PXIE Electrical Engineering

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PIP-II
17 Feb 2015
Outline

• Perceived scope of PXIE electrical activity
• Status of activity
  – The good news
  – The bad news
Systems Within Scope of PXIE Electrical Engineering

- RF Amplifiers and Distribution
- LLRF
- Power Supplies
- Power Distribution
- Instrument Interface - Data Converters & Data Acquisition
- Motion Controls
- Interlock Systems

- Machine Protection System
- Timing, Triggers, and RF
- Networking
- General Controls
  - Instrument data storage and retrieval
  - Soft control loops
  - Data analysis applications
  - Operator interface
Components Outside Scope of PXIE Electrical Engineering

• Beam line (vacuum) hardware
  – Physical instruments (BPM, Toroid, Faraday Cup, etc.)
  – Magnets
  – Accelerating Cavities (already designed)
  – Kickers, Absorbers, and Choppers

• Fuzzy Interface Items
  – Cavity input couplers
  – Cryogenics instrumentation and control
The good news: successful systems designed and commissioned.
**Ion Source System**

- Complex system involving pulsed high voltage, interlocks, and systematic controls.
- Much of the system design carried over from HINS application.
- Robustness of system improved with application of controls state machines and real time feedback.
Alison Scanner

- Successful commissioning of complex instrumentation.
- Precise motor controls and high voltage supplies interfaced to computer running LabView application.
- Timing system modified to trigger system for pulsed and CW beam operations.
- Local data processing and storage modified for optimal analysis.
Chopper Supply Commissioning

• Fast rise/fall, high voltage pulsed power supply commissioned.
• Integrated with timing system for synchronizing instrumentation.
• Ethernet communication with ACNET.
• Machine protection override feature.
RF Distribution (picture from R. Pasquinelli)

- First test of CW RF power amplifier commissioning.
- Remote monitoring through ACNET using industry standard Ethernet protocols.
- Complex, coupled interlock system involving water and detected power.
Controls Operator Interface

• Parameters set up for nearly all analog control, reading, and digital status.
• Graphical user interface standard (Synoptic) for making systems easy to read and navigate.
• Built in state machines and real time feedback maintain stability in machine setup.
EE Departments and Systems

- Diverse group of departments with many blocks of specialization.
- Systems and components are designed to be scalable and flexible.
- Designed to respond to operational pressures quickly.
The bad news: weak central collaboration.
EE Departments Collaboration

- Weak design communication between systems in different departments.
- Designers try to anticipate necessary features.
- Feature interference not well conceptualized, usually discovered during commissioning.
- Very expensive technique for system reconciliation.
Design Issues that will be Costly without Collaboration

• Placement and distribution of electrical equipment.
• Machine global timing system for pulsed and CW beam operation.
• Machine protection.

Costly/Ineffective Responses

• Many more big meetings.
• Create small group (person) responsible for generating requirements.
Mechanical Engineering Collaboration

• ME collaboration transformed into more effective system.
• Architecture developed that allows multiple engineers to contribute to global design without direct supervisory control.
• Cross boundary, peer reviews are common and expected.
Approaches to Improve EE Collaboration

• Extend mechanical engineering process with new CAD standards.
• Implement new process for system design collaboration.
Standards for Electrical Wiring Diagrams

- Extends the process developed by ME into EE realm.
- Would standardize interface between mechanical and electrical system design.
- Would point out discrepancies in wiring connections between systems.
- Would point out possible space and power shortages.
Fundamental Standards for System Architecture Design

- A well documented, graphical standard for creating and tracking system requirements.
- Used in many large commercial organizations as well as U.S. government organizations (NASA, DOE, etc.)
- Teamcenter designed as a tool for implementing this process.