Regulators, operators and utilities are faced with new challenges as our fleet of commercial nuclear plants age. And with these challenges comes the important issue of ensuring the safety and integrity of plants for workers, the public, and the environment throughout their service life while being confronted with stringent budget constraints. AREVA has a vested interest in the continuous, long term, safe operation of plants for years into the future. These facts drive CR&R to develop innovative processes, cost-effective solutions and complete services from the simple and basic to the most challenging scenarios.

Our organization designs, fabricates, and installs plant hardware for the worldwide nuclear commercial fleet. We provide comprehensive services ranging from the early planning stages through execution to sharing our expertise by supplementing your leadership team with staff augmentation. Our industry recognized resources deliver groundbreaking innovative processes such as Inner Diameter Temper Bead (IDTB) welding and our latest technologies Cavitation Peening and BWR Jet Pump Flow Collar.

Our ability to bring you excellence hinges on our resources. The physical resources of the Technical Training Center, Weld Shop, and mockups and our most valuable resources - our people. We understand the shortage of quality welders, especially during outage timeframes on short duration jobs. Our organization keeps a core team of top tier welders to ensure first-time quality. Our union agreement allows us to bring these resources for specialty projects. We have a large staff of welding engineers with extensive field experience to assist you at any point in the repair or replacement process. We utilize industry experts in material science and highly seasoned personnel to provide a complete package from start to finish – as part of your team. In addition to this organization's expertise with AREVA, our customers can benefit from a sole source, fully integrated supplier from engineering analysis and inspection to tooling, repairs and component replacements. AREVA is here to help you face your challenges and will deliver with an uncompromising commitment to safety, quality and performance.
Meet Our People

Lisa Hawkins, Business Development Manager, Component Repair & Replacement (CR&R)

In her current role, Lisa is responsible for managing the business development team, and plays a key role in the development and execution of the CR&R business and strategic plans. She drives a business model with the voice of our customers in mind and one that aligns with their safety, performance, and operational goals. Prior to joining AREVA’s Global Sales Organization, Lisa worked as the Field Operations & Equipment Manager for CR&R. With over 28 years in the nuclear industry, she has had broad experience in Fluence Analysis, serving as the B&W Resident Engineer at Davis-Besse, Steam Generator Services Project Management, and Outage Management. Lisa holds a Bachelor of Science degree in Nuclear Engineering from the University of Michigan.

Colt Stallings, Strategic Planning Manager, Component Repair & Replacement (CR&R)

Colt is responsible for identifying new business opportunities and cultivating those opportunities until they are turned over to the Global Sales Organization for proposal development. Colt began his career with AREVA in 1986 as a Valve Service Technician. He went on to hold positions as a Field Service Engineer, Field Service Manager, Field Execution Manager, and Integrated Outage Manager. Colt has over 29 years field experience. He received an associate’s degree in Machine Shop Technology and Metallurgy while serving an Inside Machinist Apprenticeship at Tacoma Ship Building in Tacoma, Washington.

Gary Poling, Strategic Projects, Component Repair & Replacement (CR&R)

Gary Poling is responsible for Strategic Projects and R&D, and is the regional R&D coordinator for the Installed Based business unit (IBA). Gary is a graduate of Ohio State University with B.S. and M.S. degrees in mechanical engineering. Gary began his career with AREVA in 1999 as a tooling engineer supporting CR&R internals segmentation activities Maine Yankee decommissioning. He has continued to serve in various leadership roles for CR&R bringing new technologies and tool designs to the market. Gary is an active member of the ASME Code Task Group for High Strength Nickel Alloy Issues (BPV XI).

Victor Montalbano, Vice President, Reactors & Services Quality & Performance

In his role, Victor provides leadership to the R&S Quality organization and works with customers and regulators to ensure the delivery of quality products and services and the effective identification and resolution of quality issues. Victor earned a Bachelor of Science degree in Organizational Management and Development from Bluefield College and served in the U.S. Air Force and Air Force Reserves from 1985 to 1992. Throughout his career, Victor has worked in a variety of areas related to power generation including gas, coal, and co-generation which has allowed him to provide a non-nuclear perspective in his roles at AREVA.
A Team of Experts

Tom Busic, Operations Manager, Component Repair & Replacement (CR&R)

Tom is responsible for the site implementation of CR&R projects. Tom is a graduate of the Virginia Military Institute with a degree in mechanical engineering. Following graduation, he was commissioned as an officer in the U.S. Army. Tom began his career with AREVA in 1998 as an engineer and site lead supporting Steam Generators and Plant Decommissioning. He transferred to CR&R in 2003, where he has served in various roles as a project engineer, manager of Component Repair Design and manager of Metrology Services prior to his current role.

Dave Waskey, Manager, Welding & Component Repair Design, Component Repair & Replacement (CR&R)

Dave has worked in nuclear services for the past 31 years. Before transferring to AREVA’s Commercial Nuclear Services Division, he worked 14 years in heavy pressure vessel fabrication for the Commercial & Navy Nuclear programs for Babcock & Wilcox in Barberton, Ohio. Dave is an ASME Section XI Standards Committee member, sits on the Sub Group for Repairs & Replacements, and is the long-standing chair of the Working Group on Welding & Special Repair Processes. Dave received his Bachelor of Science degree in Welding Engineering from LeTourneau University in 1974 and is among the AREVA College of Experts.

John Sheppard (P.E.), Tooling Engineering Manager, Component Repair & Replacement (CR&R)

John is responsible for managing a team of mechanical and electrical engineers designing robotics and remote equipment for the repair and remediation of nuclear power plant components. His responsibilities include FOAK and NOAK design, budgetary tooling estimates, schedules, concepts, training, customer interaction and field support. John began his career with AREVA in 1990 as a Design Engineer. He went on to hold the positions of Supervisor of NDE Mechanical Design, Manager of NDE Operations, and Engineering Manager, NDE Industrial Systems – North America. He was named to his current position in October 2013. John received a Bachelor of Science degree in Mechanical Engineering from North Carolina State University and a Bachelor of Science degree in General Studies from Lenoir-Rhyne College. John has been a Professional Engineer since 1997, has two patents and has designed numerous NDE and robotic tooling systems.

Bob Timberlake, Metrology Manager, Component Repair & Replacement (CR&R)

Bob is responsible for the management and planning of Metrology projects. Bob began his career with AREVA in 1999 as a Metrology technician. He went on to hold the positions of Proposal Manager for Metrology in 2009. He was named to his current position in April 2014. Bob received an associates degree while serving in an Apprenticeship at New Port News Ship Building.
Our Resources

Global Sales Organization
The Right Team to Secure Your Operational Excellence

Gerald Dansby
32+ Years Experience
Product Manager
Email: Gerald.Dansby@areva.com
Business: (434) 832-2430
Mobile: (434) 841-3721

Joel Rampal
25+ Years Experience
Product Manager
Email: Joel.Rampal@areva.com
Business: (434) 832-2351
Mobile: (704) 617-1183

Wade Markham
25+ Years Experience
Product Manager
Email: Wade.Markham@areva.com
Business: (434) 832-2767
Mobile: (434) 841-7989

Ray Perkins
26+ Years Experience
Product Manager
Email: Ray.Perkins@areva.com
Business: (434) 832-3740
Mobile: (434) 841-3482

Deborah Welsh
10+ Years Experience
Product Manager
Email: Deborah.Welsh@areva.com
Business: (434) 832-3391
Mobile: (434) 942-4967

AREVA offers a diverse team of resources as an extension of your team. And we understand that the real success is in an ongoing relationship - one where we work together to make the right decisions for your plant.
Global Services & Solutions Provider

**Our Mission:** To provide the best services and solutions to deliver safe, world-class project performance, total cost certainty, and a partner committed to excellence for all of your component repair & replacement projects.
Operations
Skills For Every Job

Our Experience
Over 350 years of Combined Experience

Diversified Background

- Integrated Outage Management
- Field Management of Complex Repair and Replacement Projects
- Project Schedulers
- Comprehensive Task-Specific Training
- Dedicated Resource Manager for Project Staffing
- Equipment Technicians for Specialized Mechanical and Electrical Tooling
- Core Team of Top Tier Welders

Comprehensive Approaches to Industry Solutions

Major Component Replacements
- Steam Generators
- Pressurizers
- Reactor Vessel Heads and Integrated Head Assemblies

Component Repairs
- Specialized Automated and Manual Welding
- Specialized Machining including Electrical Discharge Machining
- Underwater In-Vessel Components and Internals

Emergent Repairs
- Industry Best Response to Emergent Issues
- Diverse Workforce Available to Provide Timely and Quality Solutions

Recognition & Affiliation

- 2014 NEI Process TIP Award for Emergent BMN Repair at Palo Verde
- 2013 Best of the Best TIP Award for Pressurizer Heater Nozzle Repairs at Calvert Cliffs
- AREVA Vendor Award for NEI’s Top Industry Practice Award for DC Cook Lower Radial Support System Bolt Repair
- Performed World Record RVH Replacement Outage at Salem in 26 Days
AREVA Outage Managers work closely with you and the AREVA Engineering Teams to prepare for specific Component Repair/Replacement tasks, including documentation review, schedule integration, participation in Tooling Design Review Boards, equipment identification and readiness, and crew training. These individuals have strong interpersonal skills and are focused on delivery of a quality final product in a safe and timely manner.
AREVA’s Component Repair & Replacement team retains a specialized group of craft welders with extensive experience. This Core Group possesses a variety of skills, expertise and certification in manual and machine welding processes, with a focus on primary and secondary piping systems, pressure vessels and structures.

Personnel have been qualified to AREVA’s welding program for a variety of ASME Section IX processes, such as machine/manual GTAW, SMAW, and FCAW. Furthermore, they possess extensive and specialized knowledge for ambient temperature temper bead welding, application of weld overlays and pads, as well as narrow and conventional groove welding with open roots. The core group is skilled at meeting required surface and volumetric examinations to ensure first-time quality and minimal outage schedule impact.

Additionally, these individuals provide crew leadership and oversight for supplementary welding resources either provided by the local union or travelers. AREVA’s core welding team is adept, familiar, and skilled at working to either the AREVA Quality Program or the station QA program as required.
Welding & Component Repair Design

Our Experience
Over 180 years of Combined Experience in BWR & PWR Repairs/Replacements

Diversified Background

• Component Engineers
• Welding Engineers
• Licensed Professional Engineers
• Certified Welding Inspector
• ASME Code Experts
• Weld Supervisors
• Certified Welders
• Experienced in Design for NDE
• Technical Consultant
• Advisory Engineers
• Project Engineers
• Proven Field Experience
• Research & Development

Comprehensive Approaches to Industry Solutions

• Peening Technologies
• IDTB Repairs
• Pressurizer Heater Repairs & Replacements
• Mini-IDTB Repairs
• Structural Weld Overlays
• Bottom Mounted Nozzle Repairs
• Instrument Nozzle Repairs
• Expertise in Alloy 52 Weld Metal Development

Recognition & Affiliation

• Published Papers
• Patents
• NEI Top Industry Practice Awards
• AREVA President’s Innovation Growth Award
• Industry Recognized Expertise
• American Welding Society (AWS)
• ASME Section III & Section XI Working Groups and Task Groups
• BWR VIP
• EPRI
• ASNT
• PWR & BWR Owners Group
Our Resources

Ben Grimmett
25+ Years Experience
NDE & Welding Engineering
Welding Engineering Supervisor

Charles Graves
14+ Years Engineering, Tooling, & Field Experience
Manager, Component Repair Design

Pete Strubhar
25+ Years Engineering & Project Management Experience
Supervisor, Project Engineering

Jeff Enneking
19+ Years Component Manufacturing & Materials Experience
Technical Consultant

Todd Hamilton
23+ Years Welding Engineering & Field Experience
Advisory Engineer

Industry Choice
for FOAK Repair Solutions
Our Resources

Tooling Engineering

Our Experience
Over 150 years of Combined Experience

Diversified Background

- Research & Development
- Mechanical Engineers
- Electrical Engineers
- Mechatronics
- Advisory Engineers
- Tooling Design Engineers
- Product Lifecycle Management
- CAD Applications Leaders
- SolidWorks
- Smarteam PDM
- Cosmos
- ANSYS

Comprehensive Approaches to Industry Solutions

- Ultra High Pressure Cavitation Peening
- Specialized Welding Tooling Design
- Specialized Machining Tooling Design
- Electrical Discharge Machining (EDM) Tooling
- Custom Lift Rigs and Load Testing
- Robotics
- Design for Ultra-High Radiation Environments
- Design for Water-Submerged Applications
- RV and RV Internals Segmentation for Decommissioning

Recognition & Affiliation

- Published Papers & Patents
- A600 Task Group
- Department of Professional and Occupational Regulation Commonwealth of Virginia License
- Welding & Special Repairs Working Group (Section XI)
- American Society of Mechanical Engineers
- American Welding Society
- ASM International
Our Resources

Metrology

Our Experience
Over 140 Years Combined Experience
- Senior Technicians 15-25 Years Each in Measurement Services
- CAD Unit 40 Years Combined Experience

Diversified Background
- Ship Building, Aerospace, Automotive, Nuclear & Other industries
- Certified Photogrammetrists
- Microstation Trainer
- Metrology Technicians
- Machinists
- Pipe Fitting

Comprehensive Approaches to Industry Solutions
- Laser Scanning
- 3D Modeling
- Total Station
- Photogrammetry
- Precision Measurements
- Underwater Capabilities
- CMM ARM
- Structured Light Scanning

Recognition & Affiliation
- Certified Photogrammetrists
- Microstation Trainer
- ASPRS

Full-scope metrology capabilities in-house to ensure precise fit-up, from planning through installation
Welding Services
Welding Engineering

Industry best performance in welding

- Procedure qualification development
- Welder qualification
- Expert code interpretation
- Destructive evaluation and metallurgical analysis
- Failure analysis
- A&C field engineering support
- Fabrication oversight
- SME root cause analysis
- Materials selection expertise
- Extensive background in Alloy 52 weld metal development
- Prototype testing
- Craft training
- Ability to interface with all levels from work crew to management
- Independent goal-oriented oversight
- Augment site welding engineering capabilities

Craft welders

- Dedicated core group of high quality weld leadership
- Access to union and non-union resources with the highest capacity for excellence in performance
- Provide top tier welders
- Highly trained & qualified
- Eliminates customers reliance on off-the-bench resources
- Provide independent support to get projects back on track
- Task ownership
- Enhanced site support

Key Features & Benefits

- All-in-one source saves time
- Field-proven technology enhances reliability
- Remote capabilities reduce costs, risks, time, and dose
- Full in-house engineering & NDE supports all your needs
- Machine or manual welding options meet specific needs
- Dedicated center for mock-ups, tool qualification, and crew training
- Licensed facility refurbishes or decontaminates specialized tooling
- Active members of various codes and standards organizations
- Active Members of:
  - PWR & BWR Owners Groups
  - BWR VIP
  - EPRI Weld Repair Technology Committee
  - AWS Codes & Standards

Access to Top Talent in Limited Resource Pool
Specialized/Automated
Remote Machining and Welding

Most experienced vendor in specialty welding and engineered machining services

Our code experts and the industry’s most respected, accomplished team of welding engineers and field welders can perform a full range of services to meet your needs:

- Custom Designed Machining Equipment
- Conventional Machining
- Electrical Discharge Machining (EDM)
  - Remote Threading
- Rotary Peening
- Ultra High Pressure Cavitation Peening
- Thermal Cutting
- Custom Designed Welding Equipment
- GTAW, GMAW, PAW, SMAW, and FCAW Processes
- Special Welding Processes
  - Ambient Temperature Temper Bead
  - Narrow Groove
  - Weld Overlays
  - Weld Inlays/Onlays
  - High-Deposition

In addition, our Fiber-Optic Remote Weld System uses a simple containment penetration with operations outside of containment.

Key Features & Benefits

Component Repairs
- Pressurizer Heater & Instrument Nozzle Replacements
- RCS Instrument Nozzle Repairs
- RV Head Thermocouple & CRDM Nozzle Repairs
- RV Lower Head Bottom Mounted Nozzle Repairs
- Small Bore Nozzle Repairs

Materials Remediation
- Ultra High Pressure Cavitation Peening
- Rotary Peening
- Nickel Plating
- Structural Weld Overlays
AREVA is a world leader delivering innovative and cost-effective engineering solutions for ASME Class 1 systems and components.

We understand that the integrity of the NSSS is paramount to the safe operation of a nuclear power plant. Our team of experts in structural analysis, fracture mechanics, and materials engineering has the unique qualifications and experience to consistently provide innovative and cost-effective analytical approaches and solutions to NSSS challenges, with the goal of maximizing plant availability.

Our engineering team excels in developing creative approaches to solve any problem from the mundane to the extraordinary, regardless of the Original Equipment Manufacturer (OEM). We have delivered numerous solutions to emergent concerns including Alloy 600 modifications and repairs of BMI and Reactor Vessel Head (RVH) penetration nozzles. Our tools include advanced ANSYS finite element modeling of welding residual stress, flaw propagation, and elastic-plastic stress analysis. AREVA engineered solutions to NSSS and ASME Class 1 systems and components have won NEI TIP awards in 2013 and 2014 for novel and innovative approaches. Our engineering team is fully integrated with the Component Repair & Replacement and NDE teams, providing a turnkey experience for you.

Building on this expertise and experience, we are developing solutions in areas such as environmentally assisted fatigue and reactor vessel internals aging, which is critical for the long-term viability of plants as they enter extended operation. We combine advanced materials modeling with cutting-edge three-dimensional structural, radiation transport, and fluid-structure interaction modeling to assess the susceptibility of the internals to age-related degradation mechanisms.

Key Features & Benefits

No matter what the challenge or the original design, AREVA’s engineering staff is at the ready to engineer a customized solution for your plant.

- Advanced analytical tools for finite element analysis and fracture mechanics
- Integrated design, analysis, inspection, and tooling solutions
- NRC-accepted analysis methods for Alloy 600 modifications
- Detailed modeling of PWR & BWR reactor vessel internals to predict aging degradation
- Solutions for all PWR & BWR NSSS designs, regardless of original OEM
- R&D investments in new analytical techniques to support extended plant operation
Our Customers Call — We Respond

2013 - AREVA responded to an emergent Bottom Mounted Instrument Nozzle repair need. A crew was organized, prepared, and deployed to complete the job 30 hours ahead of schedule with ZERO safety and no performance issues. It was only the second repair of its kind in the industry — the first performed by AREVA in 2003.

“AREVA’s Component Repair & Replacement team demonstrated our dynamic culture of operational excellence at site and performed the entire task with rigor in safety. There were no quality issues and we completed seamless handoffs and delivery, with no rework necessary,” said George Beam, Senior Vice President of the Installed Base, Reactors and Services Business Group at AREVA Inc.

2012 - AREVA, recognized for its excellence in solving emergent issues, was contacted by a utility to complete an industry-first BWR nozzle repair. Within 24 hours, AREVA employees were on the ground. In six days, an AREVA team completed a half nozzle repair with ZERO safety issues, below dose estimate exposure and ahead of schedule.

2010 - AREVA’s experienced team and timely response helped successfully modify 24 control rod drive nozzles, allowing the plant to resume safe and reliable operations. In the middle of a busy outage season, AREVA organized, trained, and assembled teams of more than 100 people and deployed them to the site. With a focus on safety and quality, AREVA worked diligently to complete repairs to assist the plant in re-starting and running safely. The job was completed with ZERO safety incidents and below the project radiological dose goals.

Recently performed emergent jobs include:

- RV Head Repairs
- RV & RVH Flange Inspections & Repairs
- Electrical Discharge Machining (EDM)
- Pressurizer Heater Repairs
- Bottom Mounted Nozzle Repairs
- High Point Vent Installation
- Manway Removal and Replacement
- Check Valve Repair
- Welding Support
- RCP Drain Line Repair
- Reactor Vessel Nozzle Repair
- High Pressure Injection Nozzle Repair
Eliminates FME concerns

Keep your plant operating safely with innovative, customized solutions to your machining challenges. AREVA is using its exclusive Remote Electrical Discharge Machining (EDM) technology to make repairs to both PWR and BWR plants in a variety of locations – sometimes while the system is still in operation. Under water or under pressure, EDM is being used as an integral part of total repair processes as well as for complete solutions. Based on robust, field-proven technology, our EDM solutions include task-specific tooling modifications and innovative applications that leave behind little residue – and big satisfaction.

The appeal of AREVA’s EDM not only includes its ability to create detailed machine geometries, but also in how it handles the by-products of the process. EDM swarf – micron-sized material suspended in solution – is simply pulled from the area and processed, making the technology well-suited for use in primary coolant because any standard machining particles, if left in the system, can be a threat to nuclear fuel assemblies.

The adaptability of EDM technology allows AREVA to exceed customer expectations and keep plants operating safely. AREVA has also perfected EDM internal thread machining which allows bolted repairs in all types of plant components. Our internal thread machining is a qualified, proven process used for numerous field applications.

Key Features & Benefits

- Adaptable technology allows AREVA to create customized solutions to emergent repair issues
- Our EDM technology can be utilized for both BWR and PWR plants
- Proven repair method with machining that requires no force (in comparison to drilling operations) which allows for remote operations
- No FME – residue is processed through a water filtration system during machining
- System is primarily used for under water machining
- Can be adapted for use while system is still in operation for certain applications
- Can be used for numerous repairs as a complete solution or as an integral part of the total repair process
- AREVA’s EDM technology is capable of performing internal thread machining for bolted repairs
**Alloy 600**
Integrated Materials Degradation Solutions

**Comprehensive repair technologies**

From weld overlays to machining services, from our industry-best tooling to material remediation and virtually all types of repairs for components and internals, AREVA has everything you need. We provide timely solutions backed by the latest global research.

- Mini-ID Temper Bead (IDTB) for Bottom-Mounted Nozzle (BMN) & Pressurizer Heater Nozzle Integrity
- Comprehensive Repair Technology (from Weld Overlays and Inlays to Machining Technology)
- Remote-Controlled In-Pipe Manipulators
- High-Deposition Welding for Reduced Overlay Schedules
- Welding & Engineered Machining Services
- Tooling for a Variety of PWR and BWR Repair Services
  - RV Head Repairs and Modifications
  - Small Bore Nozzle Repairs (over 600 nozzle repairs performed to date)
  - Bolting Inspection and Replacement
  - Incore Guide Tube Repairs
- Mini-ID Temper Bead (IDTB) for Bottom-Mounted Nozzle (BMN) & Pressurizer Heater Nozzle Integrity
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- Welding & Engineered Machining Services
- Tooling for a Variety of PWR and BWR Repair Services

**Key Features & Benefits**

- Offering the broadest range of experience combined with the latest technology for dependable performance and reliability.
- Validity of our repair processes has been acknowledged by the NRC, ensuring that all of your tasks conform to the ASME code and regulatory standards.
- Your outage schedule is safe with our high-quality services and fully-qualified tooling.
- Personnel dose rates, inspection time, and repair duration are substantially minimized by utilizing remotely-controlled operations.
- Complete engineering analyses help tailor optimum solutions for your specific needs, while ensuring compliance with ASME standards and NRC safety analysis requirements.
- You have our assurance of thorough testing and qualification of tools on full-sized mockups – prior to arrival on site.
AREVA’s UHP Cavitation Peening Mitigates PWSCC for the Remaining Life of Your Plant at a Much Lower Risk and Outage Impact Than Other Mitigation Methods.
Stop PWSCC risk-free

Imagine that you had a way to stop PWSCC with a risk-free process that uses only water — a solution that does absolutely NO harm to the surface of your components and provides a depth of compression that exceeds MRP requirements. It’s here – AREVA’s Ultra High Pressure (UHP) Cavitation Peening. Our mission is to develop timeless solutions to stop plant aging; all while meeting our customer’s cost, schedule, safety, and performance goals.

Our peening process is applicable to key components of the primary system — Reactor Vessel Head (RVH) nozzle penetrations, Bottom Mounted Nozzle (BMN) penetrations, and Reactor Vessel (RV) Primary Nozzles. These components are Alloy 600, welded with Alloy 82/182 and are highly susceptible to PWSCC. Our peening process is qualified for BMNs and RVH Nozzles. AREVA will complete final qualifications of the peening process for Westinghouse 3 and 4 loop RV primary nozzle designs in 2015.

AREVA’s peening process uses submerged, ultra-high-pressure water jets to mitigate the surfaces of reactor vessel components. The high-pressure water flow creates cavitation bubbles. As these vapor bubbles collapse on the component’s surface, shock waves travel into the material and create compressive residual stresses, preventing PWSCC initiation.

AREVA’s innovative new process operates at a higher pressure with less restrictive parameters than other mitigation alternatives, achieving a higher depth of compression and more efficient overall implementation schedule. The long-term value of cavitation peening far outweighs the initial investment. You can always do a component replacement, or keep addressing indications with expensive repair methods. Or deploy one simple mitigation technique to significantly reduce PWSCC risk.

Key Features & Benefits

- Prevents primary water stress corrosion cracking (PWSCC)
- Provides asset life extension through elimination of the degradation process
- Compressive stress depths exceed MRP requirements
- Eliminates the risk of emergent repairs
- Lower cost than future repairs or replacements
- All wetted nozzle surfaces are mitigated
- Schedule and cost savings when integrated with NDE
- No harm to component surfaces
- Process uses only water; no FME concerns
- Does not leave abrupt edges between peened and non-peened regions
High Deposition Welding
Remote Machining and Welding

Deposition rates 3-6 times faster than conventional weld techniques

Our advanced high deposition welding system addresses the need for increased filler metal deposition rates for large diameter weld overlay projects — including Reactor Vessel Primary Nozzles and additional susceptible Dissimilar Metal Weld configurations on steam generator (SG) and reactor coolant pump (RCP) inlet and outlet nozzles.

Reliably and efficiently solving your welding challenges

As the industry moves into the next phase of Alloy 600 mitigation, solutions have been developed for implementation to support our customers’ goals, focusing on life-of-plant reliability and efficient outage execution. Existing welding approaches did not match up to the challenge due to low weld filler deposition rates that resulted in extended schedules and increased labor cost. By utilizing AREVA’s optimal high deposition welding solution, our customers will realize the benefits of reduced schedule impacts and minimized crew sizes, while avoiding conflicts with parallel work activities. These advanced welding techniques (which utilize a dual hot/cold wire) significantly increase real-time deposition rates.

The front-end design is based on tooling that has been used extensively on weld overlay tasks implemented at PWR and BWR units, as well as narrow groove welding of large-diameter primary piping.

Key Features & Benefits

- High deposition welding for large overlays
- Dual Wire GTAW—readily adaptable now
- All position capability
- Deposition rates 3-6 times faster vs. conventional GTAW
- High deposition with first-time quality
- Field-proven in multiple deployments
- Tooling readily adaptable for other applications
- Auxiliary shielding
Mini-ID Temper Bead
Remote Machining and Welding for Small Bore Nozzle Repairs

2013 “Best of the Best” TIP Award

Nearly 60 U.S. plants have the potential for Primary Water Stress Corrosion Cracking (PWSCC). When plants age, the likelihood of PWSCC occurring in a Dissimilar Metal (DM) weld increases substantially. AREVA’s Mini-ID Temper Bead (IDTB) welding techniques can eliminate all Alloy 600 from service and implement a permanent solution for continued component integrity. The mini-IDTB process was originally developed for Bottom Mounted Nozzles (BMNs); however, it was used to successfully repair 119 pressurizer heater nozzle locations in 2012. We can perform mini-IDTB weld mitigation of your BMNs with the RV in the flooded condition, reducing radiation exposure and impact to your outage schedule. This is an adaptation of our IDTB CRDM repair tooling — successfully proven with extensive experience.

As a result of extensive research and development, mini-IDTB allows for as much as an 80 percent decrease in weld volumes, thus reducing risk and schedule.

- New lower heater sleeve is inserted and mini-IDTB weld installed
- Weld process joins new heater sleeve to the bore ID by the remote GTAW process (ambient temperature temper bead welding)
- Weld is disassociated from the original heater sleeve attachment weld

Key Features & Benefits

Reduced weld volume

- Reduced weld time — compared to a standard ½ nozzle technique and a pad weld, the new nozzle weld install is approximately 4 hours versus approximately 18 hours
- Schedule savings — AREVA performed this repair on 119 locations with a savings of 14 hours per location

Design specifications

- Water-cooled, 300-amp capacity
- Dual axis wire manipulator
- Single weld vision with renewable optical cover
- Integral light guide
- Remote iris
- Actuated weld filter
- Conventional gas lens

Scan to watch video
Half Nozzle Repair
Remote Machining and Welding

AREVA is the only vendor in the U.S. market to perform Bottom Mounted Nozzle (BMN) Repairs

AREVA has performed numerous half nozzle Repairs in the industry in response to Alloy 600 PWSCC degradation, both in PWRs and BWRs. The approach is a well-known technique with field-proven technologies that has been used on pressurizer heater sleeves, bottom mounted nozzles, and instrument nozzles. The repair can be easily adapted to other nozzles in the fleet.

Bottom Mounted Nozzles
AREVA is the only vendor in the U.S. market to perform BMN repairs – South Texas in 2003 and Palo Verde in 2013. Our robust, field-proven technologies and in-depth experience with ambient temperature temper bead GTAW Alloy 52/52M weld pads make AREVA the right choice to support your needs. Our breadth of knowledge and turnkey solutions with a focus on first-time quality give you the most efficient response to your critical path, emergent repair needs. AREVA’s proven half nozzle repair approach eliminates all Alloy 600 from service and implements a permanent solution for continued BMN integrity. We can perform BMN half nozzle repairs with the RV in a flooded condition, reducing radiation exposure and impact to your outage schedule.

2014 NEI Process TIP Award
Palo Verde (Arizona Public Service) was recognized as a recipient of a 2014 NEI Maintenance TIP Award for the emergent BMN repair performed with AREVA. This challenging and complex repair, with many first-of-a-kind aspects, was completed in only 32 days from issue discovery, far less time that the 72 days required for a comparable industry repair in 2003. The results highlight our commitment to the industry with zero safety incidents, human performance issues, PCEs, or FME issues.

Key Features & Benefits
- Only U.S. vendor to perform BMN repairs
- All-in-one source saves time and enhances efficiency
- Field proven, robust technology enhances reliability
- Full in-house NDE & Engineering organization supports your needs
- Remote capabilities reduce costs, risks, time, and dose
- In-depth knowledge and robust experience with ambient temperature temper bead Alloy 52/52M weld pads
- Does not require pre-weld or post-weld heat treatment
- ASME Code and industry experts support your regulatory & licensing needs
Inside Diameter Temper Bead
RV Head Repairs

Addresses all flaw scenarios

AREVA offers the ONLY proven approach for remotely operated repair of CRDM and CET nozzles that addresses all flaw scenarios utilizing our remote Inside Diameter Temper Bead (IDTB) repair.

The IDTB repair addresses all PWSCC flaw scenarios and provides a new pressure boundary weld with PWSCC-resistant material — superior to the overlay repair which leaves embedded flaws in the material and has led to rework.

Background

History has shown that leakage occurs through flaws in the partial penetration attachment weld between the RVH and CRDM nozzle as well as through the CRDM nozzle wall in Alloy 600 nozzles. The flaws, identified as PWSCC in the weld and nozzle, are repaired using an AREVA-developed technique that utilizes remotely operated automated equipment to reduce the extensive time and dose resulting from performing manual repairs. The IDTB weld repair has been implemented on 137 of the 180 nozzles repaired since December 2000, including Westinghouse, CE and B&W plants and is readily applicable to your plant.

Highlights of the AREVA Repair Process

• Thermal Sleeve Removal (If Applicable)
• Roll Nozzle in Repair Region
• Machine Weld Prep & PT Weld Area
• Perform Ambient Temperature Temper Bead Structural Weld
• Prepare Welded Surface For NDE
• Perform Post-Repair UT & PT
• Remediate Rolled and Repaired Areas
• Install Replacement Thermal Sleeve (If Required)

Key Features & Benefits

• The ONLY repair that addresses all PWSCC flaw scenarios
• Moves highly stressed attachment weld to a region with no PWSCC degradation or flaws
• Requires much less weld volume than other repair approaches, minimizing risk & schedule
• Remote delivery and application of tooling reduces personnel exposure
• Geometry is symmetric which offers improved weldability and inspectability characteristics
• Maximizes repair life with surface remediation of the original nozzle remnant, the new weld, and the HAZ
• Does not leave embedded flaw in material
• Does not require pre-weld or post-weld heat treatment
• Has been approved many times by the U.S. Nuclear Regulatory Commission through relief request submittal

Areva has never had to perform a repair at a subsequent outage on an IDTB location
RV & RV Head
Flange Inspection & Repair

Take the guesswork out of RV & RV head flange inspection & repair

AREVA’s laser reactor vessel (RV) & RV head flange inspection technology is a proven technology with more than 22 deployments in the U.S. and Europe. This innovative tool reveals imperfections that do not meet sealing surface criteria and identifies existing and potential leak paths. AREVA repairs the flange surface via welding and machining processes.

Using the advanced Laser RV & RV Head inspection tool, AREVA’s team of metrology experts conducts a comparative analysis of the flange contact areas relative to the surrounding surface for changes in elevation. The reactor vessel scan reveals existing leak paths and other potential leak paths. Using these inspection results, AREVA will provide repair options. Indications identified for repair can be addressed by weld build-up, machining, and honing.

The first deployment in the U.S. was recognized by the nuclear industry for its flawless execution. This field-proven flange inspection project was completed:
- Ahead of schedule, resulting in minimal impact to critical path
- Under dose goals
- With ZERO safety issues

Key Features & Benefits
- Flaw mapping technology
- Provides length, width, depth, and azimuthal location of indications
- Saves time, dose, and cost
- Can set threshold to match inspection requirements
- Mitigates risk to your plant’s components
- Remote scanning
- Provides a permanent record of sealing surface condition

Precision Weld Crown Machining Tool
Permanent Canal Seal Plate
Outage Performance Solutions

Improve plant performance

AREVA’s Permanent Canal Seal (PCS) eliminates potential canal seal leakage associated with current temporary seal designs mitigating reactor vessel erosion / corrosion issues, while improving safety, human performance, and schedule.

AREVA also offers a permanent solution for wide and narrow annulus refuel canal — to reactor vessel temporary seals. Our PCS eliminates the risk associated with temporary seals, and may also mitigate nuclear instrumentation and reactor vessel nozzle access cover leakage as well.

PCS enhances personnel safety by:
- Eliminating handling of temporary canal seal
- Eliminating open areas between the vessel and canal floor when canal seal is not installed

PCS improves human performance defenses by:
- Reducing the need for recovery plans and outage plan interruptions experienced when a temporary canal seal leaks
- Simplifying processes
- Eliminating the potential for temporary seal leakage masking loss of Reactor Coolant System (RCS) inventory

PCS simplifies the process by:
- Reducing the complexity of an outage activity
- Removing a task requiring technical expertise
- Reducing the amount of fasteners, improving FME

PCS reduces schedule by:
- Providing outage schedule predictability
- Eliminating polar crane picks for temporary seal plate installation and removal
- Eliminating temporary canal seal installation and testing
- Allowing earlier stud removal setup
- Allowing parallel RV Head removal activities
IHAs, fabricated and installed by AREVA, are customized for Westinghouse, Combustion Engineering (CE), or B&W designs. Plants using IHAs have realized outage reductions of up to six critical path days, as well as dose reductions of three-to-four person REM per outage. Our design includes improved safety features, as well as features that eliminate most of the polar crane picks, leading to far fewer critical path operations. Shielded access doors around the lower shroud allow for open inspection access to both RVH and CRDM penetrations. This enables you to compress outage schedules and get your plant reconnected to the grid in a shorter period of time. AREVA supplies IHAs and service structure mods to major U.S. and international customers, installing them with new RVHs, CRDMs, cables and insulation – all on or ahead of schedule.

Proven Design Advantages of the IHA
- Folding Batwings
- Improvements to Head Vent Routing and Connections
- Integrated Shielded Work Platform
- Improvements to CCW Line Connections
- Integrated or Rolling Missile Shield
- Integrated Shielding
- Integral Fans and Ductwork
- Dome and L-Panel Metal Reflective Insulation

Our IHA design eases access to vital reactor vessel head components and lowers maintenance time. A CRDM cooling system, head area cable system, reactor head vent-piping and integral work platforms, ladders and removable access panels are all incorporated into the IHA.

Key Features & Benefits
- Reduction of up to six critical path outage days
- Design addresses main barriers to reduced outage schedules
- Dose reduction of three-to-four person REM per outage
- AREVA’s IHA design achieves the lowest personnel exposure in the industry for an RVH replacement
- IHA installation performed within a normal refueling outage schedule
- IHA design includes improved safety features

“On Sunday, November 6, 2005, the Salem 1 breaker was closed at 01:03 hours, concluding the world’s best reactor vessel head replacement. Total duration was 25 days, 6 hours — second to none. AREVA’s leadership through both 2005 reactor head replacements contributed to the two best and shortest Salem refueling outages ever.”

— Dick Labott, Project Manager
Salem 1 & 2 RVCH Replacements
AREVA is the world record holder for the best RVH Replacement

Utility leaders count on AREVA for a wide range of component services, from design and fabrication through managing the asset. AREVA manufactures Control Rod Drive Mechanisms (CRDMs) as well as Reactor Vessel Heads (RVHs). In addition, as your full-service vendor, AREVA provides design, fabrication, project management, installation, heavy rigging, and disposal services.

With the industry’s most responsive U.S. teams, AREVA’s proven track record includes the successful fabrication of 156 original and replacement RVHs for nuclear customers in 11 different countries (including AREVA, CE, Westinghouse, and B&W-designed two-, three- and four-loop plants). All of these projects were delivered on schedule.

Unparalleled CRDM Experience
AREVA’s 35 years of experience in developing, refining and qualifying the CRDM installation process has created the world’s most reliable CRDM replacement program. Moreover, AREVA has manufactured and installed CRDMs in reactor vessel heads for over 80 nuclear units. To date, AREVA’s installations number over 6,000 new CRDMs and hundreds of refurbished CRDMs, including all seven B&W plants.

CRDM Benefits
- **Integrated Latch Housing Design**
  - Eliminates lower canopy seal — no potential for leakage
  - No change in In-Service Inspection needs
- **Single Piece Rod Travel Housing**
  - Eliminates joint at the top omega seal — no potential for leakage
- **Omega Seal Weld**
  - No leaks in over 5,300 installations
  - Ease of CRDM maintenance in the field
  - No structural weld ISI inspection required

Key Features & Benefits
- **Performed World Record RVH Replacement outage at Salem in 26 days**
- Extensive experience: 156 original and replacement RVHs manufactured, including 19 replacement heads for U.S. plants
- Capabilities to manufacture both replacement RVHs and CRDMs
- The only vertically integrated supplier whose main focus is on nuclear plants
- A complete portfolio of replacement head services — from RVH and CRDM fabrication to installation and service structure upgrades to disposal
- Exclusive integrated latch housing assembly to eliminate the risk of leakage from stress corrosion cracking
- Integral rod-travel housing/cap to eliminate leakage paths from seal welds
- Raw material improvements to ensure excellent mechanical properties and reliability of pressure-retaining components
Pressurizer Replacement

Our extensive pressurizer manufacturing experience enables us to provide a custom-built design that fits exactly with your current support structures. Outstanding features minimize the costs associated with replacement and reduce the scope of in-service inspections (ISI). Key advantages include:

- The use of Alloy 690 and austenitic stainless steel reduces SCC susceptibility
- Forged shell sections eliminate all longitudinal welds
- Integrally forged nozzles

Steam Generator Replacement

With over 20 years of industry-recognized experience in replacing heavy components, AREVA has established world record outage duration benchmarks for all three PWR NSSS designs and has successfully completed 24 Steam Generator Projects.

- Narrow Groove Welding reduces total weld time
- Precision fitup enables single-pass tie-ins for the welded items
- Superior weld quality and higher reliability
- Remote capabilities reduce costs, risks, time and dose
- Full in-house engineering supports your goals
- Single-sided technique for CE- & B&W-designed components

AREVA’s Chalon/Saint-Marcel manufacturing facility is unrivalled anywhere in the world for the manufacturing of steam generators, reactor vessels and heads, pressurizers and internal equipment. The Chalon/Saint-Marcel plant deploys state-of-the-art technologies and precision machining tools to ensure that the exact requirements are met.

Vessels, steam generators, and pressurizers are complex components which require high precision machining during their fabrication. Technical operations accurate to one hundredth of a millimeter must be carried out on forged parts weighing several tens to hundreds of metric tons.

As an example, deep drilling operations, executed by 3 boring heads, on steel plates up to 1 meter thick, must be completed with geometric accuracy to 1/100 of a millimeter.

All of the internal component assembly operations are carried out inside contained, sanitized, and rigorously-checked assembly units. For certain parts, precision of assembly is guaranteed by laser guidance.

Steam Generator & Pressurizer

Major Component Replacements
Leader in U.S. for stuck or damaged heater removal

With more than four decades of emergent repair experience, AREVA can safely and effectively replace or repair your damaged pressurizer heaters — and protect the integrity of your plant.

Utilities seek to mitigate their schedule and risk associated with failed heater damage by implementing contingency plans to address long-lead tasks. These plans include engineering, hardware, and tooling. A proactive approach maintains outage predictability and addresses TB-11-8 recommendations for removal and replacement of non-functioning pressurizer heaters. AREVA offers an “a la carte” approach to contingency planning and implementation for customers based on risk and cost.

Key Features & Benefits

Solution 1 – Replace your failed heater with a new heater (like-for-like replacement)
- No analysis
- Minimal schedule impact
- Permanent solution
- Minimal contingency planning required
- No future unplanned costs

Solution 2 – Cap/plug your heater sleeve
- Customer has the documents required to install a plug or heater
- “Planned” contingency approach is less expensive than emergent
- Deliverables can be used during subsequent heater replacement campaign(s)
- Plug resolves heater failure without having to install a heater
- Minimal schedule impact
- Magnesium oxide drilling
- Hydraulic puller
Solutions to your internals needs

CRGT Replacement & Shuffles
If inspections indicate unacceptable wear on the Control Rod Guide Tubes (CRGT), AREVA has the ability to perform removal operations and install new CRGTs in the upper internals. CRGTs may also be swapped with spare locations.

Internals Bolting Replacement - Baffle Bolts
AREVA performed the first U.S. nuclear plant Baffle Bolt NDE inspection under new Materials Reliability Program (MRP-227) guidelines for Pressurized Water Reactor Internals Inspection and Evaluation. AREVA completed the record exam of 1,088 bolts 17 hours ahead of schedule. Plus, the project was completed under the exposure estimate with zero foreign material exclusion (FME) incidents. Worldwide, AREVA has removed or replaced more than 8,700 core barrel and baffle-to-former bolts to date. Additionally, AREVA can perform inspection in parallel with bolt replacement activities, further minimizing outage time.

Internals Bolting Replacement - Clevis Bolts
AREVA performed an unprecedented replacement of clevis bolts located on the lower radial support system of the reactor vessel at a U.S. plant. To complete the underwater bolt replacement, AREVA engineers designed a unique tooling system to perform work remotely from refuel floor platforms. Lessons learned from this project will improve the efficiency of future bolt and reactor vessel internals replacements. The project won the AREVA Vendor Award for NEI’s Top Industry Practice Awards.

Key Features & Benefits

Clevis Bolt Replacement
- Proven production rates based on experience
- All tooling and processes are based on existing bolt replacement equipment that has been used on over 8,700 previous applications
- EDM process is used for all machining operations to avoid FME concerns
- Improved bolt design for lower stress concentrations
- Crimp cup locking mechanism - No welding required for installation
The leader in upper internals work

The Challenge
The control rod guide tube is a safety component which ensures timely control rod drop. Its role is also to guide the rod during step-by-step movements.

Wear may occur on the guide plates, in which case guide tube replacement is required.

The Solution
AREVA offers solutions for guide tube removal and replacement. Our customers can choose to replace a guide tube either with a new tube or with a refurbished tube. Two guide tubes can also be switched.

Technical Features
The work is performed underwater during a normal outage while the upper internals are on their stand. The operators work from the refuel bridge or an auxiliary platform.

- The guide tube is removed and installed using specific tools such as:
  - An umbrella gripper to maintain the upper and lower parts of the guide tubes together
  - A tool for screwing/unscrewing, torquing/detorquing, locking cup reshaping, etc.
- Cover plates placed on the guide tube support to prevent the ingress of loose parts
- **Electrical discharge machining** to repair any screws found to be jammed
- In case of replacement with a new guide tube, the old tube is placed in a specific storage container

Key Features & Benefits

- Uninterrupted experience with more than 40 guide tubes replaced over the past 20 years
- The continuous experience of our experts, engineers, and operators means they are operational immediately
- Intensive R&D program over the past few years to develop updated tools with new technologies (patented)
AREVA has removed 90% of the industry’s thermocouples worldwide

Innovative Vibratory Method
More plants have to replace their aging thermocouples (TC) because of damage to connectors. Previously used methods of removal put a tremendous strain on the thermocouples, resulting in breakage. AREVA now offers a safe solution using the proper resonant frequency before removing your old thermocouples.

Removal Using the Vibratory System
The TC removal tool causes the thermocouples and conduit located above the upper guide tube plate to vibrate. Prior to removal of the thermocouples, AREVA performs an as-found inspection of the guide tube plate.

Three Step Method
1. The tooling is deployed from the work platform to the upper internals.
2. Proper positioning is verified by video technology.
3. The resonant frequency is determined, and the operator removes the thermocouple.

Remote Operation Enhances Safety
• Remote tooling for TC removal reduces operator exposure.

Control at All Levels:
• Less static pulling required to remove
• Removal system controls speed and pulling tension
• The pole/vibrator/gripper assembly controls vibration
• The remote control panel controls pulling tension, vibrations and vibration frequency

Key Features & Benefits
• An innovative, fully-mastered solution to meet customer requirements
• Less pulling tension for safer thermocouple removal
• Simple, easy-to-use tool
• No damage to conduits
• Reduced operator exposure
• High success rate

The innovative removal process increases extraction results from 60% to over 90%. The most recent campaign removed all thermocouples.
Secure a Jammed Fuel Assembly
Emergent Solution

One single supplier providing in-house skilled and experienced personnel to mobilize for an emergent event at any time

The Challenge
Jammed fuel assemblies are often discovered when utilities lift the upper internals. As a result, the assemblies have potential to fall and cause a major safety-related issue.

The Solution
AREVA has developed a solution to safely and rapidly secure and remove the fuel assembly (qualified for 900MWe, 1300 MWe, and 1450 MWe plants).

Technical Features
- AREVA fuel and field operations experts perform preliminary analysis of the situation based on televisional inspection data to:
  - Determine the integrity of the assembly
  - Define the conditions of the operation and the specific scenario
- Before site activities, training is performed on a representative mockup specific to each situation to ensure that personnel are prepared for specific environmental conditions
- Full set of tools dedicated to plant operation
- The assembly is secured prior to contact between the equipment used and the fuel assembly to eliminate risk of falling
- Capacity to secure one or more assemblies

Key Features & Benefits

Fast & Safe
- Experienced, dedicated team (fuel experts, engineers, and skilled operators)
- Tools designed to ensure reliability and avoid any risk of the assembly falling from any position (patented scenario)
- 4 successful operations performed in France

Your Benefits at a Glance
- Safety: process and tools ensure reliable and quick securing of the assembly
- Quick response: one single supplier providing in-house skilled and experienced people mobilized for an emergency at any time
- AREVA’s combined expertise in fuel and services
Assessment and refurbishment of fuel pins to prevent misalignment or jamming

The Challenge
During refueling outages, handling operations on the upper internals may cause impacts on the fuel pins that result in subsequent misalignment or jamming of the fuel assembly.

The Solution
Based on extensive experience in upper internals work, AREVA provides a full package to repair and — if the damage is too great — to replace fuel pins.

AREVA, a Leader in Upper Internals Work
- Experience on different types of plants in the U.S. and France, with 12 operations over the last 30 years
- Continuous training of our experts, engineers and operators in order to be immediately operational
- Intensive R&D program over the last few years to develop updated tools with new technologies
- Dose optimization as work performed with standard water level

Key Features & Benefits
- Dose optimization by underwater work
- Capability to propose and implement the most appropriate solution: refurbishment or replacement
- Low impact on outage schedule due to underwater work
- Unique worldwide experience

Technical Features
- Underwater work performed from below the upper internals while they are on the stand
- Assessment by:
  - Televisual inspection
  - Checking the angle of the pins with a specific tool
- Fuel pin refurbishment/repair by:
  - Straightening
  - Grinding
  - Electrical Discharge Machining
- Fuel pin replacement (guide tube removal performed prior to replacement) using specific mechanical tools
Metrology
Photogrammetry & Laser Scanning

Your total metrology solutions provider

Photogrammetry
Photogrammetry is a triangulation measurement process that utilizes a series of overlapping high resolution digital images and a robust software package to derive accurate, three-dimensional coordinate measurements. Field accuracies utilizing the methodology of photogrammetry are typically within ±0.005”.

To measure the features, small retro-reflective targets are discreetly installed on the components and/or cubicles, piping, structural interfaces, scribed lines, bolt patterns, walls, etc. These targets are then identified semi-automatically on each image and exported to the iterative bundling software that produces a relative series of individual three-dimensional coordinate data points. This data is then transformed into a working coordinate system by utilizing known features to orient the analysis coordinate system. The points are then analyzed to create geometric shapes such as planes, cylinders, axes, etc.

Laser Scanning

Laser scanning does not require target placement to collect dimensional information. However we do use targeting as an aid to provide a better quality end product. The technology is ideally suited for capturing the surface geometries of complex or irregular structures that require engineering or survey-grade accuracy, +/- .125 inch, that would otherwise be very time-consuming or very difficult, if not impossible, to measure and model. Finished models can be easily exported to popular CAD packages for subsequent design of facilities and structures, dimensional analysis or conversion to 2D drawings.

Key Features & Benefits
Laser scanning also replaces traditional field walk downs, minimizing resources and personnel dose exposure while increasing the amount and accuracy of the collected data. New technologies include a Measurement Arm and close-range laser scanner accurate to within +/-0.002 and a medium range laser scanner accurate to within +/- 0.012. Both scanners are capable of measuring irregular features for reverse engineering.

• Proven experience integrating multiple metrology technologies
  - Steam Generator Replacements
  - Reactor Vessel Head Replacements
  - Piping Modification Support
  - Component, Valve, and Piping Replacements
  - Reverse Engineering and Modeling Support
  - Virtual Alignment of Components and Machinery Systems
  - Animation Sequences to Ensure Proper Travel Paths
Your total metrology solutions provider

Our teams can support a variety of needs — from precision measurements accurate within .001” to large-scale, survey-grade accuracy and as-built surface modeling accurate within .25”. Plus, our wide range of metrology services supports design engineering, fabrication, installation, dimensional receipt inspection, large volume surface modeling, and interference detection and animation creation.

Laser Tracker
The laser tracking system is a ‘real-time’ measurement process that uses a laser distance meter, two precision encoders and sophisticated proprietary software to calculate, store and display the 3-dimensional position of a mirrored target (probe) or other specially developed probe systems. A beam steering system senses movement of the mirrored target and directs two servo motors to track the target. The Tracker follows the mirrored target over features, updating the position at a rate of 1,000 times per second. The abundance of data collected yields good statistical redundancy, permitting excellent accuracy and repeatability. Measurement data can be displayed in spherical, cylindrical, or Cartesian coordinates.

Field accuracies when utilizing the methodology of laser tracking is <0.003". The measured 3D data can be presented in reports, exported to CAD programs, or spreadsheet programs for further data analysis.

3D Modeling
The collected laser scan data will be "registered" together as one common data set relative to plant features in the project area to set the azimuthal and elevation position of the collected data. The point cloud data will be converted to 3D geometries that represent the as-found conditions of the described area in the areas of interference only and provided to the customer.

Key Features & Benefits
- Nuclear is our business — it’s what we do best
- Advanced metrology services combined with a track record of successful data interpretation
- Proven experience integrating multiple metrology technologies
- Installation & design risk mitigation
- Advanced interference notification
- Minimized re-work
- Reduced personnel radiation exposure
- Customized applications to meet your specific needs
**Total Station**
The total station is a ‘real-time’ measurement process. By measuring vertical and horizontal angles, and incorporating electronic distance meter (EDM) determined straight-line slope distances, a three dimensional coordinate value of each survey point is electronically calculated.

The total station measurement system is accurate to within ±0.030” in the field and provides an accurate representation of point cloud data collected and their relation to gravity. The total station utilizes retro reflective targeting to collect the required data. These targets are placed on piping, structural interferences, walls, etc.

This data is then transformed into a working coordinate system by utilizing known features to orient the analysis coordinate system. The points are then analyzed to create geometric shapes such as planes, cylinders, axes, etc.

**Scan Files**
As part of our laser scanning service, SCANView files will be created and delivered. The SCANView files are opened utilizing the TruView software, which is free software designed for mass-distribution with an intended use of comprehensive visualization of the scanned areas and includes pan and zoom capabilities, limited measurement extraction, and area/job specific annotation features that can be shared with as many employees/contractors as desired across network or the web. The SCANView files will contain all laser scanning stations and the point cloud data that was acquired from each station. This tool works well for the non-3D users within the project — no skills in laser scanning, CAD, or 3D are needed.

**Key Features & Benefits**
- Decreased Radiation Exposure
- Increased Safety
- Improved Schedule Performance
- Risk Mitigation
- Provides Optimal Weld Locations
  - Achieving Positive NDE Results
- Ensures an Interference-Free Design
- Financial Success

**You Want Innovative Thinking?**
AREVA’s underwater capabilities with laser scanning and video laser systems allows for measurement in areas once thought to be impossible to obtain.

**Fitup right the first time — everytime**
The only vendor for vertical weld repair

Internal components are susceptible to intergranular stress corrosion cracking (IGSCC), which follows the heat-affected zone of welds on the core shroud. AREVA is the only vendor who has successfully repaired a vertical weld. AREVA employs an innovative repair design that utilizes eccentric features that allow compression across the vertical weld. Electrical Discharge Machining (EDM) is used to facilitate installation of the repair. Our repair structurally replaces the flawed weld to allow continued safe operation. In addition it eliminates the UT inspection of the repaired vertical weld.

Key Features & Benefits

- Meets the pertinent criteria for vertical weld repairs BWRVIP-02
  - Maintains cylindrical configuration of shroud
  - Minimizes leakage
  - Designed for all normal, upset, emergency and faulted conditions
  - Analyzed for leakage within the limits of the Emergency Core Cooling System
- Corrosion-resistant; proven materials and fabrication
- No requirement to maintain clamp pre-load
- Accommodates cold feedwater injection
- No requirements for other design-reliant welds
- Can be installed without unloading fuel
- Minimizes future In-Service Inspection (ISI)
- No interference with top guide, core plate wedges, or tie rods
- Addresses any vertical welds, including welds behind core spray pipes
Core Shroud
Circumferential Weld Repair

Simple, rugged design for weld repairs

Tie Rod Repairs
AREVA teamed with MPR Associates to provide a tie rod design to structurally replace the circumferential welds. AREVA has installed tie rods in two U.S. plants that have operated flawlessly since 1996. Teams quickly took action and installed four tie rods in only six days.

Tie Rod repairs provide structural support for all circumferential stainless steel welds in the core shroud (welds H1 through H8). The repair limits the vertical and lateral displacement of a flawed shroud assembly to acceptable criteria under seismic and accident loads. The displacement limits ensure shroud function and proper control rod insertion. The tie rod assemblies can be pre-loaded to a value which prevents vertical separation of flawed circumferential welds under normal operating conditions (even if welds H2 and H3, as well as H5 and H6 should subsequently fail after initial preloading).

Key Features & Benefits

- Successfully installed at two U.S. plants
- Meets the pertinent criteria for horizontal weld repairs
- BWRVIP-02
  - Ensure core bypass leakage is limited to acceptable levels
  - Limits deflection and deformation for control rod insertion
  - Designed for all normal, upset, emergency and faulted conditions
  - Corrosion-resistant, proven materials and fabrication
- Accommodates cold feedwater injection
- Can be installed without unloading fuel
- Minimizes future ISI (In-Service Inspection)
- Addresses circumferential welds (H1-H8)
- Rugged and simple design; no loose parts
BWR Services

Steam Dryer Modifications

Repair/upgrade of existing steam dryers

Steam dryers are in a turbulent environment which may result in the need for repairs. AREVA is experienced in performing weld repairs on steam dryers. Recent power uprates require analysis of your existing steam dryer, which may result in necessary upgrades. AREVA can perform underwater weld repair of steam dryers by deploying the latest BWR manual and remote techniques. AREVA often utilizes divers with specialized shield platforms and FME controls to implement the repairs.

Repairs include:
- Repair or replacement of tie bars and gussets
- Drain channel repairs
- Hood replacement
- Load equalization of the support points
- Underwater / diver repairs
- Weld build-up
- EDM machining

Key Features & Benefits

- May eliminate need for replacement
- Reduced cost compared to replacement
- Reduced schedule compared to replacement
- Replacement tie bar design with low profile for reduced prying loads
- Replacement tie bar design has flared ends for increased weld area

Significant cost savings versus replacement
Core Spray Pipe
Repair

Comprehensive, proven solutions

BWR plants have reported core spray pipe cracking for over 25 years. AREVA has invested to deliver proven, comprehensive solutions. AREVA is capable of providing comprehensive solutions for emergent flaws in core spray pipe weldments. We have developed repair techniques that allow repair of most weld locations in a timely manner to allow continued operation for the life of the plant. The repair uses clamps that are mechanically engaged to the core spray pipe in order to transmit bending and axial loads without slippage. The clamp provides a mechanical load path and limits the crack opening in order to limit the leakage of core spray flow, while structurally replacing the flawed welds.

General Repair Design
The general capabilities of repair clamps for flawed core spray piping welds include:

- The repairs meet the BWRVIP-19A design criteria.
- All materials meet the BWRVIP-84 guidelines.
- The repair clamps replace the function of the flawed welds by transmitting the piping loads that exist at each joint. Due to the gaps inherent in this mechanical repair, the secondary loads will be reduced.
- The repair clamps restrict the pipe joints from opening at each flawed weld, thereby limiting the leakage of core spray flow during an injection event.

Key Features & Benefits

- All welds may be repaired within allowable leakage range
- Less invasive than replacement
- Restores the safety function of the core spray pipe to deliver emergency core-cooling water flow
- EDM during installation avoids FME issues
- A simple design replaces the suspect weld
Core Spray Pipe Replacement

Core spray pipe replacement to suit your needs

AREVA can provide a full core spray pipe replacement utilizing mechanical attachment features between the inlet nozzle and the core shroud. Designed for remote underwater installation, new piping attaches between the nozzle safe-end and core spray sparger. And for your convenience, no welding is required for the attachment of the replacement piping.

Design Features
The core spray piping partial and complete replacement design and installation approaches meet all BWRVIP and nuclear repair/replacement requirements while offering several important features:

• No welding to service-sensitive stainless steel reactor components and no in-vessel welding. The number of shop welds utilized in the replacement design are minimized and all are fully solution-annealed and IGSCC-resistant. No crevices are permitted at weld locations.

• All IGSCC-susceptible welds now in the core spray piping between the core shroud and reactor vessel nozzles are eliminated in the complete replacement. The partial replacement would eliminate susceptible welds from above the field weld coupling to the core spray sparger.

• The mechanical joints in the core spray piping and attachments to the shroud and core spray nozzle safe end provide adjustability to allow for a wide range of as-built dimensional variations and provisions to lock them at installation. This replacement assures vibration-resistant joints similar to the existing installation.

• The core spray piping hydraulic design minimizes flow resistance such that core spray delivery meets current minimum flow requirements.

• In-vessel cutting utilizes proven, qualified tooling and processes.

Key Features & Benefits

• No welding to service-sensitive stainless steel reactor components and no in-vessel welding

• Eliminates all IGSCC-susceptible welds in the core spray piping between the core shroud and reactor vessel nozzles

• Adjustable mechanical joints allow a wide range of as-built dimensional variations

• Hydraulic design minimizes flow resistance, enabling core spray delivery to meet current minimum flow requirements

• AREVA can install the design remotely from the refuel floor
Feedwater Sparger
End Pin Repair

Innovative repair solutions prevent wear on feedwater sparger end pins

Recent industry events showed that vibration has caused wear in the feedwater sparger end pins. AREVA’s innovative end pin repair restores the original condition to allow thermal growth of the feedwater sparger by providing a new bearing surface 20X greater than the original pin to reduce additional wear. The installation is performed without having to remove the existing pin and can be installed in less than one shift.

Installation Process
- Raises pin out of worn counter-bore, and the repair hardware is positioned on the head of the existing pin
- The engaging feature is inserted into the hole in the head of the existing pin
- The repair hardware is tensioned, capturing the engagement feature
- A crimp cup is then used to lock the assembly in place

Key Features & Benefits
- Faster and easier to install than other repair methods
- Designed for life-of-plant
- Low-dose repair precludes divers or added HP support
- Uses existing pin hole feature, eliminating removal or modifications to existing hardware
- No disassembly required
- Increases bearing surface by factor of 20
- Installs in less than one shift
- Two repairs installed at a U.S. utility in Spring 2014 without issue
Recent inspections revealed indications beyond the heat-affected zone of the core shroud welds. Irradiation-Assisted Stress Corrosion Cracking (IASCC) affects the base material of the shroud. To help maintain your plant integrity, AREVA’s innovative replacement concept includes bolted forgings that eliminate all vertical and circumferential welds.

Replacement Process
The shroud assembly is removed and sectioned for disposal using conventional and EDM processes. AREVA’s replacement concept utilizes bolting, as opposed to competitors’ in-air welding techniques, on irradiated materials to reduce dose and allows replacement activities to be done underwater. Our process eliminates welding on irradiated materials that could result in future weld indications and significantly reduces dose.

The replacement core shroud is manufactured from a forging to eliminate welds, thereby reducing future inspections. The bolted subsections are designed with access for future bolt inspections, which will be minimized.

Design, fabrication, removal, installation, & disposal of core shrouds

Key Features & Benefits
- Underwater core shroud replacement reduces dose
  - 100% forged components
  - Forged cylinders – alleviate vertical welds
  - Bolted connections – alleviate horizontal welds
  - Type 316L-NG material per BWRVIP-84
- Bolted connection to existing shroud support plate
  - No need to drain vessel
  - Much lower dose for entire project
CRD Housing

Repair

Stop leaks before they compromise the integrity of your plant

AREVA has developed and qualified tooling and processes to support the current and future needs of BWR Control Rod Drive (CRD) Housing repairs. AREVA worked with EPRI to develop the standard BWRVIP-58A repair for CRD Housings and the tooling to implement the CRD Housing repair design geometries. In addition, AREVA has designed the repair based on its experience with PWR head penetrations utilizing Code Case N-638.

The CRD Housing repair addresses the high tensile stresses through an innovative weld joint design. Internal Access Weld Repair replaces the load carrying capability of the CRD Housing to stub tube J-weld, and provides a seal to prevent leakage from the RV. AREVA now offers three basic repair designs: the standard BWRVIP-58 repair, a modified BWRVIP-58 repair based on Code Case N-638, and complete CRD Housing Replacement. The repair design optimizes schedule and dose considerations for the final repair and provides a permanent solution.

Key Features & Benefits

- Permanent weld repair
- Complete CRD Housing replacement option
- Repair performed from under vessel
- Optimized for schedule / dose considerations
Jet Pump Flow Collar

Jet Pump Repairs

AREVA’s repair reduces bypass flow at the slip joint

As the BWR industry faces new jet pump challenges, AREVA combines integrated programs, processes, techniques, and tooling to deliver a permanent solution. For example, studies demonstrate that leakage at the slip joint causes instability resulting in FIV. By addressing this root cause, AREVA BWR experts can deliver cost-effective technology that restricts leakage and allows for thermal expansion. A new enhanced design includes ~360° sealing capability around the slip joint without the need to remove the guide fins from the diffuser. Adjustments have also been incorporated that allow flexibility to accommodate the thermal growth differences between the diffusers and the jet pump mixer.

AREVA’s Process

Leakage through the slip joint causes Flow Induced Vibration (FIV). A new slip joint is then needed to allow thermal growth. The upper portion of the hinged collar clamps and seals around the mixer, and the lower portion of the collar sits on top of the diffuser to create a seal. The flexure region of the collar accommodates the thermal expansion.

Flow Control Collar Advantages

- The only solution that addresses the root cause of the vibration issue
- Simple installation, less than one shift per jet pump pair
- Minimizes the number of parts in the repair hardware
- Minimizes potential leak paths to restrict flow
- This design can be modified to fit jet pump locations that currently have the OEM slip joint clamp assembly installed

Key Features & Benefits

AREVA solutions provide long-term asset protection and more efficient power output when you need it most — all from a single source.

- Restricts leakage at the slip joint to potentially eliminate FIV
- Resists FIV loads at the slip joint
- Simple installation without jet pump disassembly
- Simple installation without on-site machining
- Repairs for life of plant

Other Jet Pump Repairs include:

- Riser Pipe Repairs
- Restrainer Bracket & Wedge Repairs
- Slip Joint Clamps
- Set Screw Repairs
- Riser Brace Repairs
- Sensing Line Repairs
- As-built Dimensions of Existing Jet Pumps (Underwater Laser Scanning)
- Auxiliary Wedge Installation
AREVA in North America (AREVA Inc.) combines U.S. and Canadian leadership to supply high added-value products and services to support the operation of the nuclear fleet. Globally, AREVA is present throughout the entire nuclear cycle, from uranium mining to used fuel recycling, including nuclear reactor design and operating services. AREVA is recognized by utilities around the world for its expertise, its skills in cutting-edge technologies, and its dedication to the highest level of safety. Through partnerships, the company is active in the renewable energy sector. AREVA Inc.’s 4,300 employees are helping build tomorrow’s energy model: supplying ever safer, cleaner and more economical energy to the greatest number of people.

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