NCSX
National Compact Stellarator Experiment

Onsite Fabrication Overview

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Outline

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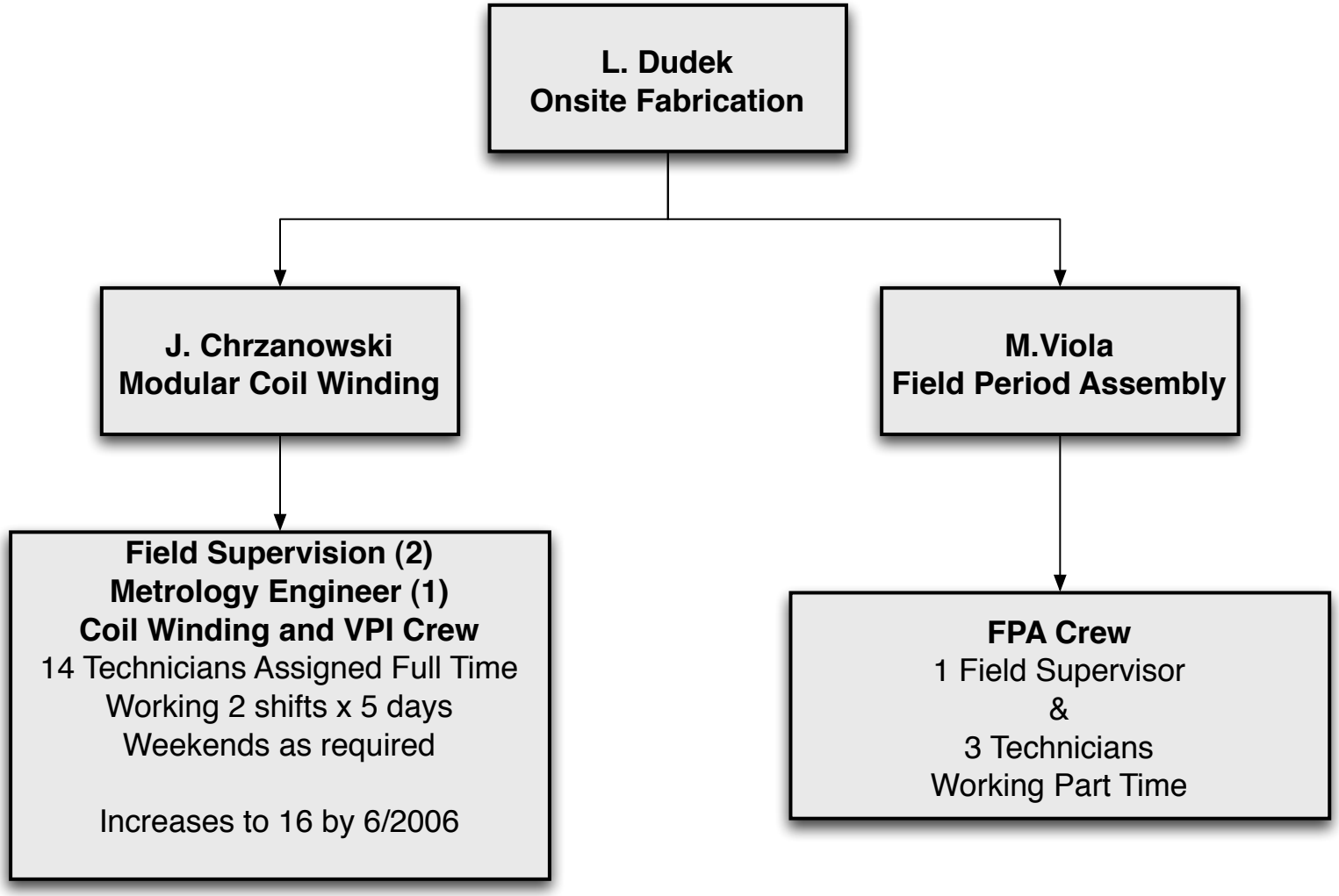
- Organization and Facility
- Modular Coil Process Control and Improvement
- Field Period Assembly
- Quality
- Safety
- Summary

Fabrication Organization



Was 6 Technicians in Nov 2005

A Master Plan with Sufficient Space

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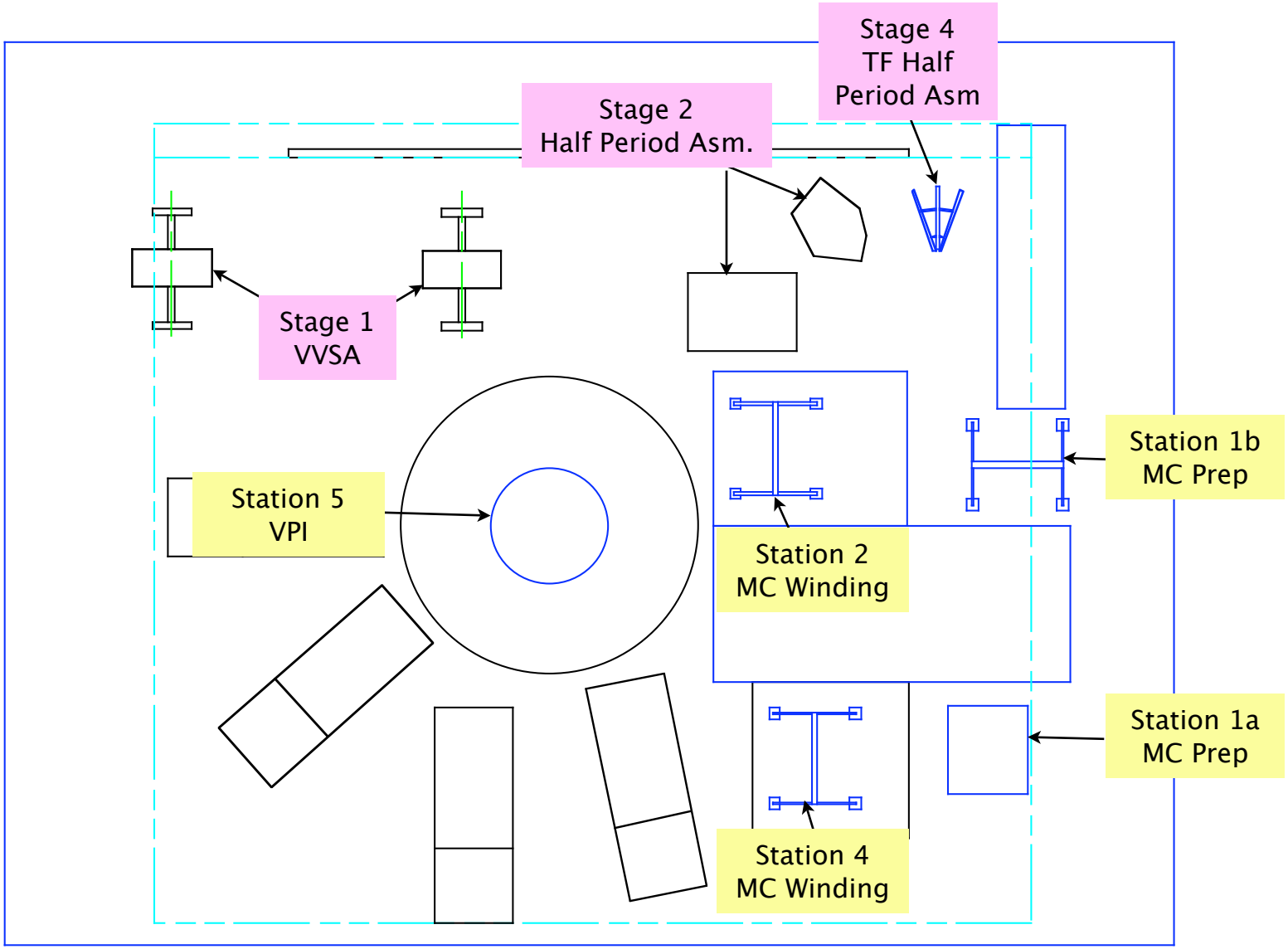

A Master Plan with Sufficient Space

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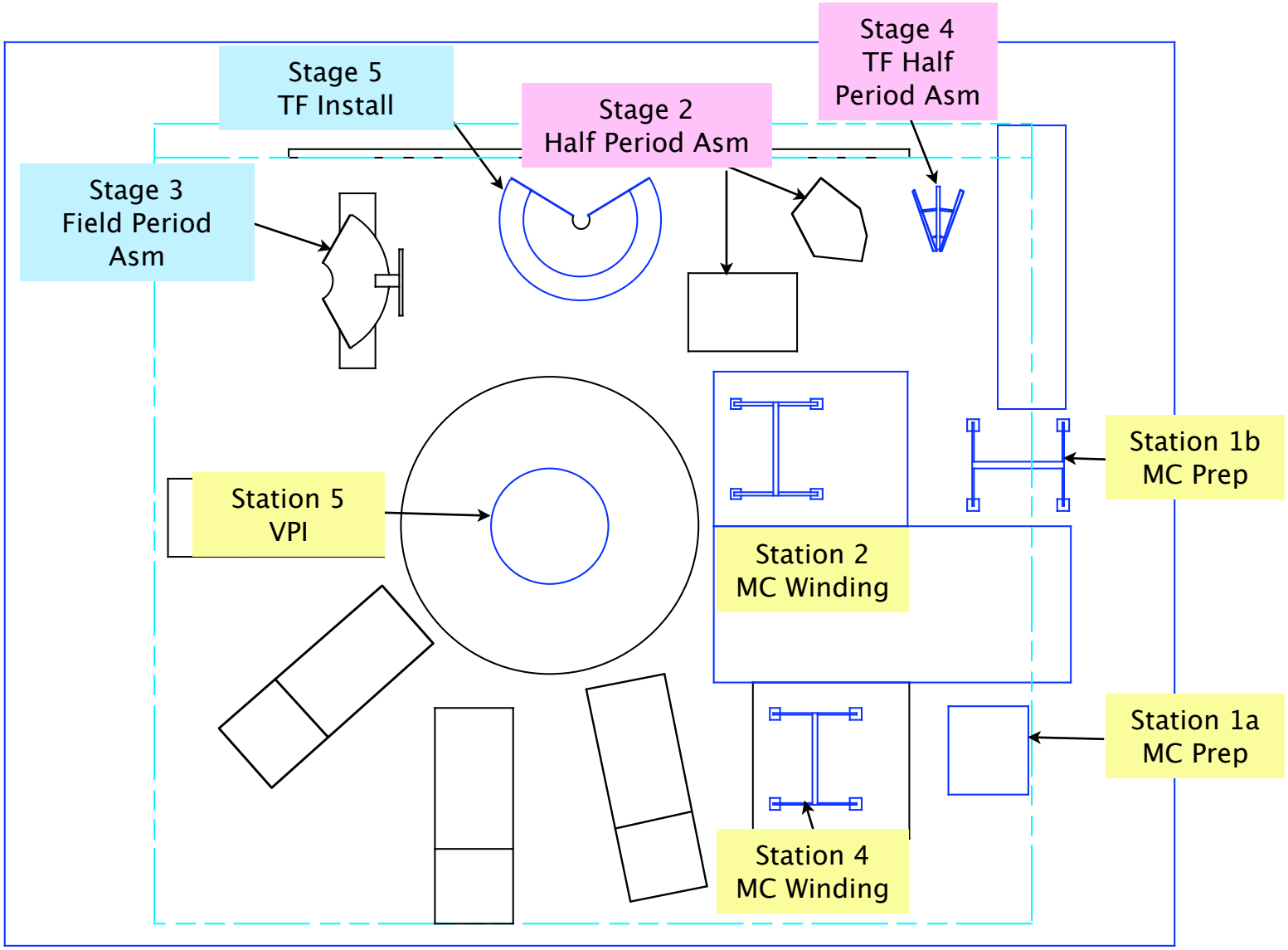

Modular Coil Process Control and Improvment

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- Project level schedules are broken down to daily work schedules with detailed work assignments
  - Work schedule issued for 2 week period, but tuned further on a weekly / daily basis
  - Two shift / 5 day operations with weekends used for makeup
- Actual hours spent on coil winding are tracked on a daily basis using a Daily Report
- Hours are tracked for 50 different tasks which account for the work needed to turn a raw casting into a completed coil
- Hours are entered into a database to collect and summarize data

Modular Coil Process Improvement-Database

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NCSX Fabrication Cost Tracking
Summary Report

	Estimate	Hours	Cost
C3 Coil			
01 Winding form rework activities	16	40	$3,257.60
03 Position & mount casting to support ring	160	48	$3,909.12
04a Balance coil in fixture	16	16	$1,303.04
05 Weld monuments, stud adapters & lead nuts	32	30	$2,443.20
06a Position and weld studs for clamps	72	73	$5,945.12
07 Fitup Lead blocks and terminals	32	8	$651.52
08 Inspect Casting	32	108	$8,795.52
09 Clean Casting	16	20	$1,628.80
10 Install edge Kapton and Mold release	16	36	$2,931.84
11 Install Inner Cladding Plates	192	56	$4,560.64
12a Install Coil in Turning Fixture	24	40	$3,257.60
12b Install / Set Winding Clamps (both sides)	60	84	$6,840.96
12c Position Ground Wrap (both sides)	225	108	$8,795.52
12d Position Lacing (both sides)	50	62	$5,049.28
13a Position and secure 1st coil lead set Side A (inc.	50	66	$5,375.04
13b Wind Side A (10 turns)	275	80	$6,515.20
14a Lift to rotate coil for Side B winding (inc. prep for	24	30	$2,443.20
15a Position and secure 1st coil lead set Side B (inc.	40	62	$5,049.28
15b Wind Side B (10 turns)	275	56	$4,560.64

Modular Coil Process Improvement

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- Data Analysis
  - Totaled every week and compared to estimate
  - Opportunities for improvement are discussed with project management at a weekly meeting
- Feedback
  - Data collected is assembled in graphical form to feedback to technicians
  - Technicians have become motivated in besting previous winding times and identifying areas for improvement
- Value Improvement Proposals (VIP)
  - Team members are encouraged to submit suggestions for process improvement
  - Improvements to Safety, Quality, Cost, Risk & Schedule

VIP's Implemented

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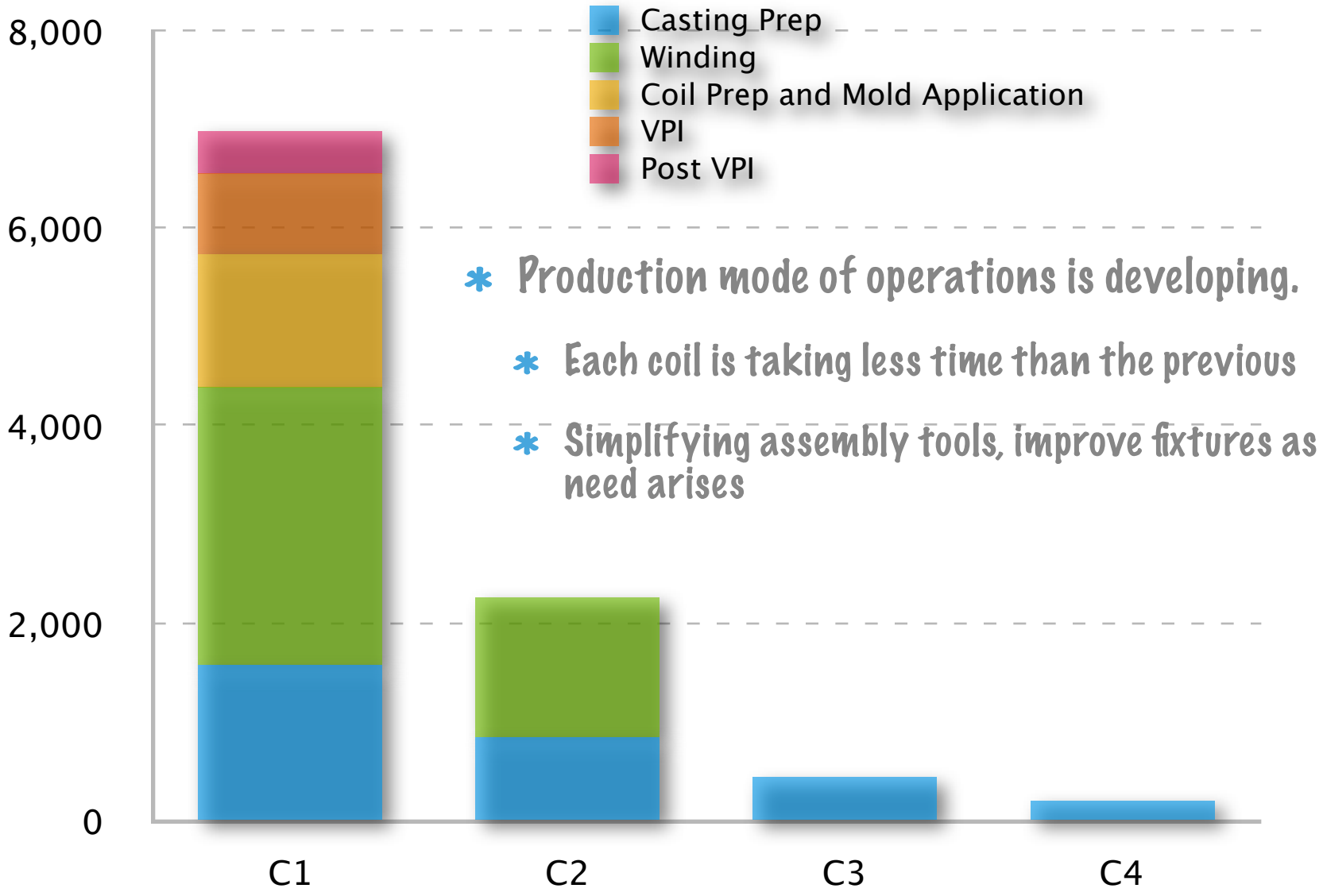
Almost 30 Value Improvement Proposals identified

Area	Identified / Implemented
Tool Changes	14/13
Design Changes	4/2
Process Changes	4/1
Autoclave Change	1/1
Labor	1/1
Vendor	1/1
Requirements Change	2/0

Coil Winding Hours



* Production mode of operations is developing.
  * Each coil is taking less time than the previous
  * Simplifying assembly tools, improve fixtures as need arises

FPA Fixture Schedule Supports Assembly Plan

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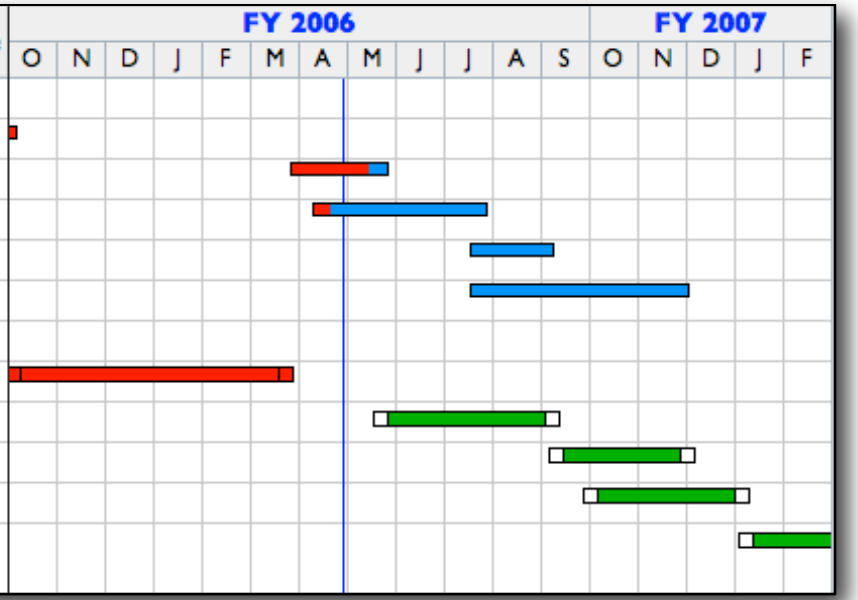
- Two (2) Stage 1 fixtures were completed
  - Second fixture fabricated to permit work on 2 VVSA's in parallel
- Stage 2 fixture design completed and in analysis

Activity Name	Start Date	Finish Date
Design		
Stage1: VV Prep Fixture Design	7/5/05	10/5/05
Stage2: Half Period Assembly Fixture Design	3/27/06	5/26/06
Stage 3: MC Installation Fixture Design	4/10/06	7/28/06
Stage 4: TF Half Period Assembly Design	7/17/06	9/8/06
Stage 5: Final FP Assembly Design	7/17/06	12/1/06
Fabrication		
Stage 1: VV Prep Fixture Fab	10/5/05	3/24/06
Stage 2: Half Period Assembly Fixture Fab	5/22/06	9/8/06
Stage 3: MC Installation Fixture Fab	9/11/06	12/1/06
Stage 4: TF Half Period Assembly Fab	10/2/06	1/5/07
Stage 5: Final FP Assembly Fixture and Platform Fab	1/8/07	3/9/07



Progress on FPA in FY06

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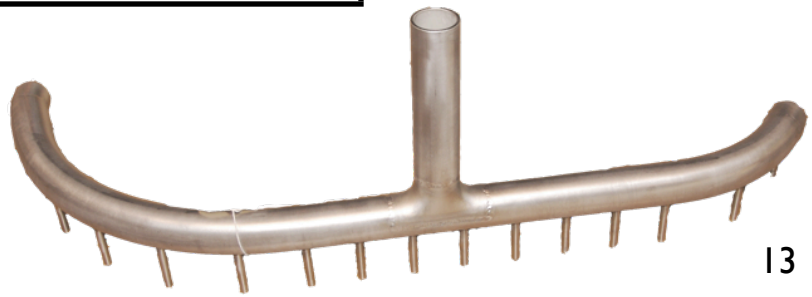
- Field Period Assembly:
  - Plans and procedures required for Station 1 are near completion
  - Lead technician preparing procedures
  - Laser Tracker training held in February for FPA/MC Technicians
  - Station 1 VV assembly Fixtures were completed
    - First VV segment scheduled to arrive 5/06
  - Many of the small parts are arriving, being inspected and stored

FPA Parts Arriving to Support Schedule

Parts	Status
VVSA	1st to arrive in May
Cryostat Interface Flanges	Arrived / Inspected
Diagnostic Loop Templates	Cut / Inspected
Heater Tapes Port 12	Arrived / Inspected
Heating Cooling Manifold	Arrived / Waiting Insp.
H/C Manifold Mounts	Arrived / Inspected
Flux Loop Conductors	Arrived / Inspected
Vacuum Vessel Supports	Partial / Inspected
Heater Tapes Remainder Ports	To be ordered
Heating Cooling Hoses	To be ordered
Heating Cooling Small Hardware	Partially ordered

Over 33,000 parts have been ordered, received, accepted and stored



FPA Plans and Procedures Support Fabrication

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Field Period Assembly Plans and Procedures		
NCSX-MIT/QA-185-01-00-dB	Field Period Assembly Manufacturing, Inspection, Test , and Quality Assurance Plan	In Approval Cycle
NCSX-PLAN-FPA-00-dA	Field Period Assembly Plan	Approved
NCSX-PLAN-FPA1SEQ-00	Station 1 Field Period Assembly Sequence Plan	Approved
NCSX-PLAN-FPA1DC-00	Field Period Assembly Station 1 Dimensional Control Plan	Approved
NCSX-PHA-142-01-01	NCSX Manufacturing Facility Project Hazard Analysis	In Approval Cycle
D-NCSX-FPA-QA1-00	Field Period Assembly Component Receipt Inspection	In Approval Cycle
D-NCSX-FPA-001	Field Period Assembly Station One	Draft

Facility Operations-Safety

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- All activities are performed Safely, Safely, Safely
- Safety is an integral part of every activity performed in the area
  - Held several toolbox safety meetings to review timely topics (Recent accidents at PPPL or other labs, new requirments, etc)
  - Job Hazard Analysis for all new activities
  - Regular safety inspections by NCSX, PPPL & DOE management
  - Daily Walkthrus by Industrial Hygiene
  - Daily Walkthrus by management
  - Prejob / Post Job Briefs
- Safety Performance: There have been no time loss accidents associated with the Modular coil production activities
  - Governor's Occupational Safety & Health Award May 4th

Facility Operations-Quality

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- Quality Control
  - Procured parts are inspected using a sampling plan
    - Dimensional Inspect
    - Magnetic Permeability
    - Other Inspections as required
  - Internal welding operations are 100% inspected
  - Critical lifts require special procedures and 100% QC review
- Example of Quality Improvements
  - C1-C2 Chill plates & cladding were originally cut internally but deburring was expensive
  - C3 thru C6 coil chill plates and cladding were laser cut and were improved but created a "Laser Oxide" problem
  - A type coil cladding and chill plates are being Wire EDM cut to eliminate oxide problem

Summary

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- The NCSX Winding Facility is up and running and aggressively improving performance and costs
- Plans for the start of the FPA Facility are progressing
- First two FPA fixtures completed, second design completed
- Planning and process improvement are being used to constantly improve safety