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.
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

PSI3/4 Exhaust Control
Turbo Expander Air
Heater Engine Air
Temperature Control

DPU1
Analog Input
Discrete Input
RTD Input

Analog Input
TC Input
Discrete Input
120VAC Output
120VAC Output

Analog Output
RTD Input

PSI3 Inlet Control
PSI3 Bypass Air Control
Davit Valve (PSI3/4 Isolation)

DPU2
Analog Input
Discrete Input
RTD Input

TC Input
Discrete Input
120VAC Output

Analog Output

PSI4 Inlet Control
PSI4 Bypass Air Control
CCB Comb Air Isolation Valves

DPU3
Analog Input
Discrete Input
RTD Input

Analog Input
TC Input
Discrete Input
120VAC Output
120VAC Output

Analog Output

Discrete Input
120VAC Output
120VAC Output
120VAC Output
DPUs 5/55 & 6/56

- DPUS
  - Analog Output
  - Analog Output
  - Analog Input
  - Analog Input
  - TC Input
  - RTD Input
- DPUS5
  - Analog Output
  - Analog Output
  - Analog Input
  - Analog Input
  - TC Input

- DPUS6
  - Analog Output
  - Analog Output
  - Analog Input
  - Analog Input
  - TC Input
  - RTD Input
- DPUS6
  - Analog Output
  - Analog Output
  - Analog Input
  - Analog Input
  - TC Input
DPU 7/57
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Questions?

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