

# Electrical Power Systems (WBS 4)

S. Ramakrishnan  
NCSX PWR System  
August 15 2007

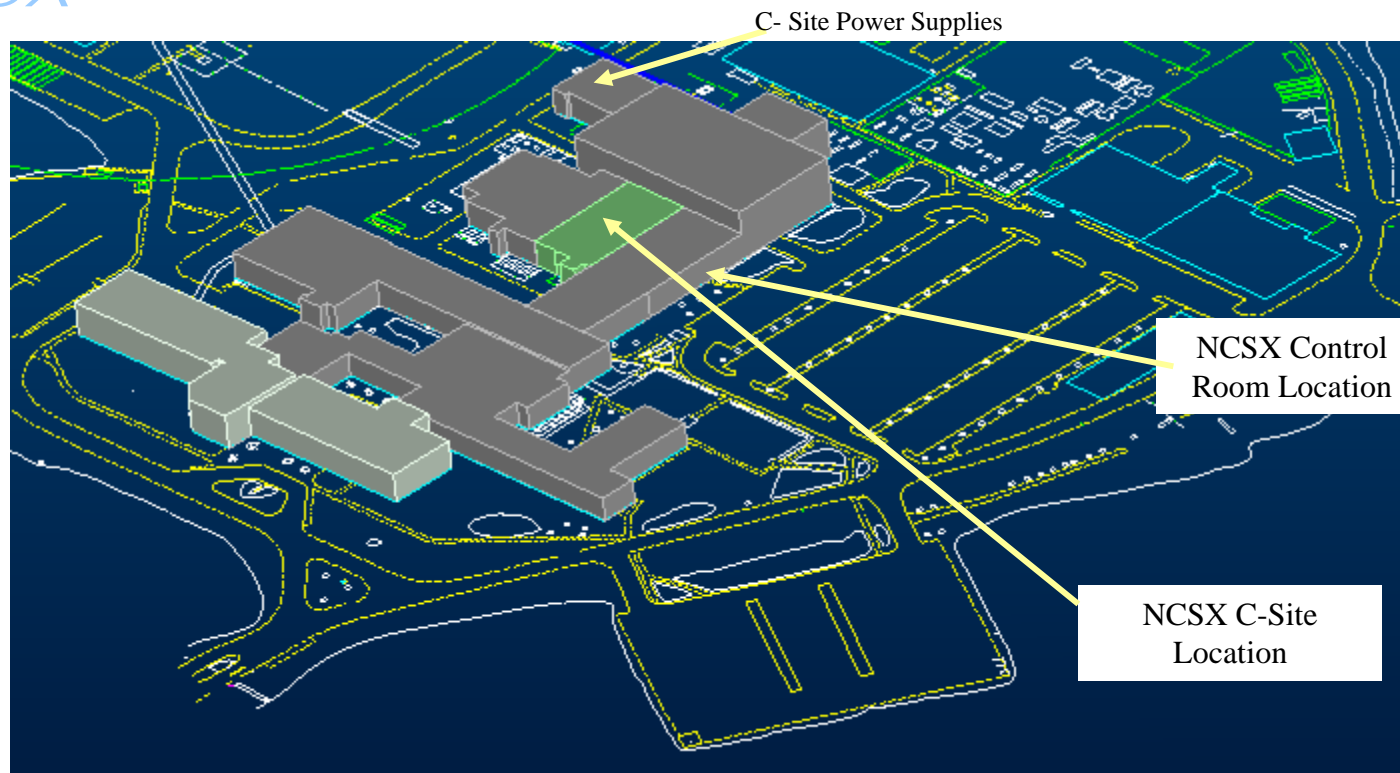
# Electrical Power System Requirements

NCSX

- **Provide Source of all Electric Power for NCSX**
  - **All AC Power**
    - **At all Distribution Voltage levels**
      - » 4.16kV,480V, 208/120V
      - » Includes Experimental AC Power
      - » Includes AC Power to NB
      - » Includes all Auxiliary AC Power up to Power Panels
  - **All DC Experimental Power**
    - **Provide DC power for stellarator coil systems**
      - **2 Modular, and 3 PF coil circuits**
        - » PS requirements based on Initial Ohmic Scenario
        - » Clear path for future upgrades (other scenarios, flexibility)
- **Provide Diagnostics support for Sensor cabling**
- **Grounding**

# PPPL Site Plan

NCSX



# C-Site Power Supplies

NCSX

---

- C-site Rectifier power supplies used for Coil circuits
  - Six (6) Robicon Rectifier Supplies. Each of (2) 6-pulse, 2-quadrant converters in parallel - 12-pulse rectified DC output.
  - One (1) PEI Rectifier Supply. Two 6-pulse rectifier bridges in parallel - 12-pulse DC output
- Sufficient power available for First Phase
- Future upgrades with D-Site Supplies

# Power Supplies Assignment

NCSX

---

<b>1st plasma &amp; Magnetic Configuration (2/2009)</b>				
<b>Circuit</b>	<b>Power Supply</b>	<b>Current 1.5s / 180s</b>	<b>Volts</b>	<b>Peak MW</b>
M1	P10	10kA	200V	2
M2 + M3	P5-1 & 4 (parallel)	10kA	300V	3
PF4	P5-2 in series with PEI	5kA	800V	4
PF6	P5-3	5kA	300V	1.5
PF1a	P20	20kA	500V	10

# Typical Circuit Arrangement Contd.

NCSX

---

- **Disconnect and grounding switches provided for each circuit**
- **Some of Existing cables used from Rectifier Supplies to Disconnects in Test Cell Basement**
- **New Cables (4/c- 500mcm, 600V) from Disconnects to the Bus Stubs in the Tunnel**
- **Current/ Voltage transducers provided**
- **Changeover to CDX possible by disconnecting cables at top of Disconnects.**

# PS Control and Coil Protection

NCSX

---

- **PLC will be provided for Hardwired Controls**
  - **Modern PLC based system**
  - **Additional interlocks as needed**
  - **Coil protection will be provided**
    - **Instantaneous overcurrent**
    - **Ground fault**
    - **Timed overcurrent**
    - **I<sup>2</sup>t limit**

<b>System</b>
<b>411 - Auxiliary AC Power</b>
<b>412 - <i>Experimental AC Power</i></b>
<b>431 - C-site AC/DC Converters</b>
<b>441 - Electrical Interlocks</b>
<b>442 - Kirk Key Interlocks</b>
<b>443 - Real Time Control</b>
<b>444 - Instrumentation</b>
<b>445 - Coil Protection</b>
<b>451 - System Design</b>
<b>452 - Electrical Systems Support</b>
<b>453 - System Testing</b>



# SCHEDULE & COST

NCSX

---

- ALL TASKS WILL COMMENCE 10/01/08 AND FINISH BY 03/01/10
- TOTAL IN-HOUSE LABOR (including overheads)
  - 1970K\$
- TOTAL M&S (INCLUDES CONTRACT LABOR)
  - 455K\$
- TOTAL ETC (May 01 2007) COST
  - 2,425K\$
- SEE SPREADSHEET FOR DETAILED BREAKDOWN

# TECHNICAL & COST BASIS (MIE)

NCSX

---

- **Using existing C-site Rectifier supplies for First Plasma is cost-effective for powering NCSX coils**
  - These supplies have been used for other machines earlier
- **Existing AC power distribution system at C-site will feed other loads & have been used for PBX/PLT/LTX**
- **Clear Upgrade path provided for final stage.**
- **Technical & cost risks is minimal**
  - **Since this is standard electrical work**
  - **Cost is based on industry feedback & PPPL experience on past projects**
  - **Is performed by experienced personnel.**
  - **Careful planning will mitigate schedule risk**
  - **Highest priority to Personnel Safety**

# UPGRADE PLAN

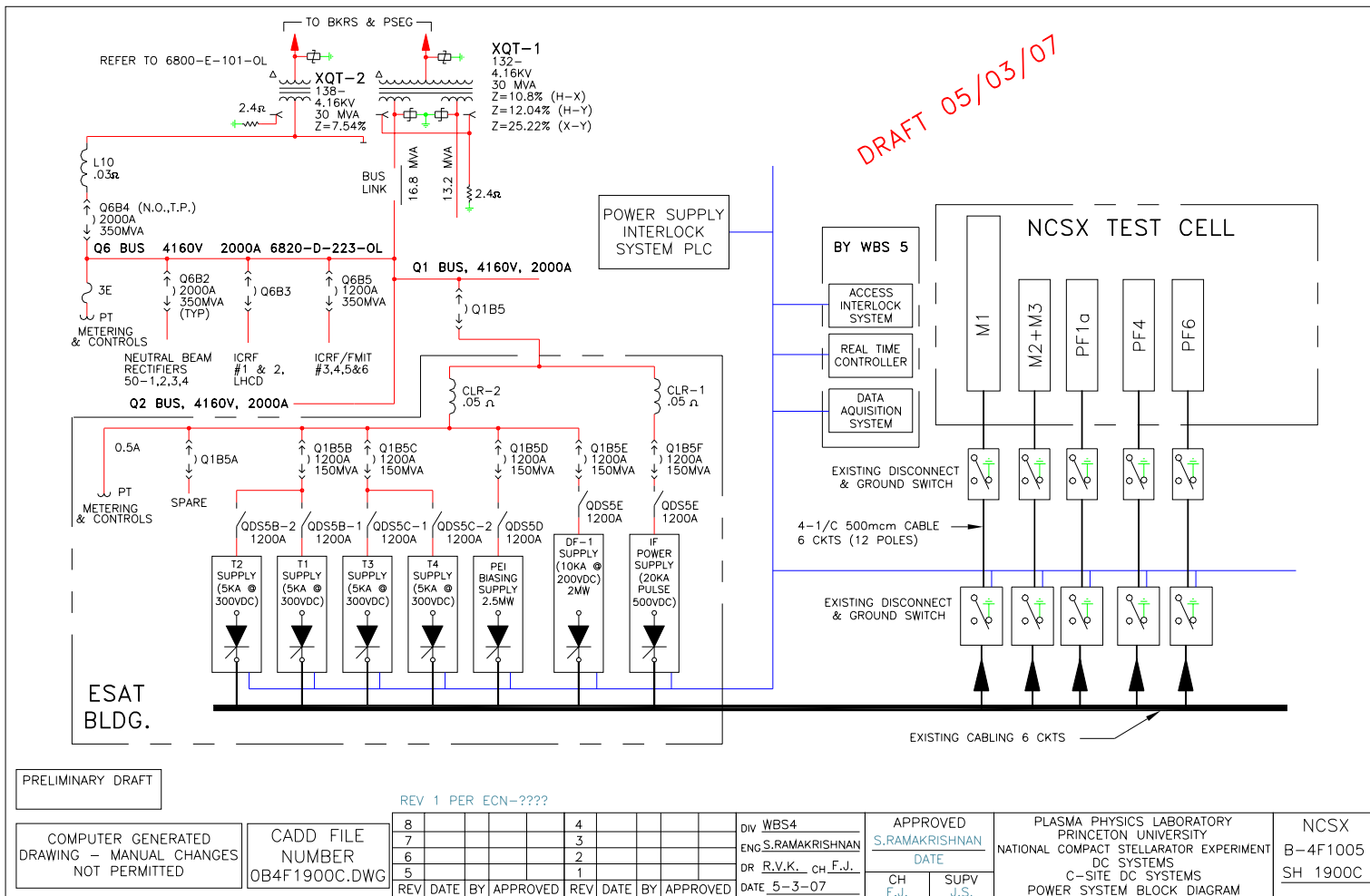
NCSX

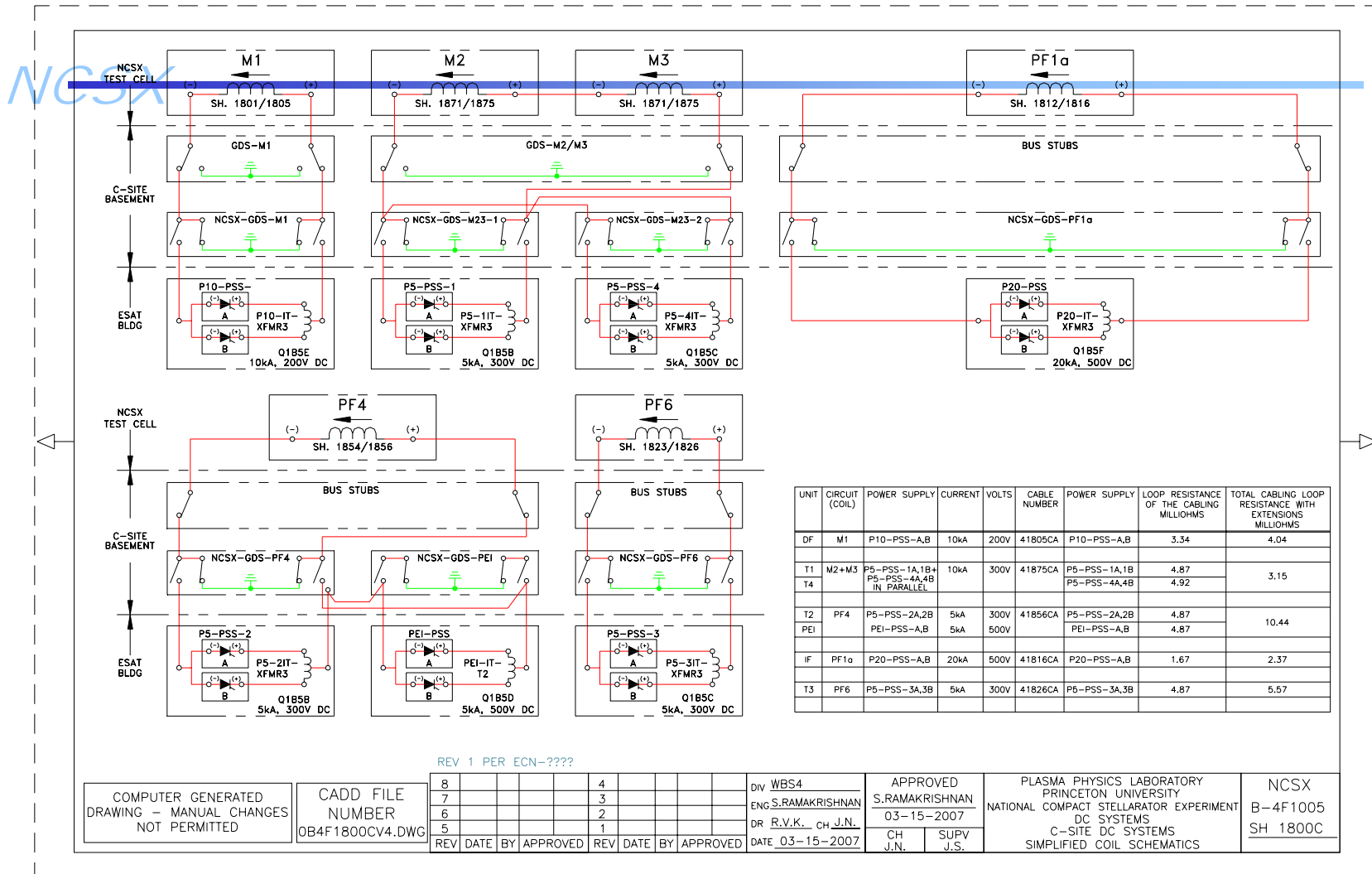
---

- Phase 3 Upgrade plan
- Logical Plan to proceed to Phase 3 Upgrade
  - D-Site supplies will be used
    - Will share supplies with NSTX
    - Only one machine will run for a whole Run period
    - Will use D-Site supplies for 6 coil ckts
    - Two coil ckts will use C-Site supplies
    - Two additional circuits for Trim coils from C-Site

# POWER SYSTEM BLOCK DIAGRAM

NCSX





COMPUTER GENERATED  
DRAWING - MANUAL CHANGES  
NOT PERMITTED

CADD FILE  
NUMBER  
0B4F1800CV4.DWG

8				4			
7				3			
6				2			
5				1			
REV	DATE	BY	APPROVED	REV	DATE	BY	APPROVED

Div WBS4  
ENG S.RAMAKRISHNAN  
DR R.V.K. CH J.N.  
DATE 03-15-2007

APPROVED  
S.RAMAKRISHNAN  
03-15-2007  
CH J.N.  
SUPV J.S.

PLASMA PHYSICS LABORATORY  
PRINCETON UNIVERSITY  
NATIONAL COMPACT STELLARATOR EXPERIMENT  
DC SYSTEMS  
C-SITE DC SYSTEMS  
SIMPLIFIED COIL SCHEMATICS

NCSX  
B-4F1005  
SH 1800C

# C- SITE SUPPLIES

NCSX

---



NCSX PWR.Systems  
August 15 2007

S. Ramakrishnan  
Slide 14

# C- SITE SUPPLIES

NCSX

---

