Controls Lifecycle
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David Kaupang
Engineering Manager; BHGE – Control Solutions
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Lifecycle Model – Control Systems

Current Production

- System Production
  - Production Parts
  - Compatible Redesign
  - Design Renewal

Post Production

- Mature
- Last Time Buy
- New Parts
- Exchange
- Remanufactured
- Return & Repair

Legacy

- Ongoing Support Options
- Migration or Retrofit
# GE’s Mark Control Product Status

<table>
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<th>Mark Controls</th>
<th>Years Manufactured</th>
<th>Production</th>
<th>Post Production</th>
<th>Legacy</th>
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<td>Mark I</td>
<td>66-73</td>
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<td>2004</td>
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<td>Mark II</td>
<td>73-82</td>
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<td>Mark VI</td>
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<td>~2019</td>
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<td>Mark VIe</td>
<td>04-</td>
<td></td>
<td>Migration or Retrofit</td>
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</table>

## Mark VIe Benefits:
- Performance – Enhanced Capabilities
- Flexibility – Scalable & Modular
- Availability – Reliability & Experience
- Usability – Intuitive & Functional
- Maintainability – Ease of Support

## Legacy Controls Challenges:
- Parts availability/obsolescence > Operational and Maintenance Risk
- Limited computational power/expandability > Limits Enabling New Technology
- Retiring skilled operators > Lower Personnel Productivity

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Mark V1e Extended Lifecycle Design

- Controller: Simplex, Dual, and TMR Controllers to meet the system needs
- Ethernet Backbone: Local and Remote IO capability and easy system expansion
- I/O: Simplex, Dual or TMR I/O, handles all turbine specific IO
- Software: Modern software tool for design, configuration, maintenance and troubleshooting
Modernization Options

**Full Panel Retrofit:**
- Complete control system replacement
- Longer downtime
- New control system may require additional floor space

**Migration:**
- Non-destructive key component replacement through plug and play
- All field wiring left untouched – no determination/re-termination
- Minimal downtime
- Reduced checkout effort required
- Decreased risk and project scope
- Lower total installed cost

* Timeline dependent on working hours/shifts
** Timeline dependent on working hours/shifts and migration product
Mark IV to Mark Vle

- Pre-assembled, factory tested, panel insert design of new Mark Vle components
- PCBs create plug-in to field wiring terminations, with factory provided cabling to Mark Vle IO.
- Retain existing:
  - Cabinet
  - Field wiring
  - Site drawings
  - Redundancy

*Depending on site conditions and hours worked per day

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Mark V to Vle Migration

- “Plug and Play” design, Mark Vle technology packaged for Mark V form factor.
- Retain existing:
  - Cabinet
  - Field wiring
  - Terminal boards
  - Passive and relay cards
  - Wire labels
  - Site drawings
  - Redundancy
- All new and remaining components on Mark Vle Lifecycle
Mark VI to Vle Migration

Phase 1

- “Platform upgrade” Mark VIe processors, power supplies & latest software

Phase 2

- Replace additional boards and add IONET switches & pack power distribution

Phase 3

- Remove Mark VI VME racks, replace remaining IO, utilize IONET capacity for added function
Phase 1 – Platform Upgrade (Mark VI)

What you’ll get:
Upgraded infrastructure provides increased processing power, latest software, and foundation for remaining phases.

What it takes:
• Install 20A power supplies
• Upgrade boards
  PCMI replaces VCMI
  UCSB replaces UCVx
  PPRO & TPROH1C replace VPRO & TPROH1A
  PSCA replaces VSCA (if applicable)
  PAMC replaces VAMB (if applicable)

Timeline:
5 Days with as few as 2-3 outage days
Phase 2 – Additional Board Replacement

What you’ll get:
Replacement of I/O boards to update components to new technology for extended lifecycle support

What it takes:
- IONET switches and pack power distribution are added for Phases 2 & 3
- Approximately 20 Mark VI I/O boards can be replaced with Mark VIe I/O packs...as required to meet customer needs and/or outage constraints.

Timeline:
Stand-Alone*: ~ 8 days, with 6 outage days
Cumulative (Phase 1 + 2)*: ~9 days, with 7 outage days

* Assumes single shift w/typical # of IO board replacements
Phase 3 – Final Steps

**What you’ll get:**
Product status is set to new Mark Vle lifecycle.

**What it takes:**
- Mark VI VME racks are removed
- Power capacity and distribution added
- Replacement of remaining Mark VI I/O boards with Mark Vle I/O packs

**Timeline:**
- Stand-Alone*: ~9 days, 7 day outage
- Cumulative*: ~14 days, 12 day outage

* Assumes single shift w/typical panel configuration (Frame 6 single fuel)
Parts and Repair Service Offerings

CUSTOMER VALUE

Premium

New

Peace of Mind assured with genuine replacement parts

Remanufactured

Lower Cost Alternative to New Parts

Exchange

Fastest Method to Receive Reconditioned Parts

Return and Repair

Most Cost Effective Repair Option

Test and Certification

Affordable Option to Verify Inventory

Affordable
Controls LifeCare* Subscription

A new partnership offering from GE to help maintain the health of turbine and plant control, generator control and static starter systems. The simple, packaged approach provides GE expertise and proactive support for the lifecycle of your system.

LifeCare offerings include:

• Parts availability and replacement
• 24/7 phone technical support
• On-Site annual visits from a Controls Field Engineer and ControlsCare Service Manager
• Software updates (TILs)
• ControlST upgrades
Questions?