each is interlocked to dump the beam.

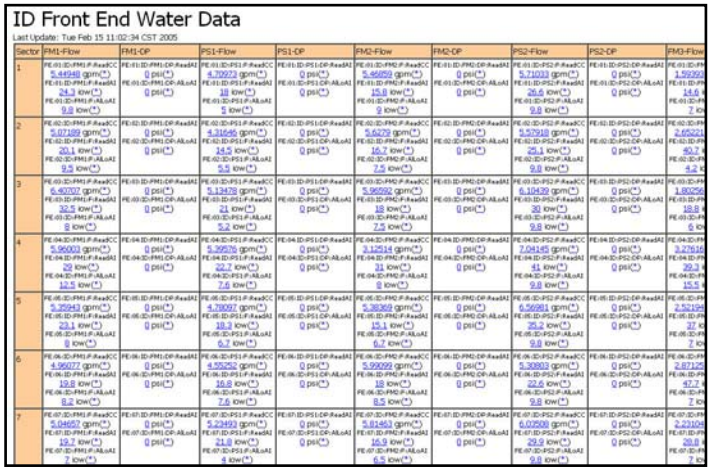




Front-end Water Systems

Monitor, maintain, improve

- Flow monitoring. Flushing 25-30 components every shutdown.
- Blowdown for bakeouts.
- Modified flushing system and procedure that now allows for simultaneous flushing of two front-end components thus reducing maintenance time.
- Eliminated 50% of interlocked process variables increasing beam reliability by reducing nuisance trips.
- Created empirical system to determine the need for citranox flushing of front-end components.

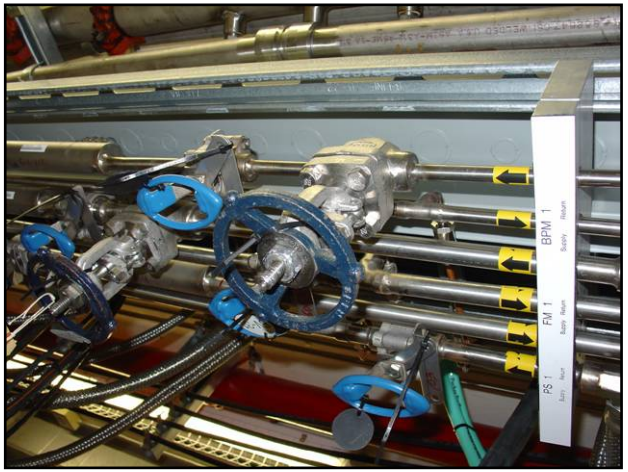


ID Front End Water Data

Last Update: Tue Feb 15 11:02:34 CST 2005

Sector	FM1-Flow	FM1-DP	PS1-Flow	PS1-DP	FM2-Flow	FM2-DP	PS2-Flow	PS2-DP	FM3-Flow
1	PE:01:ID:PM1:F:ReadCC 5.44948 gpm(*) PE:01:ID:PM1:F:ReadAI 24.3 low(*) PE:01:ID:PM1:F:AlLoAI 9.8 low(*)	PE:01:ID:PM1:DP:ReadAI 0 psi(*) PE:01:ID:PM1:DP:AlLoAI 0 psi(*)	PE:01:ID:PS1:F:ReadCC 4.70973 gpm(*) PE:01:ID:PS1:F:ReadAI 18 low(*) PE:01:ID:PS1:F:AlLoAI 5 low(*)	PE:01:ID:PS1:DP:ReadAI 0 psi(*) PE:01:ID:PS1:DP:AlLoAI 0 psi(*)	PE:01:ID:PM2:F:ReadCC 5.46059 gpm(*) PE:01:ID:PM2:F:ReadAI 15.8 low(*) PE:01:ID:PM2:F:AlLoAI 9 low(*)	PE:01:ID:PM2:DP:ReadAI 0 psi(*) PE:01:ID:PM2:DP:AlLoAI 0 psi(*)	PE:01:ID:PS2:F:ReadCC 5.71033 gpm(*) PE:01:ID:PS2:F:ReadAI 26.6 low(*) PE:01:ID:PS2:F:AlLoAI 9.8 low(*)	PE:01:ID:PS2:DP:ReadAI 0 psi(*) PE:01:ID:PS2:DP:AlLoAI 0 psi(*)	PE:01:ID:PM 1.59392 PE:01:ID:PM 14.6 PE:01:ID:PM 7 lo
2	PE:02:ID:PM1:F:ReadCC 5.07189 gpm(*) PE:02:ID:PM1:F:ReadAI 20.1 low(*) PE:02:ID:PM1:F:AlLoAI 9.5 low(*)	PE:02:ID:PM1:DP:ReadAI 0 psi(*) PE:02:ID:PM1:DP:AlLoAI 0 psi(*)	PE:02:ID:PS1:F:ReadCC 4.31646 gpm(*) PE:02:ID:PS1:F:ReadAI 14.5 low(*) PE:02:ID:PS1:F:AlLoAI 5.9 low(*)	PE:02:ID:PS1:DP:ReadAI 0 psi(*) PE:02:ID:PS1:DP:AlLoAI 0 psi(*)	PE:02:ID:PM2:F:ReadCC 5.6279 gpm(*) PE:02:ID:PM2:F:ReadAI 16.7 low(*) PE:02:ID:PM2:F:AlLoAI 7.9 low(*)	PE:02:ID:PM2:DP:ReadAI 0 psi(*) PE:02:ID:PM2:DP:AlLoAI 0 psi(*)	PE:02:ID:PS2:F:ReadCC 5.57918 gpm(*) PE:02:ID:PS2:F:ReadAI 25.1 low(*) PE:02:ID:PS2:F:AlLoAI 9.8 low(*)	PE:02:ID:PS2:DP:ReadAI 0 psi(*) PE:02:ID:PS2:DP:AlLoAI 0 psi(*)	PE:02:ID:PM 2.65221 PE:02:ID:PM 40.7 PE:02:ID:PM 4.2 lo
3	PE:03:ID:PM1:F:ReadCC 6.40707 gpm(*) PE:03:ID:PM1:F:ReadAI 32.5 low(*) PE:03:ID:PM1:F:AlLoAI 9 low(*)	PE:03:ID:PM1:DP:ReadAI 0 psi(*) PE:03:ID:PM1:DP:AlLoAI 0 psi(*)	PE:03:ID:PS1:F:ReadCC 5.13478 gpm(*) PE:03:ID:PS1:F:ReadAI 21 low(*) PE:03:ID:PS1:F:AlLoAI 5.2 low(*)	PE:03:ID:PS1:DP:ReadAI 0 psi(*) PE:03:ID:PS1:DP:AlLoAI 0 psi(*)	PE:03:ID:PM2:F:ReadCC 5.96592 gpm(*) PE:03:ID:PM2:F:ReadAI 18 low(*) PE:03:ID:PM2:F:AlLoAI 7.5 low(*)	PE:03:ID:PM2:DP:ReadAI 0 psi(*) PE:03:ID:PM2:DP:AlLoAI 0 psi(*)	PE:03:ID:PS2:F:ReadCC 6.10439 gpm(*) PE:03:ID:PS2:F:ReadAI 30 low(*) PE:03:ID:PS2:F:AlLoAI 9.8 low(*)	PE:03:ID:PS2:DP:ReadAI 0 psi(*) PE:03:ID:PS2:DP:AlLoAI 0 psi(*)	PE:03:ID:PM 1.80256 PE:03:ID:PM 18.8 PE:03:ID:PM 6 lo
4	PE:04:ID:PM1:F:ReadCC 5.96003 gpm(*) PE:04:ID:PM1:F:ReadAI 29 low(*) PE:04:ID:PM1:F:AlLoAI 12.5 low(*)	PE:04:ID:PM1:DP:ReadAI 0 psi(*) PE:04:ID:PM1:DP:AlLoAI 0 psi(*)	PE:04:ID:PS1:F:ReadCC 5.39576 gpm(*) PE:04:ID:PS1:F:ReadAI 22.7 low(*) PE:04:ID:PS1:F:AlLoAI 7.6 low(*)	PE:04:ID:PS1:DP:ReadAI 0 psi(*) PE:04:ID:PS1:DP:AlLoAI 0 psi(*)	PE:04:ID:PM2:F:ReadCC 3.12514 gpm(*) PE:04:ID:PM2:F:ReadAI 31 low(*) PE:04:ID:PM2:F:AlLoAI 8 low(*)	PE:04:ID:PM2:DP:ReadAI 0 psi(*) PE:04:ID:PM2:DP:AlLoAI 0 psi(*)	PE:04:ID:PS2:F:ReadCC 7.04145 gpm(*) PE:04:ID:PS2:F:ReadAI 41 low(*) PE:04:ID:PS2:F:AlLoAI 9.8 low(*)	PE:04:ID:PS2:DP:ReadAI 0 psi(*) PE:04:ID:PS2:DP:AlLoAI 0 psi(*)	PE:04:ID:PM 3.27616 PE:04:ID:PM 29.3 PE:04:ID:PM 15.5
5	PE:05:ID:PM1:F:ReadCC 5.35943 gpm(*) PE:05:ID:PM1:F:ReadAI 23.1 low(*) PE:05:ID:PM1:F:AlLoAI 9 low(*)	PE:05:ID:PM1:DP:ReadAI 0 psi(*) PE:05:ID:PM1:DP:AlLoAI 0 psi(*)	PE:05:ID:PS1:F:ReadCC 4.78097 gpm(*) PE:05:ID:PS1:F:ReadAI 18.3 low(*) PE:05:ID:PS1:F:AlLoAI 6.7 low(*)	PE:05:ID:PS1:DP:ReadAI 0 psi(*) PE:05:ID:PS1:DP:AlLoAI 0 psi(*)	PE:05:ID:PM2:F:ReadCC 5.38369 gpm(*) PE:05:ID:PM2:F:ReadAI 15.1 low(*) PE:05:ID:PM2:F:AlLoAI 6.7 low(*)	PE:05:ID:PM2:DP:ReadAI 0 psi(*) PE:05:ID:PM2:DP:AlLoAI 0 psi(*)	PE:05:ID:PS2:F:ReadCC 6.56981 gpm(*) PE:05:ID:PS2:F:ReadAI 25.2 low(*) PE:05:ID:PS2:F:AlLoAI 9.8 low(*)	PE:05:ID:PS2:DP:ReadAI 0 psi(*) PE:05:ID:PS2:DP:AlLoAI 0 psi(*)	PE:05:ID:PM 2.52194 PE:05:ID:PM 37 PE:05:ID:PM 7 lo
6	PE:06:ID:PM1:F:ReadCC 4.96077 gpm(*) PE:06:ID:PM1:F:ReadAI 19.8 low(*) PE:06:ID:PM1:F:AlLoAI 8.2 low(*)	PE:06:ID:PM1:DP:ReadAI 0 psi(*) PE:06:ID:PM1:DP:AlLoAI 0 psi(*)	PE:06:ID:PS1:F:ReadCC 4.55252 gpm(*) PE:06:ID:PS1:F:ReadAI 16.8 low(*) PE:06:ID:PS1:F:AlLoAI 7.6 low(*)	PE:06:ID:PS1:DP:ReadAI 0 psi(*) PE:06:ID:PS1:DP:AlLoAI 0 psi(*)	PE:06:ID:PM2:F:ReadCC 5.99099 gpm(*) PE:06:ID:PM2:F:ReadAI 18 low(*) PE:06:ID:PM2:F:AlLoAI 8.5 low(*)	PE:06:ID:PM2:DP:ReadAI 0 psi(*) PE:06:ID:PM2:DP:AlLoAI 0 psi(*)	PE:06:ID:PS2:F:ReadCC 5.30803 gpm(*) PE:06:ID:PS2:F:ReadAI 22.6 low(*) PE:06:ID:PS2:F:AlLoAI 9.8 low(*)	PE:06:ID:PS2:DP:ReadAI 0 psi(*) PE:06:ID:PS2:DP:AlLoAI 0 psi(*)	PE:06:ID:PM 2.67125 PE:06:ID:PM 47.7 PE:06:ID:PM 7 lo
7	PE:07:ID:PM1:F:ReadCC 5.04657 gpm(*) PE:07:ID:PM1:F:ReadAI 19.7 low(*) PE:07:ID:PM1:F:AlLoAI 7 low(*)	PE:07:ID:PM1:DP:ReadAI 0 psi(*) PE:07:ID:PM1:DP:AlLoAI 0 psi(*)	PE:07:ID:PS1:F:ReadCC 5.23493 gpm(*) PE:07:ID:PS1:F:ReadAI 21.8 low(*) PE:07:ID:PS1:F:AlLoAI 4 low(*)	PE:07:ID:PS1:DP:ReadAI 0 psi(*) PE:07:ID:PS1:DP:AlLoAI 0 psi(*)	PE:07:ID:PM2:F:ReadCC 5.81463 gpm(*) PE:07:ID:PM2:F:ReadAI 16.9 low(*) PE:07:ID:PM2:F:AlLoAI 6.5 low(*)	PE:07:ID:PM2:DP:ReadAI 0 psi(*) PE:07:ID:PM2:DP:AlLoAI 0 psi(*)	PE:07:ID:PS2:F:ReadCC 6.07508 gpm(*) PE:07:ID:PS2:F:ReadAI 29.9 low(*) PE:07:ID:PS2:F:AlLoAI 9.8 low(*)	PE:07:ID:PS2:DP:ReadAI 0 psi(*) PE:07:ID:PS2:DP:AlLoAI 0 psi(*)	PE:07:ID:PM 2.23108 PE:07:ID:PM 28.8 PE:07:ID:PM 7 lo

Front-end water monitoring and alarm page



Front-end water manifold and valve train

Front-end Water Systems
Plans

- Design and build additional flushing cart
- Rebuild existing flushing carts
- Calibrate/replace differential pressure transmitters
- Service flow meters
- Modify flow circuits to facilitate service

Citranox Flushing Cart Upgrade

User Support

- Maintenance of user skids
- Connecting users to APS water system
- Miscellaneous user support
  - Compressed air installation
  - Water connections, filter installation, etc
  - Chiller service
  - User laboratory equipment hook ups
  - Ventilation systems

User skid

Beamline 13 chiller utilizes APS cooling water

User Support

- 20 beamlines connected to APS water

Plans

- Connect one beamline every shutdown
- Design and implement beamline leak detection system
- Install beamline water differential pressure monitoring system

Beamline 30 process water connection

Connection of beamlines 16 and 17 to APS process water system

Facilities Engineering and CNM Support

- Review water systems design for CNM
- Heat recovery system utilizing process cooling water
- Humidity control for RF building
- Chiller plant expansion
- Storage Ring air temperature stability

Process water heat recovery heat exchanger

Chilled Water Plant Expansion – New Chiller Installation

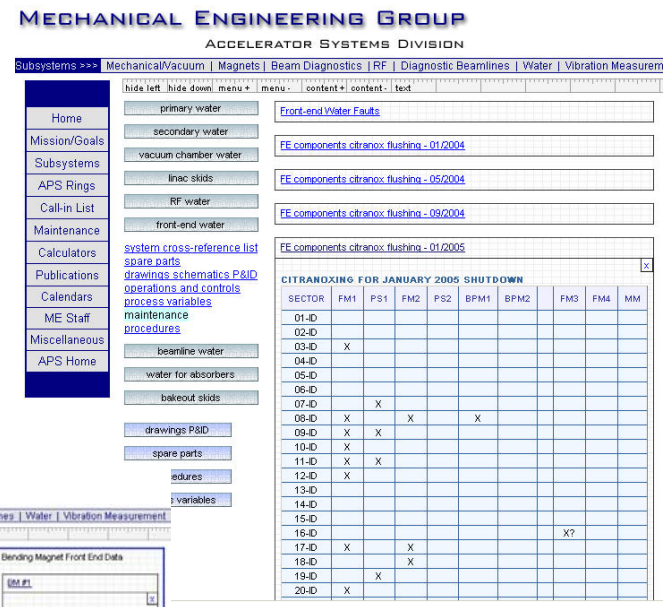
Water Systems

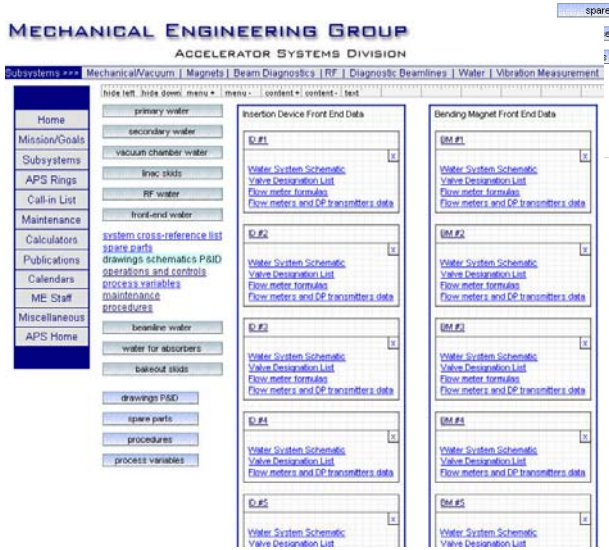
Challenges

- Equipment obsolescence and aging
  - 3-way valves, controllers, pump motors
- Reduced rate of upgrades
  - 10 pumps in 2004, 2 pumps in 2005
- Work put off due to time, budget and/or manpower constraints
  - Calibrations
  - Mitigation of flow-induced vibrations
  - Temperature stability ± 0.01 deg F

ME Group “Water” Web Page

- Drawings
- Procedures
- O & M Manuals
- Maintenance Data
- Calibration Data
- Rounds Data
- Process Variables Monitoring
- Useful Links





Energy Conservation

Design of low cost modifications to secondary water systems and work on implementation of the project that resulted in considerable energy savings without loss of reliability. By installing override switches on existing energy-saving valves operation of 3-way temperature control valve was converted to 2-way operation eliminating bypass of primary supply water into return water loop. Work was recognized in Argonne newsletter.

Modifications to APS water-supply system will save $30,000 a year

Next to electricity, water is perhaps the most critical, and costly, ingredient needed to operate the technologically sophisticated Advanced Photon Source (APS) beam acceleration and storage complex. The Accelerator Systems Division Mechanical Engineering Group has begun a series of modifications to the accelerator water-supply system that is already realizing significant cost savings — with even greater savings to come.

The APS accelerator complex (including the linear accelerator, the booster, the radio frequency system and the storage ring) relies on a reliable, year-round supply of 10,000 gallons of specially processed, deionized and chilled water each minute to cool technical components that can generate intense levels of heat. This cooling requires strict limits on variations in water temperature, pressure and chemical properties.

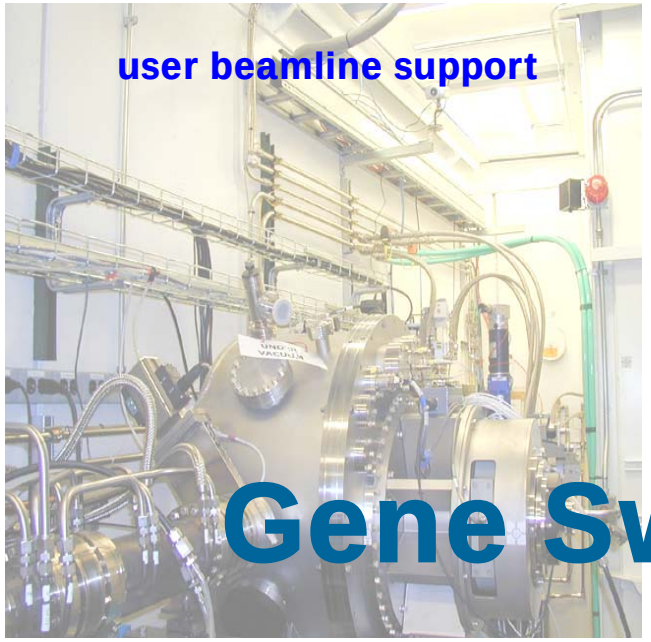
◀ From left to right are Ric Putnam, Cheryl Fusco, Gene Swetin and John Dench of the ASD Mechanical Engineering Group, in the APS Utility Building. Their modifications to the water-supply system are expected to save the laboratory up to $30,000 per year in energy costs.

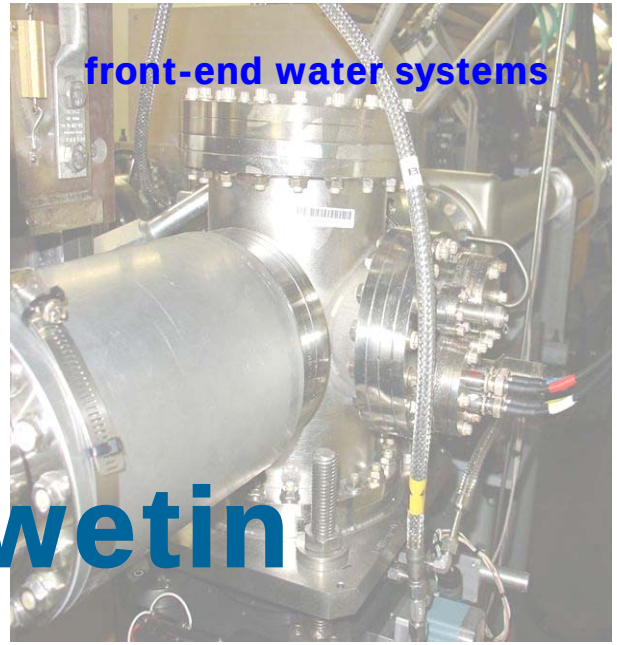
In order to control and reduce costs in this critical area, John Dench, Cheryl Fusco, Ric Putnam and Gene Swetin of the Mechanical Engineering Group revisited the design of the complex system of pumps that deliver water to the accelerators. The group decided to install override switches on the existing valves that control temperature, thus changing the pumping system from one of constant water volume to a more controlled, variable volume.

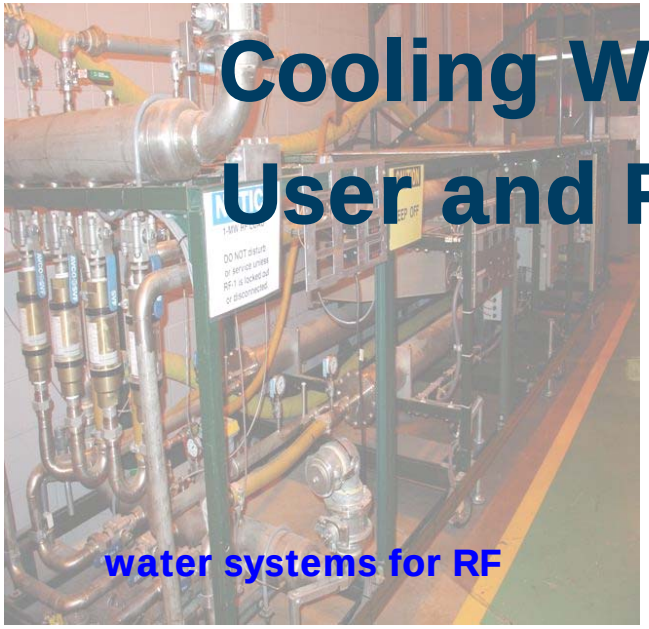
With the changeover about 60 percent complete, water flow to the accelerators has been decreased by more than 2,000 gallons per minute in the primary water-pumping loop that operates year-round. When modifications are completed at the end of 2004, water flow is expected to be reduced by a total of 3,000 gallons per minute. Additional savings will come from heavier use of low-cost water from the APS cooling tower, rather than water from the current higher-cost, two-stage system that uses tower water and then chilled water. Implementation costs of less than $2,000 are expected to save the laboratory more than $30,000 per year in energy costs.

Argonne News 1

Energy Valve Override Switch





Gene Swetin

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