Advanced Instrumentation, Information, & Controls Research Pathway

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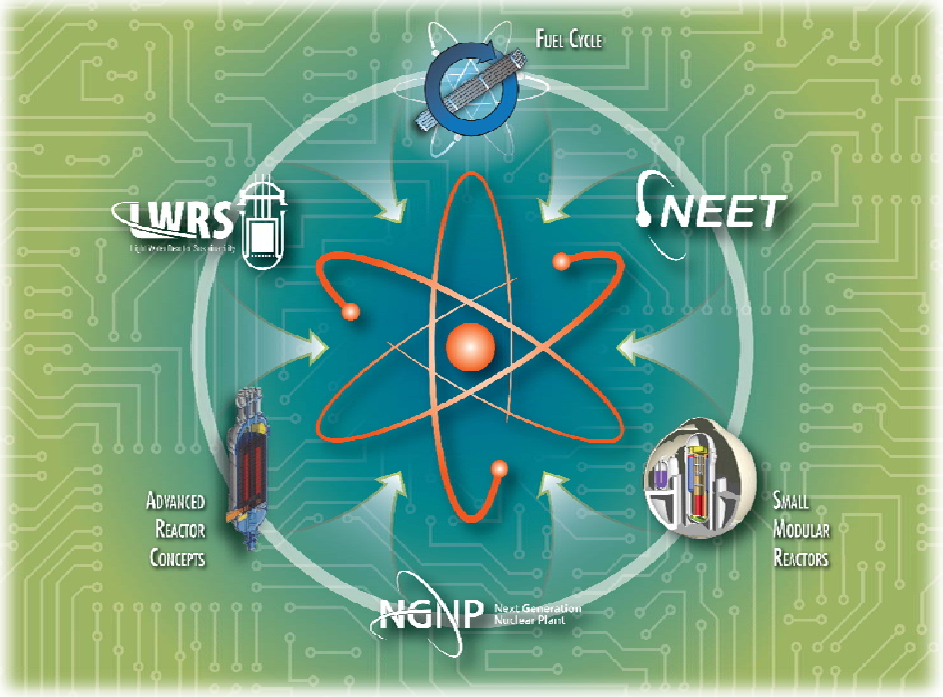
Light Water Reactor Sustainability R&D Program

Part of a Broader Set of Initiatives

- Office of Nuclear Energy R&D programs and initiatives rely upon enabling technologies, including ICHMI.
- Programs have unique objectives, as well as common and crosscutting needs.



DOE LWRSP Mission and Program Objectives

Vision

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.

Program Goals

- Develop fundamental scientific basis to understand and enable continued long-term operation of existing LWRs
- Develop technical and operational improvements that contribute to long-term economic viability of existing nuclear power plants

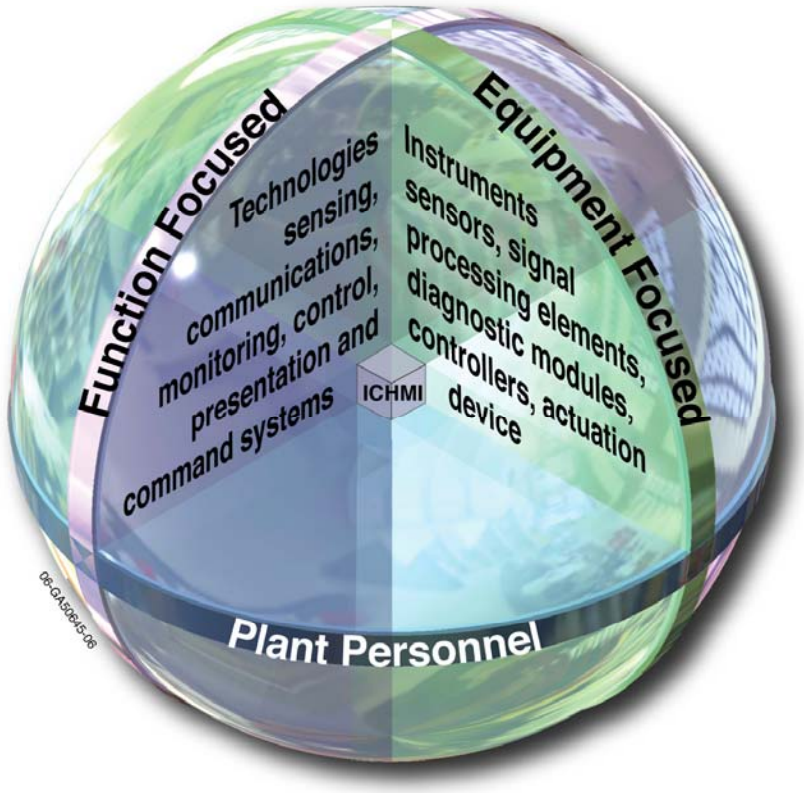
Advanced Instrumentation, Information, and Control Systems Technologies

•Address long-term aging and obsolescence of existing instrumentation and control technologies and develop and test new technologies.

•Establish a strategy to implement long-term modernization of I&C systems.

•Develop advanced condition monitoring technologies for reliable plant operation and develop the means to detect and characterize aging degradation processes.

II&C Pathway Vision & Outcomes



- The commercial nuclear power industry will undertake modernization activities based on the collaborations, strategies, approaches, and demonstrations conducted in this program.
- This program will lead to at least one utility's decision and basis for a long term program of IIC modernization and directly contribute to the decision in favor of long term operation.
- The collective vision developed together in this program will lead to new IIC technologies and commercialization.
- Confidence will be created in the process of developing and deploying technology through this program to support utility and regulatory decisions.
- Technologies developed and deployed through this program will lead to new efficiencies that will be adopted.
- A federally funded and supported IIC Laboratory will form the basis for multi-party agreements used for research, development, demonstration, test & evaluation.

Industry Working Group – 'Working' Charter

Develop agreements with host utilities to demonstrate near-term beneficial digital applications that improve performance at lower cost.

Obtain funding for these projects through a variety of means such as government grants, industry shared research funding, and pay-for-performance financial business models.

Coordinate project development among research organizations associated with the U.S commercial nuclear industry, to the degree practical, to minimize duplication of effort.

Sponsor research on a long-term vision of the nuclear power plant operating/support model based on substantial digital technology integration, and sponsor research on methodologies to identify the cost-beneficial opportunities to transition various plant support functions to a digital technology infrastructure.

Communicate the work of this research program to utility and support industry decision makers to build a collective vision for a transformed plant operating/support model based on digital technology.

Coordinate with major nuclear industry support organizations (e.g. NEI, EPRI, and INPO), to the degree practical, in the pursuit of complementary digital technology developments such as appropriate regulatory requirements, technology applications and guidance, and standards of excellence in digital implementation.

New Alarm Technologies

Alarm Displays

- Beyond alarm tiles
- Prioritized alarm lists
- Single-screen displays for all alarms
- Mode sensitive (different alarms for different plant modes)

Alarm Intelligence

- Automation of key plant functions that cause nuisance alarms
- Filtering alarms to most important information for operator
- Functional grouping of alarms into single alarm
  - More important to know that pump failed than that 25 different flow indications are abnormal

Outage Control Center Project – Paradigm Shift

- Outages represent important source of risk (PRA)
- Fleet wide outages present significant challenges
  - Safety (configuration, accident precursors, worker exposure)
  - Schedule adherence
  - Risk of revenue loss
- Manpower serves as substitute for technology in today's OCC
  - Informatics poor work environment
  - Little real time data
  - Radio & telephone communications
- Utility and site sponsorship for outage control center and work execution center modernization; infrastructure investments.

Configuration Management Pilot Project

- System configuration management a cause of forced outages and Tech Spec non-compliance
  - Non instrumented systems
  - Maintenance, testing, inspection, calibration, etc. manual
  - I&C network full – end of lifecycle technology so no further investments
- Technology substituted for verification and other manual actions
  - Reduce labor requirements in half
  - Bar coding in place
  - Wireless network will be installed if pilot goes ahead
- Development and demonstration of wireless technologies for non-permanent instrumentation and for data streaming
  - Address field reliability, RFI/EMI, cyber – low cost, wireless instrumentation
  - Business process reengineering approach being taken

The approach yields deployable innovative technologies

Requires

•Targeting business functions to displace

•Identification of enabling technologies

•Performance requirements

Achieves

•Improved availability

•Reduced staffing & O&M costs

•Fleet-wide implementation strategies

•More predictable regulatory process

Employs

•Online Monitoring – passive & active

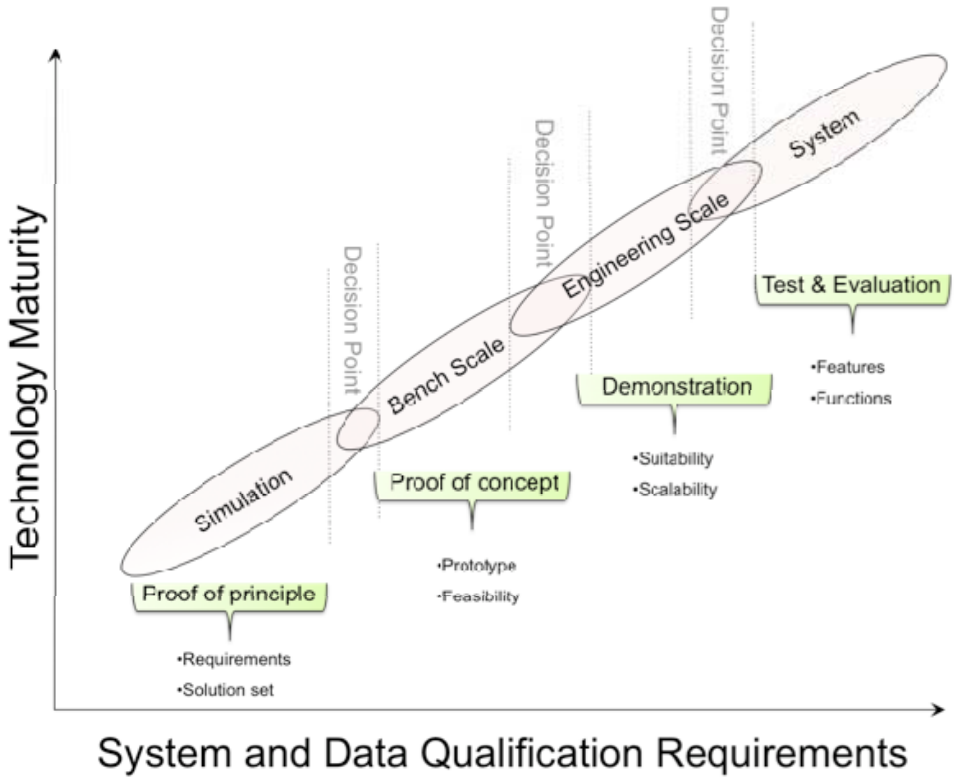
•Smart Sensor Technology

•Human-system integration

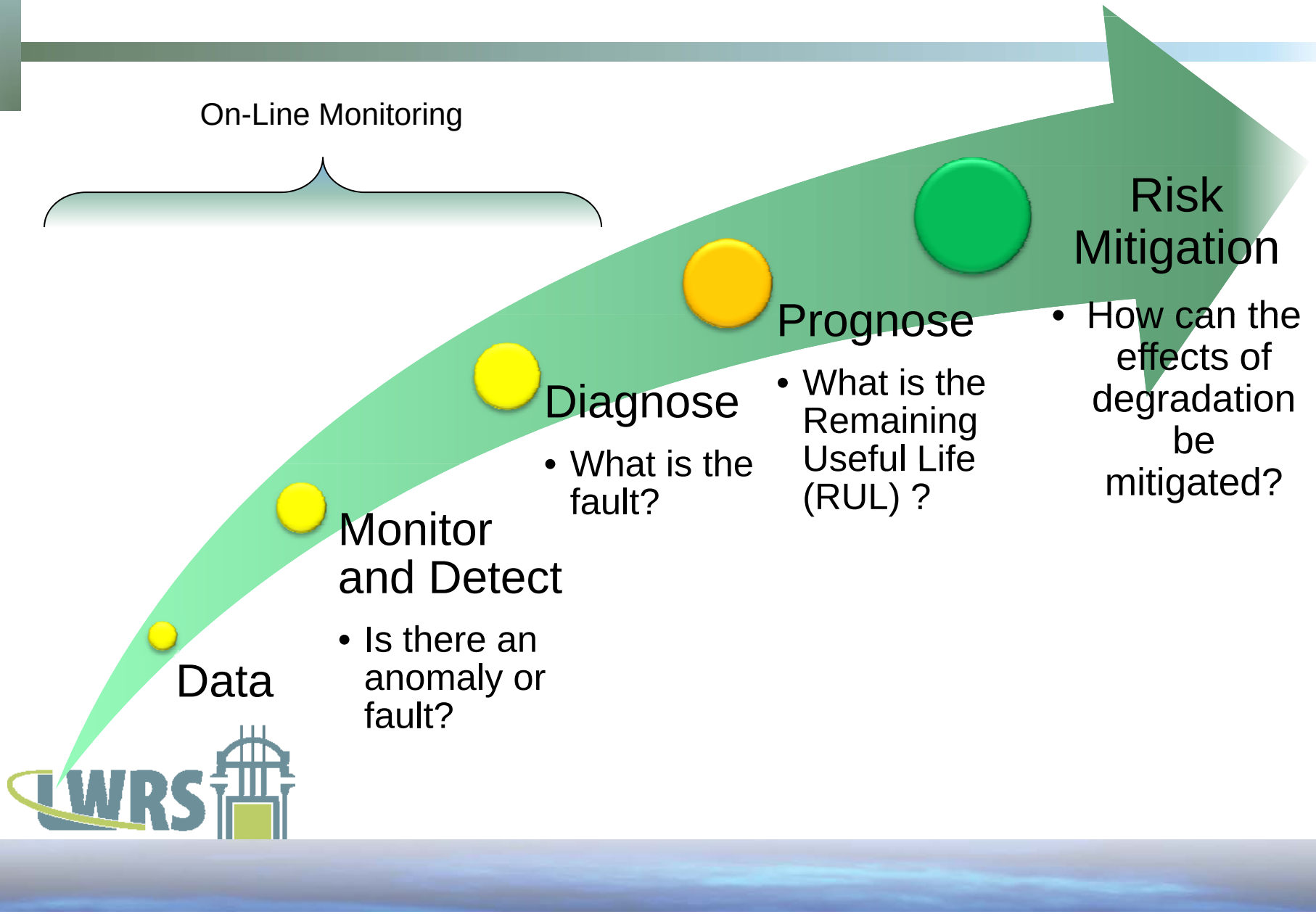
•Enhanced Communications

•Adaptive automation & resilient controls

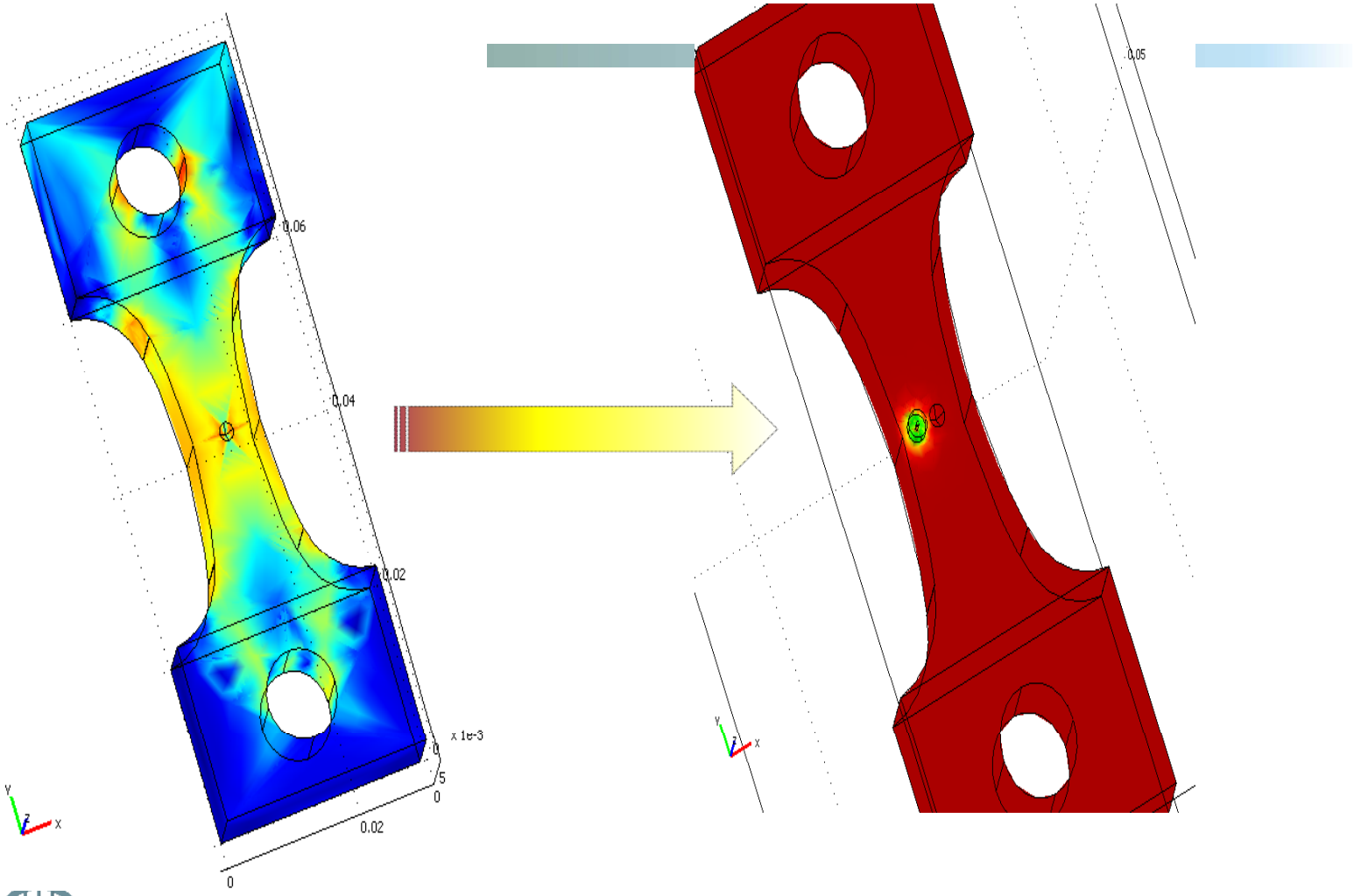
Applied Research Model



Online Monitoring: Active surveillance



Non Destructive Examination



Participants