25 JULY 2018

APS OPERATIONS AND SAFETY

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Argonne NATIONAL LABORATORY

TOPICS

- Safety
  - Near Miss Laser Exposure
  - Electrical Safety Program
- Accelerator Operations
- Reducing Cost and Improving Efficiency
  - Storage Space Reduction
  - Consolidation of the Request System
- APS 401 Patio Renovation
- APS Infrastructure Master Plan
- APS Contribution to LCLS-II

SAFETY: CLASS 4 INFRARED (IR) LASER – POTENTIAL EYE EXPOSURE EVENT

- June 12, 2018, researchers performing pre-experimental set-up to clean the laser fiber end in preparation for the second experimental run or “shot”
- A coupling was removed and the fiber was viewed using a direct sight magnification fiber scope
- Unknowingly, the cleaning and viewing of the fiber was conducted while the Class 4 1550 nanometers (nm) laser was inadvertently still operating
- To control laser light exposure, researchers depended on approved administrative controls to manage the Class 4 IR Laser light output including:
  - Completion of a checklist
  - Activation of E-stop by a laser operator following completion of each experimental shot
- APS management immediately suspended all DSC-CAT operations
- Performed extent of condition for all Class 3B and Class 4 laser operations in APS
- Thankfully, no injuries were sustained by the exposed researchers
- Final incident investigation and causal analysis report sent to Stephen Streiffer on July 24.

SAFETY, CONTINUED

- 1-ID-E electrical equipment burn-up on 6/27/18; fact-finding was performed on 6/28
- It was later determined that a Vexta motor driver had failed and scorched

  - The charred printed circuit board emitted chemicals into the hutch that could be inhaled and exposure resulted in symptoms such as headache, nausea, and dizziness.

- 6 workers felt unwell, evaluated at HEW for exposure, all were cleared and released to return-to-work without restriction


(Model #CRD5107P)

- **Positive actions/practices:**
  - Called 911 when first identifying unusual odor
  - Confirmed exposure with HEW and received medical assessment
  - Barricaded the hutch with caution tape
  - Ventilated the area
  - Exposed workers did not drive themselves to HEW
- **Preliminary/Potential Lessons Learned – similar odor event**
  - Get away quickly from potential inhalation hazard
  - Barricade area to prevent re-entry into the space
  - Turn off systems immediately
  - Check systems with a thermal imaging IR camera immediately (failed component may not be evidenced visually)
  - Using IR camera, look for components operating at >40°C indicating a component is overheating/failing. (Normal operating temperature for a motor driver is 40°C.)

WHAT IS ELECTRICAL WORK?*

- Electrical work is any task that involves a shock or arc flash hazard or that could create potential shock or arc flash hazards for future users, and therefore requires a Qualified Electrical Worker (QEW).

Source	Thresholds
AC 50- 60 Hz	≥50 V and 5 mA
DC	≥100 V and 40 mA
Capacitors	≥100 V and 10 J
Batteries	≥100 V
Sub-RF 1 Hz- 3 kHz	≥50 V and 5 mA
RF 3 kHz- 100 MHz	A function of frequency

*Courtesy Ken Belcher

INSPECTING AN OFFICE FOR ELECTRICAL SAFETY

Field Guide 23

Inspecting an Office for Electrical Safety

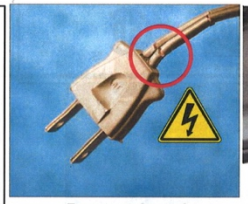
Argonne NATIONAL LABORATORY

Using this Field Guide

Use this field guide as an easy checklist to spot and correct electrical safety issues in your office or cubicle. Contact your division Electrical Subject Matter Expert (SME) or ESH Coordinator for assistance. You may also contact the Electrical Safety Group at electricalsafety@anl.gov.

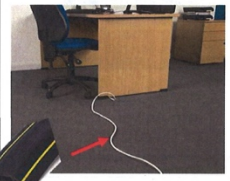
CORDS

- ❑ No damage to cord insulation
- ❑ Should lay loosely on the floor, not strung tight, stretched, or hanging in mid-air
- ❑ No zip-ties or staples (Velcro is ok)
- ❑ No trip hazards
- ❑ No sharp edges or pinch points
- ❑ Not run through walls, ceilings, or floors, or under carpets or rugs (doors and windows are ok, if short term (temporary) and protected from damage)
- ❑ Sit/stand desk not pulling on cords
- ❑ All plugs seated firmly
- ❑ No extension cords (for temporary use only)



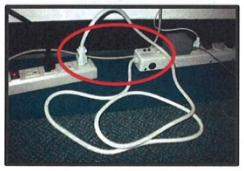
Damaged cord

Unseated plug



Trip Hazard

Cord through wall



RPT Daisy-Chained

Overloaded RPT

Overheated RPT

POWER STRIPS

Also called Relocatable Power Taps (RPTs), see Field Guide 21.

- ❑ Maximum load of 12 Amps total
- ❑ High current items (>5 A or >600W) plugged into wall outlets only
- ❑ Do not connect one RPT into another RPT (daisy-chain). Acquire one with a longer cord if needed.
- ❑ Do not mount with zip-ties, must be able to remove without tools

LISTING

- ❑ Use only listed (NRTL approved) office equipment. See OSHA website: https://www.osha.gov/dts/otpca/nrtl/nrtllist.html
- ❑ Look at the label; the most common are UL, CSA and ETL (not CE)
- ❑ Unlisted equipment should not be used, replace with listed devices.
- ❑ Check laptop power supplies, phone chargers, lamps, etc.

c UL us LISTED c ETL us Intertek c SA us

Unlisted power supply

Listed power supply

Heater plugged into extension cord

Heater plugged into power strip

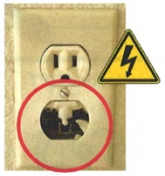
SPACE HEATERS

- ❑ Use only listed (NRTL approved) space heaters
- ❑ Plug directly into wall
- ❑ No extension cords or power strips
- ❑ Plenty of space around (3 feet, or see instructions)
- ❑ Unplug when not in use

Also see Field Guide 22.

DAMAGED ELECTRICAL EQUIPMENT

- ❑ Open electrical boxes/missing covers
- ❑ Broken electrical fittings
- ❑ Exposed wiring
- ❑ Overheated outlets/burn marks



Broken outlet

Panel left open

IS YOUR OFFICE ELECTRICALLY SAFE?

- ❑ All cords are safe
- ❑ All power taps are safe
- ❑ All equipment is listed
- ❑ All space heaters are safe
- ❑ All nearby electrical equipment looks safe

DOES ANYTHING NEED EXTRA ATTENTION?

❑ _____

❑ _____

CONTACT YOUR ESH COORDINATOR OR ELECTRICAL SME FOR ASSISTANCE

*Courtesy Ken Belcher

Argonne NATIONAL LABORATORY

ACCELERATOR OPERATIONS STATUS AS OF JULY 24, 2018 17:05

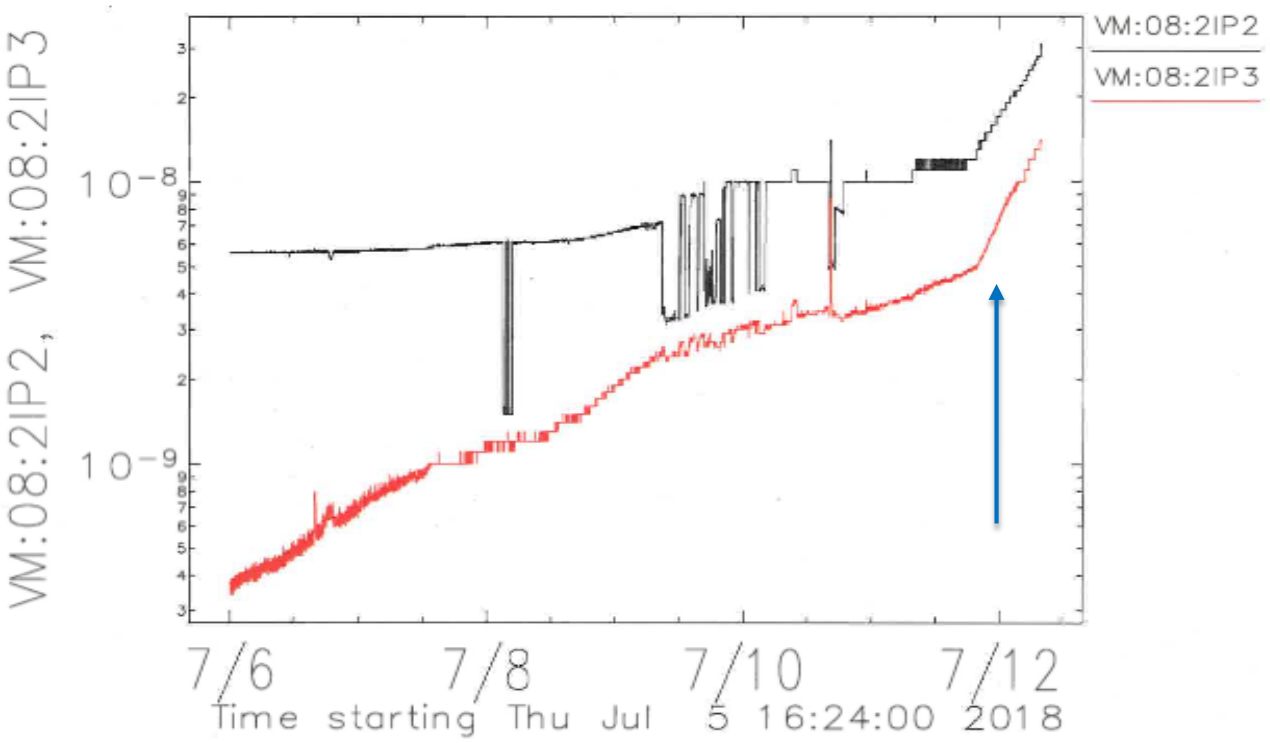
- 2018-2 User Run started on May 30, 08:00

Total Amount of User Time	1113.0 Hours
Delivered Beam	1031.1 Hours
Percentage of Scheduled Time	92.6%
Mean Time Between Faults (MTBF)	103.11 Hours
Downtime During Period	81.9 Hours
Mean Fill Duration in Period	93.7 Hours
Faults per Day of Delivered Beam	0.23
Total Number of Faults	10

- Initially, trips due to RF electronics and digital signal processing electronics cards failures; one human error
- Storage ring vacuum leak in one of the bellows resulted in 67.64 hours of down time

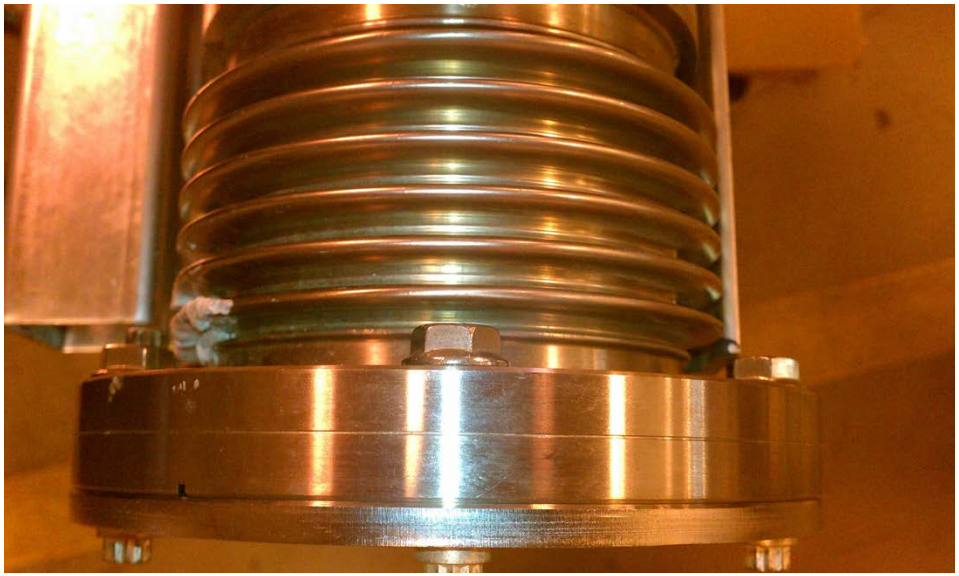
STORAGE RING SECTOR 8 VACUUM LEAK

- Early signs of trouble: July 5
  - Significant negative impact on lifetime and emittance
- Intent was to wait until July 16 for access during a machine studies/ intervention day
  - Vacuum started rapidly deteriorating on July 12, forcing intervention

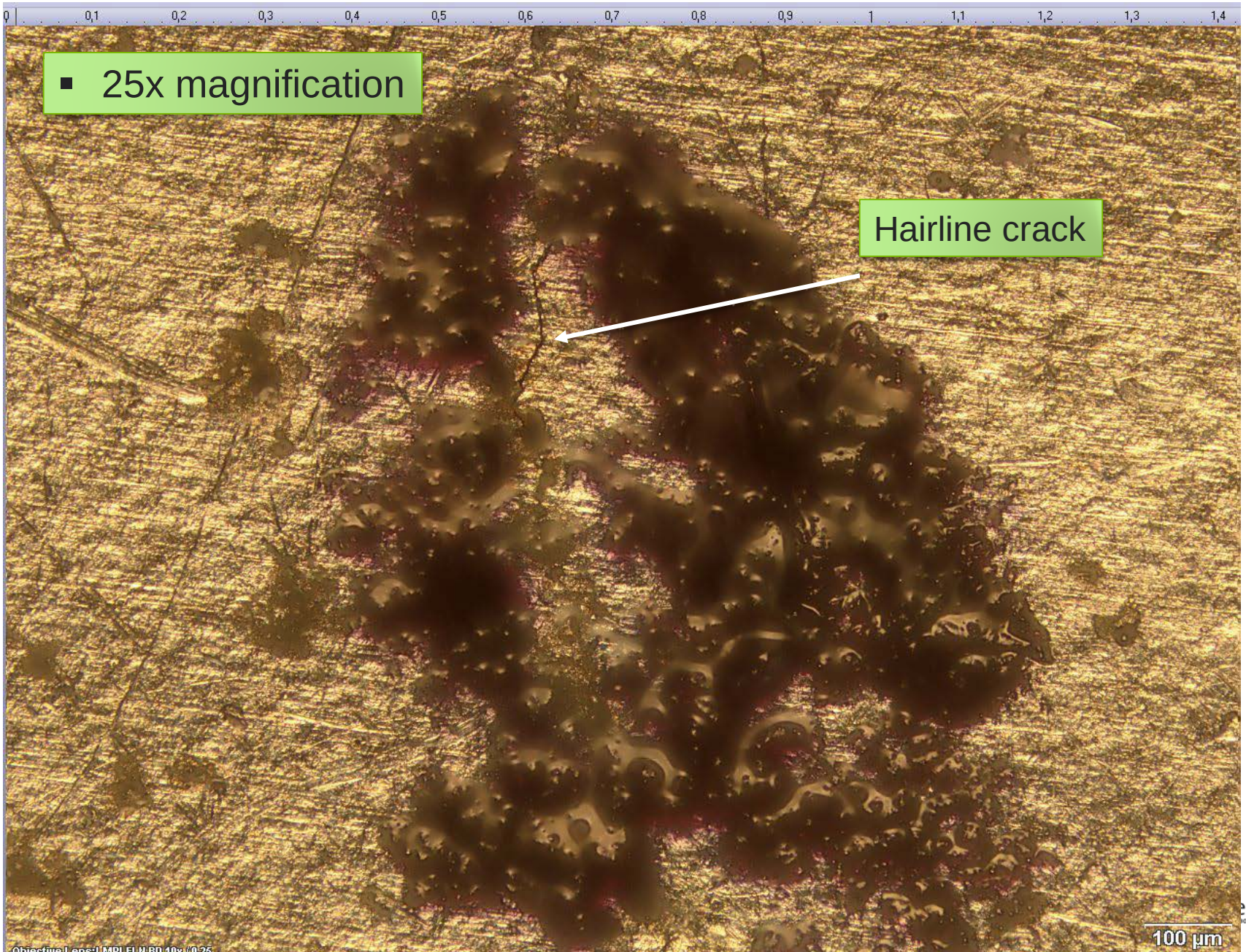


STORAGE RING SECTOR 8 VACUUM LEAK (CONT.)

- July 12 (noon): MOM group personnel entered storage ring
- Found the leak on the bellows to the 7-ID Front End exit port
  - An initial test with tape to see if leak could be sealed, plugged the leak
  - Leak further intensified and all the ion pumps tripped off while prepping and applying TorrSeal on the leak site
  - With vacuum approaching 10^{-3} Torr range, bellows replacement was warranted, requiring breaking storage ring vacuum



POST MORTEM – EXTERIOR BELLOWS SURFACE



300-AREA STORAGE SPACE REDUCTION

- APS rents approximately 35,000 ft^2 of storage space in the 300 area
- Annual cost: ~ $774,000
- Goal: Reduce storage space by at least 20%, and as high as reasonably achievable
- Annual savings: ~ $155,000, which can be put to research/engineering/facility needs

<u>Milestones</u>

- July 31: Label all equipment (in process)
  - Unclaimed equipment will be disposed
- August 31: Equipment disposal
- September 28: Vacate and return space to Lab
- 400 Area storage will be evaluated next

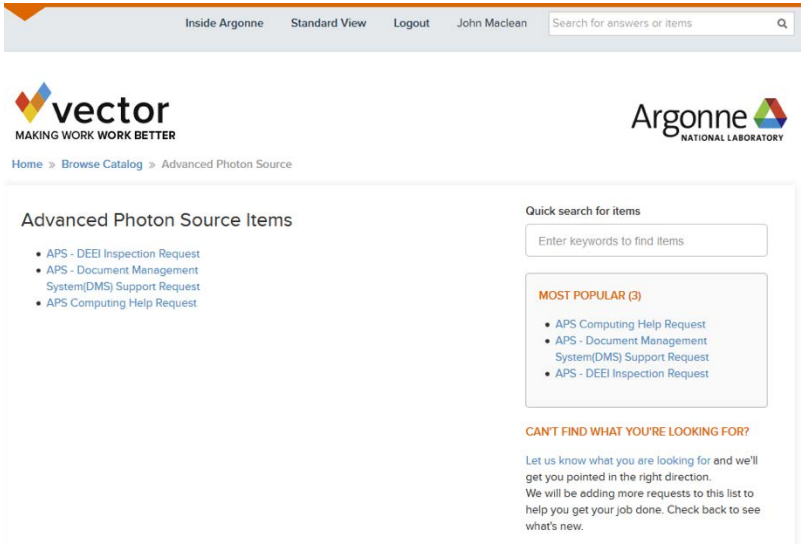
PSC	Group:
Contact:	
Scrap ☐	Save ☐
Comments:	
Move to BLDG:	
Potentially Activated Material(s) subject to criteria outlined in RS-TBD-003	
Yes ☐	No ☐
If Yes, HP sign and date below for disposition path	
Landfill ☐	
Recycle ☐	

Equipment Label for Disposition

APS TICKETING SYSTEMS MOVING TO VECTOR

- All support ticketing/request systems consolidated in one system
- Special APS section of service catalog
- Provides consistent experience
- Improved functionality, lower costs

Moved	Coming Soon	To Do
IT	Design & Drafting	Controls
DEEI request	MOM	Information Solutions
DMS		Survey and Alignment
		Mechanical Engineering
		Beamline Instrumentation
		Detector Pool
		…



APS PLAZA ENTRY REMODELING STATUS

- Reduces maintenance by removal of significant square footage of concrete; promotion of sustainable landscape and welcoming entry area
- Staff and user community input resulted in selection of alternative design
- **Schedule: Contract awarded on July 20, Construction starts on Aug 27, Construction complete on Nov 16, Landscaping by Spring 2019**
- Contract work synchronized with maintenance periods and Main Control Room due to vibration-causing work
- Web page for tracking progress on renovation: https://www.aps.anl.gov/Useful-Links
  - https://www.aps.anl.gov/plaza-remodel: weekly photos, project schedule

APS AGING INFRASTRUCTURE: FIRE MAIN RUPTURE NEAR 431 PENTAGON Z

- Flood aftermath in parking lot next to LOM 431 Pentagon Z on June 13

- Final compacting to grade after pressure and backflow testing of repaired 10-inch main as of June 18

ADDRESSING AGING APS INFRASTRUCTURE

- Contracted to Burns & McDonnell for APS Infrastructure Master Plan
- Issued near final draft (95%) report on June 18
- Comment period until just after July 4th holiday
- Identified 113 projects totaling over $96M*
  - Mechanical Piping Projects (30)
  - Architectural Projects (24)
  - Electrical Projects (19)
  - Mechanical HVAC Projects (14)
  - Remaining categories for general, specialty systems (e.g. LN_2), fire protection and IT
- Projects categorized by urgency timeline
- Final draft issuance of Burns & McDonnell report projected to be by July 31

APS INFRASTRUCTURE MASTER PLAN SUMMARY OF URGENT PROJECTS

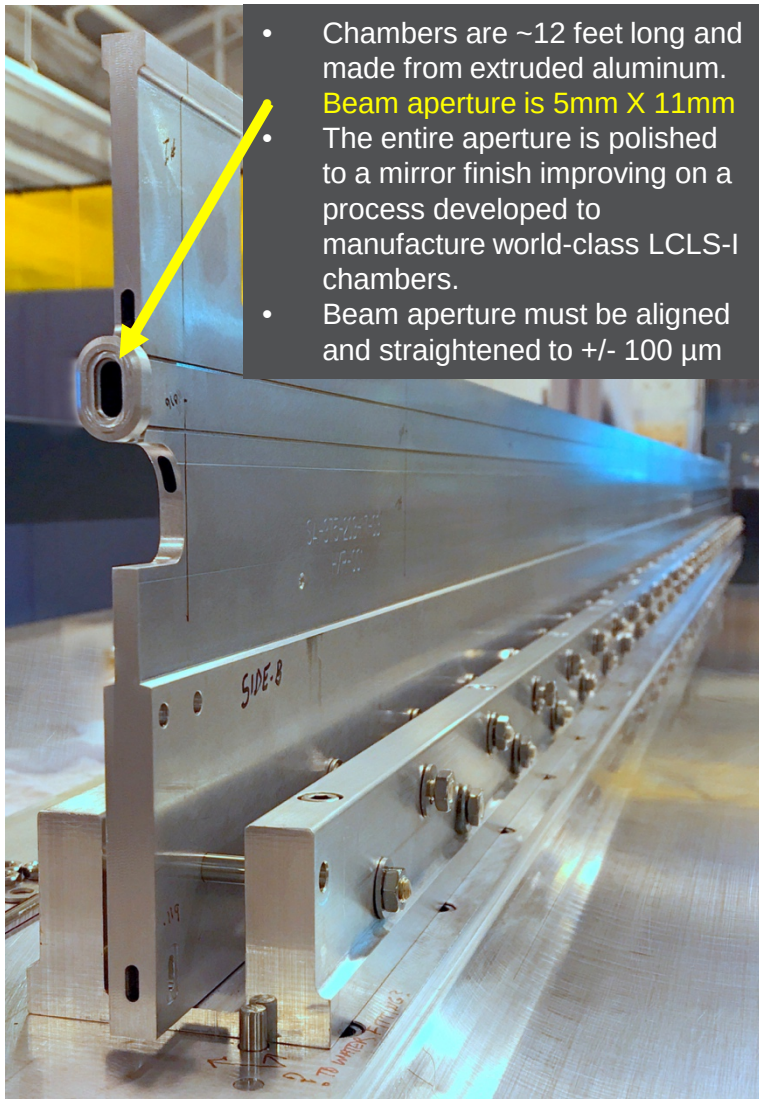
Projects with Immediate Urgency

Importance	Specific Utility Project Numbers	Brief Project Description	Cost
60	CHW-01-450-M-1-N	Wood Cooling Tower Upgrade	$ 1,535,000
60	CHW-02-450-M-1-N	Wood Cooling Tower Replacement	$ 5,500,000
60	CHW-18-400-M-1-Y	Flush Chilled Water Piping	$ 335,000
50	CHW-03-450-M-1-N	Retrofit Ice Tank	$ 3,450,000
50	CHW-04-450-O-1-Y	Refrigerant Retrofit for CH-801, CH-802 and CH-803	$ 352,000
50	CHW-05-450-O-1-Y	Replace CH-801, CH-802 and CH-803 with new	$ 3,030,000
50	GEN-03-400-M-1-N	Pipe Inspections	$ 40,000
50	NIT-05-400-S-1-N	Ventilation of LN2 Fill Stations	$ 415,000
40	CHW-14-450-M-1-N	Add Chemical Treatment Program	$100,000
40	FP-04-SITE-S-1-N	Inspect Fire Wall between Experiment Hall and LOM	$ 20,000
40	GEN-06-400-E-1-Y	Continuous Re-Commissioning	$ 935,000
40	GEN-07-450-M-1-N	Plant Operations Manual	$ 130,000
40	GEN-08-400-M-1-N	Preparation of APS Design Guideline	$ 60,000
40	GEN-09-Site-M-1-N	Inspect Underground Hydronic Piping	$ 30,000
30	LTHW-01-450-R-1-N	Temporary Boiler Connections	$ 310,000
20	GEN-01-Site-M-1-N	Pipe Labelling and Condition	$ 200,000
20	HVAC-13-400-M-1-N	Fan VFD Replacement Program	$ 85,000

- Chilled water system dominates as top priority:
  - Focus on Cooling Water Tower Upgrades, flushing of chilled water piping
  - Condenser water filtration is urgent and will need to be moved on quickly
  - Filtration is a key component of the tower upgrade (alternative to replacement), thus want to keep coupled
    - Business case previously submitted by APS Site Operations
- Non-destructive piping inspections are very important for condition assessment for APS

APS DESIGN AND PRODUCTION OF LCLS-II UNDULATOR VACUUM CHAMBERS

- Argonne is responsible to deliver 26 Soft X-Ray (SXR) and 39 Hard X-Ray (HXR) undulator vacuum chambers to SLAC by Sept 2018.
  - The entire project cost ~ $4M, and involved ~ 40 matrixed personnel during a 4-year period.
  - Production of the 65 chambers has taken advantage of in-house expertise and best-in-class facilities.
  - Project is on schedule, within budget, and expect the work to be completed next week.
- Leveraged Argonne's LCLS-I design with a few key improvements:
  1. Two different types of undulators are utilized in LCLS-II, necessitating two different extrusions and two different chamber designs.
  2. Water cooling is incorporated for high-rep rate operation
  3. Earth field corrector coils are incorporated into the chambers



- Chambers are ~12 feet long and made from extruded aluminum. Beam aperture is 5mm X 11mm
- The entire aperture is polished to a mirror finish improving on a process developed to manufacture world-class LCLS-I chambers.
- Beam aperture must be aligned and straightened to +/- 100 µm

Major contributors to the success of this effort: MED, MOM, DD, HSE, TSS, and Central Shops