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# Status of CDX-U

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# Operational Summary

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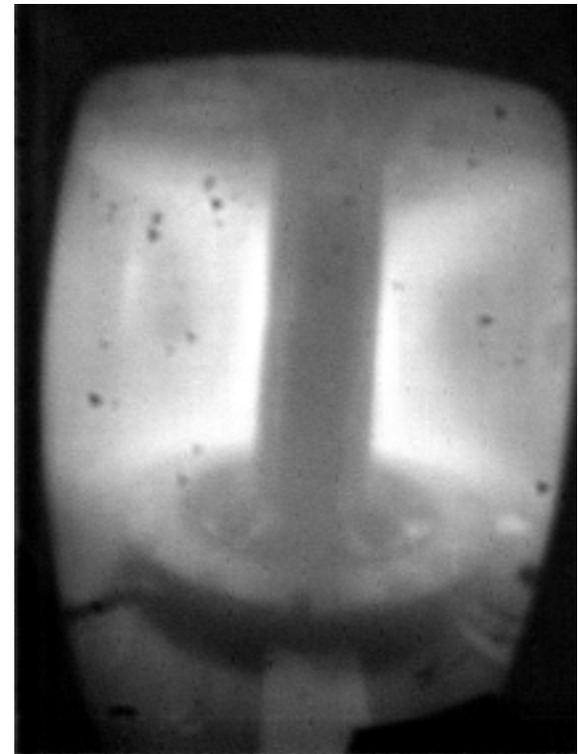
- ◆ No lithium yet.
- ◆ CDX-U suffered a destructive failure of the upper OH correction coil on Feb. 13
  - Coil lead failure at full ( $>20$  kA) OH current.
- ◆ Coil was damaged beyond repair
- ◆ Eddy currents induced by collapsing PF field elastically deformed upper vessel flange (1.4m dia, 1.6 cm thick SS); cracked main interferometer window



# Operational Summary (continued)

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- ◆ Failure of lead due to flexing, work hardening induced by OH cable motion
  - OH cables now independently supported
  - Water cooling restored (leak = early warning of impending failure)
- ◆ Conductor (1/2" square copper with cooling channel) was procured and coil rewound
  - Coil completed, installed, tested week of 3/17
  - Interferometer window had been replaced earlier
- ◆ Control computer failure delayed operations until 3/28
- ◆ CDX-U is now undergoing plasma conditioning
  - Back to 40 kA plasma current
- ◆ New lithium tray fill now scheduled for (early) May
- ◆ Diagnostics ready
  - R. Seraydarian (UCSD) managed to tame our fast camera



# CDX-U near term schedule

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- ◆ March 31 - April 4: Discharge conditioning to increase plasma current and repair diagnostics.
- ◆ April 7 - April 11: Raise tray temperature to  $>500$  degrees C and look for leaks.
- ◆ Test new RF glow discharge cleaning technique for increasing power density on limiter tray surface.
- ◆ April 14 - April 18: Condition; begin documentation of plasma conditions with limiter tray at room temperature.
- ◆ April 21 - April 25: Complete documentation of plasma conditions with limiter tray at room temperature.
- ◆ April 28 - May 2: Begin documentation of plasma conditions with tray temperature up to 350 degrees C.
- ◆ May 5 - May 9: Complete documentation of plasma conditions with tray temperature up to 350 degrees C. Insure proper supports for liquid lithium injectors above CDX-U.

# Thomson Scattering Upgrade (40k supplemental funding)

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- **Present TS system (8 channels) very photon-limited**
  - Multiple summed shots required to reduce Poisson error-bars
- **Fiber-optic sets identified as major limit to optical throughput**
  - Upgrade of fiber sets is underway
  - Improvements to laser heads (flashlamps) also underway
- **Improvement to 4x photon count expected**
  - Error-bar reduction
  - Single shot temperature measurements (core)
  - Extension of usable channels further into edge / low  $n_e$  region
  - Remote placement of spectrometer improves operability

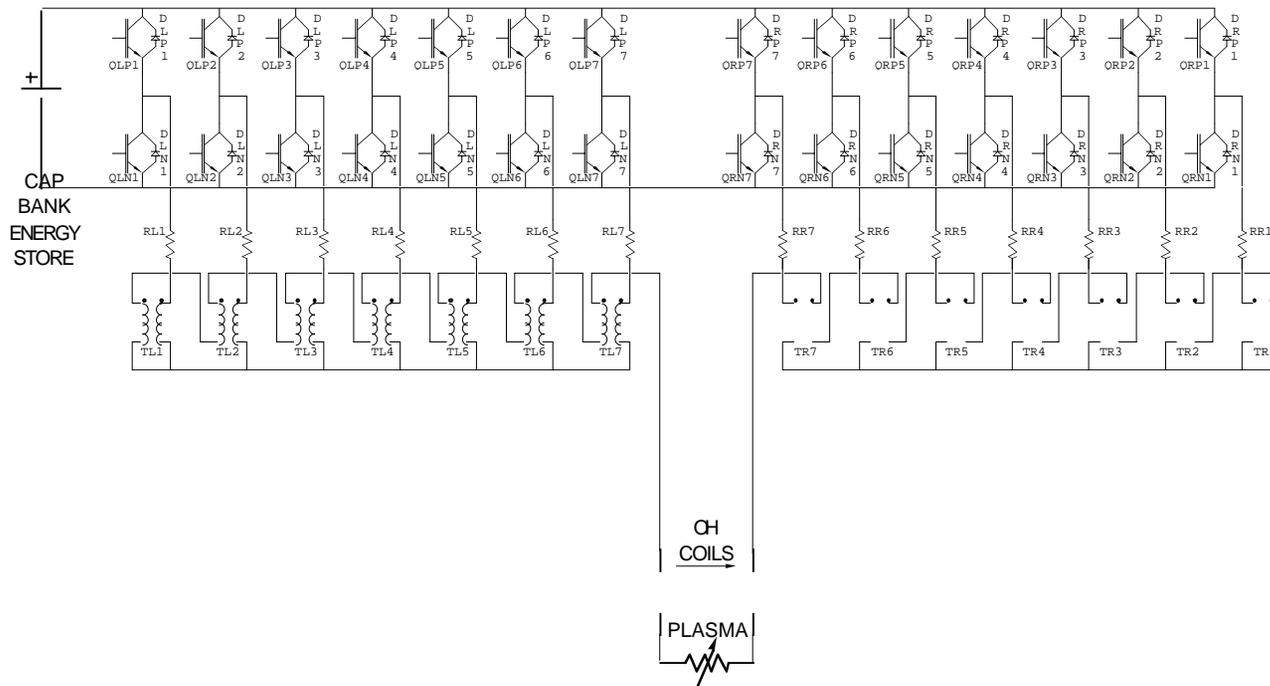
# OH upgrade progress (R. Woolley)

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- ◆ **COGNIZANT DESIGN ENGINEER IS BOB WOOLLEY**
  
- ◆ **UPGRADE PURPOSES**
  - Provide Plasma Current Control for CDX-U
  - Extend Maximum Plasma Current Duration
  - Increase Maximum Plasma Current
  
- ◆ **SCOPE SUMMARY**
  - in FY2003 provide controlled OH Coil Current to  $\pm 30$  kA
  - allow future upgrades (up to  $>70$  kA OH coil capability)
  
- ◆ **VERY TIGHT BUDGET CONSTRAINT REQUIRES**
  - using existing surplus materials and equipment
  - minimizing labor and purchases wherever possible

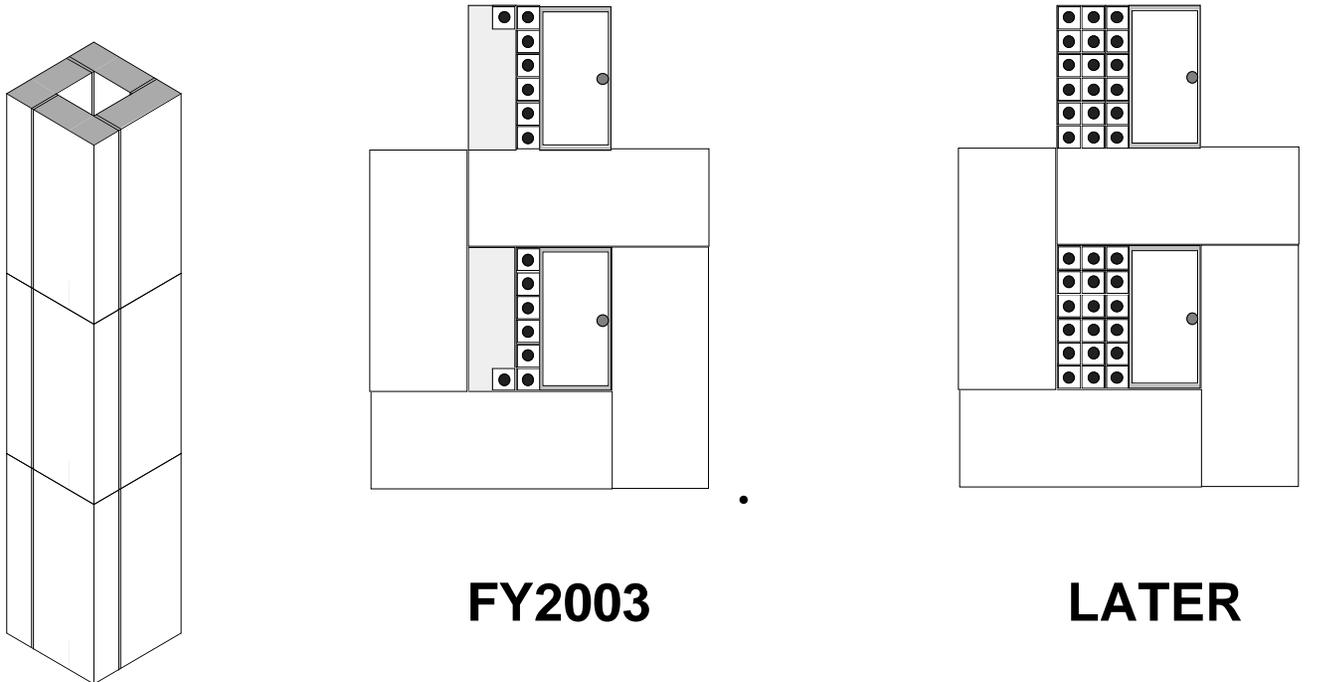
# OH upgrade progress

- ◆ **DESIGNED&ANALYZED CONTROLLED POWER CIRCUIT W/**
- ◆ **(1) paralleled H-bridge choppers employing IGBTs, and**
- ◆ **(2) passive networks limiting recirculating current**
- ◆ **365 kJ 900 volt expandable CAP bank mounted in racks**
- ◆ **PURCHASED & TESTED ALL IGBTs & IGBT DRIVER**



# OH upgrade progress

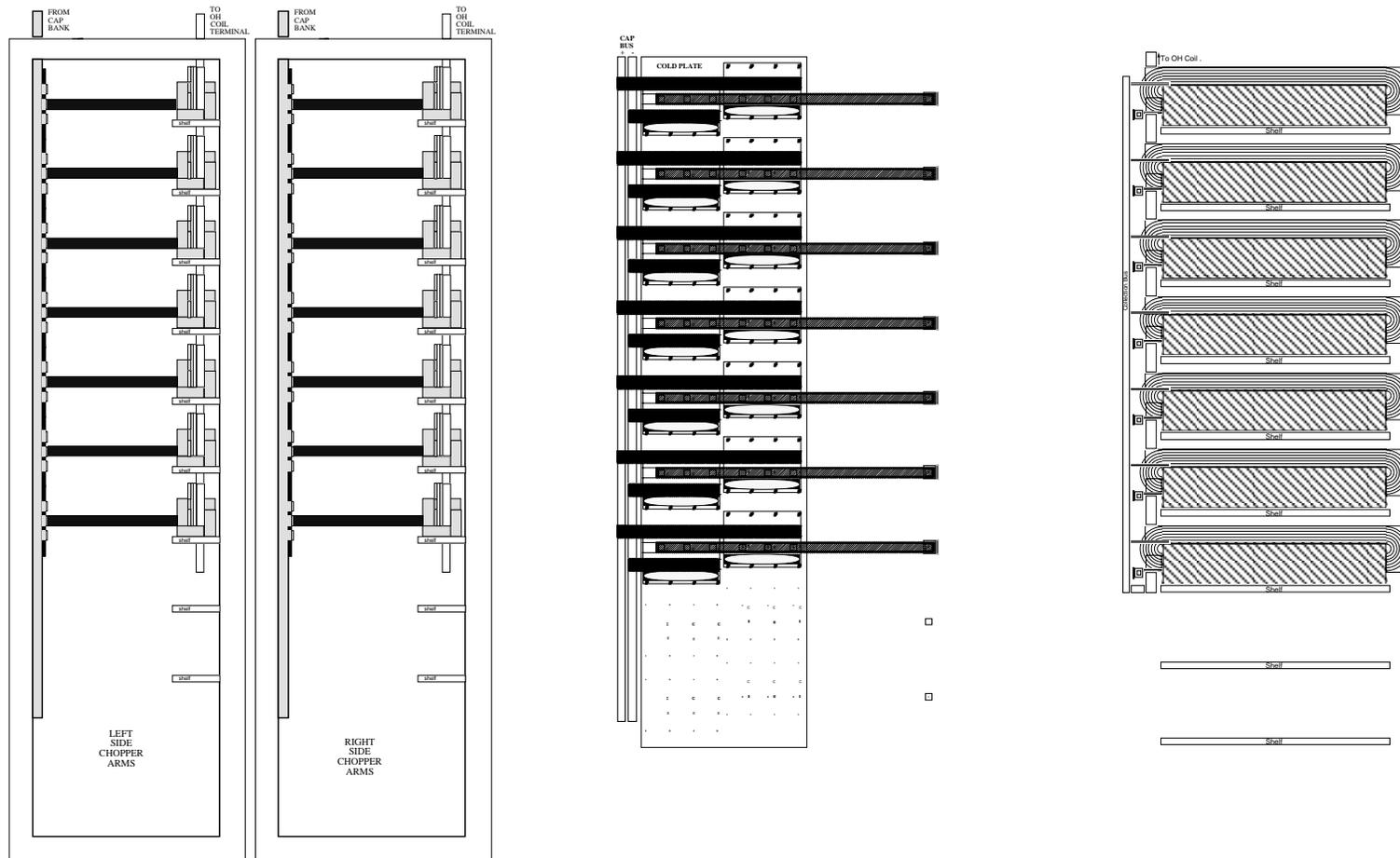
- ◆ **30 kA 5 kHz decoupling transformer design will use PPPL surplus ferrite bricks, & will be expandable to > 70 kA later**



- ◆ **Completion of detailed winding design is in progress**

# OH upgrade progress

- ◆ Power component layout will use PPPL surplus racks



# OH upgrade progress

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## ◆ REMAINING WORK

- complete decoupling transformer design detail
- fabricate & test decoupling transformers
- complete controller implementation design
- Fabricate controller
- PPPL Technical & Safety Reviews w/ documentation
- Complete power supply room
  - (remove shop items, provide safety access interlock, cooling water, OH busswork to CDX-U, etc.)
  - finish cap bank busswork, fusing, charging supply
  - fabricate racks with cooled power components mounted
  - interconnect power equipment, busswork, & controls
  - test / commissioning

## ◆ COMPLETION SCHEDULE (depends on funding & success )

- Operation late in FY2003 is the goal

# Summary - CDX-U

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- ◆ Lithium fill delayed by CDX-U coil failure
  - NSTX followed suit within 18 hours
- ◆ Coil has been replaced
- ◆ CDX-U is back in operation
  - NSTX will not operate this FY
- ◆ Meanwhile:
  - RF discharge cleaning system ready for testing
  - Diagnostics readied for operations
  - Thomson scattering problems, fix identified
  - OH system upgrade in progress

# Summary - Other progress

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- ◆ Internally funded project to demonstrate lithium coated plate technology near completion
  - Cast silver-copper sample plates in procurement
    - » Samples to be sprayed with Mo, W
    - » Disk heaters installed
    - » Mounted in e-beam deposition chamber for coating
  - LTX, NSTX (?) relevant
- ◆ Supersonic gas-jet fueling system in preparation (CDX-U, NSTX)
- ◆ LTX proposal will be resubmitted by May 1
  - Much progress in modeling of nonrecycling tokamaks (Zakharov, Schmidt, Jardin)