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# LaSalle County Station

## ISG-06 Phase 0 Meeting
## Power Range Neutron Monitor (PRNM)
## Digital Upgrade

**April 5, 2012**

# Agenda



- Introductions, Meeting Purpose & Goals (Kevin Borton – Exelon)
- LaSalle PRNM LAR & Implementation Schedule (Dale Spencer – Exelon)
- Diversity (Vikram Shah – Exelon)
- GEH Services Digital I&C System Life Cycle Development Program (GEH)
- Summary – Conclusion (Public Presentation)
- Questions and Feedback (Public Presentation)
- Conclusion (Public Presentation)
- Continuation of GEH Development Program (Proprietary Information Presentation) (GEH)
- Questions and Feedback (Proprietary Information Presentation)
- Summary – Conclusion (Proprietary Information Presentation)

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# Introductions



## Exelon and GEH Presenters

### Exelon Team

- Kevin Borton – Power Uprate Licensing Manager
- Vikram Shah – Power Uprate Senior Engineering Manager
- Dale Spencer – Power Uprate Project

### General Electric – Hitachi Team

- Eric Mino – GEH Controls Manager
- Larry Chi – GEH Chief Engineer
- Ty Rogers – GEH Engineering Technical Leader

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# Phase 0 Meeting Purpose



- Communicate update of schedule for license amendment and relationship to Power Uprate and MELLLA Plus applications
- Describe preliminary assessment of Diversity and Defense-in-Depth, especially as related to PRNM and Rod Control Management System (RCMS)
- Explain the revised GEH Services Digital I&C System Life Cycle Development Program and how it will be applied to the LaSalle PRNM project
- Discuss options for future Phase 0 meetings

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## LaSalle PRNM LAR Background

- The NUMAC PRNM Implementation at LaSalle will support:
  - Improved Neutron Monitoring System reliability
  - Improved fuel operating margins
  - Increased overall efficiency of the reactor operations
  - Planned MELLLA+ implementation at Unit 1 & Unit 2, after the EPU implementation
  - Enhanced stability monitoring
- Submittal timing of the LaSalle PRNM LAR
  - Phase 1 Submittal — April 2013
  - Phase 2 Submittal — October 2013
  - Unit 2 Installation — February 2015
  - Unit 1 Installation — February 2016

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# Dual Unit LAR Schedule



- LAR Approval to Support Implementation During Spring 2015 Outage
  - Requested Approval → Oct 2014
- Actions Needed By Exelon
  - Phase 1 Submittal → Apr 2013
  - Unit 2 FAT → Sept 2013*
  - Phase 2 Submittal → Oct 2013

* - Unit 2 will be the lead unit for the LaSalle PRNM upgrade

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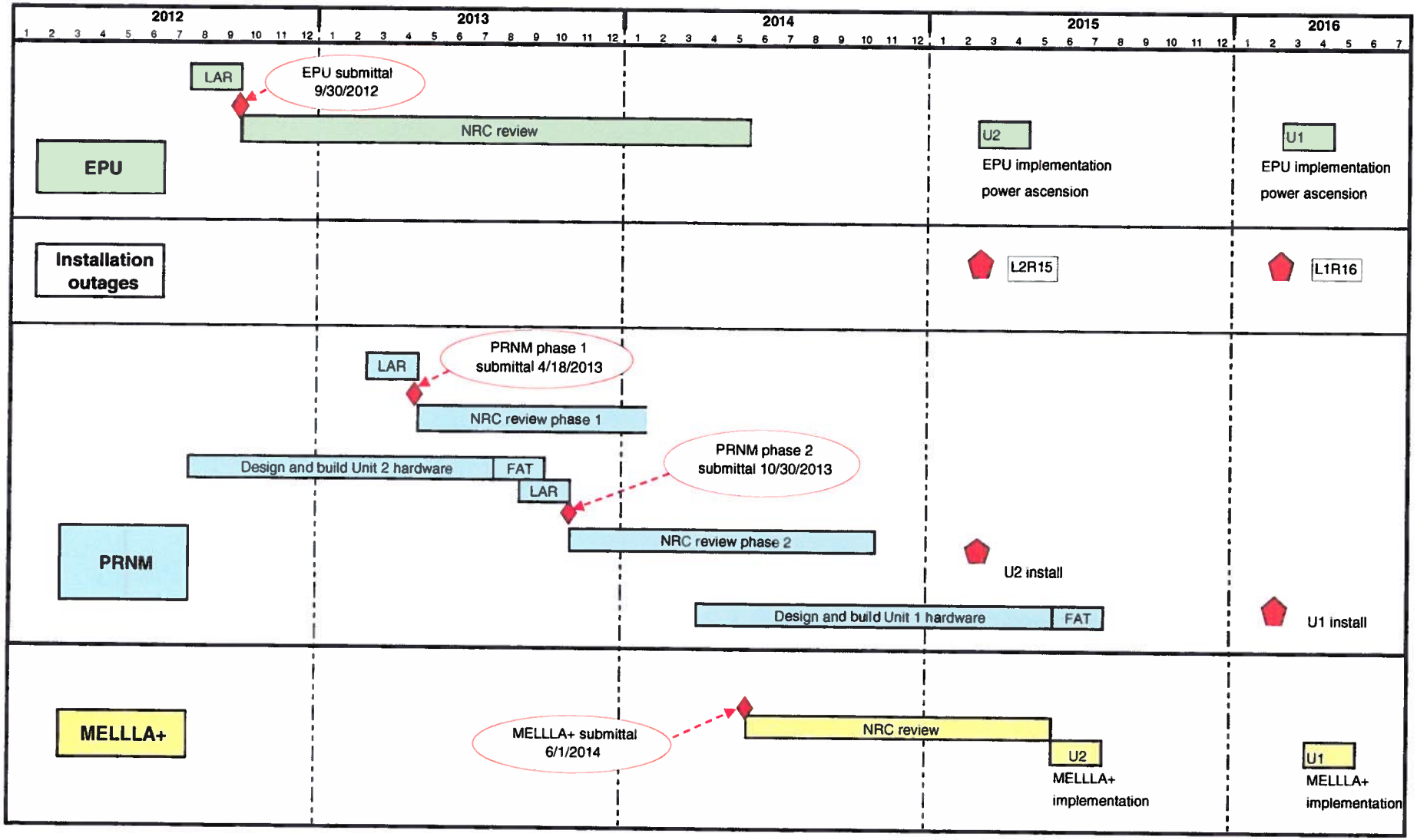
# EPU / PRNM / MELLLA+ Timeline (tentative dates)



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# Purpose

- Provide the preliminary results of PRNM Diversity and Defense-in-Depth assessment which includes the LaSalle RCMS
- Establish an understanding of PRNM Diversity in relation to Rod Control Management System (RCMS)
- Discuss approach for assessing PRNM Diversity and Defense-in-Depth

# DIVERSITY



- PRNM interface with Reactor Trip System (RTS)
  - PRNM (APRM / OPRM) only scram signals affected
  - Other scram signals (Rx Pressure, Rx Level) are diverse and not affected
  - Manual scram is diverse and not affected
- PRNM interface with ESFAS / Monitoring / Control Systems
  - PRNM does not interface with ESFAS
  - Control Room has diverse indications of power / flow state
  - PRNM provides Rod Block to Rod Control Management System (RCMS)
    - PRNM & RCMS are digital with some components of similar design
- PRNM / RCMS common elements acceptable
  - BTP 7-19 criteria met
  - NUREG/CR-6303 diversity assessment

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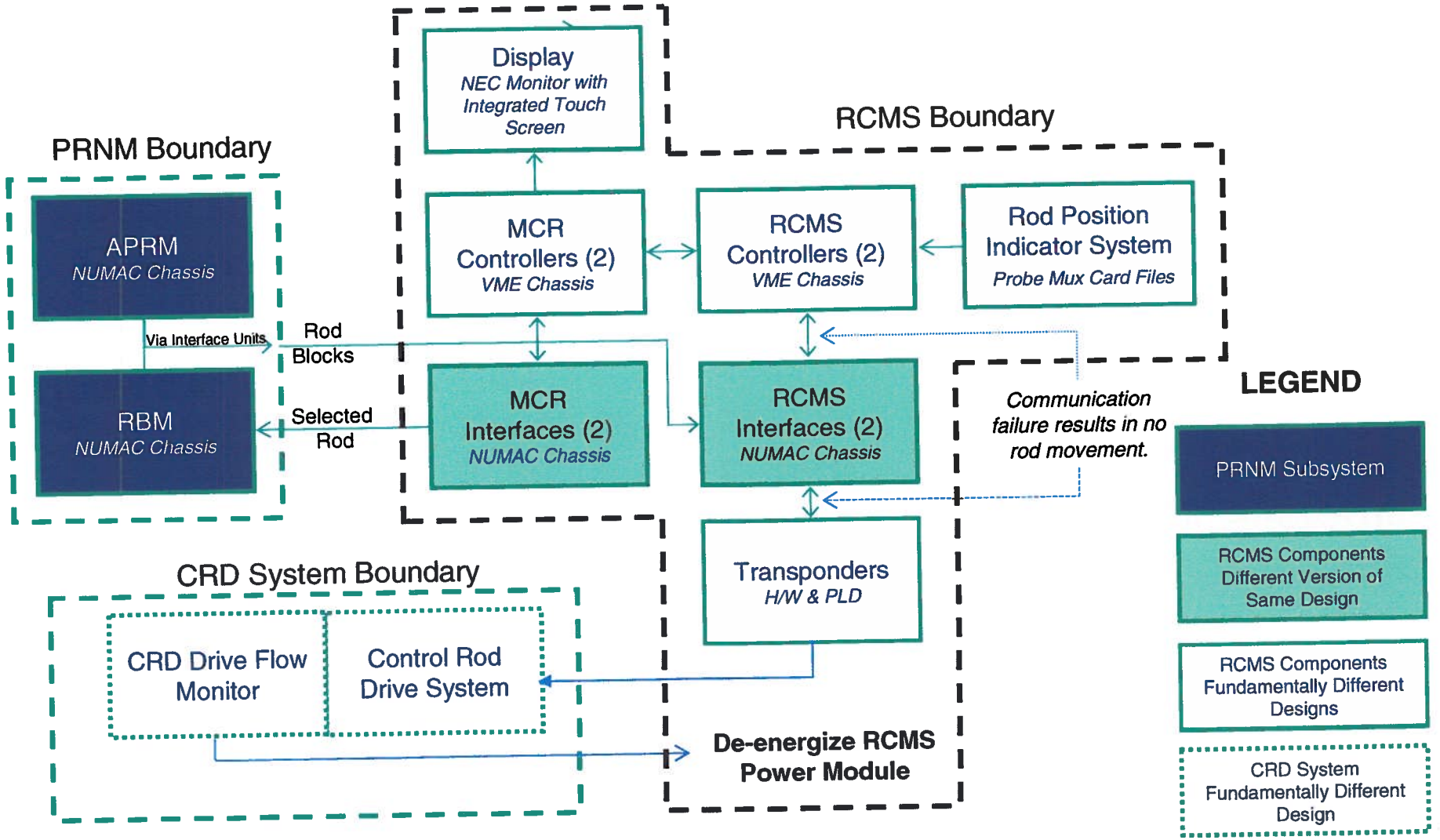
# DIVERSITY: Block Diagram – PRNM & RCMS



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# NUREG/CR-6303 - Assessment of PRNM and RCMS Diversity

| NUREG/CR-6303 (Section 3.2) Diversity TYPES | PRNM Versus RCMS Interface Units (NUMAC CPU) | PRNM Versus Remainder of RCMS Components |
|---|---|---|
| **Design** | Same Technology, Approach and Architecture | Different architecture than PRNM |
| **Equipment** | Different versions of the same design | Different manufacturers of fundamentally different designs |
| **Function** | Different underlying mechanism | Different underlying mechanism |
| **Human** | Different designers, engineers, programmers | Different designers, engineers, programmers |
| **Signal** | Different reactor process parameters | Different reactor process parameters |
| **Software** | Different algorithms, logic;<br>Different timing, order of execution | Different algorithms, logic, and program architecture |
| **OVERALL Evaluation** | PRNM / RCMS Interface Units has "high degree" of diversity based on meeting at least one of the "factors increasing diversity" in 5 of 6 Diversity Types. Therefore sufficient signal diversity exist. | PRNM / Remainder of RCMS are Diverse based on meeting at least one of the "factors increasing diversity" in all Diversity Types |

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# DIVERSITY



## BTP 7-19 Assessment

- **Criteria 1 & 2 – AOO & DBA concurrent with Postulated CCF in PRNM and RCMS**
  - Criteria met – radiological dose within limits and no impact on primary coolant pressure boundary or containment integrity
- **Criteria 3, 4 & 5 - Interactions between different echelons (defense-in-depth)**
  - Criteria 3 met - spurious rod movement blocked by CRD Drive Flow Monitor
  - Criteria 4 met - No interaction between PRNM and ESFAS
  - Criteria 5 met - PRNM does not rely on monitoring & display, RPIS and RCMD Displays functional
- **Criteria 6 - Safety-related means for manual initiation of RTS and ESFAS**
  - Criteria met - manual scram and ESF actuation are independent from PRNM
- **Criteria 7, 8 & 9 - Diverse means of actuation or diverse back-up system**
  - Criteria met – existing RTS / ESFAS diversity adequate

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# Conclusion

- **PRNM Upgrade meets requirement for Diversity and Defense-in-Depth**
- **Existing Reactor Trip System Diversity and Defense-in-Depth are adequate**
- **PRNM and RCMS common elements determined to be acceptable**
  - NUREG/CR-6303 assessment performed - PRNM/RCMS diversity identified
  - BTP 7-19 criteria fully met

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# Feedback ?

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# GEH Development Program (Non-proprietary)



## ▪Purpose

Describe the new GEH Program and its application to the LaSalle PRNM project

### GEH Digital I&C System Life Cycle Program:

- Comply with BTP 7-14 criteria and IEEE Std. 1012-1998
  - Aligns closely with BTP 7-14 and IEEE 1012, *not an alternate process*
  - Incorporates IEEE 1012 SIL Independent V&V
  - Enables full life cycle requirements traceability
  - Compliance with all applicable regulatory guidance (RG 1.152, RGs 1.168 thru 1.173, RG 5.71)
- Life cycle artifacts conducive to DI&C-ISG-06 licensing submittal
  - Produces the documentation required by DI&C-ISG-06
- One scalable process for SW / HW / Programmable Logic
  - Applies the BTP 7-14 criteria to *both software and hardware* (system approach)
- Terminology that is consistent with NRC guidance documents
  - BTP 7-14 and Regulatory Guides // DI&C-ISG-06 // IEEE Standards (ISO/IEC/IEEE 24765)
- Maximize use of standardized templates
  - Planning documents (based on NUREG/CR-6101 and IEEE standards)
  - Artifact content and verification scope

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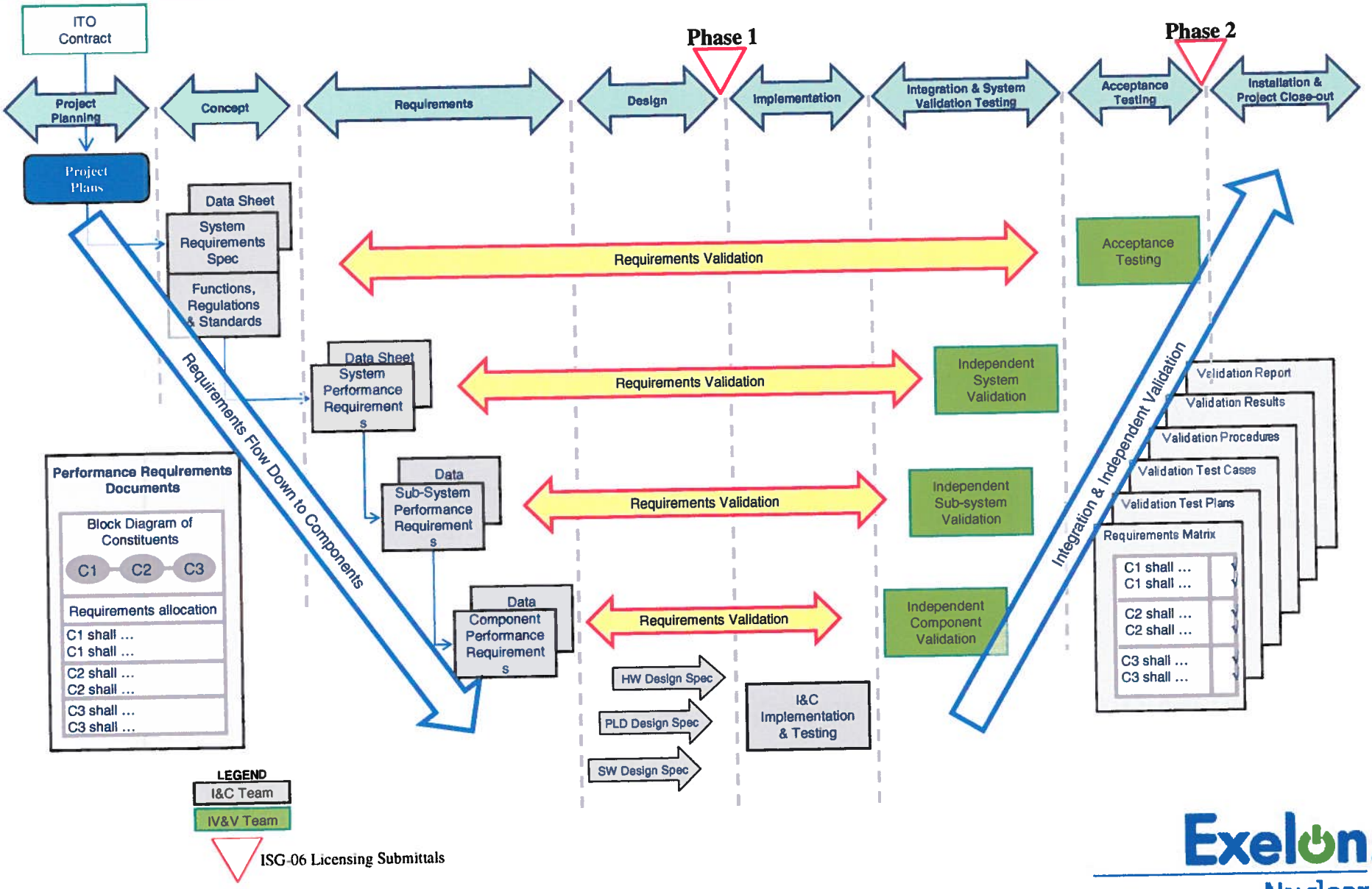
# GEH Services Digital I&C System Life Cycle Development Phases



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# Questions and Answers (Non-proprietary)



Discussion

or

Questions

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# Conclusion and Closure
# Non-proprietary Meeting

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# Acronym List:



**APRM** - Average Power Range Monitor
**BTP** - Branch Technical Position
**CCF** - Common Cause Failure
**CRD** - Control Rod Drive
**ESFAS** - Engineered Safety Feature Actuation System
**GEH** - General Electric Hitachi Nuclear Energy
**HW** - Hardware
**ISG** - Interim Staff Guidance
**LAR** - License Amendment Request
**LPRM** - Local Power Range Monitor
**LTR** - Licensing Topical Report
**MELLLA** - Maximum Extended Load Line Limit Analysis
**NRC** - U. S. Nuclear Regulatory Commission
**NUMAC** - Nuclear Measurement Analysis and Control
**OPRM** - Oscillation Power Range Monitor
**PRNM** - Power Range Neutron Monitor
**RTS** - Reactor Trip System
**RCMS** – Rod Control Management System
**RBM** - Rod Block Monitor
**Rx** - Reactor
**RWE** - Rod Withdrawal Error
**SW** - Software

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# Agenda – Proprietary Information

- GEH Organizational Independence
- GEH Baseline & Technical Design Reviews
- Summary of the GEH Services Digital I&C System Life Cycle Development Program
- Questions and Feedback (Proprietary Presentation)

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# GEH Organizational Independence



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# GEH Development Program Summary



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# GEH Development Program Summary



## GEH Services Digital I&C System Life Cycle Development Program:

- Comply with BTP 7-14 criteria and IEEE Std. 1012-1998
- Life cycle artifacts conducive to DI&C-ISG-06 licensing submittal
- One scalable process for SW / HW / Programmable Logic
- Terminology that is consistent with NRC guidance documents
- Maximize use of standardized templates

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# Questions and Feedback

Discussion

or

Questions

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# Acronym List:



**APRM** - Average Power Range Monitor
**ARI** - Alternate Rod Insertion
**ARTS** - APRM, RBM, and Technical Specification Improvement Program
**BTP** - Branch Technical Position
**CCF** - Common Cause Failure
**CRD** – Control Rod Drive
**EPU** - Extended Power Uprate
**ESFAS** - Engineered Safety Features Actuation System
**GEH** - General Electric Hitachi Nuclear Energy
**HW** - Hardware
**I&C** - Instrumentation and Controls
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**OPRM** – Oscillation Power Range Monitor
**PRNM** – Power Range Neutron Monitor

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# Acronym List (continued):



**NUMAC** - Nuclear Measurement Analysis and Control
**ODA** - Operator Display Assembly
**OPRM** - Oscillation Power Range Monitor
**PLD** - Programmable Logic Device
**PRNM** - Power Range Neutron Monitor
**QA** - Quality Assurance
**QLVPS** - Quad Low Voltage Power Supply
**RCMS** - Rod Control Manual System
**RPS** - Reactor Protection System
**RBM** - Rod Block Monitor
**RWE** – Rod Withdrawal Error
**Rx** – Reactor
**SW** - Software