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

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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 5/55 & 6/56

- DPU5
  - Analog Output
  - Analog Output
  - Analog Input
  - Analog Input
  - TC Input
  - RTD Input

- DPU5
  - Relay Output
  - 120VAC Output
  - 120VAC Output
  - Discrete Input
  - Discrete Input

- DPU6
  - Analog Output
  - Analog Output
  - Analog Input
  - Analog Input
  - TC Input
  - RTD Input

- DPU6
  - Discrete Input
  - 120VAC Output
  - 120VAC Output
  - Discrete Input
  - Discrete Input

- Cooling Tower Water Supply
- Cooling Tower Water Return
# Schedule

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<th>Task Name</th>
<th>Duration</th>
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<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>Fri 10/15/10</td>
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<td>PCs and servers</td>
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Questions?

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