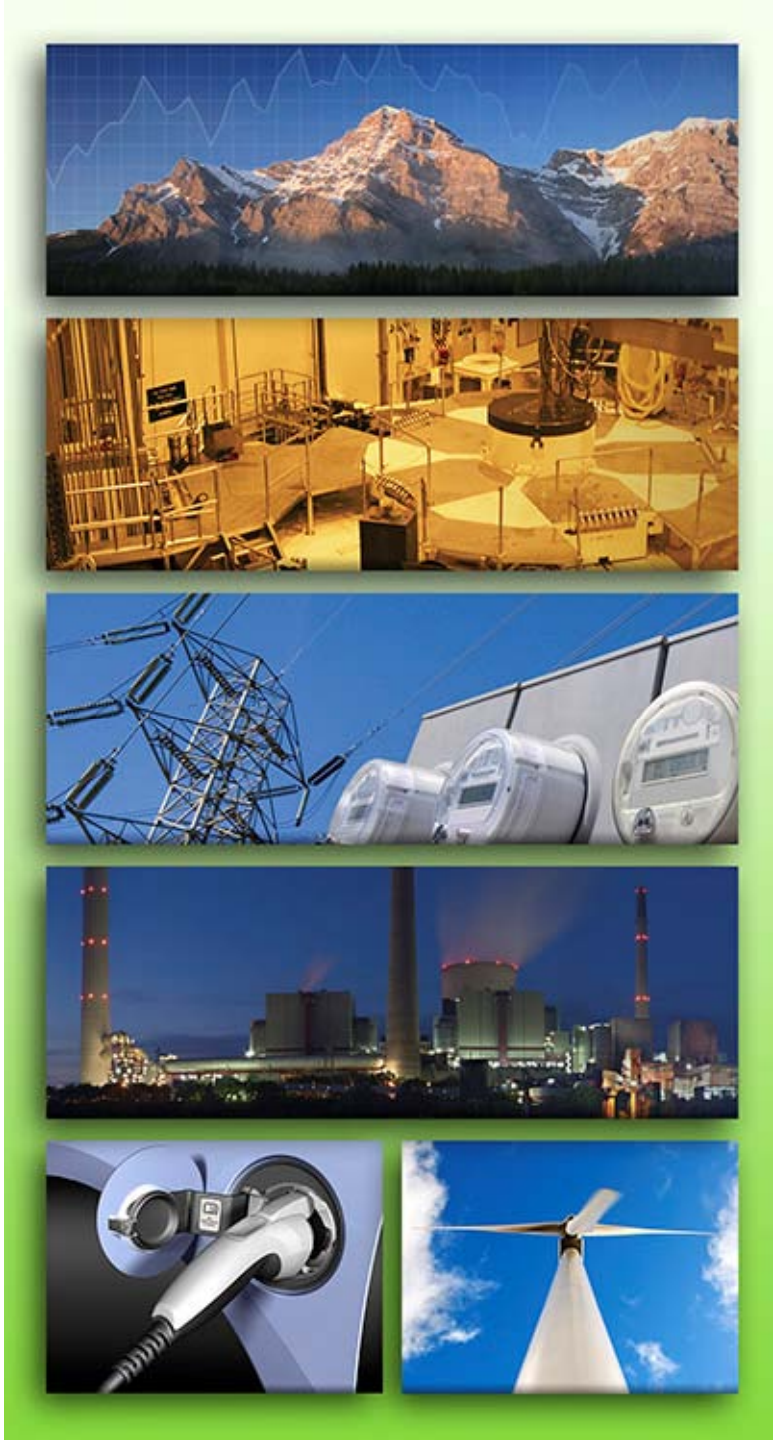

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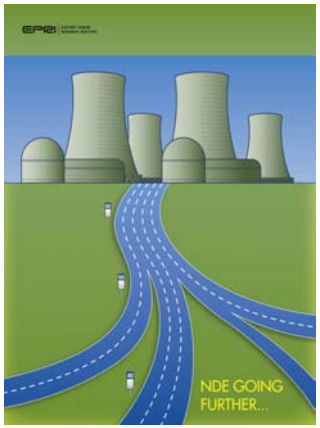
Advanced NDE Technology Innovation Program

Greg Selby
Director, NDE

NRC Information Meeting
May 2010

Advanced NDE Technology Innovation Strategic Program Objectives



- **Strategic Program Objective**
  - Develop innovative NDE technologies for nuclear power plant components
- **Primary goals** are to improve the availability and reliability of plant components by:
  - Developing new examination capabilities
  - Improving flaw detection and characterization capabilities
  - Enhancing examination quality and reliability
  - Reducing examination costs

Long Term Value – Improved NDE Technologies for Proactive Management of Materials Degradation and Examination Issues

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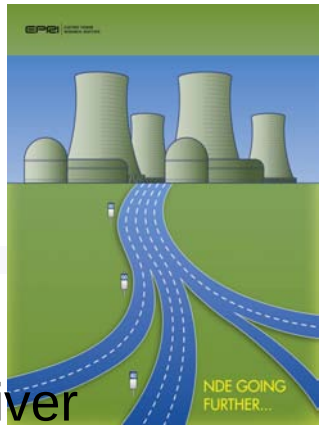
Advanced NDE TI Program - Projects



- **Acoustic Mouse -** ultrasonic examination technology that will deliver 3D imaging without robotic scanners
- **Buried piping -** guided wave ultrasonic techniques to reliably detect and characterize flaws while minimizing the need for excavation
- **Cast stainless steel inspection –** Investigate and develop advanced UT, thermography, acoustic emission, optic techniques
- **Early detection of cracking and creep damage –** detect degradation while it is still in its long, slow phase of incubation and initial growth
- **Concrete –** assess structural integrity and facilitate long-term operation of concrete structures
- **Real time NDE for Welding** - determine weld integrity prior to completion of weld

Long Term Value – Expanded and Improved EPRI NDE Toolbox

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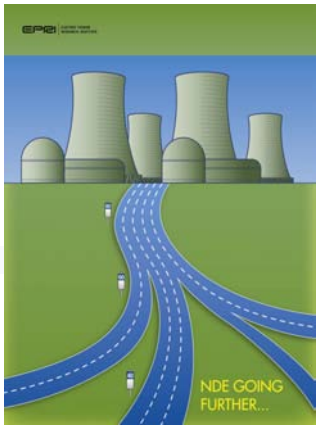
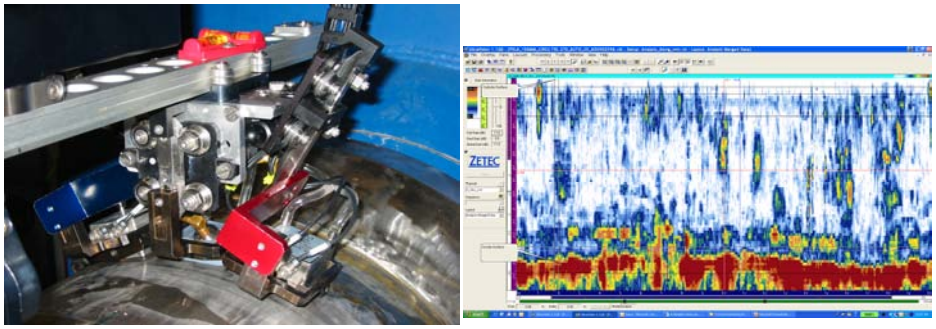
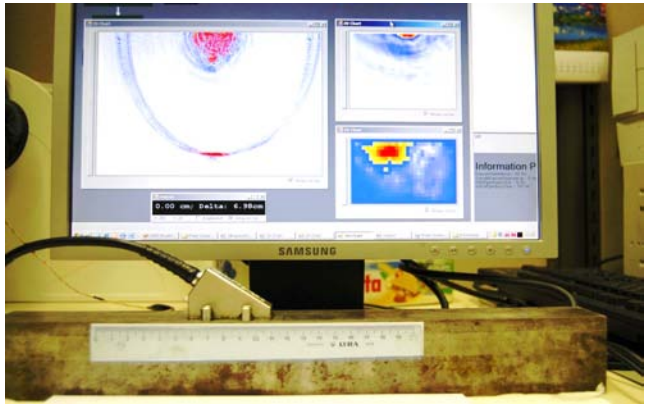
Acoustic Mouse/Motion Tracking by Optic Flow Analysis – Mark Dennis (PM)



- Goal - To develop, refine, and demonstrate the acoustic encoding and ultrasound tomography hardware and software
- "Acoustic Mouse" - Based on principle of PC optical mouse; and integrates mouse tracking technology with the UT probe for manual UT examinations
  - Uses background UT noise to provide real-time positional information; encoded, recorded UT examination data , with 3-D imaging tools equal to automated UT
- Primary deliverable is a field deployable "acoustic mouse" with hardware and software. A real-time flaw imaging system that allows faster and more intuitive ultrasonic data analysis will be available to the nuclear industry.



Automated Scanner and Data



Acoustic Mouse and Data

Long Term Value – Improved Examination Quality and Reliability and Reduced Inspection Costs

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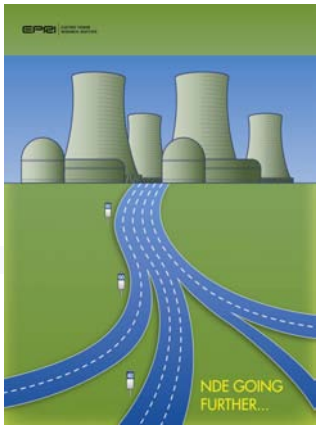
Inspection of Buried Piping
Mike Quarry (PM)



Goal - Refine guided wave ultrasound technology for improved flaw detection and characterization.

- Research guided waves through modeling and testing on buried piping test mockup
- Buried piping test mock-ups (2) have been built
- ABAQUS finite element analysis (FEA) modeling software being used to:
  - improve understanding of GW propagation; and
  - refine probes and analysis tools for improved detection, characterization.
- GW test equipment procured, training completed, testing being performed
- 2010 activities – Use of Modeling to address gaps

Long Term Value – Proactive Management, Reduced Inspection and Remediation Costs

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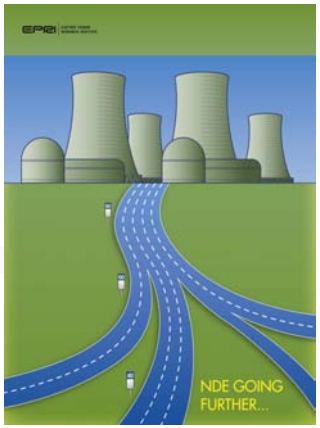
Cast Stainless Steel Inspection
Mark Dennis (PM)

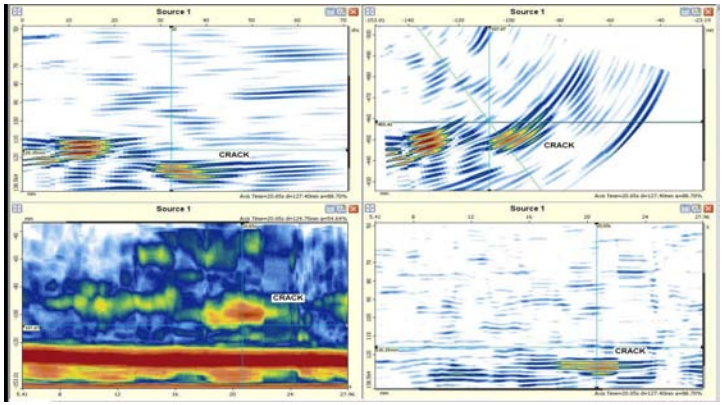


Goal – NDE technologies for solution to CSS examination problem

- Evaluate other NDE technologies (advanced UT, thermographic, optical, acoustic emission)
- Develop the NDE techniques that show promise; demonstrate, and transfer technology
- Tested low frequency phased array – promising results on WOG sample
- Coupled thermography; Clemson – awaiting results
- EMATs – didn't work
- 2010 activities – flexible arrays, low frequency phased array, grain structure mapping

Phased array UT probe

WOG CSS Sample



Long Term Value – Address long standing inspection issue, Proactive Aging Management, and Reduced Inspection Costs

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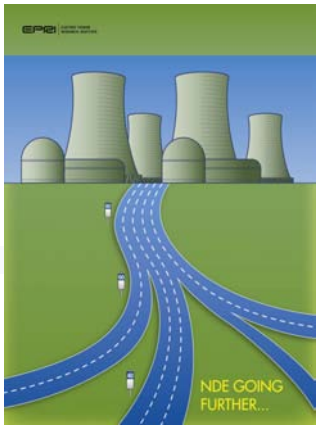
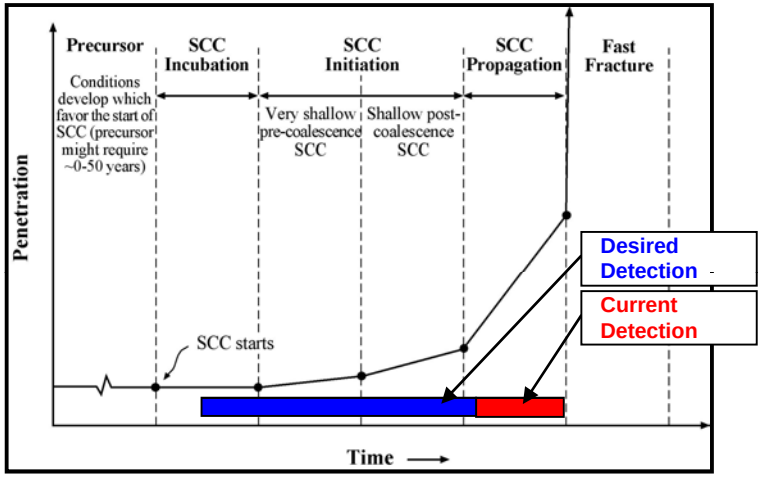
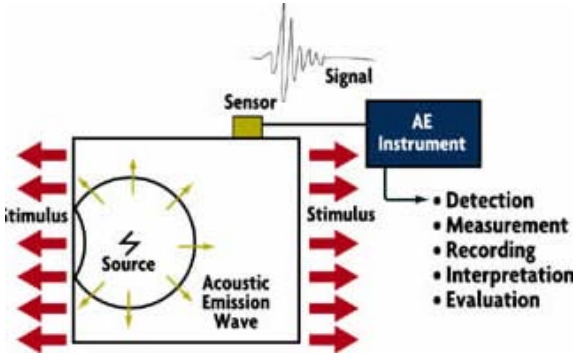
Early Detection of Cracking and Creep
Joe Wall (PM)



Goal – earlier detection of damage to plant components.

- Subject samples to temperature and stress, and study the damage in-situ using acoustic emission, strain gages
- Develop NDE techniques to detect susceptibility of materials to damage during incubation and initial growth stages
- Testing lab (creep frames) set-up
- 2010 activity – begin mechanical tests, integrate with AE and microstrain gauge testing





Long Term Value - Better Component Management and Fewer Inspections

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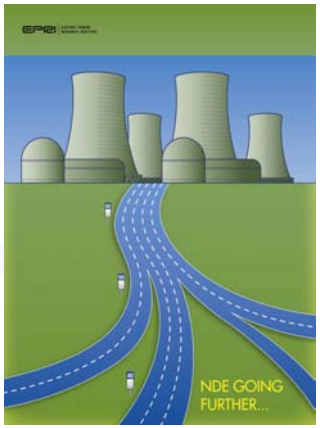
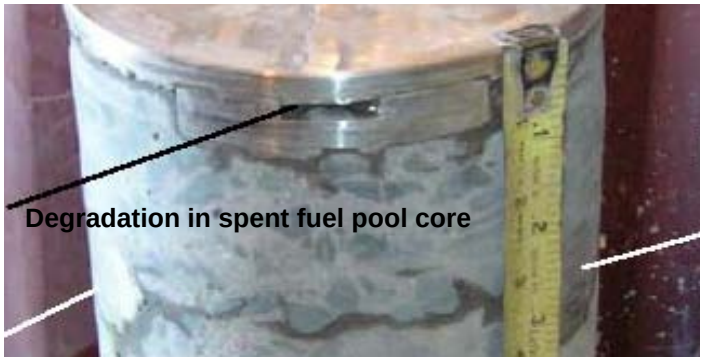
NDE for Concrete
Maria Guimaraes, Joe Wall (PMs)



Goal - assessment of long term operation of civil structures.

- Collaboration w/ MAI, EdF, ORNL
- Research and understand concrete degradation issues, and identify examination needs – Degradation database
- Identify and prioritize specific issues expected to affect long term operation of civil structures
- Develop assessment protocols for individual structures
- Identify and develop nondestructive evaluation techniques to help quantify damage



Long Term Value – Proactive Management, Reduced Inspection and Remediation Costs

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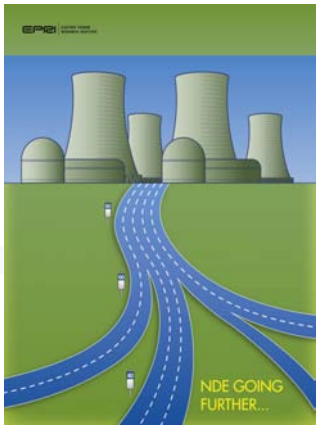
Real Time NDE for Welding
Dana Couch, Jack Spanner (PMs)



Goal - real time NDE capability to support field installation of “new weldments”, and deliver a field deployable methodology

- Allow examinations of butt welds while the welding is in process; results in a reduction of residual stresses by preventing multiple repairs
- Method for producing controlled weld root cracking has been developed
- NDE methods for R & D are:
  - Acoustic emission, RT, UT (guided wave, phased array), remote visual or infrared techniques
- 2010 activities include identifying gaps with existing technologies, conduct feasibility studies with selected technology

Controlled weld root cracking

via Ti, and Al wire implants

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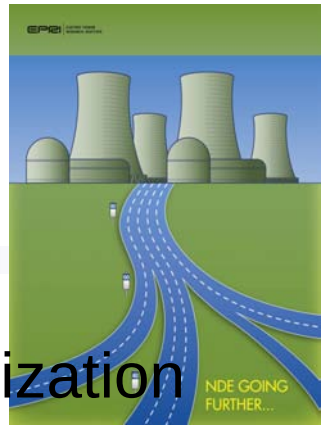
Other Technology Innovation/Polaris Projects



Portable Nuclear Magnetic Resonance for Characterization of Cold Fusion in HDPE Fusion Welds

- Use of portable NMR to detect cold fusion flaws in HDPE piping bonds

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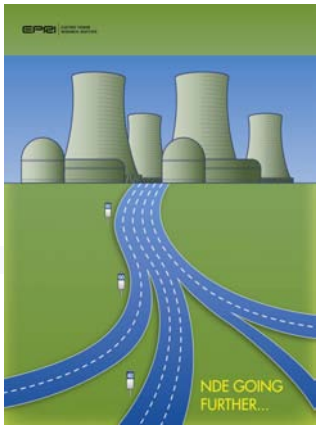
Advanced NDE for Renewables
John Lindberg, PM

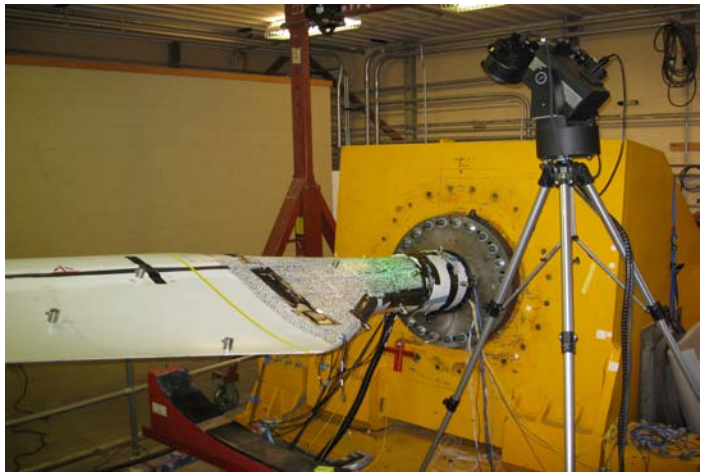


Goals - innovative NDE technologies with applications for examination of renewable energy generation components

- Evaluate state of NDE technology being performed on wind, geothermal and solar components
- Initial focus on use of advanced NDE technologies for wind, specifically wind turbine blades
  - Laser shearography, UT
- Develop techniques and examination processes for improved flaw detection and characterization
  - Ex. Guided wave for geothermal source piping

Now

Future



Long Term Value – Support long term operation of renewable generation assets

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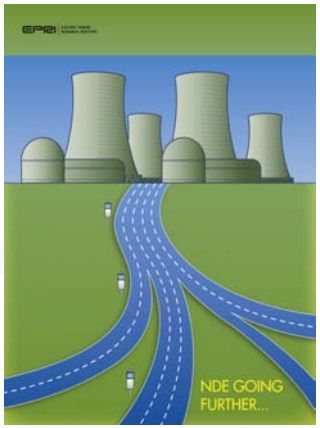
Summary



- Technology Innovation Advanced NDE program will research and develop new and advanced NDE technologies that support long term operation of the current nuclear fleet.
- These new NDE technologies are needed to address gaps that exist with current NDE to assess some materials degradation issues.
- In some cases, the NDE technologies that are developed through this program will help address material degradation assessment issues in other power generation sectors, and industries.

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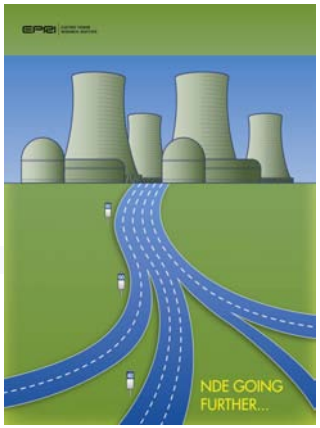
Questions



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