NASA Glenn PSL-3&4 Control System Upgrade

by

Paul J Lizanich
Tech Lead Electrical Engineer of the PSL Jet Engine Test Facility

Summary:

An overview of the PSL-3&4 Jet Engine Test Facility control system; including its history, a description of the present effort to upgrade from Emerson Ovation v2.2 to V3.3.1, and future upgrade plans.
NASA Glenn PSL-3&4 Control System Upgrade

Paul J Lizanich
Background

Facility originally constructed with panels containing pushbuttons, switches, loaders, and controllers.
Background - WDPF

In 1990 a WDPF (Westinghouse Distributed Process Family) control system was installed in PSL.
Background - WDPF

Similar systems were also installed in the IRT, 8x6, 9x15, and 10x10 wind tunnels.
Background - WDPF

The WDPF systems included state-of-the-art 8 color graphics on WEStation operator consoles with bulky CRT monitors and chiclet keyboards.
Background - WDPF

The WDPF system contained OCR-161 controllers and large Q-line I/O cards.
Ovation Evolution

Ovation supports a wide variety of industry standard platforms, operating system, and network architectures; permitting incremental or discrete evolutions of each system as needed.
Background – Ovation v2.2

In the early 2000s, WDPF evolved into the Ovation product line. NASA Glenn migrated from WDPF to Ovation v2.2 starting in 2002.
Current Ovation Configuration

• NASA Glenn’s major aeronautical facilities today:
  – Ovation v2.2
  – OCR-161 processors
  – AutoCAD control sheets
  – Win2k engineering and operator PCs
  – Windows NT servers
  – Historian

• The goal is to modernize the facilities around testing and budgetary constraints.
Ovation Improvements since v2.2

Ovation v3.0 and above recommends upgrade to OCR400 processor. Ovation v3.0 enables Q-line to Ovation I/O migration.
Ovation Improvements since v2.2

Ovation 3.1 and above requires migration from AutoCAD control sheet drawings to Emerson’s eCAD drawings.
Other Ovation Improvements Since v2.2

• HART (Highway Addressable Remote Transducer) protocol devices require Ovation 2.3 and above

• Ovation 3.3.1 runs on Win 7 or XP operator stations, and Windows Server 2008 or 2003 server class machines
Ovation Upgrade

• Emerson has a process called Evergreen for the migration of older WDPF or Ovation systems to the up-to-date versions of Ovation.
  – DPU upgrade from OCR161 to OCR400 controllers
  – Control sheet change from AutoCAD to eCAD
  – MMI/PC upgrades to Windows7 (or WindowsXP)
  – Server upgrades to Windows Server2008 (or 2003)

• Emerson Q-line I/O twilight
  – Q-line I/O is scheduled to be dropped from Ovation SureService support in 2018
  – Emerson has an upgrade path for Q-line I/O card replacement which does not require any field wiring changes
Ovation Upgrade

• There are two differing approaches being taken based upon schedule and budget
  – Incremental approach
    • Phase I - Evergreen
      – v2.2 to v3.3.1
      – OCR-161 controller to OCR-400
      – AutoCAD to eCAD
      – Win2k to Win7
    • Phase II – I/O Migration
      – Q-line to Ovation line I/O
  – All at once approach
Ovation v3.3.1 Migration Plan

- NASA Glenn has adopted a multi-year plan to upgrade all four major facilities
  - 2010
    - PSL Evergreen
  - 2011
    - IRT Evergreen and I/O card migration
  - 2012
    - PSL I/O card migration
  - 2013+
    - 8x6/9x15
    - 10x10
Verification Plans

- Each facility will perform an Ovation system Validation Plan as part of the Evergreen process
  - Prudent due to control sheet changes
  - Validation Plan includes
    - Subsystem checkout
    - Integrated subsystems test
    - Full facility operation
- Each facility will perform end-to-end checks and subsystem checkouts as part of I/O card replacement
  - To ensure all I/O connectors to the field have been properly connected to new I/O cards
PSL Ovation Network Configuration
PSL Ovation Controller Upgrade

• Fully redundant controller pair
  – Dual Intel processors
    • PCI bus structure
    • Up to five process control tasks each with different loop execution rate
    • 128MB Flash & 128MB RAM
    • Four 10/100MB Ethernet NIC ports
  – Dual network interfaces
  – Dual processor power supplies
  – Dual I/O power supplies
  – Dual auxiliary power supplies
  – Dual input power feeds
  – Dual I/O interfaces
Ovation 3.3.1 I/O Limits

- **I/O capacity**
  - Local I/O
    - Two sets of 8 branches of 8 Ovation I/O modules
    - Two nodes of 4 crates of 12 Q-line cards
  - Remote I/O
    - Eight remote nodes of 8 branches of 8 Ovation I/O modules
    - Eight remote nodes of 48 Q-line cards
DPUs 1/51, 2/52, & 3/53

- DPUs 1/51:
  - PSL3/4 Exhaust Control
  - Turbo Expander Air
  - Heater Engine Air
  - Temperature Control

- DPUs 2/52:
  - PSL3 Inlet Control
  - PSL3 Bypass Air Control
  - Damit Valve (PSL3/4 Exclusion)

- DPUs 3/53:
  - PSL4 Inlet Control
  - PSL4 Bypass Air Control
  - CCE Cold Air Isolation Valves

- Input Types:
  - Analog Input
  - Discrete Input
  - TC Input
  - 120VAC Output
  - Analog Output

- RTD Input
DPUs 5/55 & 6/56

- DPUs 5/55
  - Cell Cooling Air Control
  - PSL4 -80 Combustion Air Control
  - Dry Air/GN2 System

- DPUs 6/56
  - Cooling Tower Water Supply
  - Cooling Tower Water Return

- Analog Output
- Analog Output
- Analog Output
- Analog Output
- Analog Input
- Analog Input
- Analog Input
- Analog Input
- RTD Input
- TC Input

- Relay Output
- 120VAC Output
- 120VAC Output
- 120VAC Output
- Discrete Input
- Discrete Input

- Analog Output
- Analog Output
- Analog Output
- Analog Output
- Analog Input
- Analog Input
- Analog Input
- Analog Input
- RTD Input
- TC Input

Schedule

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<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
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<td><strong>Application</strong></td>
<td>41 days</td>
<td>Fri 8/27/10</td>
<td>Fri 10/22/10</td>
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<td>- Application software freeze</td>
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<td>Thu 9/9/10</td>
<td>Thu 9/9/10</td>
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<td>- Delivery of application to Emerson</td>
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<td>- Control sheet parameter check</td>
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<td>- Control sheet final delivery</td>
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<td>Fri 10/22/10</td>
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<td><strong>Hardware delivery</strong></td>
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<td>- DPU</td>
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<td>Fri 10/15/10</td>
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<tr>
<td>- Network switches</td>
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<td>Fri 10/15/10</td>
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<td>- PCs and servers</td>
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<td><strong>Installation</strong></td>
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<td>- Factory Acceptance Test</td>
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<td>- Hardware Installation</td>
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<td>- Software cleanup</td>
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<td>- Support Systems</td>
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<td>- Air/Exhaust Systems</td>
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<td>- Cold Pipe Test</td>
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Questions?

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