

# Welding & Repair Technology Center (WRTC)

## Program Overview

### Program Description

High-quality, reliable welds are critical to safe nuclear plant operation. Because of the safety significance of welds in many metal components and plant systems, the nuclear power industry must be confident in the quality and integrity of welds when joining various metals and using different welding systems. While maintaining this commitment to quality and safety, nuclear power plants also are interested in productivity improvements and new technology applications that can provide cost savings in terms of maintenance and operations.

The Welding & Repair Technology Center (WRTC) develops advanced materials, joining, and repair technologies for nuclear power plants, contributing to reduced operation and maintenance costs and improved plant availability. The program also supports technical interactions with code and regulatory entities to reduce the time and cost associated with implementing new technologies and repair rules.

### Research Value

Research results from the Welding & Repair Technology Center help nuclear power plants find faster, less-costly ways of making repairs using novel welding techniques or by applying existing techniques in new situations. Research results also are commonly used to support technical justifications that enable utilities to pursue regulatory relief from code requirements, typically saving time and money. WRTC participants gain access to the following:

- Repair options for key components, supplemented by application guidelines, procedures, and training.
- Materials, welding, and repair experts across the Electric Power Research Institute (EPRI) and the nuclear industry.
- Techniques for reducing repair costs, reducing component downtime, and increasing plant availability.
- Demonstrated repair techniques and technologies that improve material performance and enable component life extension.

### Approach

The Welding & Repair Technology Center combines extensive laboratory capabilities with detailed familiarity with industry and regulatory needs to investigate and evaluate welding and repair techniques. WRTC staff can replicate welding setups in the field – power supplies, weld heads, and other equipment – to create realistic welding environments in the laboratory. Through participation in many American Society of Mechanical Engineers (ASME) and industry technical committees, WRTC staff can then ensure that the program's research results can support code requirements.

- Develop, test, and evaluate safe, effective, and reliable repair techniques that contribute to shorter outages and meet or exceed all code, regulatory, and design requirements.
- Develop and assess technologies that enable repairs to be made more quickly while the plant is off-line.
- Develop and assess technologies that enable repairs to be made while the plant is on-line.
- Ensure broad dissemination and application of industry lessons learned and benchmarking practices.

## Accomplishments

EPRI's Welding & Repair Technology Center supports nuclear power industry efforts to develop and apply welding and repair techniques that ease regulatory concerns, reduce maintenance costs, and improve productivity.

- Provided technical guidance for conducting detailed root-cause analysis to support repair option selection for critical pressure components.
- Through a collaborative effort with a leading repair vendor, demonstrated the feasibility of in-vessel underwater laser beam weld repair of critical nickel alloy welds, eliminating the need to drain the reactor vessel.
- Provided technical support for implementing new technologies, including application guides for advanced welding methods, guidelines for installing and examining dissimilar metal weld overlays, and repair/mitigation of socket weld fatigue failures.
- Supported development of realistic code rules, including new code cases to reduce post-weld examination hold times and use dissimilar metal weld overlays for stress corrosion cracking mitigation. The overlay code case revision, for example, eliminated a 48-hour hold period at one utility, enabling it to bring its plant back on line 17 hours sooner than would have been required otherwise.
- Developed guidance for overlay applications, procedures for gas-metal arc welding, and new plant build specifications.

## Current Year Activities

Welding & Repair Technology Center R&D for 2010 will focus on developing repair and fabrication technologies to reduce outage time and expand the availability of repair options that may be performed during plant operation. WRTC also will provide technical support to address the challenges of new plant construction. Specific efforts will include the following:

- Develop improved productivity welding methods to address large-scale applications (weld overlays).
- Develop repair options to address fuel pool leakage.
- Evaluate mitigation options for stress corrosion cracking in low-alloy steels and austenitic materials.
- Identify welding and fabrication best practices that are cost-effective, reduce downtime, and improve quality.
- Evaluate advanced filler/welding materials for critical plant repair applications.
- Conduct failure analysis and stress measurements to assist utilities in repair decisions.
- Develop underwater laser beam welding techniques to address difficult in-vessel repairs with limited accessibility.
- Provide benchmarking support for utility repair and replacement programs.

## Estimated 2010 Program Funding

\$3.3 million

## Program Manager

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## Summary of Projects

Project Number	Project Title	Description
41.05.03d	Weld Mitigation Interest Group	Various mitigation and repair strategies are available to address stress corrosion cracking (SCC) in critical nuclear power plant pressure boundary components. To date, structural weld overlay or MSIP has been the strategy of choice. Alternative strategies are necessary to reduce outage duration and maintenance costs and to assist when certain configurations limit outside diameter access. Feasible strategies include 1) structural weld overlay with a high-deposition welding process, 2) optimized weld overlay with reduced thickness, 3) inside diameter (ID) inlay repair, 4) ID onlay repair, 5) ID cladding, and 6) underwater laser beam welding.
P41.05.03.01	WRTC Subscriber Requested Assistance (Supplemental)	SRA provides members with technical support in a broad range of repair-related areas, including materials and joining evaluations, benchmarking of welding and repair programs, and process and procedure development. Members determine the workscope of the individual projects.
P41.05.03.02	WRTC Welding Materials Issues (Supplemental)	The Welding Repair and Technology Center (WRTC) Welding Materials evaluation project is aimed at supporting member needs for reliable and cost-effective weld fabrication and repairs to improve plant availability.
P41.05.03.03	WRTC New Process Development (Supplemental)	This project provides participants with repair and mitigation technologies to improve plant availability. Online repair techniques and advanced technologies to reduce time and cost of repairs are developed to reduce outage scope and downtime.
P41.05.03.04	WRTC Advanced Weld Application (Supplemental)	This project provides Weld Repair and Technology Center (WRTC) members with advanced welding and repair technology to reduce the time and cost of repairs or modifications to critical plant components.
P41.05.03.05	WRTC Best Practices and Case Histories (Supplemental)	This project assembles valuable case history and lessons-learned data and distributes it to WRTC members to assist in the implementation of repair and replacement activities.
P41.05.03.06	WRTC Materials Evaluation (Supplemental)	This project develops guidelines and case history information to assist plant personnel in root-cause analyses to support repair and replacement planning. Guidelines concentrate on weld failures, material issues, and evaluation of defects or failure mechanisms for pressure parts in nuclear service.
P41.05.03.06b	Repair and Replacement Options for High Cycle Fatigue Failures in Socket Welds	This project is aimed at extending the life of existing socket welded systems and providing fatigue-resistant weld geometries for new socket welds. Improvement in the weld geometry specification at installation or modification of existing welds can improve the reliability of socket welds through reduced failures and extended life of susceptible socket weld locations. The project also supports the implementation of specialized online repair techniques that can assist in outage avoidance or derating of the unit.
P41.05.03.07	WRTC Equipment Development (Supplemental)	The project develops advanced repair equipment and technologies to meet emerging issues in power plant repairs.
P41.05.03.08	WRTC Materials Evaluation (Base)	This project addresses welding and replacement materials performance for nuclear plant applications. This includes support for root- cause evaluations, development of new repair technology to enhance material performance, and corrective actions for existing degradation mechanisms.

Project Number	Project Title	Description
P41.05.03.09	WRTC Welding Materials Issues (Base)	This project evaluates welding material performance in power plant service environments to improve the life of nuclear plant components.
P41.05.03.10	WRTC Subscriber Support (Base)	This project assists WRTC members in implementing new technology, codes and standards, equipment, and materials from the program. Through a series of workshops, meetings, newsletters, technical reports, and websites, WRTC members gain access to R&D results.
P41.05.03.11	WRTC Codes & Standards (Base)	This project supports the development or revision of ASME (and other) code rules to enable members to utilize the latest technology for repair and replacement activities. This is accomplished through direct engagement with the code organizations, development and authoring of new proposals, and preparation of technical basis documents.
P41.05.03.12	WRTC Best Practices & Case Histories (Base)	This project uses utility experience to support the development of new repair and replacement technology, along with supporting code case activities to enable the use of advanced welding and repair technology for nuclear applications.

## Weld Mitigation Interest Group

### Key Research Question

New and emerging repair and mitigation technologies can provide safe, cost-effective options for nuclear plant owners. Electric Power Research Institute's (EPRI's) Welding & Repair Technology Center (WRTC) works closely with welding, utility, and examination organizations to evaluate such technologies, including the following:

- Underwater laser beam welding for inside diameter (ID) mitigation and repair
- High-deposition welding processes
- Inlay and onlay repair technologies for ID mitigation and repair
- Improved weldability of Alloy 52, a high-chromium filler material with high resistance to primary water stress corrosion cracking (PWSCC)
- Improved welding methods to enhance inspectability, weld quality, and productivity
- Regulatory and code support associated with stress corrosion cracking (SCC) repair and mitigation

### Approach

The Weld Mitigation Interest Group evaluates emerging repair options through technology development to reduce the time, cost, and radiation exposure related to welding operations; enhanced inspectability with advanced welding processes; emerging technology assessments, such as inlays, onlays, and underwater laser beam welding; validation of filler metal weldability; and documentation of industry experience.

The Weld Mitigation Interest Group also hosts two workshops per year on SCC repair and mitigation, providing a forum for exchange of industry experience, solutions, and technology. The Interest Group produces an *SCC Repair and Mitigation Handbook* to support effective management of primary system components susceptible to SCC. Related products include evaluation of advanced welding technologies and a database of high-chromium filler metal weldability tests.

## Impact

- Availability of proven, cost-effective repair and mitigation techniques.
- Consistent approach for compiling operating experience and addressing regulatory issues.
- Identification of high-priority research activities to address weld overlay issues.
- Sustained EPRI leadership in SCC repair and mitigation.

## How to Apply Results

Participants use technology evaluation results to analyze repair options for future plant application. The *SCC Repair and Mitigation Handbook* provides specific guidance that can be incorporated into management and inspection plans for primary systems components susceptible to SCC. Participation in the workshops provides access to industry experts on weld repair and mitigation.

## WRTC Subscriber Requested Assistance (Supplemental) (045710)

### Key Research Question

Nuclear plant staffs have been reduced, reducing the time available for personnel to participate in technology transfer activities, stay abreast of changing codes and regulations, and monitor improved repair technologies and processes. Accelerated technology transfer would help plant personnel meet immediate needs and provide peer support among utility repair personnel.

### Approach

Subscriber Requested Assistance (SRA) facilitates technical support for application of Welding Repair and Technology Center (WRTC)-developed technology products. Through this feature, members also may receive assistance for unique repair/replace application needs, including welding qualification (PQR) database support, procedure review, repair/welding program assessments, benchmarking activities, and specific code support.

### Impact

- Immediate access to repair experts available through the Electric Power Research Institute (EPRI)
- Peer support from the repair community
- Access to welding and repair procedures to meet new challenges
- Support in development of new repair and welding procedures
- Customized support on repair issues and implementation of WRTC technology.

### How to Apply Results

The Subscriber Requested Assistance Project results directly support utility member needs. Each product is tailored to meet the request of a participating utility or utility group.

## WRTC Welding Materials Issues (Supplemental) (065811)

### Key Research Question

As nuclear power plants age, there is an increased need to address material degradation. Degradation mechanisms such as stress corrosion cracking, erosion-corrosion, wear, and embrittlement can all reduce the service life of power plant components. In some cases, this can influence license extensions and aging management. The performance of welding materials has a strong influence on the overall life expectancy of power plant components. Welding is one of the critical technologies for repairing and upgrading existing components and for installing replacement items.

## Approach

This project evaluates welding material performance in power plant service environments to improve the life of nuclear plant components. Use of corrosion and wear-resistant filler materials can markedly increase the performance of many power plant systems. Combined with advanced welding technologies, effective and practical repair/replacement activities can be accomplished more quickly and provide greater service life.

## Impact

- Improve the understanding of weld performance and welding material performance in nuclear plant service
- Identify methods and materials to improve the life of nuclear components
- Reduce outage times for repairs to critical pressure boundary components
- Mitigate emerging issues related to weld performance

## How to Apply Results

Members apply guidance to identify susceptible materials currently in service, evaluate alternative materials for replacement, and select materials for repair applications to increase service life.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Development of Advanced Welding Materials for Component Life</b> <b>Extension:</b> Products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	12/31/10	Technical Resource

## WRTC New Process Development (Supplemental) (065813)

### Key Research Question

Advanced repair technologies and processes to address emerging applications can improve plant availability. New challenges to maintain existing plant components have increased the value of advanced repair options, such as alternative materials. Repair and replacement of existing pressure systems, for example, relies heavily on welding technology. Advanced welding processes directly reduce downtime while improving the quality/reliability of repairs.

### Approach

The project supports the development of advanced repair processes and procedures to meet emerging issues in power plant repairs. Recent examples include ambient temperature temperbead welding, underwater weld repairs, overlays and designed caps (PM-Caps™) for repair of degraded vessels, and use of weld overlays for stress improvement of Alloy 600 components. Research activities include advanced processes to support repair of new materials and applications such as high-density polyethylene piping to further reduce critical path time.

### Impact

- Reduce the time and cost of performing repairs through improvements to demonstrated technology
- Extend the life of repaired components through advanced technology for repairs
- Reduce the cost of post-repair examinations and future monitoring through improved repair quality

## How to Apply Results

Members implement repair techniques and products on-site using their own staff or by sharing the methods with vendor organizations. A number of the developments from this project will be approved by code and regulatory agencies, further assisting in implementation.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Development of Advanced Repair Techniques and Processes:</b> Products will be based on member product selection to address emerging repair issues in future years. This project will develop new repair processes and techniques aimed at meeting repair challenges for improved plant materials.	03/31/10	Technical Update
<b>Small Bore Piping, Welding and Repair Technology:</b> This product will provide technology to improve the life expectancy of critical small-diameter pipe and components using socket-welded connections or butt-welded connections.	12/31/10	Technical Update

## WRTC Advanced Weld Application (Supplemental) (065815)

### Key Research Question

Advanced repair technologies and processes to address emerging applications can improve plant availability. New materials and increasing challenges to maintain existing plant components have increased the value of welding as a repair option. Repair and replacement of existing pressure systems, for example, relies heavily on welding technology. Advanced welding processes directly reduce downtime while improving the quality/reliability of repairs.

### Approach

The project develops advanced welding technologies to meet emerging issues in power plant repairs. Recent examples include spent-fuel pool repairs and use of weld overlays for repair of Alloy 600 components. This project also develops and evaluates new welding processes, such as wave-form controlled gas metal-arc welding systems and temperbead welding to further reduce critical path time for repairs.

### Impact

- Reduce the time and cost of performing repairs by improving the deposition rate of welds for repair/replacement applications
- Extend the life of repaired components through advanced technology for repairs
- Reduce the cost of post-repair examinations and future monitoring through improved repair quality
- Develop specialized processes such as temperbead welding to reduce repair cost and critical path time and provide alternatives to repair techniques based on original construction code rules

## How to Apply Results

Members implement repair techniques and products on-site using their own staff or by sharing the methods with vendor organizations. A number of the developments from this project will be approved by code and regulatory agencies, further assisting in implementation.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Development of Advanced Repair Processes:</b> Products for future years will be based upon emerging technology and plant repair/reliability issues.	03/31/10	Technical Update

## WRTC Best Practices and Case Histories (Supplemental) (065816)

### Key Research Question

The development of repair and replacement technology for power plants is an evolutionary process that requires continuous sharing of experience from nuclear plants, vendors, and research organizations. These experiences and case histories are often passed along from outage to outage within a utility or a specific vendor. Sharing this information across multiple plants informs decisions related to repair and replacement activities.

### Approach

The Weld Repair and Technology Center (WRTC) supports upcoming repair and replacement activities by compiling and sharing best practices, experience information, and benchmarking data. This project continues those efforts by using a number of resources to acquire and distribute this information to members.

### Impact

- Realize substantial time and cost savings through implementation of key products such as Welding Best Practices and the Repair & Replacement Program Checklist. In many cases, these documents also assist in ensuring compliance with the latest code or regulatory requirements.
- Access to the WRTC Sharepoint site, which provides continuously updated information on utility procedures, administration documents, repair and replacement programs, welding programs, experience reports.
- Provide peer support and benchmarking activities through information exchange services, SharePoint website, and issues meetings.

### How to Apply Results

This project is implemented by WRTC members through email and web-based communication and document sharing tools. These tools provide quick access to case history information, technical RRAC reports, and procedures/practices used by other members. Members realize value by integrating such information into plant procedures or practices.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Welding Best Practices:</b> This project will support the development and documentation of best practices for welding and repair used in the nuclear industry. Topics will include qualifications, training, application of new codes and standards, procurement, safety, documentation, vendor supplied equipment/services, and other data. The information used in preparation of this resource will come from utility procedures, site visits, interviews, member/vendor feedback, and performance history.	12/31/10	Technical Resource

## WRTC Materials Evaluation (Supplemental) (065814)

### Key Research Question

Power plant failures and repair issues often require material analyses to determine the root cause and appropriate corrective actions. Procedures for root-cause analyses are often conducted by personnel unfamiliar with the processes involved and materials and case histories associated with the failures. Guidance on conducting a root-cause analysis and the technical support to perform appropriate analysis is essential for eliminating repeat failures and establishing a basis for continuing operation.

### Approach

This project develops guidelines to assist plant personnel in conducting root-cause analyses. Guidelines will concentrate on weld failures, material issues, and evaluation of defects or failure mechanism.

### Impact

- Develop guidelines for performing material analyses to address common failure mechanisms and evaluating failed power plant components.
- Provide technical stress evaluation support for cases involving fractures or stress corrosion cracking.
- Guide evaluations of socket weld failures, overlay defects, and repair issues in determining root cause. Acceptability of a corrective action plan will be supported by this task.

### How to Apply Results

Members use the results of this work to perform in-house or vendor-supported analyses. Guidelines provide technical support for evaluation, and WRTC/RRAC staff and facilities also may be utilized.

### 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Guidelines for Root Cause Analysis of Pressure Equipment Failures, Revised:</b> Future year products will be based on the original guideline and will include revisions and updates reflecting plant and industry experience with pressure system failures. Case histories will expand the institutional knowledge available to Repair and Replacement Applications Center (RRAC) members.	12/23/10	Technical Resource

## Repair and Replacement Options for High Cycle Fatigue Failures in Socket Welds (049937)

### Key Research Question

Failures of small bore piping connections (2-inch and smaller) continue to occur frequently at nuclear power plants in the United States and abroad, resulting in degraded plant systems and unscheduled plant downtime. In current years, a number of socket weld failures have been documented, and in most cases the failures have resulted in a forced plant shutdown. Fatigue-related failures are generally detected as small cracks or leaks but, in many cases, the leak locations are not isolable from the primary reactor coolant system and result in extended outages. These failures are typically accelerated by poor weld quality at the root and toe locations (lack of fusion, undercut).

### Approach

This project will support the revision of guidelines for repair and replacement of socket welds susceptible to high-cycle fatigue failures. This includes code-approved technologies to enable on-line repair of defective socket welds in operating nuclear plants and validation of modified weld joint geometries. The socket weld configurations will be evaluated through high-cycle fatigue testing, mockup testing and finite elementA

analyses. Consequently, an understanding of socket weld fatigue failures related to weld quality and design will be improved, and successful resolutions will be implemented to reduce costs associated with forced outages and repeat failures.

### Impact

Improvement in the weld geometry specification during installation or modification of existing welds can improve the reliability of socket welds through reduced failures and extended life of susceptible socket weld locations. In addition, online repair applications can provide extended operating time, allowing replacement of the repaired connection to be scheduled during a routine outage with little or no impact on power production.

Typical downtime associated with socket weld failures is 3-5 days, equivalent to an estimated \$300,000 to \$1 million per day in lost revenue.

A standardized test configuration and vibration fatigue test conditions have been established through this program and continue to support American Society of Mechanical Engineers (ASME) code actions, overlay repair design criteria, and fitting and weld geometry modifications. The test program has successfully evaluated new joint configurations/modifications and repair scenarios and will continue to address new developments to address code acceptance criteria, Nuclear Regulatory Commission (NRC) concerns, repair guidelines, and verification of high-cycle fatigue resistance.

### How to Apply Results

This project provides test data and guideline information for modification of existing socket welds or use of improved weld geometries for new installations. The guidelines also address online repair methods that can prevent outages or derating through the use of code-approved techniques.

## WRTC Equipment Development (Supplemental) (065818)

### Key Research Question

Advanced repair technology and processes to address emerging applications can improve plant availability. Challenges to maintain existing plant components have increased the value of alternative and advanced repair options. Repair and replacement of existing pressure systems, for example, relies heavily on welding technology. Advanced welding processes directly reduce downtime while improving the quality/reliability of repairs.

### Approach

The project develops advanced repair equipment and technologies to meet emerging issues in power plant repairs. Recent examples include cleaning of contaminated surfaces, fuel pool repairs, and use of weld overlays for repair of Alloy 600 components. This project also develops and evaluates advanced equipment and processes such as laser cleaning systems and wave-form controlled gas metal-arc welding systems for underwater or overlay welding applications. Other studies will include use of these advanced repair systems to support improvement of special methods such as temperbead welding to further reduce critical path time for repairs

### Impact

- Reduce the time and cost of performing repairs by improving the deposition rate of welds for repair/replacement applications
- Extend the life of repaired components through advanced technology for repairs
- Reduce the cost of post-repair examinations and future monitoring through improved repair quality
- Develop specialized processes such as temperbead welding to reduce repair cost and critical path time and provide alternatives to repair techniques based on original construction code rules

## How to Apply Results

Members implement repair techniques and products on-site using their own staff or by sharing the methods with vendor organizations. A number of the developments from this project will be approved by code and regulatory agencies, further assisting in implementation.

## WRTC Materials Evaluation (Base) (065817)

### Key Research Question

Power plant failures and repair issues often require material analyses or improved material technology to support appropriate corrective actions. The development of advanced materials and welding technology to support complex repairs is critical to improving plant availability. Guidance on conducting a root-cause analysis and the technical support to perform appropriate analysis is essential for eliminating repeat failures and establishing a basis for continuing operation.

### Approach

This project develops technology and guidelines to assist plant personnel in repair of complex nuclear plant materials and pressure systems.

### Impact

- Develop guidelines for performing material analyses to address common failure mechanisms and evaluating failed power plant components.
- Provide technical stress evaluation support for cases involving fractures or stress corrosion cracking.
- Guide evaluations and corrective actions for socket weld failures, stress corrosion cracking (SCC) in ferritic and austenitic materials, overlay defects, and repair issues. Acceptability of a corrective action plan will be supported by this task.

## How to Apply Results

Members use the results of this work to perform in-house or vendor-supported analyses. Guidelines provide technical support for evaluation of repair and replacement material options, and members can access WRTC staff as necessary.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Guidelines for Root Cause Analysis of Pressure Equipment Failures, Revised as requested by members:</b> Future-year products will be based on the original guideline and will include revisions and updates reflecting plant and industry experience with pressure system failures. Case histories will expand the institutional knowledge available to Repair and Replacement Applications Center (RRAC) members.	12/23/10	Technical Resource

## WRTC Welding Materials Issues (Base) (065819)

### Key Research Question

As nuclear power plants age, there is an increased need to address material degradation. Degradation mechanisms such as stress corrosion cracking, erosion-corrosion, wear, and embrittlement can all reduce the service life of power plant components. In some cases, this can influence license extensions and aging management. The performance of welding materials has a strong influence on the overall life expectancy of power plant components. Welding is one of the critical technologies for repairing and upgrading existing components and for installing replacement items.

## Approach

This project evaluates welding material performance in power plant service environments to improve the life of nuclear plant components. Use of corrosion and wear-resistant filler materials can markedly increase the performance of many power plant systems. Combined with advanced welding technologies, effective and practical repair/replacement activities can be accomplished more quickly and provide greater service life.

## Impact

- Improve the understanding of weld performance and welding material performance in nuclear plant service
- Identify methods and materials to improve the life of nuclear components
- Reduce outage times for repairs to critical pressure boundary components
- Mitigate emerging issues related to weld performance

## How to Apply Results

Members apply guidance to identify susceptible materials currently in service, evaluate alternative materials for replacement, and select materials for repair applications to increase service life.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Development of Advanced Welding Materials for Component Life</b> <b>Extension:</b> Future products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	12/31/10	Technical Update

## WRTC Subscriber Support (Base) (065821)

### Key Research Question

Nuclear plant staffs have been reduced, reducing the time available for personnel to participate in technology transfer activities, stay abreast of changing codes and regulations, and monitor improved repair technologies and processes. Accelerated technology transfer would help plant personnel meet immediate needs and provide peer support among repair personnel.

### Approach

Subscriber support enables members to access Welding and Repair Technology Center (WRTC) expertise through meetings and information products. Members also may receive case history information for unique repair/replace applications, including welding qualification (PQR) database support, procedure review, repair/welding program assessments, benchmarking activities, research and development (R&D) results, and specific code support.

### Impact

- Immediate access to repair experts
- Peer support from the repair community through focused workshops
- Access to welding and repair procedures to meet new challenges
- Review/evaluation of new repair and welding procedures
- Support on repair issues and implementation of WRTC technology

## How to Apply Results

Subscriber support project results directly support utility member needs for ready access to repair and welding information. Products are aimed at supporting technology transfer of R&D results to WRTC subscribing members.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<p><b>Subscriber Services provided to WRTC/RRAC members:</b> Subscriber Requested Assistance provides members quick access to technical support and individualized research to meet plant needs and address emerging issues. Through direct Repair and Replacement Applications Center (RRAC) staff support and peer expertise, this project provides significant savings by reducing the cost and time required to perform repair and replacement activities.</p>	12/31/10	Technical Resource

## WRTC Codes & Standards (Base) (065822)

### Key Research Question

The continued downsizing of plant staffs and increasing travel restrictions make it difficult for nuclear power plants to maintain the required level of contact with code organizations and other technical bodies. Such engagement is necessary to ensure technical revisions permit implementation of new methods, procedures, materials, and technology for repair applications.

The benefit to utility members includes the availability of realistic code rules for welding and repair and the availability of technical support for future "Requests for Regulatory Relief" and assistance in obtaining Nuclear Regulatory Commission (NRC) approval of new code rules.

### Approach

This project supports Welding and Repair Technology Center (WRTC) activities in the development of ASME (American Society of Mechanical Engineers) code cases, revisions, and technical interpretations to address repairs of a wide range of components. The project also engages other code organizations, as needed, to expand the availability of repair options for members. As part of this work, WRTC provides technical information to appropriate regulatory bodies in support of member requests for use of new and emerging technology in advance of formal approvals.

Examples of this work include boiling water reactor control rod drive leakage repair, pre-emptive dissimilar metal weld overlay to address Alloy 600 repair applications, and use of specialized methods to seal leakage while under power. Other work includes streamlining code requirements for qualification of temperbead welding, socket weld assembly, installation of replacement components without costly post-weld heat treatment, composite repair of piping, and improved rules for underwater weld repair. Activities also support code updates and revisions to American Welding Society (AWS) structural and pipe/tubing codes, National Board Inspection Code (NBIC), and international codes. These revisions support the utilization of new technology and reduce the cost, time, and schedule impact of repairs on the availability of critical nuclear components.

### Impact

- Provide technical basis supporting code and regulatory rules that permit the use of innovative repair techniques, materials, and technology for critical reactor components
- Reduce the cost and complexity of repairs through the availability of practical code rules
- Reduce reliance on highly skilled staff in the application of more complex requirements

- Engage code and regulatory bodies during the development of new technologies to reduce the time and cost for implementing new technologies and repair rules

### How to Apply Results

The results of this project will be implemented through adoption of new code rules and by modifications in regulations related to repair activities.

## WRTC Best Practices & Case Histories (Base) (065823)

### Key Research Question

The development of repair and replacement technology for power plants is an evolutionary process that requires continuous sharing of experience from nuclear plants, vendors, and research organizations. These experiences and case histories are often passed along from outage to outage within a utility or a specific vendor. Sharing this information across multiple plants informs decisions related to repair and replacement activities.

### Approach

The Welding and Repair Technology Center (WRTC) supports upcoming repair and replacement activities by compiling and sharing best practices, experience information, and benchmarking data. This project continues those efforts by using a number of resources to acquire and distribute this information to members.

### Impact

- Realize substantial time and cost savings through implementation of key products such as Welding Best Practices and the Repair & Replacement Program Checklist. In many cases, these documents also assist in ensuring compliance with the latest code or regulatory requirements.
- Access to the WRTC Sharepoint site, which provides continuously updated information on utility procedures, administration documents, repair and replacement programs, welding programs, and experience reports.
- Provide peer support and benchmarking activities through information exchange services, SharePoint website, and issues meetings.

### How to Apply Results

This project is implemented by WRTC members through email and web-based communication and document-sharing tools. These tools provide quick access to case history information, WRTC reports, and procedures/practices used by other members. Members realize value by integrating such information into plant procedures or practices.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Technical Support Product selected by RRAC Members:</b> Future products for this project will continue the series of best practices, case histories, technical support documents, and products based on member, vendor, and other experience related to repair and replacement activities.	12/31/10	Technical Resource
<b>Website Document/Case History Sharing and Technical Support</b>	12/31/10	Technical Resource
<b>Benchmarking/Self-Assessment of Welding and Repair Programs for RRAC Member utilities – by request</b>	12/31/10	Technical Resource
<b>Information Request/Exchange Service to support emerging repair needs</b>	12/31/10	Technical Resource

