Improved Control Algorithm for Infrared Paper Dryers

ECE 480 Senior Design Review

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Sponsor: Potlatch Corporation, Pulp and Paper Division
Presentation Outline

• Background
  • Previous Design Work
    • November 3rd Tour
      • Design Concept 1
        • Design Concept 2
          • Design Concept 3
            • What’s Next?
Background - Paper Manufacturing

• Uniform Moisture Content = Good Paper
• IR Dryers:
  – Divide paper sheet into “zones”
  – Monitor zone moisture content
  – Adjust zone heat
Background – Control System

Paper Line
- Moisture Sensor

Control Room
- Operator Computer

Control Rack
- Phase Monitoring
- CPU Card
- Trigger Card 1
- Trigger Card 2
- Trigger Card 3
- Trigger Card 4

Power Computer
- Gate Drivers/Thyristors

IR Lamps

RS 485
Background - Potlatch Installation

- Potlatch purchased IR Dryers from Compact Engineering Ltd.
- Present Control algorithm doesn’t consider cumulative effect of individual lamp loads
- Some Total Harmonic Distortion (THD)
- High Crest Factor (CF)
Previous Design Work

• Spring 05’ design team
  – Created improved control algorithm
    • Decreases THD and Crest Factor
  – Tested algorithm with scaled system model
  – Provided demonstration of concept
  – Provided architecture for power computer
November 3rd Tour – Big Picture

- High level perspective of control hardware
- Understanding of physical locations
November 3rd Tour – Cabinets

Power Cabinet

Control Cabinet

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November 3\textsuperscript{rd} Tour – PMU

• Phase monitoring unit
  – Detects zero crossings
  – Build or Purchase
November 3rd Tour – PMU

• Layout
  – 30 hours @ $30/hour = $900

• Fabrication
  – $400

• Total = $1300
November 3rd Tour – Knowledge Gained

- Arcom manufactures Power Computer, CPU card, and SERT 485 board
- Thyristor connection details
- RS 485 hardware connections
- Phase transformer specifications
Conceptual Design – Current System

- **Issues:**
  - Some THD
  - High CF
Conceptual Design – Design 1

• **Pro’s:**
  – Least expensive solution for paper machine #1
  – Less new hardware design
  – Majority of current system left in tact

• **Con’s:**
  – More reverse engineering
  – Stuck with power computer architecture
  – Modify Compact’s power computer code
Conceptual Design – Design 2

- **Pro’s:**
  - Less reverse engineering
  - High quality power computer documentation
  - Lower long term cost

- **Con’s:**
  - Higher development cost
  - More design engineering
  - More testing required
Conceptual Design – Design 3

• **Pro’s:**
  - Little to no reverse engineering
  - Develop new communication protocol
  - Easily managed user defined power levels

• **Con’s:**
  - Most development cost
  - More development time
  - Require extensive testing
What’s Next? – Project Tasks

• **Detailed knowledge of 1st team’s work**
  – Jay with Rob

• **Operator and Power Computer code**
  – Blake with Carl

• **Hardware design**
  – Carl with Blake

• **Impact of 3-phase power**
  – Rob with Jay

• **Test and verification plan**
  – Carl with everyone

• **System documentation and organization**
  – Rob with Jay

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What’s Next? – Contact Points

- End of conceptual design
  - Mid November
- Approval of proposal
  - Mid January
- System built for testing
  - End of February
- System testing complete
  - End of March
- Installation
  - Next shutdown in April
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Questions?