Welding & Repair Technology Center (WRTC)

Program Overview

Greg Frederick
Program Manager, WRTC

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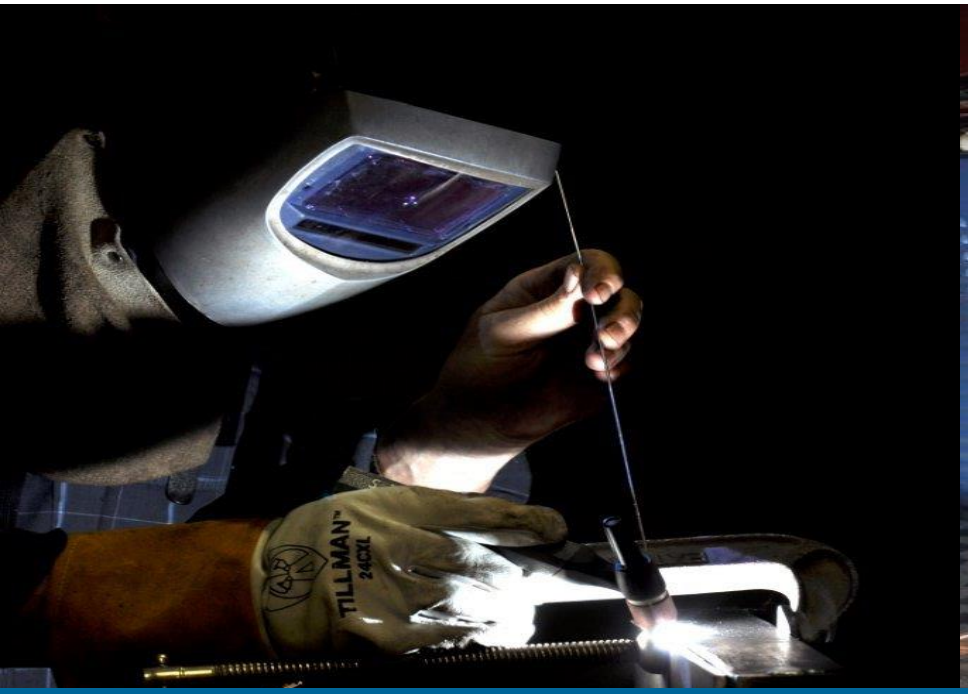

WRTC

Program Overview

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Program Overview

- Mission and Objective
- WRTC – Who We Are
- WRTC – Committees and Meetings

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Welding & Repair Technology Center–Mission

- As nuclear power producing facilities age, there is an increasing need for technology to provide effective solutions and to support life extension objectives
- Focus on both tactical issues and strategic research
  - Provide a **framework** for identifying, prioritizing, and tracking fabrication and repair related technology “gaps”
    - Technical Advisory Committee (TAC), EPRI staff, Integration Committee
    - Facilities (metallurgical lab, welding lab, materials labs, etc.)
    - Collaboration–National Labs, Universities, Internal
  - Lead R&D activities and technology development to supplying the necessary “TOOL” to address current and future repair, fabrication, and mitigation issues

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Welding & Repair Technology Center–Objective

- Establish technologies to address gaps in repair and replacement technology for nuclear power generation components and transfer that technology
  - Improve material performance and component life extension
  - Develop field-usable applications of technology focused on the repair and replacement
  - Increase plant availability and reduce repair costs and schedule
  - Support implementation - technical interactions with Code, regulators and service vendors
  - Create forums for sharing operating experience
    - Information exchange on repair, fabrication, weld program issues, and industry emerging issues
    - Provide access to materials, welding, and repair experts/peers across the nuclear industry

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Welding & Repair Technology Center–Objective

How technology is transferred...

- through comprehensive documentation
- direct communication (meeting report outs)
- rapid-response assistance (Information Exchange)
- training, CBTs, workshops
- Peer Interaction

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EPRI WRTC Program–Who We Are

EPRI Plant Support:

- Steve Swilley, EPRI Sr. Director

EPRI MAPC:

- Kurt Edsinger, EPRI Director

Executive Sponsor:

- Tom McCaffrey, Entergy

WRTC Integration Committee:

- Program and APC Chair: Dan Patten, FENOC
- Program Vice-Chair: Joe Weicks, Entergy
- IC Lead: Marc Hall, Dominion
- IC Lead: Keith Dietrich, TVA
- IC Lead: RC Folley, APS
- IC Lead: Charles Bonan, EDF

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EPRI WRTC Committees

Nuclear Power Council

WRTC Executive Sponsor – Tom McCaffrey, Entergy

Materials & Aging Action Plan Committee (MAPC) Executive and Technical Committee

Director – Kurt Edsinger
WRTC MAPC Chair – Dan Patten, FENOC

BWRVIP, SGMP, MRP, PSCR, PWROG, NDE, WRTC

(WRTC) Integration Committee

Dan Patten, FENOC,
Marc Hall, Dominion, Joe Weicks, Entergy, R.C. Folley, APS, Keith Deitrich, TVA, and Charles Bonan, EDF

Strategic Planning, MAPC Report out

(WRTC) Technical Advisory Committee (TAC)

All participating utility and non-utility members

Defining Projects, Project Coordination, Establishing and Upkeep of Technology Gaps

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WRTC Team: Who We Are

WRTC Program Manager

- Greg Frederick, (704) 595-2571, gfrederick@epri.com

WRTC Program Sr. Technical Leads

- Steve McCracken, (704) 595-2627, smccracken@epri.com, Lead for RFA 1, 3, 5 and 6
- Dana Couch, (704) 595-2504, rcouch@epri.com, Lead for RFA 4, 7, 8, and 10

WRTC Program Technical Leads

- Jon Tatman, (704) 595-2762, jtatman@epri.com, Lead for RFA 2 and 4
- Nick Mohr, (614) 325-0532, nmohr@epri.com, Lead for RFA 7, 9 and 10
- Ben Sutton, (704) 595-2833, bsutton@epri.com, Lead for RFA 8

Material Technical Executives

- David Gandy, (704) 595-2695, davgandy@epri.com, Lead for RFA 11
- Robin Dyle, (205) 426-5371, rdyle@epri.com, NRC interface

Technical Support Staff

- Stacey Wells, (704) 595-2673, swells@epri.com

- **Welding/Shop/Labs**
- MK Havens, Kendal McCrory – Metallurgical lab
- Mitch Hargadine, Robotics/Welding
- David Hansen, Welding Automation
- Scott Bailey, Welding processes

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WRTC Team: Who We Are

Greg Frederick
WRTC Program Manager
gfrederick@epri.com

Dana Couch
Senior Technical Leader
rcouch@epri.com

Steve McCracken
Senior Technical Leader
smccracken@epri.com

Stacey Wells
Assistant III
swells@epri.com

Ben Sutton
Technical Leader
bsutton@epri.com

Jon Tatman
Technical Leader
jtatman@epri.com

Nick Mohr
Technical Leader
nmohr@epri.com

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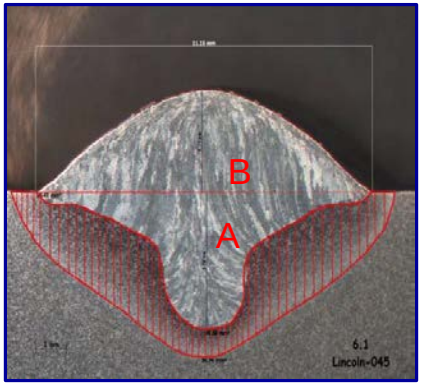
WRTC Team: Who We Are-Continued

David Gandy
Materials Technical Executive
davgandy@epri.com

Robin Dyle
Materials Sr.Technical Executive
rdyle@epri.com

Metallurgy Laboratories



- **MK Havens**
- **Kendal McCord**

Welding Laboratories

- **Mitch Hargadine**
- **David Hansen**
- **Scott Bailey**

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WRTC Team–Where We Are

United States (TAC)

22 of 22 U.S. Utility Organizations participate in WRTC (all operating BWR and PWRs)

- Ameren Services Company
- American Electric Power Service Corporation
- Dominion Resources, Inc.
- DTE Electric Company
- Duke Energy Corp.
- Energy Future Holdings Corp.
- Energy Northwest
- Entergy Services, Inc.
- Exelon Corporation
- FirstEnergy Service Co.
- Nebraska Public Power District
- Tennessee Valley Authority (TVA)
- Wolf Creek Nuclear Operating Corp
- NextEra Energy, Inc.
- Pacific Gas & Electric Co.
- Pinnacle West Capital Corporation
- Talen Energy Corporation
- Public Service Enterprise Group, Inc.
- South Carolina Electric & Gas Company
- Southern Company
- STP Nuclear Operating Company

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WRTC Team–Where We Are

International Participation (TAC)

- CANDU Owners Group (COG) – Canada, Romania
- CEZ A.S. – Czech Republic
- Chubu Electric Power Co., Inc. – Japan
- Chugoku Electric Power Co., Inc. - Japan
- Comision Federal de Electricidad (CFE) - Mexico
- Electricite de France S.A. (EDF/MAI) – France
- Emirates Nuclear Energy Corporation - United Arab Emirates
- Eskom - South Africa
- Horizon Nuclear – United Kingdom
- Kansai Electric Power Co, Inc – Japan
- Korea Hydro and Nuclear Power Co. - Korea
- Kyushu - Japan
- MVM Hungarian Electric (Paks) – Hungary
- Nucleoelectrica Argentina S.A. – Argentina
- Shikoku Electric Power Co – Japan
- The Tokyo Electric Power Company, Incorporated (TEPCO) - Japan
- UNESA – A.E. Industria Electrica - Spain

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WRTC Team–Where We Are

Non-Power Producing Memberships

- IHI Corporation – Japan
- Fluor Enterprises
- AZZ WSI LLC – Welding Services Inc.
- AREVA
- Westinghouse
- KAPL/Bettis – Bechtel Marine Propulsion Corp.
- Rolls Royce
- BWXT Nuclear Operations Group (BWXT) (2017)
- Doosan Heavy Industry (2018)

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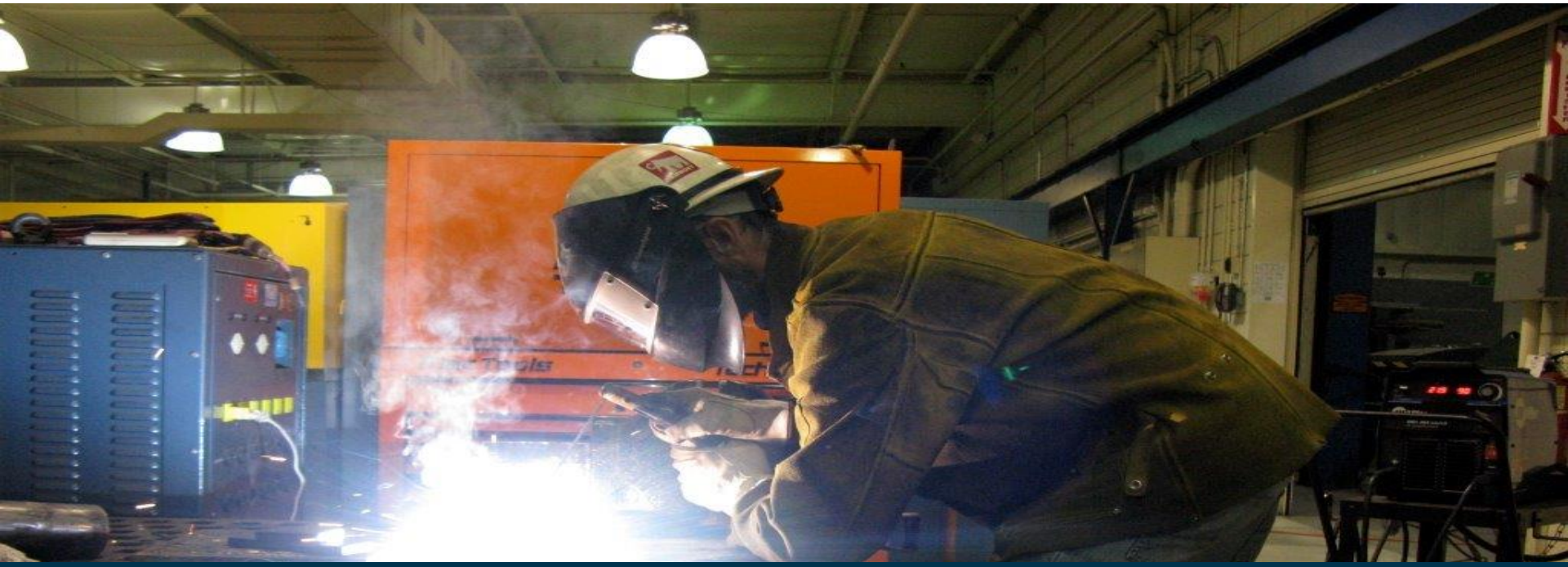

WRTC

Committees and Meetings

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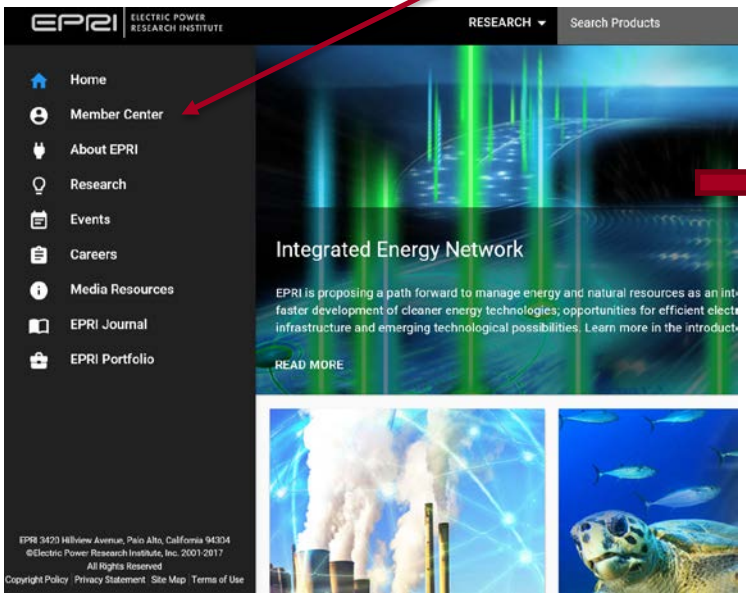
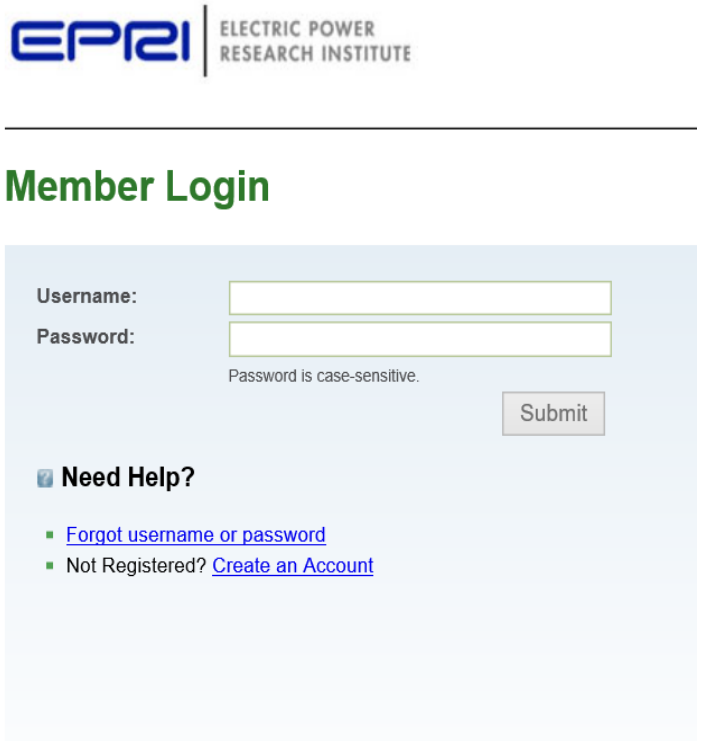
INTRODUCTION–WRTC Cockpit

- WRTC Cockpit:
  - Site: epri.com
    - https://membercenter.epri.com/programs/065758
    - Agenda and Presentations
    - Training
    - Information Exchange
    - CBT

EPRI Member Login





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WRTC Cockpit

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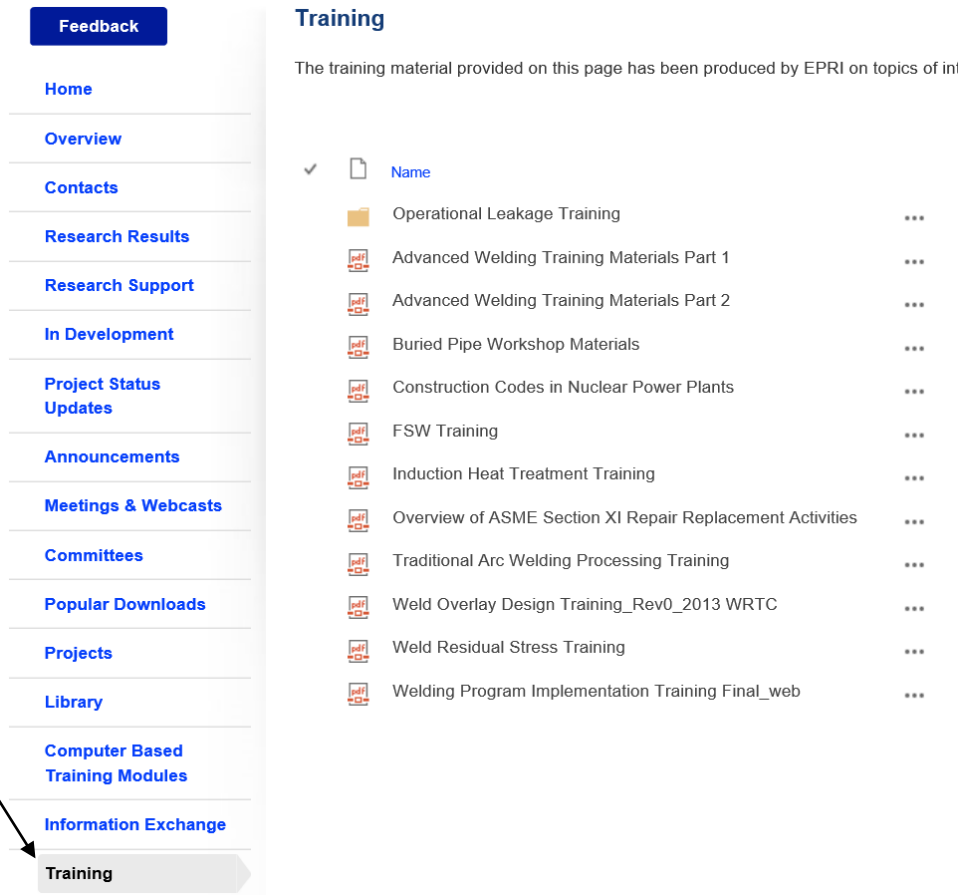
WRTC- Cockpit - Training

- Training presentations in PDF format are located on the WRTC Cockpit



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Computer Based Training

Welding CBT Modules

WRTC's First CBT

Working to Make Downloadable

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WRTC Meetings

WRTC Technical Advisory Meeting (TAC) and Technical Programs

- **Two meetings per year** (June and December)
  - Session: Project Overviews (Code Issues, Training, Alloy 52, etc.)
  - Session: Operating Experience (OE) and emerging issues, Information Exchange
  - Session: Demonstrations/Training both meetings
  - Breakouts sessions (Technology Gap)
- **Goals**
  - Maintain a high level of communication and peer interaction.
  - Increase understanding of WRTC capabilities, organization, and staff
  - Identify work scope that is important to industry

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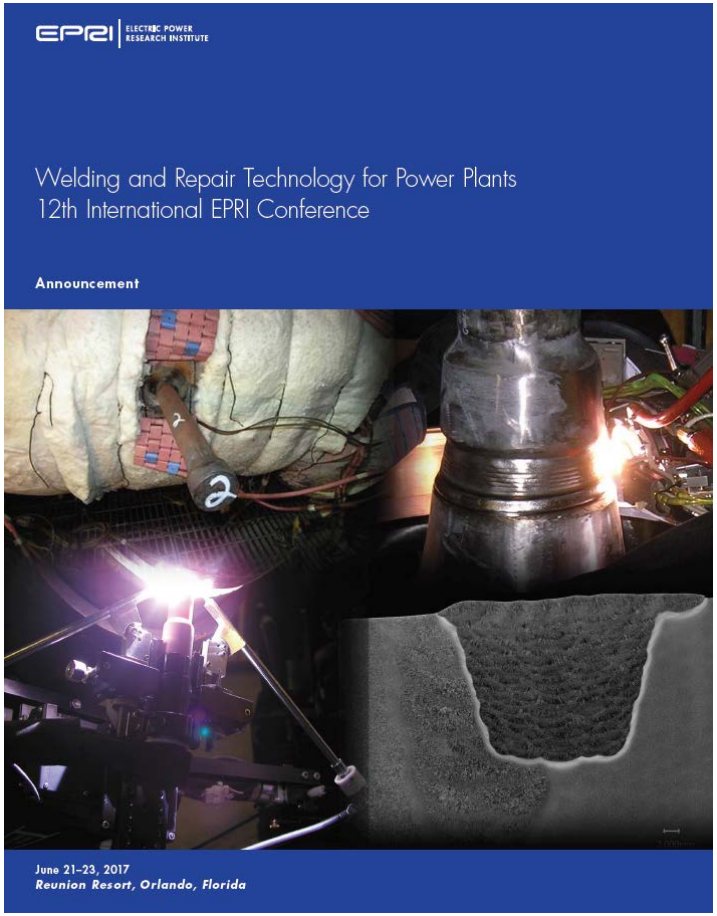
WRTC Meetings/continued

- June meeting typically in conjunction with other EPRI programs (CHUG, BOPC, P-87) and CSEF programs, and International Weld Repair Conference [2017])



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WRTC Meetings – Look Ahead

- **2017**
  - June, WRTC Technical Advisory Committee meeting (TAC) - Orlando, Florida
  - June, Welding and Repair International Conference (Orlando, FL)
  - December, WRTC TAC (Destin, FL)

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WRTC

Research Focus Areas

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WRTC Research Focus Areas–High Level

11 Research Focus Areas (RFA) established to address WRTC Core and Support areas:

- **RFA 1:** Nickel-Base Filler Metal Weldability and New Alloy development
- **RFA 2:** Irradiated Materials Welding Solutions
- **RFA 3:** Identify, Research, Develop, and Mature Advanced Welding Processes
- **RFA 4:** Optimize Joining, Fabrication, and Repair Processes (including WRS)
- **RFA 5:** Small Bore Piping Asset
- **RFA 6:** Transfer and Promote Fabrication and Joining Technologies into Codes, Standards, and Regulations
- **RFA 7:** Buried Pipe Asset Management / Repair Solutions
- **RFA 8:** Repair Solutions for Structures: Containment, Fuel Pool Asset Management, and Spent Fuel Storage
- **RFA 9:** Tactical Implementation of Repair Methods
- **RFA 10:** Document and Evaluate Operating Experience for Welding and Repair Programs
- **RFA 11:** Thermal Spray, Coatings, and Hardfacing Applications

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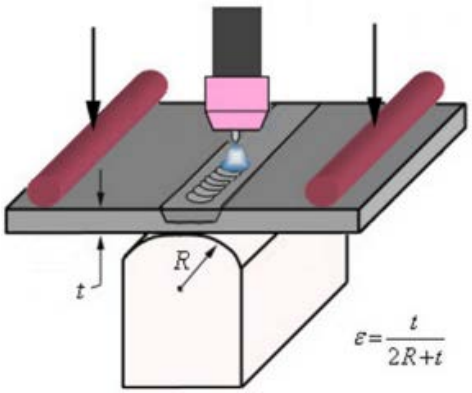
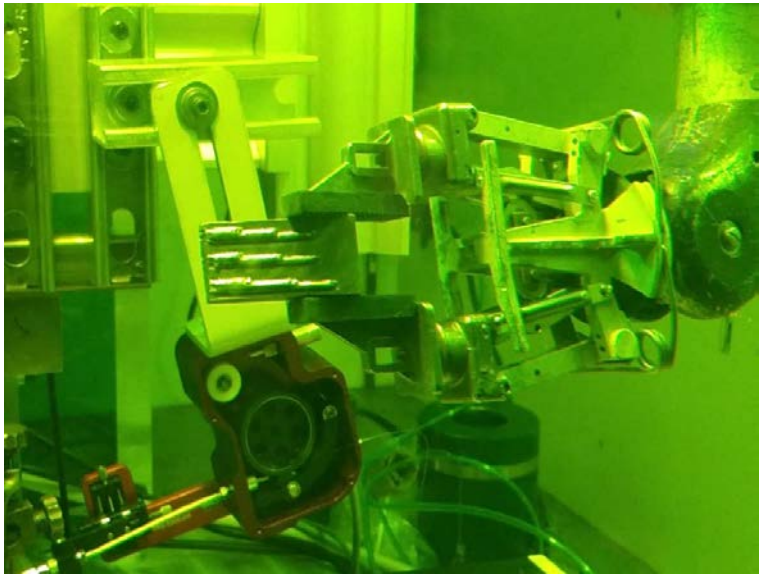
WRTC Strategic Focus Areas

- **RFA 1:** Nickel-Base Filler Metal Weldability and New Alloy development
  - Optimization of Alloy 52 weldability
  - Alternate weld filler metal that retains adequate margins to PWSCC



- **RFA 2:** Irradiated Materials Welding Solutions
  - Focus on developing near-term solutions, and fundamental research to support repairs
  - Validation tests for irradiated material

- **RFA 3:** Identify, Research, Develop, and Mature Advanced Welding Processes
  - Keeping nuclear industry up with current technology (welding and joining processes)
    - Hot wire laser, Mag-stir, FSW, etc.



Laser Welds on Highly Activated, Neutron Irradiated Stainless Steel

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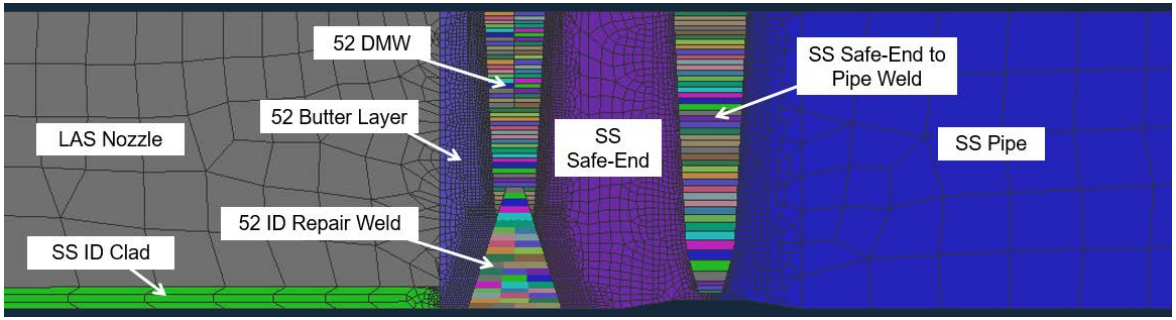
WRTC Strategic Focus Areas/continued

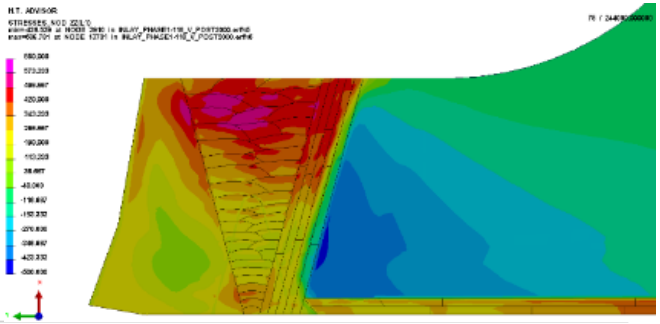
- **RFA 4:** Optimize Joining, Fabrication, and Repair Processes (including WRS)
  - Opportunity to optimize and improve established welding processes and procedures
  - Optimize residual stresses through surface conditioning and other techniques

- **RFA 5:** Small Bore Piping Asset
  - Small bore piping issues and eliminating small bore piping failures
  - Socket weld overlays

Dual GMAW for Large-Scale Heat Exchanger Overlay Repair

Residual Stress Modeling of Nozzle Dissimilar Metal Weld





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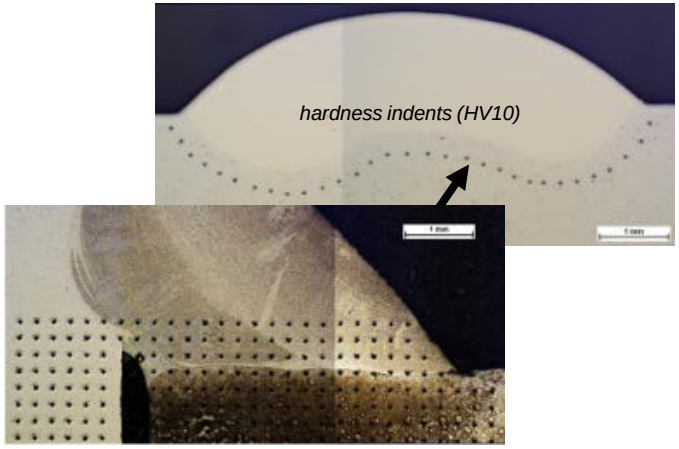
WRTC Strategic Focus Areas/continued

- **RFA 6:** Transfer and Promote Fabrication and Joining Technologies into Codes, Standards, and Regulations
  - Promoting code and regulatory adoption of code changes, code cases
  - Provide technical bases documents
- **RFA 7:** Buried Pipe Asset Management/ Repair Solutions
  - Repair/replacement issues
  - Repairs to degraded pipe
- **RFA 8:** Repair Solutions for Structures: Containment, Fuel Pool Asset Management, and Spent Fuel Storage
  - Repair solutions for critical nuclear structures

Hydrogen Testing SMAW TB – Code Case N-839



QW-290 updates and Temper bead qualification by new hardness protocol

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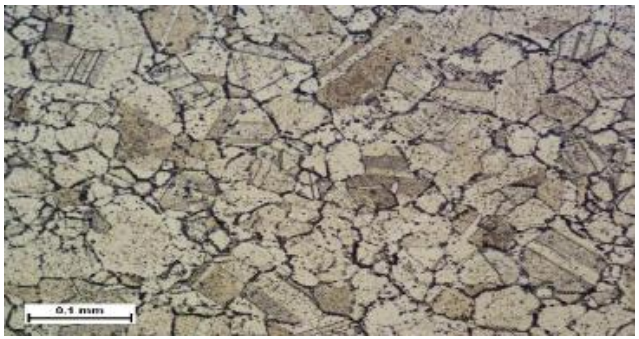
WRTC Strategic Focus Areas/continued

- **RFA 9:** Tactical Implementation of Repair Methods
  - Guidance documents for implementation (example: GMAW guidance, TB guidance)
- **RFA 10:** Document and Evaluate Operating Experience for Welding and Repair Programs
  - Trending and tracking of industry performance and development
  - Support for welding benchmarking and assessments
  - Training modules and workshops
- **RFA 11:** Thermal Spray, Coatings, and Hardfacing Applications
  - Powder Metallurgy
  - Solutions for surface conditioning, new fabrication methods

PM 316L – 1300F, 5hr



343C (650F) Galling Wear Behavior at 30 ksi

Stellite 6

NitroMaxx
(cobalt free)

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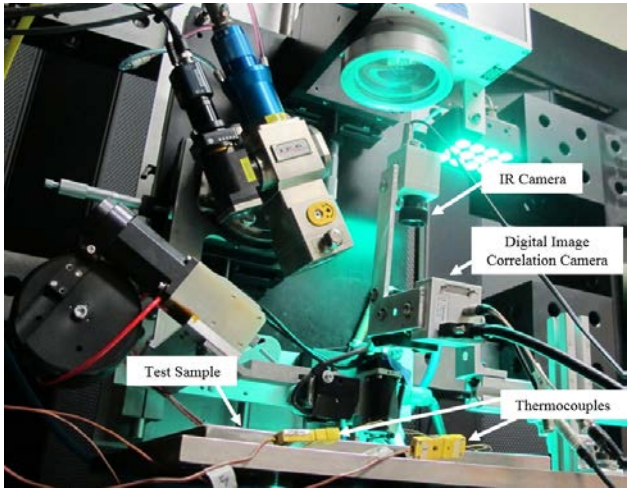
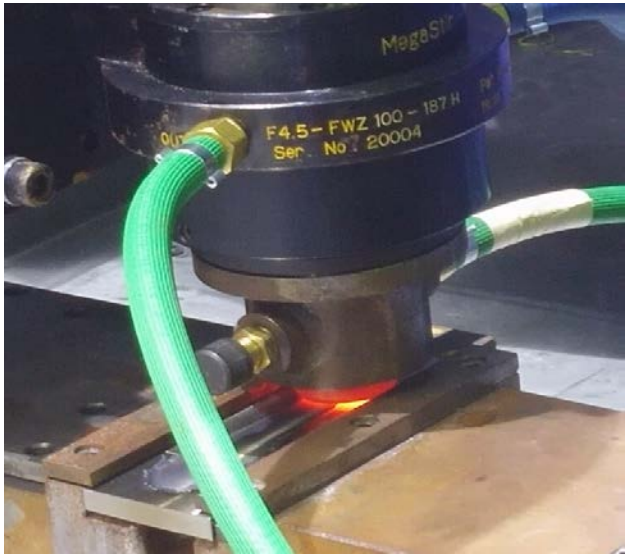
Executive Roadmaps–WRTC

- New welding technology and guidance for the repair of highly irradiated materials (RFA 2)
- Alloy 52M Nickel-base filler metal weldability guidance and material solutions (RFA 1)
- Advance welding process development in nuclear power industry (RFA 3)
- Advancements in code and regulatory requirements for repair, replacement, and mitigation techniques (RFA 6)



Auxiliary Beam Stress-Improved Laser Welding



Friction Stir Welding within Hot Cell Cubicle

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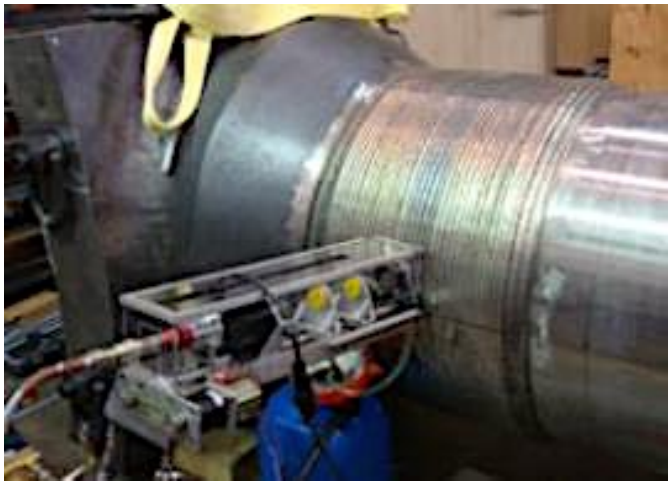
Executive Roadmaps–WRTC/continued

- **NEW** – Nuclear Pool (Spent Fuel Pool) Leakage (RFA 8)
- **NEW** – Powder Metallurgy Materials (RFA 11)
- Other Roadmaps that WRTC supports:
  - Best Practices for Welding Residual Stress for Repair and Fabrication (ANT owner)
  - Used Fuel Storage Issues regarding fabrication and repair (CCC Owner)
  - Socket Weld Resolutions (RFA 5) – Considering



Welding residual stress measurements

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Questions?

Together…Shaping the Future of Electricity

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